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HOW TO START MANUFACTURING INDUSTRIES

Technological and Investment Perspectives

Volume I

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

PREFACE

A problem often facing individuals and institutions in developing countries, especially ministries of industry, investment banks, development corporations and other bodies involved in or entrusted with industrial development, is to visualize what it would be realistic to manufacture and what such a project would look like. To help them come to grips with this problem, the United Nations Industrial Development Organization (UNIDO), in close co-operation with other organizations, issues this series of profiles covering a modest range of small and medium-sized manufacturing units.

Each profile contains a brief description of the manufacturing process involved; the necessary raw materials, machinery and equipment; and labour, investment and production costs. It does not go into the details, nor is it a replacement for a feasibility study; it is intended only to stimulate project promoters and sponsors in developing countries and to help them identify suitable products for manufacture at home. The optimal projection, including the selection of appropriate technologies, and the ultimate feasibility of any manufacturing idea emanating from this series must be ascertained by more thorough study.

To further assist parties who have identified a manufacturing idea in this series, UNIDO is building up the Industrial and Technological Information Bank (INTIB) and a roster of resources. These activities are designed to provide to project promoters and sponsors in developing countries, at their request, back-up information regarding prospective parties who can provide supplemental resources required for the development of industrial projects, including production know-how, machinery and equipment, marketing, management, preparation of project studies and the like.

Any inquiries regarding this series should be addressed to:

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A

ISIC 311, 312 FOOD

How To Start Manufacturing Industries

Baking Plant

It is not necessary to stress here the importance of bread. Many countries of the world live on bread in contrast to the Southeast Asian nations who live mainly on rice.

However, even in the countries where rice is their staple food, bread is also important, and its consumption is steadily increasing.

There are many kinds of bread peculiar to the respective countries. For example, there are French, Russian, German, British and other breads, each of which has its own characteristics in materials, methods of making and tastes.

In Japan, several types of bread are made, in addition to a great variety of Japanese type sweet rolls and buns.

The greatest reason for the present popularity of bread in Japan was the school lunch for children which got under way around 1947, a system which helped the nation to develop the habit.

The popularizing provision of school lunches has certainly contributed to the elevation of the physical standards of the younger generation and improvement in the eating habits of the nation.

Bread has thus reached great popularity in Japan. There are six large bakeries, about 20 middle-class bakeries and about 4,000 small-scale bakeries in the country. Large bakeries would consume flour 100 tons per day.

As already mentioned, there are so many kinds of bread. However, the American type bread is adopted widely throughout the world partly by the reason that it can be made without much manual labour, and developing countries have begun to follow suit.

The following description is of the bread making plant.

Wheat flour, the main raw material for bread, may broadly be classified into high protein (protein: over 13%), medium protein flour (protein: 8-13%), and low protein flour (protein: below 8%).

Generally speaking, high protein flour is used as a base, with medium and low protein flour mixed in appropriate amounts.

There are two kinds of yeast—raw and dry yeast. It is convenient to use dry yeast, because its handling is simple and its preservation easy.

As for water, there is no problem generally if city water is available. However, in the case of using well water, hard water is not desirable. Water with 6.8 pH is best.

As for the materials for packaging, some countries are using polyethylene film, however, many use wax paper.

This design is presented as, so to speak, a standard and semi-automatic plant which is characterized for easy working as well as attractive taste, shape, colour of products, etc.

Mixer

Process Description

The baking plant involves mainly the following machinery:

1) Air sifter with pneumatic conveyor

Flour will flow into the air sifter to be sifted and to eliminate foreign materials and is conveyed to the hopper of the mixer by a pneumatic conveyor.

2) Mixer

Dough is made from flour and such materials as yeast, sugar, salt, fat, yeast food, etc. The mixer has two steps of speed, low and high. For mass-production, a high speed horizontal mixer will be suitable. The dough is fermented in the first fermentation room for 2 – 4 hours and again mixed at this stage.

3) Dough divider

Mixed dough is weighed and cut by this machine.

4) Rounder

The weighed and cut dough pieces are carried by the conveyor belt of the dough divider and are rounded with this machine.

5) Proofer machine

Rounded dough pieces are conveyed by a bucket conveyor to this proofer to be fermented under an ideal condition for about 15 minutes.

6) Moulding machine

Fermented dough pieces are transferred by shooter and moulded by this machine.

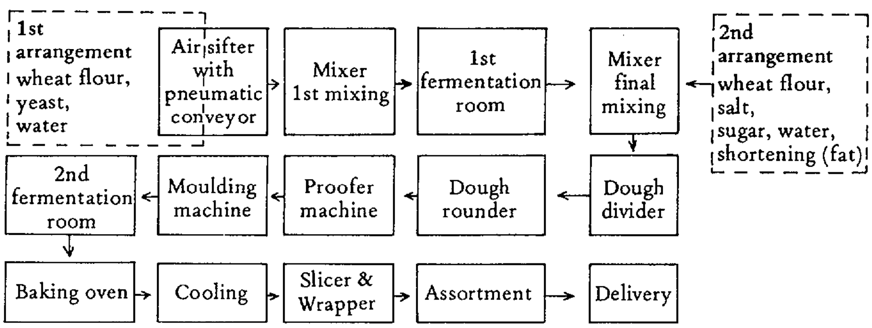
7) Second fermentation room

Cased dough pieces on racks are carried into this room which has a temperature of 38-40°C and relative humidity of 80-85 per cent.

8) Oven

Fermented dough pieces are baked by this machine.

Process Flow Sheet for Baking Plant



9) Cooling conveyor

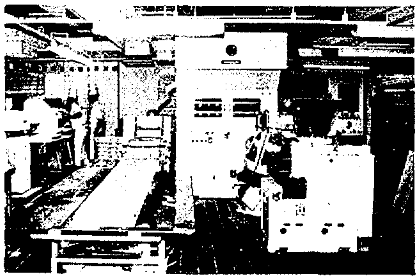
Baked products are conveyed by this machine and are cooled during conveying.

10) Slicer and wrapper

Cooled products are sliced and wrapped automatically.

Example of Baking Plant

It is possible to design and construct plants with various capacities. In this design, the cost of machinery and equipment of a plant with a capacity of processing 2,500 lbs. flour/8 hours is estimated.



Home line

Table 1: Required Machinery and Equipment for 40 Bags/Day Plant

(1 bag = 25 kg flour)

Item	kW	No. of unit
Horizontal high speed 3 - bag mixer	11.4	1
Flour sifter (pneumatic transport)	2.3	1
Water meter	0.75	1
Water chiller w/tank	1.5	1
Hot water unit w/tank	2.2	1
Dough box 300 ℓ capacity	–	5
Divider (small type)	0.75	1
Rounder (umbrella type)	0.75	1
Proofer (70 buckets x 8 pockets acrossed)	2.4	1
Moulder	0.4	1
Table conveyor (work table) 2,700 mm length	0.4	1
Baking oven (reel type)	2.2	1
Rack 3 x 12 shelves	–	10
Rack (for cooling)	–	4
Boiler 120 kg/hour capacity	0.75	1
Slicer	0.4	1
Baking pan (bun pan)	–	1,000
Bread pan (white bread pan)	–	800
Final fermentation room (prefabricated) 10 m^2	10.0	1
Box washer	1.5	1
Scale	–	1
Total	37.7	

FOB price of machinery and equipment .... **(approx.) $US 205,000**

Table 2: Daily Requirement of Raw Materials and Utilities

Item	Blend (in part)		Quantity
Wheat flour	100		880 kg
Water	58	(approx.)	530 kg
Yeast	2	(approx.)	20 kg
Table salt	2	(approx.)	20 kg
Sugar	5	(approx.)	50 kg
Fat & oil	4	(approx.)	40 kg
Skim milk	2	(approx.)	20 kg
Yeast food	0.1	(approx.)	1 kg
Fuel oil (diesel/kerosene)			90 ℓ

Table 4: Required Plant Site Area

Item	
Factory area	400 m^2
(Factory building: one floor type)	
Flour storage room	40 m^2
Subsidiary materials room	14 m^2
First fermentation room	8 m^2
Baking area	12 m^2
Make-up area (dough preparation)	60 m^2
Final proofing room	12 m^2
Baking oven space	30 m^2
Bread cooling & secondary processing	32 m^2
Bread storage room	88 m^2
Shipping room	32 m^2
Washing room	16 m^2
Toilet	4 m^2
Boiler room	6 m^2
Locker room	6 m^2
General affair, night duty & parlor	24 m^2
Others	16 m^2
Required land area (minimum)	800 m^2
20 m (width) x 40 m (length) = 800 m^2	

Table 3: Required Manpower

Item	No.
(Working hours : 8 hours/day)	
Engineer	1
Skilled worker	2
Worker	3
Clerical worker	2
Odd job man	3
Total	11

Divider – Rounder

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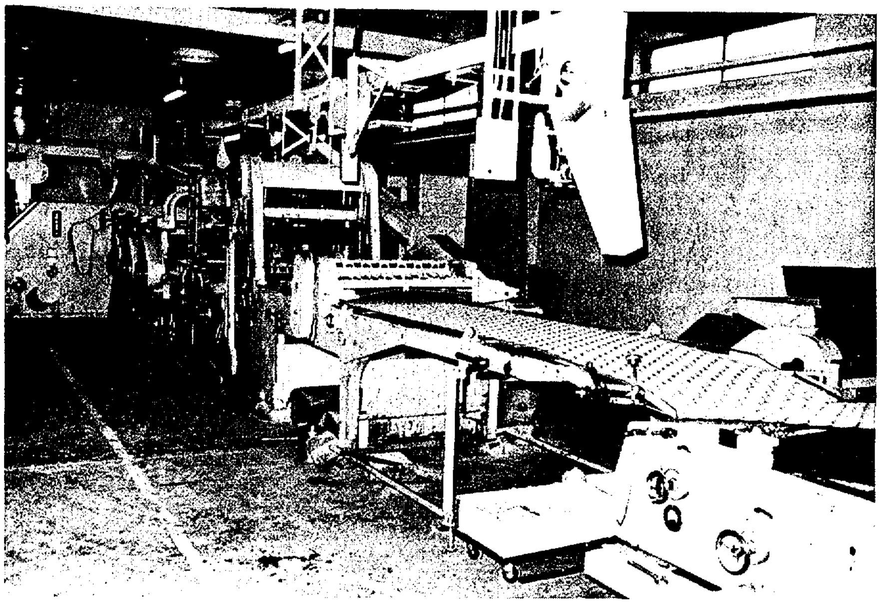
How To Start Manufacturing Industries

Biscuit Making Plant



Biscuit cutting machine & laminator

In Japan the production and consumption of biscuits have grown rapidly and the product quality has been promoted to highest standards. There are approximately 70 biscuit manufacturers ranging in production capacity from 5 to 60 tons per day, and some factories are in operation 16 or 24 hours per day. The majority of the machinery is domestically made.

The machinery and equipment manufactured in Japan is excellent enough for making biscuits of the best quality.

The Japanese-made biscuits rank at the highest level in the world and those which were sent to international exhibitions have often received prizes.

Of the machinery used for making biscuits in Japan, the machines and ovens described below are those mostly used by the manufacturers except for a few facilities. Automatic biscuit manufacturing machines and ovens are very widely used in the production of hard and soft biscuits and crackers, and these machines and ovens have been exported to Asian and African countries.

Biscuits are generally classified into soft biscuits, hard biscuits and crackers. In making soft biscuits, large amounts of sugar, fat and oil, milk and eggs are used. Therefore, wheat flour containing less protein (6-8 per cent) is used.

However, in making hard biscuits, the amounts of sugar, fat and oil, milk and eggs to be used are comparatively small. Therefore, the protein content of wheat flour for hard biscuits is higher (8-10 per cent).

On the other hand, crackers feature smaller amounts of such additives as sugar, fat and oil, and a larger amount of wheat flour.

In making crackers, yeast is used because fermentation is required. The protein content of wheat flour should be high (8-11 per cent).

As for the water to be used in the manufacturing process, if city water is used it will raise no problems at all. In case, however, well water has to be used, excessively hard water does not suit the purpose.

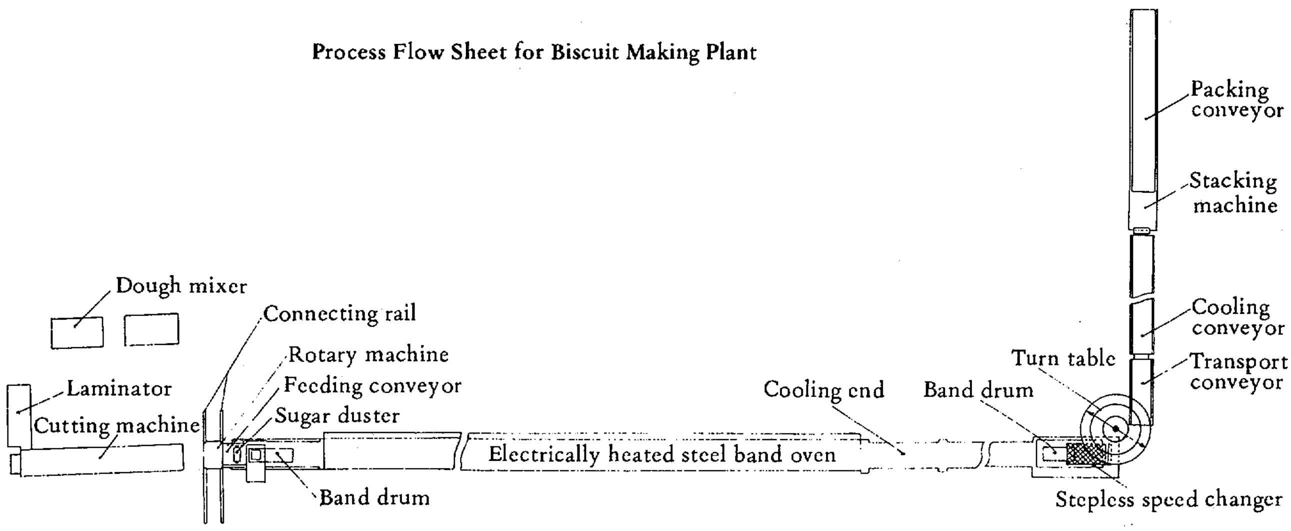
It is recommended that the pH of water be kept in the range of 5-8.

Process Description

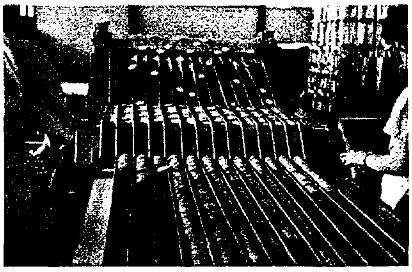
(1) All materials except flour are preparatorily mixed in a cream mixer. Materials used at this stage are sugar, shortening, salt, millet jelly, glucose, starch, skim milk, etc.
Although there are some differences according to the kind of biscuit.

(2) Materials pre-mixed in the previous stage are put into the mixing machine with flow and undergone fermentation for some products.

Process Flow Sheet for Biscuit Making Plant



(3) For making hard biscuits, the dough is to be rolled by laminator and the dough sheet is made.
(4) And it is automatically punched in a moulded design by a cutting machine.
(5) For making soft biscuits, the mixed dough is put into the rotary moulding machine for making biscuit-design moulded dough and sent to the oven automatically.



Stacking machine

(6) Biscuit is baked on a steel belt (or wire-mesh belt) running in the oven for some minutes. The speed of the belt running can be adjusted according to the kind of biscuit.
(7) After baking, biscuits are cooled on a cooling conveyor which is connected with the oven.
(8) Biscuits are stacked before packing.
(9) Each process is carried on from one to the following stage automatically except (1) and (2).

Example of Biscuit Making Plant

In case hard biscuits are taken as an example, even such a small scale with a minimum capacity of 1 ton/8 hrs. (day) would be feasible. However, an estimation is here made for a plant of three different kinds of capacity.

Table 1: Required Machinery and Equipment

Item	Description
Cream mixer	KC-110 type with motors, 3 HP & 1 HP
Dough mixing machine	MVC-8 type with motors, 20 HP & 1 HP
Laminator	AR-600 type with motor, 5 HP
Cutting machine	CI-800 type with motor, 7.5 HP and 1 set mould
Rotary moulding machine	FA-800 type with motor, 5 HP and 1 set mould
Steel belt oven	SOE 800 x 25 type with motors, 5, 2, 1 & 1 HP, oven length, approx. 50 m
Cooling conveyor	CT-800 type conveyor, length 8 m
3-step cooling conveyor	39 m long
Stacking machine	SC-11 type with motor, 1 HP
Wire-cut attachment	AWC-800 type
Oil spray machine	OSB-800 type with motors, 2 HP & ¼ HP
Revolving salt duster	RD type with motor, ½ HP

FOB price of machinery and equipment . . . . . **(approx.) $US 419,000**
(Machines are installed according to varieties of biscuits)

Table 2: Daily Requirement of Raw Materials and Utilities

Item	Quantity (approx.) (hard bis.) 5.2 tons/8 hrs.	(soft bis.) 8.0 tons/8 hrs.
Flour	3,960 kg	6,332 kg
Sugar	825 kg	1,200 kg
Shortening	225 kg	1,248 kg
Salt	27 kg	48 kg
Sal volatile (Carb. ammonium)	37 kg	21 kg
Sweet jelley	72 kg	–
Glucose	45 kg	240 kg
Starch	108 kg	–
Skim milk	–	336 kg
Water	1,050 kg	480 kg
Perfume	151 kg	116 kg
Electric power	3,800 kWh	5,000 kWh

Production Capacity

(tons/8 hrs.)

Hard biscuit	4.6-5.2
or Soft biscuit	7.5-8.0
Cracker	3.0-3.4

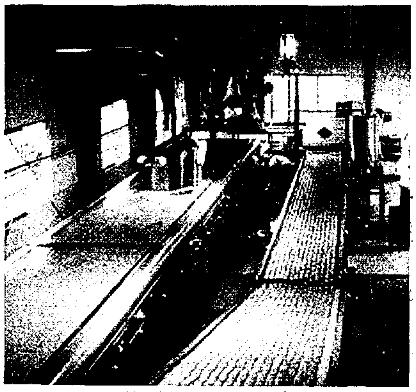
Tables 1, 2, 3 and 4 show respectively the machinery and equipment, raw materials and utilities, manpower, and plant site area required for the above plant.

Table 3: Required Manpower

	Hard biscuit	Soft biscuit	
Engineer	1	(1)	1
Skilled worker	(4)	5	5
Worker	3	(3)	3
Clerical worker	5		5
Odd job man	2		2
Total			16

Table 4: Required Plant Site Area

Item	
Factory area	1,950 m²
Warehouse area	550 m²
Control office & Delivery office area	300 m²



Electrically heated steel band oven

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How To Start Manufacturing Industries

Vegetable Oil Milling Plant

Food and Vegetable Oil

Vegetable oil and fat resources, which are indispensable to mankind as a source of nutrient and industrial raw material, are widely distributed in the form of various oil seeds such as coconut, palm and palm kernel, etc. containing lauric acid or solid fat, and sunflower seed, linseed, etc. containing unsaturated fatty acids. These resources absorbed natural sunlight energy, together with forest products, will be a very important natural resource in the age of petroleum shortage. As these agricultural products are easy to increase production, they will be suitable raw materials also for the industry of developing countries. Soybeans of Northeastern Province/P.R. of China and saflower of India were ever transplanted in the U.S.A. on an experimental scale, but now, only after several decades, the production has occupied the top of the world. Recently growing of oil palm and increase in production of rice bran oil in rice growing countries of the world have been adopted as a measures for a food policy by the United Nations, and so there is an increase in the demand for oil milling facilities.

On the one hand peanut, sesame seed, and rapeseed contain 40 ~ 60% of oil, and so these are sometimes regarded as oil and fat themselves rather than as raw materials for oil and fat; therefore, oil milling of these raw materials can be carried out in a small scale enterprise.

The vegetable oil milling industry, in view of the conception mentioned above, has been modernized, and mills today range from huge solvent extracting plants even in developing countries with a capacity of more than 1,000 tons/day to small home – shop with only one expeller of treating capacity of less than one ton/day.

According to the government statistics of Japan, 1975, the number of oil mills which are capable of treating more than 100 tons/day of raw material is said to be 40 and the number of mills which are capable of treating less than 10 tons/day is said to be 65. The medium and small scale plants were originally developed for domestic Japanese industry. These medium and small size plants, compared with the large scale plants developed in Europe and the U.S.A., match the demand of developing countries, and many presses have been exported for a long time. These presses have being used in developing countries.

Identification of Equipments in Facilities, not including Refining Unit

Depended upon the scale and method, equipments in oil milling facilities can be roughly identified as shown in Fig. 1.

Of the various methods diagrammed above, the oil in seed which has high content of oil can be extracted almost completely by mechanical method of pressing, especially by the continuous press (expeller or screw press). In order to lighten the load of the press, however, there is the prepress solvent process. On the one hand, direct extraction by solvent would be economical for raw materials such as soybean and rice bran which have oil content of approximately 20%. The various methods will be explained below.

Expeller

The expeller method which is suitable for seed which has high content of oil ranges from large size machines with a driving power of 600 HP and a treating

Fig. 1: Vegetable Oil Milling Facilities

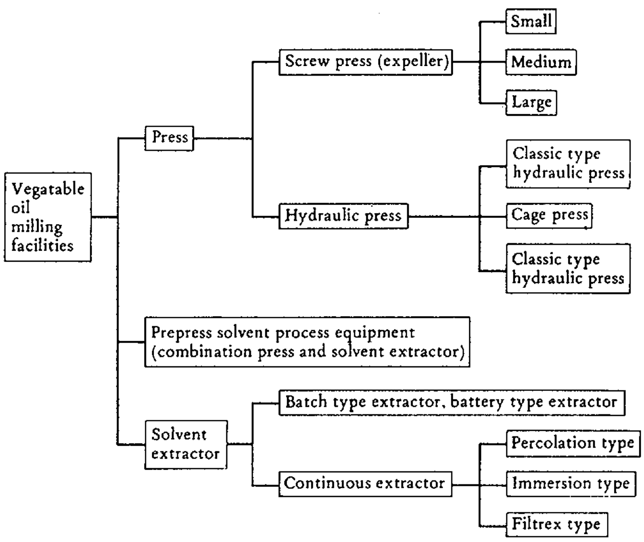
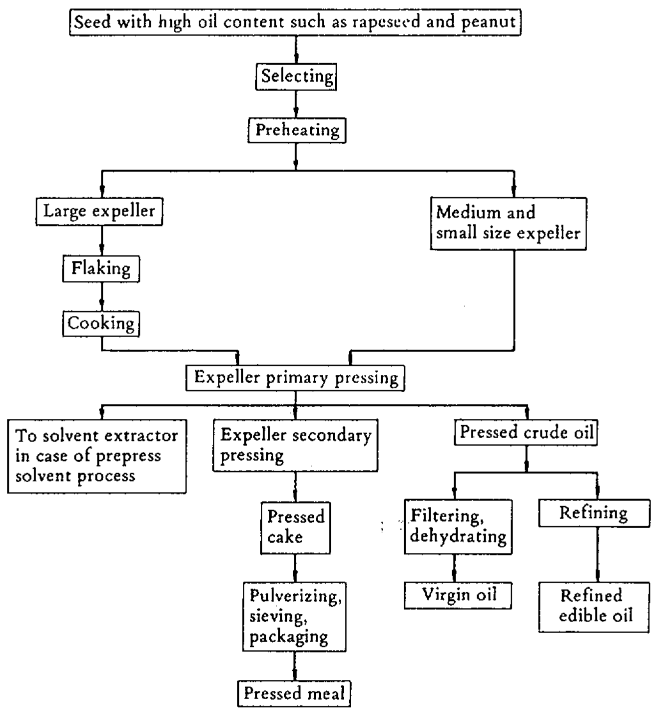


Fig. 2: Flow Sheet for Pressing Process



capacity of 460 tons/day to portable type machines with a treating capacity of 1 ton/day. Compared with the hydraulic press, such as the cage press, the expeller can work continuously, and automatically for labour saving. The yield is high, too, and so it is a representative expeller machine. Double type and Two-step type are being manufactured even for small machines; the oil yield has improved and operation has been simplified.

Cleaning, crushing, flaking, and cooking are adopted as pretreatment of pressing the seed. Fine grain like rapeseed is fed into the expeller without flaking after heating treatment, and so the simplicity of the process has been accepted warmly by users of medium and small size machines. Other features of a small size expeller are handy construction, easy to handle, practicability of simple maintenance, easy to carry around, and not costly. The heretofore weak point of wear has been rationalized by using high chrome steel for the revolving parts and frictional parts. The oil cake is produced in thin layer, and is charged into the extractor directly as it is discharged from the expeller. The temperature of the machine during operation will seldom rise up to the point of deterioration the oil. It will take a long time for a large size expeller to reach the normal operating state, but the warming-up time of a medium size or small size machine will become shorter. Therefore a medium size or small size machine will be favourable for a plant which must operate only during the daytime or intermittently. It is not uncommon for a large size machine to operate continuously, day and night, for more than a month. In such large scale industrial operation, a large size machine will of course be more favourable than a medium size or small size machine.

As to the oil extration by the expeller, the oil remaining in the oil cake will be less than 5% in the case of a two-stage press. The profitability in oil milling is swayed by the raw material cost and oil milling capacity as well as conditions of the supply of raw material and the marketing for the finished product. Therefore, even expeller pressing alone of seed with high oil content in a large scale plant would produce profitability which is comparable with or which might be higher than prepress solvent process which leaves less remaining oil content.

Cost of Expeller

The cost of expeller ranges from less than a million yen of portable type machine to more than 10 million yen of large size type machine.

In case an ancillary facility like refining unit of crude oil which has a scale merit is added to a small expeller with a treating capacity of 10 tons/day of oil seeds by using motor instead of any gas or oil engine which is often used in rural community, the cost of facilities will rise to 100 million yen. If production is to be limited to virgin oil, however, 10 million yen will be sufficient. The cost of a plant with special expeller or a palm oil milling plant which requires special pretreatment facilities for sterilization may run up to 400 million yen for a capacity of 10 ~ 20 tons/day.

Under the present conditions in Japan, the export of expeller is performed usually accompanied extracting facility; the expeller is rarely exported alone.

Prepress Solvent Method Oil Extraction Equipment

Prepress solvent method is carried out in order to reduce the remained oil in the pressed cake of seed with high oil content to less than 1%. The oil milling cost, in proportion to the expeller method, will be low. That is to say, an oil cake is made, which has been lightly pressed in the prepress step so that there will be approximately 15% remained oil, then the remaining oil is completely drawn out in the extraction step. Generally, the remained oil will be less than 1/10 of the oil in the original pressed cake.

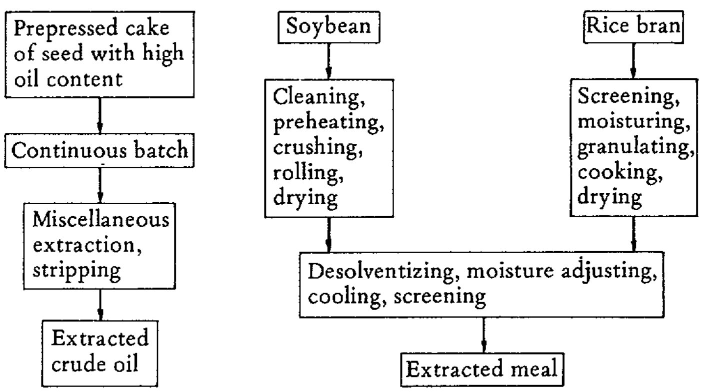
Except for the capacity, the extracting facilities of the prepress solvent method correspond to the direct solvent extracting facilities. From the standpoint of labour, the direct solvent extracting process for seed with high oil content is gradually replacing the prepress solvent process. When deciding which method should be selected, the important point to consider will be the profitability from the standpoint of running cost and initial cost. Both compressor and solvent extractor would be required for the prepress solvent method, ,so the high cost of facilities would be a heavy burden to small capacity plants. The burden, however, could be lightened by simplifying the facilities; thus, the initial cost would drop. That is to say, a simple unit has been designed, in which pressing and extraction could be considered as one unit. Therefore a prepress solvent method unit, including a refining unit, could be constructed for less than 200 million yen.

The quality of crude oil obtained by solvent extraction in the prepress solvent process is generally inferior to crude oil obtained by the press method, and so the oil is not suitable for manufacturing virgin oil. Moreover, the oil becomes edible only after going through the regular refining process. In order to install and operate it, some considerable amount of expense will be required even for a small size plant.

Solvent Extractor Facilities

A vegetable oil milling plant of ordinary scale usually adopts the solvent extraction process. Soybean, rice bran with low oil content, and the pressed

Fig. 3: Flow Sheet for Solvent Extraction Process



cake of seed with high oil content are mainly extracted by this process. (See flow sheet, Fig. 3)

In the method of extraction, there are batch system, the battery system, and the continuous extraction method.

The most simple batch method, which is also called the fixed method, consists of one to four extractors. There is a simplified version for medium and small scale enterprise which can be had cheaply and which is suitable for intermittent operation.

The battery system has one line of four to eight extractors, and is operated semi-continuously. Like the batch system, manual operation of the valve during processing is necessary.

In the continuous extraction method, manual operation of valves during processing is quite unnecessary, and so there is no trouble such as explosion of solvent due to mishandling by the operator. Also, labour saving and enlargement of the system become easy – the capacity has now expanded to 4,500 tons/day. On the one hand, the cost of equipment of small continuous extraction plant will be relatively high; accordingly, the batch system may be rather preferable for such an operation to make products at low manufacturing cost. The flow sheet (Fig. 4) of a small size batch plant which has been developed exclusively by Japanese technology and a medium size continuous extractor (Fig. 5) are given below.

When establishing a solvent extractor unit the investment in facilities corresponded to the production capacity, and the unit consumption of raw material and utilities should be carefully studied. Since the scale merit in the initial cost of a continuous extractor is large, miniaturizing of the unit is unfavourable. From the standpoint of unit consumption of raw material and utilities, intermittent operation will impede the superiority of continuous extraction. The greatest difference in these two operational conditions is less man hour in the continuous extraction, but this merit will dwindle in areas where wage is cheap. A comparison of the unit consumption of raw material and utilities of the prepress solvent process and the direct solvent extraction process which was published in J. Am. Oil Chem. Soc.. 1976 is shown in Table 1 below.

The weight of equipment cost which is not shown in the table is heavy for a small size plant, and the batch system seems to be most favourable for areas where the wage is low.

It might be advantageous to procure the know-how or import the design from the plant maker, put more weight on local made unit of machineries in order to over' the disadvantage of exchange rate, and to bring in the operating technique from the oil milling plant. Examples can be seen in the import of oil milling plants into Japan.

At present exports from Japan are

Fig. 4: Process Flow Sheet for Extracting Oil, Small Size Batch System

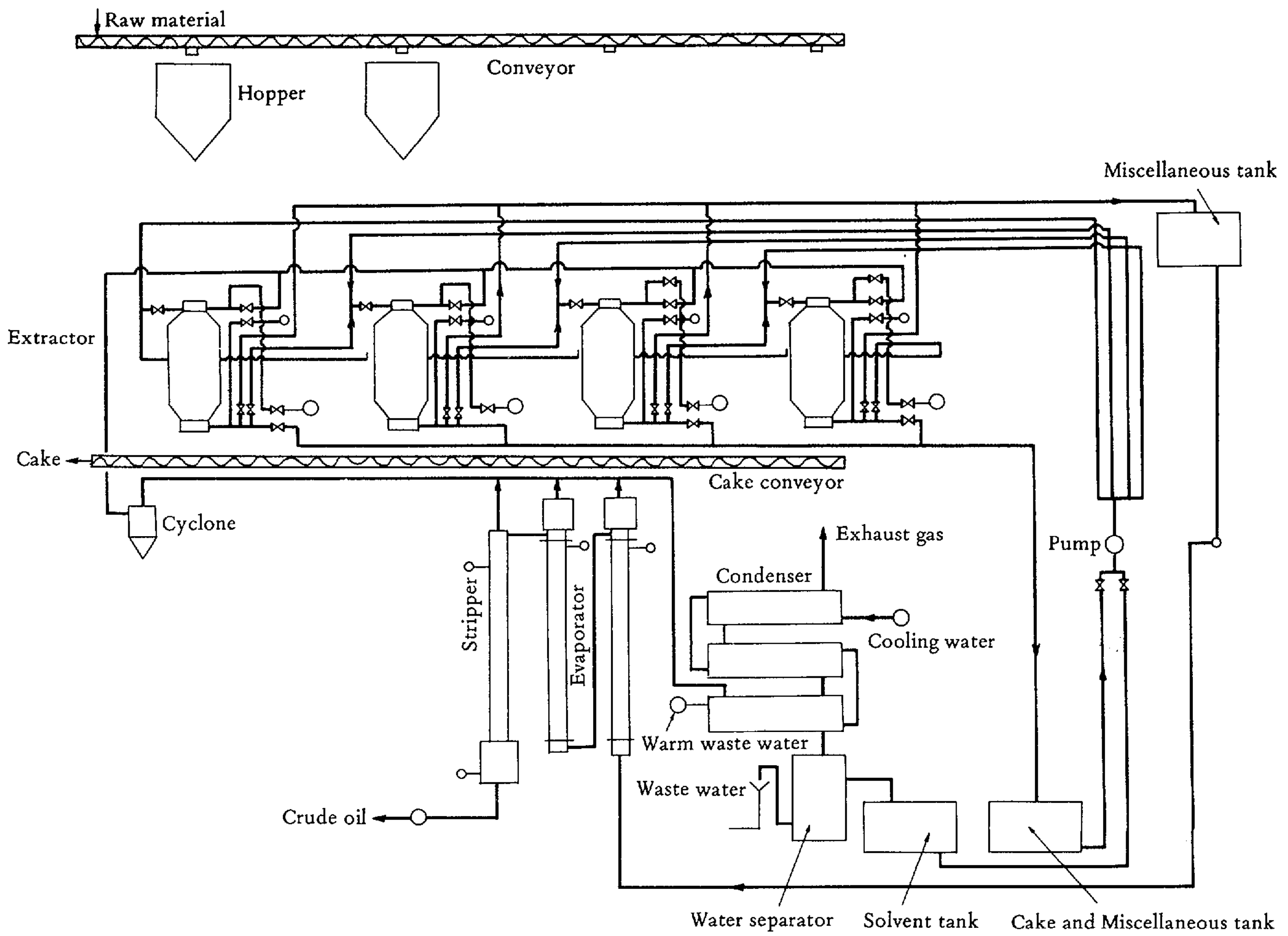


Table 1: Unit Consumption of Raw Material and Utilities in Extracting Seed with High Oil Content

Consumption per ton of raw material	Method of oil milling			
	Press	Prepress solvent process		Direct solvent extraction process, including cleaning and flaking of seed
	Expeller	Batch extraction method	Continuous extraction method	
Steam, kg	30	700	280	290
Electric power kWh	1.0	45	55	29
Water, m^3	nil	14	12	15
n-hexane, kg (liter)	–	5 (7.7)	4 (6.2)	4 (6.2)
Labour, man-hour	0.2	0.8	0.5	0.2

mostly continuous extraction plant of large capacity besides expeller of small capacity, and most of the continuous extraction plant with or without refining unit are the percolation type. Some immersion type are exported too, but small size continuous extractors are rarely exported.

The approximate cost of extraction unit in each system with a capacity of 30 tons/24 hours, in FOB, Tokyo is as follows:

Batch system extraction unit ..... $US 571,000

Continuous extraction unit .... $US 952,000

Refining Unit of Oil and Fat

The crude oil manufactured from the raw materials mentioned above is consumed as virgin oil. It becomes refined edible oil only after going through the refining process, which includes vacuum deodourization. The refining process is shown in the flow sheet, Fig. 5.

Sometimes the refining process is limited to simple physical treatment such as heating and filtering, but in regard to the refining of superior quality of crude oil generally the cake in oil is separated by centrifuge, decolourization is done by active clay, and steam deodourization is also done at high temperature in vacuum up to 5 mmHg.

Cost of Plant

A refining unit bears a large scale merit; a unit cost a treating capacity of 5 ~ 10 tons/day of crude oil is approximately 100 million yen, FOB, Tokyo, and is comparatively higher than a large scale unit. Even if the tanks and vessels are manufactured domestically the cost will run up to more than 70 million yen. Moreover if a solvent separation unit and a purification unit are to be added, an additional 50 million yen would be required for each.

As to the technical know-how and training of operators when exporting an oil milling plant, the plant maker will ordinarily be responsible, in accordance with the contract, to ask the cooperation of a presently running oil milling plant in Japan.

Locational Condition

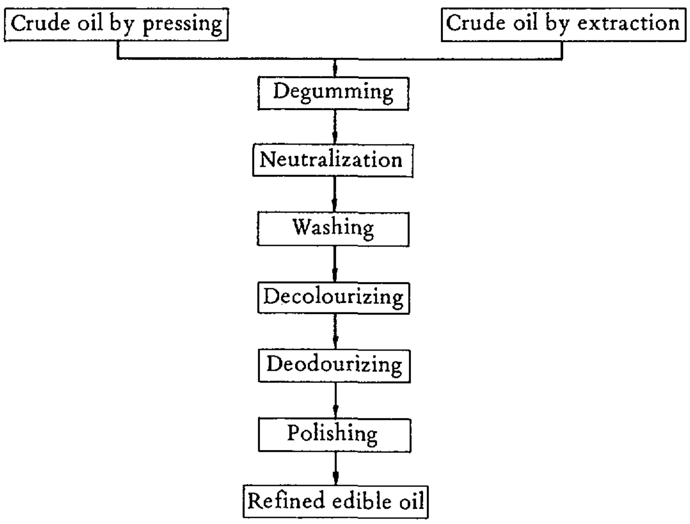
When establishing the plant the site should be selected so that raw material would be easily aquired, and the area should be the center of distribution and consumption of the finished goods.

In Japan electric motors are usually droven by 200 V (50 or 60 hertz) and 100 V (50 or 60 hertz) for lighting, but for overseas projects the voltage and hertz of electricity should be decided depended on the specification of the country concerned.

An oil milling plant with a treating capacity of 30 tons/day of raw material would require 500 KVA of electricity, 600 tons/day of cooling water (below 23°C), 80 tons/day of boiler feed water, 7 tons/day of drinking water, and 8 kℓ/day of fuel oil.

150 ℓ/day of n-hexane will be consumed, assuming that the solvent loss would be 5 ℓ/ton of raw material. Some chemicals, such as caustic alkali would be required too.

Fig. 5: Flow Sheet for Refining Process



Note: (1) As for as dewaxing of rice bran oil and cotton seed oil is concerned, it is carried out at an about middle stage between the degumming process and the polishing process.

(2) The byproduced soapstocks of the neutralization process will be hydrolysis to produce fatty acid.

(3) In steam refining the free acid is eliminated by vacuum distillation not by alkali.

(4) The method of using solvent such as n-hexane in the neutralization process and degumming process is quite modern and is applied to large scale plants, but it is not always applied to medium and small scale plants.

Table 2: Standard Yield of Oil and Fat from Raw Seed

Raw material	Oil content %	Oil yield %	Cake yield %	Total yield %
Rapeseed	40.0	38.0	56.0	94.0
Peanut	48.0	46.0	50.0	96.0
Cotton seed	20.0	18.9	51.0	69.9
Kapoc seed	22.0	21.0	73.0	94.0
Copra	66.0	64.0	33.0	97.0
Soybean	19.0	17.7	77.0	94.7

Note: These figures have been approved by industrial circles of oil and fat in Japan.

Table 3: Rough Estimate of the Oil Milling Plant

Component unit	Seed treating capacity	FOB price (approx.)
Mechanical press unit (expeller for rapeseed, sesame seed, etc.)	30 tons/24 hrs.	$US 167,000
Solvent extraction unit, batch system	30 tons/24 hrs.	$US 571,000
Continuous extraction unit	30 tons/24 hrs.	$US 952,000
Refining unit (without solvent)	10 tons of oil/24 hrs.	$US 476,000

Note: Combination of component unit to build each milling plant corresponded upon the object.

Table 4: Case 1, Case 2 and Case 3 respectively

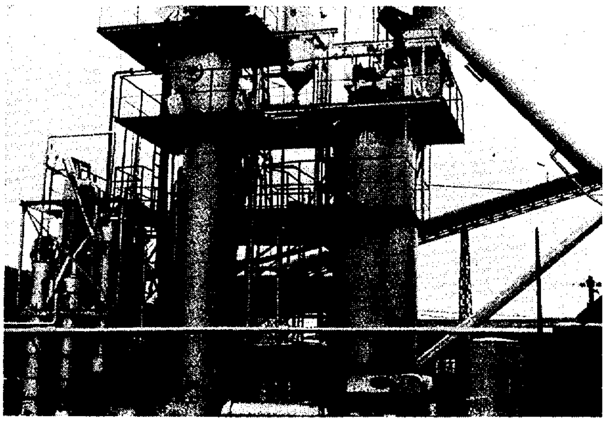
Case 1: Mechanical press unit, batch system
Solvent extraction unit, batch system
Refining unit
FOB price of machinery and equipment ...... (approx.) $US 1,214,000

Case 2: Mechanical press unit, batch system
Continuous extraction unit
Refining unit
FOB price of machinery and equipment ...... (approx.) $US 1,595,000

Case 3: Solvent extraction unit, batch system
Refining unit
FOB price of machinery and equipment ...... (approx.) $US 1,048,000

*Case 4: Refining unit, alone capacity 10 tons of oil can be treated/24 hrs.
FOB price of machinery and equipment ...... (approx.) $US 476,000

Note: Mark in* shows, only a refining unit is the aim in plant construction. Tables 5 and 6 show respectively the manpower and plant site area required in each case of Case 1 to Case 3.



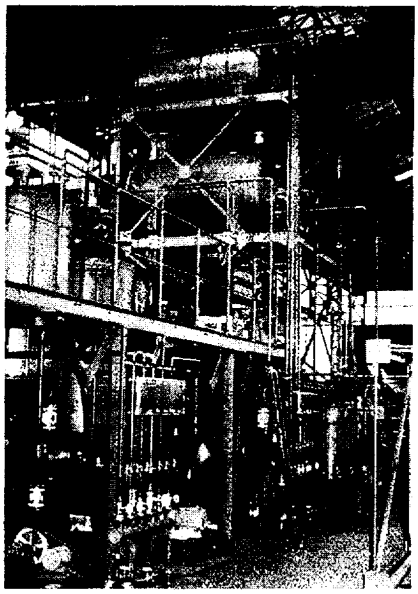
Continuous extractor for rice bran

Table 5: Required Manpower

Item	No.
(Working hours: 24 hrs./day)	
Engineer	2
Worker	8
Odd job man	5
Total	15

Table 6: Required Area for Plant Site

Item	
Building	1,000 m^2
Land	10,000 m^2



Vegetable oil refining unit

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How To Start Manufacturing Industries

Rice Milling Plant

The nations of the world have taking various measures so far to meet problems raised by the population explosion, with which annual increase in the output of foods has been unable to keep up.

It is considered of imminent necessity to expand the output of agricultural products, especially food grains. But the "campaign for sufficient food" is still far from success.

Therefore, various measures have been taken, including improvements in irrigation and flood control; increased use of new and better seeds; improvement of pest and disease control measures; increased application of fertilizers; and intensified research.

In the areas, especially in Asia, where people live on rice, the need for the promotion of the above measures has emerged as an important problem.

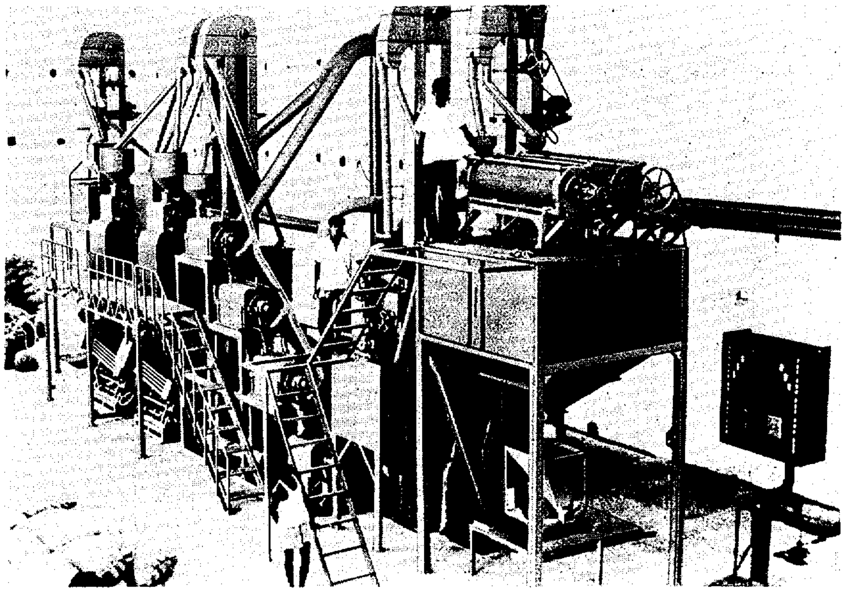
On the other hand, if it cannot be expected to achieve a sufficient yield because of improper processing, it would constitute a great loss at the present time when the shortage of food continues to be at a critical stage.

With the above background, this article is written to answer the question regarding the improvement in yield of white rice in rice milling, which can be regarded as one of the important factors involved in rice milling.

World paddy rice production in 1975 amounted to approx. 350 million tons, according to the United Nations statistics. If the recovering ratio of white rice to paddy is increased by 1 per cent, it will have the effect of an increase of about 3.5 million tons of white rice production. It is further possible to increase the yield by 3 – 5 per cent, if the most suitable rice processing machinery is adopted.

Needless to say, the most important consideration for rice mill owners is how much white rice yield is and how little the broken rice yield is.

Compared with the conventional type rice processing machinery, these machinery have many advantages and merits, which can be summarized as follows:
(1) give high yield and quality of white rice; (2) suitable for any kind of rice variety and (3) easy operation and maintenance.



Rice milling plant (hourly capacity: 4 tons)

The cost of rice processing depends on the scale of the rice mill used.

While the initial cost of a large scale mill is a little higher than that of a small one, the larger the rice mill is, the lower the operation cost would be.

This model scheme indicates the approximate requirement of such a rice milling plant. The proposed schemes are on the basis of performances of 1.0, 2.0, 4.0, and 5.0 tons of paddy per hour.

Factors which should be considered when establishing a rice milling plant are the yield, quality of product (finishing of surface, bran-removing, etc.) and mechanical efficiency.

Generally speaking, rice grain is classified into long and short grain, and further, hard and brittle grain.

Various type of processing machinery, therefore, should be of selected according to the different varieties.

Rice milling plant mentioned here is consisted of equipment of a model type.

Regarding the location of rice milling plant, it can be constructed at any place where easy collection of paddy and distribution of white rice can be achieved.

Process Description

The paddy brought in is conveyed to the paddy cleaner by a bucket elevator. The cleaner is designed to remove straw dust, pebbles, etc. for the enhancement of the value of rice as well as to prevent malfunction of the following processes due to the mixing of dust.

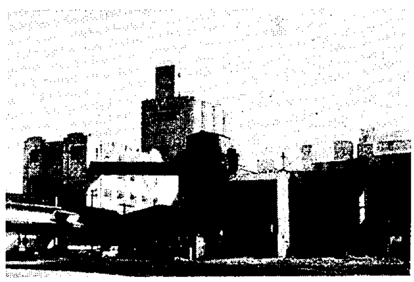
The clean paddy thus obtained is then carried into a paddy husker. This paddy husker consists of a husking chamber and an aspirator to separate husked rice and husks.

In the husking chamber, there are two rubber rollers which revolve at different speeds and in opposite directions. The paddy passes between the rollers in a gap.

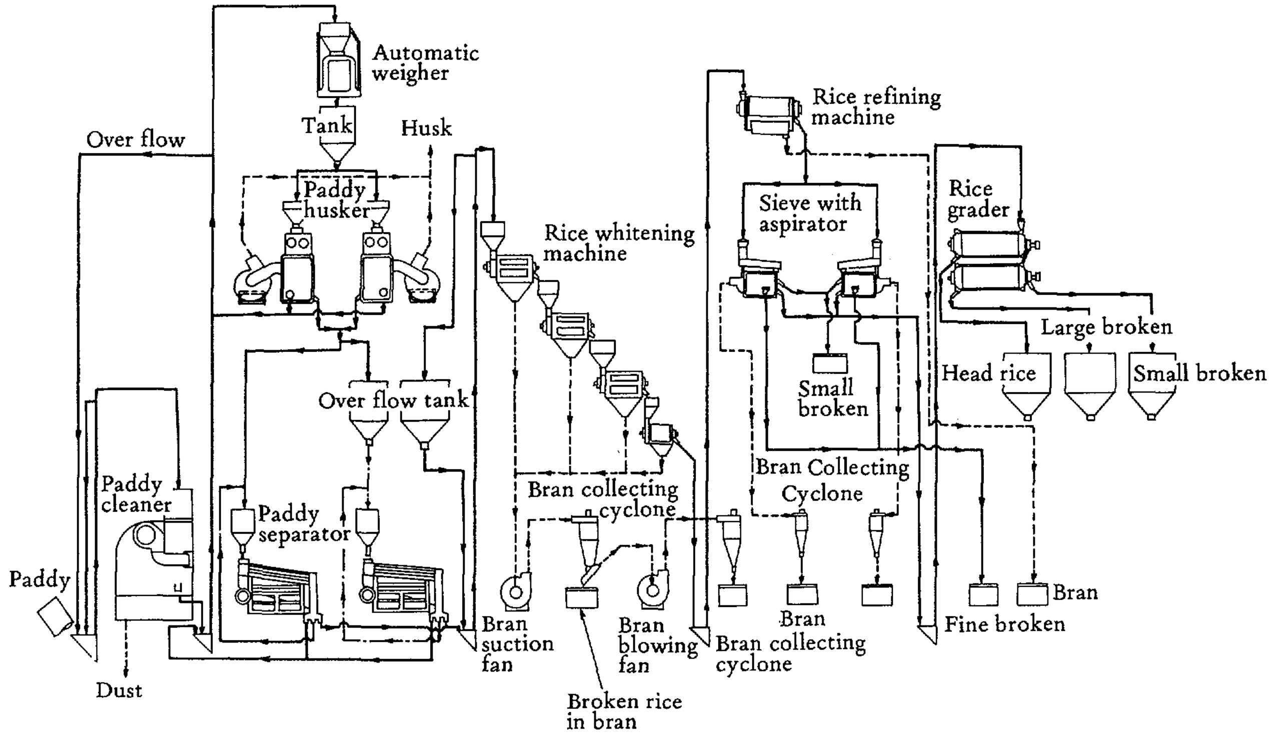
The husking rate of the paddy husker, though dependent upon the quality of paddy attains generally 85 to 95 per cent.

This means that the husked rice discharged from the paddy husker contains about 5 to 15 per cent of unhusked rice (paddy).

Utilization of specific gravity and surface roughness between the paddy and brown rice.



Process Flow Sheet for Rice Milling Plant



The separated paddy is again returned into the paddy husker for the rehusking. Meanwhile, the husked rice is moved into the next whitening machine made up of a combination of 3 or 5 units of abrasive roller type and friction type.

How to combine these units is decided by the shape, quality and other factors of rice.

The bran produced by these equipment is collected at one place by a suction fan. On the other hand, the whitened rice is conveyed to a rice refining machine for refining and further removing of bran.

The next process is sieving with aspirator in order to remove bran by wind completely and separate small pieces of broken rice mixed in the whitened rice.

The whitened rice, the value of which has been enhanced in the course of above processing, is fed again into the following process to be divided into whole rice, large broken rice and small broken rice so as to be suitable for marketing. Then they are stocked in each tank and weighed, packed in bags for shipping.

Table 1: Specifications of Plant Construction

Description	Type-1	Type-2	Type-4	Type-5
(A) Production capacity:				
Hourly capacity (T)	1.0	2.0	4.0	5.0
Production, white rice per year (M/T)	1,680	3,360	6,720	8,400
(B) Plant site (m^2)	544	931	1,320	1,320
(C) Buildings:				
1. Main Building:				
Area (m^2)	160	296	510	510
Height (m)	6	7	9	10
2. Office building:				
Area (m^2)	30	30	30	30
Height (m)	4	4	4	4
(D) Machinery equipment:				
Total Amount (FOB) (in $US)	71,000	133,000	228,000	262,000
(E) Electric power:				
Required power (kW)	30	63	89	103
(F) Required personnel:				
Engineer	1	1	1	1
Skilled worker	1	2	2	2
Unskilled worker	3	3	6	6
Clerical worker	1	1	1	1
Odd job man	1	1	1	2

Note: Buildings are the slated buildings with iron without furnitures and others.

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How To Start Manufacturing Industries

Instant Noodle Making Plant

The manufacture of instant noodles in Japan was developed in 1952. Today nearly 5,000 million packs per year are produced for domestic and export use. Meanwhile noodle manufacturing machines have become fully automatic, compact with high speed and effectiveness.

Instant noodles are manufactured in two kinds, namely, seasoned noodles and plain noodles with a soup bag. The former must contain a seasoning liquid and highly humid glutenous wheat is used to prevent weakness in stickiness.

The latter requires a white colour as its first prerequisite than stickiness. Thus wheat powder containing ash content of 0.3–0.45% is used as the raw materials.

Along with the main material of wheat powder, carbonic salt water, common salt, soft water and other additives are required for the mixture. Carbonic salt water, K_2CO_3 or Na_2CO_3, is also an important additive, giving the noodle special stickiness, elasticity, smoothness and good taste.

Salt water gives homogenuity and regulates the stickiness of the noodles as well as adding salty taste to the noodles. The necessity of the other ingredients also goes without saying.

Hereunder is introduced the process flow of manufacturing of instant noodles with a soup bag.

Process Description

1) Mixing of raw materials

Mixing or compounding wheat powder and additives (powder state) or their solution are the most important factor to decide the quality of the dough (paste state). The additives in the wheat powder are dissolved in carbonic salt solution or common salt solution or are dispersed in emultion state.

In the case of mixing wheat powder with solid additives, such as starch powder, C.M.C., and soybean protein powder, a mixing time of 10 to 15 minutes is supposed to be taken, a special cooling device is needed, for, in such cases, temperature rises by inter-powder friction, which has bad influences on wheat protein.

The quantity of water as well as of salt must be changed in summer and winter seasons, as the viscocity is influenced by atmospheric temperature.

Thus a large amount of water, as well as a long mixing time is necessary in winter, and it is better to take some maturing time of 15 to 30 minutes.

2) Dough sheet making

In this process thin dough sheets are made by means of press rollers.

Two dough sheets proceed through 2 pairs of press rollers and are charged into 3 pairs of rollers, where 2 dough sheets are pressed together into one sheet. Meanwhile the dough sheets are made thinner, finally to some 1.5 mm. During these several rolling processes, the dough sheet gains in stickiness and smoothness.

The sheet is orientated only one direction (longitudinal), being advantageously different from that of hand operation of orientating in two directions (longitudinal and lateral).

3) Cutting (strip cutting)

A cutting roller is provided to make the noodle strip.

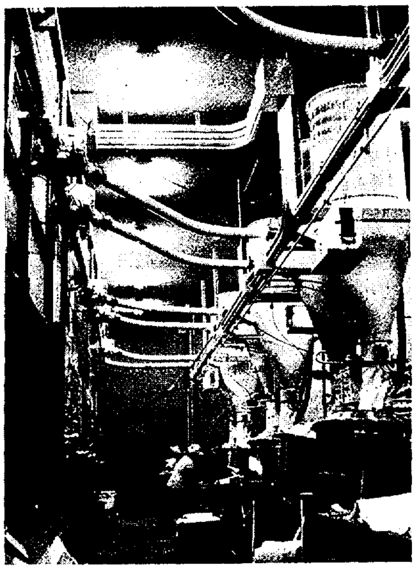
4) Measuring

The weight of one portion is calculated in consideration of the dough making conditions, dough thickness and width of dough.

Generally speaking, measure cutting is done at the front or the rear side of the cutter according to the user's convenience. (Recently cutting at the outlet of the steaming tunnel has become more popular.)

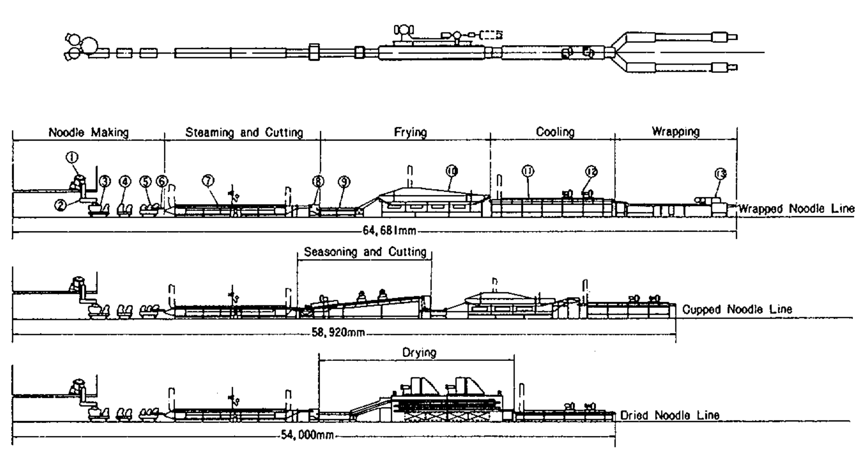
5) Steaming

In the steaming tunnel, the protein in the dough is changed into alpha-protein by steam heating, that is to say, deterioration with heat. The deterioration causes the strips to become more sticky and more smoother than before. The quality of noodles is affected by this steaming technique.



Kneader room

General Arrangement of Instant Noodle Making Plant



1. Kneader
2. Table feeder
3. Compound pressing roll machine
4. Extending roll machine
5. Pressing & cutting roll machine
6. Conveyor
7. Steam tunnel
8. Measuring, cutting & folder machine
9. Frying conveyor
10. Frying machine
11. Cooling conveyor
12. Blower
13. Wrapping machine

At first, wet steam is used to give humidity homogeneously to the noodles and at the last stage dry steam is used for alphanization.

More than 90% content of alpha-protein can be attained in one minute under the condition of steam pressure 1.5-2.5 kg/cm^2.

6) Casing

After measure cutting, cut noodle strips are made curled (often performed at the rear side of the strip cutting machine) and put into cases for easy complete frying and to prevent deformation during frying.

There are several types of cases, such as circular, square and elliptic. The cases are fitted on a net conveyor.

7) Frying

The purpose of frying is to eliminate moisture in the noodles, to secure a permanent form, and to promote the alphanization process.

The structure of fried noodles is the so-called swelling type, as against the simply dried noodles. Accordingly, the former is edible instantly by pouring boiled water over them or boiling them in water for a few minutes. This is the most advantageous feature of the fried noodles.

The temperature of frying oil generally lies between 140°C and 150°C. It is necessary to control the oil temperature to a high level at the beginning and gradually lower it at the end, or else the noodles will become spotted undesirably.

Frying time is 1.5 to 1 minutes. As to the oil, lard is recommended for better stability against acidification than vegetable oil.

8) Cooling

Fried noodles (above 100°C) shall then be cooled by cooling air to solidify the lard oil fixed on the surface of the strip nooldes, after which they are packed in cellophane bags.

If they are packed while still hot, the quality will be changed. Especially, when soup powder bags are attached, degradation of soup quality will be unavoidable and melted lard oil will adhere to the inside of the bag.

9) Inspection and packing

The cooled products are inspected as to weight, form and colour before packing.

Note: Additives such as C.M.C. polyphosphoric acid salt, soybean protein, starch powder, vitamin B and calcium are used with the aim of quality improvement. It is necessary, however, to study carefully their mixing quantity least there should be any degradation in the noodle quality.

Table 1: Required Machinery & Equipment

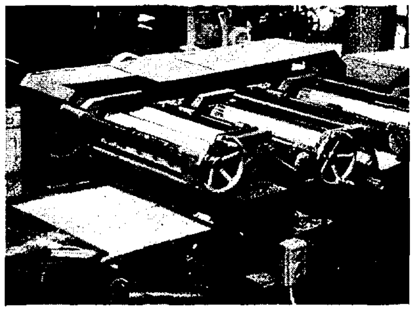
Description	Set
Noodle making equipment	
Kneader	2
Table feeder	1
Compound pressing roll machine	1
Extending roll machine	1
Pressing & cutting roll machine	1
Steaming & measuring cutter equipment	
Steam tunnel	1
Conveyor	1
Measuring, cutting & folding machine	
Steam exhaust blower	2
Frying equipment	
Frying machine	1
Exhaust blower	1
Edible oil pump	1
Heavy oil pump	1
Special chain with case	1
Case cover conveyor	1
Chain driving unit	1
Heavy oil burner with preheater, frame-eye	1
Automatic float-switch for heavy oil tank	1
Automatic elevating equipment	1
Cooling equipment	
Blower	1
Cooling conveyor with driving unit	1

Table 2: Required Amount of Raw Material for One Meal

Material for Noodle	Quantity (g)
Flour	73.3
Alkaline powder	0.12
C.M.C.	0.33
Sodium polyphosphate	0.1
Common salt	0.8
Edible colour	0.03
Lard	15.5
Soup	5.5
Poly-cellophane, 300 x 190 mm	
Carton box, 1 case/30 pcs.	
Packing tape, 50 x 800 mm	

Table 3: Required Manpower

Workshop	No.
Noodle making	2
Filling and casing	2
Frying	1
Packing and casing	8
Office	4
Chief of manufacture	1



Roller

Outline of Plant

The daily production capacity of the example instant noodle manufacturing plant is 30,000 meals on a 7-hour-a-day operation basis. The FOB price of machinery and equipment listed in Table 1 is approximately $US 161,000. However, such equipment as steam boiler; edible and heavy oil tank; kneader base; chimney, furnace materials are not included.

The utilities required per hour are:

Electricity	35 kWh
Heavy oil	40 kg
Steam	200 kg

How To Start Manufacturing Industries

Fish Meal Making Plant

It is most advantageous for a country which faces the sea or a lake to utilize marine or lake products to the greatest possible extent.

It is especially worthwhile to make use of fish in the light of effective use of protein as well as to secure a source of nutrition for the people.

The protein of fish contains amino acids, not contained in quantity in vegetable protein. Therefore, amino acids, which are indispensable and can't be taken from vegetable protein only, can be taken from fish protein.

Fish is used as foodstuff for man either in raw or dry states. However, a fairly large portion of fish – such as internal organs, head, tail and bones – is cast away, without being utilized as food.

Another means of utilization of fish is manufacture of fish meal. Fish meal provides 100 percent utilization of nutrition offered by fish, because the whole body is made into fish meal.

When the question of nutrition is studied from a national viewpoint, manufacture of fish meal can be said to be of high importance.

Fish meal is used mainly as feed for poultry farming as well as the breeding of cattle. Fish meal is extensively used throughout the world because it remarkably contributes to improvement in egg-laying as well as to enhancement of the nutritious value of eggs and meat.

Utilization of fish by making fish meal for the feeding of poultry and cattle does not mean that fish can be utilized directly as food for man.

However, fish meal offers nutrition to man indirectly in the form of eggs and meat enriched by it.

Being a dried powder, fish meal is very convenient for transport. There is no fear of deterioration in transport such as in the case of raw fish. Furthermore, as the moisture content is small, it can be transported to far distant places by sea at low freight.

Many countries are acquiring foreign currencies through export of fish meal.

Production of fish meal in Peru, for instance, is especially thriving because she has some of the world's leading fishing-grounds in her coastal waters. Therefore, fish meal is one of the largest foreign currency earner among her exports.

A considerable quantity of fish meal is produced in Japan. However, on account of the development of stock breeding in recent years, consumption exceeds production. Hence, there is a need to import a large amount of fish meal.

From the above considerations, it may be said that the production of fish meal is not only an important enterprise for the benefit of the nation's nutrition needs, but also a potential enterprise, depending upon the situation in the country concerned, for earning foreign exchange.

In the light of the economy of the fish meal industry, it is absolutely necessary to procure raw material sufficient to support minimum economic production.

If a sufficient quantity is available, it would be most ideal to make fish meal from waste of fish.

This provides a major advantage in that the cost of raw material can be saved. As for fish that can be used as raw material for fish meal, almost any kind of fish can be used except for such special varieties shark, cuttle fish, etc.

Process Description

Broadly speaking, the whole process may be classified into the following unit processes.

1. Preliminary Treatment

In case fish is large in size, the following preliminary treatments are necessary:

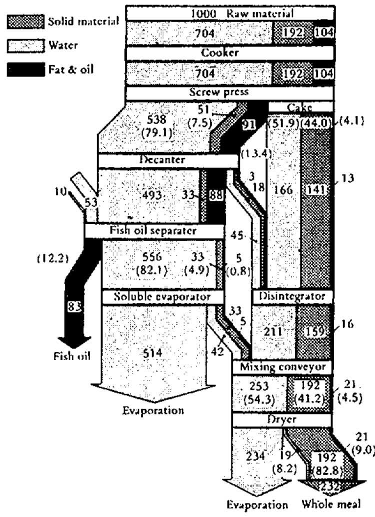
1) Cutting
Cutting of raw material into appropriately-sized pieces with cutter equipped with revolving knives.

2) Crushing
Crushing of cut pieces on a toothed roll crusher so as to provide easy cooking.

2. Cooking

1) Cooking
Cooking of raw material with steam in a cylindrical or conduit type cooker. The cooking is completed while it is moving in the cooker on a conveyor, and the cooked material is discharged from the other end.

Fig. 1: Material Balance (Example)



2) Compression
Continuous compression, by a screw press, of the raw material discharged from the cooker. Oil and water are separated turning out pressed cake containing about 50 percent moisture.

3. Drying

1) Disintegration
Disintegration of the pressed cake coming out of the screw press in order to provide easy drying.

2) Drying
Drying of cake in a long rotary

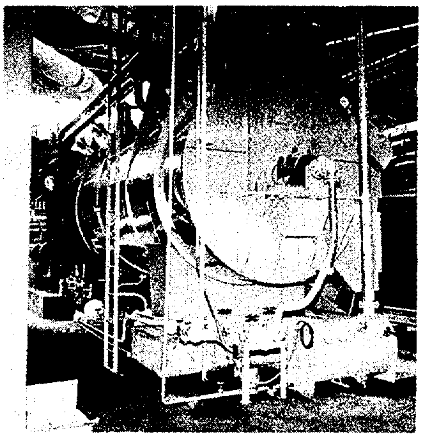
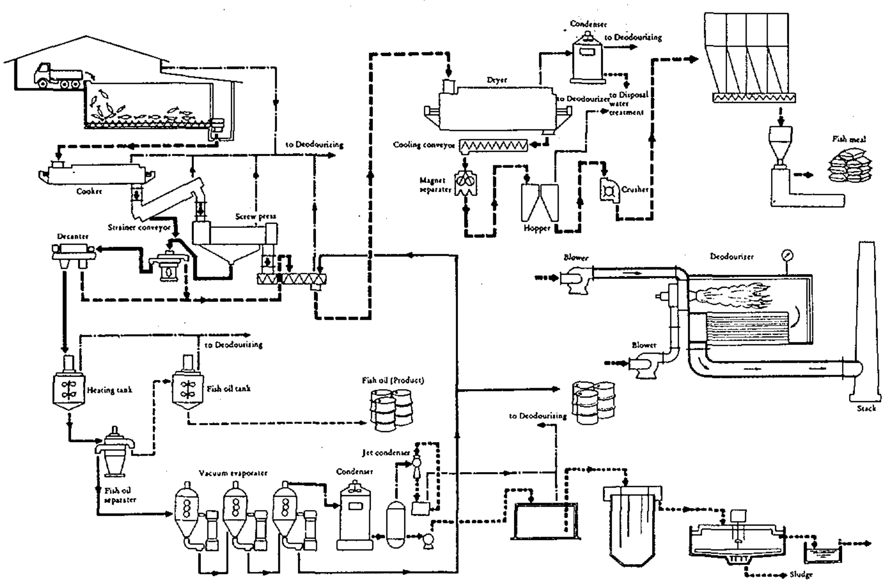


Fig. 2: Process Flow Sheet for Fish Meal Making Plant



dryer. A number of scooping blades through which steam passes are installed in the interior of the dryer. Raw material moves and is scooped up while keeping contact with the heating surfaces of the scooping blades until it falls into a section through which hot air passes.

Table 1: Required Machinery and Equipment

(In case of the raw material processing capacity is 25 tons/day)

Item	No.
Pretreatment section	
Drag conveyor	1
Toothed roll crusher	1
Cooking section	
Bucket elevator for raw material	1
Cooker	1
Screw press	1
Screw conveyor	1
Drying section	
Disintegrator	1
Bucket elevator	1
Rotary drum dryer	1
Air heater	1
Blower & exhaust pipe	1
Dust collector (cyclone)	1
Cooling conveyor	1
Crusher for finished product	1
Magnet separator	1
Boiler	1

FOB price of machinery and equipment . . (approx.) $US 381,000

3) Cooling
The cake coming out of a dryer has a temperature of 60 to 80°C, so it cannot be pushed in a crusher immediately.
Accordingly, the cake is transferred to the next process on a cooling conveyor. During the transfer cooling is completed.

4) Crushing
Crushing of the meal, which has come out of the cooling conveyor, into suitable size.

5) Final cooling
The meal still has some heat left in it. If left as it is, its quality may decline and in some cases combustion may occur. Hence, final cooling is necessary.

6) Packing
Fish meal is normally shipped in bags of 20 kg.
In addition, a cyclone type dust collector has to be installed in order to collect dust of meal mixed in air exhaused from the dryer. After the collection of dust the exhaust is discharged into air.

Outline of Plant

Contents of water, oil, protein, etc. vary according to kinds of fish.

How much finished product is available from a fixed amount of raw material depends upon the nature of the raw material. Generally speaking, however, the product corresponds to about one-fifth of the volume of raw material.

Fish meal manufacturing plants can be designed in capacities – 10, 15, 25, 50, and 100 tons/24 hours.

However, a design has been made for the 25 tons/day processing capacity plant.

Table 2: Monthly Requirement of Raw Material and Utilities

Item	Quantity
Raw fish	625 tons
Electric power	25,000 kWh
Heavy oil	60 kℓ
Industrial water	250 tons
Bag	6,250

Table 3: Required Manpower (24 hrs. with 3 shifts)

Item	No.
Engineer	1
Skilled worker	1
Worker	6
Clerical worker	1
Odd job man	1
Total	10

Table 4: Required Area for Plant Site

The required plant site area is approximately 2,000 m^2 in total, the details of which are:

Factory	440 m^2
Packing room	50 m^2
Boiler room	50 m^2
Office & laboratory	120 m^2

How To Start Manufacturing Industries

Ice Making & Refrigeration Plant

It has been no more than 50 years refrigeration machines was started in Japan. Recently, with developments in the food and chemical industries and changes in the living mode of the people, epoch-making progress has been made in the mass production of refrigerators.

In large cities such as Tokyo, Osaka, Yokohama, Kobe and others, refrigerators with capacity as large as 50,000 tons are being built. Even in smaller cities throughout the country, such refrigerators are being installed. The large refrigerator groups in consumption areas form a centre for the distribution mechanisms to supply fresh foods constantly at stabilized prices.

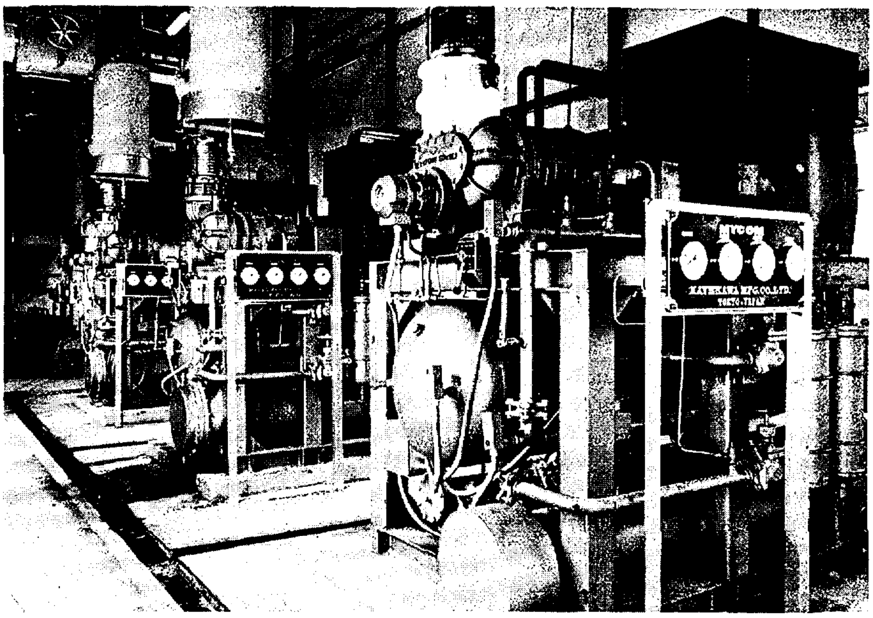
In connection with refrigerators of large capacity in consumption areas, numerous medium and small scale plants are linked with refrigerators of large capacity in the consumption areas.

On the other hand, building of refrigerator groups in local production areas, which would become trunk or branches of the distribution mechanism, as well as relay facilities in large cities, have recently materialized.

As for refrigerators, people are apt to think of them as being used for ice making, freezing, storage and air-conditioning. However, application ranges over many fields, including chemical, nuclear, fishery, medical, energy generation and linear motor super express train.

Recently, screw refrigeration compressors are becoming popular in the fields of refrigeration and air-conditioning, taking the place of high speed reciprocating, rotary and other old fashioned type compressors, especially in the U.S.A., Japan, U.S.S.R. and other developed countries. In the U.S.A., screw compressors made in Japan have been accepted by national nuclear laboratories and universities for use in the development of the nuclear fusion process. Refrigeration industries are expanding their usages in the field of the energy not only for energy conservation but also for energy generation.

According to requirements, screw composer has capability to design and complete refrigeration equipment ranging in size from the smallest to the largest capacities.



Screw compressors in the machine room

Outline of Refrigeration Plant

The refrigeration equipment for freezing, cold storage, ice making, air-conditioning, etc. is divided into (1) High pressure side equipment, (2) Low pressure side equipment, (3) Electric equipment and (4) Auxiliary equipment. The high pressure side equipment consists of compressor unit(s), oil separator, condenser, liquid receiver and non-condensible gas purger. The low pressure side equipment consists of liquid refrigerant evaporator, accumulate suction trap and auxiliary valves. The electric equipment consists of prime mover, switch board, control panel and auxiliary control equipment. The auxiliary equipment differs depending on the purpose of refrigeration, such as ice making, freezing, cold storage, air-conditioning, energy generation system, nuclear fusion system, etc.

Refrigeration Cycle

The principal parts of the system are (1) Evaporator - which provides a heat transfer surface through which heat can pass from the refrigerated space or product into the evaporating refrigerant, such as contact plate freezer, unit coolers, ceiling coils and the like in freezing and cold storage plant, or herringbone coils and shell tube type brine coolers in ice plant; (2) Suction line - which conveys the low pressure vapor from the evaporator to the suction line of the compressor; (3) Compressor - which removes the vapor from the evaporator and raises the temperature and pressure of the vapor to a point that the vapor can be condensed with normally available condensed media such as water or air. The compressor offers two types of compressors, one is reciprocating type and the other is screw type compressor; (4) Discharge line - which delivers high pressure and temperature vapor from the discharge of the compressor to the condenser; (5) Condenser - which provides a heat transfer surface through which heat passes from the hot refrigerant vapor to the condensing media; (6) Receiver - which reserves the refrigerant liquid that is liquefied at condenser; (7) Liquid line - which carries the liquid refrigerant from the receiver to the refrigerant flow control, and (8) Refrigerant flow control - whose function is to regulate the proper amount of refrigerant into the evaporator and to reduce the pressure of the liquid entering the evaporator so that the liquid will vaporize in the evaporator at the desired temperature.

Block Ice Making Equipment

Block ice making equipment consists of an ice freezing brine tank, brine agitator, ice cans, wooden frame-work for freezing tank, air agitation equipment, water pumps, crane and hoist, can dumper, water filling tank, precooling water tank, etc. In design and estimation work for an ice plant, the following information is required in order to install a suitable plant:

(1) Weight of each ice block (135 kgs., 50 kgs. or 25 kgs.) and total manufacturing capacity per day.
(2) What kind of raw water is available, i.e. well water, river water, city water?
(3) Ice usage. Is it for human consumption, marine products, vegetable cooling, or other?
(4) Is it to be stored as block ice or as crushed ice?
(5) What is the storage capacity?
(6) Electric source (voltage, phase, cycle)
(7) Water temperature both for raw water and for cooling water.
(8) Average outdoor temperature during warmest season.

Fig. 1

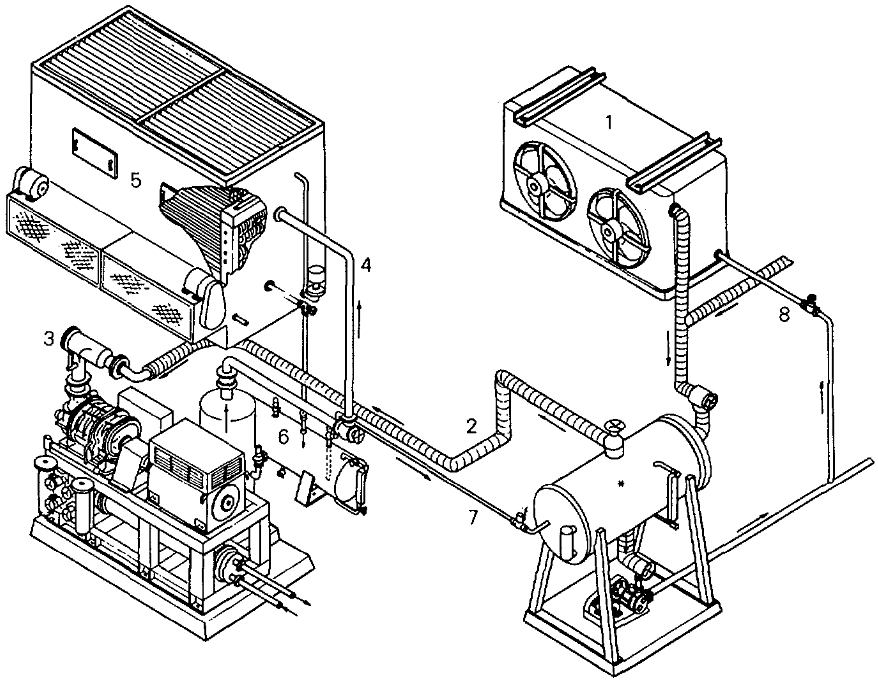


Fig. 2: Process Flow Diagram for Ice Making Plant

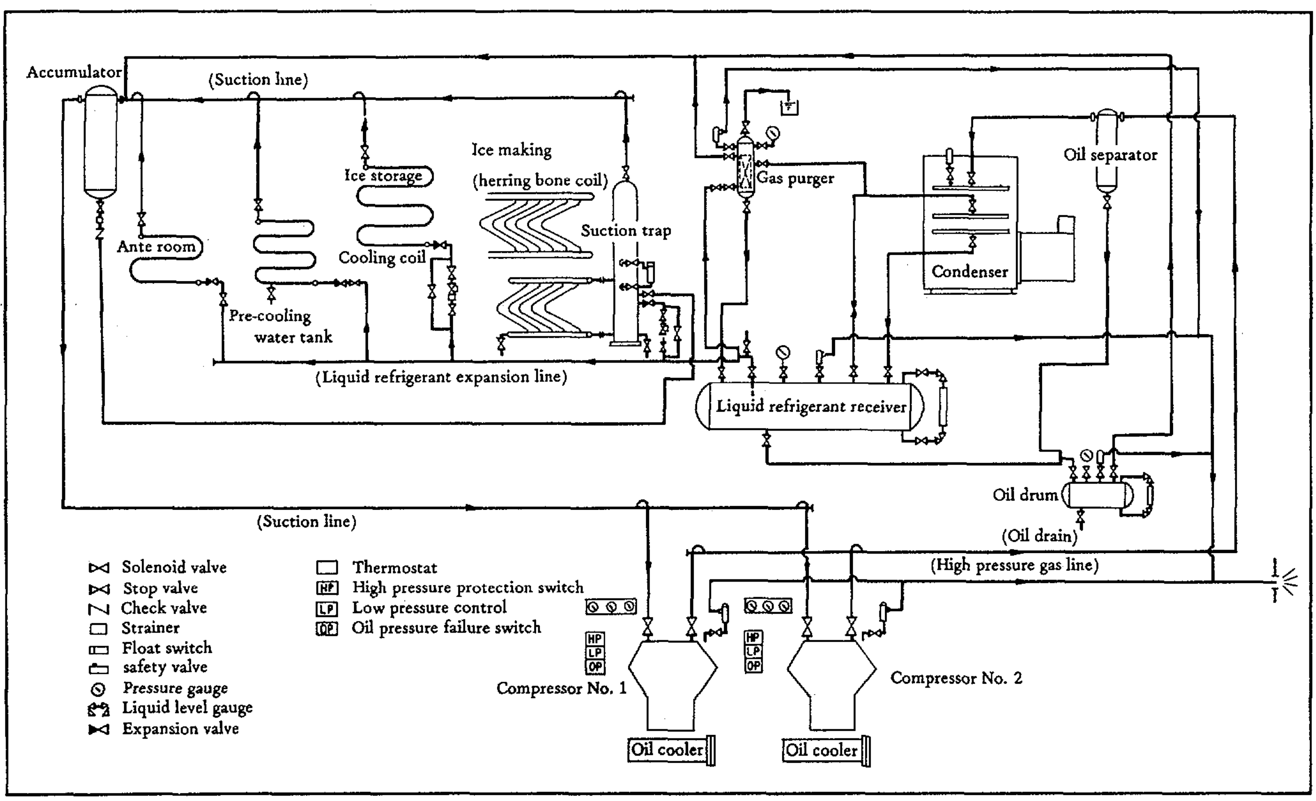


Fig. 3: Plant Layout for Ice Making Plant

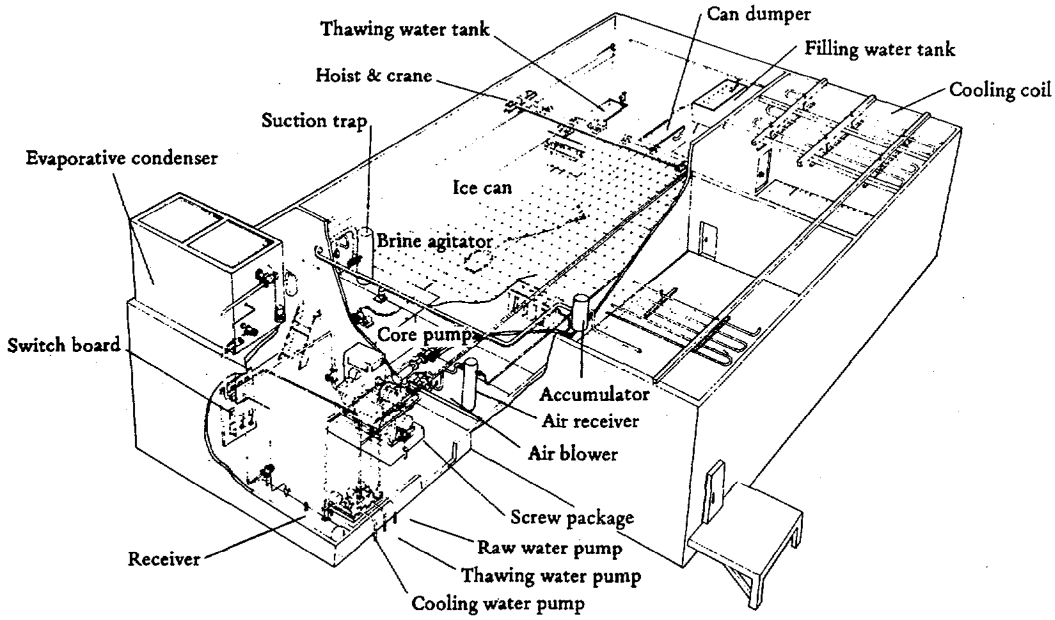


Table 1: General Information for Constructing Block Ice Plant with Concrete Flat Building

Ice production (tons/day)		10	15	20	30	50	100
Ice storage (tons)		600	700	1,100	1,500	2,000	2,800
Floor space (m^2)	Ice making room	87.0	148.5	178.5	231.0	231.0	755.0
	Ice storage	178.5	218.0	294.0	397.0	535.0	775.0
	Ante room	49.6	26.8	33.1	33.1	39.7	99.2
	Machine room	49.6	69.5	79.4	66.2	89.3	139.0
	Power station	-	-	-	-	19.8	33.1
	General office	24.8	28.9	46.3	39.7	52.9	52.9
	Lunch room & welfare	-	-	-	26.4	36.4	62.8
	Total:	359.7	491.3	631.3	793.4	1,150.1	1,917.0
Thickness of insulation	Freezing tank	150 mm					
	Ice storage	100 mm					
Compressor capacity (US. RT)	For ice making	19.1	28.2	37.4	67.1	92.4	184.8
	For ice storage	10.2	11.3	14.3	21.7	25.7	30.8
	Total:	29.3	39.5	51.7	88.8	118.1	215.6
Compressor (model & qty)	In case of reciprocating type compressor	N8A x 1	N4A x 1 N6A x 1	N6A x 2	N8A x 2	N6B x 2	N8B x 2 N8A x 1
	In case of screw compressor	N125LUx1	N125LUx1	N160SUx1	N160LUx1	N160SUx2	N200SUx2
Ice freezing tank (can grid type)	Number of cans/grid	5	6	7	5	7	7 x 2
	Depth (mm)	1,226	1,226	1,226	1,226	1,226	1,226
	Number of freezing tank	1	1	1	1	1	2
	Width of tank (mm)	4,130	4,780	5,430	7,920	10,860	11m x 2
	Length of tank (mm)	11,448	13,407	15,566	16,419	19,684	20m x 2
Approx. price of equipment	$US	105,000	138,000	162,000	200,000	343,000	667,000
Approx. price of bldg. construction	$US	105,000	138,000	162,000	200,000	343,000	667,000
Approx. cost of installation & construction works	$US	21,000	28,000	32,000	40,000	69,000	133,000
Best shipment of machineries & equipment	Months after the date of contract become firmative	4	4	4	5	5	6

Cold Storage Plant Equipment

The temperature of cold storages varies in accordance with the products stored; -20 to -30°C for frozen products such as meat and fish, +2 to +12°C for fruit and vegetable and -5 to +5°C for short term storage of fresh fish and meat.

Generally, 400 to 500 kgs. of boxed frozen products can be stored in one cubic meter, 300 to 350 kgs. for meat, and 200 to 300 kgs. for fruit and vegetable.

Storage capacity varies in accordance with product, operation method, etc. There are several cooling down systems for cold storages, for instance, refrigerant direct expansion system, brine cooling system, etc. The unit cooler system and hair pin coil system are commonly applied as evaporators in cold storage facilities. They are termed "direct expansion systems".

Refrigeration equipment should be selected taking consideration of total capacity of the plant, ambient thermal conditions, humidity, kind and size of products, product storing method, product packing method, quantity of products in/out per day, purpose of storing products, storage period, transportation method for products, cooling water (well, sea, river, city, etc.), quantity and temperature of cooling water available, extent of automatic control and operation, electric power supply available at the plant, soil conditions at the plant site, budget for purchasing equipment, technical and engineering capabilities available in area for construction and installation of the plant equipment, and any other information obtainable.

Hair pin coil system

Where local conditions or individual preference justify pipe coils, several characteristics should be considered in plant design. Ceiling coils have a long life and are simple and economical to operate, requiring no fan maintenance or costs for fan power. Defrosting the coils is more difficult and requires more manpower than unit cooler system however. An automatic defrosting is not suitable with the hair pin coil system because the defrost water falls on stored products in the room.

Unit cooler system

Defrosting time and manpower is minimized as the automatic defrost air unit clears most of the frost. Also there are fewer coils to defrost. Less air movement over products and whole space in the storage assures even temperature maintenance with this system.

Brine cooling system

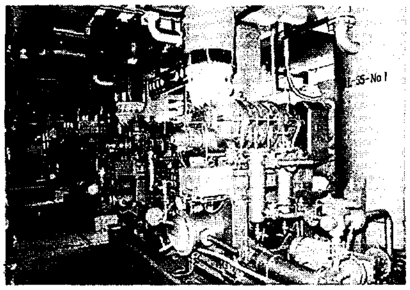
There are two types of brine cooling systems, one for quick freezing products immersed in the chilled brine and the other for cooling down products using brine heat exchanger type cooler instead of direct expansion type cooler. The later type is almost the same as the direct expansion unit cooler system, except for the heat exchanging medium passing through the unit cooler.

Liquid pump system

The liquid pump system is commonly used in fully automatic capacity control systems having a comparatively large volume of storage capacity. Recently, most cold storages being built in Japan incorporate liquid pumps and two stage compression systems.

Quick Freezing

Most products require cooling down before storing in the cold storage in order to maintain freshness and to protect products already in the cold storage from temperature increase resulting from the incoming products. Therefore, cold storages in production areas are equipped with quick freezing facilities. There are several types of freezing systems available, according to the type, size and kind of products. The type of freezing equipment to be installed naturally depends on the kind of products to be frozen. Most of the cold storage plants of today generally employ a two stage system using compound compressors. The compressors are the heart of the refrigeration system, and reciprocating or screw-type compressors are selected depending on the application and capacity of the plant as well as buyer's preferences. Compound compressors used for low temperature applications are suitable for moderate sized plants, as they contribute savings in several ways on initial investment, among which are floor space and power consumption.



Two stage compound compression system for low temperature application (based on combination of two screw machines)

1) **Contact plate freezer**
The contact plate freezer is one of the most popular types of equipment for freezing packed foods or small items. In recent years the manufacture and use of pressure type multi-plate units has expanded considerably to meet the demand for a flat, well formed frozen package that will stack compactly in retail cabinets. The product freezing rate in a contact plate freezer varies with the size of the packages, the type of product, and the packing material utilized.

2) **Semi-air blast freezing**
This system is utilized primarily for quick freezing products of comparatively large size. It is one of the most popular types of freezing marine foods both on board the fishing vessel and at onshore facilities.

Table 2: Contact Plate Freezer

Model		No. 5	No. 10	No. 15	No. 20
Refrigerant			Ammonia		
Capacity (kg/shift)		500	1000	1500	2000
Plate size (mm)			2000 x 1250		2000 x 2400
Number of station		5	10	15	17
Approximate TR at 40°C		14	28	42	55
Overall dimensions (mm)	Height	2880	3515	4150	4400
	Width	3300	3300	3300	4000
	Depth	1830	1830	1830	1830
Approximate weight (kg)		2500	3000	3500	4000

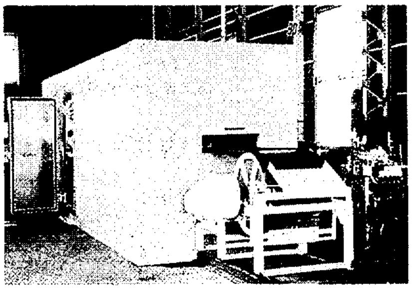
3) **Air blast freezing**
Air blast freezing is used primarily for freezing big quantities of large sized products. The system consists of a unit cooler having a large capacity with lower evaporative temperature. In case of freezing large sized products at slaughter houses, hanging rails are provided in the freezing room, considering good circulation of chilled air.

4) **Brine cooling system**
The brine freezing system is generally used in freezing special products requiring immediate freeze, e.g. bonito, to protect the product from bleaching. Freezing is accomplished by immersing the product in -20 or -25°C brine.

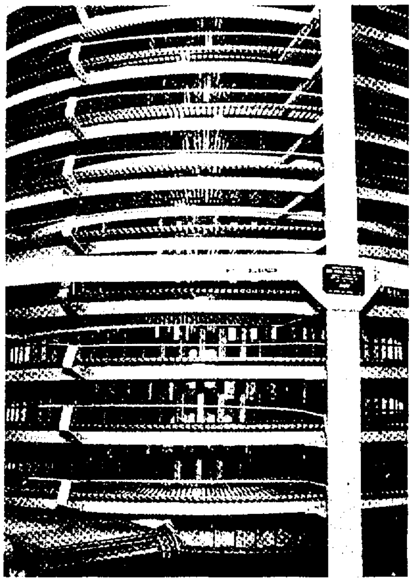
5) **Continuous freezing**
The continuous freezing system is used for freezing products at processing factories, e.g. broilers, packed meat, hamburger, etc. Recently, a steel belt freezer system has been completed for continuous efficient freezing of broilers.

6) **Steel belt freezing system**
The steel belt freezer system, designed for continuous freezing of vegetables, broilers and various kinds of fish, can be easily operated and provides high productivity.

Air blast freezing for meats



Steel belt freezer



Spiral belt continuous freezer

Fig. 4: Process Flow Diagram for Cold Storage Plant (Unit cooler system)

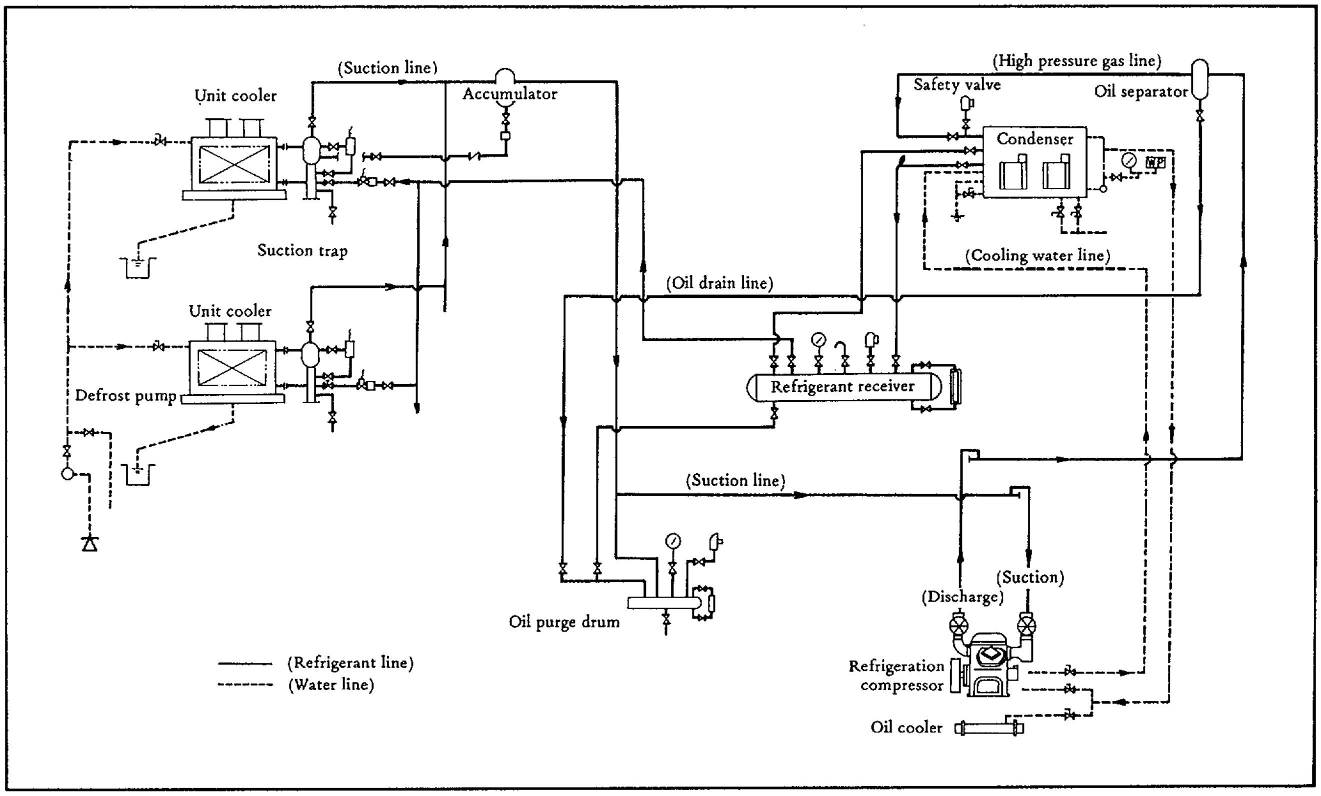
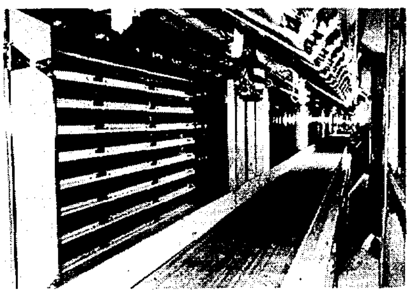
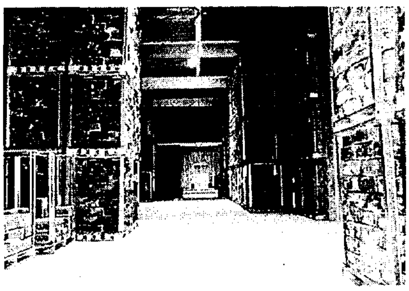


Table 3: General Information for Constructing Concrete Cold Storage Structures

Storage capacity (tons)		100	200	300	500	800	1,000
Freezing capacity (tons/day)		-	5	10	15	20	20
Space in sq.m (m^2)	Cold storage	132.0	231.5	283.5	443.5	698.0	978.0
	Ante room	33.1	54.5	69.5	49.5	99.2	132.0
	Freezing room	-	23.2	40.5	63.6	89.3	89.3
	Freezing ante room	-	-	23.2	36.4	39.7	39.7
	Machine room	33.1	46.3	52.9	59.5	109.0	129.0
	Processing room	49.6	66.1	66.1	92.5	158.5	158.5
	General office	-	-	26.4	33.1	59.5	59.5
	Lunch room & welfare	-	-	21.5	24.8	44.6	44.7
	Total space in m^2:	247.8	421.6	583.6	817.9	1,297.8	1,630.7
Insulation (thickness: mm) *Material: Styrofoam	Cold storage	150	150	150	150	150	150
	Freezing room	200	200	200	200	200	200
	Ante room	100	100	100	100	100	100
Compressor capacity in US. RT	Cold storage	11.5	22.5	25.2	34.3	46.7	64.3
	Freezing room	-	14.6	29.2	43.9	58.8	58.6
	Ante room	0.9	1.3	2.5	2.6	3.4	3.8
	Total capacity:	12.4	38.4	56.9	80.8	108.9	126.7
Type and quantity of compressors	In case of reciprocating compressor	N4A x 1	N4A x 2	N6A x 2	N8A x 2	N4B x 1 N6B x 1	N6B x 2
	In case of screw type compressor	N100LUx1	N125LUx1	N160SUx1	N125LUx2	N160SUx2	N160SUx1 N160LUx1
Refrigerant		NH_3	NH_3	NH_3	NH_3	NH_3	NH_3
Storage temp.	°C	-20 ∿ -30	-20 ∿ -30	-20 ∿ -30	-20 ∿ -30	-20 ∿ -30	-20 ∿ -30
Storing height	Approx. in meters	2.5	2.5	2.5	2.5	2.5	2.5
Approx. price of equipment (FOB)	$US	14,000	76,000	121,000	162,000	211,000	214,000
Approx. price of Bldg. construction	$US	160,000	287,000	397,000	556,000	883,000	969,000
Approx. price of installation and construction works	$US	64,000	115,000	159,000	223,000	353,000	388,000
Approx. total cost	$US	238,000	478,000	677,000	941,000	1,447,000	1,571,000
Best shipment of machineries and equipment	Months after the date of contract	3	4	4	4	5	5



Contact plate freezer



Cold storage room

How To Start Manufacturing Industries

Cassava Starch Making Plant

Starch, which is a supply source of carbohydrate, one of the three essential elements of food, occurs widely in farm produce. The starch industry is to extract starch from farm produce to manufacture agricultural processed goods.

Starch is contained in the grains of rice, wheat, maize, etc. and also in the roots and tubers of potatoes, sweet potatoes, cassava and the like. The grain starch contained in rice, maize, etc. is generally small in particle. As their starch grain is surrounded by protein, the extraction of starch is more difficult than that in potato, cassava, etc. The starch in the roots and tubers of potato, cassava, etc. is large in particle and easily settles, and moreover, the fat and protein existing with starch is small in quantity, and thus good starch can be extracted comparatively easily.

The production scale of the starch industry ranges from such a large one as 1,000-ton-per-day to 1-ton-per-day as seen in the cottage industry run by farmhouses. The production scale is greatly affected by the conditions of location involving the supply of raw material, demand and supply of the product and so forth.

Outline of Starch Production

As mentioned above, starch can roughly be classified into the grain starch and the roots and tuber starch. Consequently, the method of production of starch varies to some extent depending on the raw materials to be used. Anyway, the production of starch starts with crushing or grinding the raw material to destroy its tissue. In this way, the starch in the tissue is extracted and the fiber and protein are removed. The grain starch of wheat and maize is crushed by the dry process, and the root and tuber starch of potato and cassava is ground by the wet process, and then the starch is extracted by filtering it through water and also washing with running water. The process from gathering the raw material up to the manufacture of a final product is outlined as follows:

Gathering of raw material → washing → crushing or grinding → extracting → refining

Manufacture of Cassava Starch

Cassava is a plant originated in South America. The starch accumulated in its root and tuber is extracted. Cassava is widely cultivated in the tropics, namely in Indonesia, the Philippines, Malaysia, Thailand, Africa and Brazil. The yield per hectare is 10 to 40 tons, varying depending on the growing conditions. Cassava reportedly contains an average of 18% of starch. In case the starch yield is supposed to be 80% of the raw material and a 10-ton-per-day plant is to be set up, the quantity of cassava that should be supplied to this plant would become as below:

$$10 \text{ tons} \times \frac{1}{0.18} \times \frac{1}{0.8} = 70 \text{ tons}$$

In case the plant is assumed to be operated for 250 days a year, it will need 70 tons x 250 = 17,500 tons of cassava per year. In order to establish a plant manufacturing 10 tons of starch a day, careful planning must be mapped out in respect of cultivation and gathering of cassava. The present data is concerned with a cassava starch manufacturing plant having a production scale that can easily be industrialized. And in preparing the data, the conditions prevailing in developing countries have been taken into consideration.

(1) **Production Scale:** 5 tons/day
(2) **Specification of Product:**
Water – 18 to 19%
Starch – 90 %
This corresponds to the 3rd grade of the JAS (the Japanese Agriculture and Forestry Standards)
(3) **Requirement of Raw Material:** 36 tons/day
(4) **Requirement of Utilities:**
Industrial water . . . . . 20 tons/hour
Pure water . . . 15 tons/hour
Electric power . . . . . 20 kWh
Chemicals . . . given quantity
(5) **Required Manpower:** 12 to 28 including
manager 1
engineer 1
clerical worker 3
(6) **Required Area for Plant Site:**
Building: 200 to 400 m^2
Land: 1,000 m^2

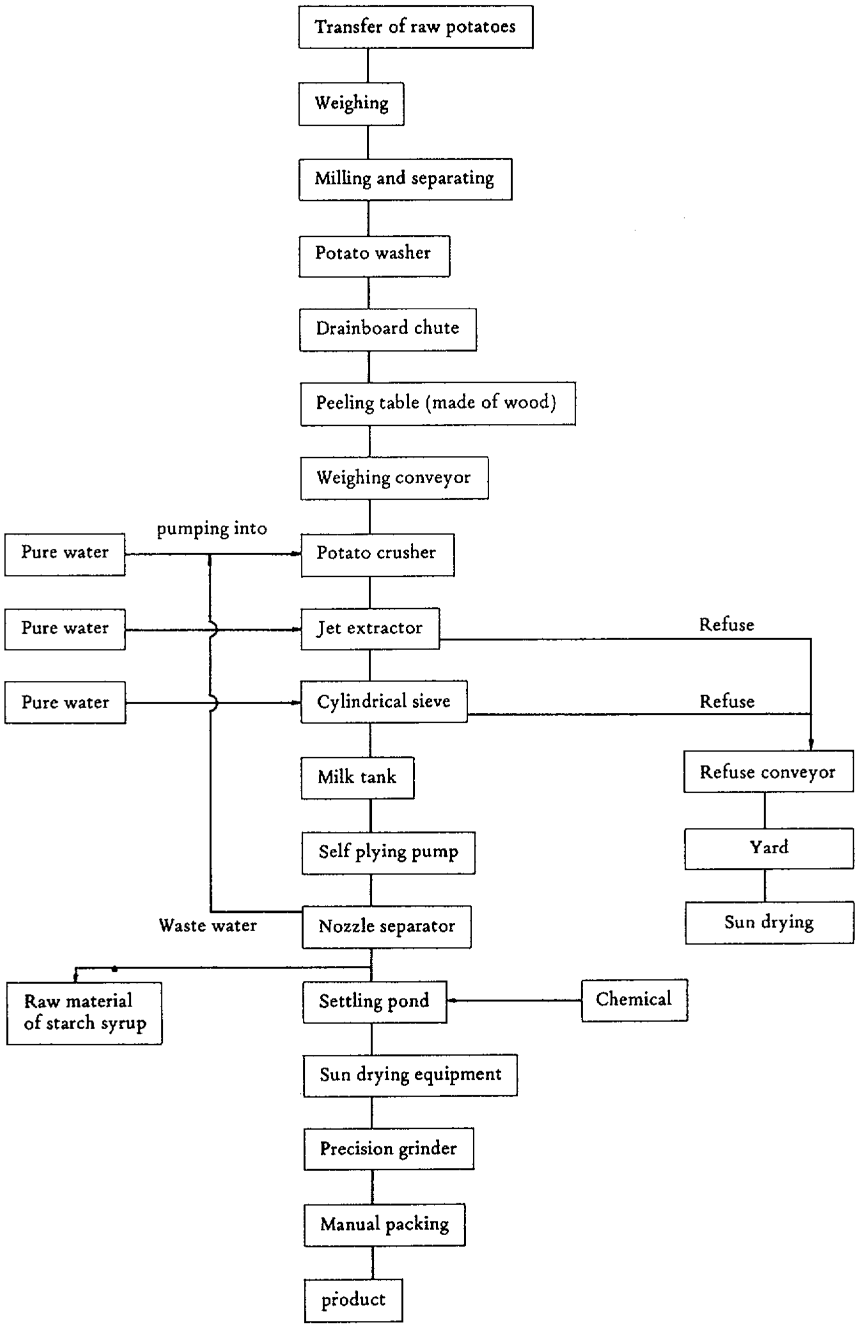
Others

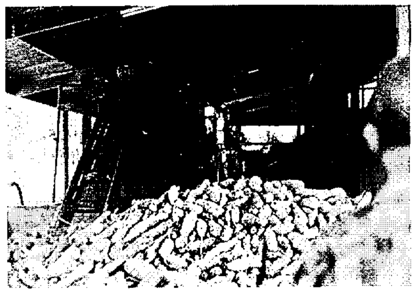
In materializing this plan, it is necessary to investigate the situation of raw material, starch market, utilities such as water, electric power and the like.

Table 1: Required Machinery and Equipment

Item	No.
Weighing platform scale	2
Separator	1
Washing machine	1 (with a 5 h.p. motor)
Chute	1
Peeling table	1
Conveyor	1 (with a 2 h.p. motor)
Grinder	3 (each with a 7.5 h.p. motor)
Starch extractor	1 (with a 7 h.p. motor)
Sieve (cylindrical)	1 (with a 1 h.p. motor)
Milk tank	1
Self plying pump	1 (with a 1 h.p. motor)
Nozzle separator	1 (with a 15 h.p. motor)
Settling pond	1 (made of concrete)
Grinder	1 (with a 3 h.p. motor)
Packing machine	1 set
Delivery pump	1
Refuse conveyor	1 (with a 2 h.p. motor)
FOB price of machinery and equipment	(approx.) $US 119,000

Fig. 1: Process Flow Sheet for Cassava Starch Making Plant (production capacity: 5 tons/day)





Cassava starch making plant

How To Start Manufacturing Industries

Starch Syrup Making Plant

The use of starch can roughly be classified into two, one is to apply hydrolytic reaction and the other is to use starch as it is.

Starch is hydrolyzed into either glucose, a constituent unit, or dextrin composed of several pieces of glucose; and in the latter case the kind of starch does not exert great influence. Nevertheless, existence of much protein poses such problems that the refining of syrup becomes difficult or fatty acid must be removed. What particularly plays an important role in the starch hydrolyzing industry is the price of raw material. Therefore, the starch hydrolyzing industry generally uses the potato starch, whose price is relatively low.

In the industry utilizing starch as it is, they have to select starch fitting well for a respective purpose. Of the properties of starch, investigation must be made on its whiteness, grain size, moisture absorption and flowability. For instance, when starch is used for making confectionery, fish-paste products or medicaments, special consideration must be given to whiteness, purity and grain size. Starch to be used in the spinning and weaving industry and in the paper making industry is required to have uniform viscosity when starch has become paste, and the selection of starch must be made by taking this point into account. In manufacturing soluble starch, potato starch is preferable. In case wheat or Indian corn starch is used, it is liable to cause a problem when it reacts. In this way, when starch is used as it is, special consideration must be given to the properties of starch.

As mentioned above, the starch processing industry is roughly classified into the starch hydrolyzing industry and the industry using starch as it is. There are reportedly 2,000 kinds of products. Starch will be used for the following purposes:

(1) Manufacture of starch syrup
(2) Manufacture of grape sugar
(3) Manufacture of foodstuff
(4) Manufacture of modified starch
(5) Manufacture of medicaments
(6) Manufacture of cosmetic, briquette, toy, shoe polish, dry battery, chemical for floatation, etc.

Manufacture of Starch Syrup from Cassava

One of the industrial uses of starch is to manufacture syrup. There are three kinds: acid saccharized syrup, enzyme syrup and malt syrup. Each of them have both merits and demerits. The following shows how they are manufactured respectively:

1) Acid saccharized syrup

In manufacturing this syrup, reaction is made by using such acids as HCL, H_2SO_4 and oxalic acid. Its merit lies in that the reaction finishes in a short time. Depending on raw material, however, if often gets coloured; and as its saccharization is done quickly, it often gets to taste bitter. Moreover, its manufacturing equipment must resist the corrosion to be caused by acid, which consequently results in the higher cost of equipment.

2) Enzyme syrup

As this syrup reacts slowly, the product tastes good, and the degree of its saccharization can be changed variously. This syrup, however, has such demerits that enzyme is dear, special care is required in handling and preserving it, the product gets coloured and its decolourization is not easy, and the reaction demands two steps of liquefaction and saccharization.

3) Malt syrup

This syrup is manufactured by reacting malt. Malt is made from barley. One of its merits is that malt can be produced privately. The principal component of this syrup being maltose, it tastes good and has high viscosity. Another merit is that it needs no colourization. Nevertheless, it has such demerits that it is difficult to control the reaction temperature and to mass produce it.

Fig. 1 shows the flow sheet of the manufacture of starch syrup by acid saccharification and enzyme saccharization.

Example of Malt Syrup Making Plant Using Cassava Starch as Raw Material

As already mentioned, there are three manufacturing methods of starch syrup. The present data describes briefly about a starch syrup making plant where cassava starch is used as raw material and saccharization is done with malt. Description is also made on the machinery and equipment required, quantity of utilities required, etc.

(1) Production Scale:
3 tons/day
(2) Requirement of Raw Material:
2.8 tons/day of cassava starch
(3) Requirement of Utilities:
Cooling water – 20 tons/hour
Electric power – 15 kWh
Steam – 300 kg/hour
(4) Required Manpower:
8 to 14 including
engineer – 1
clerical worker – 2
(5) Required Area for Plant Site:
Building: (approx.) 100 m^2
Land: (approx.) 200 m^2

Process Description

The following is a brief description of the manufacture of malt syrup from cassava starch. Its process flow sheet is shown in Fig. 1.

Refined starch is used as raw material.

Malt is made from barley.

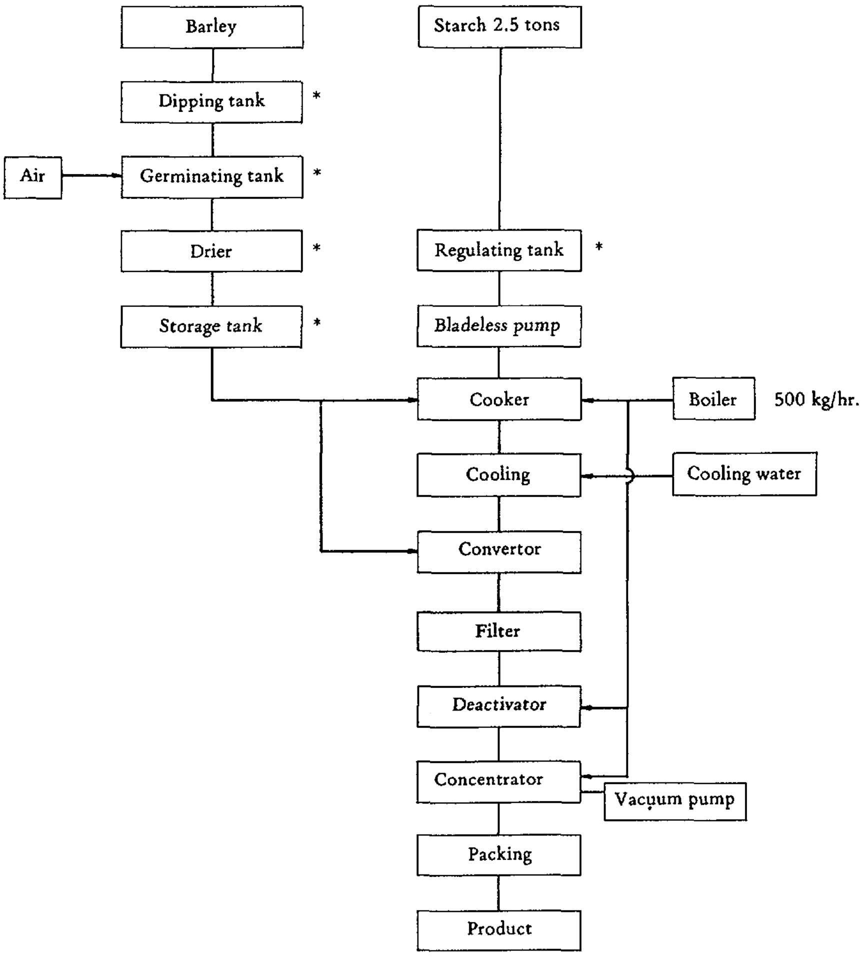
The starch is sent into a regulating tank, and then sent into a cooker by bladeless pump, and malt is added and cooked for a given time at about 105°C under a given pH. The starch is liquefied while being cooked. The starch thus liquefied is cooled before it proceeds to saccharization. The cooled liquefied starch is sent to a converter after malt is added and there it is saccharized. The saccharization reaction is performed under pH 5.6 to 5.8 and at the reaction temperature of 55° to 61°C. The saccharization takes 3 to 5 hours. The time needed for saccharization reaction varies, depending on the saccharization power of malt, the quantity of malt to be added and on the degree of saccharization. After being saccharized, the saccharized liquid goes through a filter. This is performed to remove the impurities, mainly protein, which are contained in the saccharized liquid. The filtered saccharized liquid is sent into a deactivator, where the temperature of the liquid rises rapidly. This is called the deactivating process of malt. The deactivation of malt is performed not only to eliminate the vitality of malt but also to eliminate the vitality of various bacteria existing together in the saccharized liquid. This process also serves to restrain the reaction which will change the quality of the product. This deactivating process is peculiar to the manufacture of malt syrup. The saccharized liquid after being deactivated is sent into a concentrator where it becomes starch syrup after being concentrated to a given degree.

Malt starch syrup is used to make caramels and candies.

Table 1: Required Machinery and Equipment

Item	No.
*Dipping tank	1
*Germinating tank	10
*Malt drier	4
*Malt storage tank	4
*Starch regulating tank	1
Bladeless pump	3
Cooker	2
Converter	8
Filter	1
Deactivator	2
Concentrator	2
Packing machine	1
Vacuum pump	1
Boiler	1
FOB price of machinery and equipment excluding the items marked (*), which are obtainable in the locality (approx.)	$US 95,000

Fig. 1: Process Flow Sheet for Starch Syrup Making Plant (Production Capacity: 3 tons/day)



Starch syrup

How To Start Manufacturing Industries

Flour Milling Plant

Flour milling is perhaps one of the most ancient industries. That is, it was for flour milling that man first applied the machine he invented, utilizing the machine to provide motive power as a means of improving his living. In other words, flour milling has been known from a most early date as a means of obtaining a desirable staple food by mechanical crushing and separation of grain.

Flour milling is a vital industry that constitutes the hub of diverse industries supplying foodstuff to mankind, such as the farm industry, farm products processing industry, bakery industry, noodle-making industry and others. Accordingly, the flour milling industry may well be regarded as an industry that is almost as old as the history of mankind.

Spectacular technical innovations have been achieved during the stages of evolution from the primitive system of hand-milling to the use of pneumatic rolls for milling today. And it is only natural that each country has its own history of development of its milling industry.

The principle of milling wheat basically consists of extracting inner endosperm from the wheat grain, or of separating the endosperm from the outer covering of the wheat grain.

Flour obtained through this process is recognized as a product of great international value owing to the very wide scope of uses it can be put to.

Process Description

The processes involved in the manufacture of flour and other by-products from material wheat may be roughly devided into the following three processes: Cleaning, conditioning and blending of material wheat, milling and finishing.

1) **Cleaning**
This is the process to separate and eliminate sand, pebbles, broken grains and other impurities from material wheat.
The separation is achieved by utilizing the following physical properties:
(1) Differences in the specific gravities between wheat and mixed impurities.
(2) Differences in the volume, width, length, shape and other physical properties between wheat and mixed impurities.
(3) Differences in repulsive forces between wheat and mixed impurities.
(4) Differences in the critical floatation speeds between wheat and mixed impurities in air.
Besides, the dust and other impurities adhering on the surfaces of wheat grains are removed by water washing and by scouring.

2) **Conditioning**
Depending on where the wheat is produced as well as on the kind of wheat, a wide difference will exist in the physical properties of the wheat, as:
(1) Differences in the brittleness of the wheat covering.
(2) Differences in the separability of endosperm and outer covering of the wheat.
(3) Differences in the hardness (softness) of the endosperm part.
Accordingly, the conditioning process is adopted to condition the wheat grains to suitable milling conditions.
That is, the wheat is suitably dampened to a prescribed water content in accordance with the water content of the wheat, and tempered in a tank for about 20 – 40 hours to allow the moisture to permeate into the inner parts of the wheat.
In general, damping is achieved to provide a water content of 14 – 15% to soft wheat, and a water content of 15 – 16% to hard wheat. Wheat that contains a particularly large amount of moisture is temporarily dried before being treated by the damping process.

3) **Blending**
The wheat thus conditioned is next blended. That is, since the qualitative characteristics of wheat, such as the protein content, endosperm colour and odour, as well as enzyme activation, will differ according to the kind of wheat, blending is achieved to make the best use of the independent characteristics of different kinds of wheat as a means of raising the product value.

Milling

In the milling process, several tens of roller type milling machines are employed to successively separate and reduce wheat grains into smaller and smaller particle sizes by a gradual process. That is, the gradual milling system is adopted for milling.

This system consists of the breaking, scalping & granding, purification, reduction, and dressing processes.

1) **Breaking**
In the primary stage of milling, the wheat grains are broken down into comparatively large particles. Namely, the inner endosperm is extracted without crushing the wheat grains.

2) **Scalping & grading**
Semolina generated by the breaking process is separated from the outer covering part by scalping. The fine powder contained in semolina is also removed as much as possible during this stage. This is known as the grading process.

3) **Purification**
The minute fragments of outer covering which are found mixed in semolina obtained by the preceding process, are next separated by the purification process.
Namely, the fragments of outer covering are floated by a stream of air directed at right angles to the sieve surface from the underside of the sieve. As a result, semolina is purified and, at the same time, particle size classification is advanced further.

4) **Reduction**
The process of obtaining flour of desired particle size by crushing semolina, middlings and dunst, which have been passed through the scalping, grading and purification processes, is known as the reduction process.
In this reduction process, smooth rolls are used to prevent damage to starch, protein and other substances which comprise the basic compositions of the endosperm part.

The reduction process is achieved in a number of stages, for rapid milling of endosperm under excessive milling pressure will result in the generation of flaky stock, or in the degradation of endosperm quality.
In other words, endosperm of deffering particle size and purity levels are partially milled at some suitable milling pressure by separate rolls, while remaining endosperm is further sifted and sent to subsequent milling rolls for further milling.

5) Dressing
Endosperm is milled into fime particles when stock is reduced in the reduction process. However, the outer covering of the wheat grains remains either in its original shape or exists in the form of large fragments, so a sifter of fine mesh is used to separate it from flour.
The mesh size adopted in the sifting process directly determines the particle size of the flour produced, or the quality of the flour.

Finishing

The flour obtained by means of the breaking and reduction processes (raw flour) features a characteristics all its own in points of purity, protein content and quality.

Accordingly, a number of finished flour is suitably mixed together to obtain a product that combines the merits of a variety of finished flour and possesses the desired properties and characteristics.

The flour is further bleached, its protein content is increased, its enzyme activity is adjusted and nutrients are added, before it is obtained as finished product.

The milling capacity of a single processing line is limited. Here, we shall concern ourselves with a flour mill having a milling capacity of 5 tons/hour and producing product flour containing 80% flour and 20% additives.

Example of Flour Milling Plant

1) Production scheme
The flour mill introduced here has a milling capacity of 5 tons/hour, so the volume of production will be determined by the number of shifts adopted on the basis of 8 hours per shift.
In the case of 1 shift: 8 hours/day
In the case of 3 shifts: 24 hours/day

2) Required raw material wheat
The volume of production of product flour will basically be determined by the volume of material wheat processed. As the milling capacity of the plant under study is 5 tons/hour, a material wheat supply equivalent to the product obtained by multiplying 5 tons/hour by the number of operating hours will become necessary daily.
That is, the required wheat supply will be:
5 tons/hour x 8 hours = 40 tons/day under an 8 hours/day working system, and 5 tons/hour x 24 hours = 120 tons/day under a 24 hours/day working system.
Accordingly, assuming 25 working days per month, the wheat supply required monthly will be:
40 tons x 25 days = 1,000 tons/month (1 shift)
120 tons x 25 days = 3,000 tons/month (3 shifts)
Note: Tables 1 – 4 are based on the above scheme.

Table 1: Required Machinery and Equipment

1) Screw conveyor
2) Measuring machine
3) Milling separator
4) Disc separator
5) Scourer machine
6) Suction fan
7) Double cyclone dust collector
8) Washer and stoner
9) Water wheel dampener
10) Brush machine
11) Aspirator
12) Rotary magnetic separator
13) Pneumatic conveying equipment, pressure type
14) Double roller mill
15) Square sifter 6 section x 30 sieves
16) Square sifter, 4 sections x 30 sieves
17) Double deck purifier
18) Suction filter
19) Bran finisher
20) Middling mill
21) Agitator
22) Gyratory sifter
23) Packer
24) Suction filter
25) Turbo-fan
26) Balancing fan
27) Receiver cyclone
28) Piping with bends
29) Bucket elevator
30) Shafting
31) Hanger channel bar
32) Automatic constant feeder
33) Chain feeder
34) Bag sewing machine

FOB price of machinery and equipment (approx.) $US 2,381,000

Table 2: Required Utilities

Electricity	270 kWh
Water	5 tons/hour

Table 3: Required Manpower

	1 shift	3 shifts
Chief engineer	1	1
Manager	1	1
Engineer	1	3
Skilled worker	3	9
Odd job worker	5	15
Total	11	29

Table 4: Required Area for Plant Site

Building	39m x 9m = 270m² (4 – 5 stories)
Warehouse	12m x 18m = 216m²
Land	(approx.) 1,200m²

Locational Condition

The plant location will depend largely on how raw material wheat is obtained. That is, a location near some wheat producing center will be desirable in the event wheat is produced locally, but a location close to a seaport or a market center will be the more desirable in the event wheat is being imported.

How To Start Manufacturing Industries

Fresh Milk Making Plant

Milk, as a highly nutritive drink, has today become indispensable for our daily living, and its demand continues to increase steadily from year to year for consumption by general households, hospitals and schools.

Milk available on the market may be obtained in the form of plain milk that is simply pasteurized, processed milk that is added with vitamins, minerals or other nutrients, or in a mixture with fruit juice, coffee, chocolate or other ingredients. Whatever the form in which milk is available, the basic processes involved in its preparation are generally the same, the essential difference lying in the processes preceding pasteurization.

Milk available to end consumers, particularly ordinary milk, usually comes in 200 cc, 500 cc or 1 liter containers. These containers may be made of glass, but the more general trend today is to market milk in paper or polyethylene containers which dispense with the need to recover the bottles. Naturally, the milk filling process will differ according to whether a bottle or other form of container is used.

Since milk distributed to general consumers constitutes a typical product that is produced daily and consumed more or less the same day, the milk making business may be regarded as a stabilized one closely linked to our daily living.

The milk making plant to be introduced here is designed with a minimum economic production scale, or a production capacity of 6,000 liters/day. For container is used paper container of 200 cc.

Process Description

Raw milk, stored cool and inspected for quality, is treated by clarifier and its microscopic impurities completely eliminated. The milk is then preheated by ultra high temperature sterilization and its fatty ingredient homogenized by means of a homogenizing system. This is followed with ultra high temperature sterilization at 135°C for about 2 seconds, after which the milk is cooled, then filled into paper containers.

In further details, milk making is achieved by the following processes. Raw milk conveyed by milk cans or tank lorries changed into the weighing tank by a conveyor belt for weighing, after which a prescribed volume of milk is charged into the receiving tank.

From here, the milk is pumped to the clarifier by means of the milk pump, where it is removed of microscopic impurities. Clarified milk is next sent to the plate cooler where it is cooled to about 2 – 5°C, then pumped to the storage tank.

Stored milk is preheated to about 80°C by heat exchange with pasteurized milk in the ultra high temperature sterilizer and its fatty ingredient homogenized in the homogenizer, then further recycled to the ultra high temperature sterilizer where it is pasteurized instantly in about 2 seconds at a high temperature of 135°C.

Here, the pasteurized milk is subjected to heat exchange with incoming raw milk, whereupon its temperature is gradually lowered. Final cooling is achieved by means of chilled water to lower the temperature to 3°C, after which the milk is stored in the surge tank for subsequent filling into paper containers by means of the filling machine.

For pasteurization of milk may be adopted either the high temperature sterilization system or the ultra high temperature sterilization system. The high temperature sterilization system involves pasterization at a temperature of about 85°C, while the ultra high temperature sterilization system achieves pasterization at a high temperature of about 135°C.

Today, the ultra high temperature sterilization system is more popularly adopted since it lends itself to killing escherichia coli and other heat resisting bacteria, in addition to permitting longer preservation of milk.

Example of Fresh Milk Making Plant

1) Production Sheme

Table 1: Required Machinery and Equipment

Item	Capacity	No.
Weighing tank	200 kg	1
Receiving tank	500 kg	1
Milk clarifier	3,000 liters/hour	1
Milk pump	3,000 liters/hour	1
Plate cooler	3,000 liters/hour	1
Storage tank	6,000 liters	2
Milk pump	1,000 liters/hour	1
Pasteurizer	1,000 liters/hour	1
Surge tank	1,800 – 2,000 liters	2
Filling & packaging machine	3,400 pcs./hour	1
Boiler	300 kg (evap.)	1
Chiller	40,000 Kcal/hour	1
Power receiving facilities	30 kVA	1
FOB price of machinery and equipment	(approx.) $US 286,000	

Table 2: Daily Requirement of Raw Materials and Utilities

Item	Quantity
Raw materials	
Raw milk	6,000 liters
Paper container (200 cc)	30,000 pieces
Utilities	
Electric power	162 kWh
Water	28 kiloliters
Fuel (light oil)	200 liters

The plant is designed for operation under an 8-hour day system, with 2 hours expended for preparations and after cleaning. That is, the machines are actually operated for 6 hours daily. The standard plant operation schedule is as follows:

8 hours/day
25 days/month
300 days/year

2) **Required Machinery and Equipment (Ref: Table 1)**
The principal machinery and equipment required for a 6,000 liters/day milk making plant will be as listed below. The cost of machinery and equipment for a 10,000 liters/day plant will not differ much as for a 6,000 liters/day plant, although it will be necessary to operate the packaging section under a 2-shift work system.
The cost indicated above is based on current values and includes installation as well as plant operating guidance expense.

3) **Required Area for Plant Site**
The land area required constructing the plant and its buildings will be as follows:

Land 40 m x 50 m = 2,000 m^2
Building 18 m x 35 m = 630 m^2

The buildings shall be of formed steel structure with slated roofing, and will consist of the plant building proper, office, chiller housing, power room, boiler room, paper container warehouse and others.

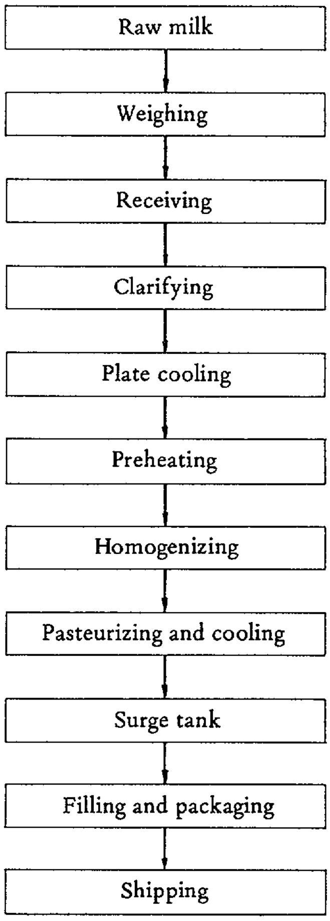
Tables 1, 2 and 3 show respectively the machinery and equipment, raw materials and utilities, and manpower required for the above plant.

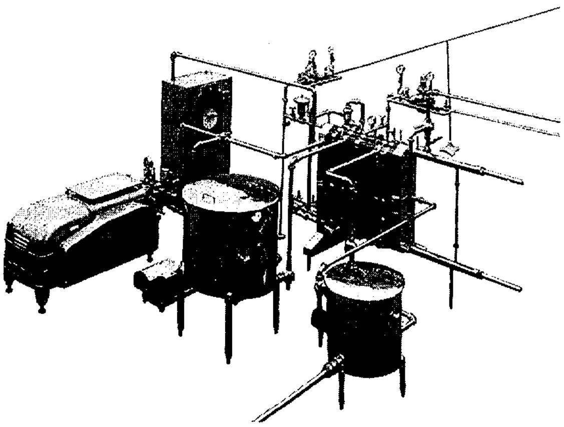
Table 3: Required Manpower

Item	No.
Plant manager	1
Engineer	3
Worker	7
Total	11

Locational Condition

For a milk making plant catering to general consumers, the primary locational condition for selection of plant site will be its proximity to milk producing centers and to a source of easy water availability. The location would be ideal if, in addition, the site is situated near consumer markets, but this condition will be of secondary importance since good product transportation facilities are generally available today.





How To Start Manufacturing Industries

Concentrated Fruit Juice Making Plant

Modern commercial production of fruit juice first began in Switzerland in 1800. Great development began in 1918 after World War I. The importance of fruit juice as military food supply was recognized from the war experience, and interest in fruit juice heightened in the U.S.A. and Europe.

From 1925, mass production of fruit juice began in the U.S.A., and since then, both technology and volume of production greatly exceeded that of Europe. Almost all production technology being used today have been developed in the U.S.A.

In 1928 the hot packing method, whereby juice is sealed in cans and then pasteurized by heating, was developed in the U.S.A. Grapefruit juice and grape juice appeared in the market; then, tomato juice and orange juice also appeared in the market. This method of pasteurizing continued up to 1937 when World War II was broken out. Up to this time all juice products were treated at the state of natural concentration, but in 1940 canned concentrated orange juice and grape juice appeared in the U.S.A. market. Concentrated fruit juice was packed in containers and pasteurized by heating. In 1945 frozen concentrated orange juice (FCOJ), which was developed and popularized rapidly, appeared sucessively.

In 1974 there were 24 plants in Japan operating on internationally industrial scale. At present, Japan is second only to the U.S.A. in production of FCOJ. However the consumption of FCOJ in the U.S.A. is 21.8 kg per capita, whereas the consumption in Japan is 3.6 kg (one-sixth of the U.S.A.).

Table 1: Production of Orange and FCOJ in Japan

Year	Orange (ton/year)	FCOJ (ton/year)
1965	1,330,000	3,213
1970		7,507
1975	3,670,000	46,644
1978	3,500,000	65,000

The consumption of natural fruit juice and fruit drinks in Japan in 1970 compared with that of 1976 shows that the former increased by 23 times while the latter increased by 14 times. The remarkable advance of manufacturing technology, the use of composite cans, and the appearance of chilled juice filled in pure pack paper containers also helped promote the growth of fruit juice. On the other hand, the methods of cut-back and add-back were employed to improve the quality of fruit juice. The technology of storing FCOJ in huge tanks and the use of containers for transporting at normal temperature also helped promote the development of the fruit juice industry.

Example of Concentrated Fruit Juice Making Plant

Generally there are two kinds of fruit juice treating plants: frozen concentrated fruit juice manufacturing plant and fruit drinks manufacturing plant. In the former, juice is squeezed out from fruit; this juice is concentrated to one-fifth by a vacuum concentrator; the juice is cooled down to –8 degrees C; the sherbet-like fruit juice is packed in composite cans or large cans and further cooled down to –20 to –30 degrees C to produce frozen concentrated fruit juice. Frozen concentrated fruit juice in composite cans is sold, and frozen concentrated fruit juice in large cans is used as raw material for fruit drinks. In the latter, frozen concentrated fruit juice is used as raw material, and syrup, citric acid, colouring matter, pulp, and carbonic acid gas are added, as required, to produce various kinds of fruit drinks. These drinks prepared are packed in bottles, plastic and paper containers and sold as products.

A description will be given for FCOJ. However, it must be understood that there are all sorts of fruit: orange, apple, grape, tomato, pineapple, passion fruit, banana, etc. The ingredients of juice are different according to the kind of fruit, and so, as a matter of course, the treating processes are different. It is difficult to describe each process, so description will be limited to the most representative orange fruit and juice treatment.

The plant given in this description is capable of treating 6,000 kg/hour of orange fruit. The production of juice 55° Brix FCOJ is 552 kg. Also 1,500 kg/hour of peel and 1,462 kg of pulp can be produced. Reprocessing of the latter by-products can be utilized for production of cattle feed and for others.

Manufacturing Technology

The most important technological point in fruit juice manufacturing is how to treat the fruit without losing the natural flavour, colour, and taste of the original fruit. From this viewpoint an explanation will be made concerning the superior points of FCOJ product, the cut-back method, the add-back method, and the vacuum concentrator.

1) Pasteurized concentrated fruit juice and frozen concentrated fruit juice

The manufacturing of pasteurized concentrated fruit juice and frozen concentrated fruit juice are carried out by almost same process. There are some differences, however, in the storage temperature, the concentration temperature, and the number of times of heat treatment.

In the former, enzym which decomposes pectin is thoroughly inactivated and sufficient pasteurization by heat treatment is done to sterilize harmful microorganisms. Since pasteurized concentrated fruit juice is stored at around 4 degrees C, higher than its own freezing temperature given, treatments should be done for the preservation of the quality of fruit juice. Therefore deairing and pasteurizing before concentration are of course necessary, and also pasteurizing again after concentration is necessary.

The latter, on the other hand, does not require repasteurizing after concentration because the storing temperature (–24 degrees C) is lower than its own freezing temperature. Accordingly, there is no deterioration in quality due to the above heat treatment. At frozen storage at the lower temperature than –18 degrees C, there are no fading and change in colour tone, no change in flavour, no loss in vitamin C, etc. According to a report from the U.S.A., the stability of flavour lasted for 750 days, and the stability of colour lasted for 275 days.

2) Cut-back and add-back

During the vacuum concentration at low temperature, the fresh flavour of raw fruit juice tends to be lost because of the loss of volatile aroma. It has been discovered that this can be restored sufficiently by adding a suitable amount of fresh raw fruit juice. This is the cut-back method which is covered by 1948 American patent (U.S.P.) No. 2.453109.

According to this method, fruit juice is concentrated to 55 – 65° Brix; then, 7 – 10 wt% fresh raw fruit juice is added to make 42° Brix. At this Brix, the whole fruit juice will not be frozen necessarily at –18 degrees C. By adding as much approximately three time quantity of water, sucrose will become 12%. Ice crystal will dissolve in the water, and the feeling of coolness at this temperature will be just right for drinking. In the U.S.A. 170 cc cans and 355 cc cans are produced for home use. Housewives purchase huge quantities from super markets and always keep a stock in the home freezer-refrigerator. The fruit juice is diluted to three times by water and served when needed.

In the add-back method, late season fruit is kept in cold storage and mixed with new crop the following year to restore the flavour and to adjust the ratio of sugar to acid and the tone of colour. Generally, FCOJ is defrosted by a defroster and mixed in the concentrator. Another method is to recover essence and return it to the concentrator.

3) Vacuum concentrator

Almost all concentrators used are of the vacuum type. There might be some deterioration in colour, flavour, taste, etc. of fruit juice even in a heat treatment at the reduced pressure by the vacuum concentrator. Therefore, the requisites of a concentrator are that the evaporating temperature must be low and that the time required to pass through the concentrator must be short.

There are various types of concentrators, but the most widely used types at present are the plate type and the falling film type. Both are high temperature short time distillation types. The evaporating temperature at the inlet is 70 – 80 degrees C, and the temperature at the outlet is 45 – 50 degrees C. The time required for full concentration is within three minutes. The time is short, and so there are no loss of flavour, loss of vitamin C, and change in colour caused by microorganism.

In the plate type there is some scorching when the fruit juice contains abundant pulp, and it is disadvantageous for long running. The falling film type can be run for long hours and the thermal efficiency is somewhat superior.

Process Description

A general outline of the manufacturing process including FCOJ is given in Fig. 1.

1) Raw material intaking

The raw material is transported to plant and weighed on a scale.

2) Storage

The raw material is kept in storage and, when necessary, it is sent to the succeeding process by way of a stream of water. Earth, sand, and other foreign matters are washed off at this time.

3) Washing and brushing

The raw material fruit which has travelled through the stream of water and which has been lifted up by the bucket conveyor is sent to the first washing tank. The coated wax and chemical onto the surface of the peel are washed off with detergent, and the fruit is sent to the second washing tank. The raw material fruit is washed with detergent again in the second washing tank; then, it is transferred by the bucket conveyor and sent to the brushing conveyor. And then brushing is carried out by a revolving brush of roll type, there.

4) Screening

The fruit which is carried on the screening conveyor is sprayed with fresh and clean water at the inlet of the conveyor, and diseased fruit, green fruit, old fruit and damaged fruit are taken away by workers lined along the conveyor on both sides.

5) Scalder

The raw material fruit from preceding process is transferred to the scalder by the bucket conveyor. The scalder is a horizontal type cylindrical revolving drum, and the raw material fruit is heated in this drum by steam for approximately one minute. Thus, the peel is softened to make peeling easy.

6) Peeling

The raw material fruit which has left the scalder is sent to the peeler mounted on a stant by the bucket conveyor. Here the raw material fruit is classified into large, medium, and small sized fruit; then, they are separated into peel and peeled fruit. The peel is sent to the hopper by the conveyor, and the peeled fruit is dropped into the hopper of the juice extractor by a separate conveyor.

7) Juice extraction

The peeled fruit is charged into the chopper-pulper. The fruit is chopped into small pieces by the chopper. The pulper consists of a cylindrical screen with 1.5 mm perforations and three paddled rotating inside. Here the peeled fruit is crushed and, with centrifugal force, it is filtered through the screen and separated into fruit juice and pulp. The fruit juice is sent to the finisher, and coarse pulp, fibre, and seed are removed by a 0.5 – 0.8 mm screen to produce clear fruit juice.

8) Deairing

The air and gas mixed in the fruit are eliminated by spraying the fruit juice in a vacuum chamber of the deaerator. The objective is to prevent breeding of microorganism, to prevnet oxidation of the oil in juice, and to prevent the loss of vitamin C, flavour, and colour.

9) Pasteurization

Instantaneous pasteurization is done by heating in a plate heat exchanger at 93 – 95 degrees C for about 15 – 20 seconds. Microorganism is pasteurized and at the same time, pectin decomposing enzym and vitamin C oxidizing enzym are deactivated to prevent deterioration of the quality.

10) Separation

Fine pulp is separated by a centrifugal separator to produce clear fruit juice.

11) Concentration

Vacuum concentration is done up to 55° Brix by the vacuum evaporator to get fruit juice concentrated to one-fifth. The evaporation temperature is 66 – 43 degrees C.

12) Blending

The 55° Brix concentrated fruit juice is put into the blending tank and, in order to restore the flavour and colour as mentioned earlier, 7 – 10% of raw fruit juice is added as cut-back to get 42° Brix fruit juice.

13) Cooling

The blended fruit juice is sent to the slush freezer immediately and is cooled down to –8 degrees C by the cooling medium of a freezer and is made into sherbet-like juice frozen. The freezer has a freezing jacket on the outside of the horizontal cylinder and a revolving rotor and scraper on the inside of the horizontal cylinder. The fruit juice frozen by the medium in the freezing jacket is scraped off from the inside wall of the cylinder by the scraper.

14) **Filling**

Generally, the piston type filler is used most widely for filling of juice into cans. Composite cans, 18 liter metallic cans or drums which are lined with double polyethylene inner bags are used as containers. These containers should be decontaminated by thorough cleaning or ultraviolet ray radiation.

15) Freezing

After filling in containers, the concentrated juice is sent to the freezing unit. The concentrated juice is frozen to –20 degrees C or less in approximately 10 minutes. If necessary, freezing temperature may be decreased to approximately –30 degrees C.

16) Storage

The product which has been frozen to sufficiently low temperature is sent to the storage where the temperature is kept at –24 degrees C and served when needed.

Table 2: Required Machinery and Equipment

Item	Specification	No.
Truck scale		1
Storage		1
Bucket conveyor	0.4 kW each	5
Primary washing tank	fresh water consumption 4,000 ℓ/hr	1
Pump	total of 6.6 kW	3
Ultra screen		3
Water tank		3
Circulation pump	total of 4.5 kW	3
Secondary washing tank		1
Roots blower	1.5 kW	1
Brushing conveyor	0.75 kW, fresh water consumption 16,000 ℓ/hr	1
Screening conveyor	1.9 kW, fresh water consumption 8,000 ℓ/hr	1
Motor-switchboard	total of 2 kW	3
Scalder	1.5 kW, steam consumption 200 kg/hr	1
Screener	1.2 kW	1
Peeler	total of 10.6 kW	4
Peeled peel conveyor	1.15 kW	1
Peeled peel conveyor	1.2 kW	1
Segment conveyor	2.2 kW	1
Stand		1
Screw conveyor	14.4 kW	1
Peeled peel hopper		1
Pulper	11.0 kW	1
Pump with hopper	total of 1.5 kW	2
Balance tank	total of 0.75 kW	4
Juice circulation pump	6.75 kW	7
Finisher	7.5 kW	1
Deaerator	5.9 kW, fresh water consumption 15,000 ℓ/hr, air consumption 100 ℓ/hr	1
Plate type heat exchanger	0.75 kW, steam consumption 480 kg/hr, fresh water consumption 10,000 ℓ/hr, 1 degree C chilled water consumption 5,000 ℓ/hr	1
Automatic-controlling panel for plate heat exchanger	1.0 kW, air consumption 100 ℓ/hr	1
Surge tank	0.75 kW	1
Centrifugal separator	30.0 kW, fresh water consumption 2,000 ℓ/hr	1
Square hopper		1
Pulp circulation pump	0.75 kW	1
Storage tank	total of 2.25 kW, chilled water consumption 9,000 ℓ/hr	3
Blending tank	total of 2.25 kW, chilled water consumption 3,000 ℓ/hr	3
Quick freezer	0.75 kW	1
FOB price of machinery and equipment	$US 1,082,000	

Fig. 1 Frozen Concentrated Orange Juice Manufacturing Process

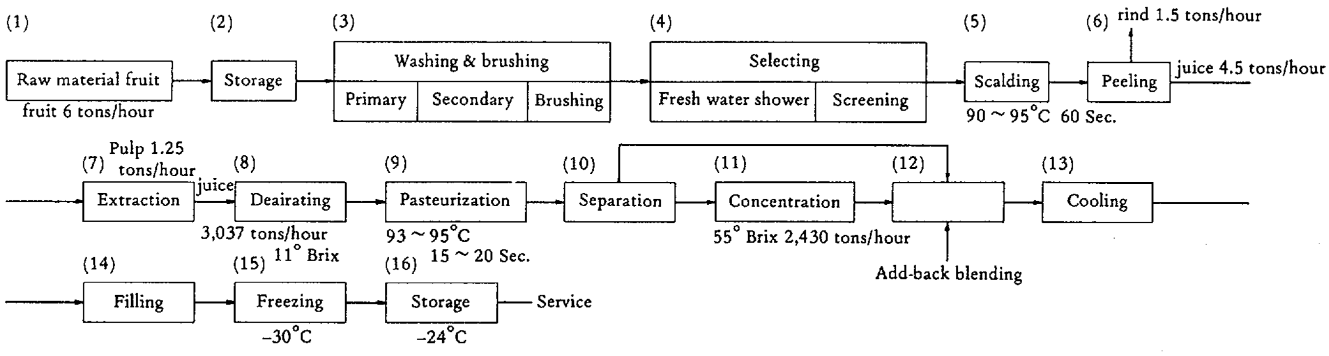
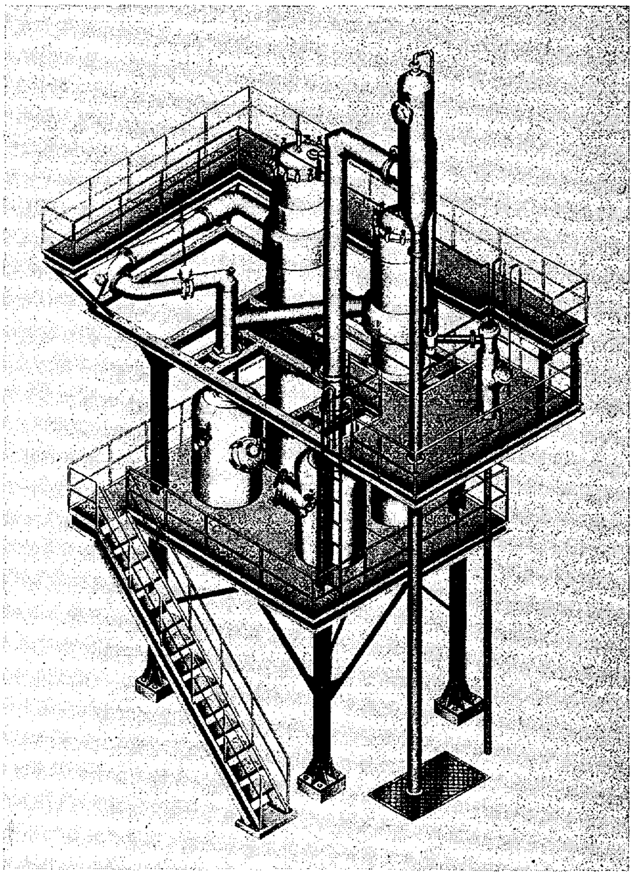
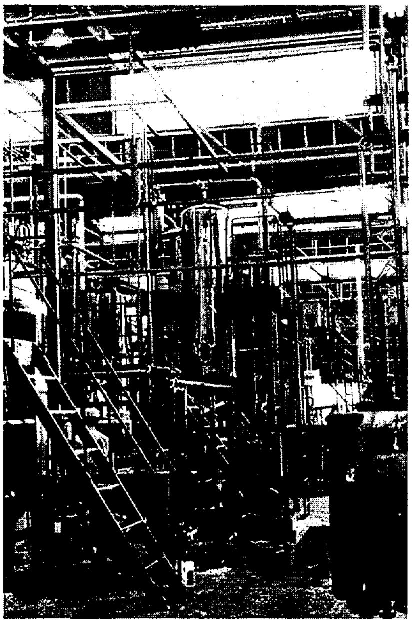


Table 3: Auxiliary Machinery and Equipment
Boiler
Freezer and equipment for freezing facilities
Facilities for receiving and delivering electricity
Facilities for receiving and delivering water
Testing equipment

Table 4: Required Raw Materials and Subsidiary Materials
Orange fruit
Citric acid
Machine oil
5 gallon cans



Falling film type, double effective evaporator



Deaerator

How To Start Manufacturing Industries

Margarine Making Plant

Margarine was first made by a Frenchman; Monsieur Mege Mauries in 1869 for use as a substitute of natural or genuine butter.

In the rudimentary stage of the manufacture of margarine, it was impossible to use all kinds of oils and fats as raw materials of margarine due to primitive oil refining techniques.

Later, it became possible to produce high quality oils and fats having suitable melting points and viscosities from various kinds of liquefied oils owing to the development of the vacuum deodorization technique in the U.S.A. as well as the development of manufacturing the hardened oil in Germany.

Consequently, so many kinds of oils and fats from animals, fishes and vegetables which could not be used as raw materials of margarine in the past, have become available for the manufacture of margarine.

Furthermore, according to the improvement in the technique of oil refining, the quality of margarine has become so high as that of natural or genuine butter.

On the other hand, when we appreciate the efficacy of the margarine for physical health as a foodstuff, oils and fats have twice calorie as the amount of sugar and have high unsaturated fatty acids called the indispensable fatty acid or vitamin F and oil-soluble vitamins such as vitamin A, D, E, etc.

Margarine is essentially produced by mixing the oils and fats described above (at a ratio of roughly 80%) with other materials such as water and lactic products (at a ratio of roughly 20%). The larger proportion of oils and fats, the principal ingredient, consists of hardened oil.

While the kinds of hardened oils (raw oils and fats) used for the manufacture of margarine differs by countries very much. In America the principal raw oils and fats are soybean oil, cottonseed oil and their hardened oils. In Europe oils and fats produced in each country and imported ones are available. In Japan principal raw oils and fats are vegetable oils such as cottonseed oil, soybean oil, corn oil, coconut oil, palm oil and rapeseed oil, and fish oil, beef tallow and lard.

A typical example of blending of raw oils and fats for the manufacture of industrial margarine in Japan is the following;

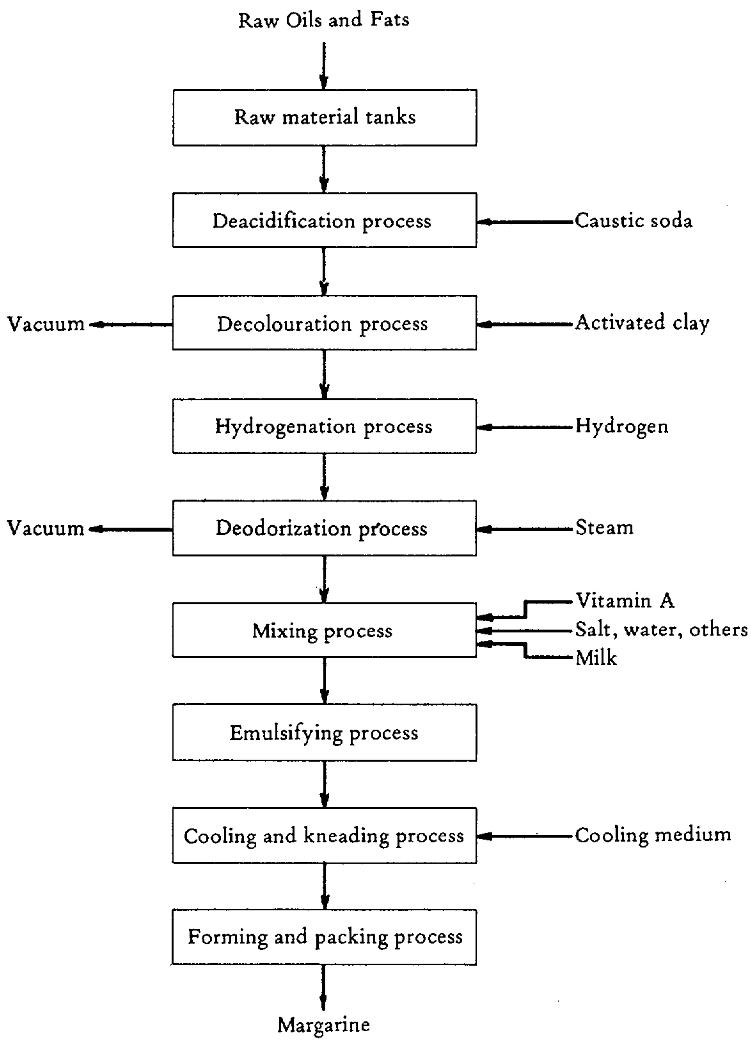
Raw oils and fats	Blending ratio
1) Fish oils	45%
2) Beef tallow	10%
3) Soybean oil	15%
4) Cottonseed oil	1%
5) Coconut oil	2%
6) Palm oil	15%
7) Lard	8%
8) Others	4%

The auxiliary and sub-materials, which are blended with the ingredients mentioned above, may consist of the following;

Materials	Blending ratio
1) Raw oils and fats	80%
2) Water or fermentation milk	16 ~ 18%
3) Salt	2 ~ 3%
4) Monoglyceride	0.2 ~ 0.5%
5) Lecithin	0.1 ~ 0.3%
6) Antioxidant	$1 \sim 2 \times 10^{-4}$%
7) Antiseptic	$1 \sim 5 \times 10^{-4}$%
8) Aroma ingredients	$1 \sim 2 \times 10^{-5}$%
9) Colouring agents	$2 \sim 3 \times 10^{-5}$%
10) Vitamin A	15,000 ~ 30,000 units/lb

As raw oils and fats to be used for the manufacture of margarine are refined to colourless and odourless level, margarine may be manufactured to

Process Flow Sheet for Margarine Making Plant



feature a number of qualities such as enticing colour, good luster, lactic appearance and good flavour by blending auxiliary, or sub-materials above mentioned.

Today, margarine is used widely on the table, also for cocking and for making bread and pastries. That is, margarine is used not only as a substitute for genuine butter but also as a vital source of edible oils and fats.

Process Description

A margarine plant comprises two principal processes. One is the process for refining the raw oils and fats by deacidification, decolouration, hydrogenation and deodorization. The other is for producing margarine by blending auxiliary materials to the refined raw materials, which can be broken into mixing process, emulsifying process, cooling and kneading process and forming and packing process.

1) Deacidification process
Free acids, proteins and other impurities or organic substances contained in raw oils and fats are removed in this process by means of alkali and other treatments.

2) Decolouration process
Undesirable colouring matters contained in raw material oils and fats are removed by the adsorption to activated clay in this process.

3) Hydrogenation process
Unsaturated fatty acids in material oils and fats are converted to saturated fatty acids by reaction with hydrogen under the existence of catalyst such as reducing nickel, etc. This treatment serves to raise the melting temperatures of these oils and fats to desirable levels, and to improve the stability of quality.

4) Deodorization process
The oils and fats subjected to deacidification, decoloration and hydrogenation still have their inherent odours and the ones created by oxidation or decomposition, and these odours are generally disagreeable. The substances giving off these odors are removed by blowing steam through oils and fats heated up to the temperature of 200°C ~ 250°C under several mmHg absolute pressure.
The refined oils and fats treated in the above mentioned processes are stored in each tank and then sent to the margarine producing process.

5) Margarine producing process
Raw oils and fats are melted and blended with salt, water, lactic substances, vitamins, colouring agents, aroma and other ingredients, and then mixed, emulsified, sterilized, cooled rapidly and kneaded. The mixture is, after being aged for a while, formed into the prescribed shape to be obtained as finished product.

Example of Margarine Making Plant

1) Production Scheme
Production capacity:
1,000 tons/month as table or industrial margarine
Working hours: 24 hours/day
25 days/month

Note: Tables 1 – 5 are based on the above scheme.

Table 1: Required Machinery and Equipment

(The main machinery and equipment within the battery limit of the plant which compose the above mentioned processes are as follows:)

1) Deacidification tanks with accessories
2) Decolouration vessels with filters
3) Hydrogenation equipment
4) Deodorization equipment with boiler
5) Mixing tanks
6) Emulsifying tanks
7) Continuous sterilization equipment
8) Continuous cooling and mixing equipment with a resting tube
9) Forming and packing machines

FOB price of machinery and equipment .... (approx.) $US 2,381,000

In addition to the above machinery and equipment, the followings are required to construct the plant:

– Machinery and equipment:

1) electric power receiving and supply system
2) process water receiving, treating and supply system
3) steam generating equipment
4) cooling water supply system
5) waste water treatment system
6) field storage and loading/unloading facilities of raw materials and product
7) laboratory and maintenance apparatuses

– Buildings, foundations, structures, paving and other civil works.

– All the works such as erection, piping, wiring, painting, insulation and others at the plant site and materials for the aboves.

Table 2: Required Raw and Subsidiary Materials

Item	Quantity
Raw material oils and fats	900 kg/ton of margarine
Water and fermentation milk	170 kg/ton of margarine
Salt	25 kg/ton of margarine
Hydrogen	$70^{N\text{-}m^3}$/ton of margarine
Monoglycerides, aroma ingredients, anti-oxidant, vitamin, etc.	small amount

Table 3: Required Utilities

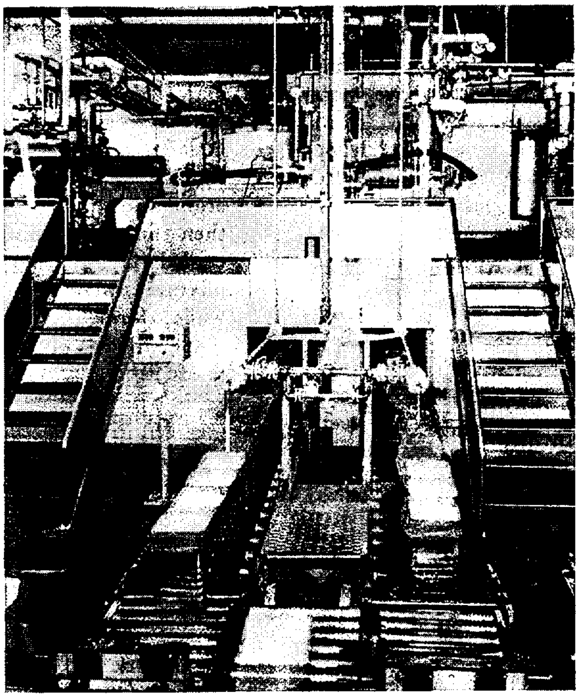
Item	Quantity
Electricity	210 kWh/ton of margarine
Steam	2,000 kg/ton of margarine
Process water	20 m^3/ton of margarine
Fuel	10 ℓ/ton of margarine

Table 4: Required Manpower

Item	No.
Manager	1
Chemist	3
Skilled worker	3 (1 man/shift)
Ordinary worker	21 (7 men/shift)
Maintenance worker	5
Total	33

Table 5: Required Area for Plant Site

Building (Plant building, warehouse, laboratory, maintenance shop, etc.)	2,000 m^2
Land	10,000 m^2



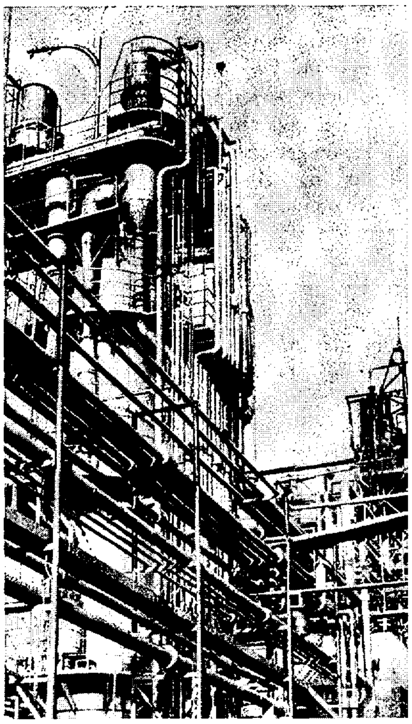
Margarine producing process

Others

The demand for margarine has been increasing steadily in all countries of the world owing to changes in the modes of our diet.

In addition, since vegetable oils and other kinds of oils and fats are available amply in developing countries for use in the secondary processing of edible oils, the establishment of a margarine making plant independently, or even as a part of an oil making complex, would be favoured with good marketability, making the business venture a highly promising one.

Besides general type margarine, a newly developed high-grade oil, for specific use in chocolate and decoration cake can be obtained through the highly integrated technology of fractionation of raw oils and fats according to the melting points of their components.



Deodorizing tower

How To Start Manufacturing Industries

Soy Sauce Brewing Plant

For more than 1,000 years soy sauce has been used without getting satiated as a seasoning. What is the secret of this enduring seasoning.

In Europe and America there are four basic "tastes": sweet, sour, salty, bitter. In Japan, however, there is one other, delicacy, which is known from of old as "delicacy."

Soy sauce contains exceptional delicacy. The delicacy of soy sauce is a natural delicacy which is brought forth by the interaction of all sorts of amino acids originating from brewing and the melting together of these amino acids with other ingredients.

The harmony of exquisite flavours is the delicious taste of soy sauce and the secret of soy sauce being patronized for many years as the king of seasonings. Recently soy sauce is made much of as a wonderful seasoning which goes well with all sorts of dish of the world, including Europe and America.

The main raw materials of soy sauce are soybean (or de-fatted soybean), wheat, and salt. Microorganisms work on these raw materials to produce soy sauce with that characteristic aroma and delicacy.

Process Description

An explanation of the manufacturing process based on Fig. 1 "Flow Sheet of Soy Sauce Brewing" will be made.

Soybean (or de-fatted soybean), the most important raw material for soy sauce protein, is heated by steam so that soy sauce Koji of Aspergillus Oryzae will easily work on the protein. The quality and yield (availability of nitrogen in raw material to product) of soy sauce are swayed by this treatment. High temperature, high pressure, short time treatment will greatly improve the quality and yield of product. After being steamed, the soybean (or de-fatted soybean) is cooled in a cooler down to the designated temperature.

Wheat, another important raw material of soy sauce, is heat-treated indirectly to produce α starch so that enzym will work on it easily. Usually heated sand is used for roasting the wheat, then the wheat is cooled in a cooler to the designated temperature, and finally the wheat is crushed by a crusher.

The two kinds of treated raw material are seeded and taken into the koji room. The temperature and humidity are controlled artificially to promote growth of koji fungus, and koji is made in two days. The koji manufacturing equipment, including feeding, agitation, and discharge, is completely mechanized and automatic. Recently, from the labour-saving standpoint, the circular type revolving system is gradually gaining popularity.

Salt, the third raw material of soy sauce, is dissolved in water to make saturated solution of salt. After adjusting the concentration of the saturated solution of salt made it is cooled in a refrigerator to the designated temperature. Then, it is mixed with the koji and fermented in the fermentation tank.

The koji and solution of salt fermented in the fermentation tank become moromi (soybean and wheat which are under fermentation). The moromi is kept under control for a long period of time in a suitable temperature so that it is matured by the action of enzym, lactobacilli, yeast fungus, etc.

The matured moromi is pressed and separated into raw soy sauce and cake. The raw soy sauce is cooled in a refrigerator and stored in low temperature. The feeding and pressing of moromi are all done automatically by mechanization.

The raw soy sauce is sweetened or other additives are added, depending on the tastes of consumers. It is pasteurized by heating and then stored for a fixed period of time for sediment separation. After sediment separation is completed, the clear soy sauce is further filtered through a filter and made into beautiful, highly fragrant, and tasty soy sauce.

The completed soy sauce is filled in glass bottles or plastic containers by the bottling machine, labeled, and shipped out.

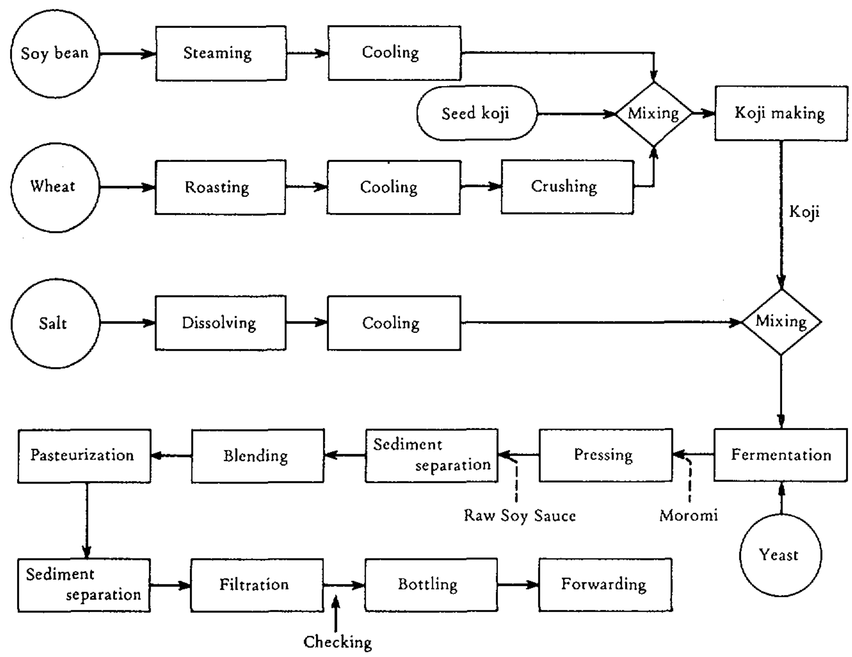
Example of Soy Sauce Brewing Plant

This plant, as shown in Fig. 2, has a continuous steaming dish koji manufacturing equipment, outdoor fermentation tank, automatic pressing equipment, and other up-to-date equipment. It is a new plant which works almost automatically.

1) Production Scheme

The plant is capable of producing 16,000 kℓ/year, 288 working days a year. The TN (Total Nitrogen) con-

Fig. 1: Process Flow Sheet for Soy Sauce Brewing Plant



tent of the product is more than 1.4%, and the rate of TN utilization is more than 80%. The required working personnel is approximately 45 persons.

2) **Price of Machinery and Equipment**
Only the machinery and equipment marked with a ○ are required (others are procured locally), and the F.O.B. price is approximately $US 4,030,000.

3) **Annual Requirement of Raw Materials and Working Days**
(ratio of raw materials, soybean : wheat = 9 : 1)
Wheat: 500 tons/year
Soybean: 4,500 tons/year
Salt: 3,100 tons/year
Working hours: 8 hours/day, 288 days/year

4) **Required Area for Plant Site**
Building .... 9,000 m²
Land .... 25,000 m²

Table 1: Required Machinery and Equipment

1) Raw material storage equipment		
Capacity: soy bean 156 tons (52 tons x 3)		
wheat 52 tons (52 tons x 1)		
	(1) Raw material receiving pit	1
	(2) Bucket conveyor	1
	(3) Charge tank	1
○	(4) Measuring machine	1
	(5) Screw conveyor	1
	(6) Bucket conveyor	1
	(7) Screw conveyor	2
	(8) Slide damper	4
	(9) Storage silo	4
	(10) Slide damper	4
	(11) Screw conveyor	2
○	(12) Control board	1
	(13) Others	
2) Soy bean treatment equipment		
Capacity: 15,600 kg/day		
4,000 kg/hour		
	(1) Screw conveyor	1
	(2) Bucket conveyor	1
○	(3) Soy bean selecting machine	1
	(4) Bucket conveyor	1
	(5) Charge tank	1
○	(6) Measuring machine	1
	(7) Bucket conveyor	1
	(8) Charge tank	1
○	(9) Soy bean washing machine	1
○	(10) Transporting pump	1
○	(11) Separator	8
	(12) Soy bean soaking tank	8
	(13) Belt conveyor	1
○	(14) Bucket conveyor	1
	(15) Belt conveyor	1
○	(16) Continuous steaming device	1
○	(17) Steamed soy bean cooler	1
	(18) Belt conveyor	1
○	(19) Control board	1
	(20) Others	
3) Wheat treatment equipment		
Capacity: 1,740 kg/day		
300 kg/hour		
	(1) Screw conveyor	1
	(2) Bucket conveyor	1
○	(3) Wheat selecting machine	1
	(4) Bucket conveyor	1
	(5) Charge tank	1
○	(6) Measuring machine	1
	(7) Bucket conveyor	1
	(8) Charge tank	1
○	(9) Wheat roaster	1
	(10) Bucket conveyor	1
○	(11) Roasted wheat cooler	1
○	(12) Roasted wheat crusher	1
○	(13) Screen	1
	(14) Bucket conveyor	1
	(15) Crushed wheat charge tank	2
○	(16) Control board	1
	(17) Others	
4) Mixing and heaping equipment		
Capacity: 4,500 kg/hour		
	(1) Screw conveyor	1
	(2) Belt conveyor	1
○	(3) Seed mould inoculating machine	1
	(4) Belt conveyor	1
○	(5) Crumbling machine	1
○	(6) Mixing screw conveyor	1
	(7) Belt conveyor	6
○	(8) Heaping belt conveyor	4
○	(9) Control board	1
	(10) Others	
5) Automatic koji making equipment		
Capacity: 17,340 kg/day		
(8,670 kg x 4 sets)		
○	(1) Koji room	4
○	(2) Machinery in Koji room	4
○	(3) Air conditioner	4
○	(4) Fan	4
	(5) Duct and damper	4
○	(6) Aerofin heater	4
○	(7) Control board	4
	(8) Others	
6) Koji mixing transporting equipment		
Capacity: 17,340 kg/day		
8,670 kg/hour		
	(1) Belt conveyor	4
	(2) Belt conveyor	2
	(3) Belt conveyor	1
○	(4) Salt water mixing screw	1
○	(5) Transporting pump	1
	(6) Compressor	1
	(7) Air tank	1
○	(8) Control board	1
	(9) Others	
7) Salt water dissolving equipment		
Capacity: 34 kℓ/day		
	(1) Salt storage and dissolving tank	1
○	(2) Salt water pump	3
	(3) Salt water tank (34 kℓ)	4
○	(4) Salt water cooling equipment	1
○	(5) Flow meter	1
○	(6) Transporting pump	1
○	(7) Control board	1
○	(8) Others	
8) Moromi fermenting equipment		
Fermentation period: 6 months		
	(1) Outdoor fermentation tank (104 kℓ)	72
	(2) Compressor	1
	(3) Air tank	1
○	(4) Moromi pump	2
	(5) Moromi blending tank	5
○	(6) Control board	4

(7) Others

9) **Moromi pressing equipment**
Capacity: 50 kℓ/day (10 kℓ/1 set x 5 sets)

o	(1) Moromi filling pump	5
o	(2) Automatic moromi pressing equipment	5
	(3) Belt conveyor	5
	(4) Belt conveyor	3
o	(5) Raw soy sauce pump	2
	(6) Flow meter	1
o	(7) Control board	1
	(8) Others	

10) **Raw soy sauce storage and cooling equipment**
Capacity: 840 kℓ (15°C)

	(1) Outdoor storage tank (84 kℓ)	10
o	(2) Cooling equipment	1
o	(3) Pump	1
o	(4) Flow meter	1
o	(5) Control board	1
	(6) Others	

11) **Pasteurization and filtrating equipment**
Capacity: 56.7 kℓ/day
9.5 kℓ/hour

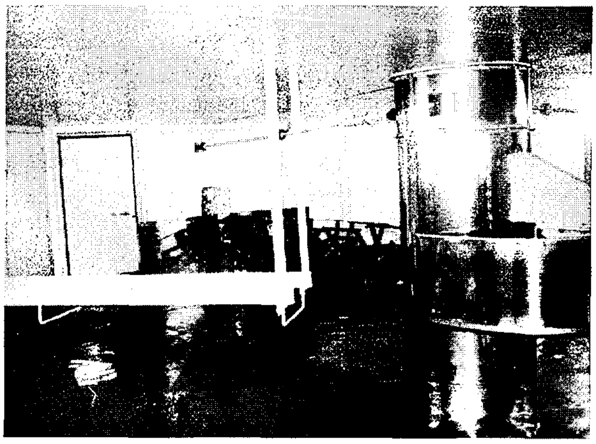
	(1) Soft water tank (15 kℓ)	2
	(2) Blending tank (57 kℓ)	4
o	(3) Agitating machine	4
o	(4) Pump	2
o	(5) Plate heat exchanger	2
	(6) Holding tank (57 kℓ)	2
	(7) Firing tank (57 kℓ)	10
o	(8) Pump	1
o	(9) Mixing tank	2
o	(10) Filtrating pump	2
o	(11) Filtrating machine	2
o	(12) Flow meter	1
	(13) Soy sauce storage tank (57 kℓ)	5
o	(14) Pump	1
o	(15) Control board	2
	(16) Others	

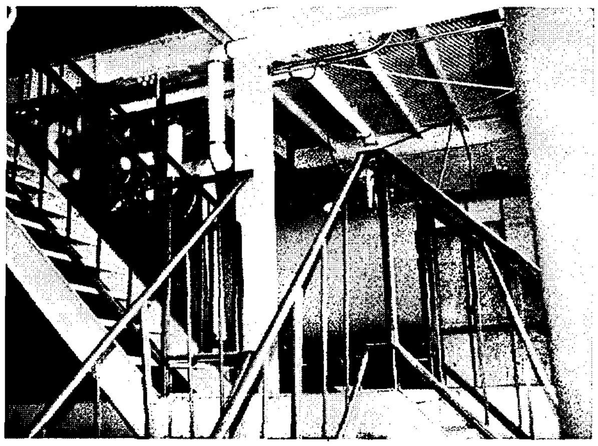
12) **Automatic bottling equipment**
Capacity: 56.7 kℓ/day
(90,000 bottles/day – 630 mmℓ)
7,500 bottles/hour x 2 sets

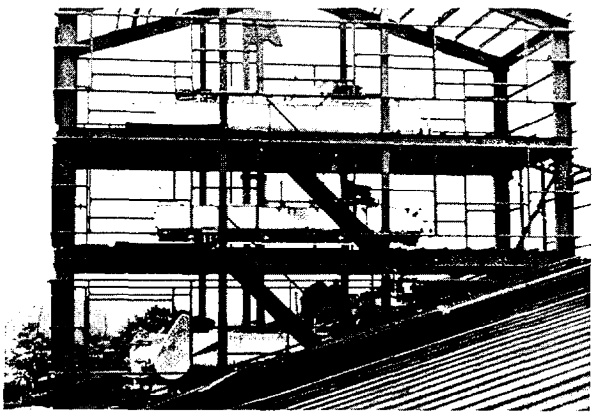
o	(1) Bottle washing machine	2
o	(2) Bottling machine	2
o	(3) Crowner	2
o	(4) Labeler	2
o	(5) Conveyor for bottle	2
o	(6) Turn-table	2
o	(7) Control board	2
	(8) Others	

13) **Boiler**
Capacity: 8,000 kg/hour
10 kg/cm² (Pressure)

o	(1) Steam boiler	1
o	(2) Incidental equipment	1
	(3) Others	


The inside of koji room


Continuous steaming device


The whole view of soy-bean treatment equipment

How To Start Manufacturing Industries

Tomato Ketchup Making Plant

Tomato ketchup, tomato juice and tomato purée, the secondary processed products of fresh tomato, have come to be consumed in vast amounts today in our homes as well as in restaurants and other places as an indispensable food in our daily living.

Tomato has long been processed into tomato ketchup in Italy, Greece, the West Coast of the U.S. and other parts of the Western World, where tomato is suited for cultivation on a large scale.

It was some 80 years ago that tomato was first cultivated and placed on local markets in Japan. In those days, with the Japanese people still quite unfamiliar with tomato, it failed to gain consumer acceptance and naturally tomato growers were distressed with the problem of how to move the product on vegetable store shelves.

It was only a few decades ago, when imported tomato ketchup paved the way, that the manufacture of tomato ketchup came to be undertaken in Japan as a home industry. And today, the most modernly equipped tomato ketchup making plants are in operation to meet the large national demand for the product.

The manufacture of tomato ketchup can be undertaken only when two basic conditions are met – the availability of a large and stable supply of fresh quality tomato, and the availability of a vast supply of water.

While tomato is an annual plant, its method of cultivation will differ according to the soil. An ideal environment for tomato cultivation would be a place having sharp temperature difference – warm in the daytime and cool in the nighttime, and the soil should preferably be dry rather than moist.

In moist regions, letting the tomato plants to trail on the ground would cause ripened tomato to be covered with dirt or other foreign matter, so to prevent this the plants are normally supported with thin bamboo stalks or other kinds of rods. In arid regions, the plants may be left to trail on the ground since there would be no such anxiety.

Since the quality of the ketchup that is produced will be determined largely by the quality of the tomato used as raw material, a great importance is attached particularly to tomato cultivation itself. For example, while Japanese tomato processors purchase their tomato by quantity or by cultivated area, they make it a point to offer technical guidance to tomato growers. This is done primarily to improve the processability of the tomato they purchase.

Now, as pointed out earlier, a large amount of water will be necessary for a tomato processing plant. Namely, since the peak tomato harvesting time is generally concentrated over a period of only about a month to 45 days, it will be necessary to process a huge amount of tomato quickly in a very short period to time. And as the same amount of water as the amount of tomato collected will be necessary for washing, a vast volume of water will be required by the plant.

Accordingly, when constructing a new tomato processing plant, the processing capacity of the plant will be determined not by the quantity of tomato available, but rather by the amount of water available with ease.

The tomato ketchup making plant, therefore, may be regarded as a typical seasonal industry, and one that is inalienably related to agriculture.

Process Description

The processes involved in the manufacture of tomato ketchup are indicated in the accompanying process flow sheet, a description of which follows:

Fresh tomato shipped to the plant is first of all washed clean with water. For this, a special washing technique has been developed that allows for preservation of the fresh, natural qualities of ripened tomato.

Washed tomato is crushed into tomato pulp, which is strained and filtered. This is followed with preheating and concentration to about one-third of its original volume by means of a continuous concentrator, for which boiler heat is used. Since the concentration should necessarily be achieved in very short time, each tomato ketchup manufacturer uses a special technical know-how.

Instantaneous concentration is necessary since, otherwise, heating the tomato pulp would cause it to be exidized and discoloured into a dark-reddish, disagreeable colour, losing the savory, delightful colour of natural tomato.

Concentrated tomato pulp is homogenized, then given an addition of salt, sugar, spices and other ingredients in the Seasoning room, to give the tomato pulp the flavour associated with tomato ketchup. The product is next filled into bottles, then packed into dozen or gross cartons for shipment.

The description given above generally summarizes the processes involved in the manufacture of tomato ketchup. But while some manufacturers may process their entire stock of tomato into ketchup at a stroke, some may process a part or all of their tomato into primary paste, tomato pulp or tomato purée, and further process these stocks into tomato ketchup in accordance with market demands.

The entire process, from the charging of tomato into the Washing and Sorting Machine to the bottling of ketchup, is consummated in a processing cycle requiring only about 30 minutes. And to process fresh tomato into ketchup by the process described above, the plant will operate for about 40 days/year, of which roughly 10 days will require plant operation for a full 24 hours/day.

1) Collection
Ripened tomato is harvested and collected at the plant during the day.

2) Charging
Collected tomato is charged into the washing line.

3) Washing
Dirt and other foreign matter are removed from tomato by washing and bubbling.

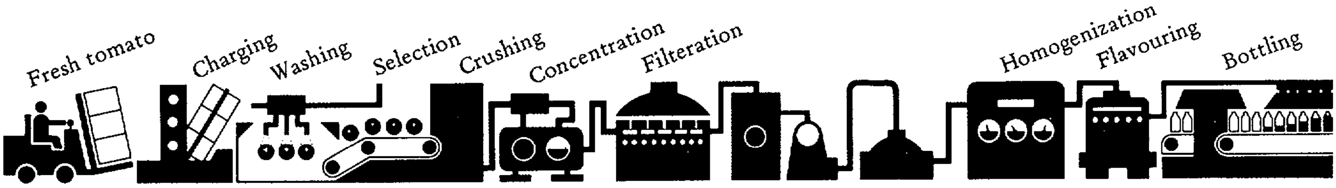
4) Sorting
Good tomato is selected by removing rotten, crushed or unripened tomato.

5) Crushing
Tomato is crushed whole.

6) Concentration
Tomato pulp is concentrated instantly by one-third its volume, to the prescribed density.

7) Filtration
Tomato peel and seed are removed here.

Process Flow Sheet for Tomato Ketchup Making Plant



8) **Homogenization**
Tomato pulp is homogenized.

9) **Flavouring**
Salt, sugar, distillation vinegar, spices, etc., are added.

10) **Bottling**
Ketchup is filled into bottles.

11) Cooling
Quick-cooling is done to inhibit quality deterioration due to temperature changes.

Example of Tomato Ketchup Making Plant

Production Scheme

Here, an introduction shall be given of a tomato ketchup making plant having a production capacity of 400 tons/day.

This plant is designed to operate about 40 days a year, with 10 days of work done continuously round the clock and the remaining 30 days of work done. under a 12 hours/day schedule.

Tables 1, 2, 3 an 4 show respectively required machinery and equipment, raw materials and utilities, manpower, and area for plant site.

Table 1: Required Machinery and Equipment

Item	No.
Tomato charging machine	1 set
Tomato washing and sorting machine	1 set
Continuous concentrator	1 set
Filter	1 set
Homogenizer	1 set
Seasoning mixer	1 set
Bottling machine	1 set
Cooler	1 set
Labeler	1 set
Packing machine	1 set
Water treatment facility	1 set
Boiler	1 set
FOB price . . (approx.)	$US 1,905,000

Table 2: Required Raw Materials and Utilities

Item	Quantity
Fresh tomato	500 tons/day
Sugar	small amount
Salt	small amount
Distillation vinegar	small amount
Spices	small amount
Bottles (400 g container)	13,250,000 pieces/year
Electric power	2,000 kWh/day
Water	500 tons/day
Fuel for boiler	5 tons/day

Table 3: Required Manpower

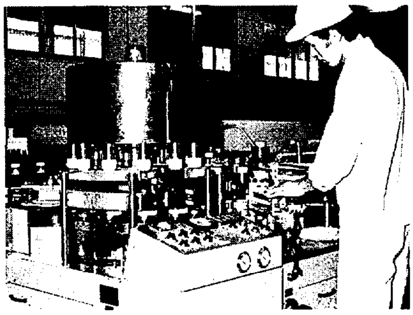
Item	No.
Engineer	1
Skilled worker	5
Unskilled worker	20
Total	26

Table 4: Required Area for Plant Site

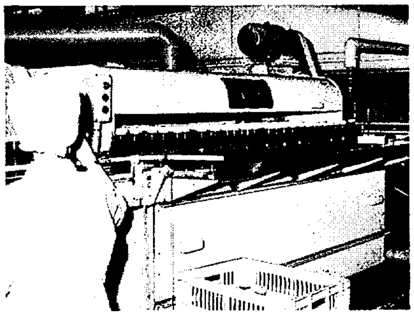
Item		
Buildings		2,720 m^2
Plant building	45 m x 50 m = 2,250 m^2	
Product warehouse	20 m x 20 m = 400 m^2	
Boiler room	10 m x 7 m = 70 m^2	
Land		6,600 m^2

Locational Condition

For the reasons described earlier, the plant should be constructed as close as possible to a tomato cultivation centre, and at a place affording an ample supply of good water. And since the plant, by its very nature, is operated at full blast for a short span of time at a specific season, the location should permit easy procurement of cheap labour. In addition, it should be situated as close as possible to consumer markets, although this may be unnecessary in countries where transportation facilities are advanced, for the product withstands long preservation.



Bottling



Cooling

How To Start Manufacturing Industries

Assorted Animal Feed Making Plant

Assorted animal feed industry is gaining rapid worldwide attention in recent years as the need grows ever more critical to supply animal protein to the chicken, hog and cattle raising industries.

The transformation of these industries from small-scale operations to large-scale operations which promise profitability with greater stability, has brought about a change even in the system of supplying feed to grass-eating, herbivorous animals, and the demand for assorted animal feed has continued to grow at a sharp pace from year to year.

In Japan, for example, the output of assorted animal feed during fiscal 1977 was about 20 million tons, of which 50% was consumed for poultry raising, 28% for hog raising, 21% for cattle raising, and 1% for other purposes.

The use of 50%, or one-half of total assorted animal feed output for poultry raising, is characteristic of the Japanese assorted animal feed industry. Perhaps this situation well underscores the great suitability of assorted animal feed to the poultry raising industry.

The demand for assorted animal feed is believed to be increasing at the rate of some 1 million tons annually. In fact, today the volume of assorted animal feed utilized by various industries reportedly runs up to about 80% of total feed consumed in the country, indicating the vital importance which assorted animal feed plays in animal raising industries.

Bullish demands have triggered a rush toward scale upping of assorted animal feed plant capacities. For instance, the minimum monthly production capacity of a plant newly constructed in fiscal 1978 was 5,000 tons, and the plant in Japan having the maximum monthly production capacity is 30,000 tons.

A wide variety of materials is employed in the manufacture of assorted animal feed, the more general ratio being maise 36.8%, milo 25.2%, wheat bran (mash) 2.6%, molasses 1.9%, soybean grounds 11.1%, fish meal 3.3% and others.

As for the breakdown of production costs in Japan the cost of raw materials assumes a very high ratio of 86 – 90% since most raw materials are imported, while other principal cost items are labour 2%, production cost 2.5 – 2.8% and sales cost 7%.

The processes involved in the manufacture of assorted animal feed are indicated in the attached process flow sheet. Briefly described, the following processes are involved.

Process Description

1) **Raw materials facilities**
The supply of principal raw materials and sub-materials are charged into silos and tanks, where these materials are mixed with additives.

2) **Primary crushing**
The raw materials stored in silos, tanks and warehouses are processed by primary crushing. Crushed materials are further separated by means of a sifter, then stored in assorting tanks (hoppers) according to the kind of raw material.

3) **Assorting and measuring**
Small amounts of additives are charged into the bins containing different assortments of raw materials. The raw materials stored in the assorting tanks are measured in accordance with their use as poultry feed, hog feed, cattle feed and others.
Raw materials of large particle size are generally used as feed for poultry, while raw materials of fine particle size are mostly used as feed for hogs.

4) **Mixing**
The raw materials thus weighed according to the kind of feed to be produced, are then mixed by means of a mixer. In this process, fatty ingredients are added to the materials in order to raise the nutrient value of the feed.

5) **Molasses mixing**
The feed obtained from the mixer is added with molasses whereupon assorted animal feed is obtained in bulk.

6) **Fine crushing**
After the feed is mixed with molasses, it is further crushed by means of the 2nd crusher in the event the feed is used for hog raising. The feed is crushed to particle sizes of about 1 mm diameter in this process, and may be used as assorted animal feed at this stage.

7) **Pellet making**
Assorted animal feed that is crushed into fine particles is further formed into pellets. These pellets, which are cylindrical type and come in sizes measuring 6 mm in diameter and 2 cm in length, are then dried.

8) **Packaging**
The assorted animal feed having been produced by the processes described above, the product is next accommodated in the product tanks, then weighed and packaged.
The mechanical facilities required for the assorted animal feed plant consist of the following:
(1) Raw materials storage tank and other facilities
(2) Crushing facilities
(3) Assorting facilities
(4) Processed feed facilities
(5) Transportation facilities
(6) Dust collection facilities
(7) Packaging and bulk shipment facilities

Example of Assorted Animal Feed Making Plant

Here, a description shall be given of an assorted animal feed plant having a monthly production scale of 5,000 tons, which is a most economical scale.

Operation hours:
8 hours/day
25 days/month
300 days/year

Tables 1, 2, 3, 4 and 5 are based on the above plant.

Required Raw Materials and Subsidiary Materials

The quantities of raw materials and sub-materials required to produce assorted animal feed are indicated in the following table.

Accordingly, the kinds of raw- and sub-materials as well as their mixture ratio can be determined as long as the specific application of the assorted animal feed in known.

As we are concerned here with a plant capable of producing 5,000 tons of assorted animal feed monthly, the principal raw materials required per month will be described in Table 2.

Table 1: Required Machinery and Equipment

Item
Raw material silo
Sub-material tank
Pre-mixer
1st crusher
Sitter
Assorted tank and hopper
Hopper scale
Mixer
Fat tank
Molasses tank
Molasses mixer
2nd crusher
Pellet manufacturing equipment
Product tank
Product measuring scale
Packing machine
Boiler
Dust collector
FOB price of machinery and equipment .... (approx.) $US 5,238,000

Table 2: Monthly Requirement of Raw Materials and Subsidiary Materials

Item	Quantity
Maise	1,875 tons
Milo	1,095 tons
Other grains (wheat, barley, etc.)	120 tons
Mash	200 tons
Rice bran oil lees	175 tons
α-meal pellet	135 tons
Others	140 tons
Soybean oil lees	460 tons
Other vegetable oil lees	475 tons
Fish grounds, meal	185 tons
Oil and fat	25 tons
Molasses	100 tons
Additives	15 tons

Table 3: Required Utilities

Electricity	1,600 kWh
Water	2 tons/hour
Fuel	156 kg/hour

Table 4: Required Manpower

Item	No.
Manager and chief engineer	1
Total machine operator	2
Packing operator	2
Crushing operator	1
Adding agent	1
Maintenance and supervision	2
Pellet operator	1
Shipment	1
Boiler	1
Pre-mixer	2
Raw- and sub-material warehouse	2
Electrical engineer	1
Mechanical engineer	1
Odd job man	7
Total	25

Table 5: Required Area for Plant Site

Plant building	1,200 m^2
Raw material warehouse	1,000 m^2
Product warehouse	1,000 m^2
Land	15,000 m^2

Locational Condition

The plant location will depend largely on how the raw materials are obtained. In a country where most of the raw materials are available locally, a location near the raw materials producing centers would be the most ideal. On the other hand, if the larger proportion of the required raw materials are imported, then a location near a seaport will be more advisable.

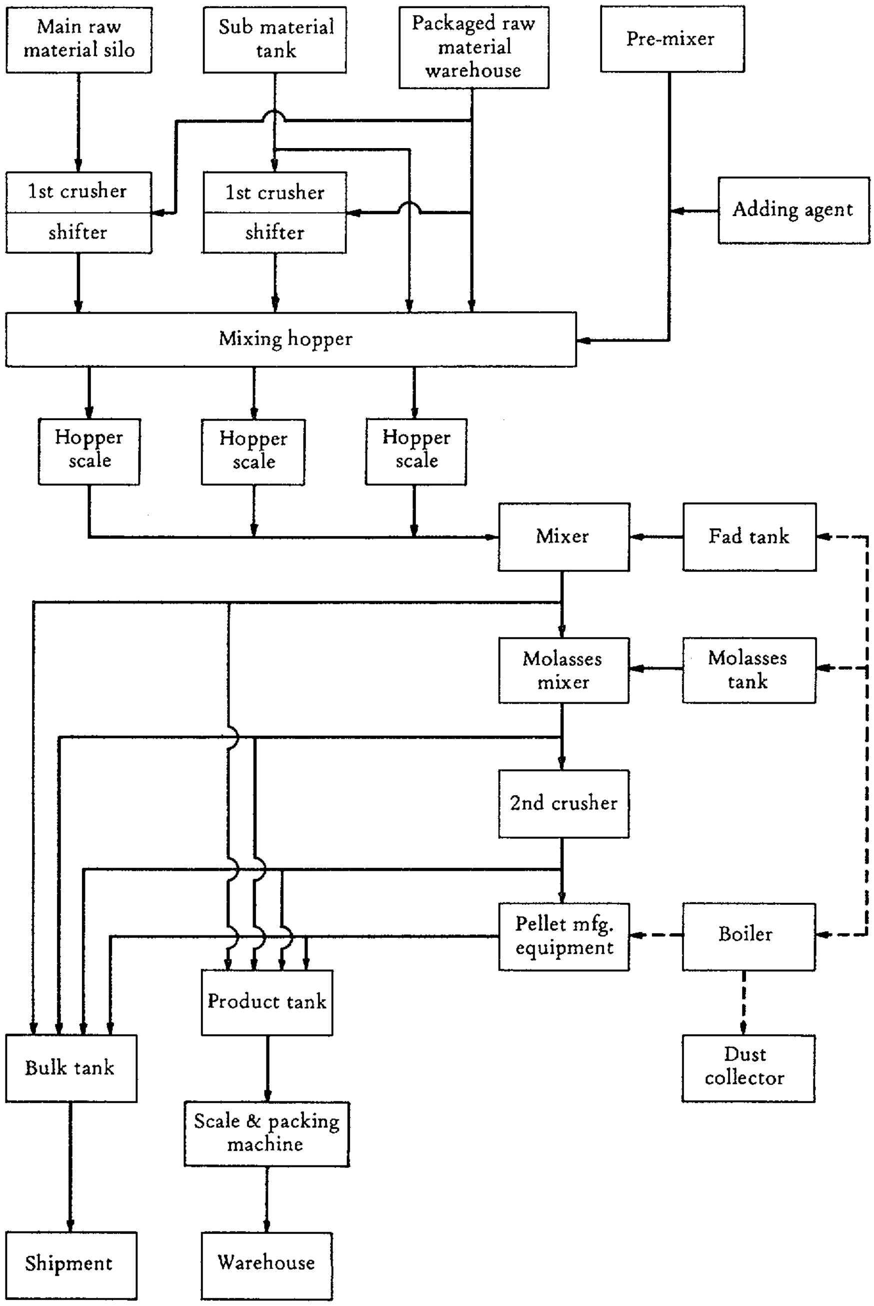
However, since some kinds of raw materials such as fish powder may generate foul odor, it may me necessary to construct the plant at some place away from general residential areas and away from city or town areas.

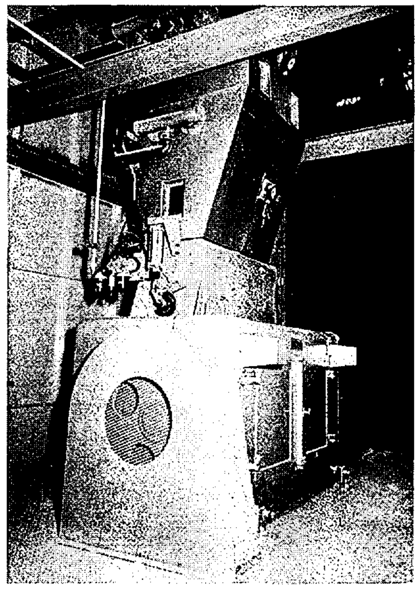
Table 5: Raw Materials for 1,000 Tons of Assorted Animal Feed

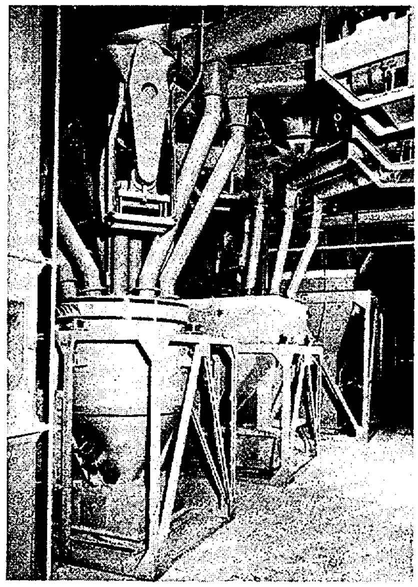
Raw- & Sub-Material	For Dairy Cattle	For Beef Cattle	For Poultry	For Hog	For Other Purposes	Average
* Maise	7.7%	12.9%	47.7%	22.3%	34.7%	35%
* Milo	19.6	28.5	18.0	33.0	12.4	21.9
Wheat	0.2	–	0.2	0.8	0.3	0.3
Barley, naked barley	1.4	7.5	–	1.2	0.8	0.8
Other grains	2.9	4.8	0.3	1.9	4.2	1.3
* Mash	11.7	7.8	1.3	6.7	2.5	4.0
* Rice bran	1.8	3.8	0.6	1.2	0.8	1.0
* Rice bran oil lees	5.3	2.5	1.6	3.4	2.3	2.5
* α-meal pellet	2.1	4.5	2.6	3.0	1.7	2.7
Other	12.0	3.2	1.1	2.5	3.7	2.8
* Soybean oil lees	10.5	8.0	9.7	8.1	5.6	9.2
* Other vegetable oil lees	13.4	7.2	3.0	3.1	4.5	9.5
* Fish grounds, powder	0.3	0.2	4.8	3.3	4.5	3.7
Adsorbent feed	0.1	–	1.1	0.1	0.6	0.7
Skim milk powder	0.7	–	0	0.6	3.7	0.3
* Fat & adsorbent feed	0.1	0.2	0.7	0.2	0.3	0.5
* Molasses	5.8	3.8	0.4	3.4	7.6	2.0
* Additive	0.1	0.2	0.3	0.4	0.3	0.3

Note: Items affixed with * are essential raw materials.

Process Flow Sheet for Assorted Animal Feed Making Plant

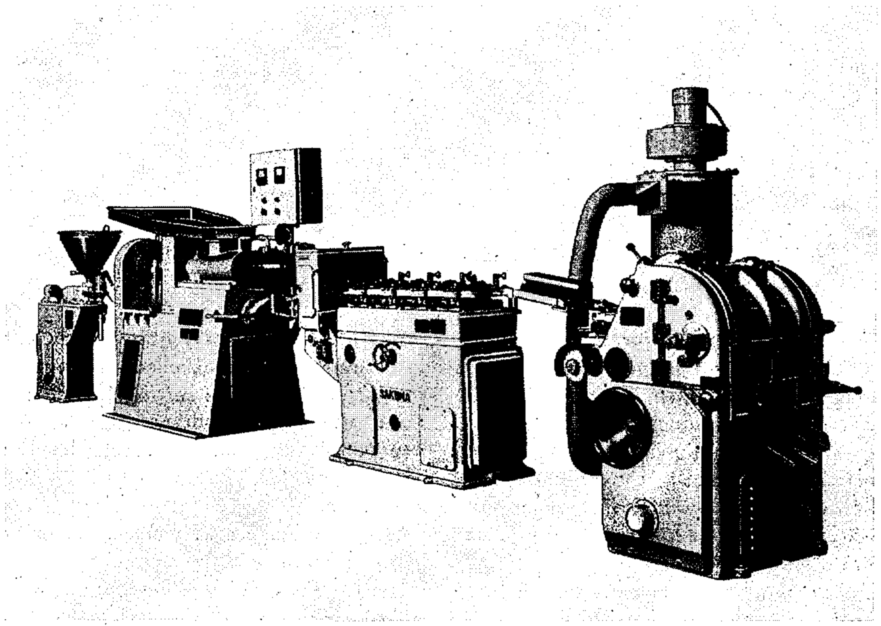






How To Start Manufacturing Industries

Candy Making Plant



The history of candy is probably a long one in any country. In ancient times, sugar must have been a highly valued consumption item. Therefore, there was no candy that used sugar as freely as we do in the present age. Even if there was sugar, it was consumed by a very limited class of people, who led a privileged life.

But a complete change occured in the picture. Anyone can now enjoy the sweet taste of candy. Today, there is a great variety of candies, which meet the desires of children.

Candies now claim an important part in the food-stuff industry.

Accordingly, it has become urgent for the confectionery industry to carry out improvements in management and modernization of operation to conform to the present age.

Such a trend is steadily in progress in Japan.

Classification of Candies

There is a great variety of what is generally termed as candy. Here is a brief classification of candies chiefly by *manufacturing processes:*

Belonging to the above category are those having centers of sugar super-saturated liquid scented with coffee, mint, fruit, etc., and wrapped in crusts of sugar crystals; and candies with chocolate-coated crusts which wrap centers containing completely liquefied fondant with or without fragment of fruit inserted.

Table 1: Required Machinery & Equipment

Automatic dissolving machine
Automatic vacuum concentrator (including receiving tank)
Cooling table
Kneading machine
Hot table (2 sets)
Batch roller (set with sizing roller)
Plastic forming machine
Three tier cooling conveyor
Shifter
FOB price of machinery and equipment .... (approx.) $US 262,000

Note: Excluding boiler and packaging machines.

Fondant candies:

Candies with creamy organization are included in the above category.

Hard candies:

These are candies made of sugar, to which are added suitable amounts of invert sugar, water jelly, cream, etc. all boiled at a high temperature.

They come in a great variety, including those with crystallized sugar, or with uncrystallized glassy sugar, those containing air, and those using nuts or fruit jam.

Fruit, Pectin jellies:

These are chiefly gelations of fruits or pectin which is contained in fruits. They also come in many kinds including those using fruit jam and pectin in combination, or pectin extracted from oranges, or Japanese isinglass.

Starch jellies:

They are candies solidified with the so-called processed starch. The liquidity of starch used for these jellies is varied.

Caramels:

Caramels may claim a place in the category of hard candies. However, they have been considered as a different item from the angle of the manufacturing process, because of liberal use of dairy products.

Whipped candies:

These are marshmallows which employ gelatin as a foaming agent, with or without fine crystals of sugar.

An old type of marshmallow uses gum arabic as a caking agent, and the combination of egg albumin and gelatin for foaming.

Apart from the above type, there is one which is made by adding albumin or white of egg whipped, to which is added sugar syrup boiled down by stirring.

It is extensively used for cream, nougat, etc.

The following lines are devoted to the introduction of the plant for manufacture of the most typical hard candies.

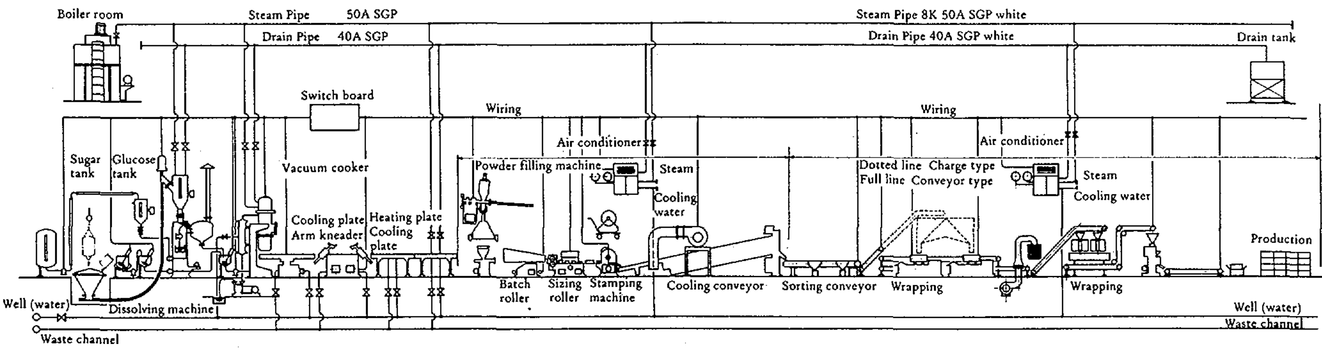
Broadly speaking, there are two processes for making candies – the conventional process which heats materials, and the one for boiling down through reduction of pressure (vacuum system).

This article will of course deal with the latter process.

The advantage of the latter over the former may be stated in a nutshell: it is modernized and rationalized in every respect. In Japan, almost all candy plants employ the above process which further features:

(1) Small consumption of fuel
(2) Small size of plant
(3) Economization on wages
(4) If required, more transparent

Production of Candy
Continuous Operation from Raw Materials up to Packed Product



candies can be produced

These features provide better taste, long shelf life, and uniformity of quality, with mass production available.

The plant outlined below is one for manufacture of six tons per day (8 hours). As for raw materials, sugar and water jelly are required at the rate of 7:3.

The number of persons required to operate the plant is about three.

As for the machinery required besides those stated in the plant layout, they should include a boiler (375 kg/h, evaporation), and packaging machines (they can not be described here individually, because they vary greatly according to the type of plant).

Process Description

The process here dealt with is roughly divided into two units, namely, one to concentrate the material and the other to form hard candies. The former consists of an automatic dissolving machine, receiving tank, automatic vacuum concentrater, cooling table, kneading machine and hot table, while the latter requires machines described in the latter half, beginning from the batch roller, of the plant layout.

The process of the vacuum concentration unit is to evaporate material under low temperature with reduced pressure. How to carry this procedure and what machine should be used for this process are very important factors because they decide the taste and colouring of the final product. Vacuum concentrators widely employed now in Japan are highly automated to make the processing time as short as possible.

The candy material taken out of the concentrator are then mixed with various additives, spicies or unique flavours according to the desire of candy makers. The mixing process requires sufficient kneading to obtain excellent products.

After kneading is sufficiently carried out, the candy is drawn out in rope shape of determined measure by the batch roller (set with sizing roller). The machine employed in this plant is designed to make a drawing of 50 m of rope per minute.

The drawn candy is then put into the hard candy forming unit, where candies are made formed by the plastic forming machine.

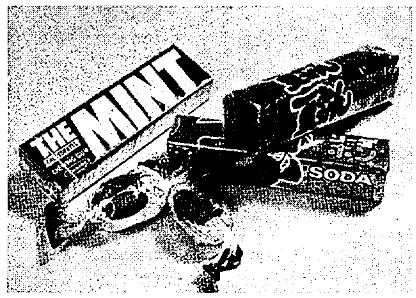
The forming machine will not only perform at high speed but also, provided with a number of die, permit various kinds of forming.

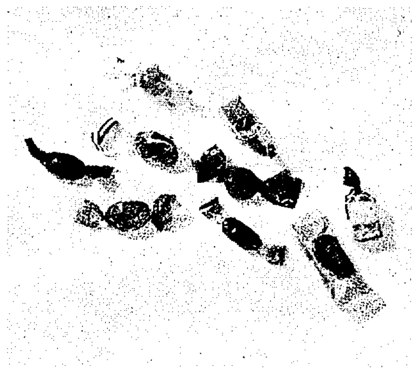
The formed candies are finally cooled down to normal temperature and charged to the packaging machine. The process for cooling down is carried out by a cooling conveyor, where it is also possible to check and adjust illformed candies.

Required Utilities

The following is the requirement of utilities per hour based on the daily production capacity of 6 tons.

	Quantity/hour
Steam consumption	1 ton
Electric consumption	65 kWh
Cooling water	70 tons





B

ISIC 321 TEXTILES

How To Start Manufacturing Industries

Woven Bag Making Plant

The kinds of heavy duty bags which are being used in Japan at the present time are paper bags, polyethylene bags, and woven cloth bags. These bags are respectively being used in the proper places.

Paper bags, which usually have the capacity of packaging 20 – 30 kg are used for feed, flour, sugar, rice and wheat (30 kg), and PVC resin, or for cement which is heavy (40 – 50 kg) but which packed in paper bags to avoid the inconvenience during filling and handling.

Polyethylene bags for 20 – 30 kg capacity are used for packaging chemical fertilizer and industrial chemical which must be protected from moisture.

Woven cloth bags are used for export chemical fertilizer, rice and wheat (60 kg), and products by the combine agriculture, which require packaging of more than 50 kg.

Woven cloth bag, compared with paper bag and polyethylene bag, is strong and is suitable for packing and carrying heavy goods. It will not tear or break easily by rough handling and bad transporting. Also, since the raw material for woven cloth bag is not natural fibre as in jute bag and since the raw material is manufactured in various parts of the world, it can be obtained at any place and at any time.

Recently, a cement bag consisting of a combination of polypropylene cloth and paper has been developed in Japan. The strength, compared with papers so far, is exceedingly great. The bag will not break or tear during transport. Polypropylene cloth is laminated with a film of resin; therefore, the moisture-proof property is excellent, and the quality of the cement can be prevented from degeneration. Also, filling and packing can be handled the same way as ordinary paper bag because of the special structure of the bag. It is being used for packaging export cement.

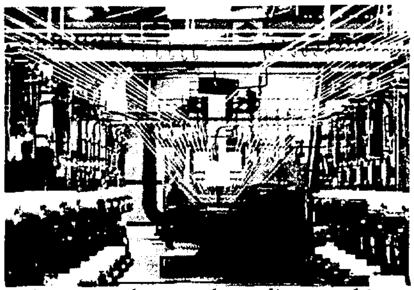
By making use of the good features of the bag, it is predicted that woven cloth bag will be used for packaging various sorts of substance.

Process Description

The production of woven cloth bag begins with the production of yarn (raw material yarn), goes on to weaving, and ends in bag making.

1. Production of yarn

Polypropylene or polyethylene pellet is charged in the hopper of the extruder, heated, passed through a die and made into a tubular film. The tubular film is cooled, slit into a fixed width, then delivered continually to the stretching equipment. The slit tape-film is heated by the hot plate of the stretching equipment, stretched by the high-speed revolving roll and formed into a stretched yarn. When left in a free state, the stretched yarn will shrink; therefore, annealing is done. The annealed yarn is wound on a bobbin in a fixed length.


Yarn stretching and winding machines

2. Weaving

There are two kinds of weaving loom: one is a flat loom which weaves in a flat state, and the other is a circular loom which weaves in a tubular state. Both are copless type weaving machine. which does not require a cop winder. The two types of weaving will be explained below.

1) Flat weaving

The yarn wound on the bobbin is set on a creel stand and wound off onto the beam as warp yarn by the beaming machine.

The warp yarn wound on the beam and the pick yarn wound on the bobbin are set on the loom. The loom automatically begins moving the pick through the warp with a shuttle to weave a cloth in a sheet state. The woven cloth is wound off by the winder.

2) Circular weaving

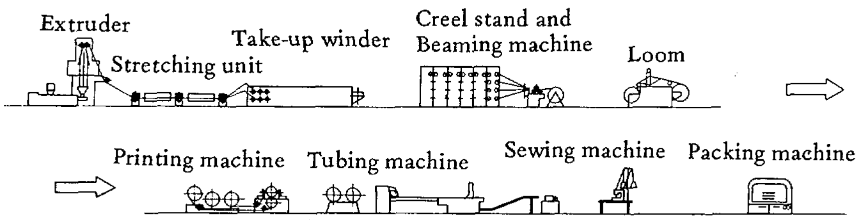
The yarn wound on bobbin is set on the creel stand arranged at both sides of the circular loom. The yarn drawn out from the creel stands is set on the loom in a circular shape and is used as the warp. The pick is set on four shuttles which are inside the loom, and when the loom is operated the shuttles rotate in a circular shape. The pick moves through the warp in a circular shape, and a seamless tube is woven. The woven seamless tube is wound off by a winder.

3. Bag making

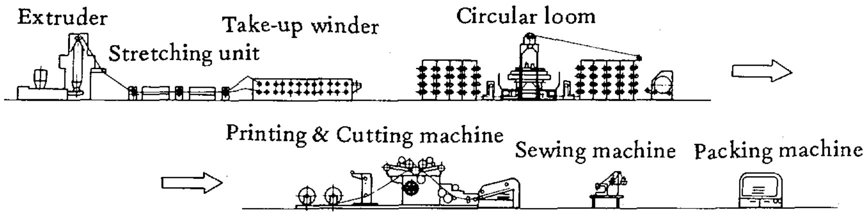
The method of bag making using flat woven cloth as raw material and circular woven seamless tube as raw material will be explained below.

Woven Bag Manufacturing Process

I. Flow Diagram for Flat Weaving



II. Flow Diagram for Circular Weaving



1) Flat woven cloth bag

The woven cloth is run through a flexo printing machine and wound off.

The printed cloth is put on the bag making machine. It is folded into a tubular shape and centre-sealed by hot melting; then, it is heat-cut into the prescribed bag size. The bottom of the heat-cut tube is folded and sewn with a sewing machine. The result is a woven bag.

2) Circular woven cloth bag

The seamless woven tube cloth is put through the printing and cutting machines. Flexo printing is done on one face of the seamless tube; then, the tube is heat-cut to the prescribed bag size. This is done continually. The bottom of the heat-cut tube is folded and sewn to get the finished woven bag.

Note:

When packaging moisture-absorbing substance such as fertilizer, lamination by polypropylene should be done on the woven cloth before bag making, or thin polyethylene inner bag should be inserted in the woven bag as a liner bag.

Example of Woven Bag Making Plant

Planned designing of a woven bag making plant for flat weaving and circular weaving would be as the attached tables.

Circular weaving loom

Table 1: Production Scheme

Bag size:	570 mm width x 1,050 mm length
	1,000 denier
	12 x 12/sq. in.
Output:	6,000,000 bags/year
Working hours:	8 hours/day
	300 days/year
	(one shift)

Table 2: Required Machinery and Equipment

1) Flat weaving	
Yarn extrusion and stretching machine	3 sets
Take-up winder	6 sets
Creel stand and beaming machine	1 set
Loom	59 sets
Printing machine	1 set
Tubing machine	1 set
Sewing machine	2 sets
Packing machine	1 set
Testing machine	1 set
Forklift truck	1 set
FOB price of machinery and equipment .... (approx.)	$US 1,914,000
2) Circular weaving	
Yarn extrusion and stretching machine	3 sets
Take-up winder	6 sets
Circular loom	29 sets
Printing and cutting machine	1 set
Sewing machine	1 set
Packing machine	1 set
Testing machine	1 set
Forklift truck	1 set
FOB price of machinery and equipment .... (approx.)	$US 1,462,000

Table 3: Required Raw Materials

PE or PP pellet . . .	156 kg/1,000 bags
Ink and solvent . . .	3 kg/1,000 bags
Yarn	2 kg/1,000 bags

Table 4: Required Manpower

The following labour force would be required. One chief engineer is required for either flat weaving or circular weaving.

	No. of shift	Engineer	Skilled worker	Ordinary worker	Required manpower
1) Flat weaving					
Yarn making	3	1	0	2	9
Weaving	3	0	7	8	45
Printing	1	0	1	1	2
Bag forming	1	0	1	2	3
Sewing	1	0	2	3	5
Packing and inspecting	1	0	3	2	5
Total		1	14	18	69
2) Circular weaving					
Yarn making	3	1	0	2	9
Weaving	3	1	2	6	27
Printing and cutting	2	0	1	2	6
Sewing	2	0	1	2	6
Packing and inspecting	2	0	2	1	6
Total		2	6	13	54

Table 5: Required Plant Site Area

Buildings area of either methods of bag making	40 m x 100 m	= 4,000 m²
Required land area	90 m x 120 m	= 10,800 m²

Note: Calculation on the plant has been based on average figures of normal operation in Japan.

How To Start Manufacturing Industries

Plastic Filament Twine and Rope Making Plant

Twine and rope have so far been made of natural fibers for the purpose of fisheries, agriculture, ships, land transportation, etc.

However, the demand for twine and rope made of natural fibers has decreased because of the reasons that they are liable to rot, injure hands while handling them, they must be dried in the sun when they got wet and the supply of natural fibers is on the decrease. In addition, the recent rapid development of petrochemistry has caused the twine and rope to be made from such plastic matters as nylon, polyethylene, polypropylene and the like. In contrast with natural fibers, these chemical products have conspicuously reduced the liability to rot and improved various other defects. As a result, light, strong and handy plastic filament twine and rope have come to be produced both in Japan and in other countries.

Process Description

1) Manufacturing of plastic monofilament

The plastic filament twine and rope are made from such plastic resins as nylon, polyethylene and polypropylene. They are extruded in the form of a filament by an extruder, and are stretched to the length three to thirteen times, and the filaments having 200 to 6,000 denier are extruded, and are wound round the monofilament bobbin.

In the case of a polyethylene filament, one having 300 to 800 denier is usually extruded. The tensile strength of a 3,000 denier polypropylene filament is 5 to 7.5 g/denier. With these filaments as basic materials, fishing net, fishing string, rope, casting net, spoon net, brush, etc. are manufactured.

The twine and rope, which are made by twisting many filaments are employed for the following purposes:

Examples:

a) Monofilament
   Nylon: Materials for fishing line, casting net and spoon net, brush
   Polyethylene:
      Materials for insect net, fishing net
b) Below 5 mmϕ (Twine)
   Hand craft material, material for various kinds of net, agricultural material
c) 5 ~ 10 mmϕ (Rope)
   Agricultural material, packing and transportation materials, fishing material
d) 0 ~ 22 mmϕ (Rope)
   Packing and transportation materials, material for fixed fishing net
e) Above 20 mmϕ (Rope)
   Fishing material, transportation material

2) Manufacturing of ropes

One hundred and fifty pieces of monofilament, which are extruded in 1-1) are cooled and solidified in the quenching bath, and go in order from No. 1 roller stand, stretching bath, No. 2 roller bath, and to No. 2 roller stand, and are heated in the stretching bath, and are stretched to the length seven to ten times between No. 1 roller stand and No. 2 roller stand.

The stretched monofilaments are annealed in the subsequent annealing bath, and become 400 denier monofilaments. Each filament is wound round the winder bobbin. The thickness of a monofilament is decided on according to its use, and is also controlled by the extruding rate of the extruder and by the stretching ratio.

The monofilament bobbin is set on the 4-spindle strander S-type creel stand, and a fixed number of monofilaments are twisted by 4-spindle strander. In this way 1 to 2.5 mm diameter strands are produced. These strands are wound round the flange bobbin, and 3 flange bobbins are set on the twine layer to produce 2 to 5 mm diameter twines. The twines are then rewound round the balling machine, and become products.

A fixed number of monofilaments are twisted by the ring doubling flame on the creel stand. As the first yarns thus produced are still thin, a fixed number of yarns are set on the dies twister creel and are twisted to become the second yarns. The second yarns are set on the strander, and strands are produced by twisting a fixed number of the second yarns. Three strand bobbins are set on the rope layer, and 5 to 12 mm diameter ropes are produced by twisting the three strands. The ropes are then rewound by the coiling machine to become products.

Strands are produced by setting the second yarns on the cylindrical strander and by twisting a fixed number of rope yarns. The strand bobbins are set on the cylindrical tandem lead machine, and ropes are produced by twisting the three strands. As this machine coils the ropes, no coiling machine is required.

Rope yarns are set on the closer-type strander, and strands are produced by twisting a fixed number of rope yarns, and ropes are produced by twisting the strands by the tandem lead machine. This does not require the coiling machine either. Thus, coiled ropes having 12 to 32 mm diameter are produced.

The above yarns are set on the closer-type strander, and a fixed number of rope yarns are twisted, and the produced three strands are twisted by the closer. Thus, ropes having more than a 32 mm diameter are produced. These being produced in the shape of coiled ropes, no coiling machine is required.

Example of Plastic Filament Rope Making Plant

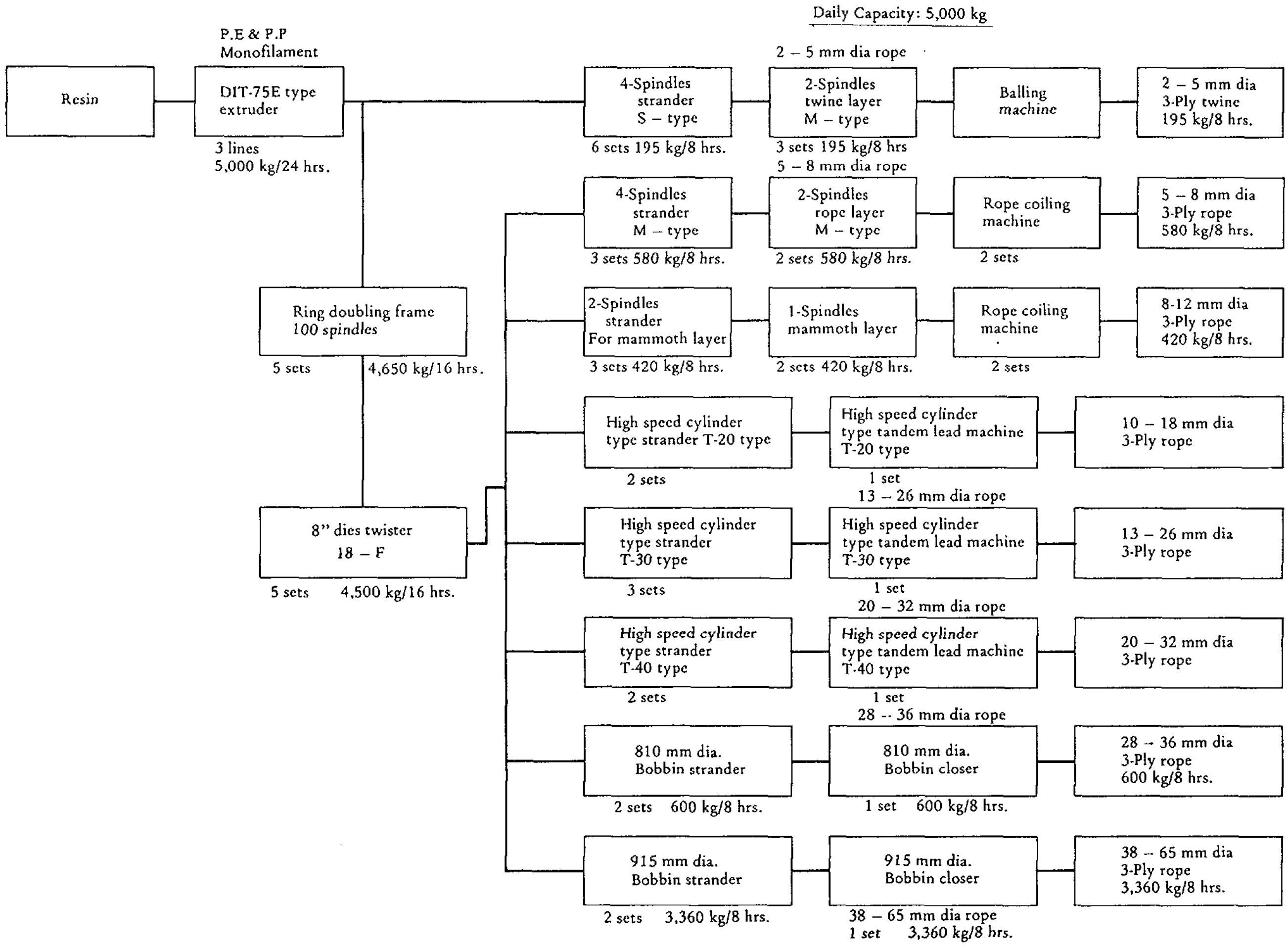
1) Production Capacity
   Monofilament . . . 5,000 kg/24 hrs.
   (as rope yarn . . . 4,500 kg/16 hrs.)

Breakdown of Final Products	
a) Rope, 2 ~ 5 mm dia.	195 kg/8 hrs.
b) Rope, 5 ~ 8 mm dia.	580 kg/8 hrs.
c) Rope, 8 ~ 12 mm dia.	420 kg/8 hrs.
d) Rope, 10 ~ 18 mm dia.	600 kg/8 hrs.
e) Rope, 13 ~ 26 mm dia.	1,130 kg/8 hrs.
f) Rope, 20 ~ 32 mm dia.	1,680 kg/8 hrs.
g) Rope, 28 ~ 36 mm dia.	1,215 kg/8 hrs.
h) Rope, 38 ~ 65 mm dia.	3,360 kg/8 hrs.

2) Required Raw Materials and Utilities
   Polypropylene and/or HDPE
   . . . . . . total 5,000 kg/24 hrs.
   Electric power
   . . . . . . 840 kW x 24 = 20,160 kWh
   Cooling water
   . . . . . . 120 tons/24 hrs.

3) Required Manpower
   Engineer 2
   Worker
   . . . . . . 9 x 2 shifts = 18
   14 x 3 shifts = 42
   Clerical worker . . . 8
   Total 68

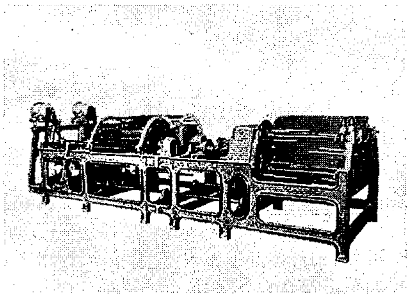
Outline of Rope Making Process and Machinery



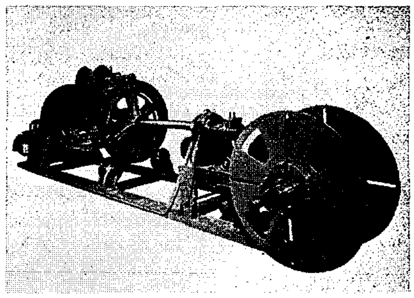
4) **FOB Price of Machinery and Equipment . . . (approx.) $US 2,500,000** including monofilament, twine and rope manufacturing machinery and equipment.

5) **Required Area for Plant Site**
   Building . . . . . (approx.) 2,800 m^2
   Land . . . . (approx.) 8,500 m^2

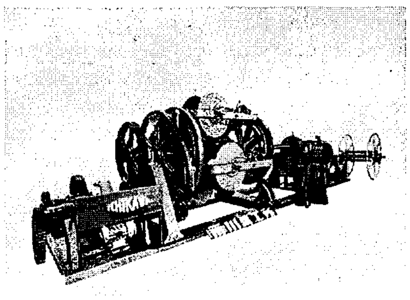
Note: It is possible to construct a plant having a smaller capacity than that. In this case, pertinent data must be prepared according to the kind of product and the production capacity if required.



2-spindles
Rope Layer M type



810 mm dia bobbin closer



915 mm dia bobbin closer

How To Start Manufacturing Industries

Polypropylene Soft Rope and String Making Plant

Up to now, ropes and strings have been made of hemp, jute, cotton, straw, paper and the like which are called a natural fiber. However, they have had some troubles of injuring fingers or hands in binding and deterioration by soaking up water in binding, transporting or storing.

With the advance of the development of petrochemical technology, ropes and strings are being made of synthetic fibers like nylon, polyethylene or polypropylene and troubles mentioned before have being solved. It is described that the string is made by stretching of polypropylene tubular film and the rope is made by twisting of three pieces of the string described above. The string is used for both mechanical and manual operation for binding of consumer goods and for binding of agricultural products and others, too.

Rope is chemically and physically stable and strong but very soft and it can be widely utilized for general purpose.

Features of Products

1) String

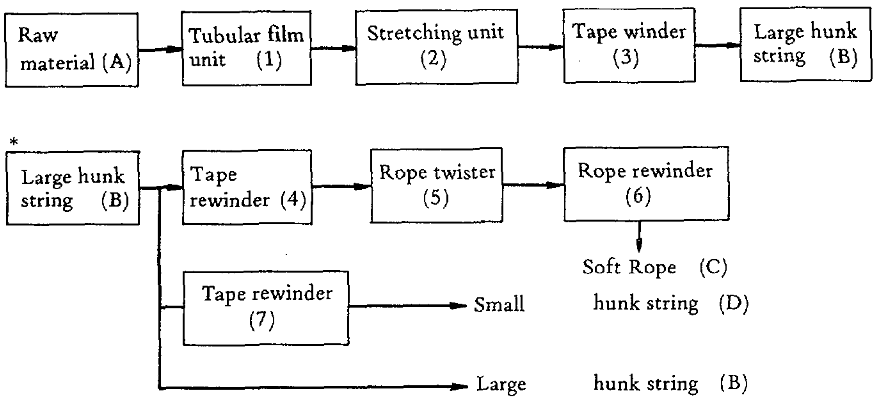
Denier:	3,000 – 20,000
Tensile strength:	3 – 4 g/denier
Type of hunk:	Non bobbin winding coil Uncoiling from the center of hunk
Winding length:	Can be adjusted as ordered

2) Soft rope

Diameter of twisted rope:	3 – 10 mm
Tensile strength:	3 – 4 g/denier
Type of hunk:	Non bobbin winding in coil Uncoiling from the center of hunk
Winding length:	Can be adjusted as ordered

Process Description (Fig. 1)

Fig. 1 Process Flow Sheet for Soft Rope Making Plant



1) Raw material A (polypropylene) is fed to extruder of Tubular Film Unit (1). Polypropylene is melted in extruder and extruded in a tubular form and it is blown up by the air to make a tubular film which is slit at the center of film tube into two sheets of flat film and then they are transferred to Stretching Unit (2). Film is heated on hot plate and stretched 3 to 6 times successively according to aimed usage and wound by Tape Winder (3). The procedure from Extruder to Tape Winder is conducted by a continuous method. The wound string has a shape of large hunk (wound long length string in other word) and it can be marketed to large users. The large hunk string is rewound by a bobbin for exclusive use for it after rewinding by Tape Rewinder (4) in order to send to Rope Twister (5) and three pieces of strings are twisted into a rope, there.

The twisted rope is rewound by Rope Rewinder (6) for the unit to be sold, and the rewinder is equipped with the length meter by which rope is cut automatically after winding the length desired by means of setting the adjustment of the length.

Large hunk string (B) is too long for general use and so it is sold as a product for general use after rewinding by Tape Rewinder (7) in the small hunk (short length string in other word). Tape Rewinder is equipped with a lengthmeter by which string is cut automatically after winding the length desired by means of setting the adjustment of the length.

Required Machinery and Equipment

1) Tubular Film Unit .... 2 sets
   a. Extruder .... 2 sets
      Screw: 50 m.m.ϕ, 45 – 135 r.p.m.
      Motor: 15 kW.
      Capacity: 12 – 35 kg/h
   b. Film take-up equipment
      Layflat width of film: 300 – 500 m.m.

2) Stretching Unit .... 2 sets
   Type: Hot plate type
   Stretching ratio: 2.5 – 6.0
   Denier of tape: 3,000 – 20,000

3) Tape Winder .... 4 sets
   Type: Two bobbin type, auto winding

4) Tape Rewinder .... 2 sets
   Tape width: 1 to 3 m.m.
   Capacity: 15 kg tape/h

5) Rope Twister .... 4 sets
   Capacity: 7.5 kg rope/h

6) Rope Winder .... 2 sets
   Capacity: 15 kg/h

7) Tape Rewinder
   Capacity: 15 kg/h

Machinery and Equipment Cost

Stretched Tape Unit .... (approx.) $US 205,000

Tubular film unit	2 sets
Stretching unit	2 sets
Tape winder	4 sets

Soft Rope Twister and Rewinder .... (approx.) $US 33,000

Tape rewinder	2 sets
Rope twister	4 sets
Rope rewinder	2 sets
Tape rewinder	1 set

Total . . . (approx.) $US 238,000

The cost of machinery and equipment is estimated at FOB price, Japan but the erection cost is not included in.

Production Capacity

Strings of 3,000 denier to 20,000 denier can be produced by this plant and further soft ropes of diameter 1 m.m. to 6 m.m. can also be made. Their production capacity varies depending upon varieties of products. In case, 15,000 denier string and 45,000 denier soft rope are manufactured, the manufacturing capacity of a soft rope is 30 kg/h and the capacity of a small hunk string and a large hunk string is 15 kg/h of each.

1) **Annual production fo soft rope and strings**

The production of the plant designed in this project is as follows under the next conditions:

a. Two shift-operation in 16 hours a day

b. 330 days operation a year

Soft rope . . . .
158.4t 31,680 km 45,000 denier

Small hunk string . . . .
79.2t 47,520 km 15,000 denier

Large hunk string . . . .
79.2t 47,520 km 15,000 denier

2) **Raw material requirement**

Tape grade polypropylene pellet is required.

Consumption of p.p. pellet
960 kg x 330 = 316.8 t/y

Loss 5% 15.84 t/y

Total 332.7 t/y

3) **Utility requirement**

Utility

Electric power . . . .
. 101.6 kW x 16 hours x 330 days = 536,448 kWh

Cooling water . . . .
. . 1.0 m^3 x 16 hours x 330 days = 5,280 m^3

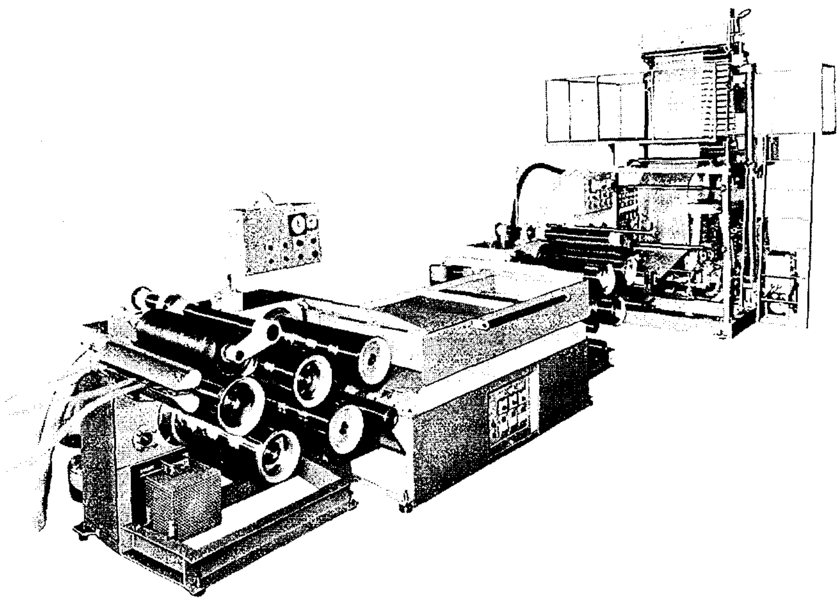
4) **Manpower**

Engineer 1

Shift operator . . . . . 5 x 2 shifts

Routine operator . . . 3

Total . . . . .14 man-day



Soft rope string manufacturing machine (General view)

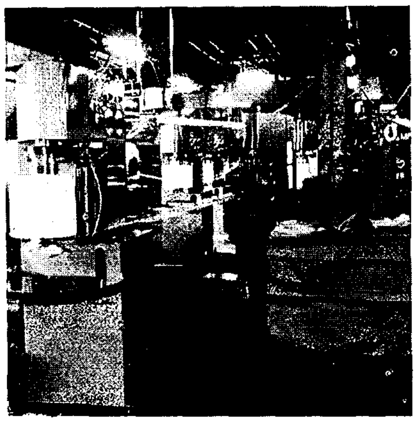
5) **Plant site area**

Floor area of factory building . . . . 400 m^2

Floor area of warehouse . . . . 100 m^2

Floor area of office building . . . . 50 m^2

Total . . . . 550 m^2



Winder of string

How To Start Manufacturing Industries

Socks Making Plant

There are two impressive things about socks (half hose): 1) socks most frankly exhibit elasticity and plasticity which are essentially characteristic of knit; 2) the first step taken in mechanizing the knitting industry began from the development of the socks making machine (hosiery machine).

The history of present-day (knit) mechanization began when the English curate William Lee designed a manually operated socks making machine in 1589. Functioning as a protective wear for the feet and playing the role of beautifying the leg lines, and after undergoing many changes, socks knitting industry gradually developed to the present state. Especially after World War II, the socks knitting industry made rapid progress. The reasons have been as follows:

(1) The change in everyday clothing pushed socks up to the realm of fashion.
(2) New synthetic fibre which consecutively appeared after World War II markedly improved knitting performance and quality of knitted goods.
(3) The appearance of all sorts of new high speed, high performance knitting machines.

In socks making, small diameter circular knitting machine is used to form the heel and toe by making a half rotation round trip. The other parts of the socks are formed by full rotation.

The standard size socks knitting machine has a cylinder diameter of 3½ – 4 inches. Generally, there are 350 needles or less.

The classification of socks knitting machines is shown in Fig. 1. They are the single cylinder machine (plain stitch type) and the double cylinder machine (rib and links type). Recently, the double cylinder socks knitting machine is used widely. As for the single cylinder socks knitting machine, the double welt socks knitting machine is used mainly.

Improvement in pattern function and production of high quality goods are advancements made in socks knitting machine. Also, productivity has been improved.

The stripping function, the spiral function, and general Jacquard are pattern functions of the single cylinder machine. There is keen competition in the pattern function of links Jacquard and links wrapping Jacquard of the double cylinder machine. As for the matter of quality improvement, the trend is toward fine gauge. All kinds of fine gauge machine have been developed. As for the matter of speed-up, the single cylinder machine now runs at 200 – 240 r.p.m. The double cylinder machine runs at 150 – 200 r.p.m. The number of feeders of both machines has increased to 2 – 3, and the trend is toward multi feeders.

Spun yarn of natural fibre (cotton, wool), textured yarn of nylon, mixed spun yarn of synthetic fibre and natural fibre, and mixed knit of synthetic filament textured yarn and spun yarn of natural fibre are used as raw materials for socks.

Process Description

1) Arrival of raw materials

The raw material yarn comes in various forms: cheese, cone, pirn. The raw material yarns can also be classified by yarn count and denier, which are sizes of yarn. Classification can also be made by colours. These raw material are arranged neatly and kept in the raw materials storeroom.

2) Winding

The raw material yarn which has been delivered is wound onto cones that are most suitable for knitting. The yarn is oiled while being wound onto the cone. Oiling of the yarn will make the yarn slide easily, and will prevent knitting damage and will improve knitting efficiency. Winding is half of knitting.

3) Knitting

The yarn wound on the cone is set on the designated socks knitting machine and knitted into the shape of socks.

In the single cylinder socks knitting machine, the completed socks come out separately one foot (piece) at a time. This is called the separate method.

In the double cylinder knitting machine one piece of the socks is completed; then, a drawn thread makes its entry and knitting begins continuously from the welt of the next piece of socks. Therefore, socks will continuously run through the knitting machine in a cylindrical shape. Accordingly, the chain of socks which come out from the knitting machine is separated into individual piece of socks by removing the yarn by hand from the drawn thread course. Recently a separating device has been developed, and this device will separate each piece while knitting.

The knitting order will be as follows: (see Fig. 2)

Welt knitting → Leg knitting →
Heel formation → Knitting instep and
sole → Knitting the toe

4) First inspection

Knitted socks are inspected for knitting damage and other flaws, and faulty goods are eliminated.

5) Linking the toe

This is the linking of the open part of the toe of the knitted socks. Linking is done with the socks turned inside out. After linking is completed, the drawn yarn of the drawn thread stitch is drawn out, and one piece of socks is completed.

6) Second inspection and mending

Inspection of the socks is done again after linking is completed, and socks with knitting damage are mended. Mending is done so that the damage would be unrecognizable. Socks which pass the inspection will go to the next process.

7) Soaping and dyeing

Socks which have gone through the various processes will have oil stains and will be soiled with dust. Soaping is done to remove the oil stains and dust; then, the socks are dyed.

8) Setting and finishing

Shaping of socks is done in this process. The most suitable finishing is done, depending on the sort of raw material used and the characteristics of the finished product, so that the quality of the product will be heightened and the product will have a good look. Generally, finishing of the socks is done by steam setting.

9) Final inspection and packaging

Final inspection before shipping must be done carefully of the finished goods for each process. Goods which have passed inspection are arranged into pairs by matching the size, colour, and pattern; they are packed in boxes and shipped out.

Example of Socks Making Plant

1) Production Capacity

The kinds of socks knitting machines for an economically minimum scale plant would be as follows:

Single cylinder double welt socks knitting machine . . . . . . 12 sets
Double cylinder socks knitting machine . . . . 12 sets
Total . . . . 24 sets

As to productivity one single cylinder machine will knit 40 – 140 pairs per 10 hours, and one double cylinder machine will knit 40 – 80 pairs per 10 hours. The margin in productivity is due to the difference in gauge, the knitted structure, and the type of machine.

Let us say that approximately 50 pairs of socks are produced by a socks knitting machine operating 10 hrs/day. If 24 machines are put in operation, the production would be 50 x 24 = 1200 pairs/day.

2) Required Machinery and Equipment

The single cylinder machine is a high class double welt type Jacquard (which can also be used for non Jacquard), and the price of one machine is approximately $US 10,500.

One double cylinder machine is approximately $US 7,600.

A setup of 12 single cylinder machines and 12 double cylinder machines, a total of 24 machines, would be $US 217,200.

3) Auxiliary Machinery and Equipment

(1) Winding machine

A cone winder of about 24 drums is used. The speed of yarn winding on cone is 200 meters per minute per drum. The price of a machine with 24 drums is $US 9,500.

(2) Linking machine

The toe of knitted socks is open, so a linking machine is used to link the opening. This is called the linking process. This work requires skill. One person operates one linking machine, and a skilled worker would link 200 – 300 pairs per 10 hours. The cost of one machine is $US 1,566. Six sets of machine would be $US 9,400.

(3) Setting machine

Socks are fit on a mould, and the machine sets and forms the socks by heat of steam. One machine will set 2,400 pairs per 10 hours. The cost of a machine of this capacity would be $US 19,000 for semi-automatic and $US 3,300 for fully automatic. One of either machines would be sufficient.

(4) Dyeing machine

The paddle dyeing machine is recommended for dyeing knitted socks. One machine has a capacity of dyeing and soaping approximately 50 kilograms of socks per operation. The cost would be approximately $US 9,500. One machine would be sufficient.

(5) Steam iron

Two steam irons would be required. They are used for finishing the socks. The cost of one steam iron would be $US 38, so 2 x $US 38 = $US 76.

(6) Boiler for steam

One set of boiler for steam would be required for the setting machine and the dyeing machine. The pressure should be 8 kg/cm^2 and the volume of steam generation should be about 500 kg per hour. The cost would be approximately $US 14,300.

4) Required Raw Materials and Utilities

(1) Yarn

When making nylon 100% socks, stretch nylon 110/2 denier yarn would be suitable. The weight of the yarn will be 400 grams per 10 pairs. Let us say that approximately 50 pairs of socks are produced by a socks knitting machine operating 10 hrs/day. If 24 machines are put in operation, the production would be 50 x 24 = 1,200 pairs/day. Therefore, the yarn required would be 1,200 ÷ 10 x 400 = 48,000 g = 48 kg/day.

When making socks with a mixture of 80% cotton yarn and 20% nylon yarn, 40/2 yarn count cotton and 70/1 denier stretch nylon are used. The face should be cotton and the back should be stretch nylon, and the knitting should be plating structure. The weight of the yarn in this case would be 500 grams per 10 pairs. Let us say that the same number of pairs of socks as in the aforementioned case of nylon 100% is to be produced. Then, the yarn required would be 1,200 ÷ 10 x 500 = 60,000 g = 60 kg/day.

(2) Latex rubber yarn

To bring out stretch in the welt of socks the welt is knit with different yarn, and latex rubber yarn is inserted in the welt. The latex yarn is made by covering cotton yarn or nylon yarn over latex rubber. The quantity required, for the plant described above, is approximately 3 kg/day.

(3) Dyestuff

If only nylon socks are to be produced in the plant, the production, as already stated in (1), would be 48 kg/day. Acid dyestuff is used for dyeing. Since most winter wear are dark coloured, 3% of the weight of the socks to be dyed would be required; that is, 48 kg x 0.03 = 1.44 kg/day. Most summer wear are light coloured, so the dyestuff required would be 1 – 1.5% of the weight of the socks to be dyed; that is, 48 kg x 0.01 – 0.015 = 0.48 – 0.72 kg/day.

If only cotton socks are to be produced in the plant, the production, as already stated in (1), would be 60 kg/day. In this case, reactive dyestuff or direct dyestuff is used for dyeing. The quantity required for either would be 3% of the weight of cotton socks to be dyed for winter wear, and 1 – 1.5% for summer wear. That is, for winter wear the quantity would be 60 kg x 0.03 = 1.8 kg/day, and for summer wear the quantity would be 60 kg x 0.01 – 0.015 = 0.6 – 0.9 kg/day.

(4) Water

The total amount of water required would be approximately 9 – 10 tons/day.

(5) Electric power

The total consumption of electric power is approximately 40 kWh.

5) Required Manpower

The layout of hosiery plant will be as shown in Fig. 3. The distribution of personnel in the plant will be two persons for winding section, three or four persons for knitting section (one person can operate and run 7 to 12 socks knitting machines), six persons for linking section, two persons for checking shop, two persons for setting machine, two persons for dyeing room, one person for office, and one person for material and finished goods store. Besides, a boiler room should be set up, and one boiler man would be required. The total number of personnel would be about 22 or 23.

6) Required Area for Plant Site

The layout of a minimum scale plant is shown in Fig. 3. The floor space of the main room is 32 m x 12 m = 384 m^2. The floor space of the dyeing room is 4 m x 5 m = 20 m^2. Also, a boiler room would be required, and the floor space is 7 m x 7 m = 49 m^2.

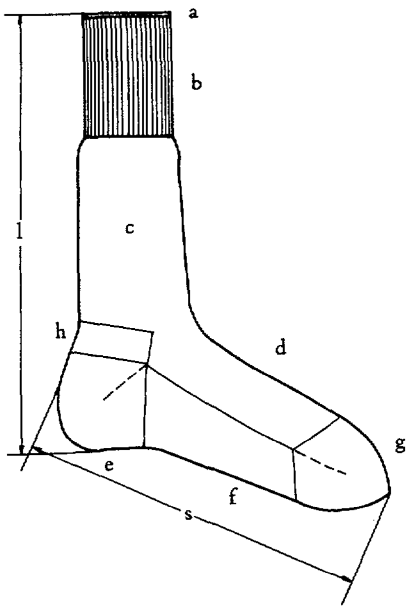
The setting machine room uses steam, so a heat insulating wall should be set up between the other rooms.

The building is a steel structure one-storied building.

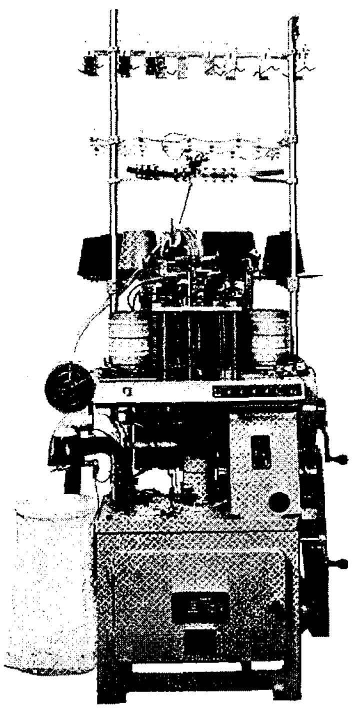
Fig. 1

- Socks knitting machine
  - Single cylinder system machine
    - Single welt machine
      - Non Jacquard machine
      - Jacquard machine
    - Double welt machine
      - Non Jacquard machine
      - Jacquard machine
  - Double cylinder system machine
    - Non Jacquard machine
    - Jacquard machine
      - Links Jacquard machine
      - Links wrapping machine

Fig. 2



a . . . . (Welt)
b . . . . (Rib top)
c . . . . (Leg)
d . . . . (Instep)
e . . . . (Heel)
f . . . . (Sole)
g . . . . (Toe)
h . . . . (High splicing)
l . . . . (Length)
s . . . . (Size)

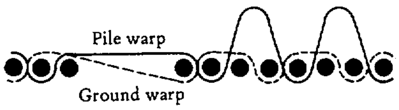


Double welt socks knitting machine

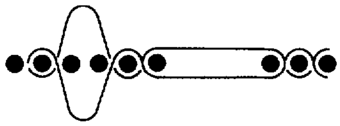
How To Start Manufacturing Industries

Terry Towel Plant

The towel is a fabric which has uncut loops formed from warp yarns while being woven on either one or both sides. Since these loops are called Terry Pile, this fabric is also called Terry fabric.



One side towel



Both sides towel

The towel can be classified into three groups, namely the figured towel which has woven figures, the dobby towel which has small geometrical figures, and the plain towel which does not have figures. All towels are woven from three kinds of yarns, namely ground warp, loop warp, and weft.

There is another way of classifying towels. One is bleached, dyed, printed, etc. on the plain towel woven of grey cotton yarn and the other is coloured woven of dyed or bleached yarn.

The quality of the towel is largely dependent upon the density of loops, i.e. the denser, the better.

Loops can be generated either every three warps or every four warps. Hence, generally speaking, towels of good quality have loops on every three warps and are consequently of high loop density.

The trade of towels is usually basing

Table 2: Required Machinery and Equipment

Item	No.
Main Production Machine	
1) Winding	
High speed cheese winder (Soft winder)	2
2) Cheese Dyeing and Bleaching	
High temperature & high pressure cheese dyeing machine	2
High pressure rapid drying machine	1
3) Rewinding	
High speed cone winder	2
4) Preparating for Weaving	
Sectional warping machine	1
Rewinding machine	1
Universal warp tying machine	1
Reaching-in machine	1
Automatic pirn winder	1
5) Weaving	
Cop change	24
Automatic towel loom	
1 x 1, RS 96" (RS: Reed Speed)	
Dobby 2 cylinders, 24 shafts	
Cop change	14
Automatic towel loom	
1 x 1, RS 96"	
Jacquard 900	
Cop change	10
Towel loom	
1 x 4, RS 74"	
Dobby 2 cylinders, 24 shafts	
6) Inspecting	
Cloth plaiting inspecting machine	1
7) Finishing	
Lock stitch sewing machine	3
Over lock stitch sewing machine	3
FOB price of machinery and equipment	(approx.) $US 1,267,000
including spare parts for 1 year's normal operation	
Auxiliary Equipment and Accessories for Production Machine	
FOB price	(approx.) $US 333,000
Laboratory Equipment	
FOB price	(approx.) $US 24,000
Total FOB price of production machine and equipment	(approx.) $US 1,624,000

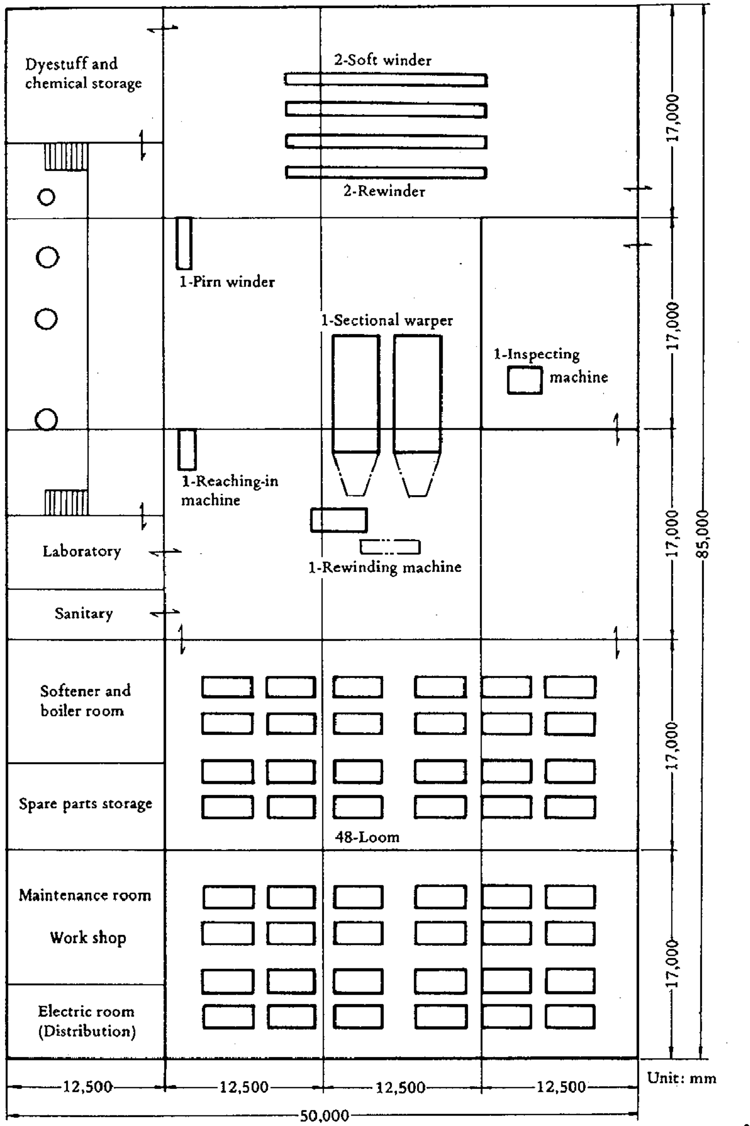
Note: 1) Erection supervising and technical instructing fee are not included in the above price.
2) Engineering and know-how fee shall be estimated separately.

Table 1: Production Sheme

Product description	Dimensions (cm)	Gram/Piece	Piece/Year	Tons/Year	Colour	Design	Sort
Medium quality terry towels	125 x 64	360	97,222	35	Multi colour	Plain	Bath towel
	35 x 33	60	250,000	15	Multi colour	Plain	Wash towel
	100 x 50	340	73,530	25	Single colour	Hotel/ Restaurant name	Bath mat
	53 x 40	100	150,000	15	Single colour		Hand towel
High quality terry towels	125 x 70	540	83,335	45	Multi colour	Plain	Bath towel
	110 x 60	400	75,000	30	Multi colour	Embossed	Bath towel
Low quality terry towels	115 x 210	560	44,645	25	Single colour (White)	Plain	Towel sheet
	80 x 40	275	36,365	10	Single colour (White)	Plain	Bath mat

Operative condition
Working hour: 8 hours/day
Working day: 250 days/year

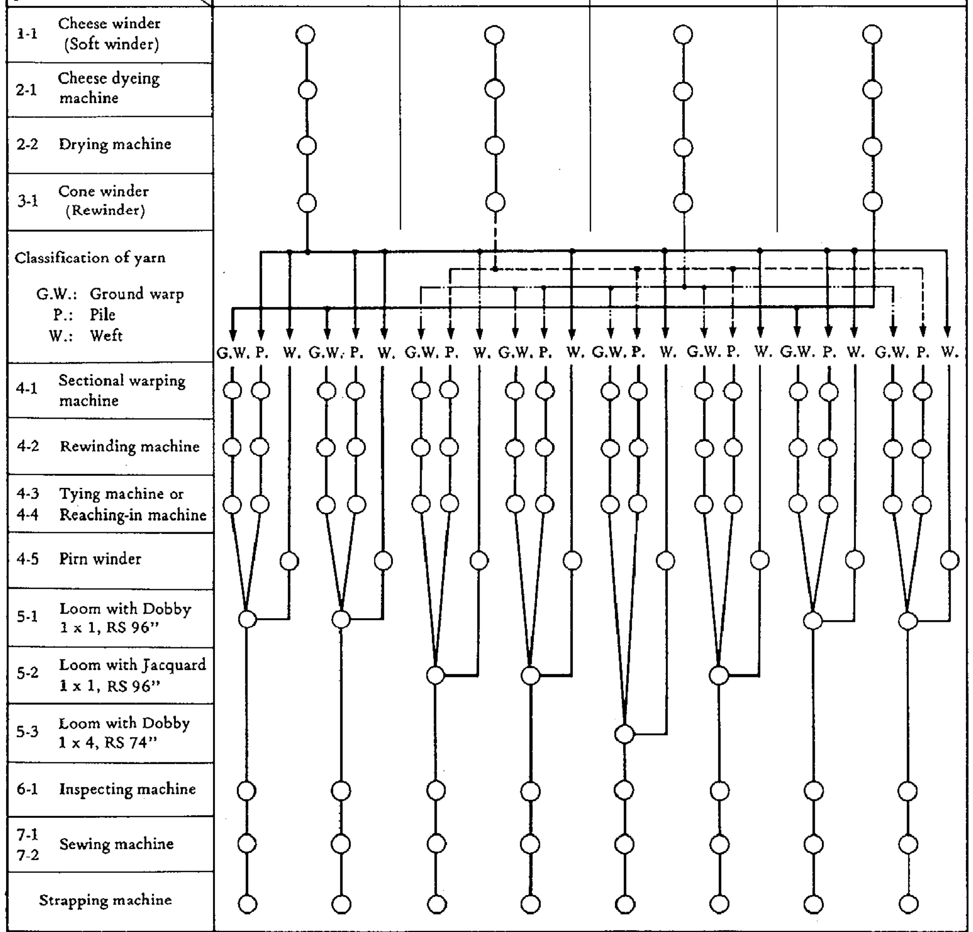
Fig. 2: Required Area for Plant



Building . . . . 4,250 m^2
Area for main production machine 3,700 m^2
Utility service zone 550 m^2
Exclusion: Administration office, warehouse, cafeteria and dressing room for labour etc.
Land . . . . Approx. 7,000 m^2

Fig. 1: Process Flow Sheet for Towel Plant

Item No. and production machine / Required raw material kg/day / Yarn count	Cotton Ne 20	Cotton Ne 20/2	Cotton Ne 30/2	Cotton Ne 40/2
	361.66	413.51	104.67	35.91



Final product									
	Size (cm)/PC.	125 x 64	35 x 33	100 x 50	53 x 40	125 x 70	110 x 60	115 x 210	80 x 40
	Piece/day	388.89	1,000.00	294.12	600.00	333.34	300.00	178.58	145.46
	Piece/year	97,222	250,000	73,530	150,000	83,335	75,000	44,645	36,365

on weight which can be adjusted by loop length, fineness of yarn, loop density, etc.

Towels can be also classified in accordance with the usage as follows: Bath towel, hand towel, wash towel, guest towel, kitchen towel, dish cloth, bath sheet, bath mat, etc.

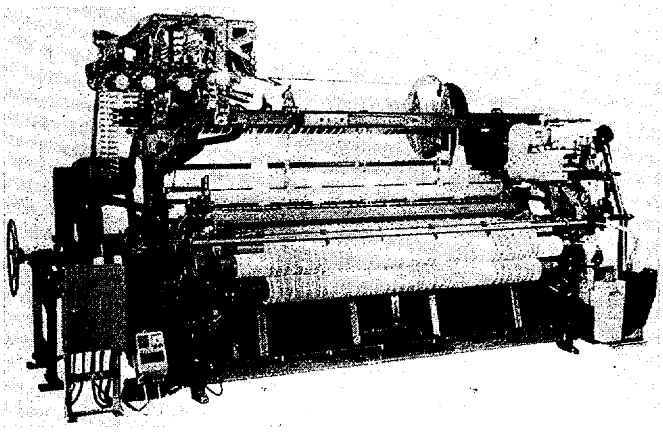
Example of Terry Towel Plant

The plant is intended to produce the total capacity of 200 tons of various kinds of Terry Towel per year. All cotton yarns shall be bleached or dyed at the mill. The plant is planned to be operated on one shift basis (250 days x 8 hours per year).

However, an increase in production capacity shall be easily achieved by adding more operation hours without creating bottlenecks.

The plant shall be capable of producing any types of towels with up to 4 weft colours and any number of warp colours.

The plant shall also be capable of producing towels with embossed design as well as towels bearing the names of owners in the case of Hotels.



Automatic cop change towel loom

Table 3: Required Utility Quantity for Main Production Machine

Machine	No. of M/C	Steam kg/hr.	Softening water ton/hr.	Cooling water ton/hr.
Cheese dyeing machine	2	1,000	15.0	20.0
Drying machine	1	1,000	–	18.0
Total		2,000	15.0	38.0

Note: Equipments for the above utility consumption shall be required as follows:

1. Packaged steam boiler .... 2 sets
   Total actual steam output: 2,000 kg/hr. x 2
2. Water softening plant .... 1 set
   Capacity: 25 m^3/hr.
3. Forced draught cooling tower .... 1 set
   Circulation water volume: 38 m^3/hr.

Installed Motor Power for Main Machine

Total 300 kW

Table 4: Suggestive Organization and Labour Allocation

Forman		Leader	Worker
Operation 1	Storage	1	2
	Winding	1	9
	Dyeing & bleaching	1	8
	Preparation	1	5
	Weaving	1	26
	Inspecting & packing	1	16
	Laboratory	1	3
Maintenance 1	Dyeing, Winding & preparation	1	2
	Weaving & finishing		3
	Utility & electricity	1	4
Total 2		9	78

Note: Management and administration staff are not included in the above table.

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C

ISIC 322 WEARING APPAREL

How To Start Manufacturing Industries

Working Clothes Sewing Plant

Industrial sewing system is one that is designed for production of clothes on an industrial scale. Based on a rational design for sewing of clothes, it calls for mechanical simultaneous mass-cutting of cloth material according to patterns, and for sewing of the cut-out cloth by high-efficiency industrial sewing machines for assembly into clothes.

On account of the need for mass-sewing of clothes of uniform quality in a short time, such a system would ordinarily require intensive labour of many sewers working in close cooperation. Therefore, it must be a modern industry, which is rationalized, through application of modern techniques, for effective operation control.

Industrial sewing, aimed at making large quantities of required clothing at a moderate cost, is used nowadays to produce clothes for almost every field, and it has emerged as a modern industry with favourable prospects for development.

Working clothes are active clothes which every worker constantly wears. Designed for work, they are all similar, little affected by taste.

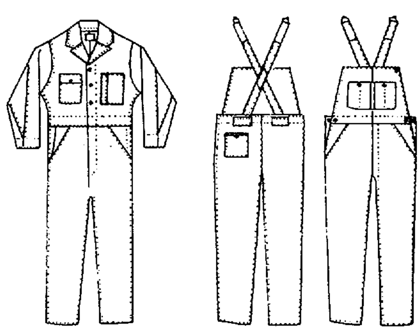
The standards of uniform working clothes are comparatively simple because they are required to be durable, highly sun-proof and wash-proof.

In making working clothes, the principal cloth material, should be of a single quality. However, the system of sewing is complex. If working clothes are made by a tailor system on an individual basis, mass-production would be impossible with higher manufacturing cost.

On the other hand, industrial sewing provides mass-production in a uniform quality.

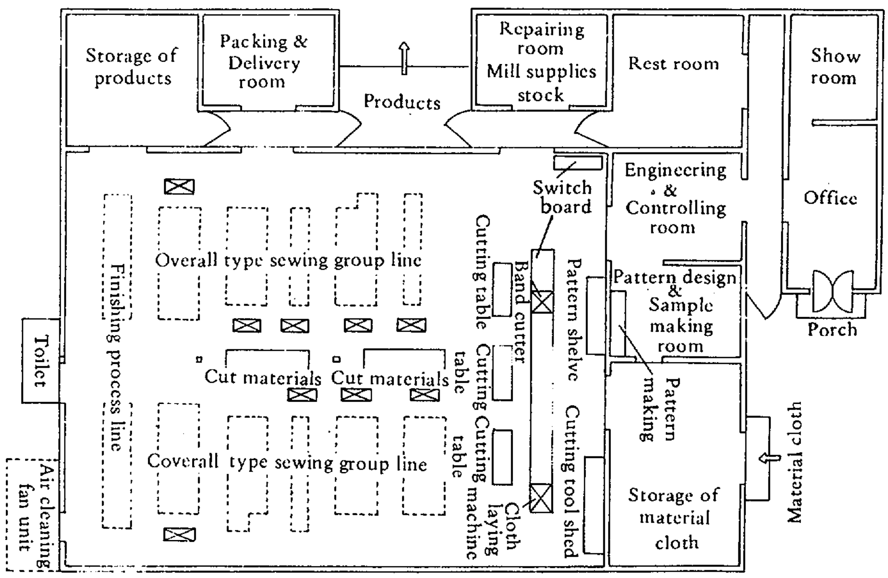
Moreover, as working clothes are little affected by seasonal conditions with stabilized demand in uniform quantity throughout a year, they present favourable conditions for industrialization.

Working clothes



Coverall type — Overall type

General Arrangement of Working Clothes Sewing Plant



Kinds of Products

The example sewing plant is to make the following:

(1) Coverall type working clothes
(2) Overall type working clothes

Type (1), called boiler suit, is a uniform worn by worker engaged in the manufacture of prime movers, machine tools, large industrial equipment, engine gears, etc.

Type (2) is popular among workers engaged in machinery operation or out-door work.

Uniformalized for workers in various machining, transportation industries and out-door work, their pattern is simple, providing favourable factors for embarking upon industrial sewing.

Production Scale

250,000 suits/year in total
viz.; overall type
130,000 suits (daily 435 suits)
coverall type
120,000 suits (daily 400 suits)

The production scale is based on the condition of 300 days/year daily 8 hours running.

The reason for the lower efficiency for the coverall type is due to the complexity of the process and the work.

Wear and tear of working clothes is heavier than that of common clothes because of the higher frequency of laundering. Therefore, the estimated consumption of working clothes is one suit per man a year. Furthermore, it will be necessary for every man to have two suits constantly.

Making Process

Here is the outline of the operational process in due order, which is the same in general as that in industrial sewing:

(1) Pattern design and pattern making; pattern making process by hand work
(2) Cloth cutting, grading process by mechanical cutting system and piece bundling
(3) Sewing by high speed industrial sewing machine
(4) Trimming and inspection
(5) Ironing and pressing for finishing process.

For sewing, process and operation analysis is conducted on which provides sewing group by group basis of a progressive bundle system, for flow operation, so as to control the process rationally.

The above process system and the one line sewing machinery system help to achieve the target of production. Furnished with one line each of sewing processes for coverall type and for overall type, it is an economic small-scale sewing plant.

Required Machinery and Equipment

The plant requires installation of one line of each coverall type and overall type, the details of which are:

Sewing machines	Coverall	Overall	Total
Single needle lock stitch	33	25	58
3-needle chain stitch	11	12	23
Chain stitch button sewing	2	2	4
Lock stitch bar tacker	2	2	4
Other special type	1	2	3
Total	49	43	92

In addition, the following machines are to be provided for the plant:

Machines	No. required
Steam press, general use type	5
Cloth laying machine	1
Band knife cutter	1
Die cutter	3
6 lb iron	10
Straight knife cutter	5

The sewing machines should all be high speed industrial sewing machines. For the single needle lock stitch machines, which are basic machines, high-efficiency machines with a speed of 5,000 rpm and more have been adopted.

In addition, the plant requires the following facilities: namely, (1) cloth laying and cutting table; (2) cloth cutting table, (3) knife sharpener; (4) trucks, carriages, wagons; (5) material boxes and chutes; (6) shelves and (7) working chairs and others.

The FOB price of machinery and equipment, including (1) cloth cutting section with tools; (2) sewing section with spare parts and tools and (3) finishing section with steam generator, air cleaning equipment with blower fan and air compressor, is approximately $US 357,143.

Required Plant Site Area

The required floor area is 1,980 m^2 including 1,200 m^2 for the main working room for the cutting, sewing and finishing sections and 780 m^2 for material storage, etc.

Accordingly, the total plant site area required is at least 4,000 m^2.

Depending upon the condition of the site, the plant requires air conditioning equipment. Air conditioning equipment, but the cost of the equipment not included on the above mentioned machinery price.

Required Raw Materials

As for cloth, it should be of Denim type and Blue Jeans cloth on account of the character of working clothes.

The width should be of 92 cm (40 m long roll).

The required cloth sizes are 92 cm x 4.0 m for coverall type and 92 cm x 3.25 m for overall type. Therefore, the cloth annually required including waste is approximately 950,000 m.

The requirement of sewing thread No. 20 (Ne. 40/2 x 3), is about 17,000 cones (each cone contains 4,000 m). In addition, such accessories as buttons will be required.

Utilities and Others

Required electricity is 52 kWh for prime movers and 13 kWh for lighting, namely, 65 kWh in total, excluding that for air conditioning and air cleaning. Power consumption of a sewing machine is 400 W.

The daily requirement of fuel oil for steam generation for pressing is about 80 liters. As for tools, although some, such as sewing needles, clips, scissors, have to be replenished, their number is rather small.

Remarks:

For overall type, it shall be available for leisure apparel of younger generation.

How To Start Manufacturing Industries

Men's Dress Shirt Sewing Plant

Planning and Selling of Products and Factory Location

Men's dress shirt, among various kinds of clothing, has wide adaptability and is consumed in huge quantity throughout the world. Transporting is easy too; therefore, if the factory can produce at a cost which can compete internationally, geographical limitation of the factory location is practically nil for both local consumption and export.

Scale of Factory

The requirements of a minimum size factory would be a factory with one production line of 700 – 800 shirts a day, and 40 – 50 employees. The cost of facilities (excluding the cost of land) would be around ¥70,000,000 – 80,000,000. The annual turnover of such a factory would be around ¥200 – 300 million, and the processing fee would be around ¥100 – 150 million.

A standard factory has one to six production lines in parallel with an output of 1,000 – 2,000 shirts a day. The equipment and labour force for a production of approximately 2,200 shirts a day (50,000 shirts a month) are given in "Outline of Factory".

Locational Condition

The apparel sewing industry on the whole does not require a huge investment. Most of the work is done by hand. Total production of every lot of dress shirt gives relatively large number, and so the rationalization, mechanization, and labour saving are quite advanced. Even so, labour intensive operation is inevitable. Therefore availability of cheap, high quality labour is most important in selecting the factory location. The consumption of electric power and industrial water is small.

Required Raw Material and Subsidiary Raw Materials

The main raw material is polyester-cotton blend cloth. (100% – cotton or polyester-linen blend are seen infrequently.) Not only broadcloth weave but also cloth with various woven patterns are used. Subsidiary raw materials are sewing thread, buttons, interlining, etc.

Process Description

1) **Cutting process**
In the cutting process the cloth is cut to the proper sizes, then is inspected, assorted, and arranged to facilitate flow to the sewing process. Cut cloth must be combined with the interlining, if to be applied.
The cutting process consists of the following four processes:
(1) Drawing
A paper pattern is placed on the cloth and the pattern is copied on the cloth.
(2) Cloth laying
The cloth is spread and piled on the cutting table.
(3) Cutting
The cloth is cut by a knife-type cutting machine or a die cutting machine.
(4) Arrangement
The cut cloth and interlining are inspected, assorted, and bundled, and a slip is attached to the bundle.

2) **Sewing process**
In the sewing process, the cut cloth is sewn one by one and the whole cloths are made into the finished product. Generally, each part of shirt is made at different section and the shirt is made in an integrating way as shown in Fig. 1.
As the workers become specialized the work is mastered in a short time, and efficiency is improved. 80% of the direct labour of the sewing factory serves for the sewing process.

3) **Finishing process**
In the finishing process the completely sewn shirt is inspected, pressed for body finishing and collar finishing, ironed to the proper shape, and then folded and packaged.

Outline of Factory

The production scale of the factory can be anywhere from 700 – 800 shirts a day to 7,000 – 8,000 shirts a day, but here a description will be made for a factory with an output of approximately 2,200 shirts a day (50,000 shirts a month).

The merit of a large-scale factory is that incidental facilities and indirect labour could be used in common. However, no great effect is not given to the profitability in respective capacity. Ordinarily a factory of such a capacity (2,200 shirts a day) is installed as a unit for further enlargement of the sewing factory.

Table 1: Production Scheme

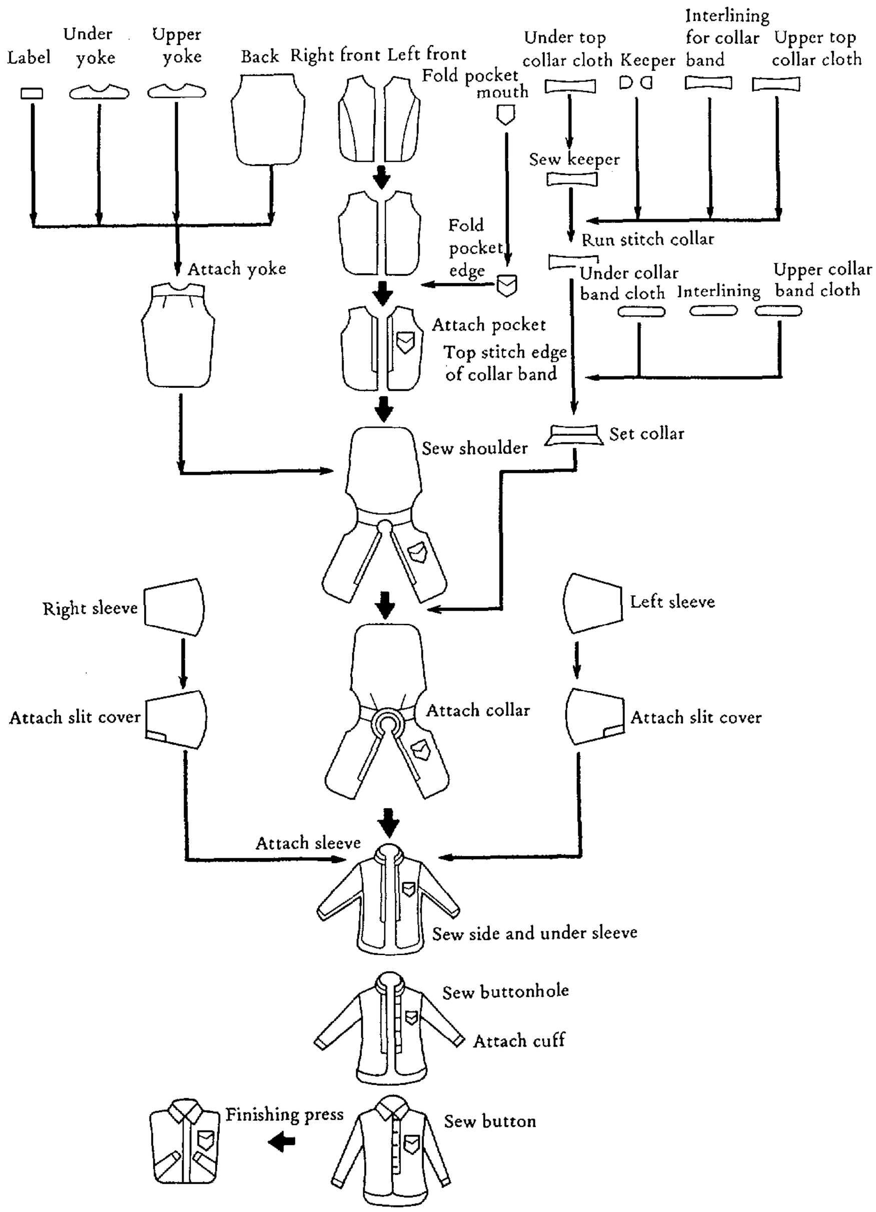
1) Production capacity
2,174 shirts/day
50,000 shirts/month
2) Working hours
7.5 hours/day
23 days/month

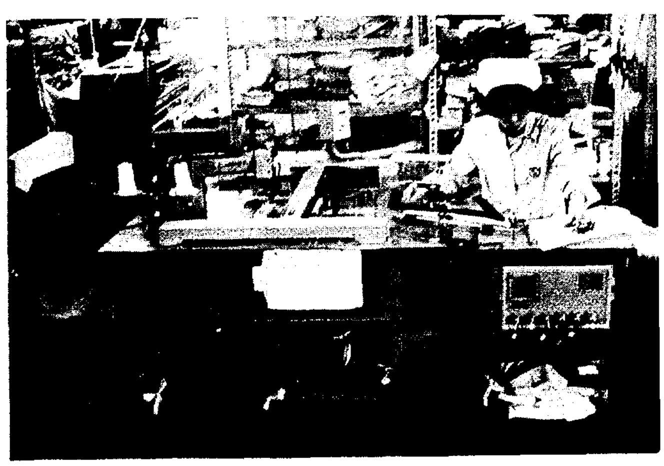
Note: Tables 2, 3, 4, 5 and 6 are based on the above scheme.

Technical Assistance

The machines used in a sewing factory are easy to operate, but each company has its own know-how on the most effective engineering of the factory facilities. Also the production management of the factory is giving important effect on the profitability. Therefore, it would be wise to receive assistance from a well experienced company.

Fig. 1 : Men's Dress Shirt Sewing Process





Pattern seamer (NC controlled)

Table 2: Required Machinery and Equipment

Item	No.
Cutting process	
Cutting table (coarse cutting)	2
Cutting table (fine cutting)	4
Straight knife cutting machine	3
Band knife cutting machine	1
Cutting press	2
FOB price (approx.)	$US 48,000
Sewing process	
Single needle lock stitch machine	35
2 needles 5 thread interlock machine	7
Single needle double chain stitch machine	2
Single needle chain stitch button sewing machine	3
Tack stitch machine for slit cover attaching (LR three each)	6
Single needle lock stitch blind buttonhole machine	2
Overlock machine	2
Label setter	2
Collar top sewing machine	2
Pocket folding and setting machine	2
Double-head automatic buttonhole machine for cuff	2
Automatic buttonhole machine for front	3
Electric iron	17
Ironing stand	17
Sleeve slit cover folder	1
Cuff forming press	2
Collar turning machine	2
Press for collar	2
Stamping machine	1
Workbench	2
Fusing press for interlining	2
All-round press	1
FOB price (approx.)	$US 190,000
Finishing process	
Press for collar and cuff finishing	2
Press for front finishing	2
Press for neck finishing	2
Folder	7
FOB price (approx.)	$US 114,000
Total FOB price of machinery and equipment (approx.)	$US 352,000
Total	70 sewing machines
Total	7 presses

Table 3: Other Expenses

Factory building	(approx.)	$US 390,000
Annex building (office, cafeteria, etc.)	(approx.)	$US 105,000
Incidental facilities (electric wiring, boiler, water works, compressed air piping, air conditioning equipment, compressor, machine tools, vehicles)	(approx.)	$US 105,000
Total (not including the cost of land)	(approx.)	$US 600,000

Table 4: Required Manpower

Item	No.
Direct labour	
Cutting	10
Sewing	95
Finishing	12
Maintenance	5
Total	122
Indirect labour	
Factory management	5
General affairs, accounting, shipment	8
Total	13
Grand total	135

Note: For planning, design, and selling another 10 or more employees are required.

Table 5: Required Area for Plant Site

Item		
Factory (including warehouse)	(approx.)	1.200 m^2
Building and incidental facilities	(approx.)	330 m^2
Land	(approx.)	5,000 m^2

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How To Start Manufacturing Industries

Underwear Making Plant

Underwear is generally classified into four kinds such as men's underwear, women's underwear, children's underwear, and babies' underwear. Electric, water absorbing, and warmth retaining properties are required for underwears. Recently, because of the change in consumer's view of value and way of living, not only the functional property but also the nicelooking and charm of underwear are being demanded, and so fashionable underwear has newly gained popularity.

Besides the classification according to wearer, underwear is also classified according to raw materials used, fabrics, and type (shape or form).

Raw Material for Underwear

All sorts of fibre, such as cotton, rayon, acryl, polyester, nylon, polyurethane, wool, and ramie are used as raw materials for underwear. Diversified uses of raw material have increased with the development of synthetic fibre. However, from the standpoint of health (protection from skin trouble) and decreased need for protection of cold, synthetic fibre failed to make further progress and the trend of using fibre has moved towards cotton. Fine yarn and combed yarn of cotton are being used now to improve the image of high grade underwear. On the other hand, to cover the weak points of synthetic fibre, cotton is being blended with synthetic fibre in order to make practical use of the superior points of each. Blended weave of cotton fibre and synthetic fibre is making progress as raw material for underwear.

Fabric for Underwear

The fabric used for underwear can be broadly classified into two types, knitted fabric and woven fabric. From the features of an underwear, knitted fabric is overwhelmingly used. Circular knitted fabric is mostly used, then follow tricot and flat knitting. Tricot and flat knitting are declining and circular knitted fabric is increasing.

Representative cicular knitted fabrics for underwear are circular rib knit, interlock stitch, and plain stitch. Because of the trend towards sheer underwear, there is a marked shift from interlock stitch to circular rib knit and then to plain stitch. Also, for a change in mood, circular rib derivative weave seems to be increasing.

As for woven fabric, crepe, broadcloth, and poplin are used for underwear. With the crispness and crispy taste as special features, crepe is especially suitable as a fabric for summer wear. Broadcloth and poplin have a dense formation and have gloss, and so they are used for men's underwear such as shorts and trunks.

Types of Underwear (according to shape or form)

Until recently, the field of underwear had little change. Such characteristic has dwindled gradually, and nicelooking property has been added to the importance of functional property. Foundation lingerie has had a great effect on women's underwear and has enhanced the fashion. In the field of young men's underwear, too, the annex, the style, the colour, and the method of sewing abounds with variety.

Underwear is classified into various category according to the style and material used, but only the representative kinds will be given here.

Men's underwear

- Short sleeve shirt
  - (V, U, and round neck)
- Long sleeve shirt
  - (V, U, and round neck)
- Button plate shirt
- Sleeveless undershirt
- Three-quarter length underpants
- Long pants
- Brief
- Trunks

Women's underwear

- King shirt
- Pullover type undershirt
- Chemise
- Shorts
- Drawers

Children's and babies' underwear

- Combination
- Rompers
- Boys' wear
- Bloomers

Outline of Plant

Roughly the production process of underwear is consisted of the following unit processes of knitting, finishing, and sewing.

There are large enterprises in which the three processes are integrated and medium scale enterprises which consign finishing to outside enterprise, knitting firms, and non-commission sewers.

As mentioned earlier underwear can be classified in accordance with raw materials used, fabrics used, type (shape or form), and user. There are all sorts of commodities. Here a description will be made for the process manufacturing men's short sleeve shirt (medium size) using 36^{s} cotton 100% combed yarn.

1) Knitting unit process

Recently many enterprises are using high speed circular knitting machine. The raw material yarn is supplied as a cone-cheese with an angle of $9°15'$, and in the rewinding process for spinning, defects such as cotton dust, nep, and slub are removed. At the same time, knitting oil or wax is applied. The use of cotton combed yarn for underwear is increasing. With the leveling up of inspecting standard, the high severity in inspection has been required. Photo electric type or electronic type auto-slub catcher is now being used in winding to prevent knitting defects caused by yarn.

The circular knitting machine has been speeded up. Number of feeder has become as much twice that of the past; it is operated at 35 revolutions per minute. Other improvements are the positive yarn feed device and the electric stopper to control the speed and tension of the feed yarn at a fixed rate so that there will be a uniform fabric of knitting, speeding up of knitting and minimizing of knitting defects. There are also the suction cleaner, the blow cleaner, the photo electric knitting detecting apparatus, and the automatic oil feeding device for oil mist. Short sleeve shirt with side seem is rare now. Almost short sleeve shirts are seamless (cylindrical). Therefore the knitting machine for size is 16" diameter and 18 g gauge, the knitting machine for the medium size is 17" diameter and 18 g gauge, and the knitting machine for the large size is 18" diameter and 18 g gauge. The raw material yarn is cotton combed yarn between 30^S – 40^S, and the weight of fabric is about 130 g/m^2 for 36^S.

After knitting is completed, sample inspection of the grey fabric is made. Inspection of grey fabric is carried out on the property, quantity and defects and the knitting machine is adjusted, if necessary.

It is desirable to install an air conditioning unit to control the temperature and humidity.

Fig. 1: Process Flow Sheet for Knitting Process

Preparing of yarns
↓
Knitting
↓
Inspecting
↓
Forwarding

2) Finishing process

There are two methods of finishing cotton knitted underwear (white finishing goods), the continuous method and the discontinuous method. The discontinuous method will be more profitable and will produce better quality goods for small scale production (less than 100 tons/month).

Sodium hypochlorite is employed for scouring and bleaching, the main unit processes of finishing, to obtain good whiteness and fine feeling.

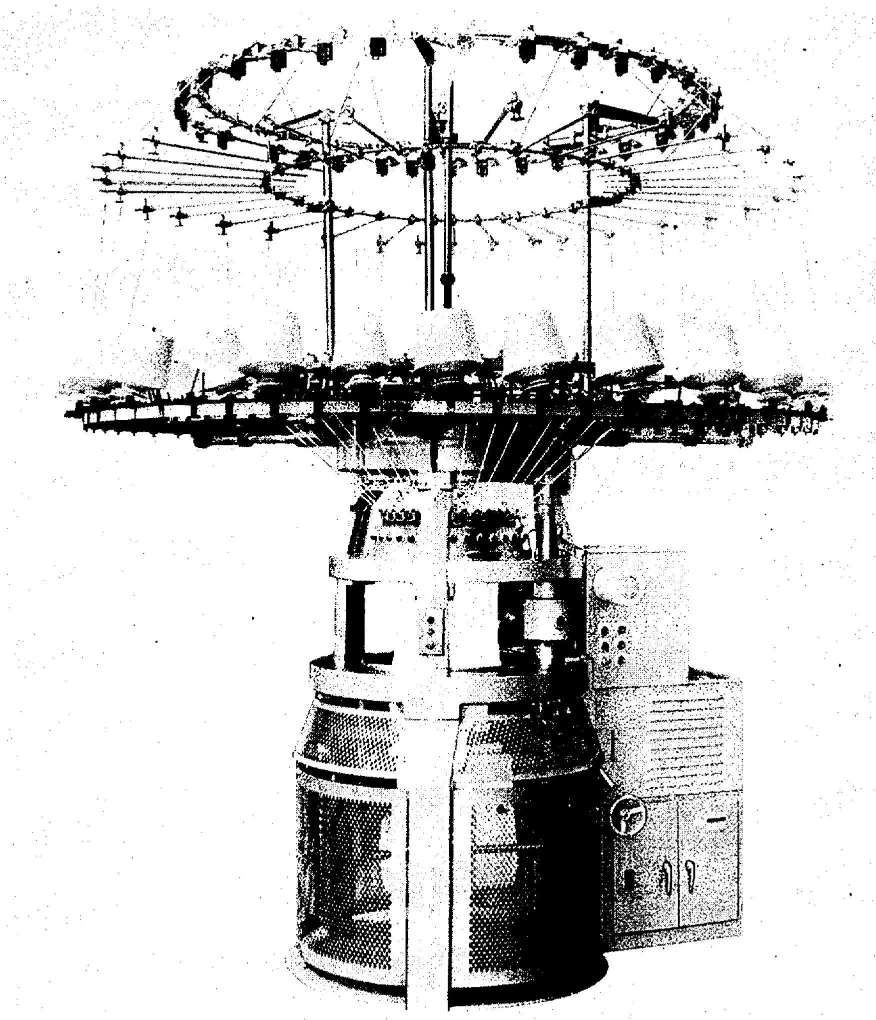
Fig. 2: Process Flow Sheet for Finishing Process

Raw material fabrics
↓
Preparing of knitted fabrics
↓
Scouring and bleaching with sodium hypochlorite and hydrogen peroxide
↓
After treating
↓
Drying
↓
Final setting
↓
Inspecting
↓
Making up and forwarding

Wherever possible the continuous method is employed in combination with the discontinuous method. High quality goods are available by employing the tensionless system. It is easier to discover defects after bleaching than in grey fablic, so inspection of knitting defects is carried out after the finishing process is completed. Thus, coloured yarns are attached to the defective parts.

3) Sewing process

The fabric, after passing through the fabric inspecting machine to have defects discovered, goes through the cloth layer machine to have the selvage arranged evenly in a fixed length; then, the fabric is piled one on top of the other. In the next step, the fabric is cut to the required length by the cutter. Cut fabrics with defects indicated by coloured yarns are taken out and sent to the precise cutting loss section, and is again piled one on top of the other. Cutting pattern is taken on the fabric, and precise cutting is done by a band knife cutting machine. Lock stitch which has only small elasticity, is not suitable for sewing knitted underwear. Overlock machine or double chain stitch machine or special machines with two needles, three needles, four needles chain stitch with looplike underthread, all of these which will stretch like the fabric, will be used.



Circular rib knitting machine

Table 1: Production Scheme

1) Yarn used	Cotton combed yarn 36^S
2) Production capacity	
Finishing process	50 tons/month (weight of circular rib knitted fabric 130 g/meter)
Sewing process	15,000 pieces/day
3) Working hours	23 days/month

Tables 2, 3 and 4 are based on the above scheme.

Table 2: Required Machinery and Equipment

Knitting process (three shifts, 24 hrs./day)	
Circular rib knitting machine (17"x 18 g)	25 sets
Inspecting machine	1 set
Winder (including waxing device)	1 set
FOB price (approx.)	$US 478,000
Finishing process (two shifts, 16 hrs./day)	
Sewing machine	1 set
Automatic grey cloth piler	1 set
Continuous saturator	1 set
Bleaching kier for sodium hypochlorite	1 set
Bleaching kier for hydrogen peroxide	1 set
Auto piler	1 set
Continuous fully automatic washing machine	1 set
Continuous optically whitening machine	1 set
Continuous softening and, pneumatic spreading and squeezing machine	1 set
Scray	2 sets
Dryer	1 set
Finishing setter	2 sets
Inspecting machine	2 sets
FOB price (approx.)	$US 437,000
Sewing process (one day-shift of 8 hrs.)	
Cloth laying machine	4 sets
Straight knife cutting machine	3 sets
Band knife cutting machine	3 sets
Border cutting machine	3 sets
Single needle overlock machine	68 sets
Two needle overlock machine	20 sets
Two needle chain stitch machine	10 sets
Lock stitch machine	8 sets
Tack stitch machine	15 sets
FOB price (approx.)	$US 286,000
Total FOB price of machinery and equipment (approx.)	$US 1,201,000

Table 3: Required Manpower

	1 shift	2 shifts	3 shifts	Total
Knitting process	4 persons	2 persons	6 persons	12 persons
Finishing process	4 persons	22 persons		26 persons
Sewing process	176 persons			176 persons
Total				214 persons

Note: Engineer and management staff are not included in the above table.

Fig. 3: Process Flow Sheet for Sewing Process

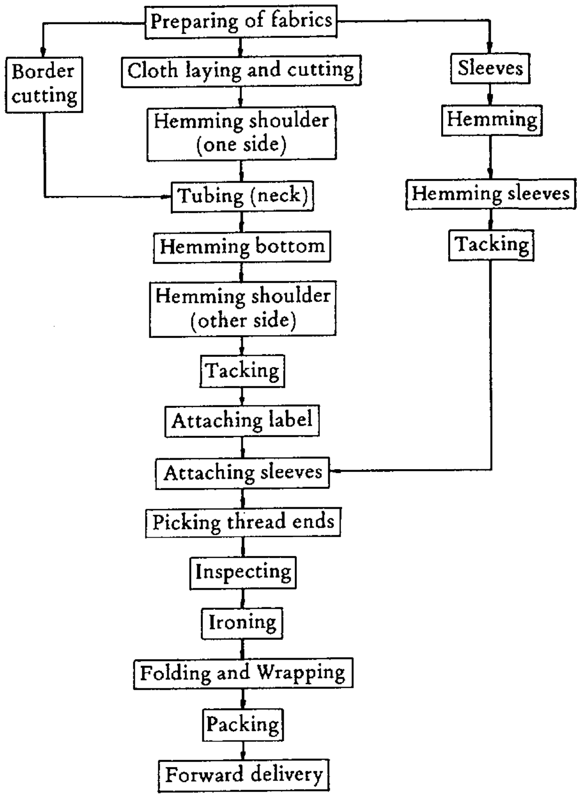


Table 4: Required Area for Plant Site

Item	
Building	2,430 m^2
Knitting process	780 m^2
Finishing process	850 m^2
Sewing process	800 m^2
Land	5,000 m^2

How To Start Manufacturing Industries

Outerwear Knitting Plant

After World War II, the knitted outerwear industry made great progress. Some of the reasons are as follows: (1) With the consecutive appearance of new synthetic fibres after World War II, knitting performance of machines and quality of knitted goods made remarkable progress; (2) Various kinds of new high performance knitting machines made their appearance; (3) The change in mode of apparel pushed outerwear knitting up to the realm of fashion.

Today, the knitting industry is in keen competition with the weaving industry. There are two desirable functions facing the knitted and woven fabrics industry. One is to produce fabric with the desired efficiency as fast as possible and at low cost. The other is to aim at fashion with beautiful elements. In these two respects, knitted wear is favourable in many ways. Let us consider some of the important factors.

1) Features of fabrics

Because of the progress in the realization of fine gauge knitting machine, it is now possible to produce beautiful light-weight fabrics dimensional stability. Knitted wear is casual and sports-like and is appropriate for present-day fashion.

2) Cost of machinery and production capability

Progress has been made in speed, automation, and versatility of knitting machine, and so the production capability per investment is much higher than loom.

3) Time required for yarn to become fabric

Generally, it takes four hours for the cone on circular knitting machine to become empty. On the other hand, it requires four weeks for the beam on loom to become empty, including the warping process and setting up time.

All in all, the productivity of knitting is higher than that of weaving. Knitting is the cheapest method of converting yarn into fabric.

The classification of knitted outerwear machine, as shown in Fig. 1, will be flat knitting machine and circular knitting machine.

Fig. 1

- Outerwear k. m.
  - Flat k. m.
  - Circular k. m.

Note: (abbreviation) k.: knitting,
m.: machine

In the flat knitting machine, the latch needle inserted in the needle bed is moved by a carriage to do the knitting action. Generally, the knitted fabric comes out in a flat state with selvedge on. Sweater and similar goods are generally produced by this method of knitting.

The circular knitting machine is a machine which knits fabrics in a tubular state. The circular knitting machine has a cylinder or a joint cylinder and dial or a double cylinder. The knitting needle enclosed in the cylinder moves to produce fabrics in a tubular state.

There are two kinds of flat knitting machine, the hand flat knitting machine and the automatic flat knitting machine. The automatic flat knitting machine is popular these days.

Fig. 2

- Flat k. m.
  - Hand flat k. m.
  - Automatic flat k. m.
    - V bed system m.
      - Full fashioned type m.
      - Transfer Jacquard type m.
      - Jacquard type m.
      - Non Jacquard type m.
    - Horizontal system m.
      - Non Jacquard type m.
      - Jacquard type m.

The classification of circular knitting machine, as shown in Fig. 3, will be yard goods machine (for knitting fabrics) and garment length machine (for knitting sweater). Generally, the yard goods machine is widely used to knit cut-and-sew knitted outerwear fabrics.

Fig. 3

- Circular k. m.
  - Yard good m.
    - Single k. m.
      - Non Jacquard m.
      - Pile k. m.
      - Inlay k. m.
      - Jacquard m.
    - Double k. m.
      - Non Jacquard m.
      - Jacquard m.
  - Garment length m.
    - Cylinder and dial m.
      - Non Jacquard m.
      - Jacquard m.
    - Double cylinder m.
      - Non Jacquard m.
      - Jacquard m.

The common points of progress seen in the flat knitting machine and the circular knitting machine these days are speed-up, automation, diversity, trend towards fine gauge, and introduction of electronics. About 20 years ago, knitting machine with gross gauge was used to produce bulky outerwear for winter use. Now, however, due to the progress in fine gauge, light-weight fabric of dimensional stability is produced for all season wear.

Manufacturing Plan

A flat knitting machine should be installed if the objective is to knit sweater, and a circular knitting machine should be installed if the objective is to knit cut-and-sew general outerwear (suit, one piece, coat, slacks, skirt, sweater, etc.).

Selection of machinery for an economically minimum scale plant will be given separately for flat knitting and circular knitting.

Example of Flat Knitting Plant

The production of sweater by flat knitting machine is most suitable for medium and small scale industry. Investment in facilities (factory and machinery) could be small, operating funds (purchase of yarn) could be small, and finished goods could be had as products.

Production Capacity

Hand flat knitting machine
(36" width) . . . . 30 sets
Automatic flat knitting machine
(52" width) . . . . 30 sets

One hand flat knitting machine will produce 6 – 10 pieces of sweater in 10 hours, and one automatic flat knitting machine will produce 13 – 17 pieces of sweater in 10 hours. The difference in production is due to the difference in gauge, knitted structure, etc.

Let us assume that one flat knitting machine operating 10 hours/day would produce approximately 10 pieces of sweater. The production of 30 machines would be 10 x 30 = 300 pieces/day.

Also, let us assume that one automatic flat knitting machine operating 10 hours/day would produce approximately 15 pieces of sweater. The production of 30 machines would be 15 x 30 = 450 pieces/day.

The total production of sweater would be 300 + 450 = 750 pieces/day.

Note: Tables B-1 ~ A-3 and Items 1) ~ 2) are based on the above scheme.

Note: k. m.: knitting machine

Table A-1: Required Main Machinery

Machine	Specification	FOB price
Hand flat k. m.	36 inch knitting width	$US 1,000 x 30 sets = $US 30,000
Automatic flat k. m.	52 inch knitting width	$US 4,318 x 30 sets = $US 129,540
Total		$US 159,540

Table A-2: Auxiliary Machinery and Equipment

Machine	FOB price
1) Winding machine (200 m/min./spindle)	$US 21,400 x 4 units = $US 85,600
2) Dial linking machine	$US 2,000 x 20 units = $US 40,000
3) Over-lock sewing machine	$US 1,000 x 2 units = $US 2,000
4) Steam iron	$US 50 x 10 units = $US 500
Total	$US 128,100

Table A-3: Required Manpower

Section	No.
Winding section	12
Knitting section	
Hand flat	30
Automatic flat	8
Linking section	20
Sewing section	2
Checking shop	4
Finishing shop	10
Office	2
Materials store	1
Finished goods store	2
Total	91

1) Required Raw Materials and Utility

When using wool 100%, acryl 100%, wool-acryl blend, or cotton yarn as raw material for sweater, the weight would be 400 – 500 grams per piece. As above mentioned, the hypothetical plant would produce 750 pieces of sweater a day. Accordingly, the raw material yarn required would be 400 – 500 grams x 750 = 300 – 375 kg/day.

The entire electric power required would be 50 kWh.

2) Required Area for Plant Site

The floor space required would be 39 m x 18 m = 702 m^2. A one-storied steel frame building would be suitable.

Process Description of Flat Knitting

1) Raw Material

The raw material arrives in various forms: cheese, cone, pirn, etc. Also, the raw material can be classified according to yarn count and denier, which indicate the size of yarn. It can also be divided by colours. The raw material is kept neatly in order in the raw materials storeroom according to the above grouping.

2) Winding

The raw material yarn which has been delivered is wound on a cone which is most suitable for knitting. The raw material yarn is oiled while being wound onto the cone. Oiling of the raw material yarn will make the yarn slide well, and will prevent knitting damage. It will also improve knitting efficiency. Winding is half of knitting.

3) Knitting

The raw material yarn wound on the cone is set on the specified knitting machine and is knitted into sweater.

An explanation will be made concerning the knitting theory of the flat knitting machine. Knitting of flat knitting machine is done by reciprocating motion of the carriage. A cam is enclosed in the carriage, and the needle will move up and down by the action of the cam to knit the fabric. The upper half of the drawing is the back bed, and the lower half of the drawing is the front bed.

4) Primary Inspection

The knitted fabric is inspected for knitting damage and other flaws, and sub-standard goods are eliminated.

5) Machine Seaming and Linking

Knitting, compared with weaving, is greatly elastic, and so knitted goods will easily unravel when cut; accordingly, seaming is more difficult than woven goods. In order to prevent unravelling of the stitched edge when seaming knitted fabric, an over-look machine is used to bind the edge with the bottom yarn. Knitted fabric is elastic, so it is necessary to provide elasticity to the seamed edge which will correspond to the elasticity of the knitted fabric.

Also, there is a lot of linking work when attaching the neck to the body. Seaming of the neck, the sleeve, the shoulder, and the armpit is generally done by linking.

6) Secondary Inspection and Mending

Sweater which has been completely linked is inspected again, and sweater with knitting damage is mended.

Example of Circular Knitting Plant

In most cases, circular knitted fabric is sold as yard goods; therefore, explanation will be made concerning yard goods only.

Table B-1: Production Capacity of Circular Knitting

1) Single circular knitting machine

Kind of machine	No. of machine	Production	Finished open width	Finished weight	Production weight/10 h.	Total production weight
Non Jacquard (26" dia., 78 feeders, 28 gauge)	5	26 m/h.	175 cm	160 g/m²	73 kg	365 kg (Production weight/10 h. x 5)
Pile (26" dia., 50 feeders, 24 gauge)	2	25 m/h.	172 cm	340 g/m²	146 kg	292 kg (Production weight/10 h. x 2)
Jacquard (30" dia., 51 feeders, 28 gauge)	3	16 m/h.	175 cm	160 g/m²	45 kg	135 kg (Production weight/10 h. x 3)
Total						792 kg

2) Double circular knitting machine

Kind of machine	No. of machine	Production	Finished open width	Finished weight	Production weight/10 h.	Total production weight
Non Jacquard (30" dia., 56 feeders, 26 gauge)	4	14 m/h.	164 cm	165 g/m²	38 kg	152 kg (Production weight/10 h. x 4)
Jacquard (30" dia., 60 feeders, 18 gauge)	2	20 m/h.	150 cm	200 g/m²	60 kg	120 kg (Production weight/10 h. x 2)
Total						272 kg

The total volume of raw material yarn used by single and double circular knitting machine is 792 kg + 272 kg = 1064 kg.

Note: Tables B-1 ~ B-3 and Item 1) ~ 2) are based on the above scheme.

Note: k. m.: knitting machine

Table B-1: Required Main Machinery

Machine	FOB price
Single knitting machine	
Non Jacquard	$US 30,000 x 5 sets = $US 150,000
Pile	$US 38,000 x 2 sets = $US 76,000
Jacquard	$US 36,000 x 3 sets = $US 108,000
Double knitting machine	
Non Jacquard	$US 34,500 x 4 sets = $US 138,000
Jacquard	$US 59,000 x 2 sets = $US 118,000
Total	$US 590,000

Table B-2: Auxiliary Machinery and Equipment

Machine	FOB price
Winding machine	
60 spindle cone cheese winder	$US 18,000 x 2 = $US 36,000
32 drum cone winder from hank	$US 21,500 x 1 = $US 21,500
Fabric inspecting machine	$US 4,800 x 1 = $US 4,800
Total	$US 62,300

Table B-3: Required Manpower

Section	No.
Winding section	6
Knitting section	
Single circular	5
Double circular	3
Checking shop	1
Mending shop	3
Office	2
Materials store	2
Yard-goods store	2
Total	24

1) Required Raw Materials and Utility

The required amount of raw materials, as above-mentioned, is approximately 1,000 kg/day, operating at 10 hours/day. The types of yarn used are cotton 100%, cotton and polyester blend spun yarn, wool 100%, acryl 100%, polyester textured filament yarn, nylon textured filament yarn, general mixed knit of natural spun yarn and synthetic fiber yarn, or blend spun yarn of natural fiber and synthetic fiber.

The entire electric power required would be 100 kWh.

2) Required Area for Plant Site

The floor space required would be 27 m x 18 m = 486 m^2.

A one-storied steel frame building would be suitable.

Process Description of Circular Knitting

(1) Raw material

(2) Winding

Raw material and winding are the same as processes (1) and (2) of flat knitting machine.

(3) Knitting

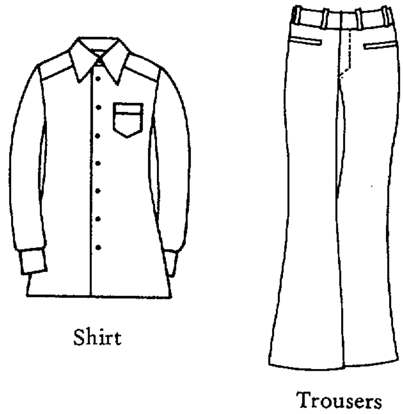
The raw material yarn wound on cone is set on the specified knitting machine and is knitted into circular fabric.

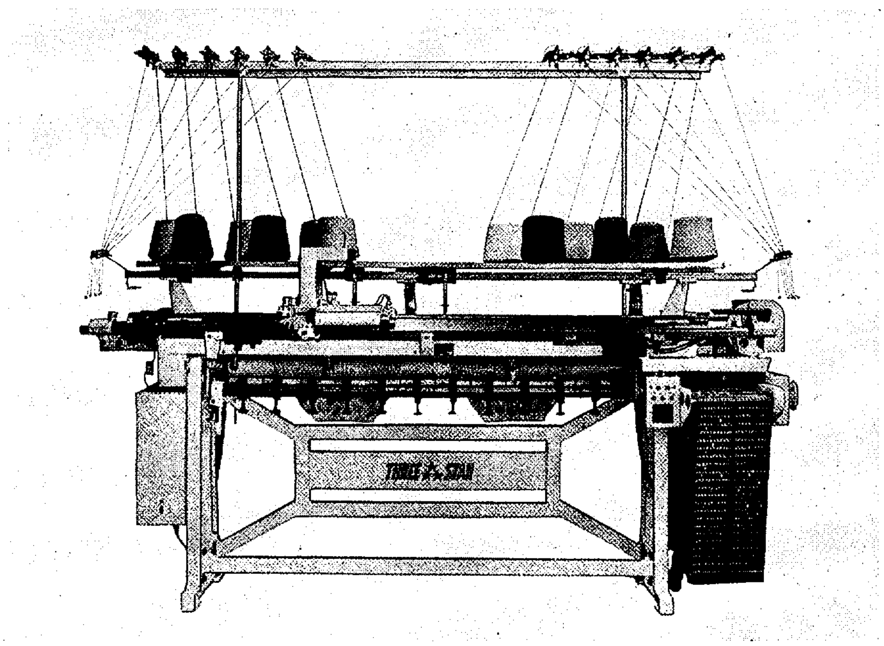
Generally, in circular knitting machine, the latch needle is enclosed in the needle groove; the needle is moved up and down or horizontally by the circular rotation of a cam; loop is knitted automatically.

(4) Inspection

The knitted fabric is inspected for knitting damage and other flaws, and mending is done when possible.

Fig. 1: Sampe of Product





Automatic flat knitting machine

D

ISIC 331 WOOD AND WOOD PRODUCTS

How To Start Manufacturing Industries

Plywood Making Plant

Plywood is a product in which several even numbers of boards are plied with glue to dissipate or compensate respective particular defects and to offer a wide size. Plywood thus produced has the particular features of being a wood with the least defects, wide size, long length and high strength mechanically (physically). Plywood is widely used in our daily life and contributes much to the development of culture and welfare. Its demand is ever on the increase.

Insofar as Japan is concerned, Nara (Quercus serrata T.), Shina (Tilia japonica S.), Tamo (Fraxinus var. japonica M.), Sen (Kalopanax Pictus N.), Kaba (Betula: Birch) and Buna (Fagus crenate: Beech) among native woods and Lauan, Mayapis, Kapor, Tanguil and Bagtikan of imported types can be used as peeler log.

In Southeast Asia, wood having the same quality as the exotic timber which Japan imports are used for plywood production and besides those mentioned above Apitong and Teak are included.

In North America, Douglas fir, Hemlock, and Spruce are used for this purpose and in Europe, Birch, Spruce, Poplar and in Africa, Okume is used. Thus, the typical woods of the world are almost entirely used as plywood material.

Outline of the Plant

This plant aims to use logs produced in tropical and semi-tropical regions and it is planned to utilize most effectively logs of large diameter class, straight and 0.45–0.55 of absolute dry specific gravity.

Type and quality of products are as follows, with a daily output capacity of 4,000 sheets (8 hrs.).

Size: 122 cm x 244 cm x 4 mm (4' x 8' x 4 mm)
Quality: Type II AA (1st class), AB (2nd class) and BB (3rd class)

The product is used for general construction purposes such as interior material for housing, ships, vehicles, and furniture, and secondary processing is done on the face and used for similar purposes.

During the course of production of plywood, edge of logs, peeled core, and other waste from plywood and veneer are produced, and these wastes are chipped and used as materials for paper, fibreboard, and particle board. At this plant, they are also used as fuel for the boiler. Some of the edge wood and peeled core are collected and together with unqualified veneer logs, they are sawed into lumber and sold.

Process Description

Preparation of Logs

1. Cutting of logs

Logs stored in a pond are conveyed to the factory yard and are cut by the chain saw to the desired length for feeding to the veneer lathe or to the length of the veneer sheets to be produced.

2. Cooking or steaming

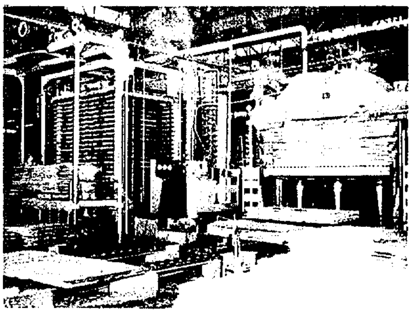
High-density logs require pre-treatment by cooking vats or steam chambers because they are hard and frequently too resinous to permit fresh cutting.

Veneer Manufacturing

1. Veneer cutting

1) Rotary cutting

In automated mills, log chargers with log centering devices are usually installed for speedly, automatic feeding of logs to the veneer lathe. As the log is centered by the centering device before feeding, it can immedi-



Hot press

ately be fixed on the spindles of the veneer lathe and peeled in an endless sheet by utilizing veneer reeling and unreeling machines. The speed of the cutting and reeling is fully synchronized. Full reels are so stored on the deck of the system.

2) Slicing

The "edge-grain" veneer required for the production of decorative plywood is cut by the veneer slicer, which slice across the grain of the log.

Fig. 2: Process Flow Sheet for Plywood Manufacturing Plant

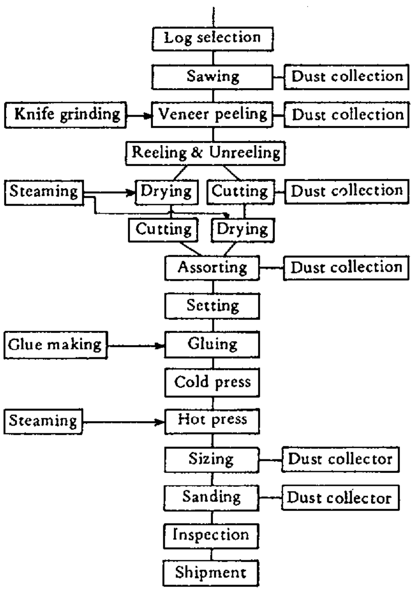
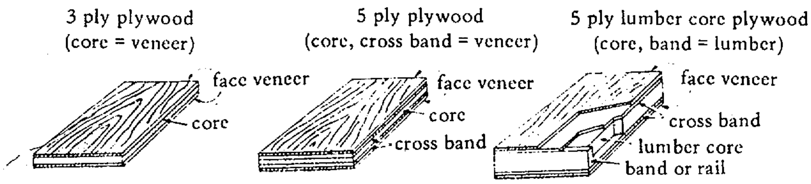


Fig. 1: Construction of Plywood



2. Green veneer clipping

The sheet of green veneer peeled by the veneer lathe is cut by the automatic or manual veneer clipper into the desired dimensions. Full rolls of the reeling machine are transferred to the unreeling unit, and the veneer is unrolled and cut by the veneer clipper.

Where the tray deck system is used the veneer can be sent directly front the tray deck to the veneer clipper of dryer.

3. Veneer drying

In order to ensure the maximum bonding effect of adhesive, veneer sheets must be dried adequately before gluing them together. The moisture content of veneer sheets is the most important factor in gluing. There are two types of veneer dryers, – namely roller and continuous veneer dryers.

4. Veneer Preparation

Narrow strips of veneer are joined together into full size by the following methods.

1) Veneer jointing

For the practical use of narrow on irregular pieces of veneer, the edges must be cut straight for precise jointing. The Arisun clipper or the veneer guillotine jointer are used for this purpose.

2) Veneer taping

After the veneer is processed by the veneer jointer, the veneer taping machine is used to join the veneer edge to edge to prescribed dimensions. This machine is usually used for the jointing of the back veneer sheet.

3) Veneer edge gluing

The veneer edge gluer is used for continuous glue-coating and splicing of the edges of veneer pieces which are carried with the grain at right angle to the direction of the feeding, automatically cutting the veneer to the desired length. Thermo-setting or thermo-plastic glue can be used with this machine. The veneer splicer is used to join the edges of veneer with glue instead of tape and is suitable for both back and core veneer sheets.

Manufacture of Plywood

1. Glue mixing

The glue mixer is used to mix the liquid or powder with the proper amount of water, hardener, filler and other ingredients.

2. Glue spreading

The glue spreader spreads the glue uniformly on the core veneer sheets in the first process to produce plywood from veneer sheets.

3. Pre-pressing

Veneer sheets glued together are stacked and pre-pressed by the cold press. Pre-pressing minimizes overlapping or gapping of the center core veneer which may occur during the carrying of the glued veneer sheets to the hot-pressing process.

4. Hot pressing

After pre-pressing, the plywood is fed to the hot press, where it is put under pressure of 10 – 15 kg/cm^2 in a temperature of 110 – 120°C.

Finishing

1. Sizing

After being hot pressed, the plywood is cut to prescribed specifications by the double sizer, which consists of rip-saw and cross-cut machine.

2. Sanding

The wide belt sander is generally used to finish plywood panels. It utilizes an abrasive belt which runs on serrated rubber contact rollers or platens. The number of heads, the combination of contact rollers and platens and the hardness of the rubber are determined by the kind and grade of finish desired.

3. Grading and inspection

After sanding, the plywood panels are carried by an automatic conveyor for grading and inspection. The panels are inspected and selected for delivery while they are on the conveyor.

Required Plant Site Area

The required building site is 32,000 m^2 (400 x 80 m) plus 10,000 m^2 for future expansion.

The detailed description of machinery and equipment required for 4,000 sheets/day plant are omitted here. However, the FOB price of machinery and equipment which should be imported is $US 5,620,000 while the machinery and equipment locally procurable would cost $US 1,670,000.

Locational Condition

1. Site where collection of logs is easy and storing is available.
   (1) Site facing unfrozen rivers, lakes and sea.
   (2) If there is no available water surface, site must be convenient for log collection.
2. Convenient site for sale and transportation of products.
3. Site where labour force is available.
4. Site where procurement of utilities is convenient.

Table 1: Requirement of Raw, Sub Materials & Utilities

Item	Spec.	Quantity
Logs	Suitable for plywood	106 m^3/day
Gum tape	For veneer lathe	23,000 m/day
	For patching	7,000 m/day
Urea resin		3,220 kg/day
Wheat flour		705 kg/day
Ammonium chloride		0.65 kg/day
Electricity		980 kWh
Steam		10 tons/hr.
Water		20 m^3/hr.
Nitrogen gas		150 ℓ/50 hr.
Lubricating oil	JIS No. 1 turbine oil	5,000 ℓ/300 days

Table 2: Required Manpower

Item	No.
Engineer	13
Skilled worker	54
Ordinary worker	96
Odd job man	9
Senior clerical worker	1
Junior clerical worker	7
Total	180

How To Start Manufacturing Industries

SAWMILL

Most of timbers needed in Japan have to be imported and lumber has to face international competition in price and quality as marketable goods. Sawmill operation of extremely higher productivity has been studied since 1958, and from 1960, it was put into practice. Today, sawmill facilities having productivity several or ten odd times higher than ever before have been completed for operation.

The following example is based on techniques developed in Japan.

The sawmill industry producing various products from logs is a fundamental industry among the many wood-using industries.

Products are classified by use into wood for construction, furniture, fittings, civil engineering, packaging, shipbuilding, vehicles, etc., and further subdivided into squares and boards of various dimensions. Thus the industry enjoys a wide range of demand. Furthermore, woods are sometimes classified by the variety of logs, the shape of species depending upon the operability of sawmilling.

In the past, sawmilling was operated mostly by a hand or semi-hand driven system, in which high grade skill and intuition in operating machines as well as individual processes of milling were required. Accordingly, many workers were needed who had to face hazardous work. On the contrary, modern sawmilling to be described hereafter is operated by an automatic and remote control system with an extremely small number of workers and minimum hazards.

Many developing countries export lumber in the form of logs owing to a lack of sawmills at present. But recently, installations of sawmill equipment are being planned among them to meet the domestic and export demand for lumber.

In Mindanao, the Philippines, more than ten modernized sawmills have been set up and started the operation.

Such a trend is seen also in Malaysia and Indonesia. It appears that the countries of Asia having abundant forest resources are devoting efforts toward the promotion of the sawmill industry in preference to other industries, in their industrialization program since wood products have the closest relation to the daily life of people.

Outline of Plant

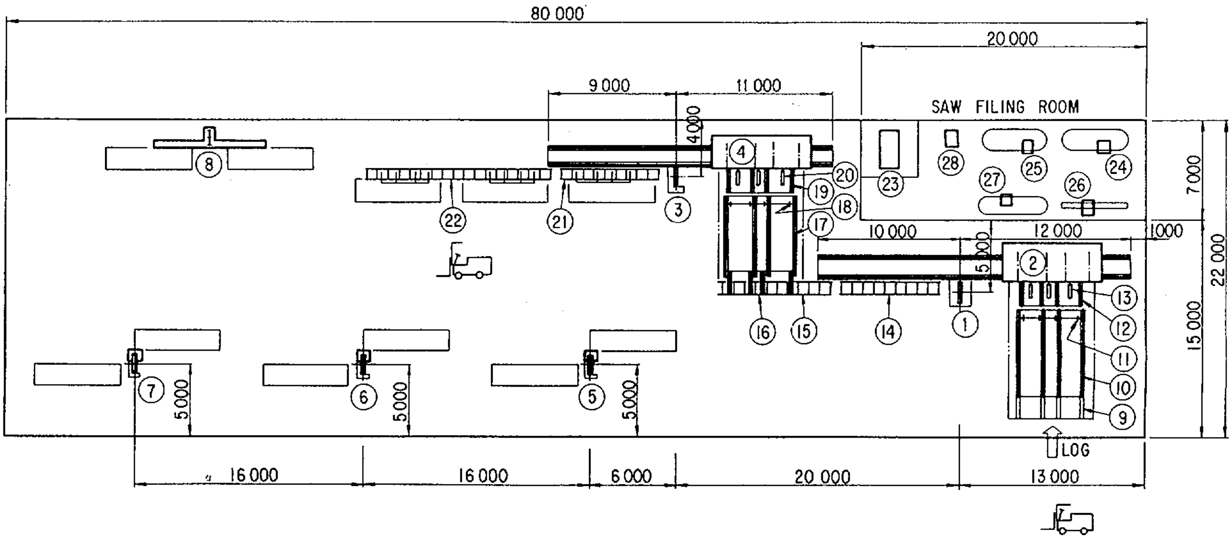
The plant referred to hereafter is one which operates sawing on a medium scale, and can attain the highest efficiency equipped with the most modern machines.

The plant produces inch-board, furniture wood, and flooring board. The production capacity of the plant is 1,500 m^3 of logs per month (8 hours/day) and the yield is around 60%. In case, however, the plant is combined with the production facilities of by-products to recover chips from wood waste, which are materials for pulp, fibreboard and particle board, the total yield of products in the mill will become higher.

Process Description

The lumbering process, in simple terms, consists of sawing a chunk of log a number of times to obtain lumber or square timber of the desired dimensions.

Fig. 1: Layout for Sawmill



1 Log bandmill
2 Automated log carriage
3 Log bandmill
4 Automated log carriage
5 Table bandmill
6 Table bandmill
7 Table bandmill
8 Pneumatic cross cut saw
9 Log rail
10 Chain live peak
11 Log stopper
12 Chain loader
13 Deak flipper
14 Live rolls
15 Live rolls
16 Chain trip skid
17 Chain live deak
18 Lumber stopper
19 Chain loader
20 Deak flipper
21 Live rolls w/skid
22 Live rolls w/skids
23 Air compressor
24 Bandsaw sharpener
25 Bandsaw sharpener
26 Bandsaw stretcher
27 Bandsaw sharpener
28 Circular saw sharpener

However, since various processes are available depending on the kinds of timber products to be manufactured, it will be difficult to offer a description of any generic lumbering process.

Here, we shall concern ourselves with the processes involved in the manufacture of lumber.

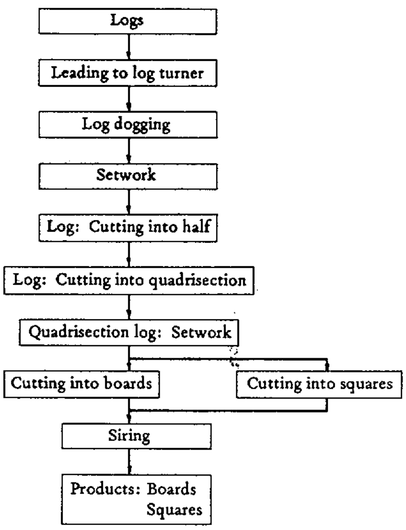
Lumber manufacturing may be roughly divided into the process up to quartering the log and the process of further cutting the quartered parts of the log into lumber.

1) **Log quartering process**
   The log conveyed into the mill is first placed on a loader, fixed in position by means of dogs, then advanced to the sawing position where it is sawed in two along its grains.
   The halved logs are drawn back and, one after the other, are set again on the loader to be halved, with the result that the original log is sawed into quartered parts.

2) **Quartered log lumbering process**
   The quartered log is placed on the chain loader, fixed in position, advanced to the sawing position, then sawed into lumber.
   Sawed lumber is then conveyed to the edger, which trims the lumber to a regular shape having parallel sides.

Note: **Logs management**
When different kinds of trees are handled, it is desirable to select and assort them specieswise and diameterwise.

Fig. 2: Process Flow Sheet for Sawmill



Features of Plant

With the operation of this plant, the product in exact dimension as well as multiple sawing system to meet various conditions of wood in place of limited sawing system is obtained, and eventually, the value of products produced from the same log can be increased remarkably in this way.

Furthermore, no special skill or technique is required for operation. As all the processes are semi-automatic through hydraulic and pneumatic pressure or electric devices, safety and accurate operation by remote control can be carried on by means of pushing a button alone.

Notwithstanding the fact that the production scale of the plant is medium, it has an installation of much higher efficiency to provide products having much more added value than the existing plants. It is presumed that more and more plants of this type are going to be established in future.

Number of workers required is almost one half of those engaged in the convention plant, in addition, the operation being quite simple no special skill is needed.

Consequently, although investment in installation might possibly be rather more expensive, the profit rate would be remarkably higher based on lower labour cost, higher productivity and better quality of products.

Locational Condition

A considerably large yard is needed for carrying in and storing of a large volume of logs along with storing and shipment of products. Particularly, as there are many log ponds to store logs, the convenient site for collection of logs to be selected should preferably be faced rivers or ports.

Required Area for Plant Site

Some 1,500 m^2 pond or yard area are required for log storage, 1,500 m^2 for storage of products and 2,000 m^2 for plant and office, totalling at least 5,000 m^2. Should the log supply flutuate seasonally, a larger log yard shall be needed, some 7,500 m^2 for a plant of this type if possible.

Raw Material & Utility

The operation hours are 8 hours/day (2 shifts), 25 days/month or 300 days/year with a plant capacity of 60 m^3/day.

The monthly requirement of logs, subsidiary materials and utilities are:

Log	1,500 m^3
Band saw	5 pcs.
Oil	40ℓ
Others (gasoline, etc.)	
Electricity	25,000 kWh
Employees required:	
Engineer	2
Skilled worker	3
Ordinary worker	10
Odd job man	4
Clerical worker	3
Total	22

Table 1: Required Machinery and Equipment

Sawmill machinery	
1,200 mm Log bandmill	1
1,000 mm Auto-feed carriage	1
1,100 mm Log bandmill	1
900 mm Light duty automatic Log carriage	1
Cross cut saw	1
Table band resaw	3
Saw filing equipment	
Large type band saw sharpener	1
Medium type band saw shapener	2
Circular saw sharpener	2
Large type band saw stretcher	1
Conveying equipment	
Log rail	1
Chain live deck	2
Log stopper	1
Chain loader	2
Deck flipper	2
Live rolls	2
Chain trip skid	1
Lumber stopper	1
Live rolls w/skid	2

FOB price of machinery and equipment ....(approx.) $US 381,000

How To Start Manufacturing Industries

Woodscrew Making Plant

The woodscrew, a secondarily made product of wire rod, is enjoying an excellent demand side by side with wire nails, bolts and nuts. Woodscrews generally have the head tapered to a point and the shank threaded, and are being used mainly for fastening woodwork. The head is commonly of the countersunk shape and is slotted suitably for the screw driver. The size of woodscrews is designated by the gauge number of the shank and by the full length. The most popular size is 1/2" x GAUGE No. 4 to 3" x GAUGE No. 14. As is seen on the wooden furniture and railway coaches, woodscrews are being used in various industrial fields such as the woodworking industry, musical instrument manufacturing industry, furniture manufacturing industry, automotive industry, rolling-stock manufacturing industry, etc. Recently, woodscrews have become an essential item of do-it-yourselfers. Thus, like wire nails, woodscrews are being used in general households by Sunday carpenters.

In this way, woodscrews have a very brisk market, and moreover, a woodscrew making plant can be started on a comparatively small scale, and can be expended with the accumulation of capital and with an increase in the demand. Accordingly, the woodscrew making plant can be recommended as one of the most recommendable and promising businesses.

The woodscrew making plant varies in its scale according to the maximum and minimum sizes of woodscrews to be manufactured and to their output.

A description will be made here on a small-scale model plant. Threading has two kinds, one is the cut thread and the other the rolled thread. The thread cutting system has been taken up here, because it can put out the product better in accuracy and strength.

Process Description

1) Rivet making
The wire coil, which has the gauge fitting the woodscrews to be manufactured, is conveyed from the wire stand into the automatic double stroke heading machine to produce rivets automatically. When the wire gauge and the head shape are to be changed, the die and the punch must be exchanged too.

2) Polishing
After the heading process, rivets are polished to make their surface smooth and shine. For polishing the rivets, sawdust and leather waste are put together into the tumbling barrel for use.

3) Slotting
The polished rivets are thrown into the hopper of a slotting machine to slot the heads automatically.

4) Threading
The slotted rivets are thrown into the hopper of a threading machine to perform pointing and threading automatically.
Threading is done by the single bite and the comb-shape bite, and the woodscrews are completed.

5) Finishing
The cutting oil and dust sticking to the completed woodscrews are washed off with light oil, and then the light oil is removed by centrifugal separator. Thus, there come out the finished products which are packed and delivered to the market.

6) Maintenance
When a specially-made bite and cutter grinder is employed for the grinding of the bite of threading machine and the slotting cutter of slotting machine, grinding can be done relatively easily.

Example of Woodscrew Making Plant

1) Production Capacity

3/4" x GAUGE No. 6	130 grosses/8 hrs.
1" x GAUGE No. 8	116 grosses/8 hrs.
1½" x GAUGE No. 9	80 grosses/8 hrs.
2" x GAUGE No. 10	80 grosses/8 hrs.
2½" x GAUGE No. 12	66 grosses/8 hrs.
3" x GAUGE No. 14	66 grosses/8 hrs.
Total	538 grosses/8 hrs.

Note: In case the working efficiency is 85%, it will result in about 457 grosses/8 hrs.

2) Required Material
Material wire: about 700 kg/8 hrs.
The required quantity of material wire varies according to the size of woodscrews to be manufactured.

Table 1: Required Machinery and Equipment

Item	No.
Automatic double stroke heading machine	
Type I	1 set
Type II	1 set
Automatic slotting machine	
Type I	1 set
Type II	1 set
Automatic woodscrew threading machine	
Type I	1 set
Type II	1 set
Type III	2 sets
Type IV	2 sets
Tumbling barrel	1 set
Oil separator	1 set
Bite and cutter grinder	1 set
Spare parts required for operating the above machinery and equipment for about one year	1 lot
FOB price of machinery and equipment	(approx.) $US 196,000

3) Required Utilities
   Electric power . . . . . 130 kWh/538 grosses
   Sawdust . . . 35 kg/538 grosses
   Grease, cutting oil, machine oil and light oil . . . . 20 liters/538 grosses x 25 days

4) Required Manpower
   Skilled worker 2
   Unskilled worker 4

5) Required Area for Plant Site
   Building . . . 22 m x 10 m = 220 m^2
   Land . . . . . 25 m x 15 m = 375 m^2
   For building the plant, a slated roof and light steel framework will do. The height of ordinary plants will serve for the present purpose.

Technical Guidance

As woodscrews are in a fair demand, after starting the operation on a small scale, the plant will be able to expand the production and the sizes of woodscrews by increasing the number of machinery and equipment, when occasion demands. Also by increasing the number of the thread rolling machine it will become possible to produce the machine screw and the roll-threaded woodscrew.

Locational Condition

The plant can be built anywhere if the site is convenient for obtaining the material wire and for delivering the products to the market.

Fig. 1: Process Flow Sheet for Woodscrew Making Plant

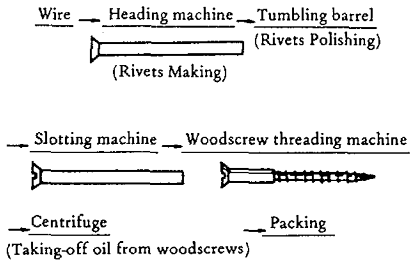
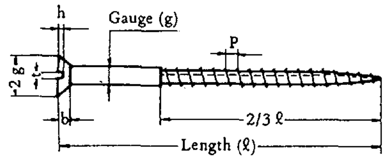
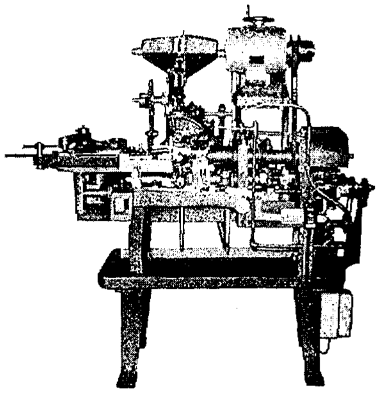


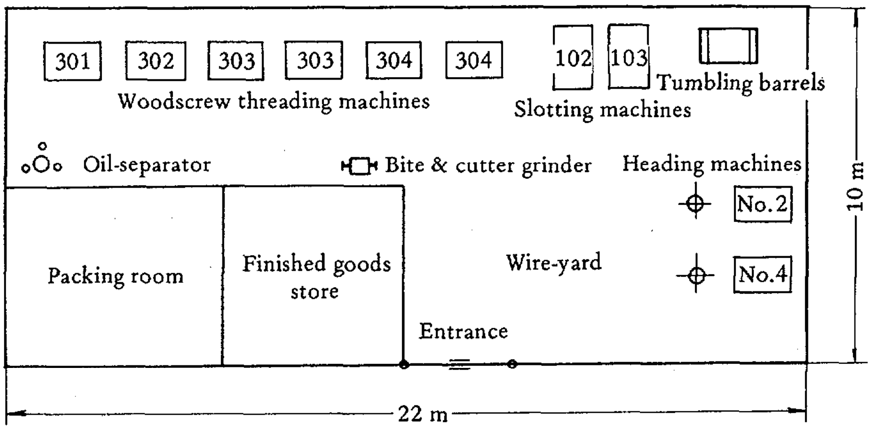
Fig. 2: Standard Woodscrew Size





Super speed automatic woodscrew threading machine

Fig. 3: Layout for Woodscrew Making Plant



Gauge No.	4	5	6	7	8	9	10	12	14
Dia. of wire	2.67 ~ 2.68	3.07 ~ 3.08	3.46 ~ 3.47	3.76 ~ 3.77	4.05 ~ 4.06	4.45 ~ 4.46	4.75 ~ 4.76	5.43 ~ 5.45	6.12 ~ 6.15
g.	2.7	3.1	3.5	3.8	4.1	4.5	4.8	5.5	6.2
b.	1.5	1.7	2.0	2.1	2.3	2.5	2.7	2.9	3.5
Cutter No. t.	21 0.72	20 0.81	19 0.91	19 0.91	18 1.02	17 1.14	16 1.30	16 1.30	15 1.45
h.	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.5	1.6
p.	1.2	1.3	1.4	1.6	1.8	1.9	2.1	2.4	2.7

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ISIC 341 PAPER AND PAPER PRODUCTS

How To Start Manufacturing Industries

Toilet Paper Making Plant

It was as late as in 1803 or so that the paper industry came into being in Canada, which is one of the leading paper manufacturing countries in the world.

Development of raw materials and the invention of paper machines have ushered in an era of high quality and mass-production, and paper is now called the symbol of culture.

Toilet paper is in large and increasing demand and its manufacture can easily be embarked upon by small industry and parties who have had little experiences in paper making.

In Japan, mass-producing mills generally use wood pulp as the raw material for toilet paper. But smaller mills use wood pulp and waste paper together, or use waste paper 100 per cent. Waste paper is recovered at a high rate, and selection of quality is well controlled.

Wood resources are not distributed uniformly in the world. There are many countries which are poor in wood resources. It would, therefore, be meaningful to use waste paper which could be recovered easily as material for pulp.

Outline of the Plant

Broadly speaking, there are two methods for processing waste paper, namely, continuous and batch systems. In general, the batch process is recommended when the daily production capacity of the mill is less than 100 tons. Introduced here is a 5--15 tons/day batch system plant using waste paper as raw material. The raw materials and utilities required for this plant are as shown in Table 2. In this plant, other kinds of sanitary paper may be produced besides toilet paper.

Toilet paper is packed 100 or 120 rolls to a case of corrugated board for delivery to the primary wholesaler.

The Japanese standard of toilet paper is:

Roll width: 114 mm±1 mm
Inner dia. of winding core: 37–39 mm

*1: Finished measured length: 45, 55, 64, 75 m

*2: Substance of paper (crepe): 21–23 g/cm^2

*1: Out of the four lengths, the most popular on the market are 45 and 55 m.

*2: Makers employ their respectively unique patterns of crepe.

Process Description

The manufacturing process begins when waste paper is moved up to the sorting yard above the digester by elevator.

The sorted waste paper is fed into the global digester. Simultaneously with the feeding, sodium sulphite, soda ash, etc. are sprinkled thoroughly over the waste paper.

After stuffing of the digester has been completed, the gut for the digester is tightly closed. Steam is blown into the digester as it is rotated.

The next step is the charging of the material into the blow pocher.

Circulation is performed by a propeller agitator, and the digesting chemicals are thoroughly washed in the washing drum.

When the washing is over, the material is transferred into the dump chest, from where it is moved up into the head box by pump. Water is added for dilution in the head box.

The material is then sent through the sliver screen and the Jonsson screen for removal of dust. The material which comes out of the screen is transferred into the extractor for washing and deckering.

The material coming out of the extractor is stored in the bleaching chest.

When a chest becomes full, bleach liquor is added.

After the material has been left in the bleaching chest for a fixed time following the bleaching, it is flow-fed into the mixing chest, in which bleach liquor is thoroughly washed away.

Washing takes place in the washing drum. After the washing, flourescent dyestuff or rhodamine is applied for colouring as may be required by consumers.

Now that this process has been completed, it is dropped into the stock chest, and sent into the machine chest.

Out of the machine chest, the stock is fed into the head box for flow-fed into the mixing tank at a regulated feed level.

In the mixing tank, the stock is diluted with white water coming out of the wire part, of which more hereafter, and then sent onto the vertical screen.

On the vertical screen, stock with a comparatively larger specific gravity and non-digested stuff are removed.

The material which has passed through the vertical screen goes into the tank and, via the high-pressure pump, is fed into the cleaner, with only accepted material fed into the paper making machine.

The accepted material goes into the flow box of the paper machine, out of which a fixed amount flows out into the wire part in consistency of about 0.15–0.2 per cent.

The stock which flows out is dehydrated by the table roll and suction box for transformation into a wet web, which is sent into the press part over a blanket. The wet web is dewatered under the pressure of the roll, and pushed against the yankee dryer.

The wet web is dried by the heat of steam inside the yankee dryer. At the outlet of the dryer, the web is creped by a special crepe doctor, after which it is wound into rolls.

The base paper of the toilet paper, which has been reeled, is cut into the fixed width by the slitter on the toilet machine and wound into rolls in the required length.

The above plant can be easily extended, and it may be constructed in large numbers as a common enterprise.

Recently many medium and small scale industries in Japan employ paper machines with cylinder type wire part and yankee dryer. The width of wire is 3 – 3.5 m, and the running speed of wire in most case is 350 m, 450 m, or 600 m. The production output is approximately 20 – 50 tons per day.

Locational Condition

(1) It is absolutely necessary to ensure a supply of good quality water as well as to have a good drainage system available.

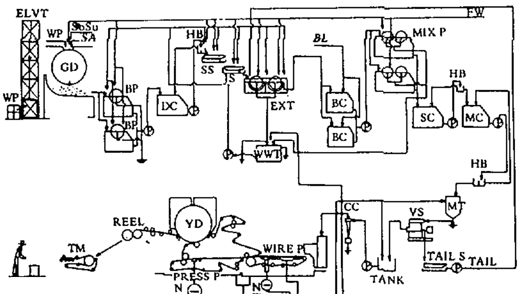
(2) As the products of the plant offered are necessaries for the home, if the secondary expenses, such as forwarding charges, are too heavy, the end selling price would be affected. The plant should also have access to locations where raw materials and electric power supply are easily available.

The total plant site area for the five tons/day toilet paper plant is 5,300 m^2 (53 x 100 m). If, however, a plant of the same capacity should be built additionally, the site should be 6,500 m^2 (65 x 100 m).

Table 1: Required Machinery and Equipment

Item	No.
Digester	
Global digester (3,965 mm dia.)	1
Material Preparation	
Blow pocher (agitator dia: 610 mm)	2
Conveyor pump (capacity: 1.5 m^3/min.)	1
Dump chest (tank capacity: 50 m^3)	1
Conveyor pump (capacity: 0.5 m^3/min.)	1
Head box	1
Sliver screen with vibrator and transmission equipment	1
Jonsson screen (nominal size: 1 x 2 m)	1
Extractor, two-stage cylinder type	1
Bleaching chest (tank capacity: 35 m^3)	2
Conveyor pump (capacity: 1.5 m^3/min.)	1
Mixing pocher (tank capacity: 35 m^3)	2
Stock chest (tank capacity: 68 m^3)	1
Conveyor pump (capacity: 300 ℓ/min.)	2
Machine chest (tank capacity: 10 m^3)	1
White water pump (capacity: 1.5 m^3/min.)	1
Material feed equipment	
Vertical screen (bed size: 926 x 1,466 mm)	1
Tail screen (sliver type)	1
Tail pump (capacity: 0.3 m^3/min.)	1
High pressure pump (capacity: 2.5 m^3/min.)	1
Super clone (passing volume: 2,000 ℓ/min.)	1
Paper making equipment	
Wire part (wire cloth of 1,735 mm x 10.7 m of endless wire)	1
Nozzle slice	1
Deckle device made of brass plate	1
Breast roll (418 mm dia. x 1,840 mm face length)	1
Formation box	1
Table roll (172 mm dia. x 1,840 mm length)	5
Deflector	4
Suction box	3
Wire roll	3
Shower pipe	3
Hand guide	1
Hand stretcher	2
Bottom couch roll	1
Top couch roll	1
Save-all device	1
Edge cutter	1
Frame and sole cutter	1
Nash pump (aperture: 100 mm)	1
Back water pump (aperture: 200 x 200 mm)	1
Wire pit pump (aperture: 150 x 125 mm)	1
Press part	
Top press roll (510 mm dia. x 1,785 mm length)	1
Bottom press roll (410 mm dia. x 1,785 mm face length)	1
Frame and pressure device	1
Press doctor device	1
Squeeze roll (300 mm top roll dia. x 1,785 mm)	2
Squeeze frame and pressure device	1
Felt roll (160 x 1,800 mm dia.)	8
Felt guide, pneumatic type	1
Felt stretcher	1
Suction box	1
Shower pipe	3
Nash pump (75 mm aperture)	1
Yankee dryer part	
Yankee dryer (3,050 x 1,876 mm)	1
Steam joint, rotary type	1
Dryer gear, helical	1
Dryer bearing and housing	1
Dryer doctor, cleaning and crepe	3
Dryer ventilator, centralized type	1
Ventilator fan	1
Touch roll (410 x 1,876 mm)	1
Touch frame and pressure device	1
Squeeze roll (300 mm top roll dia. x 1,785 mm)	2
Squeeze frame and pressure device	1
Felt roll	9
Felt guide, pneumatic type	1
Felt stretcher	1
Shower pipe	2
Paper roll (100 x 1,785 mm)	2
Dryer and lubrication apparatus	1
Frame and sole plate	1
Hand rail and platform	1
Operation air panel, desk type	1
Calender machine (460 x 1,742 mm)	1
Toilet reel	1
Transmission apparatus	1
Air compressor, automatic unloader type	1
Finishing equipment	
Toilet machine	7
Fresh water pump (capacity: 3.75 m^3/min.)	1
Steam drain pump of LPDG type	1
Bleach liquor pump (100 ℓ/min.)	1
Electric hoist (2 and 0.5 tons)	2
Tubular boiler, type BC-20	1
Transformer and accessories	1

Process Flow Diagram for Toilet Paper Making Plant



ELVT–Elevator, Sosu–Sodium sulphite, SA–Soda ash, GD–Global digester, BP–Blow pocher, DC–Dump chest, HB–Head box, SS–Sliver screen, JS–Jonsson screen, EXT–Extractor, WWT–White water tank, BC–Bleaching chest, MIX P–Mixing pocher, BL–Bleach liquor, SC–Stock chest, MC–Machine chest, FW–Fresh water, MT–Mixing tank, VS–Vertical screen, TAIL S–Tail screen, CC–Centri-cleaner, WIRE P–Wire part, N/P–Nash pump, P–pump, *Press P–Press part, YD–Yankee dryer, TM–Toilet machine.*

Table 2: Daily Requirement of Raw Materials and Utilities

Raw materials	Standard	Quantity
Waste paper	High grade (70%)	6 tons
Waste paper	Imitation (30%)	2.5 tons
Wire net for wire part	1,735 x 10,700 m	per sheet
For blow chest drum	1,500 x 3,600 m	for 2 sets
For mixing pocher drum	1,500 x 3,600 m	for 4 sets
Extractor	1,500 x 2,800 m	2 sheets
Wet blanket	1,700 x 19,000 m	1 sheet
Top blanket	1,800 x 15,800 m	1 sheet
Soda ash		43 kg
Sodium sulphite		300 kg
Fluorescent dyestuff		6 kg
Rhodamine (dyestuff)		0.6 kg
Bleach liquor	$Ca(ClO)_2$ (8%)	600 kg
Utilities		
Electric power, fuel for boiler	Grade C heavy oil	2,550 ℓ
Water	Underground or river water	4,600 tons

The machinery and equipment to be imported listed in Table 1 would cost approximately FOB, $US 1,524,000.

Table 3: Required Manpower

Item	No.
Engineer	1
Ordinary worker	22
Odd job man	3
Technician	3
Senior clerical worker	1
Junior clerical worker	2
Total	32

How To Start Manufacturing Industries

Corrugated Board Box Making Plant

Packing may be defined as a means of protecting contents from ordinary handling, providing ease in packing and unpacking and at the same time, becoming a means of publicizing the contents.

Against the above background, the corrugated board box is replacing the conventional wooden box steadily, attracting a worldwide demand.

In Japan, the demand for corrugated board box has been increasing at a great rate since 1957 with the present output in Japan second only to the United States.

Of late, improvement has been made in realizing greater resistance to water, which had been the only defect of the corrugated board in the past.

Corrugated board box is now being used for carrying refrigerated provisions and fish. Because of its increased strength, it is used for packaging fairly heavy items such as bicycles. Thus it is bound to claim a large part in industrial pakaging.

The corrugated board box is composed of two elements, one called "liner" and the other, "medium."

The liner is generally used for the outside of the board and the medium for the inner. So the former has more strength than the latter. Various combinations of these will be described later. The medium has on its base paper a wave-like form (corrugated), so as to act as a shock absorber called the "flute."

Liner

The liner is classified into three classes according to the bursting strength. JIS (Japan Industrial Standards) A is the strongest, followed by B and C in order. A and B are used for the outer liner and C for the inner liner. The inner liner does not require much strength. We have two kinds of liners, one is the kraft liner, and the other, the jute liner.

The former is made out of unbleached kraft pulp, but in some cases, semi-chemical pulp is blended partially And this liner is mainly on a "Foudriniers' paper machine" (or occasionally on a "cylinder paper machine"), and is always listed in the A class.

On the contrary, the jute liner is ranked in all classes, A, B and C.

In spite of its name, it is not made out of jute pulp (meaning that it is strong like jute), but out of unbleached kraft pulp for the surface, and out of waste paper for its middle and back side.

That is to say, this liner is made on a "combination board machine," in which the raw material of the sheet can be made differently in each layer (generally it consists of 4-7 layers).

For the waste paper, we can use newsprint, cement bag, paper board, and corrugated board mixing.

During the box-making, the liner goes through such processes as cutting, printing, ruling, slotting, etc.

Medium

The base paper of the medium is made with wood pulp, straw, waste paper and screenings (rejections from screens).

In Japan, straw pulp was used formerly, but semi-chemical pulp has been used recently.

In addition, there is another kind of medium, that is, one composed mainly of waste paper.

The medium is corrugated during the box-making (this being the origin of the name "corrugated board").

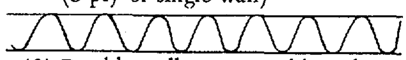
The pitch and the height of the flute (wave) is made in accordance with its uses (to be explained later).

Sheet

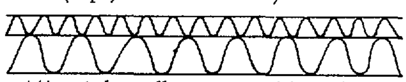
The sheet is constructed of liner and medium, and can be classified as follows:

(1) Single-faced corrugated board (2-ply)

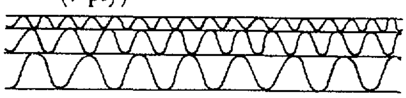
(2) Double-faced corrugated board (3-ply or single wall)



(3) Double wall corrugated board (5-ply or double wall)

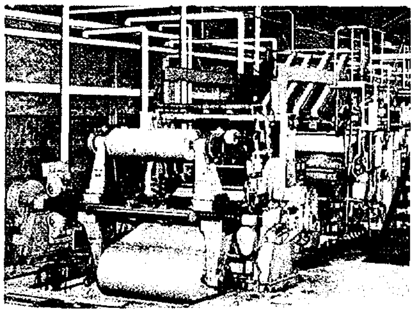


(4) Triple wall corrugated board (7-ply)



The first is used only as anti-shock packing. The last-named is not very popularly used.

In case of (3), two flutes are generally chosen, A and B, although other various combinations are available.



Corrugator

This is mostly used for packing of heavy articles or articles liable to damage.

Board (4) is used for packing heavy and large sized articles. It is possible to pack goods weighing over 100 kg.

Flute	No. of corrugation /30 cm	Height of corrugation (cm)
A	36 ± 3	4.5 – 5.0
B	51 ± 3	2.5 – 3.0
C	42 ± 3	3.5 – 4.0
E	92 – 100	1.1 – 1.3

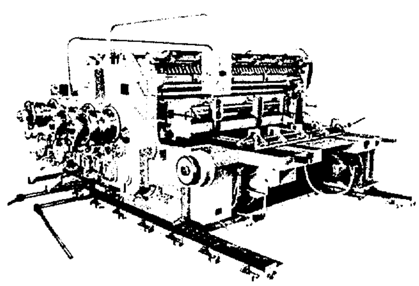
1) Flute A

In case of Flute A, the pitch of the wave is the biggest and its height, the tallest.

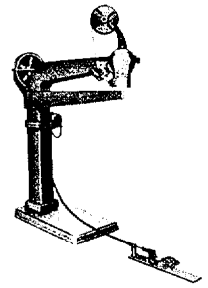
The one used by Flute A provides a large buffer effect.

2) Flute B

The pitch of wave is shorter than A, while the height of wave is lower than A. This flute has less shock absorbency, but has strength to compression. Thus it is suitable for packing of canned goods, bottles, etc., which have hard surfaces.



Printer slotter



Stitcher

3) Flute C

This type comes between A and B. Its quality and characteristics also come midway between the two.

4) Flute E

This is a type with the most fine corrugations, chiefly used for individual articles or inner packing, and is advancing into the field of paper board boxes.

The demand is expected to increase because of its high printability for offset and flexographic printing and the lamination with pre-printed sheet.

5) Special corrugated boards

They are manufactured in conformity with various purposes.

First of all, the water-proof corrugated board is designed to resist wetting in water.

This type of corrugated board does not change in strength even if exposed to water for a long time.

There is a type of corrugated board which has water repellency.

Differing from the water-proof corrugated board, it repels water from its surface, but it cannot resist penetration of water for a long time.

In addition, there is a type which is called moisture-proof corrugated board.

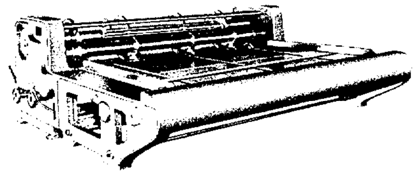
Of late, the development of corrugated board as a building material is in progress. For example, there is one made of foaming resin sandwiched between liners to develop excellent heat insulation property and sound-proofing effect.

Moreover, there are corrugated boards with anti-slip processing (designed to prevent slipping of piled-up packages during transit or handling) and corrugated board "sheets" using pre-printed liners.

Outline of the Plant

The daily output capacity (8 hrs./day of the plant in terms of surface area will be approximately 20,500 m^2 offering economic speed of the corrugator, 60 m/min., and rate of operation, 70%.

The details of the machinery and equipment are not described here. However, the approximate FOB price



Rotary slotter

of machinery and equipment to be imported is $US 824,000.

Process Description

The plant offered here adopts a corrugator with a maximum capacity of 200 m/min., 150 m/min., 100 m/min., and 60 m/min.

The "sheets" which have been cut off to about the fixed size is discharged from the corrugator horizontally and is ruled by slitter scorer. If the lot number is small, the "sheet" is printed on a printer. On the rotary slotter it simultaneously receives lengthwise ruling and slotting, and is made into a complete box when it is stitched by a wire stitcher.

On the other hand, when the lot is large, the printer slotter provides simultaneous printing, ruling and slotting. As the printer slotter runs at a high speed by automatically feeding the stock, it will be far more efficient to carry out the gluing process on a high speed folder gluer.

The boxes thus completed are generally bound, 10 pieces per bundle, for shipment.

Locational Condition

It is important to know whether there is a demand for corrugated boards on the perimeter of the site conforming with capacity of the plant.

Other factors are whether the products can be smoothly transported, or whether there will be little trouble in procuring labour.

The plant preferably requires a site area of about 7,880 m^2 including space for future expansion.

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Process Flow Sheet for Corrugated Board Box Plant

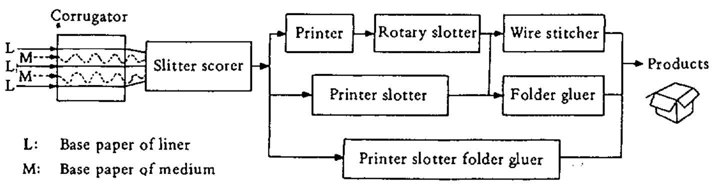


Table 1: Requirement of Materials and Utilities

Item	Standards	Quantity
Materials required monthly		
Semi-medium	125 g/m^2	3.7 tons
Liner	220 g/m^2	4.5 tons
Back liner	200 g/m^2	4.0 tons
Starch for sheet	Corn starch	275 kg
Wire	3–4 mm	2 rolls
Glue	Vinyl acetate	15 kg
Ink	Oil ink	2 kg
Utilities required/hour		
Electricity	AC 220 V	90 kWh
Fuel	Heavy oil C	71 kg
Steam	Saturated steam	800 kg
Water	Turbidity below 2 degrees, Hardness below 2.5 degrees	3 tons

Note: The above data are based on 8 hrs./day operation producing 15,000 m^2 of "sheets" of 135 cm width.

How To Start Manufacturing Industries

Straw Pulp & Yellow Board Making Plant

Yellow board, which is the most basic among paper boards, is used for a wide range of purposes, including folding boxes, back board for writing pads, etc.

As yellow board is made from rice straw and treated with small amounts of lime milk, soda ash, etc., available at low cost, its manufacturing cost is cheap.

Yellow board is a kind of paper board, which can be turned into white board if bleached pulp is added as a surface layer in the process of manufacture. It has a good appearance, and can be used for the packaging of foodstuffs and cosmetics.

However, as the manufacturing of white board involves heavy expenditures for equipment and high cost of materials, it is recommended that a yellow board manufacturing plant be established to begin with. After the plant operator has become skilled in making the yellow board, he may advance to the field of higher grades, such as the manufacturing of white board and surface coated boards.

In Japan, this pattern of developing the paper industry was witnessed in the past, and yellow board manufacture is being carried out on a scale of 5-30 tons a day from the point of economy and procuring sufficient raw material.

The variety of yellow board merely means a variety in thickness. Yellow board is classified into several grades by weight per m^2, although such grades are available as 300-950 g according to uses, and thinner grades also are available.

Raw Materials and Utilities

Consumption of rice straw for making one kg yellow board is 1.8-2 kg (bone dry straw). If the straw contains 50 per cent moisture, 3.6 – 4 kg is required.

Accordingly, a 5 tons/day plant needs 9-10 tons of bone dry straw a day. The success or failure of the enterprise largely depends on the costs of collection, transport and storage of straw.

Especially in a case where crops of rice straw are concentrated once or twice a year, consideration should be given to the risk of decomposition which may occur during the storage of a large quantity of straw to meet the yearly need.

Lime is required as a chemical to process straw at the rate of 260-270 kg per ton of straw board, or 1,340 kg a day for daily output of 5 tons.

Utilities involve water, steam and electric power, and it is desirable to have water as clean as possible. A large volume of water is required for making yellow board, some 1,500 m^3 a day of 24 hours for a 5-ton plant.

One of the conditions essential for location of the plant site is that pure water is available at a low cost.

One and a half tons of steam are required per hour, and, if a fuel oil boiler is used, oil consumption will be 3.36 kℓ a day.

If some fuel cheaper than fuel oil is available, the manufacturing cost would be that much cheaper. However, in view of the expenditure for equipment, it is desirable to burn fuel oil in a low cost package boiler.

Electric power consumption will be 250 kW at a maximum and 170 kW on an average.

As the monthly consumption of electric power is 4,080 kWh, it is necessary to have a service cable for more than 440 V.

Locational Condition

Climate at the plant site is not a major problem, but, as already stated, availability of utilities is important.

The absolutely important locational condition is that there would be a river nearby the plant for the sake of drainage, because the entire amount of water used – 1,500 m^3 as stated above – has to be drained.

Process Description

Generally speaking, the Fourdrinier paper machine is used for printing and writing paper. In making yellow board, however, the cylinder mould machine is used which does not involve a large expenditure in spite of easy maintenance and operation.

A stationary spherical digester is used for digestion of straw, because its operation is to be carried on in a batch system, without requiring complex instruments. The above type of digester provides easier operation than the continuous digester.

Straw pulp comes in two kinds – yellow pulp and white pulp. In making yellow pulp, lime is used as stated above. There are cases where it is used with soda ash.

However, in the case of white pulp, it is made by various processes – caustic soda, sulphate, and chlorine processes. Whatever the process, it is complex.

Pulp Making

1-1) Pretreatment of straw

The rice straw, which has been collected and stored, is cut to a suitable uniform length by a cutter, and it is sent to the duster via a belt conveyor. The dusted straw is carried to the next process on another conveyor.

1-2) Cooking

The straw stored in a chip bin is put in a digester at the rate of about 2.5 tons of bone dry straw at a time.

The above operation is performed on the second floor.

When the above operation is over, a fixed amount of lime solution is added, after which digestion continues for several hours (6-8 h/cycle) with steam under a pressure of 4-6 kg/cm^2.

The cooked material is blown into a blow pit, and waste liquid is washed away by a beater placed in the lower part of the pit.

2. Stock preparation

The raw material made available from the above operation is fed into a dilution box with a pump. Fresh water is added to the box to provide consistency to suit the following beating process.

Nodes and sheaves are eliminated by the inclined screen to drop the stock into the next beater, in which it is treated for an appropriate number of hours so as to make its suitable for paper machining, as well as to provide a good quality for the finished paper.

Stock which has been subjected to

the beater process is stored in the beater chest, out of which it is sent into the head box by the pump.

The stock goes out of the above equipment into the selective screen, where is is dusted, for transfer to the distributing box and head box.

3. Chemical preparation

This is an independent section, in which the lime for digestion is dissolved to the stipulated concentration and stored.

The process so far described constitutes the first half of the paper making process, namely the section for the manufacturing of raw materials.

Required Machinery and Equipment

Pretreatment section

Straw cutter	1 set
Belt conveyor	1 set
Duster	1 set
Ventilater & Hood	1 set
Dust fan	1 set
Belt conveyor	1 set

Cooking section

Chip bin room	
Spherical digester	2 sets
Blow pit	2 sets
Blow chest	1 set
Conveyor pump	1 set

Beating & stock preparation section

Head box	1 set
Inclind extructor	1 set → Dirty water
Beater	2 sets
Beater chest	2 sets
Conveyor pump	2 sets
Machine chest	1 set
Conveyor pump	1 set
Mixing box	1 set
Selectifier screen	1 set
Distribution box	1 set
Head box	5 sets

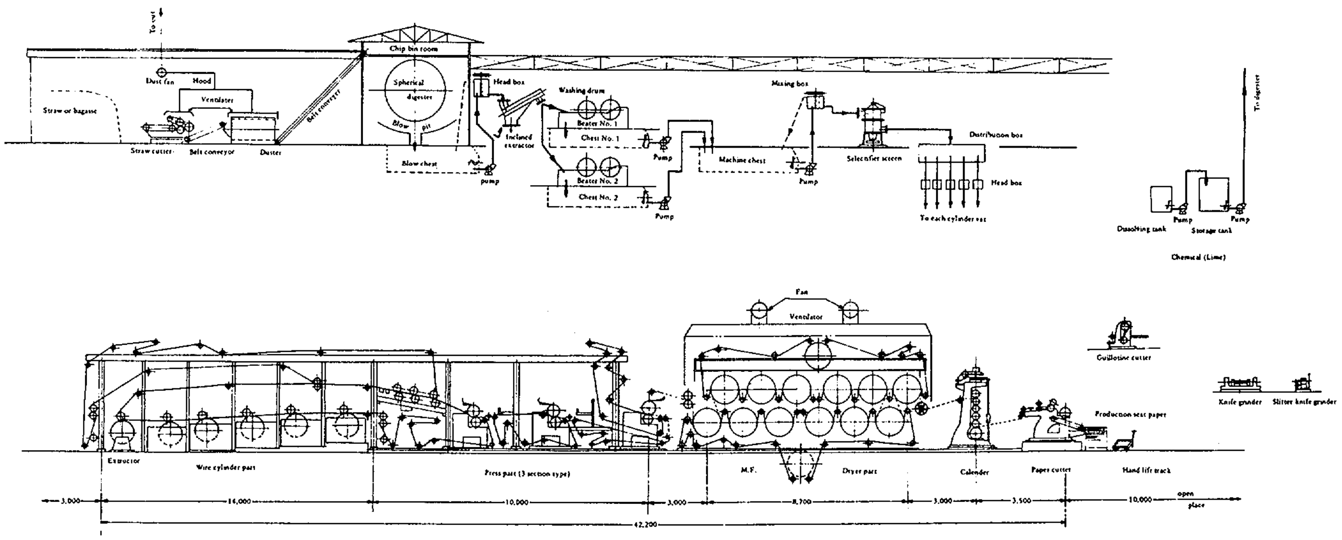
To wire cylinder vat.

Chemical section
(Lime)

Dissolving tank	1 set
Liquor pump	1 set
Storage tank	1 set
Liquor pump	1 set

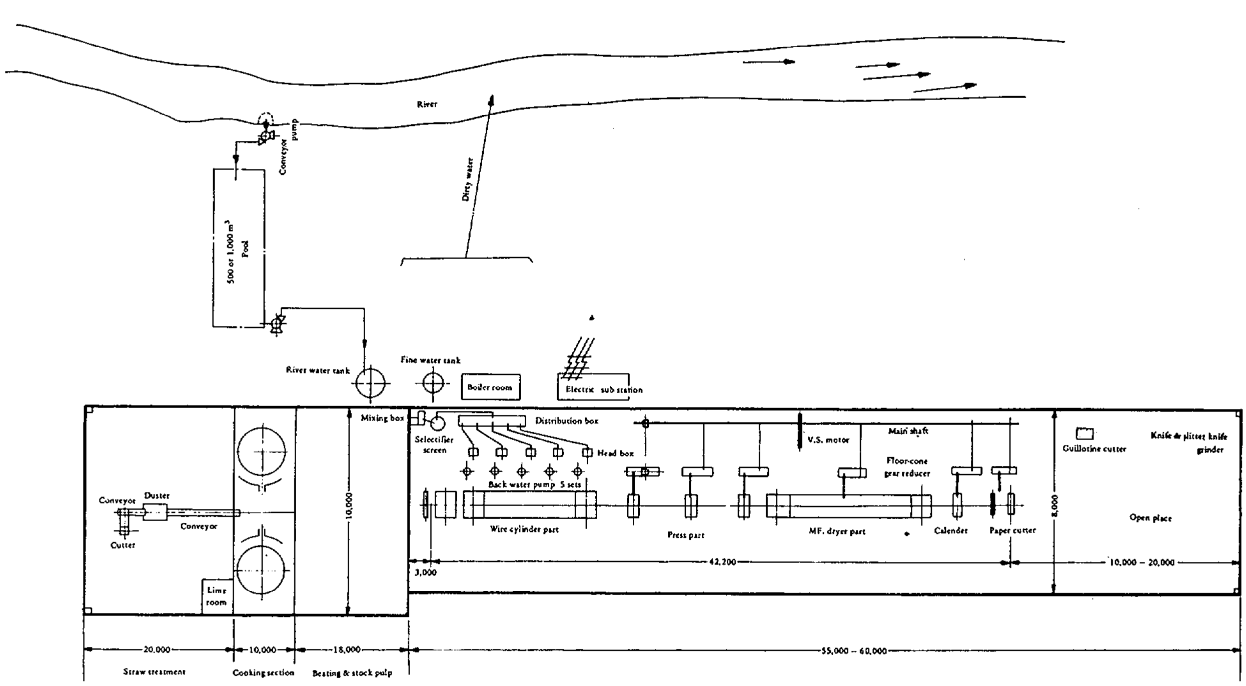
FOB price of machinery and equipment
.... (approx.) $US 714,000

Process Flow Diagram for Straw Pulp & Yellow Board Making Plant



Note: It is also possible to manufacture writing, printing and toilet paper by using the above-layout of machinery and equipment.

Layout for Straw Pulp & Yellow Board Making Plant (Capacity: 5 tons/day)



Paper Making

1. Paper machine

The raw materials in the head box, flow into the paper machine. The paper machine consists of wire, press, dryer parts, calender and paper cutter. Paper is continuously made in the order of the above parts.

1-1) Wire part

One or several (five, in this plant) cylinder moulds rotate in each vat. The stock which has been fed is scooped up by the rotating cylinder mould machine for formation of sheet.

When cylinders go out of the stock liquid, the surfaces of the cylinders are covered with wet paper which constitutes fabrique.

The number of cylinders is decided according to the thickness of paper to be made. The thicker the paper, the larger the number of cylinders.

1-2) Press part

The bottom felts, which rotate endlessly, pass the crests of the cylinders one by one to pick up the paper layer formed there.

After passage of the second press roll, felt and paper are separated, with felt resuming its advance to the cylinder after water has been squeezed out of the felt by the squeeze roll, and paper proceeding towards the next dryer part.

1-3) Dryer part

The paper which comes out of the final press roll has both smoothed by the smoother. It is dried when it comes into contact with the surfaces of the fourteen paper dryers (cylindrical, with steam inside), one after another.

Canvass or dry felt is employed to insure good contact with cylinders.

2. Calender

The calender comprises for chilled rolls, the surfaces of which are hardened. Paper gains glaze as it passes between the rolls through the slip action of heat and pressure.

3. Cutter

Paper is finally cut into the required size by the cutter, thereby ending the continuous paper making process.

When paper is specially required in a smaller size, it is cut by a guillotine cutter which is provided separately.

Example of Straw Pulp and Yellow Board Making Plant

A plant site of 80 m x 200 m would be sufficient in consideration of the future extension of the plant.

The required area of the building is nearly 1,500 m^2. The paper manufacturing room should be made fire proof, but the other buildings may be wooden ones.

How To Start Manufacturing Industries

Kraft Bag Making Plant

Multi-wall kraft bag is a large size multi-ply paper bag made up of more than two sheets of strong kraft paper (normally 3-4 ply) for the purpose of holding heavy matter over 10 kg.

It is the most suitable container for certain amounts of cement, fertilizers, rice, barley, wheat flour, sugar, common salt, pelletized resin and other industrial chemicals in powder, grain and small lumps for transport of storage.

It comes in the following four types to suit the shape of the material to be contained:

(1) One end machine-sewn

(2) Both ends machine-sewn

(3) One end pasted

(4) Both ends pasted

When air-tightness is required, a highly anti-moisture paper bag is available by the insertion of pitched kraft or such moisture-prevention paper as polyethylene paper in between the kraft papers of (3) or (4) type bag.

Pitched kraft, which is also called tarpaulin paper, is a piece of kraft paper, one side of which coated with asphalt, over which another piece of kraft paper is attached to organize, so to speak, an asphalt sandwich.

In the case of cement paper bag which contains 50 kg., 20 bags are required per ton. Accordingly, the larger the output of cement in a country, the larger the demand for kraft bags.

There are favourable prospects for increasing the demand for paper bags for fertilizer and other materials.

The current demand for multi-wall kraft bags in Japan is about 2,350 million bags a year, and the quantity of kraft paper for making these bags comes up to about 450,000 tons.

The consumption of paper bags in Japan may be classified by use as shown in table 1, which indicates that the scope of the demand is fairly wide.

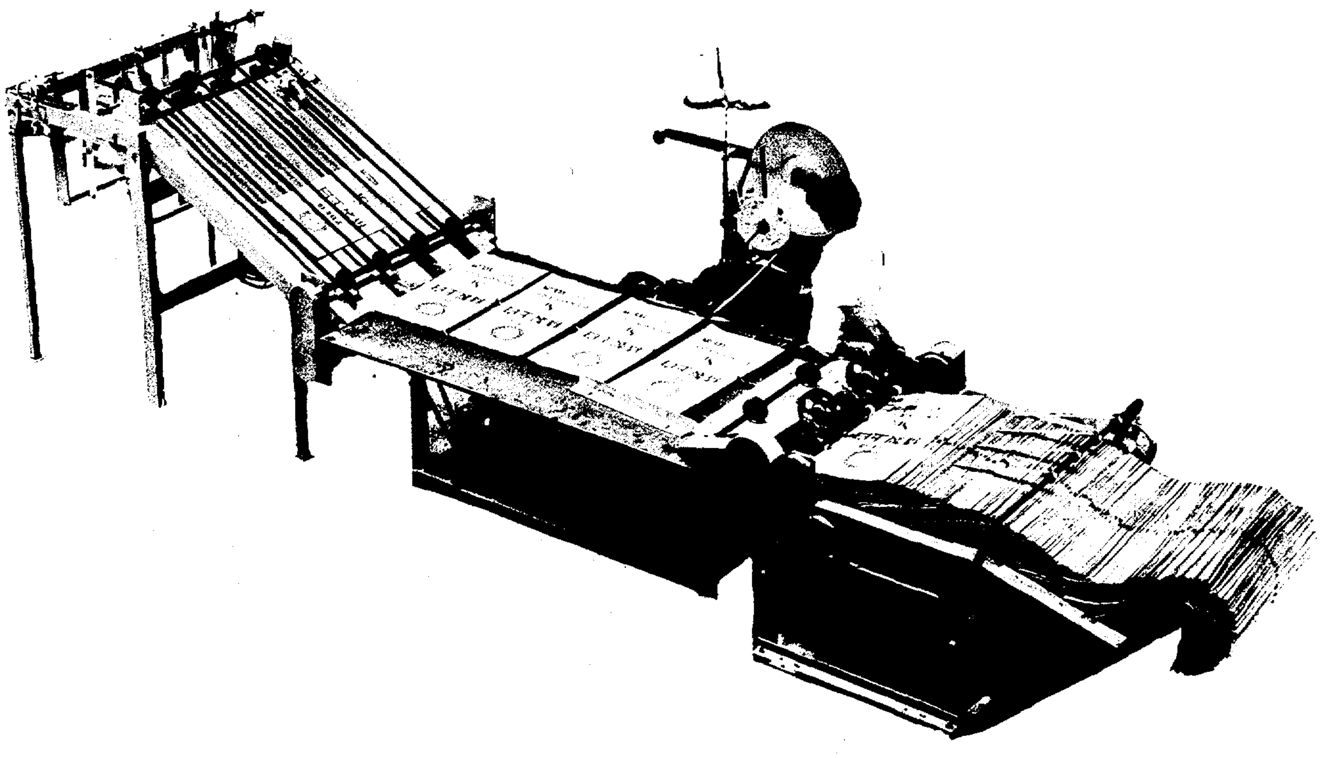
The scope of the consumption of multi-wall kraft bags is extremely large, with the demand increasing by six to ten per cent year after year.

Multi-wall paper bag is pasted into a cylindrical shape on a tubing machine with both ends cut. Both ends or one end of the bag is either machine-sewn or pasted.

In the case of cement bags, the pasted type is used overwhelmingly in Europe, while in Japan and Southeast Asia the sewn type bags are mostly used.

The design and letters on the surface, at the side or back of paper bags, can be printed simultaneously with tubing because a mono-colour or multi-colour printing press is attached to the tubing machine.

In the case of cement bags, mono-colour (generally in black) printing with water ink in common. However, two or three-colour printing is necessary for fertilizer, sugar and other bags.



Sewing machine

Table 1: Consumption of Paper Bags in Japan (1976)

Item	Number of bags (million)	Weight of contents (tons)
Cement	354	63,000
Sugar	74	15,000
Fertilizers	367	84,000
Wheat powder, feed	656	120,000
Salt	59	10,000
Starch	32	7,000
Rice, barley	163	35,000
Agricultural products	69	13,000
Chemicals, etc.	564	86,000

Table 2: Required Machinery and Equipment

			No. of set
1)	Tubing machine		1
	(complete with 2-colour press, hoist, and 1 beam)		
	length of bag	20 – 43"	
	width of bag	14 – 23½"	
	(through exchange of shaping plate)		
	width of gusset	0 – 5"	
	body paper	width up to 48"	
		dia. up to 39"	
		up to 6 ply.	
	manufacturing capacity	120 bags/min.	
2)	Both-ends sewing machine		2
	length of bag	24½ – 36½"	
	manufacturing capacity	1,500 bags/hr.	
3)	One-end sewing machine		2
	length of bag	25½ – 36½"	
	manufacturing capacity	1,500 bags/hr.	
4)	Packing machine		2
	100 – 150 bags per bale		
	capacity	50 bales/hr.	
5)	Compressor	7 – 10 kg/cm^2	1
6)	Paste making machine		1
7)	Inspecting machine		4
	(for elongation, tearing point, permeability of air, weighing)		

FOB price of machinery and equipment . . . . . (approx.) **$US 190,000**
(not including automatic feeder, auto-stacker, and valve former)

Raw materials and sub-materials required for the manufacture of multi-wall bags include kraft paper, crepe paper, sewing thread, filter code, paste and ink.

If all of the above materials cannot be obtained within the country, when building a plant for paper bag manufacture the unavailable items have to be imported.

In selecting a suitable location for the plant, it is necessary to look for a lot offering convenience in transporting raw materials into the plant and still be close to consumers so as to economize on expenses in forwarding bags.

It is understood that the plant should be located where it is easy to obtain supplies of electricity, water and labour.

From the technical point of view, the manufacturing of kraft bags is not especially difficult. On the business side, management may not be so difficult because of the fact that the consumers and the quantity required are comparatively stabilized.

Therefore, multi-wall kraft bag manufacturing may be recommended as a promising example for smaller enterprises.

Table 3: Monthly Requirement of Raw Materials and Utilities

Item	Quantity (ton)
Kraft paper	186
Crepe paper	7
Sewing thread	1.5
Filter code	1.5
Paste	15
Ink	1

Example of Kraft Bag Making Plant

Here is an outline of a plant with a daily production of 40,000 bags (1,000,000 bags a month) of machine-sewn paper bags. Tables 2, 3, 4 and 5 show respectively the machinery and equipment, raw materials and utilities, manpower, and plant site area required for this plant.

Outline of the Plant

A plant which has been planned carefully should be able to produce 40,000 bags a day (1,000,000 bags a month). Machines can be increased with the increase of demand.

There are two ways of manufacturing pasted type paper bags. One way is to paste the bags with an automatic bottomer, and the other way is to paste them manually.

In the automatic bottomer, the cost of labour will be cheap. Mass production will be possible too, which would be around 30,000 bags a day. The required number of operators will be seven or eight.

Approximately 60 persons would be required in manual one end (bottom) pasting to manufacture 30,000 bags. In Japan, however, the automatic bottomer is used mainly.

The manufacture of machine-sewn type paper bags is comparatively simple. Furthermore, if the sewing thread is pulled out of the bag with care so that the bag may not break when taking the contents out, it would be possible to reuse the bag.

Re-manufacturing of bags does not require any special machines. The ordinary sewing machine for industrial use and the printing press would be sufficient.

For a country which has to import kraft paper from abroad, it would be more economical to manufacture machine-sewn type paper bags.

Automatic feeder, auto-stacker, and valve former could be attached optionally to the sewing machine as special apparatus at extra cost. These apparatuses would speed up the sewing machine work and simplify mastering of the machine.

Process Description

There are two kinds of multi-wall paper bags, one with gussets on both sides (mainly machine-sewn type paper bags) and the other without gusset (mainly pasted type paper bags).

However, through exchange of the shaping plate on the tubing machine, it is possible to turn out the above two kinds of bags on the same tubing machine.

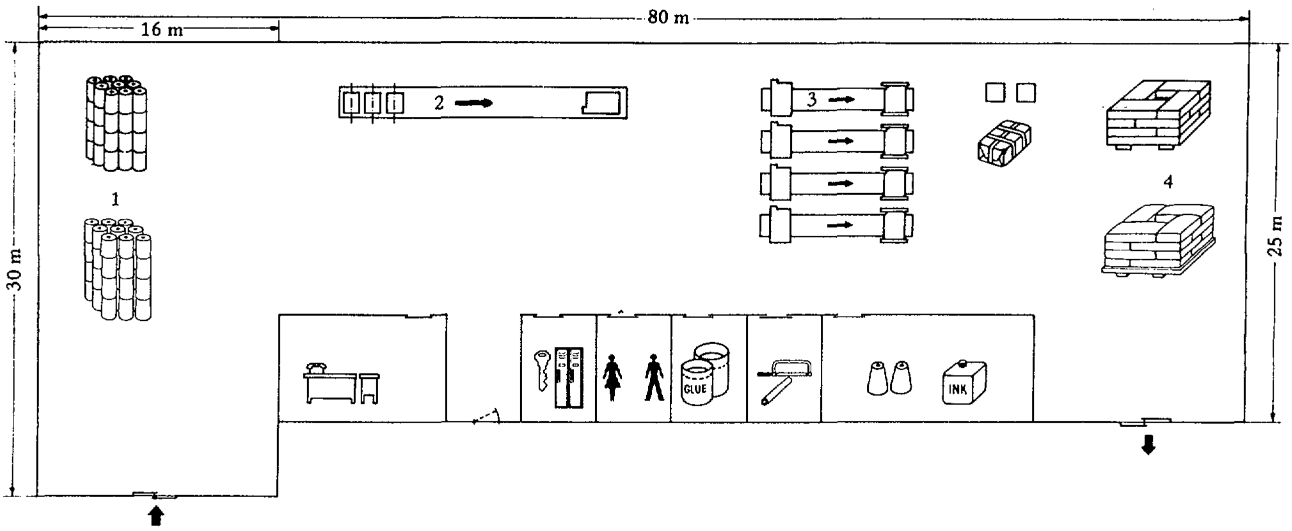
Here is an outline of the manufacturing process of multi-wall paper bags mainly made by the sewing process:

(1) Kraft paper is put on the tubing machine, placing the number of sheets corresponding to the required number of ply, for simultaneous tubing and printing with a press interlocked with the tubing machine. The length of the paper bag depends on the order, but it is generally cut to 43 - 20 inches. The length of the bag may be adjusted through exchange of gears on the tubing machine.

(2) Paper tube manufactured on the tubing machine is machine-sewn on an automatic both-ends sewing machine, after the shaping of valve (normally done manually).

(3) The manufactured paper bags are inspected and bundled into 20 or 25 bags to a bundle, then stacked alternately 100 to 150 bags to packing. There are two methods of packing: automatic and manual. Polypropylene flat cord is used in the automatic method, and straw cord of polypropylene round cord is used in the manual method.

Layout for Kraft Bag Making Plant



Process Flow Sheet for Kraft Bag Making Plant

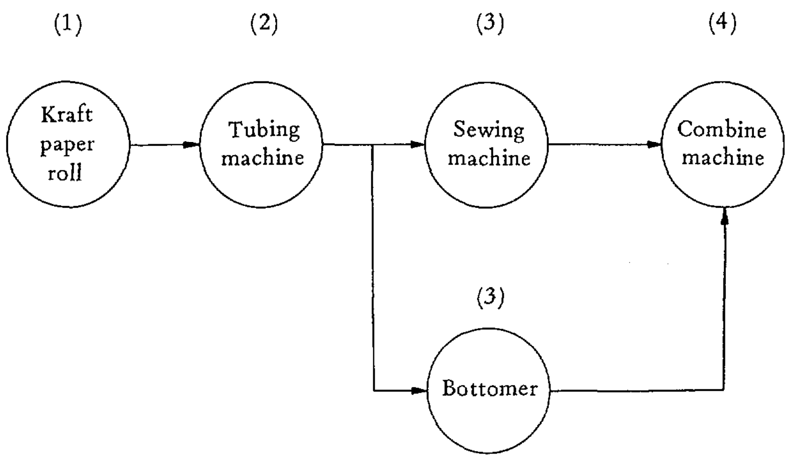


Table 4: Required Manpower			
Item	Number		
	Man	Woman	Total
Managerial staff			
Plant manager	1		1
Operation supervisor	1		1
Material supervisor	1		1
Miscellaneous duty		1	1
Direct labour force			
Tubing machine	2	4	6
Sewing machine	1	12	13
Packages and products warehouse	6		6
Raw materials warehouse	1	1	2
Total	13	18	31

Table 5: Required Plant Site Area	
Item	
Building area	1,750 m^2
Paper products store house	800 m^2
Working space	650 m^2
Office	300 m^2
Required land area	3,300 m^2

When manufacturing pasted bags, both bottoms (ends) are pasted securely. There are two ways of doing this: automatic and manual. Ordinarily, pasting is done manually. In automatic pasting, one machine will manufacture 30,000 bags a day, but a high-grade machine would be necessary.

Any inquiry about the information contained should be sent to: IO/COOP, Registry file No. ID/562/12, UNIDO, P.O. Box 300, A-1400 Vienna, Austria.

F

ISIC 342 PRINTING AND PUBLISHING

How To Start Manufacturing Industries

Printing Plant

Printing is often refered to as a barometer of civilization. Where there is civilization, there is always information. And information, without exception, coexists with printing.

In the beginning of the 20th century, printing developed as a full dress industry in Europe and in the United States.

In Japan, the industry, which came to be conducted in real earnest around 1930, has continued to grow along with the economic development of the country, establishing a firm status as an industry free from depression.

The yearly growth rate of the printing industry has been 15 – 20% on an average.

In the light of its history in industrially advanced countries, it may beyond dispute that the industry will show a rapid progress in developing countries, contributing to knowledge and public welfare.

On top of that, the printing industry is one of the fundamental industries in that, it is said, one printing office is demanded per population of 10,000 – 20,000, equal to the ratio in the case of doctors. Accordingly, it is usually locally operated with few imports and exports.

Scope and Classification

The plan in this project is designed to turn out a variety of printing matter, including that for publicity activities, for education, for sales promotion and so forth.

Kinds of Processes and Features

Although this plant is mainly for lithographic printing, it can also serve for letter printing.

As printing methods, there are lithographic printing, letter printing and intaglio printing. Among them, letter printing and lithographic printing are widely adopted for printing of pamphlets and handbooks.

Historically, letter printing had long been the nucleus of printing, but in recent years it was complete in the United States, Europe and Japan.

Among the printing plants, with priority given to lithographic-printing like this plant in this project, there are large scale ones which manufacture multicoloured printed products, such as textbooks and large scale posters in large quantities, but many of them are of medium scale to produce multi-coloured or single – coloured printed matter on a moderate scale.

Some printing plants, in the meanwhile, integrate the whole process of printing – from planning, design and preparing of copies (including colour-photographing) to camera work, plate making and bookbinding.

This plant as a smaller plant is planned to start with one-colour or two-colour printing, while orders for plate making are placed outside.

If you can not find a plant for colour separation in your country, you may order it from Japan where there are many advanced printing plants.

General Description

Lithographic paper, art paper and coated paper are used to produce pamphlets, handbooks, forms, labels, small-sized newspapers, etc. of one or two colours.

On receiving an order from a customer, a working plan is established at the planning division, and according to the plan, the art division prepares photographs, draw pictures by hand and selects types of letters to prepare the copy.

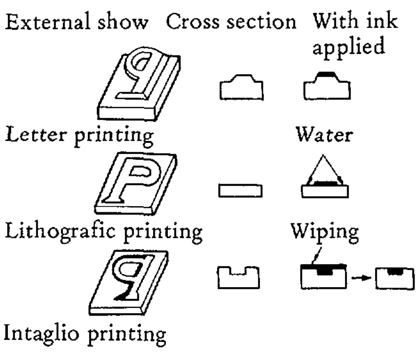
The copy is returned to the planning division, where, if necessary, it is looked over by the customer.

The camera work division makes the negative out of the copy, which is sent to the plate making division.

The division makes the plate out of the negative in preparation for printing.

The printing division receives the plate from the plate making division to conduct printing with paper and ink sent from the materials division.

Comparison



Production Scale

This plant has a capacity to produce three items of 100 page handbooks by 3,000 copies each a day.

High grade coloured printing demanding huge production scale, elaborate technology and advanced equipment are not made objects of this plant for the time being.

However, the planning of the plant construction should be done with consideration that the plant may be improved in the future in case the demand for high quality printing rises.

The operation time is decided on as seven hours a day excluding recesses.

Locational Condition

As to the location of this plant, a region which has stable temperature and humidity is desirable. For instance, a sudden change of temperature of more than 10°C will cause wavy edges on paper to make printing difficult.

Change of humidity should be within 15%. Plate making and camera work may be favourably conducted if the temperature is below 30°C.

The first thing needed for a printing plant is easy access to the prospective market including government offices, firms, etc. In this respect an urban area is preferred as the plant site.

Raw Materials and Utilities

Paper, ink, films, PS plate and others are required as raw materials. As utilities, electricity, fuel and water are required.

The required raw materials for producing three items of 100 page handbooks by 3,000 copies each a day are shown in Table 1.

Required Area for Plant Site

As the plant area, 3,000 m^2 is required, taking future expansion into consideration.

The floor space of the one storied plant building with steel frames and slating is 1,000 m^2, which includes the factory and office.

Table 1: Monthly Requirement of Raw Materials		
Item	Specification	Quantity
Paper	800 mm x 650 mm	750,000 sheets
Ink		250 kg
Film	220 mm x 150 mm	4,000 sheets
PS plate	800 mm x 650 mm	550 sheets
Others		

Table 2: Required Machinery and Equipment (imported)

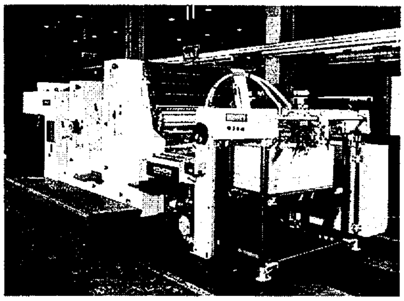
Item	No. of set
Art section	
IBM MT2 typewriter	3
Photo – composing machine	1
Camera work section	
Camera	1
Processer	1
Dryer	1
Plate making section	
Printer	1
Composer	1
Working and drying table	1
Printing section	
Printing machine (for one colour, 650 mm x 400 mm)	1
Printing machine (for one colour, 800 mm x 650 mm)	2
Printing machine (for two colours, 800 mm x 650 mm)	1
Cutting machine	1
Seasoning machine	1
Hand lift	2
Bookbinding section	
Multiple folding machine	1
Stitcher	1
Collator	1
Cutting machine	1
Transformer	1
FOB price of machinery and equipment ...... (approx.)	$US 671,000

Table 3: Other Equipment (procured on the spot)

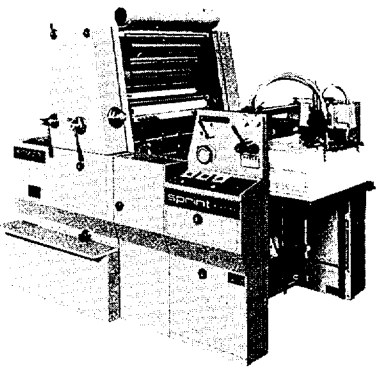
Item	No. of set
Light table	1
Dot etching table	7
Working table	2
Sink	1
FOB price ...... (approx.)	$US 8,000

Note: Other expenses including those for writing and tubing should be taken into consideration.

Table 4: Required Manpower	
Item	No.
Engineer	2
Clerical worker	16
Art & camera work section	19
Plate making section	13
Printing section	16
Bookbinding section	14
Total	80



Offset printing press



Offset printing press

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G

ISIC 351 INDUSTRIAL CHEMICALS

How To Start Manufacturing Industries

Urea Resin Adhesive Making Plant

This is the industry for making the non-concentrated adhesive mainly used by the plywood industry, and the concentrated adhesive for woodworking. The glue is made from such raw materials as urea, melamine and formaldehyde.

A long time ago, plywood was made by using adhesives of starch and protein groups. But, thanks to the development of adhesives of the synthetic resin group, all kinds of plywood are manufactured with this type of resin at present.

About 500,000 tons of adhesives for plywood were used in Japan in 1977. The greater part of such adhesives were of the urea-formaldehyde group, and this type of adhesive is being further developed in future.

The adhesive requires some modification in its characteristics so as to conform with the conditions for use at plywood manufacturing plants. But the basic manufacturing process will be mentioned below:

The adhesives to be manufactured at the plant are for making plywood. There are two kinds of plywood, namely Type II, which is to be used for interior decoration of buildings, and Type I for the facing of buildings on the outside, which is water proof.

The adhesive of urea-formaldehyde resin (Type II) is to be used for the Type II plywood.

The adhesive of urea-melamine-formaldehyde resin (Type I) is to be used for Type I plywood. The concentrated adhesive is mainly used for woodworking.

Thus, adhesives are supplied in Type I and II as well as the concentrated type, all of which are supplied. in a liquid shape. They are shipped either in drums or, in case of delivery to big consumers, on tank lorries.

The adhesives also include that of the phenol-formaldehyde, which is mainly used for making plywood for the facing on the outside of buildings. However, its use is a bit difficult as compared with the adhesive of the urea-melamine-formaldehyde resin group.

In such tropical zones like the South Seas, the life of products is shortened, and so it is suggested that they be not stored for a long time. In such a case, adhesives are used in the form of powder.

The principal raw materials are urea, melamine and formaldehyde. In addition, catalysts, modifier, stabilizing agents, etc. are used. Such agents may be available in a stabilized manner.

Furthermore, the plant will need electric power for operation, steam for heating, cooling water and pure water.

All the processes are of the batch system, in which transformation into methylol and reaction for transformation into methylene take place in the same reactor, and the progress of reaction is regulated by analytical checking.

Whether the reaction has arrived at the final stage or not is judged by analysis. This judgment requires technical skill.

As for the locational condition of the plant, it is desirable that it is constructed in the neighbourhood of a plywood plant because of the convenience in sales of products.

Since the consumption of electric power, steam, cooling water, etc. is not large, it would be advantageous if such utilities could be made available from a nearby plant.

The plant will offer no environmental problem to speak of.

Outline of Plant

A urea resin adhesive plant may be considered economical if its monthly capacity is over 500 tons in normal operation during the daytime. Extension of the plant will be easily made available through extension of the reactor.

In addition to the above stated raw materials, the plant will require such subsidiary materials as ammonia, caustic soda or sodium carbonate. Formic acid are also used as a pH controller.

The plant may be built at considerablly cheap cost, and its operation and maintenance are not so complicated.

The number of workers may be small.

However, the plant should be operated by trained workers.

Products of both Types I and II are most suitable for the manufacture of plywood for general purposes, and they are effective for promotion of the operation efficiency because of easy manufacture.

Process Description

When manufacturing the adhesives, a fixed amount of formaldehyde is supplied into the reactor and, after control of pH with ammonia or caustic soda, urea and melamine are added, at the fixed ratio, for agitation and melting in order to increase the temperature of the reactor and to proceed the reaction for a fixed length of time.

In the final stage of reaction, it is necessary to take small amounts of sample for inspection of the degree of polymerization.

When the required polymerization has been obtained, the reaction vessel should be cooled immediately, thereby to stop the progress of polymerization, and to send it into the product tank.

Cooling is arranged by circulating cooling water through the jacket, and reducing the pressure of the reactor by water jet so as to bring about fast cooling by evaporation.

The product has about 50% of non-volatile matter in T-II, and about 58% in T-I. The product is packed in drums for shipment on tank lorry. In case of a concentrated adhesive, it is generally shipped in 5-gallon cans.

Table 1: Required Machinery and Equipment

Item	No.
Reactor	1
Agitator	1
Condenser	1
Vaccum pump	1
Water receiver	1
Cooler and refrigerator	1
Transport equipment	1
Measuring instrument	1
Filling equipment for shipment	1
Tanks	
Formalin storage tank	1
Product storage tank	1
Others	
Analytical instrument	1
Boiler (2 tons/hr.)	1

FOB price of machinery and equipment ..... (approx.) $US 381,000

Process Flow Diagram for Urea Resin Adhesive Making Plant

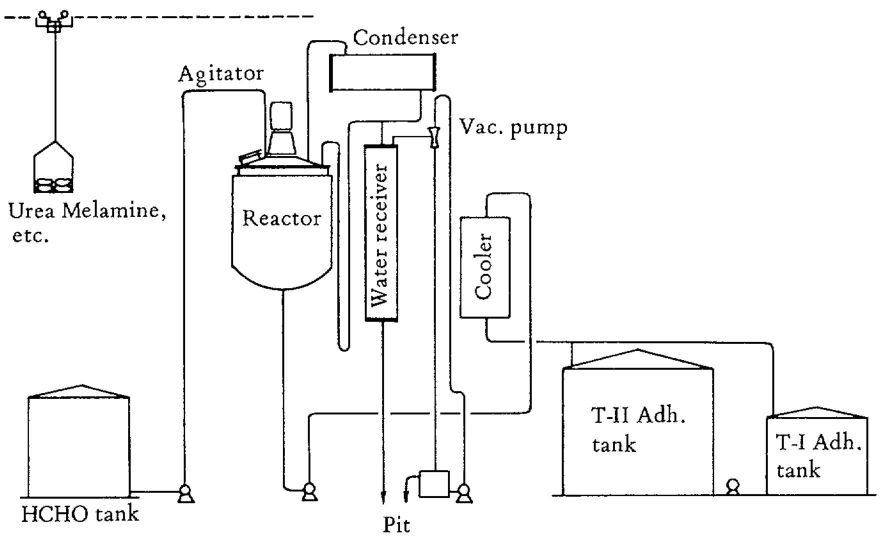


Table 4: Required Area for Plant Site

Item		
Building	(approx.)	400 m^2
Tank yard	(approx.)	800 m^2
Warehouse	(approx.)	150 m^2
(Packaging materials, urea, melamine, subsidiary materials)		
Office, analytical room	(approx.)	50 m^2
Land		3,000 m^2

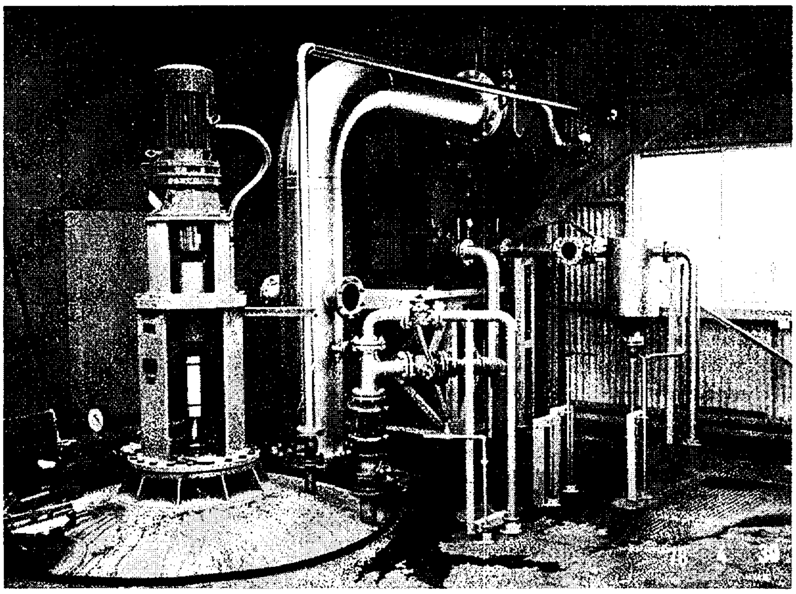
Note: It is recommended that the plant buildings have iron frames with slated roofs.
If the mounting stand and hoist are made of iron frames, the other parts may be wooden.

Table 2: Required Unit of Materials and Utilities

Material	T-I bonding agent	T-II bonding agent
Formalin	610-620kg/ton	660-680kg/ton
Urea	90-100kg/ton	290-300kg/ton
Melamine	250-260kg/ton	
Other items:		
Electric power	5-10kWh/ton	5-10kWh/ton
Steam	100-150kg/ton	70-100kg/ton
Cooling water	30-40tons/ton	25-30tons/ton

Table 3: Required Manpower

Item	No.
Engineer	1
Operator	2
Assistant operator	1
Analyst, Chemist	1
Total	5



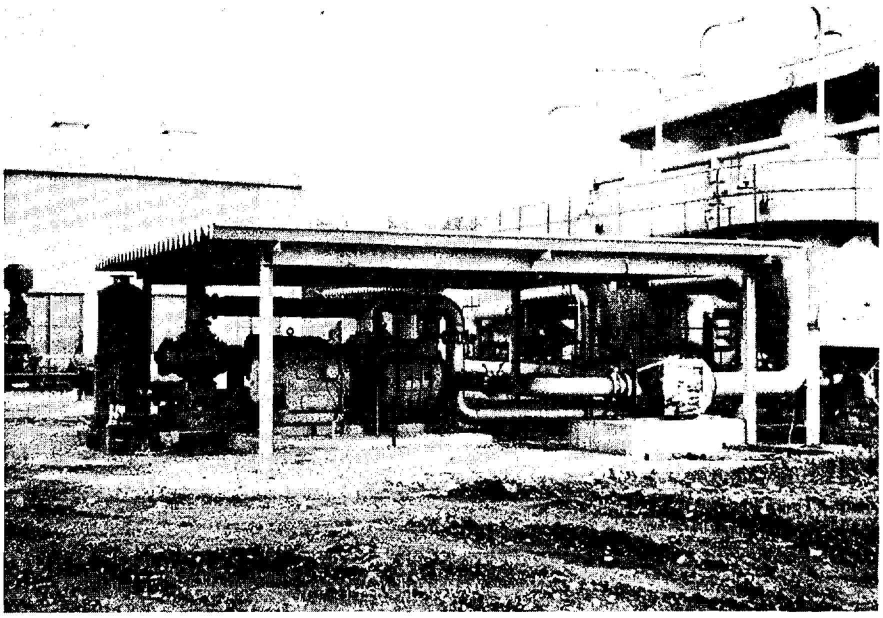
How To Start Manufacturing Industries

Packaged Type Oxygen Plant

Most of oxygen being consumed today in Japan, is produced by the cryogenic air separation process which is represented by the name of "Linde process". The cryogenic process has been in use over 70 years but cryogenic process plant is an elaborate and complex plant to operate. Because it is operated under high pressure which requires a supervisory engineer and skilled labours. Oxygen produced in a large oxygen plant of the cryogenic process is usually transported either in heavy steel cylinders in gaseous state or by tank lorry trucks in liquid state. The transport of oxygen by these vessels to consumers for a long distance is not only troublesome but it makes the oxygen price very expensive.

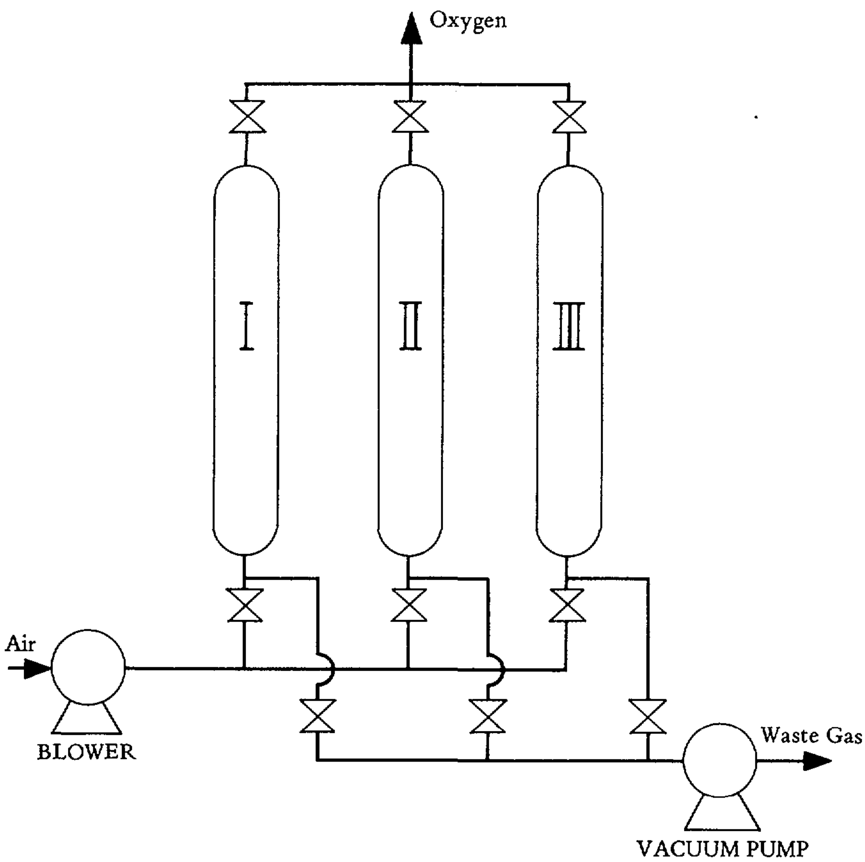
For example, the oxygen price here in Tokyo is now about ¥350* per normal cubic meter in cylinder and more in local districts of Japan.

*Approx. $US 1.67.



90% Oxygen 300 m^3/hr.

Fig. 1: Process Flow Diagram for Oxygen Production



Besides such large oxygen consumers as the iron and steel industry, the chemical industry and the like, there are numerous small consumers, who use oxygen, for example, for cupola, cutting steel plate, inhalation in the hospital, treatment of waste water and so forth. Unlike the oxygen intended for large consumers mentioned above, the oxygen to be used for these purposes just cited is not always necessary to be of high quality.

The packaged type oxygen plant is either small or medium-sized, and has the following merits in the case of small consumers:

(1) The plant can be small or medium-sized, which produces 100 liters to 300 cubic meters per hour.
(2) The plant is not based on the cryogenic process and so it can be a compact and packaged type.
(3) The oxygen produced in the plant has 90% purity.
(4) The plant is operated automatically.
(5) No special technician is required.
(6) This oxygen generation plant is very safe, because the unit is operated at atmospheric pressure.
(7) Oxygen is separated from air by using electric power which drives pumps, blowers, etc.

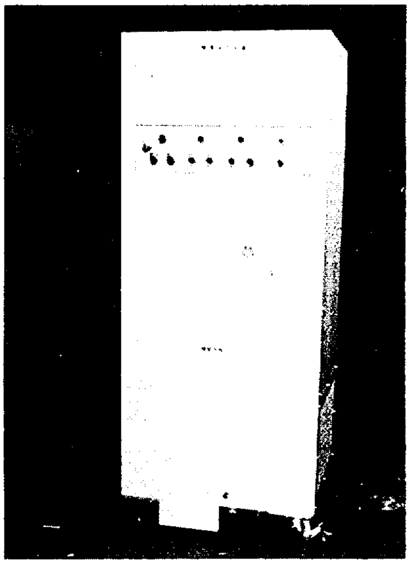
A small-sized packaged type oxygen

Table 1: Breakdown of Oxygen Plant

Item	No.
Adsorber column	3
Air blower	1
Vacuum pump	1
Pipe and valves	1 set
Control panel	1

Table 2: Plant Costs by Capacities

Capacity/hour		Plant cost, FOB (approx.)
100ℓ	90% oxygen	$US 14,000
300ℓ	90% oxygen	$US 24,000
1,000ℓ	90% oxygen	$US 33,000
5,000ℓ ($5m^3$)	90% oxygen	$US 57,000
10,000ℓ ($10m^3$)	90% oxygen	$US 76,000
50,000ℓ ($50m^3$)	90% oxygen	$US 195,000
100,000ℓ ($100m^3$)	90% oxygen	$US 333,000
300,000ℓ ($300m^3$)	90% oxygen	$US 667,000

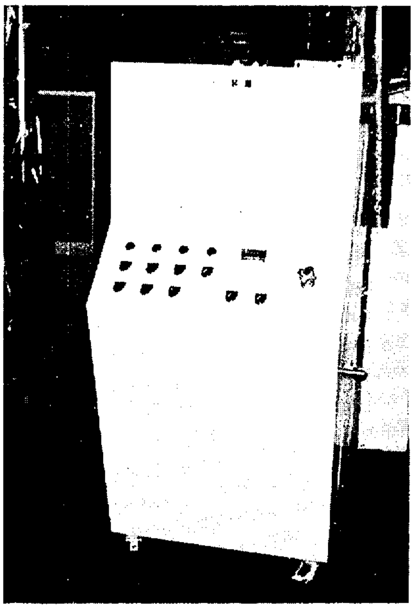


90% Oxygen 300ℓ/hr.

unit is enough for the purpose of supplying oxygen to the hospital for inhalation. When a patient inhales pure oxygen through an oxygen inhalator, he actually inhales about 50% oxygen which was diluted with fresh air. Accordingly, the oxygen to be used for the medical purpose does not need to have 100% purity, and is sufficient if it has 90% or so purity.

Process of Oxygen Production

This process is based on an entirely different principle from cryogenic process which separates air to oxygen and nitrogen by cryogenic liquefaction of air and distillation of liquid air. A certain kind of the inorganic matter such as zeolite has been known to adsorb nitrogen selectively from air with a result that oxygen can be separated from



90% Oxygen 500ℓ/hr.

nitrogen.

Through utilizing the above characteristic of zeolite, the air is fed into a vessel in which natural or artificial zeolite is packed and oxygen comes out from the vessel while leaving nitrogen adsorbed by zeolite. Since a state of equilibrium exists between nitrogen and oxygen adsorption by zeolite, the maximum purity of oxygen made by this process will be 95% or so. Therefore this oxygen plant will guarantee 90% oxygen to be produced.

The process flow sheet of this process is shown in figure 1. The air is at first blown into vessel I where moisture, carbon dioxide and nitrogen in the air are adsorbed by zeolite, letting out 90% oxygen from the top of vessel I. Next, inlet and outlet valves of vessel I are closed and air is blown into vessel II where the adsorption described above takes place again and separated 90% oxygen can be produced. During the production of oxygen by Vessel III in the same way as in Vessel II by turns, Vessel I is kept at low pressure by the vacuum pump with a result that zeolite in it is regenerated and Vessel I becomes free from adsorbed moisture, carbon dioxide and nitrogen.

In this way, Vessel, I, II and III repeat by turns the production of oxygen and the regeneration of zeolite successively and continuously. These operations are started automatically just by pushing the button and are stopped by the same way. Since whole plant is operated at atomospheric pressure or low pressure the operation is completely easy and no special technique is required. The suitable capacity of this process plant ranges from the small size of 100 liters per hour to the medium size of 300 cubic meters per hour or more.

If this plant is equipped at a hospital or factory, oxygen will be secured at all times and no transportation of oxygen cylinder for a long distance with high costs is required.

Raw Material and Utility

10 cubic meters per 1 cubic meter of oxygen of 90% purity

Electricity

About one to 1.5 kWh per 1 cubic meter of oxygen of 90% purity

Required Manpower

For small scale oxygen plant, no full service operator is required but for larger plant like 1 m^3/hr. capacity, one worker who checks the plant once a day after starting is required.

Technical Fee

Know-how and engineering fee are required besides plant cost.

How To Start Manufacturing Industries

Mosquito Coils Making Plant

Having its origin in Japan, the mosquito coils are an insecticide which has long been familiar to the Japanese because of its handiness and economy. Now, production has been started in Southeast Asian and African countries under technical cooperation with Japan.

The production of the mosquito coils date from the period around 1890. Pyrethrum seed had been imported into Japan in 1885, and in the 1910s powdered dried pyrethrum flower had come to be used as the main component of mosquito coils. At last, mosquito coils became an effective repellent as well as an effective insecticide. In the early stage, mosquito coils took the shape of an incense stick used at household Buddhist altars, but they were gradually improved to the present spiral form so that they could keep burning for as long as possible. The spiral coil has a burning time of more than seven hours.

For the purpose of alleviating the inefficiency of production, efforts had been made to find ways for mechanization, and it was after World War II that the automatic mosquito coil manufacturing machine was invented and commercialized. This machine materialized mass production of mosquito coils of uniform quality.

The raw material of the mosquito coils is pyrethrum (vermifuge chrysanthemum), in which the effective component for killing mosquitoes is pyrethrin. Pyrethrin is efficacious against insects, such as mosquitoes, flies etc. On the other hand, it is completely harmless to warm-blooded animals including human beings.

As the safest existing insecticide in this world, pyrethrin is keeping a dominant position over the rest, in the midst of the social problem raised by reports that insecticides of organic chloride, such as DDT, BHC, etc., are poisonous to the human body.

Almost at the same time with the invention of the automatic mosquito coil manufacturing machine, was developed the method of synthesized pyrethrin, the effective component of pyrethrum. It was these two successes that brought to mosquito coil makers an epochal change never seen before.

The automatic mosquito coil manufacturing machine has materialized mass production by getting rid of various restrictions in manufacture. Synthesized pyrethrin, on the other hand, enabled production of the material for the coils freely, while pyrethrum had a limitation in its harvest.

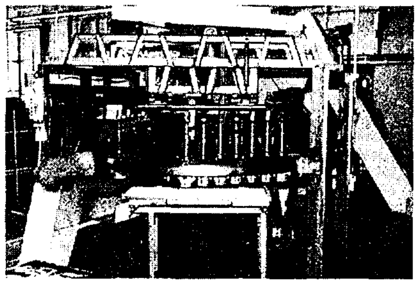
The things described above may well be called the technical innovations of the mosquito coil manufacturing industry.

Process Description

1) **Preparation of raw materials**
The raw materials for mosquito coil are extracted residue of pyrethrum or powdered dried pyrethrum flower and Machillus Thunbergii, and sawdust of cedar or cypress. These sawdusts are pulverized to the proper size by an atomizer.

2) **Blending of subsidiary materials**
A fixed amount of binder, which is one of sub raw material, is added to the raw materials of which the sawdust has been pulverized to the proper size. The mixture is blended thoroughly by a mixer.

3) **Kneading**
The mixture of raw materials which have been blended thoroughly in the mixer is fed into the kneader. Pigment, antimould preservative, and water are added and blended and kneaded thoroughly. Then a fixed amount of pynamin or pynamin-forte and emulsifier, which has been prepared separately, is blended with the kneaded mixture. The amount of water is adjusted carefully in this process.



Mould punching machine

4) **Punching and moulding process**
The mixture which has been blended and kneaded thoroughly in the kneader is broken to particles by the crusher and is made as uniform as it is possible. Then, it is formed into the shape of a board of the fixed width and thickness. This formed product is cut into the fixed length, and is punched out into the proper shape by the mould punching machine; then, it is arranged on the drying net.

5) **Drying process**
The crude product which has gone through the moulding process and which has been arranged on the drying net is first sent through the low temperature drying process to reduce the water content to about 20%; then, it is sent through the high temperature quick drying process to reduce the water content to approximately 10%.

6) **Packing**
The products of processes 1) – 5) are packed 10 pieces to a dressy box, and the boxes in turn are packed in carton boxes for delivery.

Outline of Plant

The model plant described here is to have a production capacity of 100,000 mosquito coils per day. The

Fig. 1: Process Flow Sheet for Mosquito Coils Making Plant

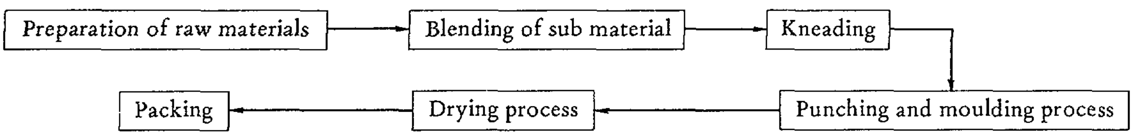


Table 1: Required Machinery and Equipment

Item	Specifications	No.
Atomizer	Capacity: 400 kg/8 hrs. or more	1 set
Mixer	Capacity: 1,000 liters	1 set
Kneader		1 set
Crusher		1 set
Extruding machine		1 set
Size cutting machine		1 set
Mould punching machine		1 set
Conveyor		1 set
Dust collector		1 set
Carts		(approx.) 250
Wire nets		(approx.) 18,000 pcs.
Boiler	Pressure 4 – 5 kg/cm^2 G.; Volume of steam 145 kg/hour	1 set
FOB price of machinery and equipment .... (approx.) $US 167,000		

Table 2: Required Auxiliary Equipment

1) Boiler
2) Steam piping
3) Water supply and drainage piping
4) Electrical distribution network
5) Ventilator
6) Laboratory facilities
7) Firefighting appliances
8) Lighting facilities

Table 3: Monthly Required Raw Materials and Subsidiary Materials

Item	Quantity (approx.)
Primary substance of insecticide (pynamin or pynaminforte)	100 kg
Antimould	70 kg
Green colorant	70 kg
Spice	15 kg
Extracted residue of pyrethrum	9 tons
Sawdust	18 tons
Machillus Thunbergii	9 tons
Synthetic binder	120 kg

Other required materials are packing material, small box, packing case, packing tape, etc.

Table 4: Monthly Required Utilities

Item	Quantity
Electricity (not including lighting)	22,040 kWh
Steam (pressure 4 – 5 kg/cm^2)	(approx.) 20 tons
Water	(approx.) 50 tons

Table 5: Required Manpower

Item	No.
Manager (chief engineer)	1
Skilled worker	4
Unskilled worker	15
Inspector-analyst	1
Total	21

Table 6: Required Area for Plant Site

Item	
Building	(approx.) 1,500 m^2
Land	(approx.) 5,000 m^2

weight of one coil is 14 grams.

The FOB price of the required machinery and equipment for this plant is given in Table 1.

The list of required auxiliary equipment for the plant is given in Table 2.

The list of required raw material and subsidiary material for the plant for 25 days/month operation is given in Table 3.

The list of monthly required utilities is given in Table 4, and the list of required manpower is given in Table 5.

The required plant site area for office building and factory is given in Table 6.

Locational Condition

When establishing the plant, a consultation or an investigation of the conditions of the location should be made in advance concerning the following matters:

(1) Permission regarding the manufacture of insecticide

(2) The electric voltage and cycle

(3) The components and percentage of contents

How To Start Manufacturing Industries

Aerosol Insecticide Making Plant

The Aerosol type insecticide first made its appearance during World War II when the U.S. Army, fighting in tropical jungles and faced with the need to cope with malaria, developed a pocketable type of pressurized insecticide container.

It was in the latter part of the 1950s that this type of aerosol insecticide came into use in Japan. At first, the aerosol container made in Japan consisted of a can made from a single strip of tin plate, or was seamless. Accordingly, while it displayed great resistance to internal pressure, it naturally involved a high manufacturing cost.

In addition, as the refrigeration system was adopted for filling the can with insecticide, the can making process called for the additional use of facilities such as freezer and was then rather inefficient. Moreover, the valve essentially comprising the spray mechanism had to be imported.

Since then, the side-sealed (crimp-soldered) type can came to be mass-produced, artistically designed for maximum consumer appeal. In parallel, the pressure-filling method, or under-cap method, came to be adopted for insecticide filling, which involved less loss in pressurized gas and allowed for mass-production of aerosol cans by an automatic process. At the same time, the spray mechanism (valve) was improved and became available at a far lower price through mass production.

Today, roughly 25 years after the appearance of the first aerosol type can, a countless number of commercial products has become available in convenient, aerosol type cans – hair sprays, household insecticides, garden insecticides, deodorants (for space and human body), paints, glass cleaners, perfumes, medical products (disinfectants, asthma suppression, etc.), perspiration inhibitors, and the widest scope of foodstuff.

In fact, it is claimed that roughly 6 billion aerosol type products are produced annually throughout the world. In Japan, some 350 million cans of aerosol type products are turned out annually.

A wide variety of aerosol type products can be produced with the same production facility, excepting for special types of products, although it will be necessary to clean the pipeline thoroughly when switching from the production of one product to another.

Where aerosol type insecticides are concerned, petrolizers consisting primarily of pyrethrum essence (extracted from vermifuge chrysanthemum), filled in hand-pressing type of sprayer cans, had been used in Japan from before the outbreak of World War II. Today, aerosol type insecticide cans, worked with finger-tip touch, are naturally in widespread use.

Insecticides being indispensable for securing a sanitary national living environment, a large demand is anticipated for the product, with the result that no difficulty is expected in the management of the plant.

However, where the construction of an aerosol type insecticide making plant is concerned, preliminary survey will have to be conducted on the permits to be obtained from governmental organs. A survey should also be conducted on the existence of competitors, the chemical compositions of competitive insecticides, the kind of pressurized gas used, and on other factors.

Process Description

The process flow sheet of this aerosol type insecticide making plant is shown in the accompanying diagram. Essentially, the following processes are involved:

1) Aerosol can delivered by the can manufacturer are inspected carefully and temporarily stored in the materials warehouse, then conveyed from warehouse to can feeder (unscrambler) to place the cans on the insecticide filling line, where the insides of the cans are cleaned by suction by means of pneumatic can cleaners.
2) The insecticide is prepared by piping the prescribed volumes of insecticide, synergist, perfume and solvents into the mixing tank and mixing these ingredients. The insecticidal solution, after being removed of inclusions or impurities with the filtration system, is temporarily piped to the storage tank from whence it is led to the filling machine and filled in fixed volume into the cans expelled from the pneumatic can cleaners. Filled cans are sampled at random from time to time to check the insecticidal solution filling condition.
3) Valves (spray mechanism), upon their delivery, are sampled at random for inspection. These valves are mounted on the mouths of aerosol cans which have been filled with insecticide.
4) After this, propellant is charged under pressure from gas bomb to propellant filling machine, then filled in fixed volume into the valve-capped cans under high pressure. Here, too, gas filled cans undergo random sampling from time to time for inspection.
5) Cans filled with propellant the next passed through a hot water bath whose water is heated to a temperature of more or less 50°C as a means to check against cans having improper crimp, and cans with pressurized gas leakage (in the form of air bubbles) are removed from the production line.
6) At this stage, the valves of these cans are depressed for an instant to confirm spraying is achieved satisfactorily, and faulty cans are discarded.
7) The cans are next wiped clean to remove residual water, oil and other impurities.
8) The cans are then weighed to confirm they contain the prescribed volume of insecticide.
9) The caps are mounted on the cans.
10) The manufacturing serial numbers are imprinted on the bottom of the cans.
11) The cans are given final inspection to confirm the gas volume, insecticidal solution volume and internal gas pressure.
12) The cans are finally packaged for shipment.

Table 1: Production Scheme

1) Production capacity:	8,000 – 10,000 cans/day
2) Working hours:	8 hours/day 25 days/month 300 days/year

Note: Tables 2 – 6 are based on the above scheme.

Table 2: Required Machinery and Equipment	
Item	No.
Automatic aerosol filling line	1 set
Pump unit for gas filling machine	1 set
Vacuum pump unit for gas filling machine	1 set
Compressor unit	1 set
Hot water bath	1 unit
Ventilation fan system	1 or 2 sets
Filtration system	1 set
Insecticide solution mixing tank with agitator	1 set
Insecticidal solution storage tank	1 set
Spray test conveyor	1 set
Packing conveyor	1 set
Ton container (for gas) elevating device	1 set
Control equipment	1 set
Inspection equipment	1 set
FOB price of machinery and equipment	(approx.) $US 167,000

Table 3: Monthly Requirement of Raw Materials	
Item	Quantity
Insecticide	
(Allethrin, Resmethrin, Dichlorvos, Fenitrothion, etc.)	125 kg
Synergist	250 kg
Perfume	125 kg
Refined kerosene	30 k-liters
Propellant	
(Liquefied gases such as LPG, fron gas, etc.)	45 k-liters
Cans, valves, caps	75,000 pcs. each

Table 4: Required Utilities	
Electricity	50 kWh
Water	125 tons/month

Table 5: Required Manpower	
Item	No.
Manager and chief engineer	1
Skilled worker	2
Ordinary worker	11
Tester	1
Total	15

Table 6: Required Area for Plant Site	
Building	1,250 m^2
Land	3,200 m^2

Note: Should the plant building and warehouse be contained in a single building, it will be necessary to use non-combustible such as concrete for the walls. The ceiling of the building should be slated roofing.

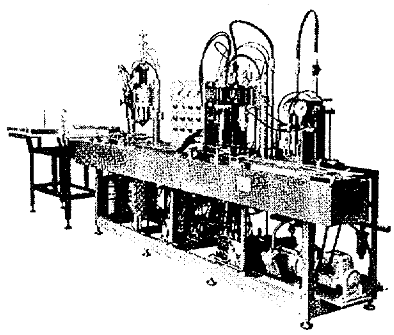
Locational Condition

The aerosol type insecticide making plant should be situated fairly well away from any densely populated region, and no public or private building or housing should be located anywhere within a distance of about 20 m from the plant compounds. No fire should be used in the plant itself, in the plant compounds or in the surrounding areas. In addition, the plant location should lend itself to easy procurement of raw materials.

Others

Where tanks (Insecticide solution mixing tank with agitator and Insecticidal solution storage tank) are concerned, their fabrication at the plant site may prove more economical.

As described earlier, the plant under study is designed with a daily (8 hours of operation) production capacity of 8,000 – 10,000 aerosol cans. With a daily output of about 8,000 cans, a comparatively small capital investment will suffice since a semi-automatic production line will serve the purpose. However, should the output exceed 30,000 cans daily, a large capital investment will become necessary since a propellant storage tank will have so be provided additionally, and since an insecticide filling line of higher performance will become indispensable.



Automatic aerosol filling line

Any inquiry about the information contained should be sent to: IO/COOP, Registry file No. ID/562/12, UNIDO, P.O. Box 300, A-1400 Vienna, Austria.

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ISIC 352 OTHER CHEMICAL PRODUCTS

Match Making Plant

The development of matches was preceded by centuries of experiment with many methods of fire making, but the production of fire by spontaneous chemical reaction was unknown until the 17th century. A variety of experiments continued until the friction match, introduced in the 19th century, provided a means of making fire that was poketable, reliable, safe and speedy. With early methods of fire production it was common to use specially made splinters tipped with some combustible substance, such as sulfur, to transfer the flame. An increased interest in chemistry let to experiments to produce fire by direct means on the splinter.

The raw materials used by the match industry generally include wood splints, paper and chemicals such as potassium chlorate and red phosphorus. A global survey of the present state shows that the match industry is a monopoly in many countries. Under this system matches are bought from private industry by the government, which monopolizes sales. The consumption of matches steadily increased with the advance of sales of tabacco and the increase in the population. Match makers can look forward to a continued increase in consumption as living standards go up.

Generally the consumption of match is three pieces per person. However, as can be seen in advanced nations, the supply would be eight pieces of match per person if match for advertisement could be anticipated.

Kinds of Matches

By splint

1) Wooden splint match (stick type)

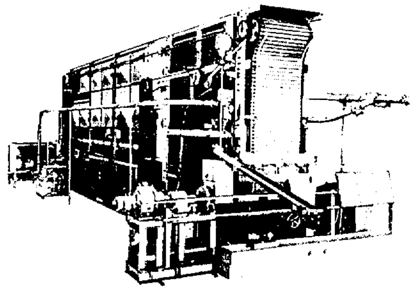
The stick type match is generally square. But there are round and rectangular sticks. There are many kinds of woods for raw material, such as white poplar is most widely used as splint. The colour, hardness and combustibility of white poplar are very superior.

2) Paper splint match

The paper splint match is made from impregnated cardboard. It is widely used because it is suitable for advertisement. In order to preserve resources of wood and in countries where there are shortages of wood for match making, the paper splint match is used domestically.

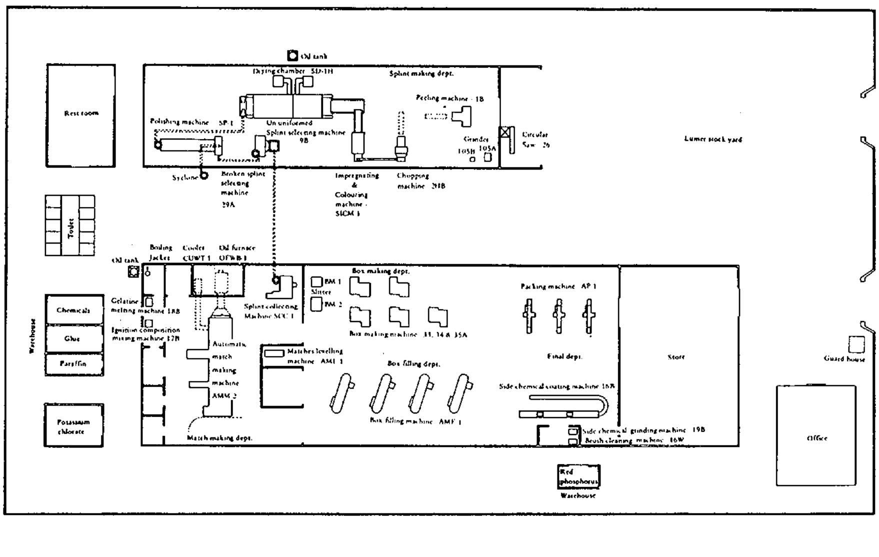
3) Wax coated splint match

Wax coated bundled paper-string is used to produce the wax coated splint match. Wax has a high melting point, so the wax coated splint match will not blow out easily. The manufacturing process is complicated and the price of raw material is high, but recently the wax coated bundled paper-string is used instead of the cotton-string. Because a simplified machine has been developed, splint of this type is generally used.



Automatic match making machine

Plant Layout for Boxmatch Production



Process Description

The manufacturing process of wooden splint match is as follows:

1) **Splint manufacturing**

Lumber is cut to suitable lengths by a circular saw. After the peeling of the bark, the log is peeled into veneer-like thin long shavings by the peeling machine. Then, the veneer-like shavings are split and chopped to the designated splint size by the chopping machine. These splints are impregnated by the splint impregnating machine and dried until 7% humidity. The dried splints are selected by the splint selecting equipment after drying, and the unsuitable splints are rejected.

2) **Match manufacturing**

The process starts from the feeding of suitable polished splints into the splints selecting and feeding machine. This machine is called the automatic match making machine. The selected splints are placed on trays where the splints are paraffined and dipped with head chemical; then, they are dried by the automatic match making machine.

3) **Match box manufacturing**

In this process, match boxes are manufactured to contain match sticks. Printed sheets for outer boxes delivered from printing houses are cut on a slitter, and cut and creased cardboard is delivered from paper stores.

Then, paper boxes are made by the paper box making machine and side boxes are formed.

4) **Filling**
The match splints are filled into the match box by the automatic filling machine.

Table 4: Required Plant Site Area	
Building area	1,405 m^2
Required land area.	3,600 m^2

5) **Finishing process**
In this process, the side chemical coating machine applies chemical to the match boxes, which have been filled with match sticks by the box filling machine as they come on trays. Then the boxes are wrapped 12 boxes to a packet, and 120 such packets are placed in a carton, and the matches are ready for marketing.

Example of Match Making Plant

There are three types of safety matches, which we described above. Here we explained about the most popular type match, which is the wooden splint type. The production scheme, machinery and equipment, raw materials, and plant site area for the above plant are as shown in the attached tables.

Table 1: Production Scheme

Production capacity:	2,000 gross boxes/day	
Specification of match:	Box dimension	51 mm x 36 mm x 16 mm
	Length of splint	45.5 mm x 2^2 mm
	No. of splints	40 splints/box

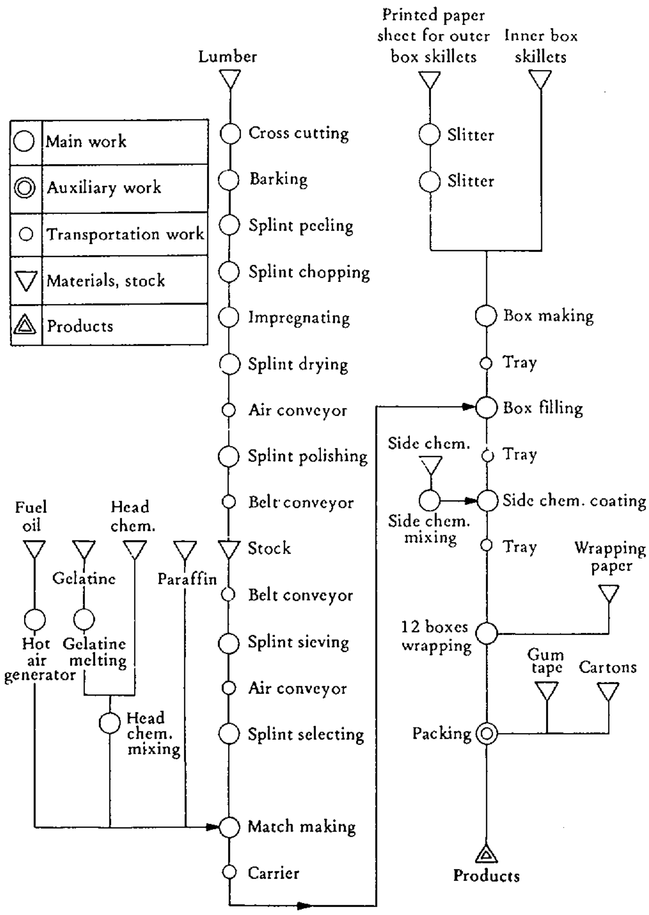
Table 2: Required Machinery and Equipment

Item	No. of set
Circular saw	1
Peeling machine	1
Chopping machine.	1
Impregnating and colouring machine.	1
Drying chamber	1
Polishing machine	1
Broken splint selecting machine	1
Un-uniformed splint selecting machine	1
Grinder (0.75 kW).	1
Grinder (0.2 kW).	1
Splint collecting machine	1
Automatic match making machine	1
Oil furnace.	1
Cooler.	1
Ignition composition mixing machine	1
Gelatin melting machine	1
Slitter	1
Slitter for short cut	1
Box making machine	1
Match levelling machine	1
Box filling machine	1
Side chemical grinding machine	1
Side chemical coating machine.	1
Brush cleaning machine	1
Packing machine	1
FOB price of machinery and equipment . . . . **(approx.) $US 714,000**	

Table 3: Annual Requirement of Raw Materials

Item	Quantity
Lumber for splint	970 m^3
$KClO_3$.	34,000 kg
Red phosphorus	14,000 kg
Paraffin wax.	25,800 kg
Glue	9,700 kg
Sulphur.	8,100 kg
Resin powder	490 kg
MnO_3	3,600 kg
Antimony sulphide	3,600 kg
Glass powder, Potassium bishromate, Zinc oxide, Carbon-black	
Outer box paper . . . . (size: 42 cm x 58.5 cm, substance: 310 g/m^2)	2.2 mil. sheets
Inner box paper . . . . (substance: 240 g/m^2)	86.4 mil. sheets
Wrapping paper. . . . . (size: 310 mm x 1,500 mm/roll, substance: 33 g/m^2)	880 rolls

Process Flow Sheet for Match Making Plant



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How To Start Manufacturing Industries

Toilet Soap Making Plant

It goes without saying that soap is indispensable to our daily life. Accordingly, the soap manufacturing industry should continue to develop as one of the most important industries.

Soap may broadly be classified by use as follows:

Household soap
(toilet soap, laundry soap)
Industrial soap
Special soap

Among them, the consumption of special soap which is used for medical purposes and shampooing is not large. Industrial soap which is important, being used in the textile industry, etc., is not consumed in a large quantity, either.

Household soap which is the most important quantitatively, accounts for the larger part of the consumption of soap. The production of laundry soap has sharply decreased in recent years with the global spread of synthetic detergents.

Indeed, it appears as though soap has given place to synthetic detergents.

However, toilet soap enjoys a stabilized demand, and its manufacture is not likely to lose in importance for a long time to come.

Soap making falls into two main process stages – Saponification and Production of Finished Soap.

Saponification

There are three types of saponification processes: Full-Boiled, Semi-Boiled and Cold.

Full Boiled Process

Of the three processes, the Full-Boiled process is the best and most widely used. This is because it can produce high-grade, pure neat soap plus the valuable by-product, glycerine. In this process, fats and oils and liquid caustic soda are fed into a pan and processed in accordance with the following stages: 1) boiling, 2) salting out, 3) washing, 4) setting.

At the second stage, the contents separate into an upper layer of separated soap and a lower layer of soap-spent lye plus glycerine. After a settling period of a few days, there are three distinct layers: a top layer of neat soap, a middle layer of nigre and a bottom layer of soapspent lye.

The neat soap thus produced contains about 33% water and, if the process is carried out under the proper conditions, is free from such impurities as unsaponified fats and oils, alkali, glycerine, and metallic soap. In most cases a mixture of 70 – 80% beef tallow and 20 – 30% coconut oil is used as raw material.

The Semi-Boiled and Cold processes are economical and simple ways of making soft or potash soaps, requiring low-cost investment in equipment and no sophisticated skills. The use of both processes, however, is markedly decreasing due to the poor quality of the soap produced and the imposibility of glycerine recovery. This is especially true of the production of toilet soaps where quality is always a critical factor.

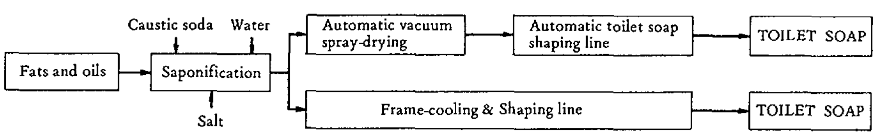
In addition to the above three types of batch process thus far described, continuous processes with automated and compact equipment are widely employed to save installation space, consumption of steam and electric power and labour.

Production of Finished Soap

Neat soap (liquid soap) produced in the saponification process is turned into various grades of marketable soaps by means of different process lines.

Generally they are composed of drying or cooling, mixing, refining, extruding, cutting, stamping, and packaging.

Process Flow Sheet for Toilet Soap Making Process



Automatic Vacuum Spray Drying Line

The neat soap produced by the process outlined above is run into a feed tank by a pump. Another pump delivers the neat soap to the heat exchanger. The neat soap temperature is raised to reasonable degree in the heat exchanger.

The heated neat soap is sprayed through a nozzle onto the conical bottom of the drying chamber. The drying chamber is kept at to vacuum in advance. The hot neat soap is charged into the chamber and is instantaneously dried and cooled by the evaporation of moisture. This accelerated reaction is due to the lower boiling point under vacuum. Deprived of moisture, the neat soap is turned into solid soap, which sticks to the rotating conical bottom of the chamber. A stationary scraper removes the solid soap, which falls to the plodder. The vacuum plodder extrudes the soap to the pellet in the moderately dried form through the rotary perforated outlet.

Automatic Toilet Soap Shaping Line

The solid soap obtained from the vacuum spray-drying chamber is refined in the vacuum plodder and extruded to the pellet form. The soap pellets are dropped via a chute onto the conveyor, then stored in the pellet storage tank.

The soap pellets are conveyed to the automatic weighing machine. The necessary amount of soap pellets are weighed out, and fed into the mixing machine. On the other hand, the dosing machine adds a correct amount of perfume, pigment, etc. to the soap pellets. After mixing, the pelletizer, in turn, produce homogeneous and refined soap pellets. These are then conveyed to the duplex vacuum plodder by a conveyor. Finally, the plodder refines the material and extrudes it in the continuous soap to the bar form.

Subsequent processes differ in accordance with the types of lines used, i.e. (1) or (2).

(1) The soap bar is cut into cakes by the automatic cutter. Then, they are loaded into the conditioning tunnel and cooled enough to accept stamping by automatic high

Table 1: Required Machinery & Equipment

(Production capacity : 5 tons/8 hours)

Saponification process	
Fats and oils melting tank	1
Fats & oils transportation pump	1
Caustic soda dissolving tank	1
Caustic soda lye tank	1
Caustic soda lye transportation pump	1
Caustic soda measuring tank	1
Water measuring tank	1
Salt dissolving tank	1
Salt aqua tank	1
Salt aqua transportation pump	1
Salt aqua measuring tank	1
Soap boiling pan	3
Soap spent lye tank	more than 3
Intermediary liquid soap translator	1
Boiler	1
Automatic continuous vacuum spray-dryer	
Neat soap transportation pump	1
Feed tank	1
Filter	1
Feed pump	1
Heat exchanger	1 or 2
Vacuum spray drying chamber	1
Vacuum plodder	1
Cyclone	2
Barometric condenser	1
Water reservior	1
Water pump	1
Separator	1
Vacuum pump	1
Automatic continuous toilet soap shaping line	
Conveyor	1
Pellet soap storage tank	1
Screw conveyor	1
Automatic weighing machine	1
Mixing machine	1
Dosing machine	1
Pelletizer	2
Conveyor	1
Duplex vacuum plodder	1
Automatic cutter	1
Conditioning tunnel	1
Automatic high-speed stamping machine	1

FOB price of Machinery and Equipment .... (approx.) $US 405,000

speed stamping machine.

(2) The continuously extruded soap bar is loaded into the cooling tunnel, where is cooled to a temperature suitable for stamping and cutting. The cooled soap bar is stamped and cut simultaneously on the automatic stamping machine. At this point, a variety of soap shapes – round, oval, square, and rectangular – can be produced easily by changing dies.

Frame Cooling & Toilet Soap Shaping Line

The neat soap (liquid soap) is fed into the crutcher by the pump. The cooling frame is introduced under the crutcher and the neat soap is charged into the cooling frame in which the soap is solidified within, 2–3 days. After the neat soap has completely solidified, the every wall side of the cooling frame is disjointed. Then the soap-loaded wheeled base is introduced to the automatic slabbing cutter. The soap slabs are cut into bars on the automatic cross cutter and the bars then are cut into chips on the chipping cutter.

The soap chips are loaded onto drying racks which are then placed into the shelf dryer, where the chips are steam-dried. The dried chips are stored in the storage tank. An appropriate amount of dried chips is charged and then mixed with such additives as perfumes, pigments, etc.

The 3-roll mill (or pelletizer) homogenizes the mixture. The soap ribbons made are then conveyed to the simplex plodder.

The plodder further homogenizes and refines the mixture, and forces it through the tapered liner to form a soap bar. The soap bar is cooled in the cooling tunnel to a temperature suitable for stamping and cutting. Then the soap bar is stamped and cut simultaneously on the automatic stamping machine.

Wrapping and Packing

Products are wrapped and packaged by the wrapping machine and packaging machine, and delivered out.

Outline of Plant

It is possible to design and manufacture plants at any production scale, from small capacity with a daily output of 2-3 tons, to as larger capacity plants as may be required.

However, a toilet soap manufacturing plant with a daily output capacity of 5 tons is described in, the capacity of which corresponds to 50,000 to 55,000 cakes a day because one cake of soap generally weighs 90 to 100 grams.

The main machinery, their costs, required number of workers, the size of building site, area of building and secondary materials are shown in the tables.

Table 2: Monthly Requirement of Raw Material and Utilities

Production capacity: 5 tons/day x 25 days/month = 125 tons/month
Working hours: 8 hours/day, 25 days/month

	(tons)
Tallow	73.0
Coconut oil	23.0
Palm oil	8.5
Sodium hydroxide	18.8
Industrial salt	13.7
Perfume	1.3
Electric power	25,000 kWh
Industrial water	6,000
Fuel (heavy oil)	45ℓ
Colouring material	some

Table 3: Required Area for Plant Site and Manpower

The total required area is 2,000 m^2. The details of building area are:

Factory	650 m^2
Office & laboratory	200 m^2
Warehouse	300 m^2
Boiler room	70 m^2
Engineer	1
Skilled worker	3
Unskilled worker	12
Clerical worker	2
Odd job man	2
Total	20

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How To Start Manufacturing Industries

Detergent Plant

Detergent, one of the most important products of today, is increasing in consumption. In 1976 the total consumption of detergent marked 13 million tons in the world. The main reason why detergent is penetrating into the daily life so fast is that it is superior to soap at many points.

Detergent is different from soap in three major points as you may know. The first one is raw materials, namely detergent is made from petro-chemicals, while soap is made from natural fat and oil. The second one is performance. Detergent is easy to change the formulation to fit for the local washing conditions, such as water hardness and way of washing. Because these conditions give big influences to the washing power and foaming ability of detergent. The third one is packaging. Powder detergent is able to be packaged in any styles and any sizes that would be convenient for consumers, but soap is rather difficult in these points.

It is said that the consumption of detergent will increase in accordance with the rise of the standard of living, so the demands for detergent will increase rapidly in many countries from now on.

Process Description

This powder detergent manufacturing plant consists of mixing, drying, after drying, packaging and anti pollution units.

1) **Mixing unit**
Alkyl benzene sulphonic acid (ABS) is neutralized and mixed with builders such as sodium tripoly phosphate (STPP), sodium silicate, sodium sulphate and other minor ingredients. This detergent slurry is transferred to the top of the spray drying tower by the high pressure pump.

2) **Drying unit**
The mixed slurry is sprayed from the nozzles at the top of the spray drying tower. The sprayed detergent slurry is dried by hot air coming from the furnace. The dried detergent powder is taken out of the bottom of the tower, and is transferred to the sieve by a belt conveyor and air lift equipment.

3) **After drying unit**
Fine shaped detergent powder is screened by the sieve and stocked in baggies after being perfumed.

4) **Packaging unit**
The final product is packed here. Detergent powder is fed into the packaging machine from baggies. There are several kinds of packaging machines depending on the sizes and styles of bags or containers, therefore the most convenient packaging machines should be chosen.

5) **Anti pollution unit**
Dust, contained in the exhaust air, is washed and separated by the water spraying system. This water, containing detergent dust, is recycled to the mixing unit again.

Table 1: Monthly Requirement of Raw Materials (Product: 1 ton/hour x 500 hours)

Item	Quantity
Alkyl benzene sulphonic acid	120 tons
Sodium tripoly phosphate	150 tons
Sodium sulphate	90 tons
Sodium silicate	110 tons
Caustic soda	20 tons
Other ingredients	some
Packaging materials	

Table 2: Monthly Requirement of Utilities

Electric power (200 V)	25,000 kWh
City water (clean)	1,000 tons
Industrial water	4,000 tons
Fuel oil	40 kℓ
Steam	100 tons

Table 3: Required Manpower

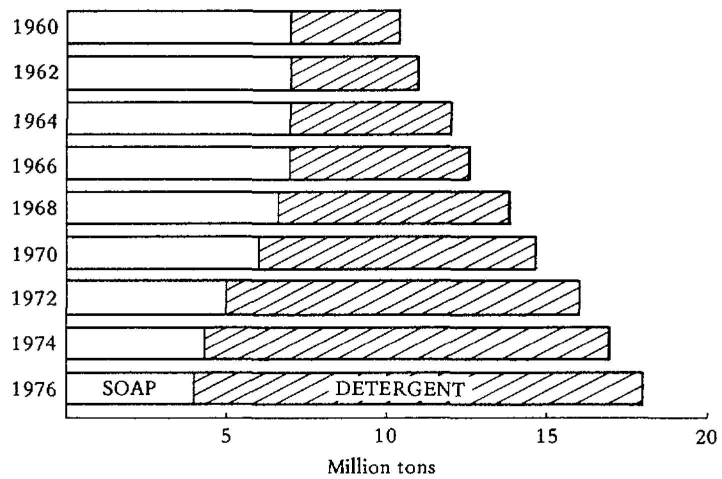
Item	No.
Engineer	2
Chemist	1
Skilled worker	5
Unskilled worker	30
Clerical worker	2
Other	3
Total	43

Table 4: Required Area for Plant Site

Item

The required land area is 4,000 m^2.
The detail of building area are:

Factory	250 m^2
Total floor area	600 m^2
Warehouse	500 m^2
Office etc.	200 m^2



Detergent Consumption in the World

Process Flow Diagram for Detergent Plant

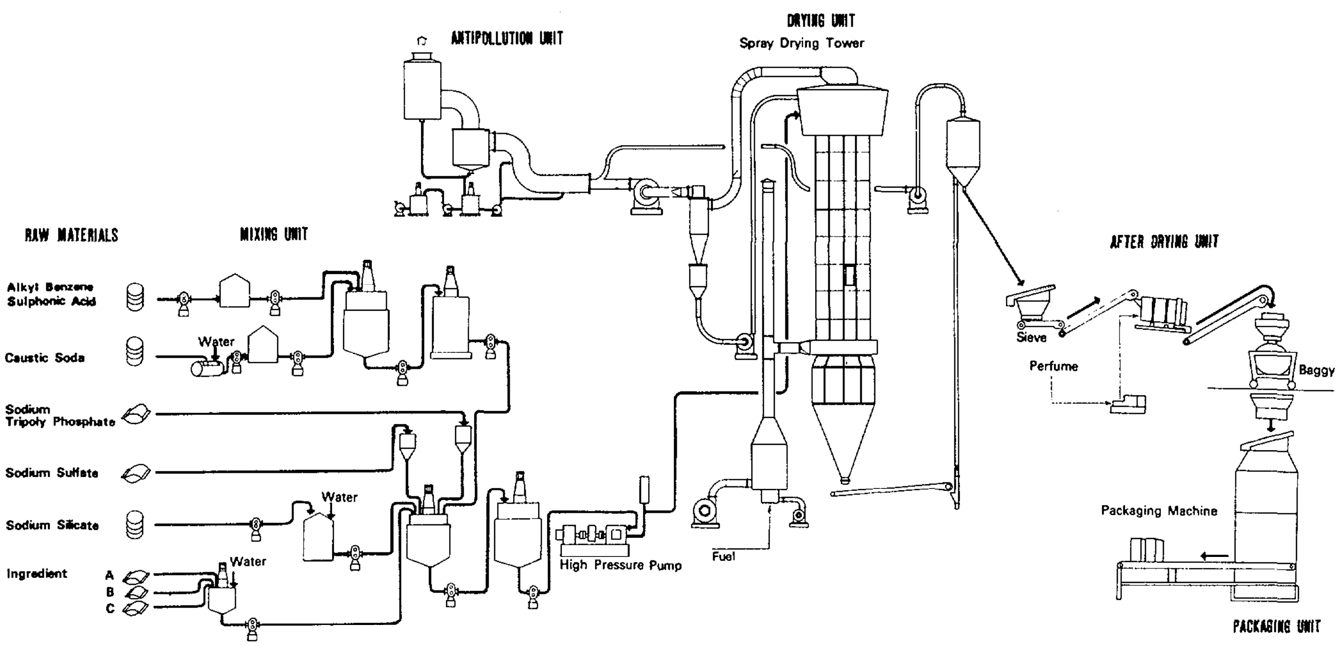


Table 5: Required Machinery & Equipment

Item	No.
Mixing unit	
Caustic soda solution tank	1
Alkyl benzene sulphonic acid tank	1
Neutralizer	1
Sodium silicate tank	1
Mixing vessel	1
Booster vessel	1
High pressure pump	1
Pumps	
Drying unit	
Furnace	1
Blowers	
Spray drying tower	1
Cyclone	1 set
Conveyors	
After drying unit	
Sieve	1
Perfumer	1
Baggies	
Packaging unit	1 set
Anti pollution unit	1 set

FOB price of machinery and equipment is approximately $US 952,000 (Know-how and license fees are not included.) This price is not including packaging machines, because packaging machines are quite changeable depending on the size and style of the final product.

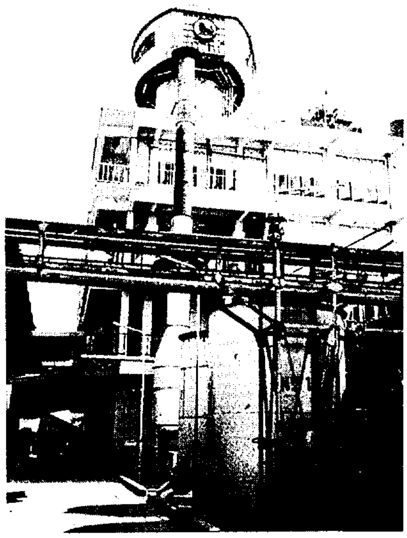
Special Features

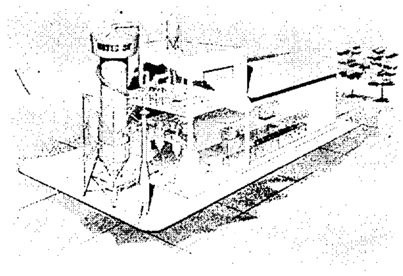
This plant is the result of an art which was studied for a long time through the actual production of detergent.

This is specially designed economical plant that is suitable for the markets in developing countries, and any kinds of anionic surface active agents, such as hard alkyl benzene sulphonate, soft alkyl benzene sulphonate, alpha olefine sulphonate and alcohol sulphate, are able to be used.

And it is needless to say that the plant is designed for simple and effective operation.

The production capacity of the plant is one ton per hour and can be operated twenty four hours continuously.





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ISIC 355 RUBBER PRODUCTS

How To Start Manufacturing Industries

V-Belt Making Plant

General Description of Industry

1) The cross-section of a V-belt is a symmetrical trapezoid. Friction drive power is provided by the grooved pulley and wedge effect of the belt.

2) V-belt is classified according to the shape of the cross-section. The standard shapes are M, A, B, C, D, and E. But there are also all sorts of derivations from the standard, depending on the demand.

3) Merits of V-belt drive
(1) Driving is possible from small horsepower to several hundred horsepower.
(2) A large ratio can be had between the drive shaft and the converted power drive shaft.
(3) Highly efficient transmission is possible in a small space.
(4) Cost of installation is cheap and economical.
(5) Transmission is silent.
(6) Oil resistant and heat resistant when used in a suitable environment.
(7) The transmission efficiency of V-belt is better than flat rubber transmission belt.

4) Because of the merits described above, V-belt is the mainstream of power transmission today and its weight in the rubber industry is tremendous.

5) V-belt has all sorts of cross-section and circumferential length. Because of the combination of the two, the production tends to be small with great variety. In order to make a plant profitable, when designing it, due consideration should be given to the kind of product to be produced and the scale of production.

Outline of Plant

Because there are all sorts of cross-section and circumferential length, variety production of V-belt is inevitable.

The hypothetical plant is to have a monthly production (25 days, 8 hrs/day operation) of 30,000 pieces (1,200 pcs/day) of B Type 60 inch as the main product.

The consumption of rubber (natural rubber, including synthetic rubber) is 4,000 kg/month.

The processing facilities before making V-belt, i.e. the refining installation (rubber mixing machine, calender roll, extruder, etc.), boiler and electrical facilities, are assumed to be existing, and so they are not included in the hypothetical plant.

A testing laboratory and a set of belt running tester are necessary.

Fig. 1: Cross-Section of V-Belt and Size

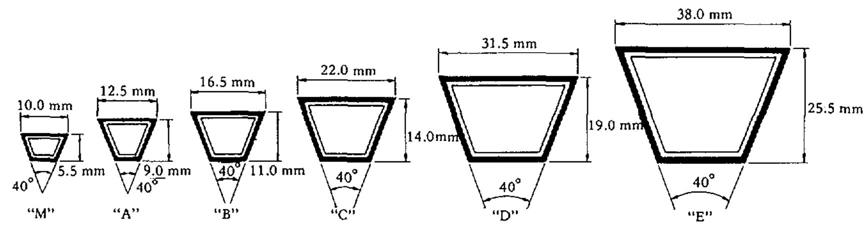


Table 1: Required Machinery and Equipment

Item	Specification	No.	Remarks
Bias cutter	Horizontal type: Cover cloth let off and liner cloth wind up unit, 0.4 kW geared motor; Cutting knife carrier, 0.4 kW geared motor; Cloth jointing and pull out unit, 0.2 kW geared motor.	1 set	
Case making machine	Cord traverse, 0.4 kW geared motor; Cord tension and guide rollers; Cushion rubber sheet send out unit, 0.4 kW geared motor; Expanding drum driving unit, 1.5 kW geared motor; Saw cutter, 0.4 kW geared motor.	2 sets	
Skiving machine	Two skiving knives, 0.4 kW geared motor; Length of belt is adjusted by compressed air;	5 sets	Various type exclusive machines
Covering machine	0.4 kW geared motor: Length of belt is adjusted by compressed air; Four sets of folding rollers.	5 sets	Various type exclusive machines
Autoclave	Two steam inlet pipes.	5 sets	
Expanding drum	The circular length of drum can be adjusted by screw, and maximum adjustable range is 5 – 6 inches.	14 sets	
Long size belt making machine	1.5 kW motor. This machine consists of two or three drums. One drum is fixed to the driving unit and one or two drums are movable. Forming is done by adjusting the machine to the length of the belt which is to be manufactured.	3 sets	
Belt press	Belt press, which is a hydraulic (oil) press, is a 2 daylight press which consists of three heat plates. The heat source is steam. The press has a draw gear. Operation is done by hydraulic (oil) pump. Various size (500 mm x 500 mm, 1000 mm x 1000 mm, etc.) heat plates are required.	3 sets	
Ring mould	Assembling type belt with a length of 15" – 100" is suitable as ring mould product. Sizes which have a relatively huge demand are usually made by ring mould. At least 80 pieces of ring mould are required.	80 pieces	
Flat mould	Six sets of flat mould M – E which match the size of the heat plate of the press are required for one press.	6 sets	
Hydraulic (oil) pump	For the belt press	3 sets	

FOB price of machinery and equipment .... **(approx.) *$US 571,000***

Also, a storehouse with overpass and underpass is necessary in order to receive and deliver the finished products smoothly.

Process Description

1) Sometimes, on a small production scale of ring mould products, instead of using a rubber sleeve, cloth wrapping is done by a cloth wrapping machine, then vulcanizing is done and the cloth wrapping is removed after vulcanizing.

2) Instead of using a press in press moulding, an endless belt (mainly consisting of glass fibre) may be used for continuous vulcanizing.

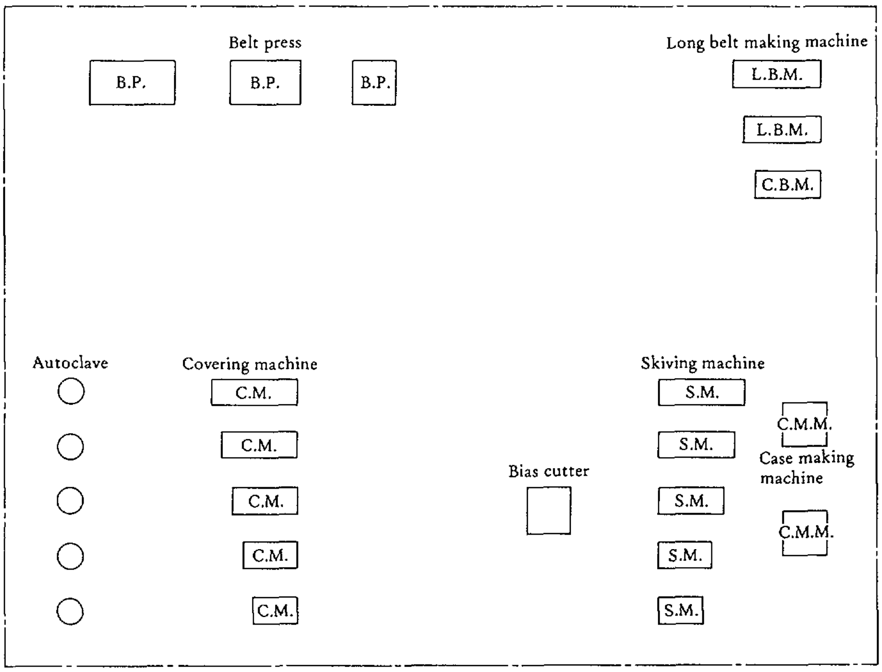
Required Manpower

Employees required for manufacturing V-belt are 38 persons in total.

Required Area for Plant Site

Building .... (approx.) 6,000 m^2
Land .... (approx.) 9,000 m^2

Fig. 3: Layout for V-Belt Making Plant (1,200 m^2)



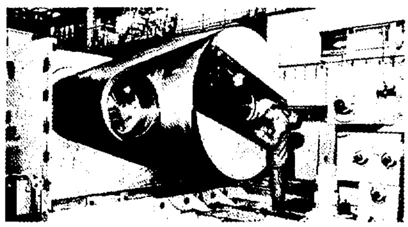
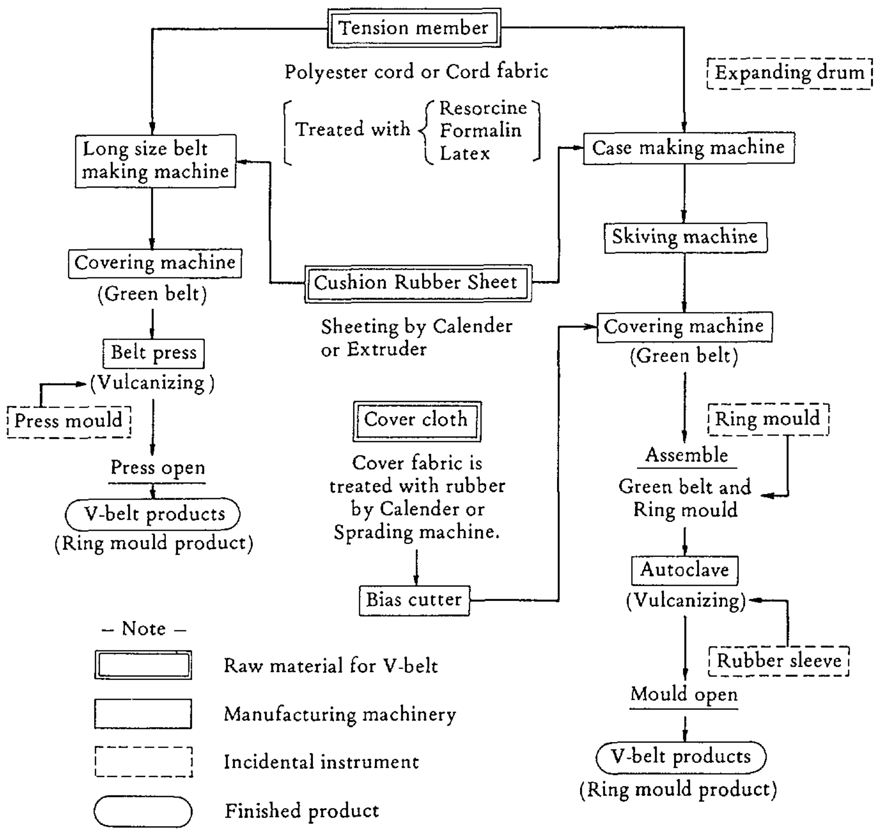


Fig. 2: Process Flow Sheet for V-Belt Making Plant



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ISIC 356 PLASTIC PRODUCTS

How To Start Manufacturing Industries

Polyethylene Bag Making Plant

Recently, all chemical fertilizers in Japan are being packed in polyethylene heavy duty bags. This is a world-wide trend. Some of the reasons for this trend of shifting from paper bag, jute bag, and rice straw bag to packing fertilizer in polyethylene bag are given below.

(1) Fertilizers of high hygroscopic property such as concentrated compound fertilizer and urea fertilizer have begun to be used with the modernization of agriculture. Packing materials of the past could not prevent moisture sufficiently. Polyethylene heavy duty bag is moisture proof. It prevents the fertilizer from absorbing outside moisture after packaging; therefore, it prevents quality deterioration.

(2) Polyethylene heavy duty bag is water-resistant, and so fertilizer packed in it can be piled and stored outdoors without fear. (For long period of storage, however, the bags of fertilizer must be covered and protected from ultraviolet rays.)

(3) Fine coloured printing can be done on polyethylene heavy duty bags. This will multiply the commercial value of the contents.

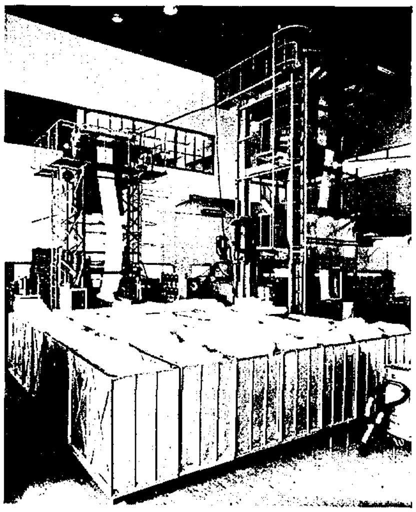
(4) The manufacturing process of polyethylene bag is more simple than other packaging materials, and so the cost of product is cheap.

(5) The quality of polyethylene heavy duty bag is stable, and it can be used easily.

(6) The raw material polyethylene pellet is manufactured in various countries of the world, and the supply of raw material is stable.

At present many fertilizer manufacturing plants are being established or are being planned for establishment throughout the world. When these plants are completed and when they begin running, packaging material will immediately become necessary. Accordingly, polyethylene heavy duty bag manufacturing plants will be necessary.

Polyethylene heavy duty bag is used for packaging not only fertilizer but also petrochemical products, industrial chemicals, and agricultural products.

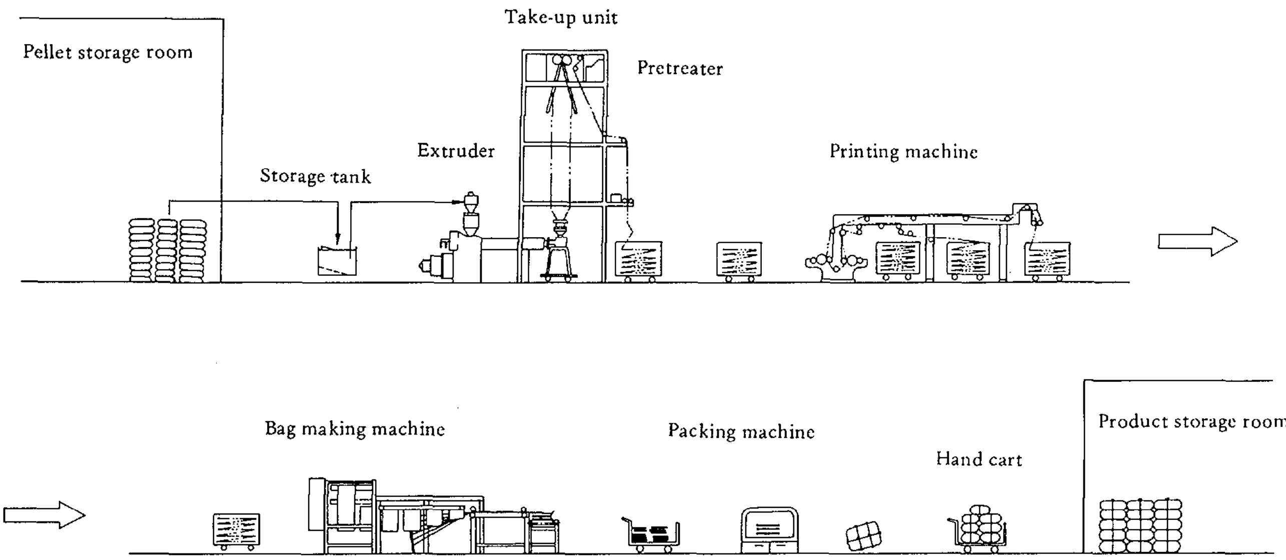


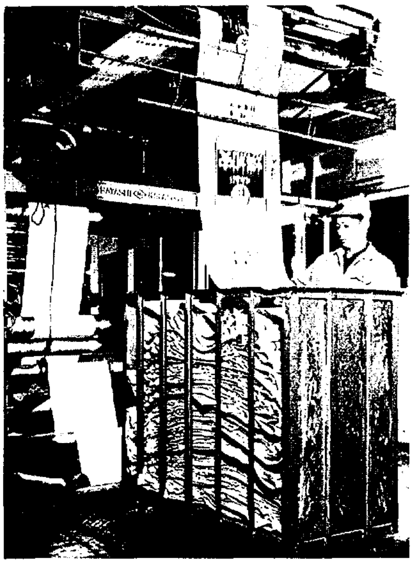
Inflation film extruder

Process Description

It is consisted of three processes in polyethylene heavy duty bag manufacturing; extrusion, printing, bag making. All of the processes are done automatically by machine. Once the machine is adjusted, the operator (worker) needs only feed the raw material and taking off partly finished goods in order to get the finished product.

Process Flow Sheet for Polyethylene Heavy Duty Bag Manufacturing Plant





Printing machine

1) Extrusion process
The polyethylene pellet is fed in the hopper which is attached to the extruder. The pellet is fed forward by a revolving grooved screw which is inside the cylinder of the extruder. The pellet, during the travel, is softened and melted by the regulated heating temperature of a heater; then, it travels through a die and is extruded out of the extruder in a tubular form. The extruded tube is inflated to the prescribed size, picked up by the pinch roll while being cooled by the surrounding open air, folded, passed through the guide roll in a tubular film form, and delivered into the hand cart.

2) Printing process
The tube manufactured by the extruder is delivered to the printing machine. The tube is beautifully printed automatically to a fixed size by the printing plate which has been preset on the printing cylinder; then, while drying, it is delivered into the hand cart.

3) Bag making process
The printed tube is set on the bag making machine. The tube is first cut into the preset size, then the cut tubes are caught continually by a set of belts and carried to the heat seal section. Here the bottom is heat sealed to produce the finished product.

4) Inspecting and packing
The size and condition of heat seal are inspected by the inspector. Then, the bags are packed into a fixed quantity and delivered to the finished product storage room.

Example of Polyethylene Heavy Duty Bag Manufacturing Plant

Planned designing of a most efficient and economical polyethylene heavy duty bag manufacturing plant would be as follows:

Basis of designing
Size of bag: 500 mm(W) x 780 mm (L) x 0.2 mm(T)
Output: 9,000,000 bags/year
Working days: 300 days/year
Temperature condition: 20 degrees C

The machinery and equipment, raw materials, manpower, and plant site area required for the above plant are as shown in the attached tables.

Table 1: Required Machinery and Equipment

Item	No.
Extruder	1 set
Die	1 set
Take-up machine.	1 set
Surface finishing machine	1 set
Printer (one side, two colours) .	1 set
Bag making machine	2 sets
Packing machine	1 set
Inspecting machine	1 set
Hand cart.	20 sets
Electrical equipment	1 set

FOB price of machinery and equipment . . . (approx.) $US 688,000

Note: A cooling system would be necessary when the temperature rises over 20 degrees C.

Table 2: Required Raw Materials

Item	Quantity
Polyethylene pellet .	155 kg/1,000 bags
Ink and solvent	4 kg/1,000 bags
Gummed tape	

Table 4: Required Plant Site Area

Item	
Building area . . . . .(approx.)	20x50m =1,000m^2
Required land area. .(approx.)	40x70m ≒ 3,000m^2

Table 3: Required Manpower

	Engineer	Skilled	Unskilled	Shift	Total
Extruding	1		1	3	3 x 2
Printing.		1	1	1	1 x 2
Bag making		1	4	1	1 x 5
Inspecting and packing. .		5		1	1 x 5
Total.					18

How To Start Manufacturing Industries

Agricultural Use PVC Film Making Plant

Features

(1) High permeability of ultraviolet ray
(2) Low thermal conductivity
(3) Water proofing
(4) Durability
(5) No deterioration due to agricultural chemicals and fertilizers
(6) Easy to handle and moderate cost

For Utilization of PVC

PVC Tunnel:

Tunnel cultivation logically suits large area farming.

However, thanks to the development of traffic facilities, it has become possible, in recent years, to undertake large area cultivation. Therefore, even beginners in PVC farming can expect to easily achieve effective application.

Here is how the tunnel may be applied to cultivation:

(1) Use for long period for producing single products once a year—strawberry, carroto, leek, spinach, celery.

(2) Priority utilization for growing early ripening fruits and vegetables, and use for short period for other products as preliminary crops—tomato, cucumber, egg-plant, Spanish paprika, watermelon, musk melon.

(3) Use for short period in other seasons—chrysanthemum coronarium, spinach, lettuce, sprouts of beefsteak plant; and protection of other plants against cold.

In consideration of the area for which the PVC tunnel is utilized, the main products may be fruits and vegetables, with cucumber and tomato being most popular items for cultivation.

PVC Hothouse:

PVC hothouses are built in three types: prefabricated type using unsplit or split bamboo sticks, wooden frame made up of wooden props, and iron-framed affair.

The types of hothouses are to be selected according to area, site, crop and fund. For instance, in case intensive utilization of farm is required because of small area, an iron-framed house is to be used that will last semipermanently if the necessary fund is available.

On the other hand, the prefabricated house will be advantageous when intensive cultivation is unpractical on account of wide area.

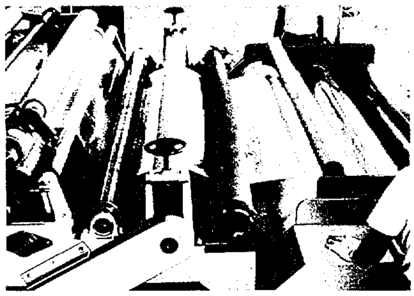
Kinds of Crops and PVC:

Nursery—Good seedlings are obtainable in case the nursery is fully sprinkled prior to seeding, and sprinkling is avoided, as far as possible, during the growth of seedlings.

Vegetables, flowering plants — Over recent years, in order to effect shipment at profitable times, vegetables are grown at times when sunlight is weaker than in other seasons, through semi-intensive, or intensive or controlled cultivation.

Therefore, it is necessary to use PVC which has higher permeability of light. Drops of water which may have attached to the interior of PVC may be cooled during the night, and they may fall on crops, thereby causing damage to, or diseases for crops.

To make up for the above shortcomings, anti-drip PVC has been developed so as to prevent adhesion of water drops on the inside, improve light permeability, and eliminate damage caused by water drops.



Winding unit

Furthermore, visibility of the interior (as compared with common type PVC) provides convenience for control. Accordingly, anti-drip PVC is suitable for cultivation of vegetables.

Outline of the Plant

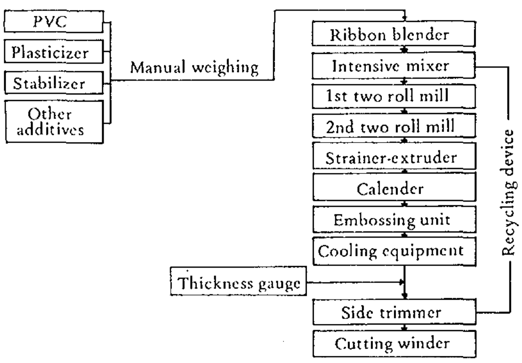
1. Basic figure of estimate
   1) Width of products
      1,800 mm

Table 1: Required Machinery and Equipment

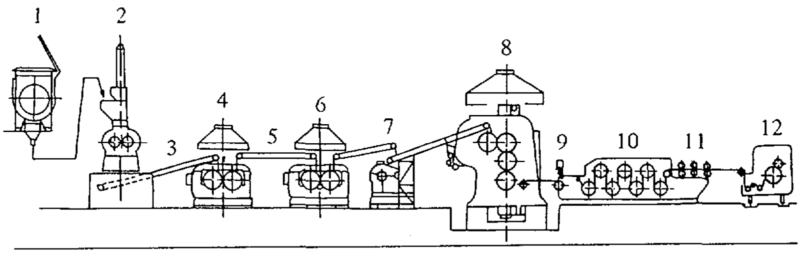
Item	No. of set
Instrument for compounding	2
Blending equipment	1
Intensive mixer with induction motor (75L heavy type)	1
Two roll mill with induction motor (610 mmϕ x 1,830 mm length)	2
Strainer-extruder with D.C. motor (200 mmϕ)	1
Conveyor	5
Calender (Inverted "L" 815 mmϕ x 2,290 mm)	1
Cooling equipment (2,100 mm length)	1
B-ray thickness gauge	1
Size trimmer	1
Cutting winder	1
Driving D.C. motor	4
Control equipment	1

FOB price of machinery and equipment . . **(approx.) $US 1,190,000**
Engineering & Know-how fee . . . . **(approx.) $US 143,000**

Process Flow Sheet for PVC Film Production



Process Flow Diagram for PVC Film Production



1. Ribbon blender
2. Intensive mixer
3. Conveyor
4. 1st two roll mill
5. Conveyor
6. 2nd two roll mill
7. Strainer-extruder
8. Calender
9. Embossing equipment
10. Cooling equipment
11. Thickness gauge
12. Winder

2) Thickness of products
0.075 mm

3) Weight of raw material
94 gr/m^2 170 gr/m

4) Production capacity
(approx.) 21,600,000 m^2/year
Weight of raw material
(approx.) 3,672 tons/year
Working hours
24hrs. x 250 days = 6,000hrs./year

2. Standard capacity of this plant

1) Mixing capacity
600 kg/hour

2) Calender speed
max. 80 m/min.

3) Calender train speed
60 m/min. (3,600 m/hour)

4) Working width
2,100 mm (width of products max. 1,800 mm)

5) Thickness of PVC calender film
0.05 mm – 0.1 mm

3. Required power consumption

1) Steam (14 kg/cm^2)
1,700 kg/hour

2) Water (at 15 – 20°C, pressure 3 kg/cm^2)
20,000 tons/hour

3) Electric power A.C. 380 V, 1,600 kWh

4. Electric source
380 V A.C. 50 cycle 3 phase

5. Required manpower for machine operation (Table 2)

Table 2

	Person
Blending process	3
Intensive mixer	1
Two roll mill	2
Strainer	1
Calendering, embossing, cooling & winding process	5
Total	12

6. Guarantee of the plant machinery
The guarantee period shall be 12 months after successful test operation but not to exceed 18 months after shipment from Japan.

7. Guarantee of the production
The quality of the products at the guarantee operation will be in accordance with the recipe stipulated before contract. The raw materials to be used should be confirmed mutually before contract. The calendering production quantity will be guaranteed by the capacity of guarantee operation per hour i.e. 3,600 m of 1,800 mm width x 0.075 mm calendering PVC thickness of the subject products.

Process Description

1) Blending equipment
PVC, plasticizer, stabilizer and other additives necessary for film production are fed into blending equipment to be blended uniformly.

2) Intensive mixer
Compound discharged from blending equipment is fed into intensive mixer to be mixed roughly.

3) Conveyor (No. 1)
Compound roughly mixed by intensive mixer is discharged onto conveyor (No. 1) to transfer to 1st two roll mill.

4) 1st two roll mill
Compound transferred by conveyor (No. 1) is put on 1st two roll mill to be mixed.

5) Conveyor (No. 2)
Compound mixed by 1st two roll mill is transferred to 2nd two roll mill by conveyor (No. 2).

6) 2nd two roll mill
Compound transferred by conveyor (No. 2) is put on 2nd two roll mill to further be mixed.

7) Conveyor (No. 3)
Compound mixed by 2nd two roll mill is transferred to strainer-extruder by conveyor (No. 3).

8) Strainer-extruder
Compound transferred by conveyor (No. 3) is fed into strainer-extruder to be mixed.

9) Conveyor (No. 4)
Compound extruded from strainer-extruder is discharged onto conveyor (No. 4) to transfer it to conveyor (No. 5).

10) Conveyor (No. 5) – Charge Conveyor
Compound transferred by conveyor (No. 4) is charged onto calender by charge conveyor.

11) Calender
Compound charged by charge conveyor is fed to calender and it is passed through the four rolls so that film in a specified thickness can be formed (hereinafter called PVC film). This process is called calendering.

12) Embossing equipment
PVC film calendered by calender is passed through embossing equipment.

13) Cooling equipment
PVC film is then passed through cooling equipment.

14) B-ray thickness gauge
When PVC film is passed through cooling equipment thickness of PVC film is measured by B-ray thickness gauge.

15) Side trimmer
Before PVC film is wound, both edges are trimmed by side trimmer. Edges trimmed are fed back to 1st two roll mill to be reclaimed.

16) Winder
PVC film trimmed is wound up by winder. From the end of rolled PVC film, suitable length of film should be cut to keep aside for inspection, and the roll is craft packed and labeled.

Table 3

Kinds of works	No. of consultant chemist	No. of supervising engineer	No. of specialist	Total man/day
(1) Supervision of erection and test operation of each machine (2 months required)		5		300
(2) Supervision of test operation of production line and short term production guidance (1 month required)	1	5	3	270
Total	1	5	3	570

How To Start Manufacturing Industries

Unplasticized PVC Pipe Making Plant

Unplasticized PVC (U-PVC) pipe came into being during World War II in Germany, where it was used as piping for plants and waterworks. In Japan, its mass production got under way in 1952, and today, more than 25 years after, quality products are being efficiently mass-produced by automated processes.

The application possibilities for U-PVC pipe are unlimited. Waterworks, irrigation, drainage and sewerage -- these are only a few of the application fields of U-PVC pipe.

U-PVC pipe has outstanding properties and performance. Its specific weight, 1.43, is about one-fifth of that of a steel pipe. And it has enough strength which does not dent or flatten under external and internal pressure.

Its properties are chemically excellent, it resists acid, alkali, fat and oil. It is, therefore, highly recommendable for transporting chemical solutions, gases, and other corrosive materials. Furthermore it is free from rust and keeps good hygiene, which urges many cities to adopt for piping waterworks.

U-PVC pipe minimizes flow loss and impedes the build-up of deposits and corrosive scales thanks to its mirror smooth inside surface and chemical resistance.

U-PVC pipe is ideal as an electric conduit. As it is itself an integral insulator, it eliminates the possibility of electrolytic corrosion which so often destroys underground metal piping.

Furthermore installation of U-PVC pipe is so instant and carefree thanks to a complete line of joinning system which is solvent cement method or elastic seal ring method. The latter method is very suitable for waterworks and drainage which is installed in building and underground.

Uses and Shapes of Products

1) Common pipes

Common pipes have such a large range of uses, possessing unparalleled characteristics with respect to non-corrosiveness and chemical resistance. They are, therefore, used for piping for transport of chemicals in various types of plants in every industry, including chemical plants.

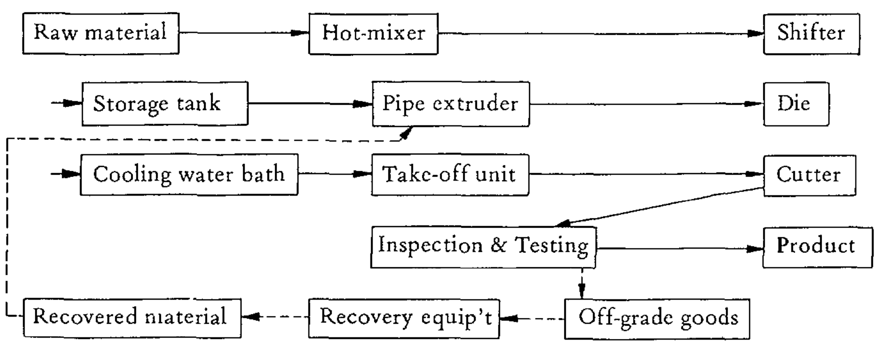
2) Pipes for waterworks

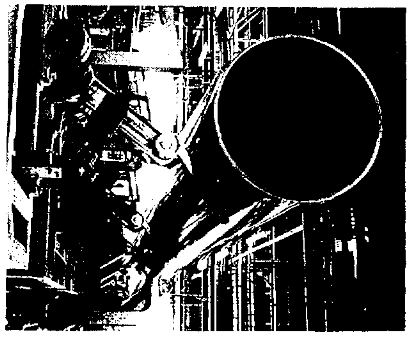
Being made of pure U-PVC, PVC pipes are harmless to the human body, and free of any colouring, odour, deposit, etc.
They have a greater strength than asbestos pipes while they do not rust like cast iron pipes.
U-PVC pipes remain unchanged underground for a long tim
Therefore, they are free from accidents due to corrosion and there is little fear of change in flow because the condition of their surface remains unchanged even if used for a long time.

3) Thin wall pipes

They are employed for purposes where comparatively large strength is required, such as draining pipes for various structures and those for plants. They are most suitable for drainage in buildings and at home.

Process Flow Sheet for U-PVC Pipe Making Plant





Pipe take-up machine

4) Electrical conduits

Thanks to their exceedingly superior electrical insulation, it is unnecessary to provide earthing and insulation coating. As they are not affected by electromagnetic influences in AC circuits, they provide singlewire plumbing. U-PVC conduits are most suitable for wiring in places where corrosive gas is likely to generate or electrical corrosion may occur as in the case of chemical plants. They are also free from risk of fire by leakage of electricity or sparks. As they are easily workable, they make complex wiring easily available.

Production Capacity

As mentioned, the minimum monthly output capacity per pipe extruder is 45 tons -- the minimum economy unit, using PVC resin, stabilizer, pigment, etc. as raw materials.

The working hour is 24 hr./day or 25 days/month on a three or two shift basis.

The reason for adopting 24-hour-a-day operation is that consideration has been given to prevention of loss in time (heating-up, etc.) at the beginning and ending of operation and consequent loss in chemicals as in the case of other industries.

Although above mentioned plant capacity of 45 tons/month is a minimum scale, other bigger scale plants and expansion of production capacity are easily available.

Locational Condition

The ambient temperature preferred is between 10-30°C. Humidity has nothing to do with the operation, but it is preferably around 70%.

Recommendable water temperature is 25°C approx. Electric power, water and compressed air are required. However, steam is not required.

The required plant building area is 600 m^2 (15 x 40 m).

The required land area is about 2,000 m^2.

Kinds of Processes

Although there is not much difference between the processes for making U-PVC pipe, the classifications might be roughly as follows:

Compounding system:
- Pellet system
- Powder system

Pipe moulding system by:
- Single screw extruder
- Twin screw extruder
- Other screw extruders

The above systems differ somewhat from each other from the standpoint of being automated or manual, as well as in regard to accessories.

It is difficult to say in the lump, which process is best because each process has its strong and weak points.

However, from many years of experience in research and development the powder system has been found to be the best for the compounding of raw materials, and among the equipment for pipe making, the twin screw extruder is the best for moulding.

The twin screw extruder has many types mentioned as follows:

(1) Parallel-rotation
(2) Counter-rotation screw
(3) Conical screw
(4) Special designed screw

The most recommendable extruder type is conical screw type thanks to its economic and easy maintenance among other extruders.

Kinds of Products

The annual output of U-PVC pipes in Japan is over 300,000 tons, the greater part of which is turned out by plastic products makers. U-PVC pipes are classified into pipe for: (1) water works (2) sewerage and drainage (3) irrigation (4) electrical conduits (5) industries (6) special purposes

In addition, the above pipes are manufactured with varying wall thicknesses according to their uses.

U-PVC pipes are manufactured, through application of extrusion techniques, with apertures ranging from 1/4" to 28".

The future trend of manufacture of U-PVC pipes in Japan is not only for making it possible to manufacture efficiently large aperture (30, 40") pipes, but also for advance into fields of pipes with special properties, namely, those with high-heat-resistance and strong anti-shock property, etc.

Of course, high-heat-resistant and anti-shock pipes are being manufactured. However, it is believed that unique products of PVC will be manufactured through improvements.

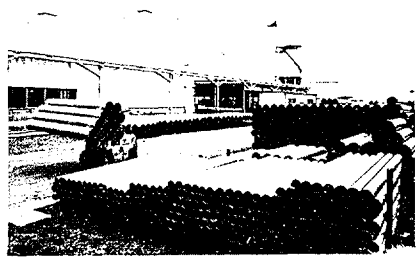
Table 1: Required Machinery and Equipment

Item	No.
Pipe moulding section	
Hopper loader	1
Extruder, twin conical screw	1
Automatic thermal controller	1
Moulding dies 20ϕ - 160ϕ	8
Water bath	1
Take-off and cutting machine	1
Ancillary equipment and device	1
Working tools for special use	1
Compressor and vacuum pump	1
Recovery section	
Scrap cutter	1
Crusher	1
Post fabrication section	
Socket forming machine	1
Socket forming dies 63ϕ - 160ϕ	4
Bell sleeve socket forming device 20ϕ - 160ϕ	8
Testing and inspection section	
Pressure test equipment	1
Impact test equipment	1
Gauge	1

FOB price of machinery and equipment........ (approx.) $US 377,000

This price does not include the following items:

(1) Utility equipments
(2) Foundation and installation works and materials
(3) Piping and wiring works and materials
(4) Know-how fee and/or royalty



Pipes stockyard

Incidentally, off-grade pipes may be put in recovery equipment for regeneration of raw material for pipes which may be used as a first grade product.

Table 2: Required Raw Materials and Utilities

The monthly requirement of compound for manufacture of U-PVC pipes is about 45 tons on the operation basis of 24 hours/day, 25 days/month.

Required utilities are:

Electricity ...... 32,000 kWh/month
Water (18-25°C) .... 120 ℓ/min

Table 3: Required Manpower

Item	No.
Worker for pipe manufacture	8
Worker for post fabrication	4
Engineer	1
Test, scrap recovery, etc	2
Packaging and delivery	2
Maintenance, office work	1
Total	18

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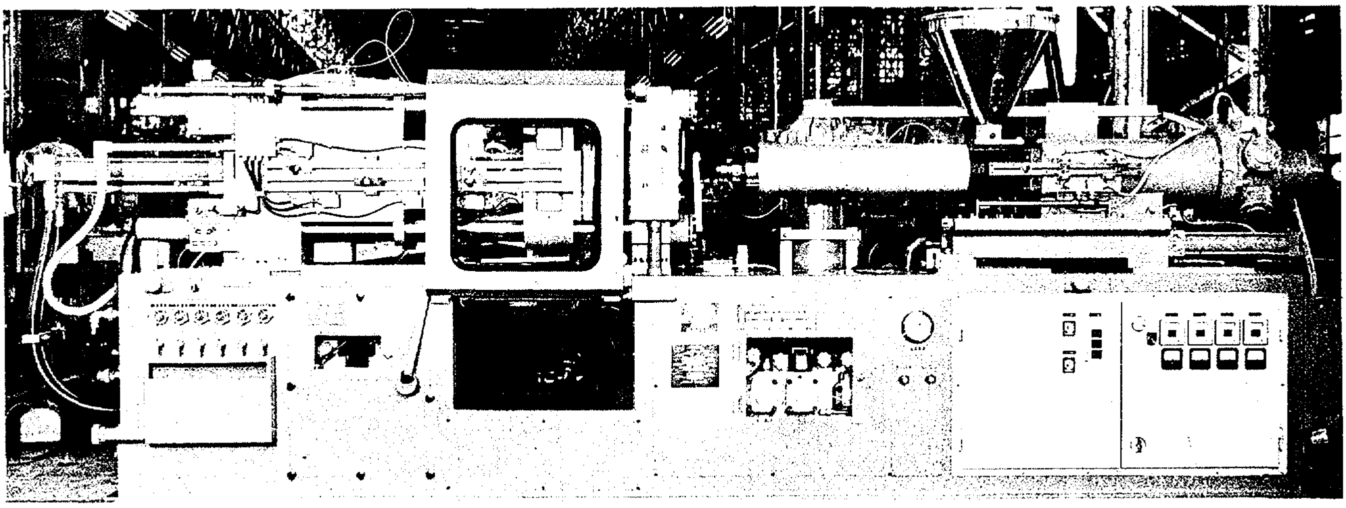
ISIC 3560

How To Start Manufacturing Industries

Plastic Container Making Plant



Injection moulding machine

Plastic is a compound which is synthesized with various raw materials as petroleum, natural gas or coal, and industrial salt. There are solids, liquids, and semi-solids such as phenol resin, urea resin, polyethylene, and styrol. Each is used in suitable ways.

Generally, plastics are classified into thermosetting and thermoplastic resins. The characteristic of the former is that when heat and pressure are applied to it and hardened, it will not become flexible when heat and pressure are applied again. The latter, however, will become flexible when heat and pressure are applied again, and so it can be repeatedly transformed.

Features of Plastics

(1) Plastic is a good electric insulator.
(2) Plastic is lighter and strong enough compared with metals and ceramics.
(3) Plastic is immune to moisture and mould. It will not rust or rot, and it will endure chemicals.
(4) Most plastics have good clarity, and so they can be coloured freely.
(5) Difficult and complicated shapes can be produced rather easily.
(6) Processing is easy and mass production is possible; therefore, products can be supplied cheaply.

Kinds of Plastics and the Uses

1. Thermosetting Resins

1) **Phenol resin**
Phenol resin has superior electric insulating property. It is also strong against water, oil, and chemical. Therefore, it is used as insulating material, and for paint, and adhesives.

2) **Urea resin**
Urea resin is used as insulating material, adhesives for plywood, and for paint.

3) **Melamine resin**
Melamine resin is used extensively for tableware. It is also used widely for paint.

4) **Unsaturated polyester resin**
This plastic with reinforced glass fibre (FRP) is well-known.

5) **Epoxy resin**
Epoxy resin is poured into the mould in a liquid state. It is used for moulding electrical parts.

2. Thermoplastic Resins

1) **Vinyl chloride resin**
Vinyl chloride resin is used for forming pipe, joint, and sheet. Plasticizer is used for softening the resin to make film, sheet, and artificial leather.

2) **Polyethylene**
Polyethylene is flexible, and the cost is cheap. It is used for packages for packing food, and also for making buckets, and other daily necessaries.

3) **Polypropylene**
Polypropylene is quite heat-resistant, and it is the lightest plastic. It is used for various sorts of containers, daily necessaries, and packing films.

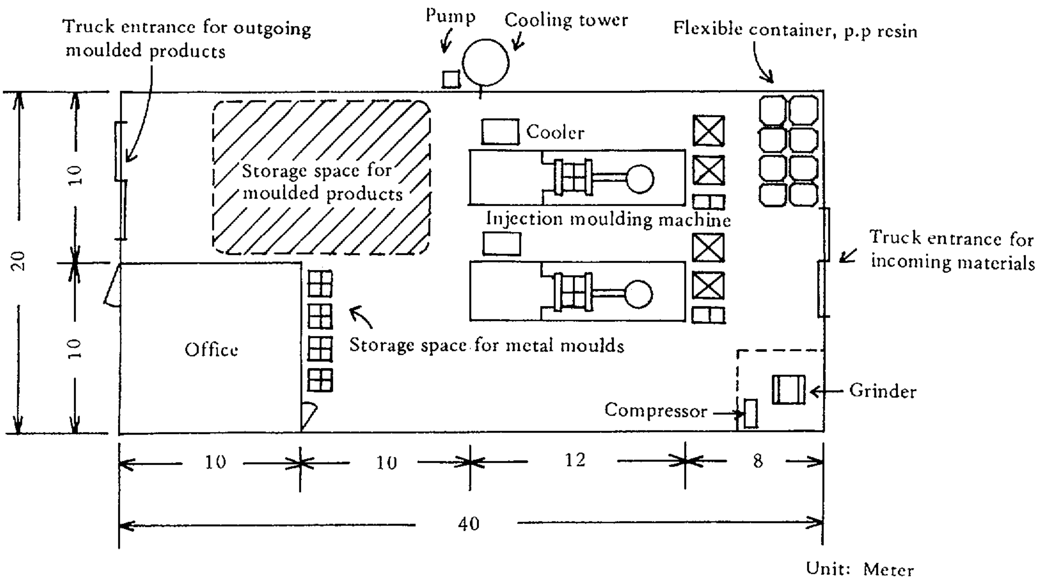
4) **Polystyrol resin**
The price of polystyrol resin is cheap. It has good forming property, and the transparency is good. It is used extensively for containers, but it breaks easily. It is generally called GP. GP polystyrol in which synthetic rubber was added is called HI polystyrol, and the anti-shock property is excellent. HI is used for cabinets and cases such as that for radios.

5) **AS resin**
AS resin is hard and strong. It is used for the handle of toothbrush and for containers.

6) **ABS resin**
ABS resin is made by mixing synthetic rubber with AS. It is used for electrical parts, automobile parts, and in many other ways.

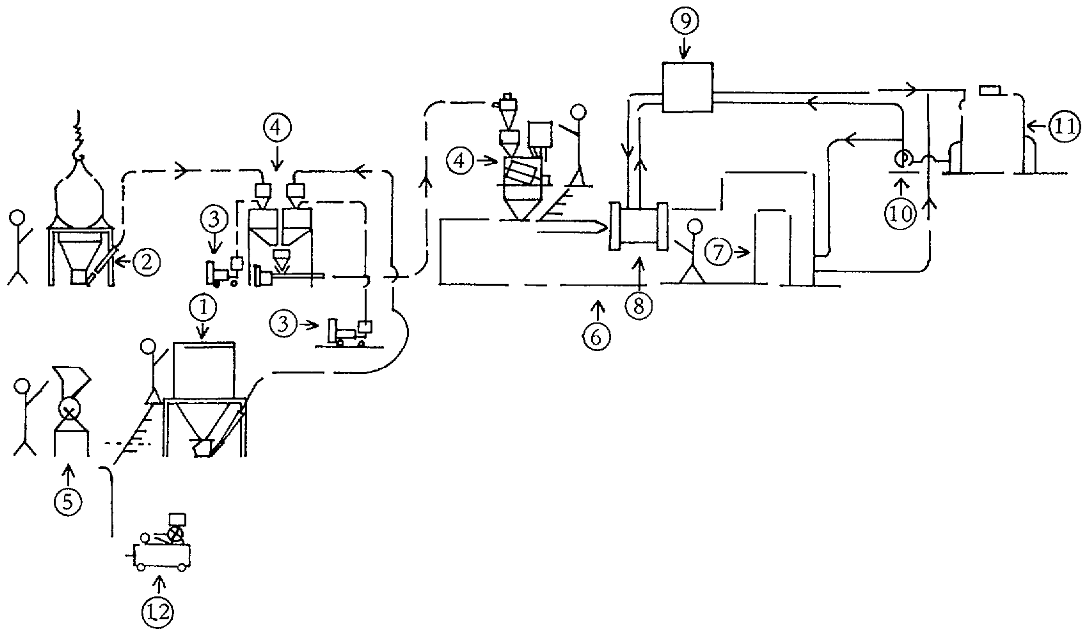
7) **Meta acrylic resin**
Meta acrylic resin is hard and glossy. The transparency is excellent; therefore, it is widely used for lens and as organic glasses.

Layout for Plastic Container Making Plant



Note: Building area . . . . 800 m^2
(including office area . . . 100 m^2)

Process Flow Diagram for Plastic Container Making Plant



8) Polycarbonate

Polycarbonate has high resistance to impact, and so it is used for machine parts and helmets of safety appliance.

9) Polyamide (nylon)

The wear resistant quality of polyamide is excellent, and so polyamide is used for gear and bearing. It is well-known as a textile fibre.

10) Acetal resin

As an engineering plastic, this plastic is now used widely for electrical parts and machinery parts.

Moulding Techniques of Plastics

1) Injection moulding

This method is used widely in forming thermoplastic resin. The resin melted in the heating chamber of the injection moulding machine is forced through an opening into the cooled mould where it sets.

2) Extrusion

The resin is melted in the heating chamber. Then it is extruded through the die opening and formed continuously.

3) Blow moulding

The resin extruded in a tube shape is inserted in a metal mould. Then compressed air is blown in to expand the melted resin.

4) Compression moulding

The resin is put in a metal mould. Heat and pressure are applied to melt the resin into the desired shape.

5) There are other methods such as the inflation and T-die methods which are widely utilized for film making; the calendering method which is widely used for forming artificial leather; and the foaming method in which a foaming agent is added to the resin.

Plastic Container Making Plant

Recently, plastic container is being used in various ways. It is used as a bottle container for beer, sake (beverage), and juice; as an agricultural container for vegetable and fruit; as a container for marine products; and as a container for processed goods such as bread. (The plastic container described in this report does not include daily necessaries such as bucket, washbasin, and cup.)

The description here will be made for the layout of an injection moulding plant for container using as raw mateiral polypropylene which is generally used widely for various purposes.

(1) The raw material polypropylene is procured in 500 – 1,000 kg flexible containers. The container is lifted onto the container bag stand by an electric hoist. When the container bag is stabilized the bottom seal is cut open, and the raw material is charged into the stock tank.

(2) The raw material is hauled automatically to the weighing section of the full automatic measuring, mixing and colouring equipment.

(3) After being weighed correctly at the measuring section, the raw material is carried to the mixing section. The raw material is mixed with the correctly weighed pigment. Then the mixture is stored in the hopper which is on the forming machine.

(4) The raw material which has been plasticized in the cylinder is injected into the cooled metal mould.

(5) After a fixed length of time the moulded product is taken out by the operator, and the "flash" on the moulded product is scraped off to produce the finished product.

(6) The spool runner is crushed by the grinder and then stored in the stock tank. The crushed material in the stock tank is returned to the measuring section by the suction loader and weighed correctly for regeneration.

(7) Generally, a metal mould cooling equipment is used to speed up forming. The cooling time can be shortened by 15 – 20% in the summer compared with cooling only by industrial water.

(8) It would be desirable economically to use a cooling tower to circulate the water for cooling the forming machine and the metal mould cooling equipment.

Moulded Product at the Model Plant

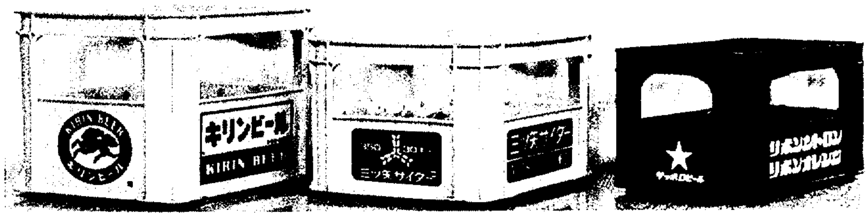
Raw material:	Polypropylene
Size:	(top) 628 mm x 475 mm, (bottom) 544 mm x 393 mm, (height) 317 mm
Weight:	(main body of product) 2.2 kg, (spool runner) 0.2 kg
Colouring:	Dry colour (0.5% of main raw material)
Moulding cycle:	60 seconds/piece
Injection moulding machine:	24 hours running time with two machines will produce 2,880 pieces of moulded products and 576 kg of spool runner.

Required raw materials and utilities:

(1) Polypropylene .... 6,912 kg

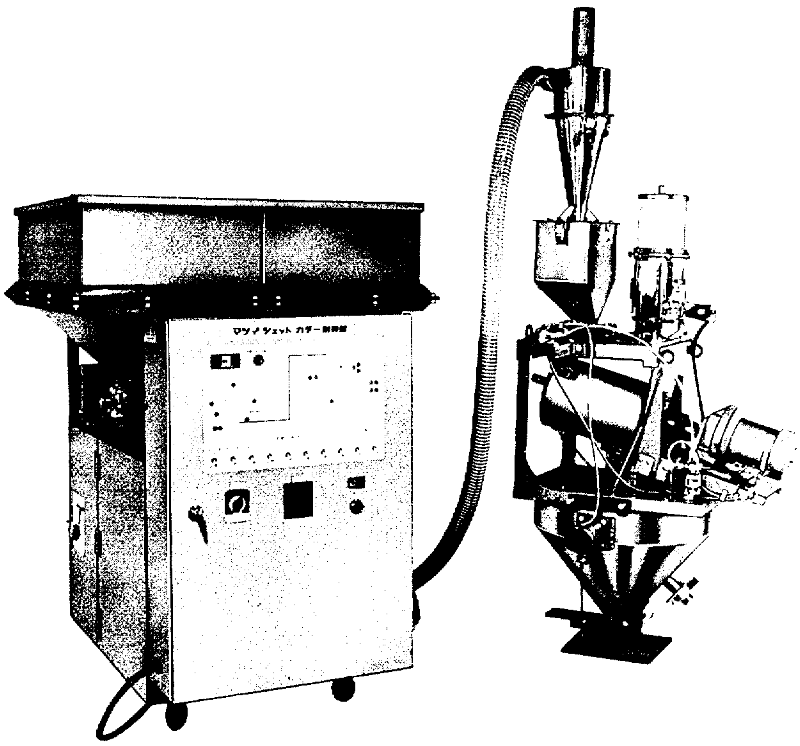
(2) Pigment .... 34.56 kg

(3) Electricity .... 10,478 kWh/day



Product pallet

The colouring process and the material conveying process of this forming plant are rationalized, i.e. labour saving, and so manual labour will be limited to handling of the flexible container bag, charging the pigment, taking off and transporting the formed product, crushing the spool runner, and charging the material into the stock tank. The work of mixing the raw material (purchased in 25 kg paper bags) and pigment in a drum tubler, returning the mixed material in the bag and carrying it manually to the hopper of the forming machine will be eliminated; thus, one male worker would be unnecessary. No heavy work would be necessary, and so even a female worker would be able to do the work.



Full automatic weighing, mixing and colouring equipment

Table 1: Required Machinery and Equipment

	Item	No.
1	Tank for ground material (1 m^3 mounted tank)	2 sets
2	Mounting (0.5 m^3) for flexible container and material tank	2 sets
3	Vacuum loader (33 kW)	4 sets
4	Full automatic measuring, mixing and colouring equipment (4.3 kW)	2 sets
5	Grinder (22 kW)	1 set
6	Injection moulding machine (176.6 kW, 800 tons, 100 oz.)	2 sets
7	Automatic control panel for injection moulding machine	2 sets
8	Die for container	2 sets
9	Cooling equipment for dies (15 kW)	2 sets
10	Pump (3.7 kW)	1 set
11	Cooling tower (3.7 kW, 100 tons)	1 set
12	Air compressor (2.2 kW)	1 set
13	Various kinds of scale	1 set
14	Various kinds of tool	1 set

FOB price of machinery and equipment ...... (approx.) $US 1,762,000

Besides the above, the following would be necessary at the spot.

(1)	Travelling crane for moulds	1 set
(2)	Hoist for flexible container	2 sets
(3)	Equipment for water supply	1 set

Table 2: Required Manpower

Item	No.
Engineer	3
Foreman	3
Technician	3
Plain worker	3
Clerical worker	1
Total	13

Any inquiry about the information contained should be sent to: IO/COOP, Registry file No. ID/562/12, UNIDO, P.O. Box 300, A-1400 Vienna, Austria.

How To Start Manufacturing Industries

Polyester Button Making Plant

Needless to say, polyester buttons have become synonymous with shirt buttons, because nowadays if one says "polyester button," it is understood to mean shirt buttons, leaving it to enjoy the largest demand in the button industry.

There are various types of buttons on the market, including shell buttons, the oldest type, urea buttons mainly for men's suits, trousers, and pajamas, acryl buttons for ladies dresses, casein buttons, wood and metal buttons, etc., including special buttons which are manufactured in small quantities.

Manufacture of polyester buttons in Japan made rapid strides after the war with mass consumption seen at home and in exports.

The fast development of the polyester button industry is attributed to improvement in manufacturing methods, which have made mass-production available, although it is also due to the advent of polyester resin.

Process Description

There are various manufacturing processes of polyester buttons, as outlined hereafter:

1) Sheet processing

This is the primary process of the plant, generally called the material plant.
The materials required for manufacture of sheets are 100 parts of polyester resin, 1 part each of promoter and catalyst, and 1 – 1.3 parts of pearl essence.
The only machine used for sheet making is a centrifugal spinning machine.

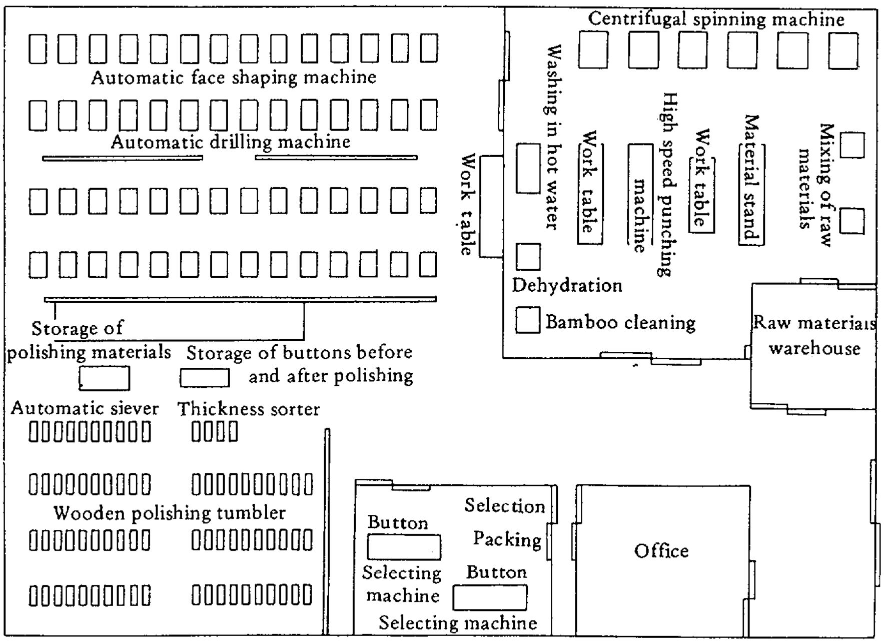
2) Button blank cutting

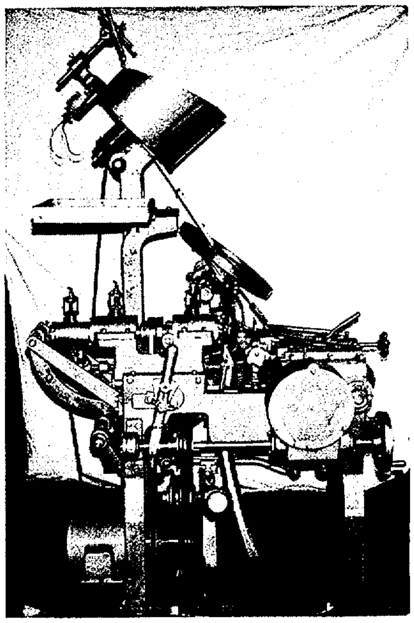
In this process, different machines are employed according to the hardness of the sheet desired. High speed automatic punching machines are used when punching soft sheet, and automatic blank cutting machines when punching harder sheets.

3) Button making

Button blanks are then fed into (1) an automatic face shaping machine with electric eye, or (2) an automatic drilling machine or automatic fish eye cutting and drilling machine, so as to manufacture buttons into the required designs.
There is a rotary type automatic button making machine (vertical and horizontal) which carries out face shaping, fish eye cutting and drilling on a single machine.
In Japan, there are two types of plants—one adopting the (1) and (2) processes, and the other using the rotary type machine.
So far as quality is concerned, the former is better.
The above processes both refer to manufacturing of flat buttons, the remaining process for which being polishing in the tumbling barrel.

General Arrangement of Polyester Shirt Button Making Plant





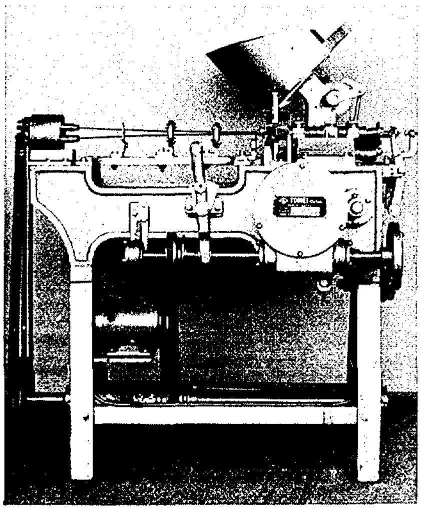
Automatic face shaping machine

4) Wavy pressing

If a wavy effect is required for the surface, a wavy pressing process is necessary with an hydraulic press while the sheet is still soft after manufacturing. Buttons made from wavy sheets are called wavy buttons.

5) Shank button making

There are two processes. One is a process in which sheet is made to a fixed thickness in the conventional manner for the making of shank by shaping the back side of the sheet. Afterwards, face shaping, rear side cutting and drilling take place. In this process, (1) an automatic face shaping machine for back side shaping; (2) automatic face shaping machine for surface and (3) automatic rear side cutting and drilling machine are required.
In another process developed recently, the shank is to be stitched on to the back of the sheet. The shanked sheet is then cut and drilled with the semi-automatic blank cutting and drilling machine, and lastly given a surface design by the face



Automatic Drilling Machine

shaping machine. In this process, (1) shank stitching machine; (2) semi-automatic blank cutting and drilling machine, and (3) automatic face shaping machine are required.

6) Polishing

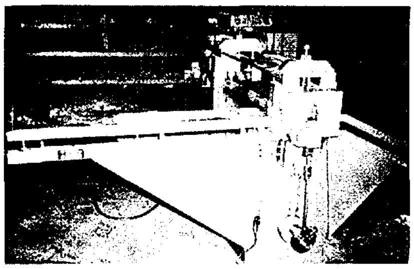
Buttons are then polished through three processes in the wooden polishing tumbler.

7) Selection and packing

Polished buttons are selected before packing. All the processes come to an end when the buttons are placed in designated packages.

Outline of the Plant

The plant is primarily designed to turn out polyester plain flat buttons of 14, 16, 18, 20, 22, 24, 26, 28 and 30 line sizes, and of maximum and minimum grades with a daily output



High speed punching machine

capacity (8 hrs./day) of 400 great gross or 10,000 great gross/month (25 days/month).

Tables 1, 2 and 3 show respectively the machinery and equipment, raw materials and utilities, and manpower required for a construction plan of the above plant.

Locational Condition

No strict locational condition is required for the plant on account of the character of its products, except for the need for giving attention to the combustibility of products as well as for installing a dust collector.

However, it is desirable that the plant will be located in a provincial area where raw materials and products can be easily transported.

Polyester should be kept in a place where the temperature is low (below about 20°C). It is necessary not to keep resin in quantity that will be consumed over a long period, but to keep it in a small quantity matching consumption.

Table 1: Required Machinery and Equipment

	Item	No. of set
1)	Centrifugal spinning machine	6
	Portable type mixer	2
	Pressure glass	100
	Scale	1
	Tube	1
2)	High speed automatic punching machine	1
	Cutter for all sizes	9
	Cutter grinder	1
3)	Automatic face shaping machine with spare parts	28
4)	Automatic drilling machine	28
5)	Wood polishing tumbler (1st process)	8
	Same for 2nd process	64
	Same for 3rd process	2
6)	Auxiliary machines	–
	Automatic thickness sorter	1
	Automatic siever	1
	Button selecting machine	2
	Washing tumbler for bamboo	1
	Dehydrator	1
	Auxiliary tools such as bench grinder, hand siever, oil stones, diamond stones, drill gauge, button calculator, packing machine, etc	1

FOB price of machinery and equipment ..... (approx.) $US 333,000

Table 2: Monthly Requirement of Raw Materials and Utilities

Item	Quantity
Raw material	
Polyester resin	6,500 kg
Promoter	65 kg
Catalyst	65 kg
Pearl essence	65 kg
Electricity	9,750 kWh
Others ...... Packing items, Lubricating oil, Spare parts, Polishing materials, others	

Table 3: Required Manpower

Item	No.
Director	1
Clerical worker	2
Technician	2
Worker	11
Total	16

How To Start Manufacturing Industries

PVC-Asbestos Tile Making Plant

The so-called plastic tiles include PVC asbestos tile, PVC tile, asbestos tile, rubber tile, etc., among which the most produced item is PVC asbestos tile.

As of 1970, the output of PVC asbestos tile was 33.3 million square meters, including 30 million m^2 of 2 mm, 80,000 m^2 of 3 mm and 2.5 million m^2 of special sizes and unique types.

They included 2.3 million m^2 of PVC tile and 300,000 m^2 of asphalt tile, and the quantity of rubber tile is negligible.

The total of tiles other than PVC tile is less than ten per cent of 2 mm PVC tiles. Accordingly, the output and the production costs mentioned below will all be based on PVC asbestos tile measuring 2 mm in thickness and 300x300mm.

Features of PVC Asbestos Tile

(1) Colourfulness
Large variety in colour and finish.

(2) Outstanding non-slip property
With suitable flexibility, it is not slippery and free from such unpleasantness as loud footballs.

(3) Remarkable anti-water property
Long durability in anti-aging and resistance to injury.

(4) Anti-chemical property
Strong resistance to such chemicals as acid and alkali and fat and oil.

(5) Perfect insulation to electricity and fire proof
Strong electric insulation and highly incombustible.

(6) Easy laying
Precise size prevents deviation in laying tiles together.

(7) Economy and cleanliness
Wiping with a piece of cloth, either dry or wet will do and maintenance is simple.

Minimum Economic Production Unit

Minimum economic production unit means the minimum unit of production capacity with which an industrial plant can turn out a product at a production cost that can withstand international competition. It is rather difficult in developing countries to make appraisal of, and set, the minimum economic unit for an industry from the present state of things in every country. In the initial stage of promoting an industry in the manufacture of PVC asbestos tile in any country, therefore, it is considered to be rather recommendable to start the industry from the minimum production unit from technical point of view.

Outline of Plant

The plant provides mass-production of PVC asbestos tile by continuous calender processing.

1. Basic type
   Output – about 200 m^2/hr., namely 1,200,000 m^2/year (6,000 hr./year) 4,800 tons/year (4 kg/m^2)
2. Standard capacity
   1) Mixing capacity of raw materials by intensive mixer: 1,000 kg/hr.
   2) Calender speed (mechanical maximum speed): 12 m/min.
   3) Calender train speed (normal) : 3-5 m/min.
   4) Working width: 1,000 mm
   5) Thickness range: max. 4 mm
3. Required power consumption (approx.)
   1) Steam (10 kg/cm^2): 450 kg/hr.
   2) Water (at 15-20°C, pressure 3 kg/cm^2): 3,000 ℓ/hr.
   3) Electric power (380V, AC, 50 c/s 3 phase 4 wire): 600 kW/hr.
4. Required manpower (total: 12 persons)
   1) Compounding & blending process: 3 persons
   2) Intensive mixer: 1 person
   3) Two-roll mixing mill: 2 persons
   4) Calender: 2 persons
   5) Cutting machine 2 sets: 4 persons
5. Erection, installation and test operation
   If requested, the Japanese manufacturer is ready to dispatch engineers for supervising the erection, installation and test operation at the plant site. In this case, such expenses as round-trip ticket, inland transportation fee, personal insurance fee, boarding, lodging fee and daily allowance shall be borne by buyer. The required period and the number of engineers shall be estimated as follows.
6. Guarantee of the production
   The quality of the products at the guarantee operation will be in accordance with the recipe stipulated after checking/studying the locally available materials by the manufacturer.
   The raw materials to be used should be confirmed mutually study of local materials by the manufacturer.

Process Description

1) Measuring/Compounding
To measure precisely PVC resin, plasticizer, filler, stabilizer, binder and pigment according to the compounding instruction submitted by the consultant.

2) Blending
To give the measured raw materials into the ribbon blender then blend to uniform wet powder-compound.

3) Mixing
Mixing is made in two steps;

a) Intensive mixer
Wet powder-compound from the blender is fed into the intensive mixer, where it is compulsorily mixed, under steam-heated condition, by 2 rotors in steel chamber and floating pressure ram. Here, wet powder-compound becomes to elastic lump and is discharged onto the conveyor out of the lower door of the mixing chamber.

b) Two-roll mixing mill
Compound in a form of elastic lump discharged onto the conveyor which is situated under the intensive mixer, is charged onto the two-roll mixing mill, the rolls of which are heated by steam.

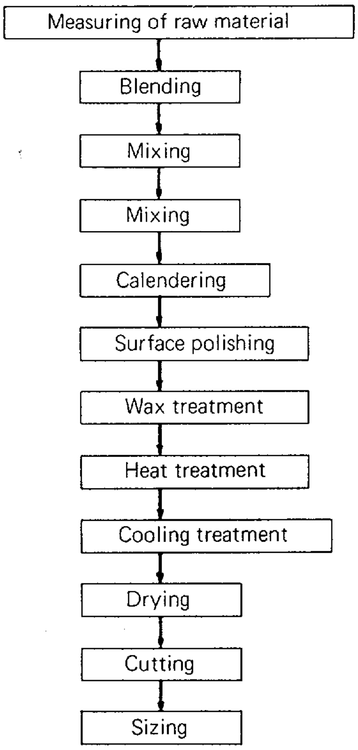
Here, it is fully heated and becomes to uniform compound.

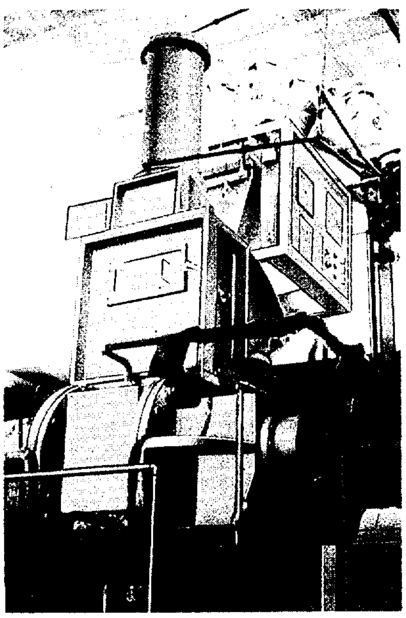
In this process, material, in a pellet form or in a sheet form, for giving marble design is added.

Marbling material in a pellet form is scattered by the help of marbling device which in installed on two-roll mixing mill, while marbling material in a sheet from behind the two-roll mill.

4) Cutting of compound
In case marbling material of sheet form is used, compound with the marbling sheet is rolled and fed to the cutting machine, then devided into 4 parts, horizontally and vertically.

In case of pellet form, the marbling pellet is scattered on the surface of com-





Intensive mixer

pound and is rolled in a moderate size, then is directly fed to the calender machine.

5) Feeding to calender machine

Compound, divided into 4 parts or in a roll, is put vertically on the charge conveyor and is transferred to the feeding device.

Feeding device is a device which compulsorily feed the compound to the calender machine.

If the feeding ability is not strong enough, you can not expect good quality of tile. (Tile with holes and/or with damage at both ends.)

Machinery and Equipment	Capacity	No.
1) Ribbon blender (50 HP motor with starter)	200 ℓ	1
2) Intensive mixer (150 HP motor with starter) (Ventilator)	100 ℓ	1
3) Warming roll (100 HP motor with starter)	23" x 72"	1
4) Two-roll calender, vertical (20 HP motor with change gear and starter)	24" x 60"	2
5) Annealing equipment		1
6) Cutting machine		1
7) Inspection equipment		1
8) Air compressor tank, receiver		1
9) Package boiler	1 t/hr.	1
10) Tanks: Fuel oil		1
Plasticizer		1
11) Water treatment equipment		1
12) Electric equipment: output 380V		
13) Transportation equipment (including two-folk lift)		1
14) Mixing roll for special pellet	18" x 54"	1
15) Pelleizer with motor		1
16) Pellet tank and transportation		1
17) Laboratory equipment		1

FOB price of machinery & equipment .... (approx.) $US 1,048,000
Engineering and know-how fee .... (approx.) $US 143,000

Kinds of works	No. of consulting chemist	No. of supervising engineer	No. of speaialist	Total
1) Supervision of erection and test operation of each machine (2 month required)	–	4	–	4
2) Supervision of test operation of production line and short term production guidance (1 month required)	1	4	2	7

6) Rolling by calender rolls

Compound fed by feeding device is rolled into a certain thickness and width by the help of calender machine.

Thickness control is made by electrical control mechanism in the calender machine.

Sheet cut at both ends is recovered by the trimming conveyor and is fed again to the two-roll mixing mill.

Sheet rolled by the calender machine has rough surface to some extent. So it is polished in the embossing device for better surface.

7) Surface treatment

Wax is spread onto the sheet after embossing device. This wax treatment is done so as to give property as a tile such as anti-abrasion, anti-flaw, easiness of cleaning, glaze, dirt-proof, etc.

8) Annealing

Sheet rolled by calender machine has tendency to shrink after tile is formed because the sheet is stretched the direction of rolling.

Annealing equipment eliminates this shrinkability by feeding the sheet onto the surface of rolls heated by hot water or by steam with the simultaneous heating on the surface by infra-red heaters.

9) Cooling

The heated sheet is soft just after annealing equipment and is necessary to be completely cooled by the cooling equipment.

As a first step, it is cooled by air to the temperature of wax being stiffened then shower with a certain water temperature is given on the sheet.

Shower water is cooled by the chilling unit.

10) Dryer

Cooled sheet with water from shower is passed through rubber tolls for water absorption then completely dried up by blowing hot air.

11) Shearing

Dried sheets are cut here into certain length and then piled up face to face.

12) Sizing of tile

Sheared sheet with a certain length is left as it is for 2-3 days, than is piled up on the table of circular sawing machine fixed by archery type springs and is cut to a certain size in one direction by 90 degree, again to fix by archery type spring then to cut to the remained direction.

Thus PVC asbestos tile with a certain size comes out.

13) Pelletizer

This machine is for making marbling material in a pellet form.

Locational Condition

For the plant site, it will be sufficient to procure a lot about 2,500 square meters including one train of calenders, inspection yard, warehouse for materials and products, office, boiler room, and rooms for workers and guardmen.

How To Start Manufacturing Industries

PVC Wall Covering Making Plant

Features of PVC Wall Covering

The definition of PVC wall covering is "a sheet with PVC lamination on the back of the paper, which has plasticity and which can be plastered on the wall and ceiling by using an adhesive."

The main purpose of using wall covering is for interior decoration. Accordingly the required features for fully satisfying the definition and use are necessary in PVC wall covering. That is:

(1) PVC wall covering must be easy to plaster.
(2) The interior decorating effect must be great, and the effect should last.
(3) PVC wall covering must be washable, and must be durable.
(4) PVC wall covering must be flame retarding.
(5) Heat insulation must be good, and dew condensation must be difficult.
(6) PVC wall covering must be highly resistant to fungus and moisture.

What sort of machinery would be best for manufacturing PVC wall covering with the above-mentioned features? The general cost, the method of processing, the production output, the required power, the required man hour, installing, conditions of dispatching engineer for operation guidance, engineering and know-how, and many other things must be considered. These points will be explained below.

General Terms and Conditions

1. Size of finished product
   Width: 1,000 mm - 1,200 mm (standard)
   Thickness of PVC calendering sheet: 0.15 - 0.20 mm
2. Production capacity
   1) PVC thickness on paper: 0.15 mm
   2) Width: 1,000 mm
   3) Calender train speed: 40m/min.=2,400m/hour
   4) Raw material consumed: 480 kg/hour
3. Required power consumption
   1) Steam (14 kg/cm): 1,500 kg/hour/line
   2) Water (at 15-20°C pressure 3 kg/cm^2): 50,000ℓ/hour/line
   3) Electric power A.C. 380V: 1,300 kW/hour/line
4. Electric source
   380 A.C. 50 cycle 3 phase
   Allowable voltage fluctuation±10%
   Allowable frequency fluctuation ±2 cycle

Process Description

1) Blending
   Such raw materials as PVC, plasticizer, filler, stabilizer and other additives are weighed manually according to the prepared mixture ratio to be fed into blender to be blended evenly. (In this section, auto-weighing and auto-feeding systems are also available, if so required.)
2) Compounding
   The mixture discharged from blender is then intensively compounded by intensive mixer.
3) Mixing
   The compound discharged from intensive mixer is uniformly mixed by 1st two roll mill and then by 2nd two roll mill.
4) Calendering
   The compound is passed through the four rolls of calender so that a flat film in the desired thickness can be formed.
5) Laminating
   The calendered flat film and back paper unwound from paper supplying device are laminated by laminating device.
6) Cooling
   The film with paper laminated is passed through cooling equipment to be cooled.
7) Winding
   The film is lastly wound by turret winder.
8) Making surface designs
   The film wound by turret winder is only a semi-finished product, whose surface should further be treated on the strength of such auxiliary machinery as embossing machine, printing machine, surface coating machine, foaming embossing machine, and valley printing machine, according to the surface design required. This process as well as embossing and/or printing rolls to be used for these machines will produce an infinite variety of PVC wall covering designs.
9) Inspecting and measuring
   The PVC wall covering thus produced is finally inspected and measured to the specified length by inspecting and measuring machine to subsequently be wrapped and labelled properly.

Table 1:

Kinds of works	No. of consultant chemist	No. of supervising engineer	No. of specialist	Total man/day
1) Supervision of erection and test operation of each machine (2.5 months =75 days required)	-	6	-	450
2) Supervision of test operation of production line and short term production guidance 1.5 month=45 days required)	1	6	3	405
Total	1	6	3	855

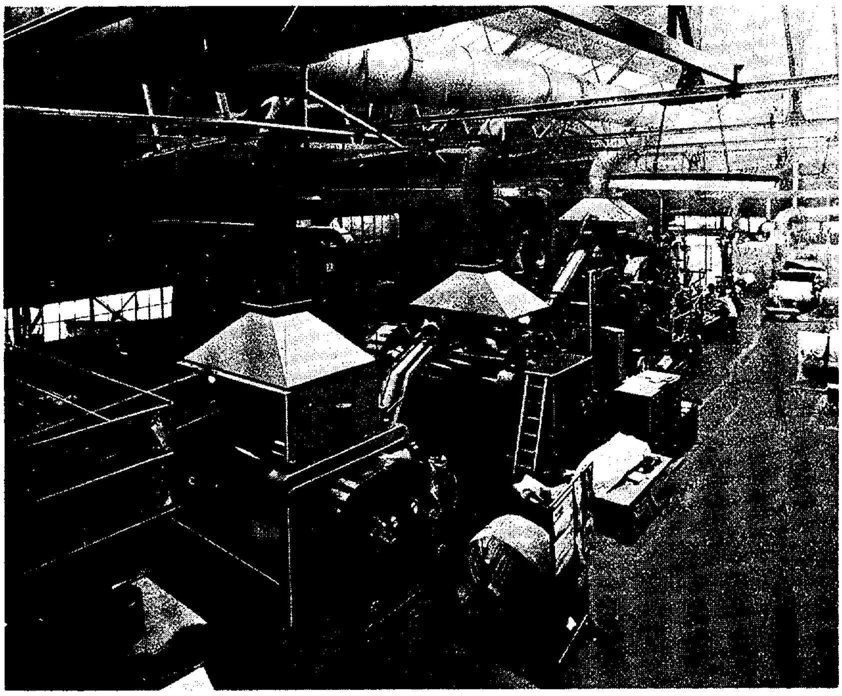
Table 2: Required Machinery and Equipment

Item	No. of set
1. Compounding equipment	
1) Instrument for compounding	1
2) 400L ribbon blender	1
2. Mixing equipment	
1) 75L intensive mixer	1
2) 150 KW induction motor for item 2.-1)	1
3) 24" x 72" two roll mill	2
4) 110 KW induction motor for item 2.-3)	2
5) No. 1 conveyor from intensive mixer 2.-1) to first two roll mill 2.-3)	1
6) No. 2 conveyor from first two roll mill 2.-3) to second two roll mill 2.-3)	1
7) Charge conveyor	1
3. Calender and calender train equipment	
1) Calender 24" x 72" inverted "L" 4-roll type	1
2) Trimmed edge conveyor	1
3) Edge position regulator	1
4) Laminating device	1
5) Paper supplying device	1
6) Cooling equipment	1
7) Turret winder	1
8) 150 KW DC motor for calender	1
9) 5.5 KW DC motor for laminating device	1
10) 5.5 KW DC motor for cooling equipment	1
11) Control equipment	1
4. Auxiliary equipment	
1) Kneader	1
2) Dissolver	1
3) 4-colour printing machine	1
4) Valley printing embossing machine	1
5) Unit embossing machine	2
6) Foaming embossing machine	1
7) 1-colour printing & surface coating machine	1
8) Embossing roll (standard)	6
9) Printing roll (standard)	12
10) Inspecting & rewinding machine	4
11) 8" x 20" test mixing machine	1
12) Boiler (actual rated evaporation: 2,000 kg/hour)	1
5. Spare parts for 2 years' running operation	
FOB price of machinery and equipment (approx.)	$US 1,905,000
Engineering and know-how fee (approx.)	$US 143,000

Table 3: Required Manpower for Machine Operation per Shift

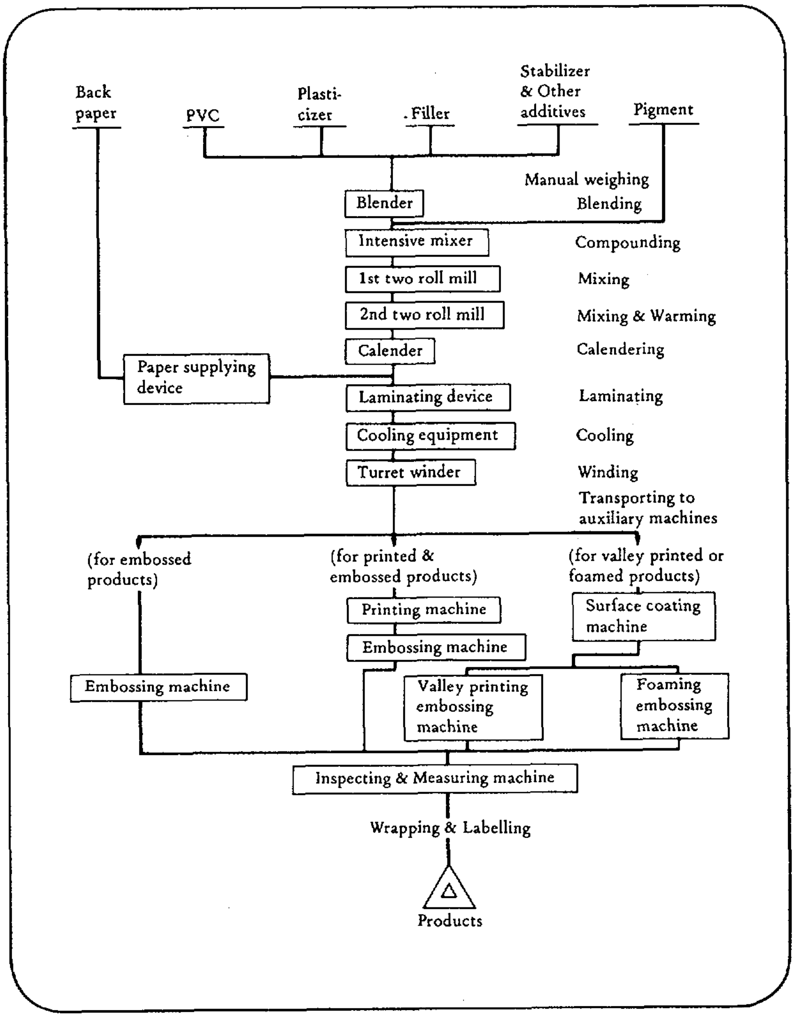
Workshop	No. of set	No. of person
Feeding process		3
Ribbon blender	1	1
Intensive mixer	1	1
Two roll mill	2	2
Calendering, embossing, cooling & winding process	1	5
4-colour printing machine	1	3
Foaming embossing machine	1	3
Unit embossing machine	2	4
Kneader & dissolver		1
1-colour printing & surface coating machine	1	3
Inspecting & rewinding machine	4	8
Boiler	1	1
Total		35

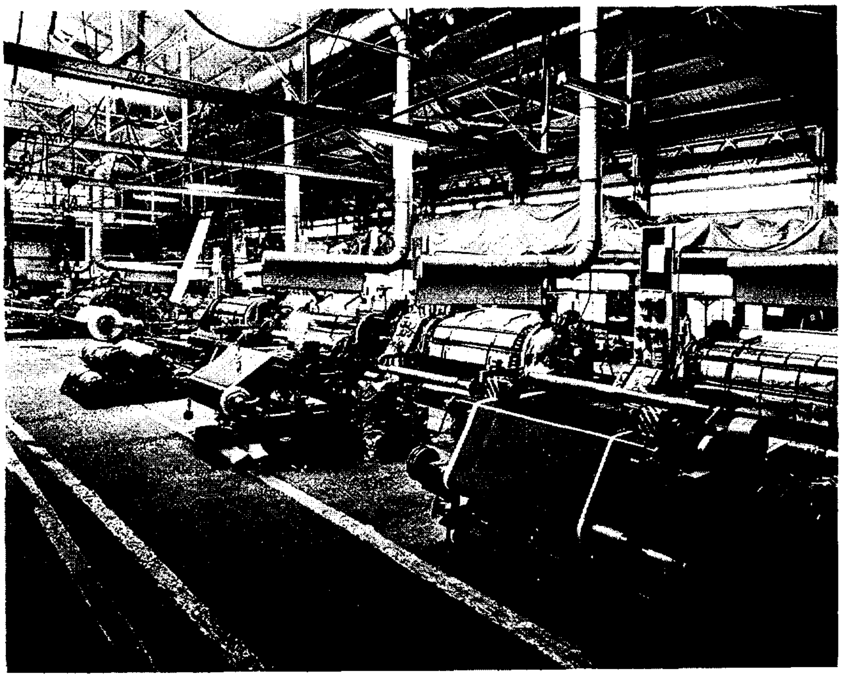
Note: Manpower for transport, warehouse, maintenance, and others necessary for factory management are excluded.



Two roll mill

Process Flow Sheet for PVC Wall Covering Making Plant





Any inquiry about the information contained should be sent to: IO/COOP, Registry file No. ID/562/12, UNIDO, P.O. Box 300, A-1400 Vienna, Austria.

How To Start Manufacturing Industries

PVC Flexible Tube Making Plant

In Japan PVC was first industrialized in 1949. Because of its being excellent in electric and chemical properties and of flow, it can easily be processed; in consequence of which, PVC has been developed and utilized for various purposes. As a result, the annual production of PVC has increased rapidly, attaining approximately 1,200,000 tons a year. In order to make use of PVC for various purposes, the technical development of plasticizer, stabilizer and other additives as well as of processing machines have rapidly been achieved.

Features

The production of PVC flexible tubes from PVC compound was started in 1949 by using an extruder. With the industrialization of PVC, extruders were developed in company with the injection moulding machine. In Japan too, the technical development of the extruder has been made in the past thirty years, attaining remarkable progress, and thus the demand for the extruded products, that can meet various purposes, has been expanded, attributing greatly to the growth of the plastic industry.

The first PVC flexible tube was a transparent, thin and light one which was used as an electric insulating material because of the excellent electric property PVC has, but subsequently, much thicker tubes, having a greater diameter, have come to be manufactured for more other purposes than the electric insulating material.

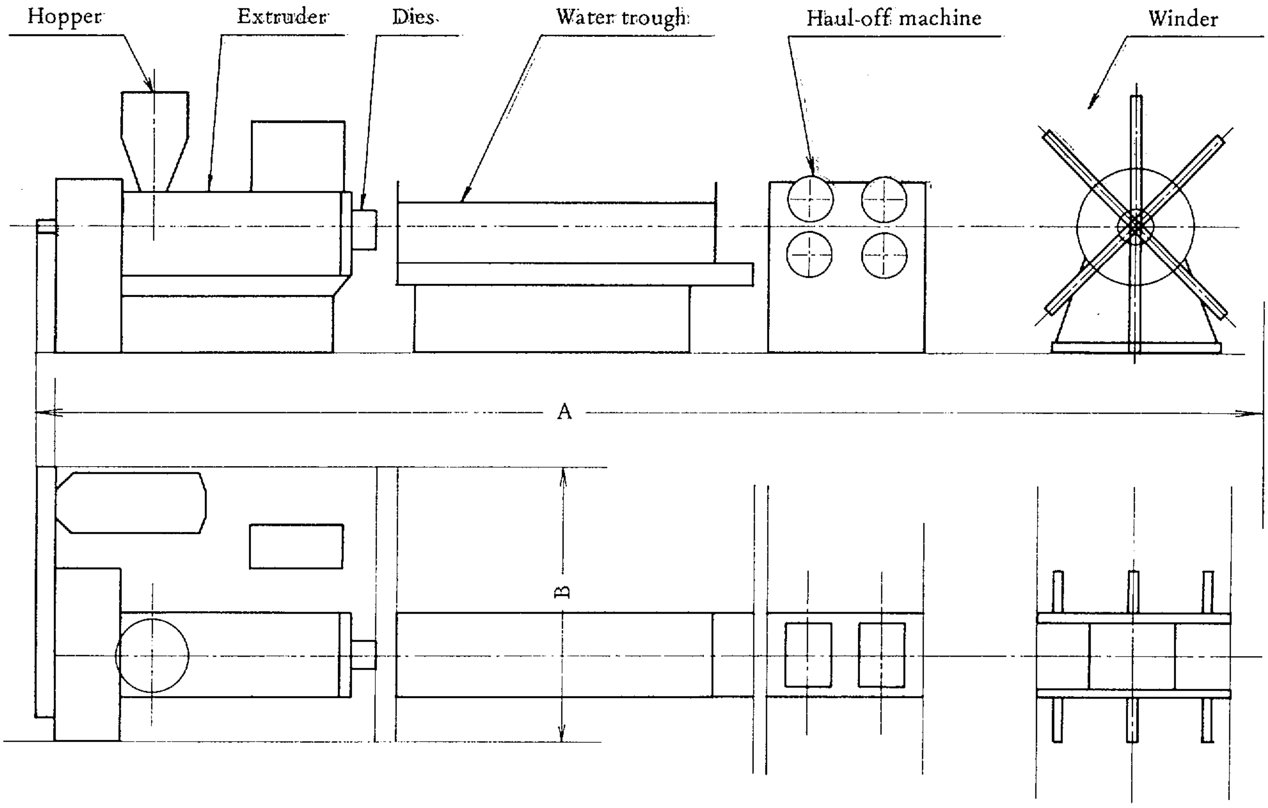
Namely, the PVC flexible tube is lighter than the conventional rubber hose, and more colourful and beautiful, and has aging and wear resistance and is easy to handle, and also a long tube can easily be extruded. For these reasons, PVC tubes are much in demand as household goods. Thanks to the development of special blending and mixing techniques in producing PVC compound, PVC tubes are being utilized in such new fields as agriculture, manufacturing industry, food processing, automobiles, etc.

Main Kinds and Purposes of PVC Flexible Tubes

1) PVC garden hose
In Japan beautifully coloured translucent or opaque hoses having a 15 mm to 50 mm inside diameter are being produced, of which the hoses with a 15 mm to 18 mm diameter are being produced in larger quantities. PVC garden hoses are more beautiful and lighter than rubber hoses, and slower in the aging, and are cheaper; because of which, PVC garden hoses are being widely used for gardening, car washing, farming and for home use.

2) General purpose hose
A variety of colourless and transparent or coloured hoses having a 3 mm to 100 mm inside diameter are being produced, and are used widely

Fig. 1: Projection and Plane Figure of Extruding Equipment



in agriculture, manufacturing and other industries as well as in the water supply, drainage, and in the transportation of liquid chemicals and the like.

3) **Oil resistance hose**
This hose is used as an automobile fuel tube and as a tube supplying oil to various machines and equipment. These hoses are made from a compound, in which special plasticizer and stabilizer, which are suitable for various kinds of fluid, are blended.

4) **Hose used for food transportation**
This is used as a tube transporting foodstuffs, refreshing drinks, beer, soy sauce, milk, etc. This hose is made from a specially blended compound containing no harmful things, when viewed from the point of food sanitation.

Process Description

PVC flexible tube manufacturing process is shown in Fig. 1. The main process consists of five sections as below:

1) **Compound manufacturing**
2) **Extruding**
3) **Haul-off**
4) **Winding**
5) **Packing**

The project to be described here is intended for a small-scale plant having the capacity of producing 24 tons of tubes a day. In this small-scale plant no manufacturing equipment of a compound is installed, and the ready-made compound is to be used as material, as is described below, and the process manufacturing the compound is omitted here. Merely for information, however, the process will be outlined here.

The packing of the products in the proposed plant is to be performed by manual operation, because only one kind of tube is produced in the plant. The products are cut into a fixed length, and are bundled together to be packed in the packing paper.

1) **PVC compound manufacturing, outlined**
("PVC compound manufacturing" is not included in the present manufacturing process, and is described here only for information.)
Such raw materials as PVC resin, plasticizer, stabilizer and pigment are supplied to a high-speed revolving mixer, and after being mixed uniformly, they are properly mixed and kneaded by either mixing roll, intensive mixer, double screw mixer, kneader or plastificator according to the purpose and the quantity of the compound. Then, they are cut into pellets by pelletizer to make PVC compound.
What is the most important point in the production of PVC compound is to use the raw materials which appropriately blended suitable for the final products regardless of making a rigid or flexible final product. This blending technique is an important know-how that determines the quality of the final product. Those who engage in processing PVC products are required to master this extensive know-how.

2) **Extruding of PVC flexible tube**
The mono-axial screw extruder is the most economical equipment and is easy to handle, and is employed for mass production.
The raw material compound is charged into the hopper of an extruder, and is carried forward through the inside of a cylinder by the revolution of a screw. In this process

Fig. 2: Process Flow Sheet for PVC Flexible Tube Manufacturing Plant

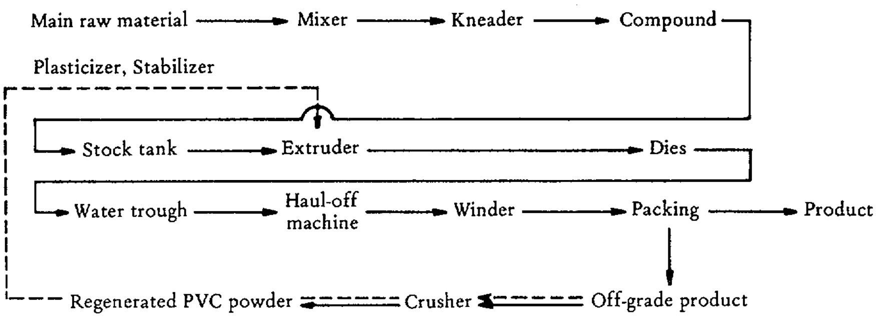


Table 1-1): Specifications of PVC Flexible Tube Manufacturing Plant

Item		Specifications	No. of unit
Extruder	Type: Screw:	Electric heater, mono-axial, horizontal L/D = 24 R.P.M = 8 ~ 80	
Control panel	Type: Meters:	Vertical panel equipped with meters Automatic temperature control equipment	5
Moulding dies	Type:	Straight spider	
Water trough	Type: Material:	Horizontal, equipped with sizing plate SUS-304	
Haul-off machine	Type:	Rubber roll	
Winder	Type:	Parasol shape in by vertical winding	2

Table 1-2): Machinery and Equipment Cost

Dia. 40 mm PVC flexible tube manufacturing equipment	FOB price (approx.) $US 33,000
Dia. 65 mm PVC flexible tube manufacturing equipment	FOB price (approx.) $US 57,000
Dia. 90 mm PVC flexible tube manufacturing equipment	FOB price (approx.) $US 71,000

Note: For information, the characteristics of extruders are shown in Table 1-5).

the compound in the cylinder melts while being heated from the outside and with the frictional heat of the raw material itself, and becomes a viscous fluid. The fluid is pushed out with a fixed size from the die set at the end of the extruder. Then, the fluid is cooled and hardened, and is taken out by haul-off machine, and becomes the product after being wound by winder.

The size of the extruder is shown by the screw diameter. In case the outside diameter of a tube or pipe is shorter than 16 mm, it is desirable to employ a 40 mm extruder; for a tube or pipe having 16 mm to 30 mm, a 65 mm extruder; for 31 mm to 58 mm diameter, a 90 mm extruder.

The quality of raw material PVC compound will have an effect on the extruding and moulding processes as well as on the quality of the tube or pipe to be moulded. A prerequisite for making a high-quality tube or pipe is to use an excellent processing equipment and a good compound. If not, the product will become an ununiformed, thick one having an uneven surface, which will result in producing the product with insufficient strength.

Coloured PVC Hose

Of the garden hoses being used in Japan there are ones having both outer and inner layers, forming a double structure. These hoses have become a sort of fashion. Especially popular are such household hoses having the white, opaque inner layer and the bright, primary colour, transparent outer layer, which give cleanliness and rich colour effect. To produce these kinds of hoses will require a separate small extruder, to which a special die, which is designed for a double-tube extrusion, is attached.

Special PVC Hose

In Japan, in addition to the extruded PVC flexible tubes already mentioned, there are ones made by braiding a synthetic fibre or steel wire.

1) Synthetic fibre braided hose
   This is an reinforced hose, in which nylon or polyester yarn was braided with the thick inner PVC layer so as to increase pressure resistance.

2) Steel wire braided hose
   This is another reinforced hose, in which steel spring was braided with the thick middle PVC layer for the same purpose as described above.

These hoses, however, are not included in the present project as they are produced by a different manufacturing process from PVC flexible hoses.

Table 1-3): Auxiliary Equipment

Air compressor
Crusher for off-grade product

Example of PVC Flexible Tube Manufacturing Plant

As one example of the manufacturing plants, a description will be made here, and the raw materials, utilities and the number of persons required for the manufacture of garden hoses by using two 65 mm extruders.

In the proposed project PVC compound is to be purchased. An access to attaining success in the manufacture of plastic products is to use the compound suitable for the product to be processed, and manufacture and sell the tubes made from it by the extruding equipment.

What is recommendable is to start the production of a compound within the plant when the production and sale of the tubes have been so stabilized that the consumption of compound reached to such a level that it can be produced economically within the plant.

The off-grade tubes, which will come out in the initial operation of extrusion, are to be crushed by a recovering crusher, and the material thus regenerated is to be used for making pipes.

Table 1-4): Dimensions of Extruders

Extrusion Plant	Screw diameter of extruder			
Item	Dimension	40 (mm)	65 (mm)	90 (mm)
Extruder	length	1,600	3,000	3,200
Switch board	length x width	600 x 350	750 x 350	800 x 350
Water trough	length x depth x width	2,000 x 250 x 200	3,000 x 250 x 300	4,000 x 300 x 300
Haul-off machine	length x width	670 x 500	670 x 500	670 x 500
Winder	length x width	1,600 x 1,100	1,600 x 1,100	1,600 x 1,100
A in Fig. 2		9,000	10,000	11,000
B in Fig. 2		1,500	1,500	1,500

Table 1-5): Characteristics of Extruders

Kind of extruder	Design capacity	Power capacity					Cooling water
	kg/hr.	Main motor	Heater	Haul-off	Winder	Total	m^3/hr.
40 mm s.d.	20	22 kW	6 kW	0.75 kW	0.8 kW	29.55 kW	1
65 mm s.d.	60	30 kW	15 kW	0.75 kW	0.8 kW	46.55 kW	2
90 mm s.d.	100	45 kW	24 kW	0.75 kW	0.8 kW	70.55 kW	5
Total	180					146.65 kW	8

Table 2-1): Production Scheme

Product:	Total length . . . . . 124,000 m Diameter, inside . . . . . 18 mm Diameter, outside . . . . 23 mm
Production capacity:	24 tons
Working hours:	8 hours/day, 25 days/month

Table 2-2): Required Machinery and Equipment

Item	No. of unit
Extruder (65 mm. screw dia.)	2
Control panel	2
Moulding dies	6
Water trough	2
Haul-off machine	2
Winder	2
Air compressor	1
Crusher	1

FOB price of machinery and equipment . . . . (approx.) $US 124,000

Note: The following are not included in this price.

(1) Utilities equipment
(2) Foundation and installation works and materials
(3) Piping and electric wiring works and materials
(4) Know-how and other technical fee

Table 2-3): Monthly Requirement of Raw Materials and Utilities

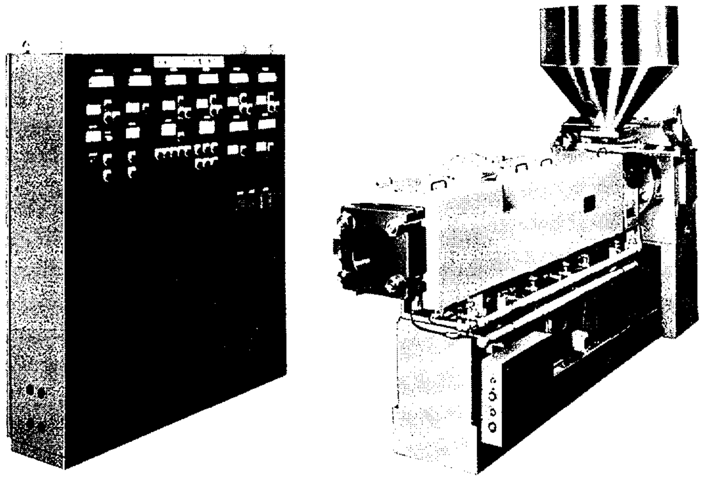
Item		Quantity
PVC compound	(approx.)	24 tons
Electric power	150 kW	30,000 kWh
Water (18 ~ 25°C for cooling)		100ℓ

Table 2-4): Required Manpower

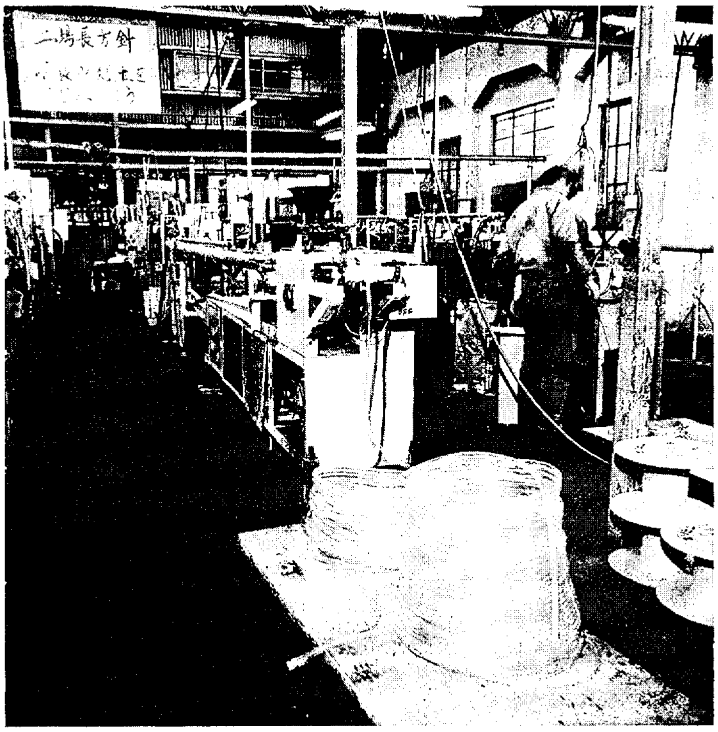
Item	No.
Chief engineer	1
Engineer (for extruding section)	2
Worker (for packing and delivery sections)	3
Total	6

Table 2-5): Required Area for Plant Site

Item		
Building	(approx.)	240 m^2
Land	(approx.)	1,000 m^2



Extruder & Control panel



How To Start Manufacturing Industries

Fastener Equipped Polyethylene Bag Making Plant

Unlike ordinary polyethylene bag, fastener equipped polyethylene bag has an occluding snatch at the mouth of the bag which can be opened and shut freely. The contents can be filled and emptied freely, and the mouth can be closed tightly easily.

The use of this bag is varied; it is being used for packing and sealing clothing, cosmetics, medical supplies, stationery, electrical parts, food, agricultural products, general merchandise, etc. Recently, because of the convenience of the bag being equipped with a fastener, it is becoming a household necessity with its use being expanded to packaging food for the home refrigerator and freezer, storing away clothing, and carrying bag for travelling, driving, sports, etc.

Feature of the bag is as follow:

(1) Various sizes are possible: film thickness 0.03 mm – 0.1 mm, length below fastener 60 mm – 500 mm, width of bag 50 mm – 500 mm.

(2) Printing can be done up to four colours. Because printing is done on a flat film, before bag making one printing process is applied; this is very economical.

(3) Transparent and glossy P.P., heat and cold resistant and stiff H.D.P.E., or flexible L.D.P.E. may be used as raw material.

Process Description

The basic manufacturing system and equipment are patented (Japanese patent No. 606657). One large extruder and one small extruder and one T die and take-up unit and a winding machine make one set. If necessary, a folding system of films is attached. Printing.and bag making comes next and the bag is completed.

1) Extruding process
The raw material pellet is put in the hopper of the large extruder (film extruder) and the small extruder (fastener extruder) which have been preheated to the designated temperature. The raw material is melted by heat and screw rotation. Then, it is extruded through the die in a flat state. Resin is extruded through the designated fastner mould to form the fastener portion, and this fastener portion is fused onto the flatly extruded film and chilled. The film is chilled by the take-up unit and is wound off into the designated length by the attached winding machine.

2) Printing process
The designated pattern is printed on the film wound off by the winding machine by printing machine.

3) Bag making process
The printed film is set on the bag making machine which has been preheated to the designated temperature. It is cut to the fixed size and sealed.

4) Inspecting and packing
The tensile strength of fastener part, the size of the bag, the tensile strength of the sealed part, and the state of printing is checked by the inspector. The quantity is confirmed, packing is done in boxes, and the goods are kept in a warehouse.

Table 1: Required Machinery and Equipment

Item	No.
Extruder	1 set
Die	1 set
Take-up unit	1 set
Winding machine	1 set
Heating and chilling unit	1 set
Temperature controlling panel	1 set
Folding system of films	1 set
Printing machine	1 set
Bag making machine	2 sets
Hand cart	5 sets
FOB price of machinery and equipment (approx.)	**$US 603,000**

Example of a Most Economical Plant

Average size:	Thickness	Length below fastener	Width
	0.04 mm	450 mm	500 mm

Production: 18,000,000 bags/year
Working days: 300 days/year, 24 hours/day

Table 2: Required Raw Materials

Item	Quantity
Polyethylene pellet	23 kg/1,000 bags
Ink and solvent	35 kg/1,000 bags

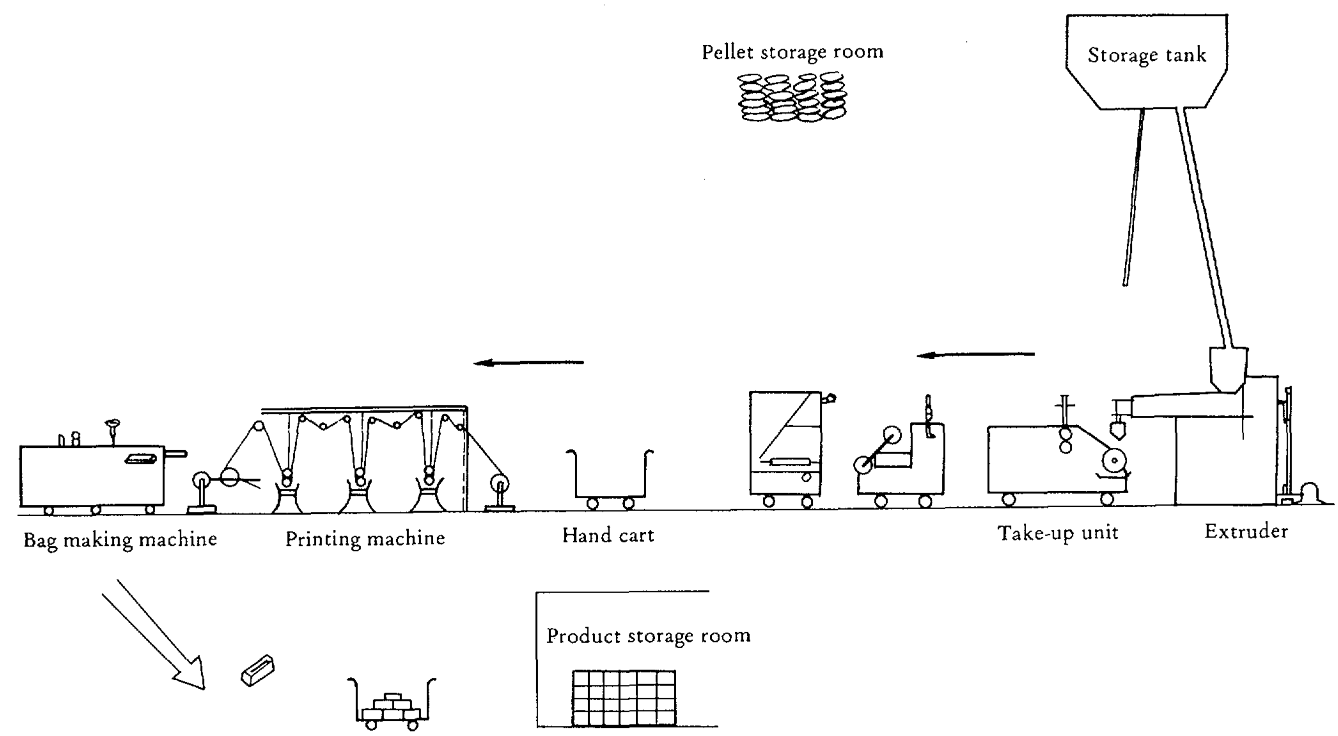
Table 3: Required Manpower

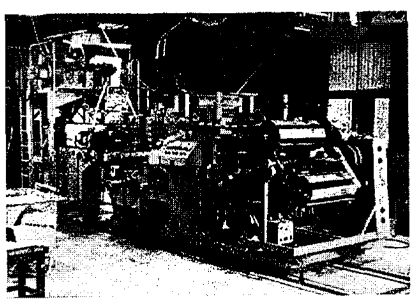
	Engineer	Skilled worker	Unskilled worker	Shift	Total
Supervision	1			1	1
Extruder		1		3	3 x 1
Printing		1	1	1	1 x 2
Bag making		2		1	1 x 2
Inspecting and packing		1	1	1	1 x 2
Total					10

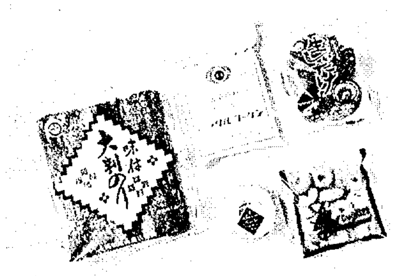
Table 4: Required Area for Plant Site

Building	(approx.) 20 m x 25 m = 500 m^2
Land	(approx.) 31 m x 31 m = 1,000 m^2

Process Flow Sheet for Fastener Equipped Polyethylene Bag Making Plant







How To Start Manufacturing Industries

Plastic Container Making by Blow Moulding

This model plant is capable of manufacturing the 3 most marketable types of plastic containers in the 5, 10 and 20 liter capacity range, handling the complete process from plastic raw material, to container moulding, to parts, manufacturing, to delivery. This process is the most advanced standard type for economically manufacturing products under stringent quality control.

Besides the plastic containers for 5, 10 and 20 liter capacities introduced here, we can supply plants for production of various special plastic cases of wide application, including large-size plastic tanks with 500 and 1,000 liter capacities, upon request. Furthermore, we are ready to cooperate fully in the supply of materials, sub-materials and packaging materials. Also, we are prepared to give plant operation guidance, including operation training and education, and assist you in any way for total plant operation.

Blow Moulding Process

Blow moulding is carried out just like inflating a balloon in a metal mould. In the moulding process, melted plastic (called parison) is extruded in a tubelike condition from the extruder, and held by the metal mould as shown in Fig. 1.

Compressed air is then injected shown in Fig. 2 causing the parison to be shaped like a bottle. After the metal mould has been cooled, it is opened to take off the moulded bottle as shown in Fig. 3.

Description of Machinery and Equipment

1) **Blow moulding machine**

The blow moulding machine is composed of three devices: the parison head, moulding unit and metal mould for forming. It performs the plasticization of resins, extruding of parison, opening and closing of the metal mould, air blowing, cooling, and finally taking-off of moulded products. (For mass production two methods are available; One with the moulding unit made rotary, the other with the extruder provided with several parison outlets.)
Drawing upon our technological experience, deviation in the thickness of moulded products are minimized.

2) **Injection moulding machine**

Using a screw in-line automatic injection system, this machine manufactures such plastic parts as caps, O-rings and nozzles that are attached to blow moulded plastic containers.

3) **Crushing machine**

Flashes caused during production are collected, fine crushed and reclaimed for re-use. Employing a hot melt system, this crushing machine is capable of collecting hot flashes, and features decreased horse power with reduced noise.
In addition, reclaimed flashes can be utilized without any damage to the properties of the materials, thus resulting in no waste of raw material.

4) **Colouring mixer equipment**

This automatic mixing machine is designed to automatically draw resins (main material) and pigments (sub-material), measure, mix and feed them to the blow moulding machine. The equipment is utilized particularly when colouring is automated.

Table 1: Required Machinery and Equipment

Item	No.
Material bunker	1
Screw conveyor	1
Service bin	1
Tumbring mixer	1
Carry tank	1
Pneumatic conveyor	1
Recycle bin	1
Blow moulding machine	1
Trimming table	1
Crushing machine	1
Container cage	1
Mouth finisher	1
Dust blower	1
Checker	1
Cap tray	1
Cap moulding and labelling	1
Material tank	1
Pneumatic conveyor	1
Injection moulding machine	1
Belt conveyor	1
Cap and parts carrier	1
Weighing scale	1
Hand cart	10
Auto-bander	1
Products carrier	2
Moulds for blow moulding machine	5, 10, 20 liter
FOB price of machinery and equipment (approx.)	$US 671,000

Fig. 1: Parison is extruded in a tubelike condition.

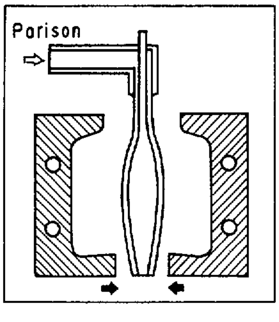


Fig. 2: Metal mould is closed and air is injected.

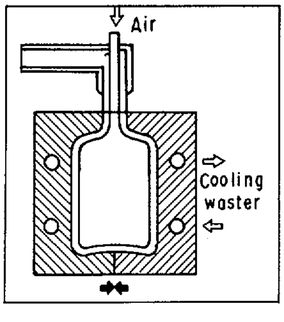


Fig. 3: Metal mould is removed.

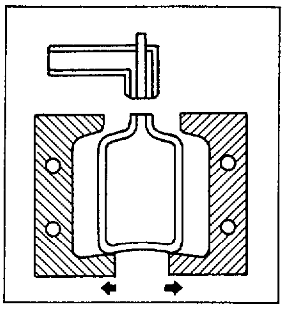
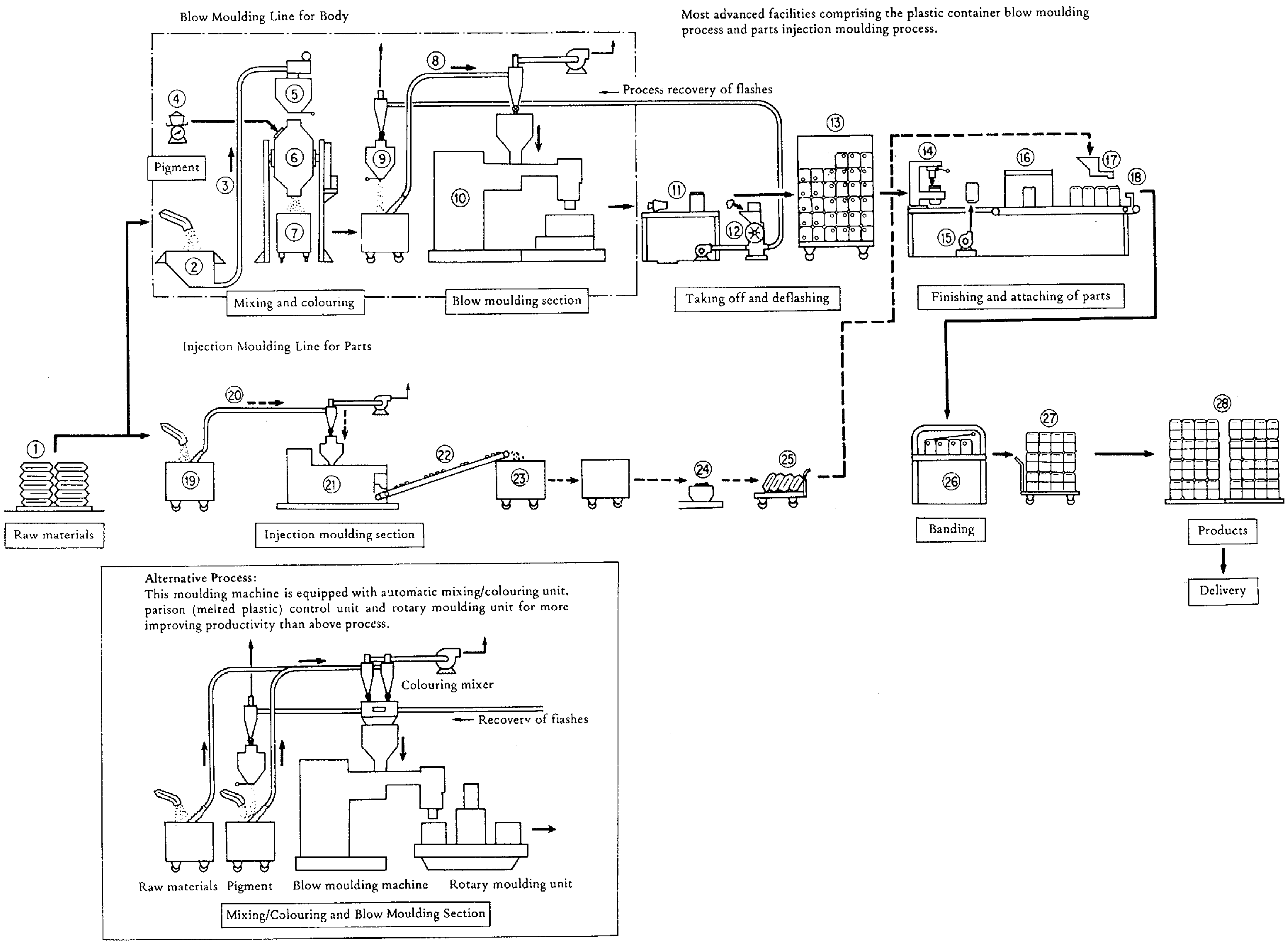
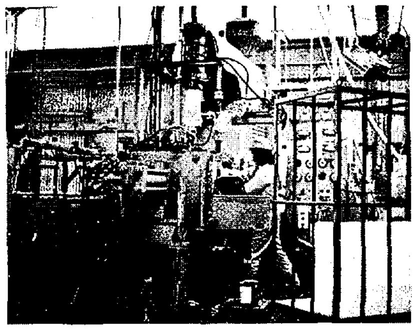
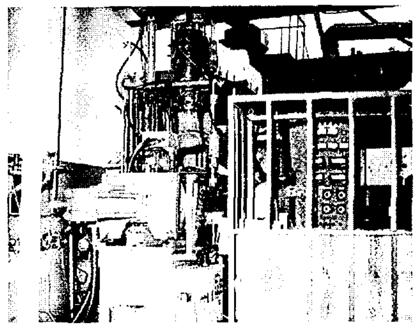
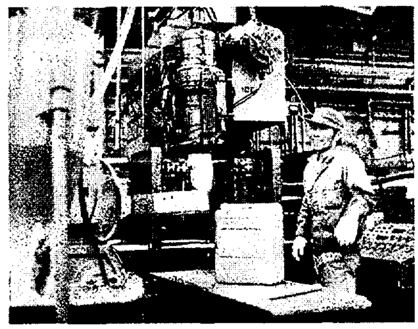


Fig 4: Process Flow Diagram for Plastic Container Manufacturing by Blow Moulding









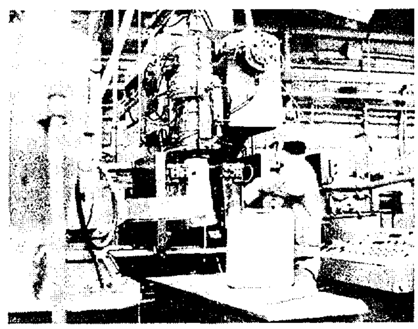


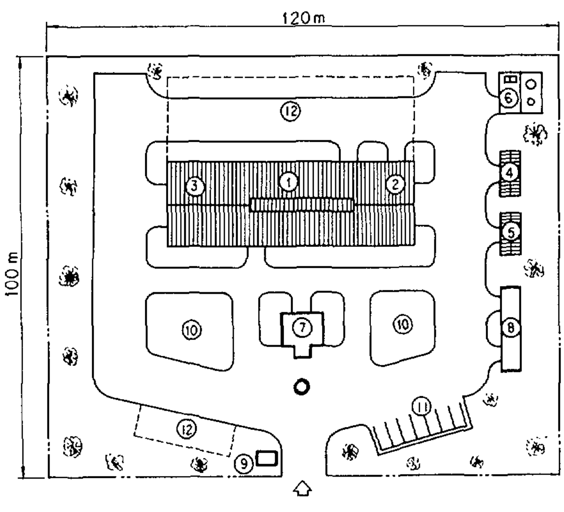
Table 2: Specification of Plant

Description	Contents	Quantity
Production capacity	20 liter plastic container 10 or 5 liter plastic container Attachment for plastic container	350,000 pieces/year 250,000 pieces/year Cap & O-rings, etc.
Operation hour	Number of shift: 3 shifts Monthly working day: 25 days	24 hours/day 300 days/year
Utilities	Water Electric power	50 tons/day 600 kWh
Plant site area	Land area	12,000 m^2
Manpower	Engineer: 3 Office staff & clerk: 4 persons Worker: 20 persons Indirect worker: 3 persons	30 persons
Main raw materials	Polyethylene	100 tons/month

Table 3: Uses of Plastic Containers

Uses	Contents	Features
Home use	Drinking water Edible oil Sauce & seasoning Kerosene, etc.	Plastic containers are free from discoloration and decomposition or rust, enabling their contents to be hygienically stored. Lightweight permits easy handling.
Agricultural use	Agricultural chemicals Liquid fertilizer Fruit juice, etc.	Rugged, easy to handle, and convenient to carry.
Industrial use & others	Chemicals Machine oil Fuel oil Industrial liquid soap Foodstuffs, etc.	Convenient to store and transport chemicals. Highly resistant to acid and alkaline chemicals.

Fig. 5: Plant Layout for Plastic Container Manufacturing by Blow Moulding



1. Plastic container manufacturing factory by blow moulding process
2. Raw materials storehouse
3. Products storehouse
4. Utility house (Electric station & air compressor)
5. Maintenance & repair house
6. Water pool & cooling tower
7. Main office
8. Dining & locker house
9. Guard house
10. Products & materials yard
11. Parking area
12. Future extension area

How To Start Manufacturing Industries

Rigid Polyvinyl Chloride Corrugated Sheet Making Plant

With the advancement of plastics, the desire for light-weight and safety of plastic lighting material evolved. Glass fiber reinforced polyester corrugated sheet (FRP corrugated sheet) was developed first; then, rigid polyvinyl chloride corrugated sheet was developed as a product in 1956. In the beginning, it was processed by pressing calendered sheet to form corrugation. This was the so called pressed corrugated sheet. Productivity was low and the price was high for that process, so popularization was difficult. The extrusion moulding method of producing R. PVC corrugated sheet, however, was developed during 1957 – 1958, and R. PVC corrugated sheet became the mainstream material for taking in the light through the roof. Since then, because of the low price, it was popularized rapidly, and the domestic annual production in 1972 exceeded more than 70,000 tons temporarily. Since 1973, because of the promotion of technology export and the overseas expansion of industry, export of products to Europe declined. Also, the demand of users turned to other material which is pervious to light. Consequently, the annual production dropped to approximately 50,000 tons. This volume, however, has continued steadily and has been settled. In the beginning corrugated sheets were either transparent or semitransparent, but now, besides transparent and semitransparent R. PVC corrugated sheet, there are all sorts of variety such as galvanized iron net reinforced corrugated sheet, glass fiber net reinforced corrugated sheet, and embossed corrugated sheet being sold in the market. Here, therefore, transparent and semitransparent R. PVC corrugated sheets, which are most popular, will be described.

Table 1: Types of R. PVC Corrugated Sheets

Type	Length (mm)	Width (mm)	Thickness (mm)	Depth of corrugation (mm)	Pitch (mm)	No. of corrugations
32 corrugations	1820	660	0.8, 1.0, 1.2 1.5, 2.0	9	Approximately 10	Approximately 20.5
		720				Approximately 22.5
63 corrugations	1820	720	1.0, 1.2, 1.5 2.0, 3.0	15 18	Approximately 63	Approximately 11.5
76 corrugations	1820	720	1.0, 1.2, 1.5 2.0, 3.0	18	Approximately 76	Approximately 9.5
		800				Approximately 10.5
130 corrugations	1820	720	1.0, 1.2, 1.5 2.0, 3.0	36	Approximately 130	Approximately 5.5
		980				Approximately 7.5

Note: Long size is available.
Square wave corrugations are available.

Types of R. PVC Corrugated Sheet

Plastic corrugated sheets were originally developed as a material which is pervious to light to be used instead of the galvanized iron corrugated sheet. Later, it has also been used as a material which is pervious to light to be used instead of asbestos slate corrugated sheets. Therefore, because plastic corrugated sheets are used instead of galvanized iron corrugated sheets and asbestos slate corrugated sheets for taking in the light through sheet, the types and sizes conform to these sheets in order to make mixed roofing. The types are shown in Table 1. 32 corrugations correspond to Japanese Industrial Standards (JIS) small corrugation of galvanized iron sheet and 76 corrugations correspond to standard (JIS) large 3 inch corrugations of galvanized iron sheet. 63 corrugations correspond to the standard (JIS) small corrugation asbestos slate and 130 corrugations correspond to the standard (JIS) large corrugation asbestos slate.

Characteristics and Precautions in Handling

The characteristics of R. PVC corrugated sheet and precautions in handling thereof will be described below.

1. Characteristics
1) The types of R. PVC corrugated sheet are transparent, semitransparent, and opaque. Each type can be colored freely, and so R. PVC can be selected in accordance with the perviousness to light and color of the place where it is to be used.
2) R. PVC will not rust like metal and it resists chemical, and so it does not require any heatment as painting on the surface; therefore, it is most suitable for use in factories which are easily attacked by corrosion.
3) The weight is 3/4 – 1/2 of galvanized iron corrugated sheet and about 1/10 of asbestos slate corrugated sheet; therefore, it is easy to handle and install.
4) Cutting, drilling and nailing can be easily done by ordinary tools.

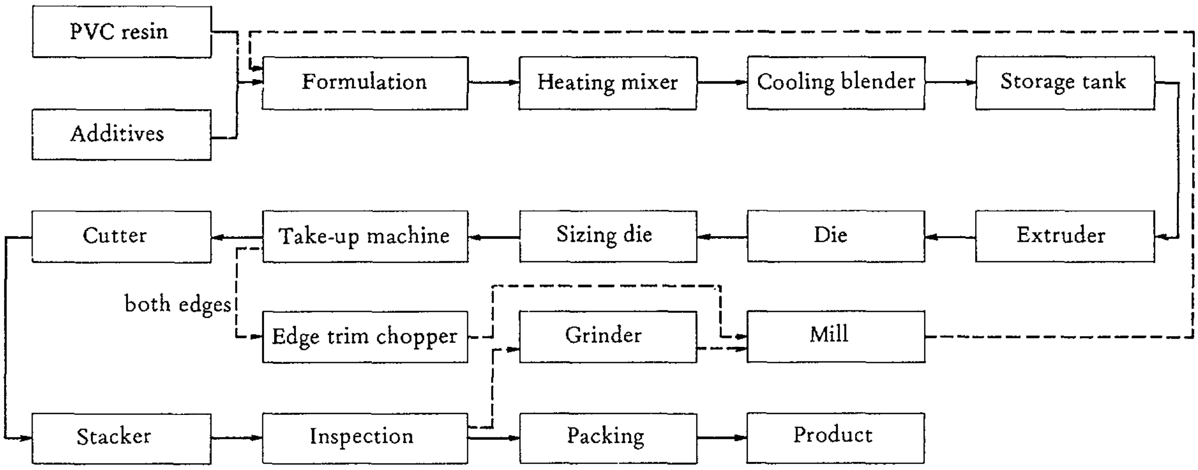
2. Precautions in Handling
1) R. PVC is thermoplastic resin, so it will soften by heating. Accordingly, it must not be used in the situation above 60 degrees C.
2) Deflection is great compared with asbestos slate; therefore, the span, when installing, should be as small as possible.

Extrusion Machine and Equipment for R. PVC Corrugated Sheet Manufacturing

The block flow diagram of the process is given in Fig. 1. The process is the one by which the R. PVC corrugated sheet can be processed by using extruder and equipment at the maximum extruding speed giving the most superior quality to R. PVC products.

Needless to say, the extrusion of R. PVC product, in general is carried on by either one of two basic procedures. The one is the extrusion will be carried

Fig. 1: **Block Flow Sheet for R. PVC Corrugated Sheet Manufacturing**



on either by PVC pellet which essential additives were already compounded or PVC compound which essential additives shall be blended and compounded for a formulation suitable for the quality of product to be processed. From the point of economy, the latter method is employed.

Process Description

Generally, the manufacturing processes are: (1) Formulation, blending and mixing process; (2) Extrusion process; (3) Inspection and packing process.

1) Formulation blending and mixing process

Polyvinyl chloride resin and additives such as stabilizer, and pigment, etc. are formulated and blended to the fixed ratio and mixed evenly in this process. The mixer used must be of the type which can be heated and cooled. The important thing is this process is that the bulk density of the compound must be fixed so that stable extrusion will be maintained. The compound which has been mixed by heating and then cooled is sent to the storage tank to be readied for the subsequent extrusion process.

2) Extrusion process

From the storage tank the raw material compound is charged into the extruder hopper. The raw material compound is mixed and kneaded in the extruder by heating, and is extruded by a die into flat sheets. The extruder and die used must match the formulation of raw material. The sheets are passed through the sizing die to form corrugations; then, they are cooled, cut, and stacked in stackers.

The kinds of extruders are: single-axial extruder, one direction rotating biaxial extruder, diverse direction rotating biaxial extruder, multi-axial extruder. In this description, however, the use of a single-axial extruder or a diverse direction rotating biaxial extruder is recommended. The merits and demerits of these two machines are shown in Table 2.

The user, by comparing the merits and demerits, must judge and select the kind of extruder which is most suitable for his plant.

3) Inspection and packing process

Sampling inspection is done at fixed intervals to check the appearance of product, the size, the physical properties, etc. of the molded product. Sampling inspection of the entire product is not necessary.

Packing is not necessarily required, but the product is sometimes banded or packed in corrugated paper box depending on the arrangement between the maker and the user.

There is fear of deformation by heat during storage, so the temperature during storage must be kept below 40 degrees C.

Production Capacity

As mentioned earlier, the production capacity will differ depending on the sort of machinery used. In case of single-axial extruder, the minimum production capacity will be 110 tons/month per extruder. In case of diverse direction rotating biaxial extruder, the minimum production capacity will be 150 tons/month per extruder. The basis of calculation of the production capacity is 24 hours per day, 30 working days per month.

Details of the plant are given in Tables 3 – 5. The machine and equipment given here is for a diverse direction rotating biaxial extruder with a production capacity of 150 tons/month of 32 corrugations sheet. The following things are not included in Table 3.

(1) Utility facilities.
(2) Raw material intaking equipment and compund storage tank.
(3) Cost of electric wiring and piping.
(4) Inspecting instruments and weighing scale.
(5) Know-how fee and royalty.

Table 2: Comparison of Extruders

	Single-axial extruder	Diverse direction rotating biaxial extruder
Production capacity	Great	Small
Blending cost	High	Low
Machinery cost	Cheap	Expensive
Life of machinery	Long	Short

Table 3: Required Machinery and Equipment

Item	No.
Mixer	1
Cooling blender	1
Extruder	1
Control panel	1
Die	1
Corrugating-taking-up-cutting machine	1
Edge trimmer	1
Grinder	1
Mill	1

FOB price of machinery and equipment .... (approx.) $US 705,000

Table 4: Required Manpower

Item		No.
Engineer		1
Foreman		1
Formulation and mixing	1 x 4 shifts	4
Extrusion	1 x 4 shifts	4
Packing and delivery		3
Total		13

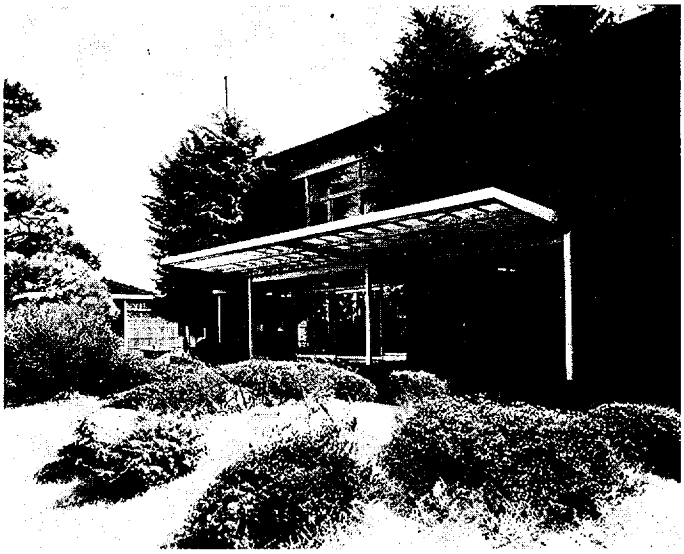
Table 5: Utility Facilities

Utility	
Electric power	250 kWh
Cooling water	350 ℓ/min.
Equipment	
Boiler	50 ℓ/min.
Air compressor	15 kW

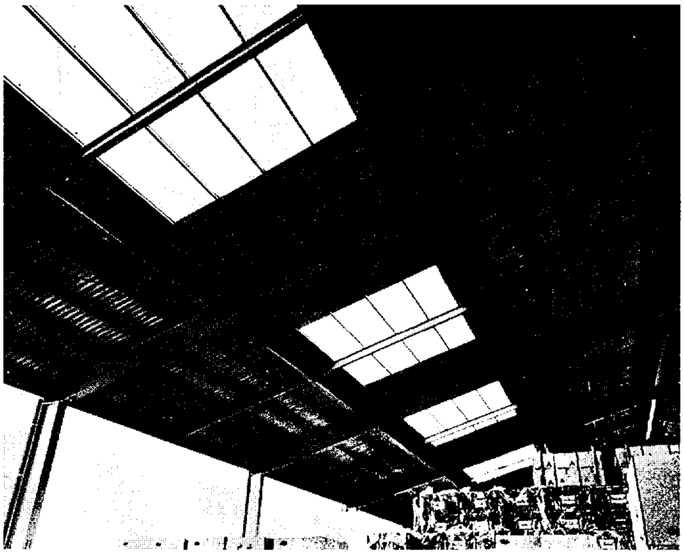
Table 6: Required Area for Plant Site

Building	
Area	175 m^2
Height to ceiling	9 m
Land	(approx.) 1,000 m^2

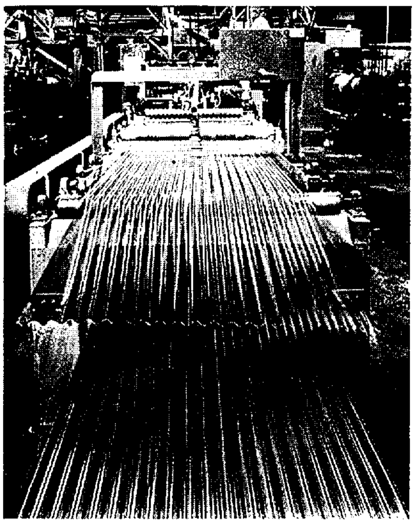
Note: Raw material and finished product storage space and space for packing are not included.



How the product is employed.



How the product is employed.



Any inquiry about the information contained should be sent to: IO/COOP, Registry file No. ID/562/12, UNIDO, P.O. Box 300, A-1400 Vienna, Austria.

How To Start Manufacturing Industries

PVC Plastisol Moulding Plant

Plastisol moulding of PVC resin is a relatively new technology. The trend toward practical use in various countries began only in 1950, and real production began around 1955–1956.

The main method, however, was slush moulding or dip moulding. The former was employed for living-feel doll, and the latter was employed for coverings of household metal utensil. Based on these moulding processes, rotational moulding of PVC was devised. Large merchandise began to be produced one after another. Even automobile parts began to be produced, and plastisol moulding of PVC got into the limelight of plastic processing.

With the advancement of moulding processes, the study of raw material PVC plastisol became more and more active. With the collaborative study of raw material makers and moulders, there is no doubt that plastisol moulding of PVC will become an increasingly promising industry.

The principle of almost all plastisol moulding is as follows: A film of plastisol paste is formed on the surface of the metal mould; the film is cured (gelled) by heating and then cooled; the completely moulded product is taken out of the metal mould. Dip moulding is done by dipping the mould in plastisol; a film is formed on the surface of the mould. In slush and rotational moulding, the film is formed on the inner surface of the mould. Dip moulding is solid mould; slush moulding and rotational moulding are cavity mould. The mouth at the top of dip mould is narrow and the mould gradually spreads out at the lower end; therefore, this method of moulding is not suitable for products with sudden undercut or marked unevenness. However, products with sudden undercut or marked unevenness can be moulded sufficiently by slush moulding and rotational moulding.

1. Merits of plastisol moulding

(1) The moulding equipment is rather simple and cheap. If necessary, the mass production can be carried out by the continuous operation of machineries.
The cost of installing the equipment is low. Initially, the mould and oven would suffice to begin business on a small scale. As marketing of the product is enlarged, the facilities could be rationalized for cost down. Thus, the business would be fascinating as a medium and small scale industry.

(2) The metal mould, compared with other methods of moulding, can be produced comparatively easily and cheaply. Also, the mould can be reproduced (increase the metal moulds) relatively easily.
This method of moulding can be done at normal pressure, so the metal mould need not be as strong as metal moulds for other methods of moulding, such as injection, extrusion, blow, etc.
Cast mould by electroforming or cast mould of aluminum alloy or copper alloy is used as metal mould. Electroforming mould can be made easily by the moulder himself, and reproduction is simple. However, the model for producing the mould must be made delicately.

(3) Many kinds of products can be produced simultaneously, and shifting of mould from one sort to the other can be done comparatively easily.

2. Demerits and limits of plastisol moulding

(1) Rigid products cannot be produced by plastisol moulding process.
Products produced by this method have the hardness up to 70 to 75 by Shower Hardness Tester.

(2) Scraps such as burr of products and sub-standard products cannot be reused as raw material for plastisol moulding.
At the present time compounding of plastisol raw material has many problems yet to be solved, and so the experience and degree of skill of the technician are appraised highly. Therefore, since plastisol moulding enterprise is a small scale industry which can be started with relatively small investment, it is a promising industry with a bright future for energetic medium and small scale industrialists who are enthusiastic in the work of study.

Kinds of Plastisol Moulding Process

As mentioned earlier, there are three kinds of plastisol moulding process. They are dip moulding process, slush moulding process, and rotational moulding process.

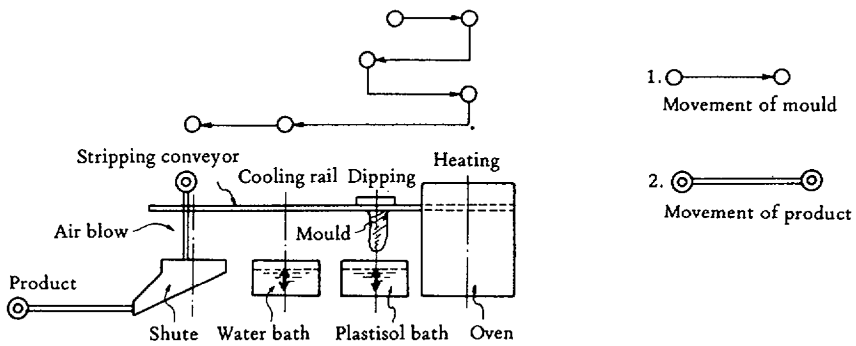
1) Dip moulding process

The mould is inserted in the plastisol bath, and a film is formed on the outer surface of the mould. Fusing is done in an oven, and the mould is cooled and hardened. The hardened product is stripped off the mould. The product is used for electrical insulating coverings (of terminal, spark plug, outdoor wiring joint, etc.), gloves, toys, etc. The material for mould is aluminum, brass, stainless steel, ceramics, etc.

The process of dip moulding is shown in Fig. 1.

Fig. 1: Dip Moulding Process

Preheating → Dipping → Fusing → Cooling → Stripping



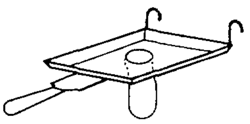
Preheating is done before dipping. The preheating temperature and time varies depending on the thickness of the product (1.5 mm–2.5 mm). After being preheated, the mould is dipped in plastisol bath to form the product film on the surface. The film-covered mould is taken into the fusing oven, and after being fused it is cooled in a water bath. After being cooled, the product is stripped off by compressed air. Although the preheating oven and the fusing oven are explained as if they were separate ovens, they are actually one oven used in combination. The movement of mould in the moulding process is generally done as shown in the figure.

2) Slush moulding process

In this method, plastisol is poured into the cavity of the mould to form a film on the inner surface of the mould. The mould is shell-shaped and is made by electroforming copper as the raw material.

As shown in Fig. 2, the mould is equipped and operated in a skillet-shaped pan.

Fig. 2: Skillet-shaped Pan Mould



Plastisol is poured into the shell-shaped mould, and deairing of the plastisol is done by centrifugal force or vibration. The mould with adhering plastisol is immersed in the preheating oil bath which has been heated in advance. This operation is generally known as "modeling" and is done to give the product the prescribed thickness. By this operation semi-gelation of the plastisol on the inner surface of the mould occurs, and the film takes the general shape of the moulded product. At this point, the plastisol which is in direct contact with the inner surface of the mould is in semi-gel state, the rest of plastisol in the mould, however, is still in a sol stage. Therefore, the mould is taken out of the bath and excess plastisol is removed. Then, the mould is immersed in fusing oil bath. The plastisol film on the inner surface of the mould will be gelated completely to form the plastisol product. The product on mould is cooled in a cooling bath. After taking it out of the bath, the cured product sticking to the inner surface of the mould is gripped with pinchers and pulled out.

Here, the process employs preheating and fusing in the oil bath, but an oven may be used in place of the oil bath. The process can be made into a continuous process by employing a conveyer line system.

3) Rotational moulding process

This process is a transformation of the slush moulding process. The mould of the slush moulding process is in one piece, and it does not require a closure. The mould of the rotational moulding process, however, requires a closure and so it consists of two pieces. In slush moulding plastisol is fully filled in the mould, but in the rotational moulding plastisol only enough to form the film of the product is poured into the mould. After pouring in plastisol the closure is clamped, and then the moulding process begins.

The rotational moulding process, as in the slush moulding, has the batch type and the continuous type. Both types use the same mould which is, in most cases, a copper electroforming mould or a nickel electroforming mould. Sometimes, an aluminum cast mould or other sorts of aluminum mould are used.

In this rotational moulding process, a circular plate-like closure itself, with several or dozens of moulds attached, turns round its vertical axis in the oven, revolving around its orbital axis at the same time, as shown in Fig. 4. After being completely moulded, the product is cooled and stripped. The moulding process has been completed.

The speed of turning round the axis

Fig. 3: Slush Moulding Process

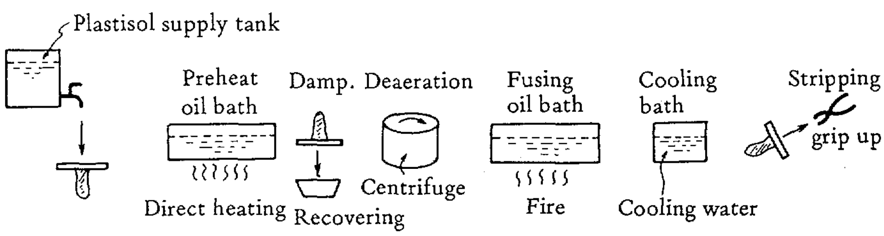
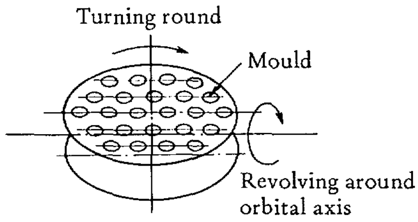


Fig. 4: Turning Round and Revolving of Mould Enclosure



and revolving around the orbital axis, the number of revolution, and the combination of both varies by the sort of product, the shape, the size, etc. This process is the same for batch, semicontinuous, or continuous. A flow sheet of the rotational moulding process is given in Fig. 5.

All sorts of products are manufactured by the rotational moulding process. Products with complicated shape, such as toy, toy-ball, armrest for automobile, pillow for automobile, display ball, etc., can be produced. Unique products which cannot be manufactured by the slush moulding process, such as balls, can be manufactured by the rotational moulding process.

Fig. 5: Flow Sheet of Rotational Moulding Process

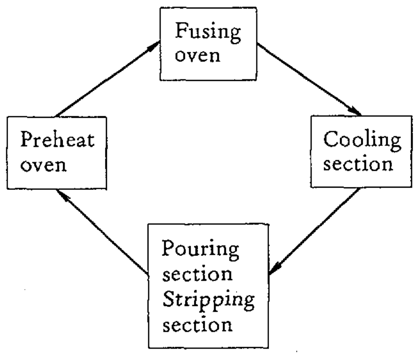


Table 1: Production Scheme

1) Dip moulding process
   Insulator cap
      960 pieces/8 hrs./day
      960 x 25 = 24,000 pcs./month
2) Slush moulding process
   Doll (keupie 30 cm high, @200 g)
      50 sets/8 hrs./day
      50 x 25 = 1,250 sets/month
3) Rotational moulding process
   Toy ball for soccer
      2,300 pieces/8 hrs./day
      2,300 x 25 = 57,500 pcs./month

Note: Tables 2 ~ 5 are based on the above scheme.

Table 2: Required Machinery and Equipment

	No. of set
Dip moulding process unit (automatic operation system)	
Preheating and fusing oven	1
Dipping apparatus	1
Cooling apparatus	1
Stripping apparatus	1
Mould holder and carrier	1
Conveying apparatus	1
Hydraulic unit	1
Air compressor	1
Control panel	1
Note: a) Mould is not included in the cost of machinery and equipment. b) Heating medium for oven is easy to procure and cheap.	
FOB price	(approx.) $US 47,000
Slush moulding process unit	
Plastisol supply tank	1
Dump tank for plastisol recollector	1
Oil baths for preheating and fusing	1
Centrifuge for deairation	1
Cooling bath	1
Stripping table	1
Mould pan (skillet-shaped to be equipped with moulds)	1
Pinchers for stripping	1
Deairation apparatus	1
Note: a) Mould is not included in the cost of machinery and equipment. b) The heating medium used for bath is in powder state.	
FOB price	(approx.) $US 71,000
Rotational moulding process unit (semiautomatic operation system)	
Curing oven with rotator and control panel	1
Cooling apparatus	1
Stripping table and conveyer	1
Connecting conveyer	1
Operator's deck	1
Closure for mould setting	1
Metering pump	1
Air compressor	1
Note: Mould is not included in the cost of machinery and equipment.	
FOB price	(approx.) $US 95,000
Total FOB price of machinery and equipment	$US 213,000

Table 3: Required Raw Materials and Utilities

Raw material plastisol for:

1) Dip moulding .... 24,000 kg/month
2) Slush moulding .... 14,000 kg/month
3) Rotational moulding .... 14,500 kg/month

Total .... 52,500 kg/month

Utilities

1) LPG for:
   (a) Dip moulding, 4 kg/hour, 32 kg/day = 800 kg/month
   (b) Slush moulding, 2 kg/hour, 16 kg/day = 400 kg/month
   (c) Rotational moulding, 7 kg/hour, 56 kg/day = 1,400 kg/month

   Total 2,600 kg/month
2) Electric power for:
   (a) Dip moulding, 21.44 kWh/day = 536 kWh/month
   (b) Slush moulding, 7.6 kWh/day = 190 kWh/month
   (c) Rotational moulding, 37.6 kWh/day = 940 kWh/month

   Total 1,666 kWh/month
3) Cooling water for:
   (a) Dip moulding, 3,200 ℓ/day = 80,000 ℓ/month
   (b) Slush moulding, 3,200 ℓ/day = 80,000 ℓ/month
   (c) Rotational moulding, 6,400 ℓ/day = 160,000 ℓ/month

   Total 320,000 ℓ/month

Table 4: Required Manpower

(three process units are to be run in the plastisol moulding unit)

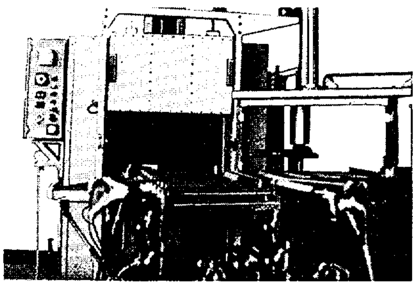
1) Dip moulding process
   One skilled worker
2) Slush moulding process
   One skilled worker
   One shift worker
3) Rotational moulding process
   One skilled owrker
   One shift worker
   One engineer

Working days:
25 days/month, 8 hours/shift/day

Table 5: Required Area for Plant Site

Building
1) Dip moulding .... 250 m^2
2) Slush moulding .... 64 m^2
3) Rotational moulding ..... 300 m^2

Land .... (approx.) 1,500 m^2



Rotational moulding machine

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ISIC 361 POTTERY, CHINA AND EYRTHENWARE

How To Start Manufacturing Industries

Wall Tile Making Plant

Wall tile which is used to cover building walls is made in various types – porcelain, semi-porcelain, fine earthenware, etc.

Wall tile shows a trend toward increasing use in modern architecture, and its manufacturing technique is comparatively easy because it is mainly made in simple square shapes. Funds required for the construction of a plant are also not so large.

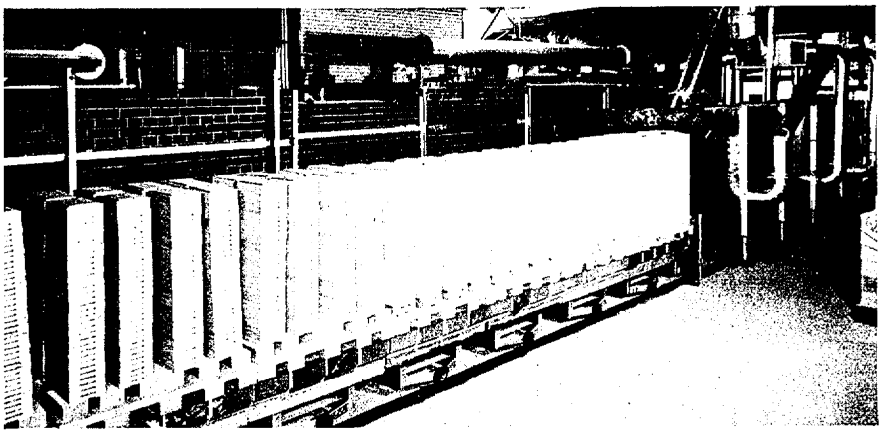
Tile manufacturing resembles tableware manufacturing in so far as raw materials are concerned. However, depending upon the kind, the wall tile has a larger scope of allowance for selection of raw materials.

Therefore, its manufacture has high merit in countries where the construction of high buildings is brisk with the progress toward urbanization or where urbanization is projected.

Wall tile is made, as already stated, mainly from raw materials similar to those for tableware, that is quartz, feldspar, kaolin, clay, etc.

Its manufacturing process chiefly consists of crushing, moulding, drying, and firing, and it is made either glazed or unglazed.

The baking process varies according to the quality of body. For example, porcelain tile is subjected to glost firing at a temperature between 1,250 and 1,300°C, while earthen tile is subjected to glost firing (1,050 – 1,100°C) after bisque firing (1,150 – 1,200°C).



Tunnel kiln

In mapping out a plan for the building of a wall tile manufacturing plant, it is essential to select raw materials of quality according to marketability and use, and also to take technical problems into consideration in making a decision.

Table 1: Required Machinery and Equipment

Unit	Description
Crushing & preparation unit	Jaw crusher, Impact crusher, Bucket elevator, Electric hoist, Screen, Ball mill, Slip tank and agitator, Vibrating screen, Magnetic separator, Spray dryer with accessories
Forming & glazing unit.	Conveyor, Mud control hopper, Automatic oil press, Friction press, Glazing & finishing conveyor, Endless type table conveyor
Firing unit	Bisque tunnel kiln, Glost tunnel kiln, Tunnel type dryer
Miscellaneous unit	Inspection conveyor, Packing conveyor, Shovel loader
Sagger making unit	Edge runner mill, Pug mill, Friction press, Bucket elevator, Hopper
Facilities of fuel oil supply	Main tank, Service tank, Pump, Piping
Facilities of electric power	Transformer, Switch board, Distribution panel
Facilities of water supply	Water service tank, Water pump, Piping materials

FOB price of machinery and equipment . . . (approx.) $US 2,760,000

Wall tile may broadly be classified into those for external and internal decoration. Generally speaking, porcelain tile is used for exterior and earthen tile for interior purposes.

As for the use of glazed tile and unglazed tile, the unglazed type is in many cases used for the coverage of floor. Glazed tile is commonly used for the purpose of decoration.

But in special cases, decoration tile with under or over-glaze is used.

The desirable raw materials for wall tile have uniform qualities with minimum impurities.

In case of colour glazing, which covers the colour of the body, some impurities in raw materials may be allowed.

Needless to say, however, the higher the degree of whiteness of body, which constitutes the basis for colour, the brighter the colour.

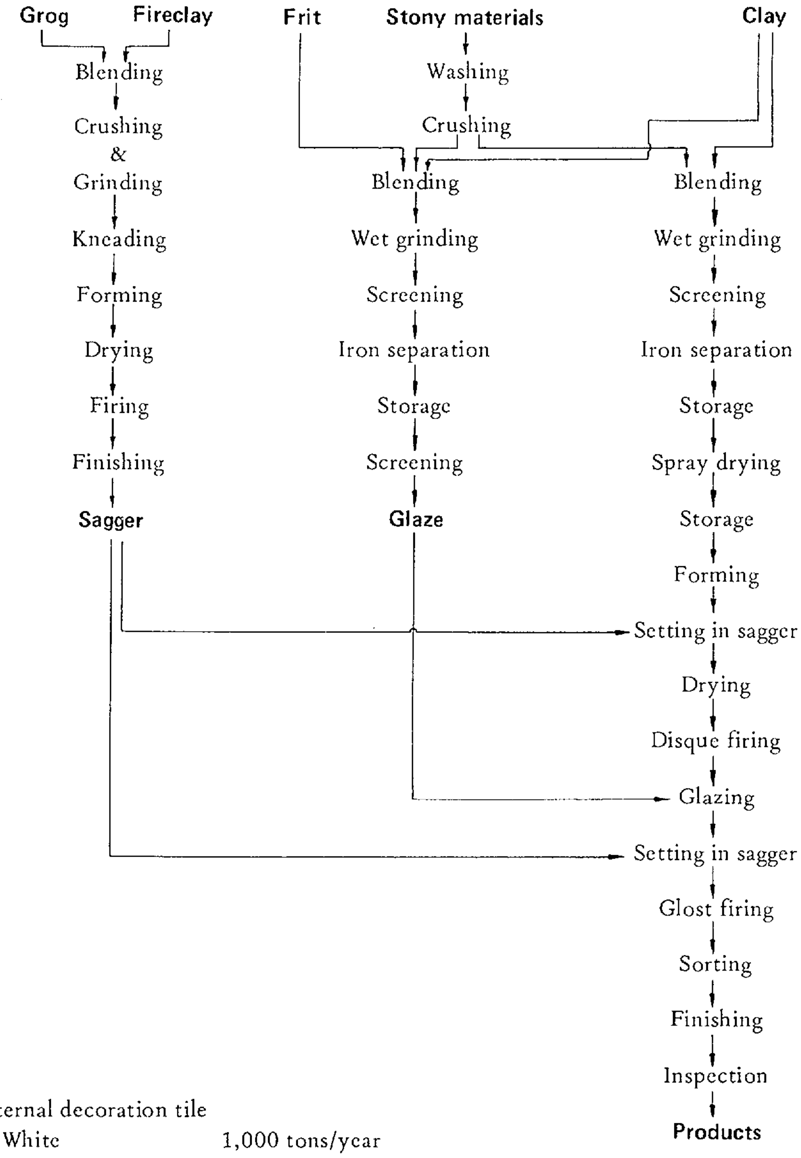
Production Capacity

Refer to the attached table. In view of the simple shape of tile, a press machine is used for forming. Automation is easy, and a semi-automatic process is generally adopted.

In Japan, the economical capacity of a specialized wall tile plant is about 3,000 – 9,000 tons/year. But the economical scale of a plant should, of course, be adjusted somewhat according to the state of the country where the plant will be built.

The following is the breakdown of a 3,000-ton-per-year production capacity of a wall tile plant.

Process Flow Sheet for Wall Tile Making Plant



Internal decoration tile

White	1,000 tons/year
Colour	2,000 tons/year
Total	3,000 tons/year

Size of tile 108 mm x 108 mm

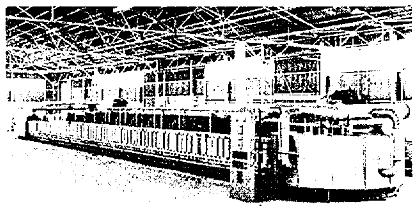
Tables 1, 2, 3 and 4 show respectively the machinery and equipment, raw materials and utilities, manpower, and plant site area required for the above plant.

Utilities

Utilities needed for the wall tile manufacturing plant are mainly electricity, fuel oil or natural gas and water. In addition, a lubricant for the maintenance of machinery, and small amounts of pigment, chemicals, etc. are requried.

Table 2: Required Raw Materials and Utilities

Item	Annual quantity
Raw Materials	
Clay	3,200 tons
Feldspar	380 tons
Quartz.	540 tons
Lime stone.	750 tons
Frit.	180 tons
Pigment & stain. . . .	40 tons
Utilities	
Fuel oil	2,000 kℓ
Electric power	1,300,000 kWh
Water	4,000 m^3



Endless type glost firing tunnel kiln

Locational Condition

In studying the location, special importance should be attached to the firmness of the ground because it should support a tunnel kiln for firing, which is a heavy structure.

The underground water level should be low, and good drainage should be provided. The site of the plant should be near to where key raw materials are produced, and also to the area of consumption, with sufficient roads for the transport of raw materials, fuels and products into and out of the plant.

Table 3: Required Manpower

Item	No.
Office staff & engineer.	10
Factory worker	
Skilled worker	20
Unskilled worker.	55
Total	85

Table 4: Required Plant Site Area

Item	
Building area . . . .(approx.)	100x60m =6,000m^2
Required land area.(approx.)	130x150m =19,500m^2

Note: This building area does not include the living quarters of employees.

How To Start Manufacturing Industries

Ceramic Tableware Making Plant

Ceramic tableware is the most commonly used article in the world, because it is indispensable for man's daily life. Accordingly, domestic manufacture of ceramic tableware definitely contributes to economizing on foreign currency.

The industrialization of tableware is one of the easiest to carry out. However, the prerequisite to successful industrialization is that either the greater part of the raw materials required is available in the country, or can be imported cheaply from a neighbouring country.

Tableware consists of body, which is mainly made of quartzite, feldspar, kaolin and clay, and glaze which constitutes glass on the surface to provide gloss and beautiful touch.

The amount of glaze required is about 10 per cent of body, and the raw materials required include quartzite, feldspar, talc, lime, dolomite, kaolin, etc.

These raw materials are blended in a prescribed ratio, after which they are crushed into a fine powder. After moulding, they are dried and fired into products. They are then coloured with inorganic pigments.

Generally speaking, it is economical and easy to manufacture more than a dozen shapes in one project.

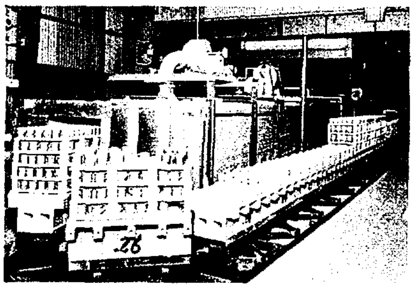
Of course, the larger the variety of shapes, the higher the cost of equipment, and the greater the technical difficulty.

Although much depends upon the condition of the country, and its population as well as whether or not it is possible to export tableware to neighbouring nations, existence of several tableware plants is economically feasible because such plants may develop their individual features in design (shape, colour and decoration).

Operation of the plant becomes comparatively easy when workers become skilled in the manual work.

Tableware is indispensable for daily life. They are generally available in the shape of plates, dishes, bowls, coffee or tea cups and saucers, milk pots, sugar pots and coffee or tea pots, etc.

Tableware is packed in straw bales, cartons (corrugated paper board), or cases. But it may be shipped in bamboo baskets with pieces wrapped in straw.



Endless type glost firing kiln

Table 1: Required Machinery and Equipment

Item	Description
Main Machinery & Equipment	
Crushing & grinding unit	Rotary washer, Jaw crusher, Crushing roll, Table balance, Bucket elevator, Belt conveyor, Hoist cart, Ball mill
Mud preparation unit	Slip tank with agitator, Magnetic separator, Vibrating screen, Diaphragm pump, Filter press, Membrane pump, Vacuum auger machine, Cart
Moulding unit	Automatic jigger, Dryer, Grand conveyor, Finishing jigger, Overhead slip agitator, Casting apparatus
Biscuit firing unit	Biscuit firing tunnel kiln
Glazing unit	Belt conveyor, Service tank, Vibrating screen
Glost firing unit	Glost firing tunnel kiln
Decorating unit	Conveyor for transference, Grand conveyor, Decorating tunnel kiln
Accessory equipment	
Sagger manufacturing unit	Edge runner, Pug mill, De-airing auger machine, Automatic jigger, Dryer, Cart
Gypsum mould unit	Jigger, Cart, Agitator
Auxiliary facilities	
Laboratory equipment	Pot mill, Ball mill, Pilot kiln, Miscellaneous equipment & apparatus
Facilities of electric supply	Emergency power equipment, Transformer
Facilities of water supply	Water service tank

FOB price of machinery and equipment . . . (approx.) $US 2,950,000

Process Description

The desirable extent of automatic operation depends upon the scale of operation, the amounts of raw materials and output.

However, excessive automation may not be economical, and so in a country where wages are cheap, only partial automation may be recommended.

So far as Japan is concerned, the economical capacity of the plant is 700 – 1,300 tons/year. Here is a description of the plant with a basic capacity of 1,300 tons/year:

(1) Aim of manufacture is medium-class goods.
(2) The plant should be laid out with a view to easy expansion and to provide economic feasibility.
(3) The number of workers is stated later. However, this depends on the state in the country concerned.
(4) The prices of machinery and equipment are on FOB basis. The prices are approximate, and they may differ from country to country.

The manufacturing process of tableware, for which a flow sheet is attached, may summed up as follows:

1) Washing of stony materials

Such stony materials as feldspar and quartz should be fully washed to remove impurities which may have adhered during mining or transportation, before they are crushed.

2) Crushing process

In the case of the crushing of stony

materials, a jaw crusher should be used for coarse crushing, and, thereafter, a roller crusher for medium crushing.

After the above procedure, the materials should be weighed and batched to the predetermined ratio for fine grinding by a ball mill.

3) Moulding process

The throwing of tableware is an important process for the moulding of products. This requires considerable skill. More often than not, therefore, an automatic throwing machine is used without depending on a manual jigger.

4) Drying process

Drying is carried out by a continuous system, drawing the heat required for drying from waste heat in the firing kiln so as to economize on heat.

5) Glazing

A conveyor system is used for the flow drying process.

6) Firing process

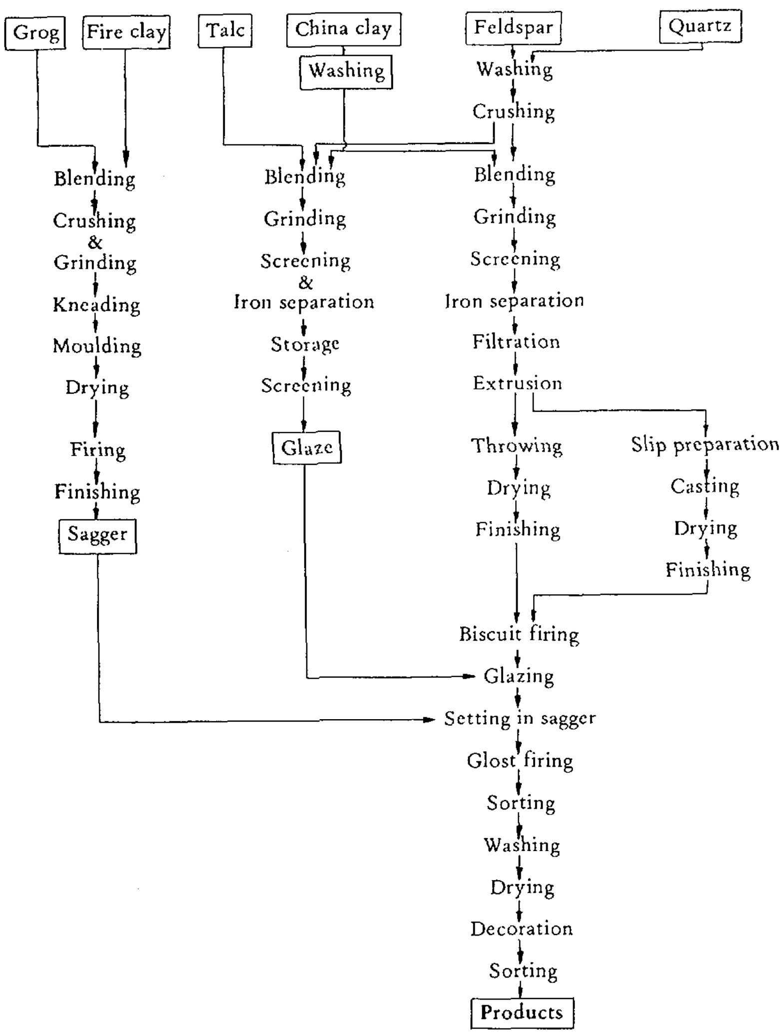
This is the most important process in the manufacture of tableware. In order to give strength to the green body after moulding, by adding ceramic bonding, biscuit firing is perfomed. Later, the glazed body is subjected to glost firing.

Generally speaking, the above firing is provided in a tunnel kiln which is good for heat economization and easy in quality control.

7) Decoration

Decoration is applied in order to enhance the value of products as merchandise, adding elegance and beauty. This work needs skilled workers who have a sense for art. However, there is the over glaze decoration system based on an industrially efficient transference process.

Process Flow Sheet for Ceramic Tableware Making Plant



Example of Tableware Manufacturing Plant

Here is an outline of tableware manufacturing plant with an annual production capacity of 1,300 tons.

The machinery and equipment, and raw materials and utilities required for the above projected plant are as shown in the attached tables.

The required plant site area is approximately 30,000 m^2 (120 x 250 m), in which the area for future expansion is included.

The required floor area is about 8,400 m^2. However, this does not include the site for the living quarters for workers.

Locational Condition

As for the desirable locational condition, the ground should be firm, because it has to support such heavy structures as the tunnel kiln for firing, which is the heart of the plant. In addition, the level underground water should be low and the draining good.

The ideal site for the plant is one situated near a consumer area, and along a road on which the raw materials, fuel and products may be carried in and shipped out.

Table 2: Annual Reuirement of Raw Materials and Utilities

Item	Quantity
Raw materials	
China clay & Fire clay	1,554 tons
Feldspar	461 tons
Quartz	348 tons
Talc	15 tons
Sub materials	
Alumina	1,800 kg
Sodium silicate	600 kg
Gypsum plaster	54 tons
Decorating materials	
Utilities	
Fuel oil	1,350 kℓ
Electric power	1,432,000 kWh
Water	32,000 m^3

How To Start Manufacturing Industries

Sanitary Ware Making Plant

Sanitary ware is the general nomenclature given to ceramic wares used for sanitary facilities--water supply, drainage, sewerage and sanitary treatment of excretion--for the purpose of comfortable living.

Because of the incombustible, waterproof, non-abrasion, and chemical resistant properties, all sorts of ceramic products have played a constructive role in improving our living standard. Sanitary ware, especially, is closely connected with housing, and so it has developed considerably with the structural improvement and modernization of dwellings. It is indispensable to modern dwellings.

In addition to the practical usefulness, the space decorative effect of sanitary ware cannot be overlooked. The requirement of sanitary ware will increase in various ways with the development of the housing industry, and the demand will also increase in proportion to the diversified dwellings.

Based upon the properties of the "body," sanitary ware can be classified into three categories: porcelain, pottery, chamotte. The body of porcelain-type sanitary ware is fused; the structure is fine and even; it is almost non-porous; the colour is white. Porcelain-type sanitary ware is most commonly used in advanced nations at the present time. The body of pottery-type sanitary ware is porous, it is not very strong. Accordingly, the use of pottery-type sanitary ware is declining. The history of pottery-type sanitary ware, however, is older than that of porcelain-type sanitary ware, and pottery-type sanitary ware has a significant importance in that porcelain-type sanitary ware gave birth from the development of the former. Moreover, pottery-type sanitary ware is still being used widely in developing nations. Chamotte sanitary ware is mainly used for large bathtubs, but, because of the rapid development of enameled ware and plastic ware, it is not being manufactured at present. A comparison of the properties of the three types of sanitary ware is shown in Table 1.

Broadly speaking sanitary ware will include glazed brick and glazed tile, but here we shall limit it to a narrower sense.

Ordinarily all surfaces other than those which come in contact with the floor or wall are glazed, and the glaze is generally transparent.

Recently coloured glaze such as light blue, light pink, and light yellow, for decorative purpose, has become popular.

Sanitary ware must have the following features:

(1) The surface of sanitary ware must withstand shock and corrosive chemicals.
(2) Sanitary ware must not have cracks which will hold filth.
(3) Sanitary ware must be non-permeable.
(4) The surface of sanitary ware must be smooth.
(5) Washing of sanitary ware must be easy.
(6) The appearance of sanitary ware must be beautiful and clean.

Process Description

1) Preparation of raw material to make body

The main raw materials of sanitary ware are ball clay, kaolin, feldspar, quartz, dolomite, and limestone. These are washed or elutriated and transfered into the plant. The raw materials are roughly crushed by the jaw crusher and roll crusher, and then sieved, and weighed. The particles of raw material are mixed with the required amount of water and fed into the ball mill to be ground for many hours into fine particles. The prepared slip taken out of the ball mill is transfered into the agitating tank. The iron in the slip is removed by a magnetic filter. The slip is further sieved and made into uniform size particles.

Casting & Drying section

2) Shaping

Shaping is done by the casting mould method. The casting mould is made of plaster, which should be high grade baked plaster. The shaping

Table 1: Physical Properties of Various Types of Sanitary Ware

	Porcelain	Pottery	Chamotte
Water absorption factor (%)	0 – 1	5 – 10	12 – 15
Balk specific gravity (g/cm^3)	2.4 – 2.43 (true specific gravity)	1.9 – 2.1	1.8 – 1.9
Anti-pressure strength (kg/cm^2)	5,000 – 5,500	600 – 1,000	350 – 400
Bending strength (kg/cm^2)	460 – 760	200 – 300	200 – 250
Impact strength (cm-kg/cm^2)		1.2 – 1.5	1.0 – 1.2

Table 2: Production Scheme

1) Production capacity

Products:	Wash basin. .	1 (27 lbs)
	Pedestal. . . .	1 (26 lbs)
	Commode . .	1 (29 lbs)
	Water tank. .	1 (15 lbs)
		4/sets
Quantity:		2,200 tons/annum (4,400 sets/annum)

2) Standard of products

Vitreous sanitary ware
Conform to JISA 5207 in several plain colours such as white, yellow, blue, pink

3) Working shift

8 hours/day, 300 days/year
(except tunnel kiln : 24 hours/day, 360 days/year)

of the plaster mould, too, is done by casting, and the original shape of the plaster casting mould is also made of plaster.

The prepared slip is kept in the agitating tank for many hours; then, it is poured into the casting mould to be dewatered and solidified into the shape of sanitary ware. Special care should be taken not to introduce air in the slip when pouring it into the mould. The slip is poured fully into the mould, but

Kiln section

Table 3: Required Machinery and Equipment

Item	No.
A) Raw materials crushing section	
1. Jaw crusher	1 set
2. Roll crusher	2 sets
3. Belt conveyor	4 sets
4. Bucket elevator	1 set
B) Body preparation section	
1. Ball mill: 10,700 lit.	3 sets
2. Agitator for tank	9 sets
3. Cart for mixing	4 sets
4. Weighing scale	1 set
5. Diaphragm pump	5 sets
6. Vibrating sieve	1 set
7. Magnetic ferro filter	1 set
8. Water flow meter	2 sets
C) Glaze preparation section	
1. Ball mill: 2,600 lit	2 sets
2. Ball mill: 300 lit.	3 sets
3. Diaphragm pump	2 sets
4. Vibrating sieve	2 sets
5. Magnetic ferro filter	2 sets
6. Pot mill	1 set
7. Portable stirrer for tank	8 sets
D) Casting section	
1. Agitator for tank	4 sets
2. Pressure slurry container	4 sets
3. Diaphragm pump	4 sets
4. Electric controlled casting equipments for 400 moulds of commode and wash basin	1 lot
5. Casting equipment for 200 moulds of water tank and pedestal	1 lot
6. Casting equipments for water tank lid	1 lot
7. Revolving table	20 sets
8. Various tools	1 lot
E) Glazing section	
1. Glazing conveyor	2 sets
2. Glazing booth for colour glazing	3 sets
3. Pressure glaze container	5 sets
4. Spray gum	10 sets
F) Drying and firing section	
1. Drying equipments for casting section	1 lot
2. Table lift for kiln car loading	1 set
3. 85 M tunnel kiln	1 set
G) Inspection section	
1. Inspection equipments for flushing function	1 lot
2. Grinder for wall installation surface	2 sets
3. Appearance inspection table	3 sets
4. Inspection gauge, measuring tools etc	1 lot
H) Moulding making section	1 set
I) Laboratory section	1 set
FOB price of machinery and equipment . . . **(approx.) $US 1,429,000**	

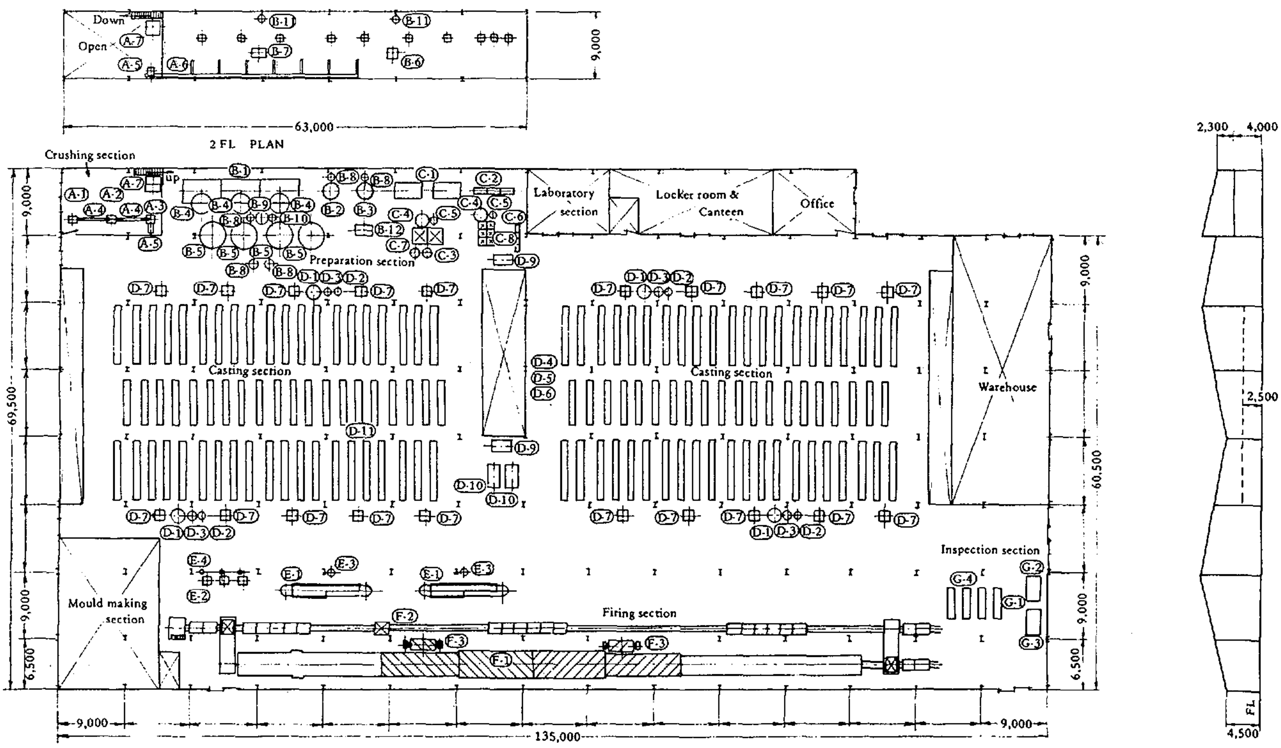
No.	Description	Q'ty
A.	Raw material crushing section	
1	Jaw crusher	1
2	Roll crusher	1
3	Roll crusher	1
4	Belt conveyor	1
5	Bucket elevator	1
6	Belt conveyor	1
7	Cargo lift	1
B.	Body preparation section	
1	Ball mill	3
2	Dissolving agitator	1
3	Dissolving agitator	1
4	Stirring agitator	3
5	Stirring agitator	4
6	Transportation cart	4
7	Weighing scale	1
8	Diaphragm pump	5
9	Vibration sieve	1
10	Magnetic ferro filter	1
11	Water flow meter	2
12	Air compressor	1
C.	Glaze preparation section	
1	Ball mill	2
2	Ball mill	3
3	Diaphragm pump	2
4	Vibration sieve	2
5	Magnetic ferro filter	2
6	Pot mill	1
7	Portable stirrer	2
8	Portable stirrer	6
D.	Casting section	
1	Stirring agitator	4
2	Pressure slurry container	4
3	Diaphragm pump	4
4	Electric controlled casting equipment	1
5	Casting equipment	1
6	Casting equipment	1
7	Revolving round table	20
9	Dust collector	2
10	Air compressor	2
11	Working table	122
E.	Glazing section	
1	Glazing conveyor	2
2	Glazing booth	3
3	Pressure glaze container	2
4	Pressure glaze container	3
5	Spray gun	10
F.	Drying, firing section	
1	Tunnel kiln	1
2	Table lift	1
3	Dryer	2
G.	Inspection section	
1	Inspection section	1
2	Grinder	1
3	Grinder	1
4	Appearance inspection table	3
5	Inspection gauge	1

only the slip within the inner wall which is to be formed into a suitable thickness is left to remain and the rest of the excess slip is removed to be reused. The moulded ware taken out of the mould is dried for a suitable length of time under the proper temperature and moisture. The plaster mould, too, is dried in the same way to be reused.

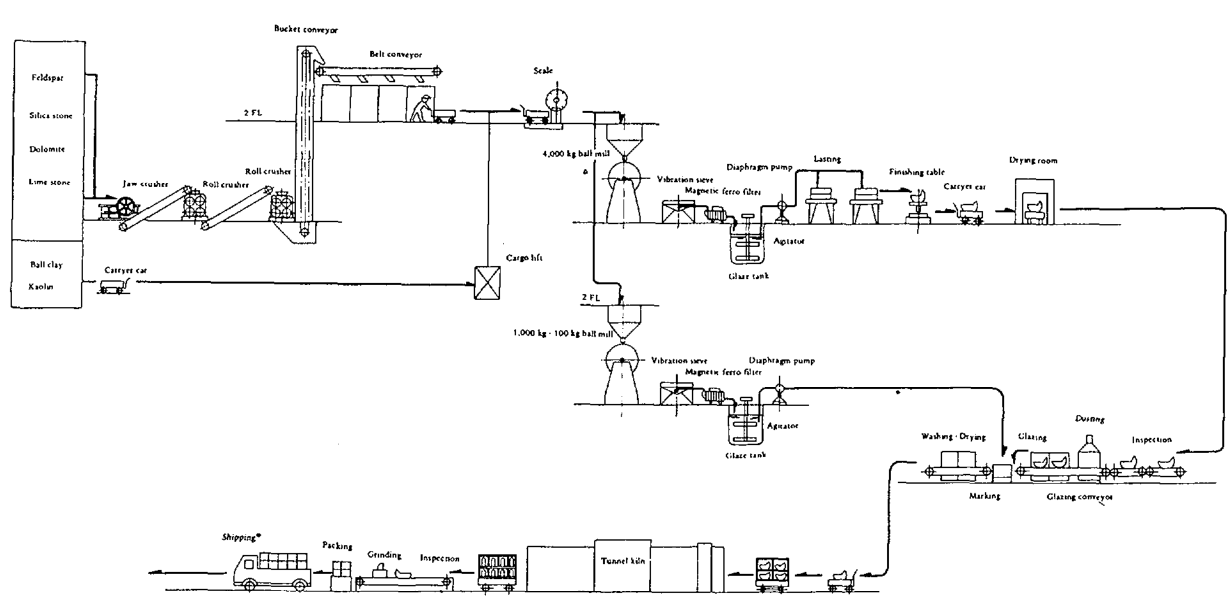
3) Glazing

Glazing will have to be prepared beforehand in the same way as the body slip. Feldspar, quartz, zircon oxide, kaolin, zinc white, and limes-

Layout for Sanitary Ware Manufacturing Plant



Process Flow Diagram for Sanitary Ware Manufacturing Plant



tone are mainly used as raw materials for glazing. Pigment is added if coloured glazing is desired.

Glazing is done either by spraying or by dipping the moulded ware into a tank filled with glazing medium. Because of the size and weight, however, the spraying method would be most convenient. This method is generally used now. Even in the spraying method, there is the semi-automatic conveyor system method and there is the method whereby each piece of moulded ware is placed on a table for spraying. The conveyor system is better from the standpoint of efficiency. The important thing in glazing is that the glaze must be of suitably even thickness.

4) Firing

When glazing is completed, the moulded ware is ready for firing. There are all sorts of firing kiln: the simple box kiln, the shuttle kiln, the tunnel kiln, etc. The tunnel kiln, however, is most efficient and is most commonly used today. The sorts of fuel or energy used for firing are heavy oil, diesel oil, kerosene, natural gas, LPG, electricity, etc. The most economical method is used case by case. In each case, however, the firing kiln must be designed most suitably by taking various conditions into consideration. Glazed ware is fired for 25 - 30 hours at a temperature of 1,100 - 1,200 degrees C. In the case of tunnel kiln, the glazed ware should be stacked efficiently on the kiln car and, since the process is a continuous one, the unloading operation should be done speedily. Because defectively fired ware cannot be reused or remade, the draft pressure, the temperature distribution, and the length of firing time within the kiln should be carefully controlled and established from sufficient test data. The primary aim of kiln control is to obtain an even body and to retain the quality of the glaze.

Metal Parts for Sanitary Ware

Water piping, faucets, and many other metal fittings are attached to sanitary ware depending on the use, but these are beyond the scope of ceramics, so the description will be omitted.

Example of Sanitary Ware Making Plant

The layout of a model plant producing four sorts of representative sanitary ware—wash basin, pedestal for wash basin, toilet stool, water tank for toilet stool--has been given as an example. The products of this plant are porcelain.

Assuming that the plant is to be an economical one in a medium scale, the capable output would be 2,200 tons in terms of weight and 4,400 sets (one set will be one each of the four products given above) in terms of quantity.

Tables 2, 3 4, 5 and 6 show respectively the production scheme, machinery and equipment, raw materials and utilities, manpower, and plant site area required for the above plant.

Table 4: Annual Requirement of Raw Materials and Utilities

Item	Quantity (approx.)
Body materials:	
Feldspar	413 tons
Quartz	275 tons
Ball clay	687 tons
Kaolin	1,292 tons
Dolomite or Lime stone	83 tons
Total	2,750 tons
Glaze materials:	
Feldspar	165 tons
Quartz	28 tons
Zircon oxcide	22 tons
Kaolin	8 tons
Zinc oxcide	16 tons
Lime stone	36 tons
Total	275 tons
Plaster of paris	Total 165 tons
Industrial water	Total 25,000 tons
Fuel (Low sulpher oil)	Total 1,200 tons
Electricity	Total 1,000,000 kWh (2,780 kWh average/day)

Table 5: Required Manpower

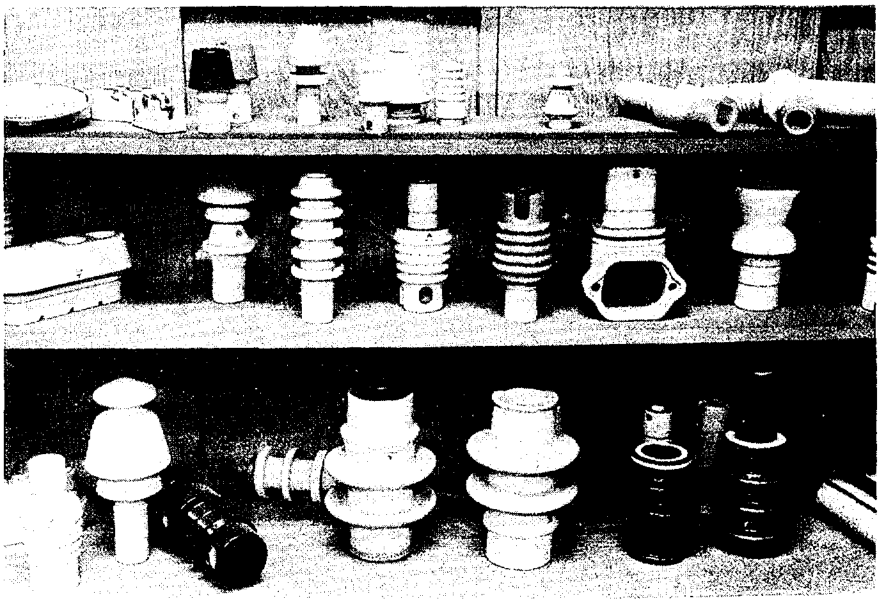
Item	No.
Management staff	4
Engineer	3
Quality control staff	3
Laboratory staff	4
Building repair staff	2
Clerical worker	10
Skilled worker	20
Worker	97
Total	143

Table 6: Required Plant Site Area

Item	
Factory building area	(approx.) 9,400 m^2
Required land area	(approx.) 20,000 m^2

How To Start Manufacturing Industries

Porcelain Insulator Making Plant



There is a wide variety of electric porcelain insulators which are used for supplying electricity, and the quality and shape differ depending on the use.

There are the super high-tension and high-tension insulators used for transmitting electricity along a transmission line from the power station to the substation. There are the high, middle, and low-tension insulators used for transmitting electricity from a substation to the consumer through an electric power company. And there are other types of insulators which go with the transmitting and supplying systems.

The demand of electric insulator is constantly increasing with regional development, rise in cultural and living standards of a nation, and the improvement in conditions of electric supply. The trend in various countries is toward domestic production, depending on internal conditions. Depending on the variety and use, however, the method of manufacturing requires high skill, technology, and knowledge. The manufacture of super high-tension glass insulator, especially, requires high manufacturing technology.

In planning to establish an insulator plant, it would be advisable to begin manufacturing low-tension and high-tension insulators which are easy to manufacture, or something similar with a simple shape; then, by gradually acquiring the manufacturing technology, manufacturing should shift toward more complicated shape or high-tension insulators. This is the quickest way to succeed in the project.

A plant which is capable of producing 800 tons per year of four items (nine types) of insulators which are relatively easy to manufacture and which have a huge demand has been given here as a model. The production items are shown in Table-1.

As a characteristic of ceramic industry, research of raw materials and body requires a considerably long time. Accordingly, in taking up this plan in the actual plant, sufficient research of raw materials available in respective countries should be effected before setting up the plant. This plan is laid out on the supposition that the problem of raw materials has been solved in one

Table 1: Production Scheme

Item	Production quantity (pcs./year)	Production quantity (tons/year)
Pin type insulator		
Large	300,000	510
Small	230,000	161
Strain insulator		
Large	30,000	36
Small	30,000	21
Spool insulator		
Large	100,000	50
Small	100,000	10
Wire holder		
Large	20,000	10
Middle	30,000	9
Small	20,000	3
Total	860,000 pcs./year	810 tons/year

Table 2: Operation Condition

1) Firing unit:	3 shifts per day, 350 days/year	8 hours per shift
2) Other relevant unit:	1 shift per day, 300 days/year	8 hours per shift

way or another.

Ceramic industry also requires considerable time in the aquisition of production technics and the training of skilled workers. For this reason, in setting up the porcelain insulator plant, the manufacturing should be started from comparatively simple types and extended gradually to more complicated ones.

Producing insulators up to standard quality requires materials of high quality, and it will be desirable to acquire these materials in respective countries. But if self-support is not possible, it will be necessary to import them. Any obstruction in the way of the import will cause an immediate impediment to the production.

Facilities of considerable scale will be required for the study of raw materials and green body, and the test of products, but in view of the scale of the plant proposed in this plan, it will not be possible to install in the plant such scale of laboratory and testing equipment. Therefore, maximum assistance should be obtained from ceramic laboratory, electric testing institute and others situated in respective countries.

Also, as for maintaining and repairing machinery and equipment, cooperations with maintenance workshop would be necessary. But the minimum facilities required to manufacture machine tools used in the plant must be prepared.

Table 3: Required Raw Materials

Main raw materials and subsidiary materials are quartz, feldspar, kaolin, ball clay or plastic clay, limestone, gypsum plaster, alumina, etc. The consumption will be about 1,300 tons/year. Yearly required quantity is shown below.

Item	Yearly required quantity (tons)
Feldspar	240
Kaolin	200
Silica	420
Ball clay (plastic clay)	340
Limestone or Dolomite	20
Gypsum plaster	40
Alumina	0.2
Tap bolt	40
Sodium silicate	0.5
Total	1,300.7

Fig. 1: Process Flow Sheet for Porcelain Insulator Making Plant

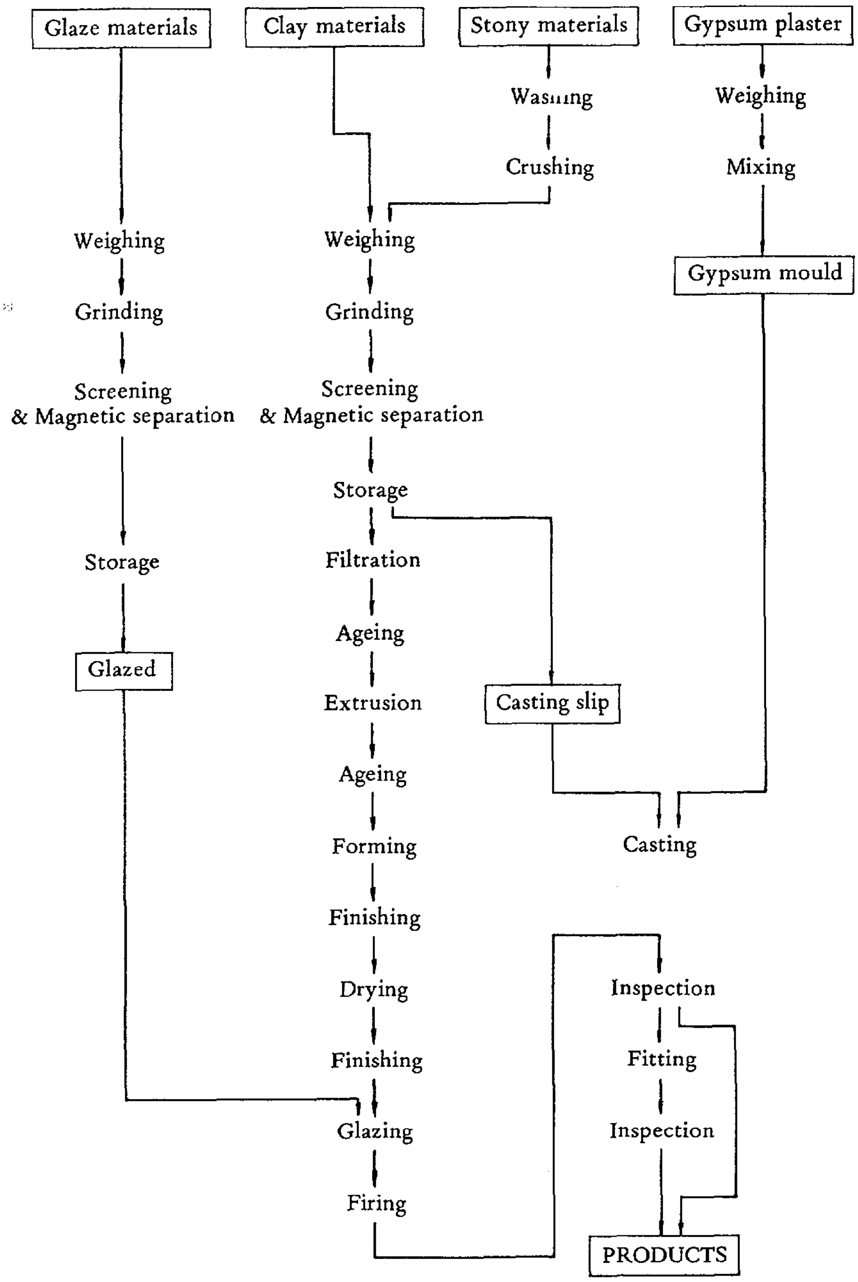


Table 4: Required Machinery and Equipment

Item	Quantity
1) Body preparation section	
Jaw crusher	1 set
Rotating screen	1 set
Roll crusher	1 set
Ball mill (4,000 kg)	2 sets
Ball mill (400 kg)	2 sets
Filter press	1 set
Diaphragm pump	1 set
Magnetic separator	2 sets
Vibrating screen	2 sets
Agitator	4 sets
De-airing auger machine	1 set
Cart	20 sets
Weighing balance	2 sets
Belt conveyor	2 sets
2) Moulding section	
Semi-automatic moulding press	8 sets
Semi-automatic finishing machine	3 sets
Casting apparatus	1 set
Continuous dryer	4 sets
Hot air generator	1 set
Cart	35 sets
3) Drying and glazing section	
Chamber dryer	1 set
Glazing conveyor and accessories	1 set
4) Firing section	
Endless type tunnel kiln	1 set
Cart	10 sets
5) Gypsum mould making section	
Plaster mixer	1 set
Finishing jigger machine	1 set
Finishing hand jigger	2 sets
Finishing table	1 set
6) Fittings setting section	
Mixer	1 set
Setting tools	1 lot
7) Laboratory equipment	
Pot mill with driving unit	2 sets
Mortar with pestle	2 sets
Standard screen	1 lot
Electric test kiln	1 set
Testing tools	1 lot
Extruding machine	1 set
Refractoriness testing apparatus	1 set
8) Workshop	
Bench drill	1 set
Grinder	1 set
Lathe	1 set
9) Others	
Water supply facilities (overhead tank, water pump, pipe and fittings, etc.)	1 unit
Electric supply facilities (receiving facilities for primary input, transformer, distributions panel, lighting equipment, wiring materials and fittings, etc.)	1 unit
Fuel oil supply facilities (main oil tank, oil service tank, oil pump, oil strainer, pipe and fittings, etc.)	1 unit
Transportation equipment (shovel loader, forklift truck)	1 set
FOB price of machinery and equipment (approx.)	$US 1,233,000

Table 5: Required Utilities

1) Fuel oil (Light diesel oil)	
2) Electric power	550,000 kWh
3) Industrial water	6,000 m^3
4) Machine oil	2 kℓ
5) Grease	0.5 kℓ

Table 6: Required Manpower

Item	No.
Factory manager	1
Engineer	5
Clerical worker	3
Foreman	6
Skilled worker	25
Unskilled worker	50
Total	90

Locational Condition

The main factors of selecting the location for porcelain insulator manufacturing plant are as follows:

(1) Raw materials easily available
(2) Easy-to-get utilities (clean water, electricity and fuel oil)
(3) Free from iron contamination
(4) Near the area of consumption
(5) Machine works for maintenance available
(6) Good workers available

Table 7: Required Area for Plant Site

1) Land:	80 m x 100 m = 8,000 m^2
2) Buildings:	
Main factory building:	50 m x 40 m = 2,000 m^2
Mud preparation building:	15 m x 40 m = 600 m^2
Office and laboratory:	10 m x 20 m = 200 m^2
Canteen and workshop:	10 m x 20 m = 200 m^2
Guardhouse:	2 m x 4 m = 8 m^2
Total:	3,008 m^2

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M

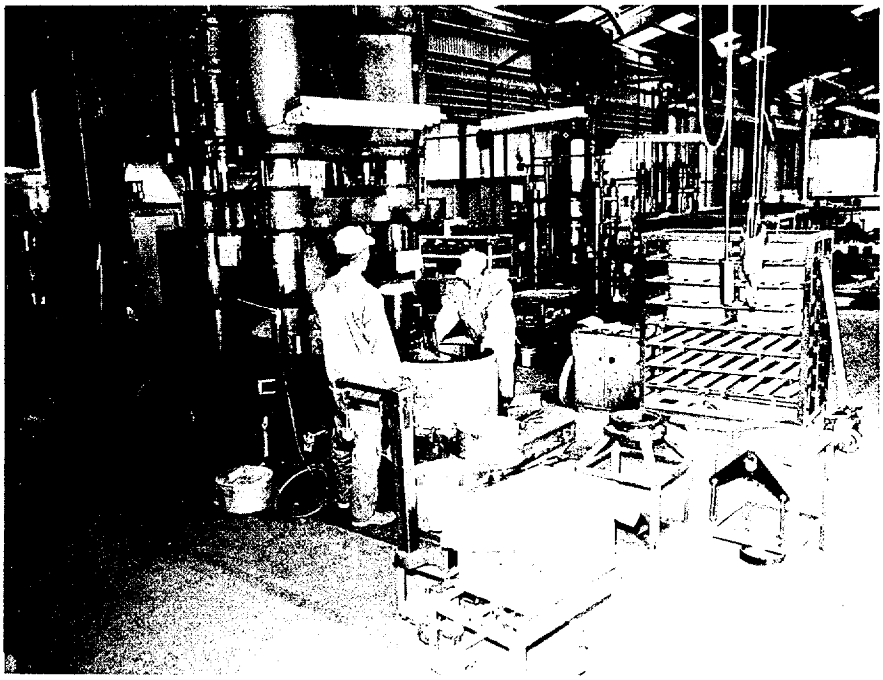
ISIC 369 OTHER MINERAL PRODUCTS

How To Start Manufacturing Industries

Grinding Wheel Making Plant

The demand for grinding wheels has increased with the development of industry. Grinding wheels have contributed considerably to the development of various industries, including iron and steel, machine tools, automobile, shipbuilding, and aircraft.

It is expected that grinding wheels will play an important role in the future—more important than can be imagined—with the improvement of metal materials, the improvement in the performance of grinding machine, and the increased need for precision processing.



Press machine

The production capability of makers in Japan range from 10 tons to 600 tons a month. More than 50 small enterprises are turning out unique products in their specialized fields. The manufacturing process of grinding wheels belongs to the same ceramic field as pottery, in which Japan takes pride. The quality of Japan's grinding wheels is as good as those of any other industrially advanced nations.

There are two typical manufacturing methods—the Vitrified method and the Resinoid method.

Products made by the Vitrified method are used over a wide range from heavy grinding to precision grinding.

Products made by the Resinoid method are used for high speed grinding, and the safety factor is high. Grinding wheels made by this method are widely used in the field of rough grinding and snagging.

A grinding wheel making plant was exported to Calcutta, India in 1960. At first a 20 tons/month plant was built as a test plant. With the good quality of the product gradually gaining recognition by users, it has become an enterprise of high merit, and it is now turning out 300 tons a month with a labour force of 400.

Table 1

Year	Production output (ton)	Export price
1974	83,000	$US 2,448,000
1975	51,000	$US 1,671,000
1976	60,000	$US 2,081,000

Process Description

Vitrified process and production

As shown in Fig. A, a small amount of starch solution as a binder is added to the grinding material, and both are mixed enough in a mixer. A further 20% of bonding material is added and mixed, then the mixture is shaped to the required dimensions by a press using a metal mould, or by the casting method. The shaped green wheel, after going through the drying process, is baked for about 60 hours at a temperature of 1,250 – 1,300 degrees C. It is discharged after cooling for about 70 – 80 hours. After going through the final finishing process, the wheel is ready for delivery.

A suitable production scale to start with is 15 tons a month. The maximum dimension of shaping is 14" (dia.) x 6" (thickness), and manuacture is done by a 200-ton hydraulic press. Two 3-ton rotary kilns are alternately used for firing. A monthly output of 18-20 tons can be attained by using two rotary kilns continuously. What should be especially taken into consideration when constructing the kiln is that the level of the underground water should be as low as possible.

As the preparation of the binder and the washing of grinding material require water, it is desirable that the plant site has favourable supply of water.

Resinoid process and production

As shown in Fig. B, thermo-setting phenol resin as a bonding material and inorganic filler are added to the grinding material and mixed.

A hydraulic press with metal mould is used for shaping. The heating temperature is 180-200 degrees C, and the heating time is 30-50 hours.

The quality of the resin is sensitively affected by the temperature and humidity, so an air-conditioned room should be used for the mixing and pressing processes.

As the operation features low cost of equipment and short finishing time, a favourable output is enabled with a high profit rate.

The maximum shaping dimension of a grinding wheel for a plant with a capacity of 10 tons/month is 14" (dia.) x 6" (thickness). In the case of the cutting-off wheel, it is possible to manufacture products up to 18" in diameter.

A capacity of 15 tons/month would be possible by firing two units of 1-ton kiln alternately.

Although no particular consideration is required for the plant site, a site where the temperature and humidity fluctuate considerably is not desirable because synthetic resin is used as the bonding material.

Required Manpower

The required manpower is shown in the attached tables.

As for the technical level, one of the two engineers in the staff should have academic achievement approximately equal to a graduate of the industrial chemical course of a university, and the other should have academic achievement approximately equal to a graduate of the mechanical engineering course of a university. The former is to be assigned to quality control, research on binder, and development of new products; the latter is to be assigned to maintenance and design of equipment and machinery, and management of the plant.

As the backbone of the staff, four or five persons with an approximate educational background of the graduate of high school will be required for making adequate preparations for each process.

It will be convenient if the general workers include those who have had experiences as operators of lathes, boilers, and those who have had experience of job in the ceramic industry.

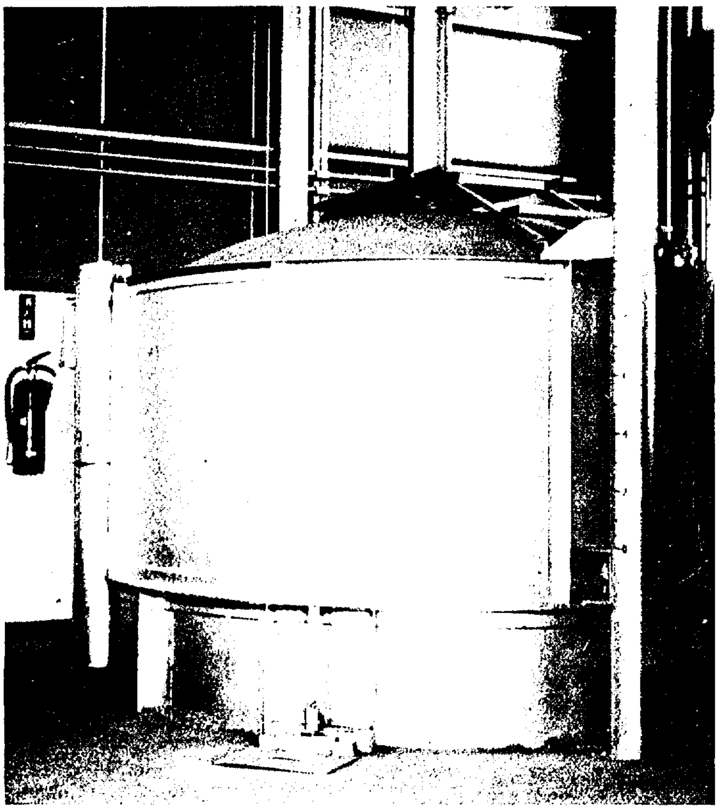
The working hours are 8 hours/ day, 300 days/year.

Diamond Grinding Wheel

Diamond grinding wheel is used for grinding sintered hard alloys, special alloys, and nonmetals, and the use is spreading rapidly. Cubic boron nitride is used as the grinding material for grinding wheel. A great demand for this sort of grinding wheel is expected in the future. Around five workers would be enough to begin the work.

As the operation features low cost of equipment and short finishing time, products with high added value are possible. The most important thing would be the bonding material.

Mixer



Rotary kiln

Table A-1: Required Machinery and Equipment for Vitrified Method

Item	No.
Batching process	
Mixer	1
Agitator A	1
Agitator B	1
Pressing process	
Hydraulic press (200tons)	1
Hydraulic press (60tons)	1
Drying process	
Dryer	1
Green wheel forming process	
Pre-finishing machine A	1
Pre-finishing machine B	1
Firing process	
Rotary kiln (3tons)	2
Carborundum plate	2
Finishing process	
Finishing machine A	1
Finishing machine B	1
Finishing machine C	1
Inspecting process	
Bonding force tester	1
Revolution tester	1
Balance tester	1
Air compressor	1
Reduction process	
Rinsing machine	1
Magnetic separator	1
Vibrating sieve	1

FOB price of machinery and equipment .... (approx.) $US 367,000

Table A-3: Monthly Requirement of Raw Materials and Utilities for Vitrified Method

Item	Quantity
Grinding material	16 tons
Bonding material and glue	4 tons
Lead	220 kg
Heavy oil	7,000 ℓ
Electric power	20,000 kWh
Water	17,000 m^3

Table A-4: Required Manpower

Item	No.
Engineer	2
Skilled worker	5
Worker	20
Clerical worker	2
Total	30

Fig. A: Process Flow Sheet for Vitrified Method

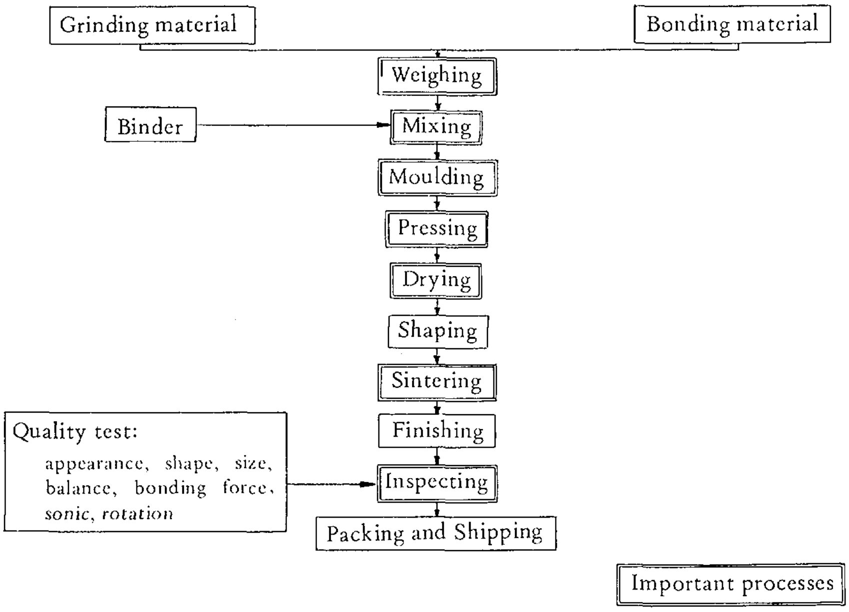
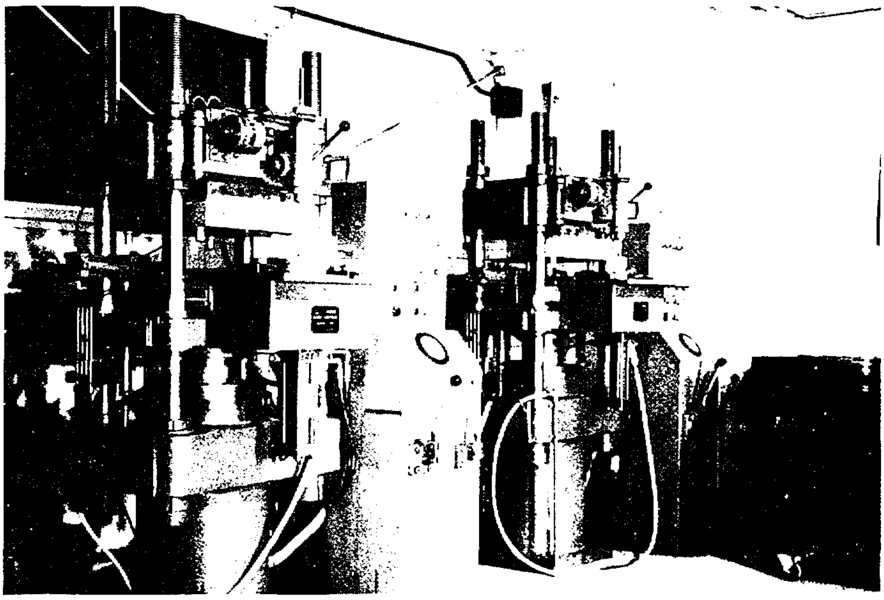


Table A-2: Auxiliary Machinery and Equipment for Vitrified Method

Item	Specification
Generator and transformer	100 kW
Dust extractor	7.5 kW
Chimney	
Heavy oil storage tank	5,000 ℓ
Water works	



Press machine

Table A-5: Required Plant Site Area

Item	
Factory area	570 m^2
Office area	65 m^2
Required land area	1,800 m^2

Table B-1: Required Machinery and Equipment for Resinoid Method

Item	No.
Blending process	
Mixer	1
Blending machine	1
Air conditioner	1
Pressing process	
Hydraulic press (200tons)	1
Hydraulic press (60tons)	1
Curing process	
Curing oven	2
Finishing process	
Finishing machine A	1
Finishing machine B	1
Finishing machine C	1
Bushing apparatus	1
Inspection	
Bonding force tester	1
Revolution tester	1
Balance tester	1

FOB price of machinery and equipment....... (approx.) $US 189,000

Table B-3: Monthly Requirement of Raw Materials and Utilities for Resinoid Method

Item	Quantity
Grinding material	10 tons
Bonding material and filler	2 tons
Lead	150 kg
Electric power	14,000 kWh
Water	34,000 m^3

Table B-4: Required Manpower

Item	No.
Engineer	1
Skilled worker	4
Worker	13
Clerical worker	1
Odd job man	1
Total	20

Table B-5: Required Plant Site Area

Item	
Factory area	270 m^2
Office area	39 m^2
Required land area	900 m^2

Extra charge for technological know-how is required.

Fig. B: Process Flow Sheet for Resinoid Method

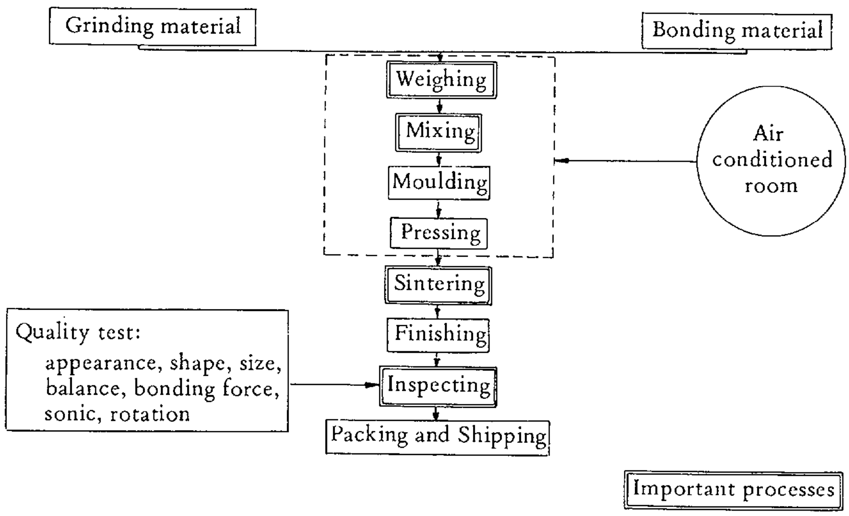


Table B-2: Auxiliary Machinery and Equipment for Resinoid Method

Item	Specification
Generator and transformer	100 kW
Dust collector	5.6 kW
Water works	
Ventilator	

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How To Start Manufacturing Industries

Concrete Block Making Plant

Concrete blocks for buildings were made for the first time in Europe around 1850. Mass production of concrete blocks got under way in step with the development of the cement industry, chiefly in the Western countries, especially around 1918.

In the United States, the concrete block industry recorded a major development after the introduction of the vibration process as a new method of compaction around 1930.

Furthermore, during the after-World War II period, the concrete block industry developed significantly in the European countries and the United States.

In Japan, where concrete blocks were introduced about 50 years ago, the industry took long strides with the post-war import of the latest type block making machine.

As cavity type blocks are chiefly made of such raw materials as sand, gravel and cement, they are used for the building of walls for houses and other structures with embedded steel reinforcement.

They are also used for the building of fences or partitions in concrete buildings and other purposes in large quantities.

Concrete block buildings may be considered as a type of a reinforced concrete building as stated above. Accordingly, they are safe and have good durability in earthquakes and fires.

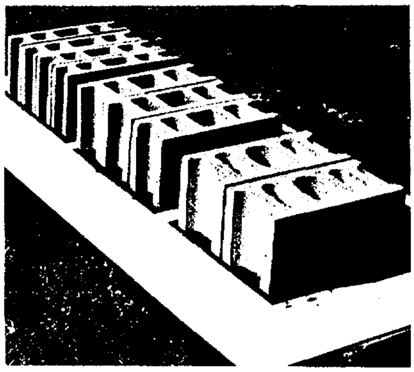
The existence of cavity in concrete blocks helps keep rooms cool in summer and warm in winter, thereby offering comfortable living. Furthermore, the construction cost of concrete block houses is not high, as compared with wooden buildings.

From the technical point of view, the manufacture of concrete blocks does not offer many difficulties. As concrete blocks are heavy, it is not advantageous to transport them over long distances because of the cost of transport.

Therefore, a concrete block manufacturing plant should be built on a site near the area of consumption where it is easy to obtain the raw materials required. And it is the sort of industry that profits despite a comparatively small production capacity.

Process Description

The principal raw materials for concrete blocks are cement, aggregate and water. The secondary materials are various admixtures.



As for cement, there are Portland cement, blast furnace slag cement, silica cement and fly ash cement. Generally speaking, however, Portland cement is used for making concrete blocks.

Sand, gravel, etc. are called aggregates. Aggregates are classified into heavy and light weight types.

The heavy type includes river sand and gravel and macadam, while the light ones include light weight sand and gravel, volcanic sand and gravel, cinder and slag, all of which are inflammable.

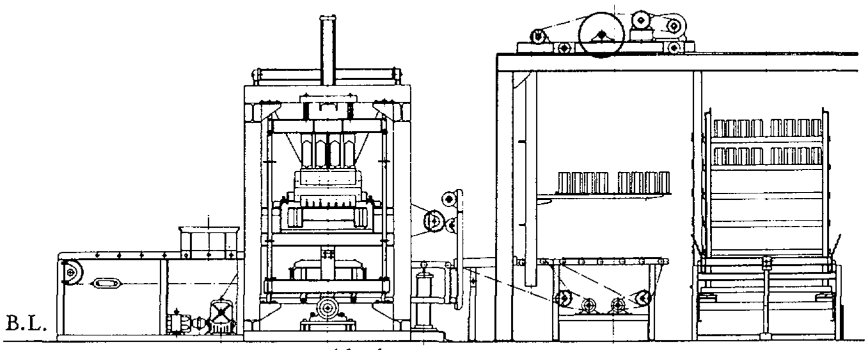
It is essential for aggregates to have suitable grading (namely the proportion of the mixture of large and small grains). The size of grain should be below 10 mm, and aggregates should be free from organic and harmful matters.

The water usable may be city water or well water. Generally speaking, it is acceptable if it is drinkable.

The admixtures are the materials which are mixed for the purpose of providing concrete or mortar with a special property. For instance, they are used for making cement water-proof or making coloured cement.

Example of Concrete Block Manufacturing Plant

1) Process Flow Sheet. . . FK – 50 type plant



FOB price of machinery and equipment . . . . (approx.) $US 190,000

1) Production Capacity

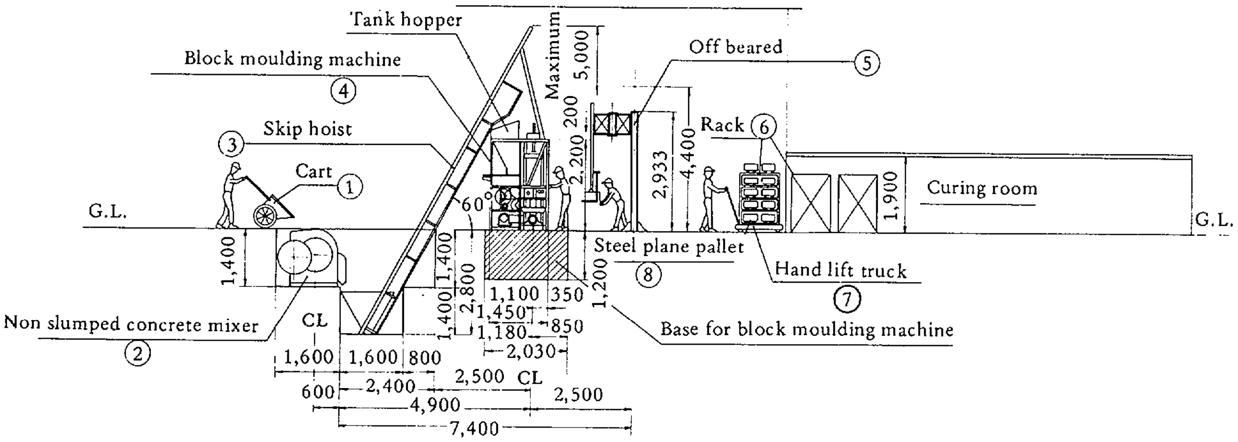
Thickness	
4" (100 mm)	1,200 pcs./hr.
6" (150 mm)	900 pcs./hr.
8" (190 mm)	900 pcs./hr.

Table 1: Monthly Reuirement of Raw Materials and Utilities

On the basis of 90,000 pcs. of 150 mm concrete block per month: a piece of 150 mm concrete block is 15 kg.
(Working hours: 8 hrs./day, 25 days/month)

Sand	750 m^3
Gravel	375 m^3
Cement	139.5 tons
Water	150 m^3
Electric power	1,350 kWh
Fuel oil	7,500 ℓ

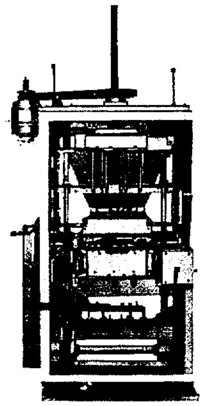
2) **Process Flow Sheet. . . CF – 2 type plant**



FOB price of machinery and equipment . . . (approx.) **$US 95,000**

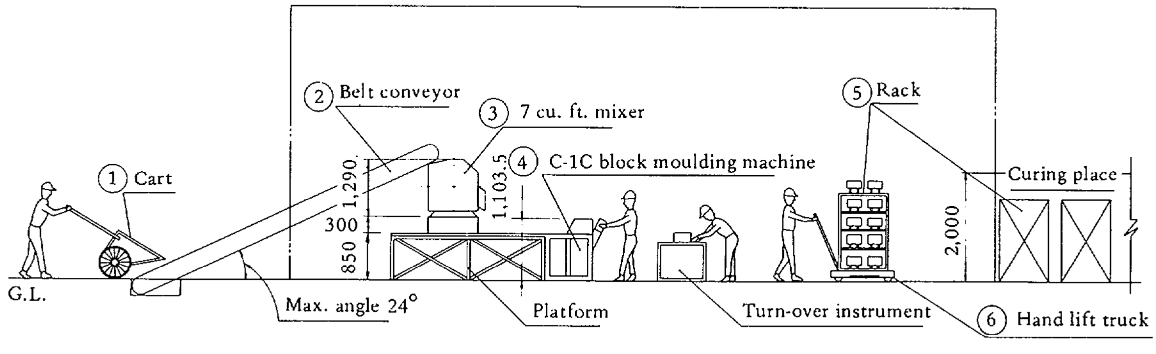
2) **Production Capacity**

Thickness	
4" (100 mm)	600 pcs./hr.
6" (150 mm)	450 pcs./hr.
8" (190 mm)	300 pcs./hr.



CF-2 type block moulding machine

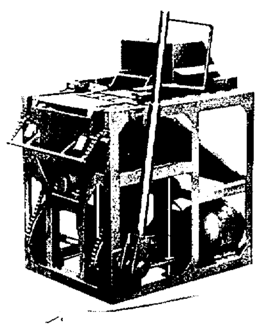
3) **Process Flow Sheet. . . C – 1C type plant**



FOB price of machinery and equipment . . . . (approx.) **$US 24,000**

3) **Production Capacity**

Thickness	
4" (100 mm)	180 pcs./hr.
6" (150 mm)	90 pcs./hr.
8" (190 mm)	90 pcs./hr.



C-1C type block moulding machine

Any inquiry about the information contained should be sent to: IO/COOP, Registry file No. ID/562/12, UNIDO, P.O. Box 300, A-1400 Vienna, Austria.

How To Start Manufacturing Industries

Refractories Making Plant

Application of refractory bricks is varied and wide. They are indispensable materials for such industries as those necessitating high temperature heating processes and heating facilities. That means that almost all heavy industries require refractory bricks.

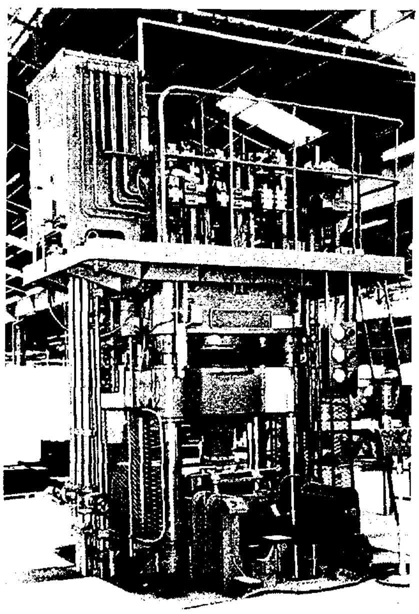
Refractories are very heavy in weight, so that their transportation cost can not be disregarded. Moreover, in case of imports from abroad, their price would be substantially increased, reflecting upon the final products.

Among refractories, fireclay bricks are most widely used. To manufacture fireclay bricks is easier than other kinds so long as basic material fireclay is abundant. And fireclay, with only insignificant differences in quality, is found almost everywhere in the world.

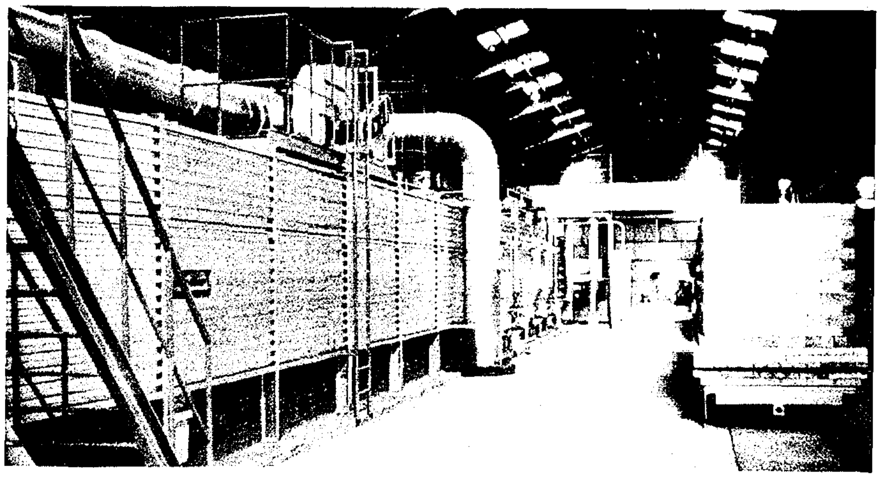
With favourable prospects for the market, simple manufacturing processes, easy accessibility to raw materials and low initial investment cost, the refractories manufacturing plant is a recommendable smaller scale plant.

The plan for a refractories manufacturing plant presented here is of a capacity of 10,000 tons/year, mainly making high alumina bricks and fireclay bricks.

In the case of manufacturing of high alumina bricks, however, the firing condition is much more rigid–higher firing temperature, longer firing time, etc.



Full automatic hydraulic oil press



Economical tunnel kiln

Process Description

Fireclay bricks are chiefly made from clayish material which generally presents substantial shrinkage when it is fired.

Accordingly, in consideration of *shrinkage, cracking, malformation, etc.* of product and yield, raw material is fired into stable chamotte (grog), before being used for manufacture of bricks.

Here is a description of the manufacturing process and an outline of the equipment.

Fireclay bricks are chiefly made of chamotte, crude clay and bonding clay. The principal manufacturing processes, similar to that for other high grade refractories, include crushing and grinding, kneading, forming, drying and firing.

1) Crushing and grinding

For manufacturing high grade fire bricks, it is important to crush and grind crude and fine powders separately, and to use them after mixing at a fixed ratio and uniformly kneading them.

This plant has therefore been planned for the above system of crushing and grinding. In order to minimize loss and manpower during the crushing and grinding process, various machinery have been selected to provide automatic feeding and discharging of raw materials.

2) Forming

Broadly speaking, there are two systems of forming bricks–dry and wet. To manufacture high grade bricks of stable quality, the dry process is recommended. With this plant, in addition to the dry system, the press forming system is adopted in view of high productivity.

As a forming press, the full-automatic, highly efficient friction press has been selected. The press adopted for the plant is of a special type, which can easily be switched over to semi-automatic or manual operation to meet the needs for a special form, or to cope with other conditions that may be required for manufacture.

As regards the manufacture of certain specially shaped bricks, which cannot be press-formed, the plant has been designed to provide forming with pneumatic hammer as well.

3) Firing

For the kiln of the firing process, an economical tunnel kiln has been adopted which provides the most economical mass and uniform firing.

It is a large type kiln which makes available simultaneous firing of bricks and chamotte (grog) used as raw material. The normal firing temperature is 1,350 – 1,450°C. For fuel, heavy oil is used because it provides simple and uniform firing work.

Waste heat from the tunnel kiln is led into a sub-tunnel dryer, which is installed on its side for improvement in thermal economy, being utilized as heat for the drying of green body.

4) Chamotte (grog) making

In the case of fireclay bricks, which mainly use agalmatolite instead of chamotte, when clay materials (plastic clay, ball clay, kaolin, high alumina clay etc.) are chiefly used, it is necessary to fire such clay materials into chamotte so as to stabilize quality.

This plant includes the machinery and equipment which manufacture grog (chamotte).

Table 3: Required Manpower

Item	No.
Office staff and engineer.	7
Skilled worker	45
Unskilled worker.	108
Total.	160

Production Capacity

1) Kinds of bricks
   - High alumina brick (SK35 – SK38)
   - Fireclay brick (SK30 – SK34)
   - Refractory mortar (SK30 – SK38)
2) Annual production capacity
   - High alumina brick: 3,500tons/year
   - Fireclay brick: 6,000tons/year
   - Refractory mortar: 500tons/year
   - Total 10,000tons/year
3) Plant site
   - Building area: 11,050 m^2
   - Required land area: 120 x 220 m = 26,400 m^2

Tables 1, 2 and 3 show respectively the machinery and equipment, raw materials and utilities, and manpower required for the above projected plant.

Locational Condition

The selection of the plant site has to be made in consideration of the market for the main product, the supply of raw materials and utilities and the personnel available. Among these factors, the supply of raw materials has the most important bearing.

The reason is that the transport cost for the required quantity of raw materials is heavy, involving loss of raw materials during transport, Ig loss and the loss of humidity, etc. at the time of firing.

Process Flow Sheet for High Alumina & Fireclay Bricks Manufacturing Plant

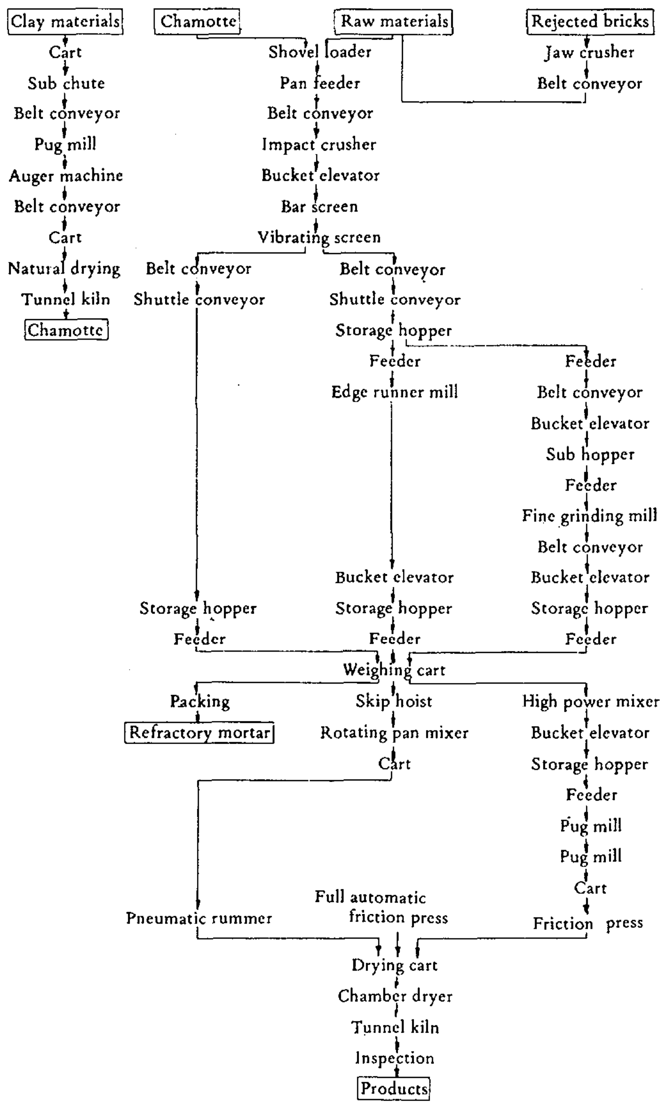


Table 1: Required Machinery and Equipment

1) Crushing and grinding unit:
   Jaw crusher, Belt conveyor, Pan feeder, Impact crusher, Bucket elevator, Vibrating screen, Shuttle conveyor, Edge runner mill, Fire grinding mill, Vibrating feeder, Screw feeder, High power mixer, Dust collector
2) Mixing and kneading unit:
   Pug mill, Rotating pan mixer with skip hoist, Weighing cart
3) Forming unit:
   Full-automatic friction press, Friction press, Air compressor, Pneumatic rummer, Cart
4) Drying unit:
   Drying cart, Chamber dryer, Hot-air generator
5) Firing unit:
   Tunnel kiln
6) Grog making unit:
   Belt conveyor, Pug mill, Auger machine, Hand cart
7) Transportation equipment:
   Shovel loader, Forklift truck, Truck scale
8) Laboratory equipment:
   Refractoriness testing apparatus, Compressive strength testing apparatus, Standard screen with shaker, Refractoriness under load testing apparatus, Spalling test furnace, Vacuum pump, Laboratory pan mill, Brick cutter, Grinder, Laboratory test kiln

FOB price of machinery and equipment . . . (approx.) **$US 3,143,000**

Table 2: Required Raw Materials and Utilities

Raw Materials	
High alumina chamotte clinker.	1,450 tons/year
High alumina refractory clay	3,900 tons/year
Refractory clay.	9,500 tons/year
Utilities	
Electric power	1,800,000 kWh/y
Fuel oil	2,100 kℓ/year
Water	7,500 m^3/year

How To Start Manufacturing Industries

Concrete Pole & Pile Making Plant

Concrete poles and piles, which play a great role as secondary products of cement, differ from each other in the objectives of their use, but their manufacturing methods and processes are almost the same.

The products turned out by the plant in this project are pre-cast spun (centrifugal compaction) concrete poles and piles of the prestressed concrete type.

The superiority of the spinning process over the vibration process is due to the following:

(1) The spinning process is highly suited to mass production and requires fewer workers.
(2) The centrifugal compaction of the concrete gives it a high density, resulting in a low porosity and an attractive surface finish.
(3) The final water-cement ratio of concrete is lower due to the loss of water which occurs during the spinning process. This results in an increase in the strength of the concrete.
(4) The automated spinning process ensures a much higher consistency in the quality of the concrete than the vibration process.

Various Uses of Products

Concrete Poles

1) Poles for transmission lines
2) Poles for distribution lines
3) Poles for trolley lines
4) Poles for communication lines
5) Lighting poles

Concrete Piles

1) Foundations for buildings
2) Piers for bridges
3) Foundations for heavy machinery, elevated bridges, and high ways
4) Foundations of various elevated structures
5) Parts of concrete structures

Outline of the Pole Plant proposed in this project

1. Manufacturing Process

Refer to the process flow sheet

2. Production Scale

The following is a consideration of the production scale in the case of manufacturing prestressed spun concrete poles 7m ∿ 16m in length:

1) Amount of production
30 poles/shift (one shift : 8 hours)
25 working days/month

a) In the case of a one-shift operation
30 poles/shift x 25 days = 750 poles/month
750 poles/month x 12 months = 9,000 poles/year

b) In the case of a two-shift operation
(two-shift operation: 8 hours x 2 = 16 hours)
30 poles/shift x 2 shifts = 60 poles/day
60 poles/day x 25 days = 1,500 poles/month
1,500 poles/month x 12 months = 18,000 poles/year

3. Possibility of Expanding the Production Scale

When a constant production of more than 750 poles/month becomes necessary, the equipment utilization can be extended.

In case the period of expanded production is expected to be short and the extra amount is small, the demand may be met through overtime work, and if the amount is sufficiently large, the desired quantity may be produced by adopting a two-shift operation.

Table 1: Required Machinery and Equipment

	Item	No.
1)	Batch plant	1 set
2)	Concrete injection plant	1 set
3)	Spinning machine	1 set
4)	Wire-straightening & cutting machine	1 set
5)	Wire-caging stand	3 sets
6)	Wire-heading machine (upsetter)	2 sets
7)	Stretching machine	1 set
8)	Stretching tools	45 sets
9)	Mould 190ϕ - 7 ~ 16 m	33 sets
10)	Mould rolling device	1 set
11)	Demoulding bed	1 lot
12)	Traverser	3 sets
13)	Over head crane ($6^t + 6^t$) x 17m	1 set
14)	Over head crane ($6^t + 2^t$) x 17m	2 sets
15)	Over head crane 2^t x 17m	2 sets
16)	Jib crane 1^t	1 set
17)	Mould hooker	4 sets
18)	Wire cage hooker	2 sets
19)	Testing machine & equipment	1 lot
20)	Mortar spacer & cover making equipment	1 lot
21)	Miscellaneous machine & others	1 lot
22)	Equipment & tools for maintenance	1 lot
23)	Spare parts (for 2 years)	1 lot

FOB price of machinery and equipment
..... (approx.) $US 1,514,000

Table 2: Required Machinery and Equipment (procured in the country of operation)

	Item	No.
1)	Boiler 1.8t/hr., 7kg/cm²	1 set
2)	Oil storage tank 30m²	2 sets
3)	Compressor 37kW 7kg/cm²	1 set
4)	Pressure tank for water, 0.3m³/min.	1 set
5)	Shovel loader 1.2m³	1 unit
6)	Fork lift 3 ton	2 units
7)	Rail for cranes & traversers	1 lot
8)	Crane runway structure 220m	1 lot
9)	Materials for piping for air, water, steam, oil and electricity	1 lot
10)	Materials for electrical wiring	1 lot
11)	Power receiving & distributing equipment 500KVA, transformer, distribution boards, switches	1 lot
12)	Light fixtures	1 lot

FOB price of machinery and equipment
..... (approx.) $US 435,000

Table 3: Required Raw Materials (based on a one-shift operation)

Item	Quantity
Port land cement	4,883 kg
Sand	7,429 kg
Gravel	11,556 kg
Additives (admixture)	32 kg
Prestressing wire	873 kg
Reinforcement wire	825 kg

(The above figures include probable damage and loss in the manufacturing process.)

Table 4: Required Utilities (based on a one-shift operation)

Item	Quantity
Electric power consumption	2,400 kWh
Fuel (heavy oil for steam boiler)	750 ℓ
Water	25 tons

Table 5: Required Manpower

Item	No.
Engineer	2
Skilled worker	25
Ordinary worker	23
Total	50

Proposal for Establishing a Concrete Pole Plant

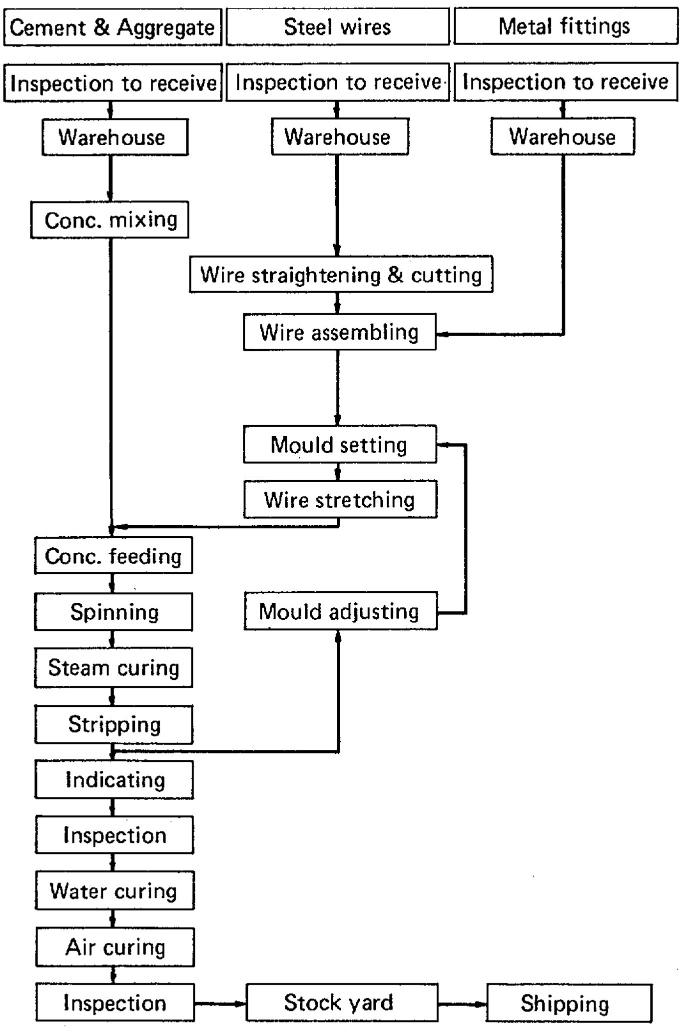
(based on a one-shift operation)

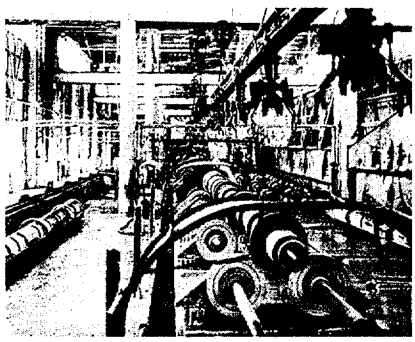
Tables 1-5 show respectively the machinery and equipment, raw materials, utilities, and manpower required for the Pole Plant in this project.

Required Area for Plant Site

1) Required Land Area for Plant
   Approx. $20{,}000m^2$ (including a stock yard sufficient to store one month's production)
2) Required Building for Plant
   (1) Main Building . . . . . (approx.) $2{,}200m^2$
   The main building of the plant shall have following structure.
   The main structure shall be constructed of columns and crane runways, with the roof built on top of the main structure.
   The above shall be made with steel frames. The roofing shall use corrugated asbestos sheets or a suitable material to insulate against extreme temperatures.
   The floor shall be made of reinforced concrete.
   (2) Ancillary Buildings
   The plant shall have the following ancillary buildings: plant office, boiler room, laboratory, warehouse, canteen, maintenance room, power receiving and distributing house, etc.

Process Flow Sheet for
Concrete Pole & Pile Making Plant





Spinning machine

How To Start Manufacturing Industries

Gypsum Board Making Plant

Gypsum board is made of gypsum, which consists of the core of the board and the both sides of the gypsum core are covered and adhered with paper, and is widely used as a construction material. Gypsum board was originally invented in 1902, developed in U.S.A. since then, and widely in production in many countries over the world.

The characteristics of gypsum board as building material are briefly summarized as;

good processing properties and easy application, light as for a heat insulation and fire resistance material, no practical deformation and warp as the lath of the wall.

And because of these excellent properties, gypsum board is regarded as one of the indispensable materials among the interior finishing materials.

Gypsum board is commonly used for the construction of the inside wall, the ceiling, and the partitions. The application technic can be broadly classified into two categories, namely the dry method, in which the gypsum board is finished with wall-papers or is painted, or the printed gypsum board is directly applied, and the wet method in which the surface of the gypsum board is plastered. Hence the choice of the suitable type of gypsum board and the application method thereof are to be considered according to the circumstances.

The paper covering the both sides of gypsum core of the gypsum board is normally consisted of 3 to 8 layers of fibrous tissue. In Japan a paper of 4 layers tissue made of regenerated pulp is commonly used. While it is typical in U.S.A. and U.K. to use a paper of 6 to 8 layers made of the blend of tip pulp and regenerated pulp. The most important properties required for the paper are the adhesion characteristic with gypsum, the strength and the resistance against the undulant tendency caused by the repeated drying and humidification.

The major portion of gypsum consumed for the gypsum board production is dependent to the chemical gypsum in Japan.

Process Description

The by-product gypsum of wet phosphoric acid production normally contains about 10 to 20% moisture by weight dependent to the pretreatment of the gypsum. The wet gypsum is dried in a dryer, then calcined to form plaster, hemihydrate of calcium sulphate (partly water soluble anhydrite) in a calcination unit, and stocked in Silos after milling of the calcined product. Heavy oil is usually used for drying and calcination, and the exhaust gas is released into air passing through a scrubber.

The pulp used as a filler is mixed with required amount of water in a Pulper.

In a board forming process, plaster, filler, water and additives are fed under fixed ratios into a mixer, and the slurry leaving the Mixer is sent to a forming unit. While the paper for the top and the bottom of the gypsum board is supplied to the forming unit continuously through a feeding machine, the slurry is fed in between the top and the bottom papers moving, sandwiched and enveloped by the papers. Setting of the plaster in the slurry takes place on the belt conveyor of the forming unit along the moving of the formed gypsum board, and after certain time allowed for setting the board is cut into uniform size. The setting progresses further on a following conveyor, and at the end of the conveyor the cut gypsum board pieces are placed in a drying unit. In this unit the board travels very slowly through, is dried to 2 to 3% moisture, taken out cooled through a cooling section, and stored in warehouses. The use of steam is common for heating medium of the drying unit.

It was in 1922 when the first production of gypsum board started in Japan, however the commercial production enhanced in large quantity after the World War II. Gypsum boards of the following specifications are available in Japan.

- Wall board
  - 9 mm, 12 mm, 15 mm thickness
- Lath board
  - 7 mm, 9 mm thickness
- Acoustic board
  - 7 mm, 9 mm thickness
- Waterproof board
  - 9 mm, 12 mm, 15 mm thickness
- Print board
  - 7 mm, 9 mm thickness

Example of Gypsum Board Making Plant

Table 1: Production Scheme

Raw gypsum	By-product phosphoric acid gypsum
Plant capacity	3,500,000 m^2/year
Product board	1,820 mm x 910 mm x 9 mm plain board

Tables 2, 3, 4 and 5 are based on the above scheme.

Table 2: Required Machinery and Equipment

Item	No.
Gypsum drying section	
Oil storage tank	1
Furnace	1
Gypsum feeder and conveyor	1 set
Gypsum dryer	1
Cyclone	2
Exhaust gas blower	1
Scrubber	1
Dry gypsum hopper	1
Gypsum calcining section	
Kettle	2
Furnace	1
Hot pit	2
Pulverizer	2
Silo	3
Plaster hopper	1
Electrical dust collector	1
Bag filter	1
Scrubber	1
Exhaust gas blower	1
Feeder and conveyor	a few
Forming and drying section	
Mixer	1
Additives preparation unit	a few
Paper feed unit	1 set
Cutter	1
Drying unit	1 set
Conveyor	a few
Utility section	
Boiler unit	1 set
Oil storage tank	1
Others	
Instruments	1 set
Electrical equipment	1 set

From a raw gypsum feeder to a final product conveyor, the FOB price of all machinery, equipment and materials is .... (approx.) $US 4,762,000

Table 3: Required Area for Plant Site
Building . . . 30 m x 200 m = 6,000 m^2
(for the board forming and drying)
Land . . . . 100 m x 250 m = 2,500 m^2

Table 4: Required Raw Materials and Utilities

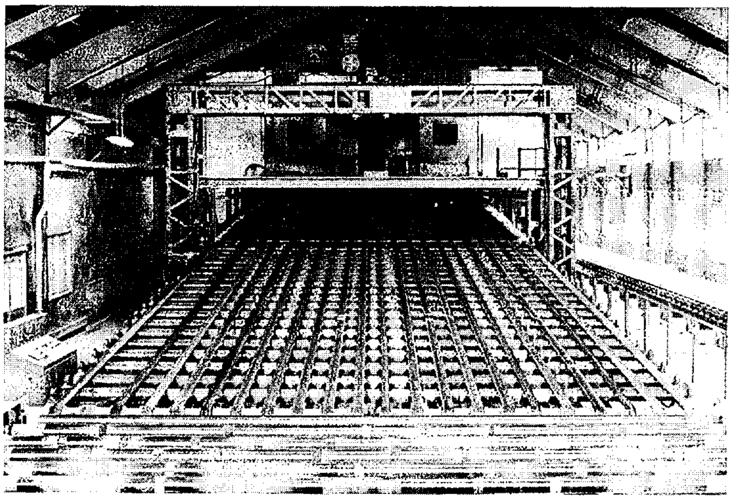
Item	Quantity
Raw materials	
Gypsum	6.4 kg
Paper	0.6 kg
Pulp	0.04 kg
Additives	0.1 kg
Utilities	
Steam	8.0 kg
Fuel (Heavy oil)	0.3 liters
Process water	12 liters
Industrial water	40 liters
Electric power	0.6 kWh

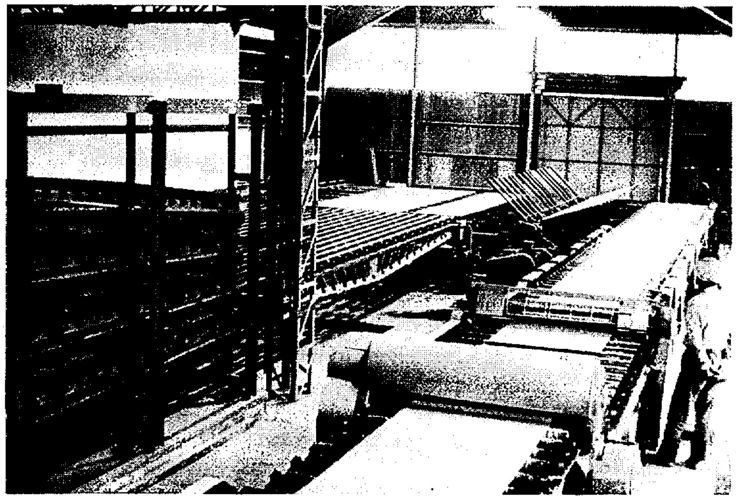
Table 5: Required Manpower

Item	No.
Foreman	1 per shift
Operator	12 per shift
	13 per shift
Engineer	2 per day
Inspector for product	1 per day
Shipping worker	4 per day
	7 per day

Locational Condition

Gypsum board plant will be desirable to be constructed in a position, where the product boards can be sold within an area of several hundreds kilo-meter radial and also raw gypsum can be easily obtained near the plant. For instance, it is the best condition that the proposed plant is constructed at a neighbouring site of a wet-process phosphoric acid plant in a densely populated locality.





How To Start Manufacturing Industries

Hume Pipe Making Plant

Centrifugal reinforced concrete pipe is a kind of concrete pipe which is manufactured as follows: concrete is compacted by huge centrifugal force (30 – 40 times the acceleration of gravity) of a rigid reinforced steel cage rotating at high speed to form the body of the pipe.

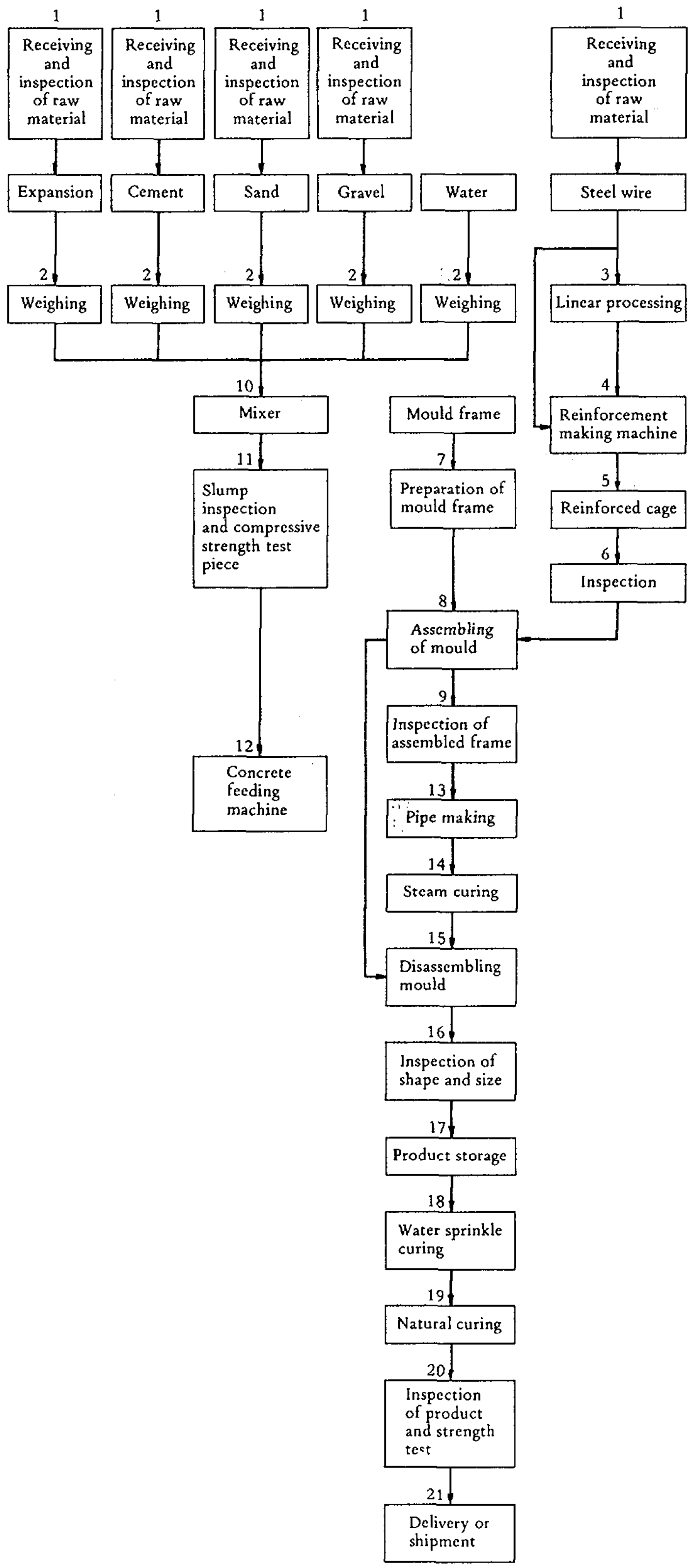
This pipe is generally called "Hume Pipe" in Japan and is prescribed in the Japan Industrial Standards as JIS A5303.

The classes of pipes which are actually being manufactured range broadly from small 150 mm inside diameter pipe up to extra-large 3,000 mm inside diameter pipe. The standard length of a small diameter pipe (inside diameter 150 mm – 350 mm) is 2,000 mm, and the standard length of pipes with larger inside diameter is 2,430 mm. Depending on requirements, long pipe about 4,000 mm could be made. The following points are features of this method of producing concrete pipes.

(1) The concrete body is compacted tightly. There are no bubbles, and so water absorption is small.
(2) Surplus water is removed by centrifugal force; the water: cement ratio of concrete will be small; therefore, the pipe body will be strong and endurable.
(3) The outside appearance is more beautiful than any other method of production. The inside surface, too, is very smooth; accordingly, resistance of water flow is small.
(4) The manufacturing facilities are rather simple and trouble-free. Manufacturing does not require high technical skill.
(5) Adjustment of machinery is not necessary for a certain range of inside diameter, so occasional changeover of inside diameter will not lower production efficiency.

The compressive strength of concrete manufactured in this way is more than 400 kg/cm^2. High-class blending will easily produce concrete with compressive strength of about 600 kg/cm^2. Various ranks of pipe body strength could be had by combining concrete strength and amount of steel reinforcement. Recently, by using special blending material, it has become possible to greatly increase the strength against external pressure and internal pressure.

Process Flow Sheet for Hume Pipe



All sorts of pipe joints can be made by selecting the appropriate mould. The socket type using a collar or a rubber gasket for the joint and the caulking type are employed for the excavation method of laying pipes. Working efficiency of the former is inferior, so the latter type of joint is generally used. The right type of joint, however, should be used, case by case, depending on the objective of using the hume pipe and the ground condition of the laying site. The standard joint of pipe which is to be laid by the jacking method is a combination of steel collar and rubber gasket, and the body of the pipe itself is thicker than that which is used in the excavation method.

The main uses of concrete pipe are as follows:

(1) Sewer system (rain, sewage, drainage).
(2) Waterworks (service water), industrial water conduit.
(3) Agricultural waterworks and water supply.
(4) Cross channel duct for freeway.
(5) Cable duct.
(6) Well wall (The product can also be used as huge foundation material by employing the post-tensioned method of prestress construction).

Process Description

The manufacturing process of this method of production is shown in the attached flow sheet.

A simple description according to order of processing will be made concerning the main manufacturing facilities.

1) Construction of the reinforced steel cage

The reinforced steel cage of a hume pipe consists of a circumferential spiral steel wire reinforcement and a longitudinal steel wire reinforcement. By setting up an automatic reinforcement forming machine, the point of intersection of the circumferential spiral reinforcement and the longitudinal reinforcement can be spot-welded quickly and the cage can be constructed in a short time. The longitudinal reinforcement is cut to the designated length by a high-speed linear cutter, and is processed directly from steel wire coil.

2) Manufacturing of concrete

In manufacturing concrete, a mixing plant is necessary. The capacity of the installation is decided by the capacity of the hume pipe production capacity. The plant under discussion has a storing bin, weighing equipment, and a mixer. A central control system makes one-man control possible. Materials storing tank, cement silo, and blending material tank are ancillary equipment, and these are joined to the plant by belt conveyor, bucket conveyor, pipe, etc.

3) Concrete conveying system

Concrete is conveyed from the mixer to the various pipe making machines by remote control, and the bucket has an automatic opening – closing lid.

4) Pipe making facilities

The centrifugal machine is the main machine of the pipe making facilities. The revolving wheel is connected to a large capacity variable speed motor, the revolving speed of which can be changed continuously.

Concrete conveyed to the hopper by the concrete conveyor is supplied to the mould by a screw conveyor or a belt conveyor, depending on the diameter of pipe to be manufactured.

5) Steam curing

In order to speed up disassembling of the frame of the completely moulded pipe, the mould frame is carried into the sealed steam tank; steam is fed to quicken curing. The capacity of the boiler for supplying steam is decided by the production capacity.

6) Disassembling and assembling of mould frame

The complete moulded product which has been completely cured by steam is placed on the mould frame disassembling rack; the mould frame is disassembled, and the completely

Table 1: Production Capacity

Size of pipe	Range of diameter	Quantity produced in one complete process	Quantity produced per day
Small diameter	150 – 350 mm	8 – 12 pieces	80 – 120 pieces
Medium diameter	400 – 1,000 mm	3 – 5 pieces	20 – 40 pieces
Large diameter	1,100 – 2,000 mm	2 – 3 pieces	12 – 20 pieces
Extra-large diameter	2,000 – 3,000 mm	1 – 2 pieces	6–12 pieces

Table 2: Required Machinery and Equipment

Item	No. of sets
1) Batcher plant (32 m^3/hr)	1
2) Cement conveying equipment	1
3) Cage material conveying equipment	1
4) Concrete conveying equipment	1
5) Steel rod drawing machine	1
6) Reinforced cage making machine (one for each series)	4
7) Overhead crane (two for each series)	8
8) Centrifugal force pipe making machine (one for each series)	4
9) Mould frame assembling and disassembling equipment (one for each series)	4
10) Mould frame disengaging agent spraying equipment (one for each series)	4
11) Boiler (steam volume 2.0 tons/hr, pressure 7 kg/cm^2)	1
12) Compressor (37 kW)	1
13) Pump for water supply	1
14) Draining pump	1
15) Equipment for testing materials and finished products	1
16) Tools	1
17) Instruments for measuring and testing	1
18) Maintenance and control equipment	1
19) Spare parts for machinery	1
20) Mould frames (150 mm – 3,000 mm)	174
FOB price of machinery and equipment	(approx.) $US 3,395,000

moulded product is taken out. After the product is taken out, the mould frame is transferred onto the mould frame assembling rack; after being washed, the mould frame is assembled to take the shape as if reinforced steel wire cage were in it.

7) Movement of the mould frame

Movement of the mould frame from one process to another — pipe making → steam curing → disassembling and assembling of mould frame → completed product — is done mainly by a traveling overhead crane, but chain conveyor is also used for short distance movement.

8) Product storage

The product which has been taken out of the mould frame is carried by an overhead crane or a forklift to the stock yard, arranged according to diameter and classification, and kept in stock until time of delivery or shipment. During this waiting time, if necessary, wet curing is done by a sprinkler.

General Plan for Establishing Plant

As mentioned previously, the diameter of pipe to be manufactured ranges from small diameter pipe to extra-large diameter pipe; therefore, actual designing of the plant should be based on the scope of pipe diameter required.

Consideration has been given here for manufacturing all sizes of pipes. Accordingly, the lineup will be four series: small diameter, medium diameter, large diameter, extra-large diameter. However, depending on the planned amount of manufacturing, each series may be used plurally by changing the range of diameter.

For the purpose of reference, in case of four sereis, a table will be given below, which shows the standard inside diameter of each sereis and the amount of production in one complete process. The total production in tons is about 230 tons.

Table 3: Required Raw Materials per Day (including loss)

Item	Quantity
1) Cement	54,800 kg
2) Sand	78,600 kg
3) Gravel	115,000 kg
4) Mixing material	380 kg
5) Steel reinforcement	5,700 kg

Table 4: Required Utility

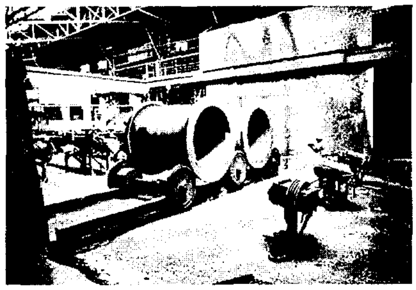
1) Consumptin of electric power	1,500 kWh/day
2) Crude oil	700 liters/day
3) Water	40 tons/day

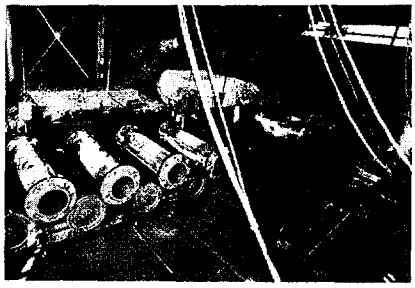
Table 5: Required Manpower

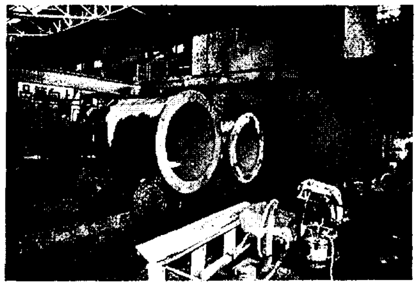
Item	No.
Engineer	3
Skilled worker	40
General worker	60
Total	103

Table 6: Required Area for Plant Site

Main building	3,200 m^2
Other building	1,300 m^2
Land	38,000 m^2







How To Start Manufacturing Industries

Aggregate Plant

Investments in public utilities and private construction projects in Japan have increased year after year, causing the output of aggregate, indispensable basic material for construction, to grow in proportion. As a matter of fact, annual production of aggregate has reached about 800 million tons.

Among the various types of aggregate, so-called natural gravel which comes from rivers has become increasingly difficult to obtain because of yearly draining resources.

Therefore, its place is being taken over more and more by crushed stone, which is obtained from quarries, where large-sized rocks are crushed by high explosives, and screened into the required size.

In recent years, from the angle of bringing down cost through mass-processing, the popular scale of aggregate manufacturing plants is 150 tons/hour (30,000 tons/month). Moreover, larger plants at a level of 1,000 tons/hour (200,000 tons/month) have made their advent.

Quality of aggregate

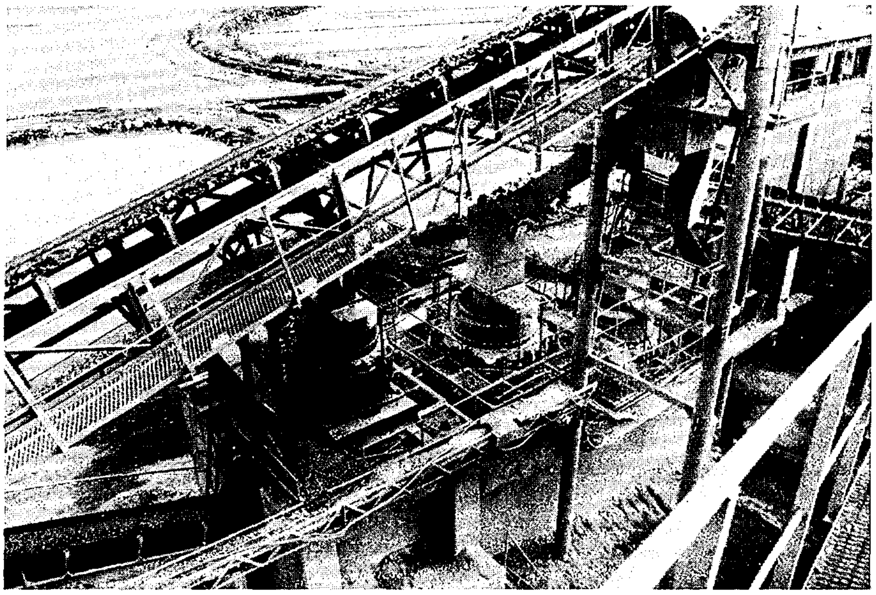
Crushed rocks to be used as aggregate should possess full strength and durability for use in civil engineering. In this sense, the stronger and harder, the better the rocks.

However, if they are too hard, they would shorten the life of equipment and machinery at the plant and increase consumption of supplies and spoil machine parts. Therefore, extremely hard rocks are not desirable because they bring about an increase in the crushing cost.

The quality and size of aggregate differ according to the kind of civil engineering for which it should be used.

The size of grain and the quality of crushed stone are standardized by Japan Industrial Standard (JIS). Crushed stone for road construction is provided for in JIS A5001-1970, and crushed stone for concrete is provided for in JIS A5005-1965.

The size of grain of crushed stone for road construction is shown in the chart below.



200 T/H cone crusher
(secondary & tertiary)

Size of crushed stone

S-80	80 – 60 mm	C-40	40 – 0 mm
S-60	60 – 40 mm	C-30	30 – 0 mm
S-40	40 – 30 mm	C-20	20 – 0 mm
S-30	30 – 20 mm	M-40	40 – 0 mm
S-20	20 – 13 mm	M-30	30 – 0 mm
S-13	13 – 5 mm	M-25	25 – 0 mm
S-5	5 – 2.5 mm	F-2.5	2.5 – 0 mm

Kind of rock

Basalt, andesite, hard sandstone, hard limestone, or rocks of similar properties.

Quality of rock

Aggregate shall not include in quantities long and/or thin pieces. Rocks shall be uniform in quality, clean, tough, and durable.

According to JIS regarding crushed stones for road construction, the specific gravity must be more than 2.45, the water absorbing capacity must be less than 3%, and the loss from wear must be less than 35% or 40% depending on the variety of stone. According to JIS regarding crushed stones for concrete, the specific gravity must be more than 2.5, the water absorbing capacity must be less than 3%, and the loss from wear must be less than 40%.

Locational Condition

From the viewpoint of transport cost, it would be advantageous to build the aggregate plant at a site near the area of consumption (in many cases on the outskirts of a city).

However, it is considered impossible to built it in housing area in consideration of the danger of explosives on the occasion of quarrying as well as such nuisances as dust, noise, etc.

But if the plant is located too far away, the plant will be unable to operate on an economical basis. Therefore, it is required that plant is located at a site convenient for transport.

The operation of the aggregate plant is almost entirely carried out outdoors, and so the efficiency of operation is considerably affected by weather. This would cause reduction in efficiency and raise the cost of crushing stone. It is, therefore, recommended, when projecting construction of a plant, to investigate fully the meterological conditions of the site.

Process Description

The operation of the aggregate plant involves the following: rocks from the quarry undergo the process of crude and medium crushing on a crusher, and they are then given the shapes required on the grain forming crusher.

They are then screened into the required size on a screen. In between the processes of explosion, crushing, and screening and the storage there run conveyor belts to organize the plant.

In addition, some plants are provided with washing equipment for aggregate to be used in ready-made concrete, the equipment for regulation of size for road pavement and that for the mixing of crushed stones.

Quarried rocks are carried by dump-truck into the rock hopper, at the bottom of which they are drawn by an apron feeder and, after removal of mud by a grizzly, they are fed into the primary crusher (single toggle crusher).

Rocks crushed by the primary crusher are carried by a belt conveyor into the medium bin for storage. Stones after the grizzly treatment are put on the screen for separation into mud and stones which are sent into the storage bin.

Stones drawn from the bin via the vibrating feeder are supplied into the cone crusher for medium crushing. The crushed stones are fed into the impact crusher for regulation of grains for simultaneous fine crushing and regulation of size.

The stones coming out of the impact crusher are screened on the primary screen so that the oversized stones may be sent into the cone crusher for fine crushing via the switching route and are crushed on the impact crusher.

Stone after the primary screening are passed onto the secondary and tertiary screens for screening into required sizes for storage in product bins. Products discharged from the bins may be shipped out directly by trucks. If necessary, they are sent into a mixing bin via a belt conveyor for mixing to the required ratio before effecting the shipment.

Table 2: Required Plant Site Area and Manpower

Plant scale	200T/H	100T/H	50T/H
Plant site area	2,500 m²	1,500 m²	600 m²
Engineer	1	1	1
Skilled worker	2	1	1
Unskilled worker	4	3	2
Clerical worker	2	2	2
Truck driver	5	4	3
Loader driver	1	1	1

Features of Machinery and Equipment

1) **Single toggle crusher**

The main features of the crusher of this type are as follows:

(1) Being light in weight, both transportation and erection can easily be made.

(2) As spherical roller bearings are adopted, driving power can be economized and reliability is high.

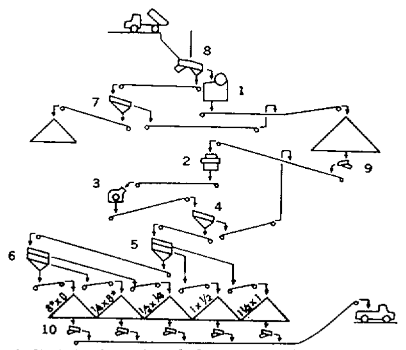
(3) Since the crushing chamber has a large depth and crushing angle is designed sharply, a large crushing ratio can be obtained and in some cases, a single toggle crusher can render both coarse and medium crushing or medium and fine crushing.

2) **Cone crusher**

Cone crushers vary in their function. Some are for large and coarse feed while others are for finer reduction. Cone crushers introduced here are, whatever the plant capacity may be, all prominent for crushing efficiency with the latest design, and are most suitable for secondary or tertiary crushing, or as the final crusher in a crushing process.

However, cohesive materials – those containing much clay – should be avoided.

Process Flow Sheet



1 Single toggle crusher, 2 Cone crusher, 3 Impact crusher 4 5 6 7 Vibrating screen, 8 Vibrating grizzly feeder 9 Vibrating feeder, 10 Belt conveyers.

3) **Vibrating screen**

The vibrating screen here recommended is a type which features extreme simplicity in construction and gives smoothest operation. Intensive vibration is uniformly effective over the entire screen cloth, equally effective on every deck and provides constant, vigorous screening action under light or heavy loads.

This type of vibrating screen can be, therefore, furnished as either floor-mounted type of suspension type. It can be also furnished as an enclosed type or with special pipes for rinsing.

4) **Vibrating grizzly feeder**

Vibrating grizzly feeder delivers a smooth, controlled flow of over size material to the primary crusher enabling the crusher to perform at maximum capacity. The heavy magnetic vibrating unit provides a constant powerful vibrating motion.

Table 1: Required Machinery and Equipment

Machinery name	200 T/H		100 T/H		50 T/H	
	Size	Motor kW	Size	Motor kW	Size	Motor kW
Single toggle crusher	42" x 30"	75	36" x 24"	55	30" x 20"	37
Cone crusher	60"	110	48"	95	36"	55
Impact crusher	53" x 80"	150	53" x 40"	95	40" x 40"	55
Vibrating screen	5' x 12'	11	4' x 8'	5.5	3' x 8'	3.7
Vibrating screen	5' x 16'	15	4' x 10'	5.5	3' x 8'	3.7
Vibrating screen	5' x 16'	15	4' x 10'	5.5	3' x 8'	3.7
Vibrating screen	5' x 10'	11	3' x 10'	5.5	3' x 10'	5.5
Vibrating grizzly feeder	5' x 12'	15	4' x 10'	11	3' x 8'	7.5
Vibrating feeder	38" x 56"	1.1	28" x 52"	0.5	18" x 48"	0.35
Vibrating feeder	34" x 56"	3.5	22" x 48"	2.5	14" x 48"	1
Belt conveyors etc.		75		55		45
Total electric power		481.6		336		217.45
Total FOB price	$US 1,219,000		$US 1,455,000		$US 450,000	

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ISIC 371 IRON AND STEEL BASIC INDUSTRIES

How To Start Manufacturing Industries

Foundry

Foundry has been there always in the basis of all kinds of industry for over hundreds of years supporting the progress of technology and convenience of human life.

Today, we are surrounded by cast metal products such as automobile engine, components of under-carriage, agricultural machine parts, various water pump, pipe fitting, weaving machine parts, manhole cover, ashtrays and even ornamental artistic items. Cast products around us are really countless.

There are many different ways to produce these varieties of castings. Most of them were started with a primitive, manual method several hundred years ago and gradually mechanized. Under the pressure of high labour cost in the recent years, the only way to survive is mechanization and automation.

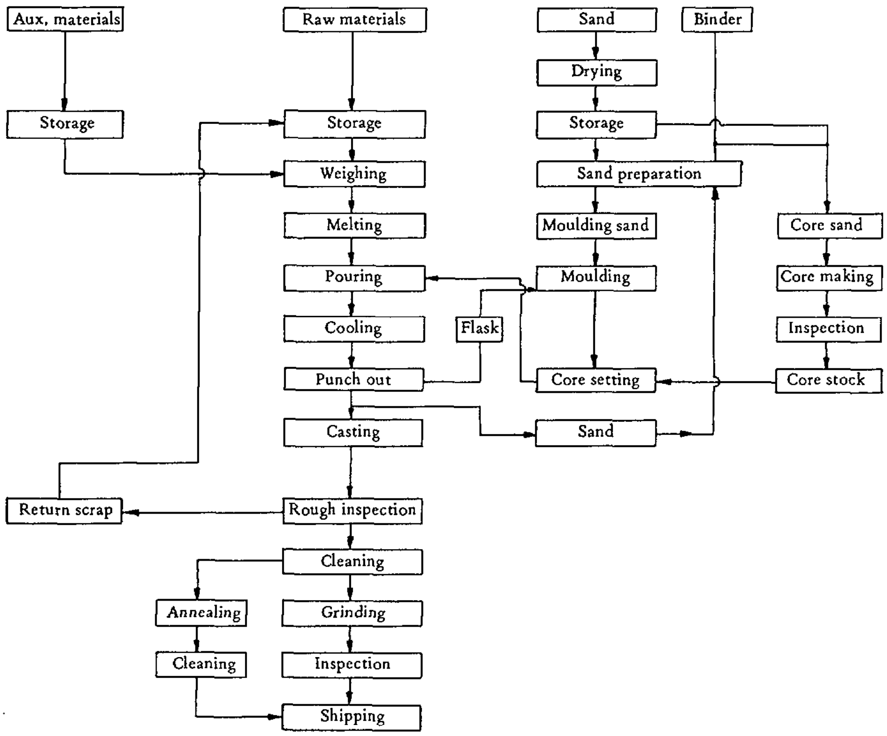
Foundry Process in General

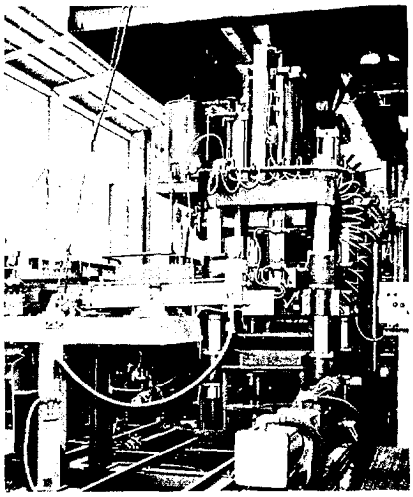
Foundry operation consists mainly of melting, moulding, sand preparation and conditioning, core making, pouring, cooling, surface cleaning, fettling, heat treatment if necessary, inspection and casting repair. If any one of these is lacking, it is difficult to obtain sound castings.

1) Melting
Coke-fired, air-blast cupola is the commonest and cheapest way to obtain molten iron. However, it requires a high grade foundry coke and pig iron, and it emits fumes and dust.
Electric induction melting system is popularly used in place of cupola with its advantageous capacity of melting almost all kind and shape of iron and steel materials in a silent and clean manner without using coke.
Channel type or crucible type induction holding furnace is also often used for the purpose of keeping the best timing for pouring.

2) Moulding
In this series, two mechanical moulding systems both most popularly applied in Japan are introduced: i.e. semi-automatic vibrate-squeeze moulding system for medium size castings and automatic flaskless side-blow moulding system for small size castings.

Process Flow Sheet for Foundry





Automatic flaskless side-blow squeeze moulding machine

3) Sand preparation and conditioning
The bentonite added green sand is used for the above moulding systems.
Sand is separated from castings and reclaimed and reconditioned by means of magnet separater, breaker screen, sand mixer and the conditioned sand is distributed to the moulding station.
Above cycle is automatically repeated.

4) Core making
Shell core system using resin coated silica sand is most popularly adopted. Carbon dioxide system, chemical bonded system are also applicable for core making.
Cores are set in the drag to complete the mould.

5) Pouring
Molten metal is poured into the completed mould by means of pouring ladle.

6) Cooling
Castings punched out from flask releasing station of the moulding line are still red hot.
Castings are air cooled on the conveyor line and delivered to the surface cleaning and fettling shop.

Gates and runners are broken off manually from castings.

7) Surface cleaning
Cooled castings are shot-blasted by super drum type blast cleaning machine.

8) Fettling
Burrs and irregular surfaces are smoothened by grinders, and surface pits are weld repaired.

9) Heat treatment
Some of cast iron parts are required to be dimensionally accurate and physically resistible. These parts are heat treated at 580°C.

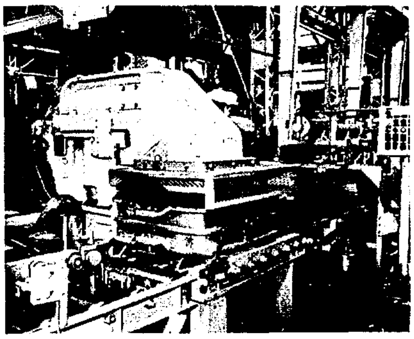
10) Inspection
Various tests and inspections are carried out during the production process.

Explanation on Moulding System

1) Outline of semi-automatic moulding system
Cope and drag are independently moulded on cope moulding machine and drag moulding machine. Drag is rolled over and furnished with cores, and is closed by cope at mould closing station. Here, the bottom plate is set underneath the mould manually. Drag is lifted up by lifter mechanism and rolled over manually at the top of lifting stroke.
Then, the bottom plate is pulled in by the operator and the drag is lowered and set on the plate. Then, the drag is furnished with cores manually and pushed out to the mould closing station.
Here the drag is closed by the cope and a mould is completed. Then the weight is automatically set on the mould and the mould is conveyed on the rollers to the pouring and cooling station by means of a pneumatic pusher. After pouring, the weight is removed automatically and the moulding boxes are released from sand and castings. Emptied boxes are cleaned by brush mechanically and are returned to cope and drag moulding line.

2) Outline of automatic flaskless moulding system
The heart of this system is horizontal flaskless side blowing moulding machine.
One moulding machine can produce cope and drag simultaneously, and moulding boxes are not required, so the cost of the system is greatly reduced. Another factor of economy is that the moulding machine does not require any deep pit. Cores are set manually on the machine and the completed mould is discharged smoothly onto the mould bogie type conveyor system.
Mould is furnished with jacket and weight and then poured. After passing the cooling zone, the jacket and weight are removed and the naked mould is crushed mechanically and sand is separated from castings and is reclaimed to the sand conditioning plant. Castings are conveyed to the fettling shop.

3) Green sand conditioning shop
Spilt sand at the moulding station is to be collected by spilt sand returning conveyor, while the shake-out sand is also returned to the sand plant.
During the returning process, the sand passes through magnet separator and breaker screen where the tramp iron pieces are removed and lumps are crushed.
The reusable sand will be cooled down by multi-cooler compulsorily and stored in the sand storage.
The fixed volume of sand is then fed to the sand mixer by means of belt feeders located beneath the storage. Dried new sand will be added to the used sand.
The sand is blended by bentonite, coal dust, water, etc. for about three minutes to obtain a necessary compressive strength for moulding. The conditioned sand is automatically delivered to the moulding station.



Automatic vibrate-squeeze moulding machine

Table 1: Specifications of Plant

(Operating hours: 8 hours/day, 25 days/month)

	Semi automatic line	Automatic flaskless line
Moulding machine	2 sets	1 set
Flask size (mm) (Inner)	800 x 600 x (250 + 250)	420 x 520 x (150 + 150)
Moulding capacity	45 seconds/mould	80 seconds/complete mould
Production volume	250 tons/month/shift	100 tons/month/shift
Kind of sand	Synthetic unit sand	Synthetic unit sand
No. of worker	5	3

Capital Cost

The rough cost guideline of the plant can be given as follows.

These prices are including melting furnace (low frequency induction furnace), induction holding unit, moulding system, new sand drying, green sand conditioning, core making, shot blasting, fettling and laboratory equipment.

FOB price of machinery and equipment.

Semi-automatic line
(approx.) $US 2,857,000

Automatic flaskless line
(approx.) $US 1,429,000

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ISIC 381 FABRICATED METAL PRODUCTS

FILE: 01
ISIC 3819

How To Start Manufacturing Industries

Wire & Wire Product Making Plant

Products proposed for manufacture by this project are secondary products of wire rod, including naked wire, galvanized wire, nail, screw, staple and barbed wire.

They are products which enjoy a large demand both in industrial areas and agricultural districts. Therefore, the market for the products is great.

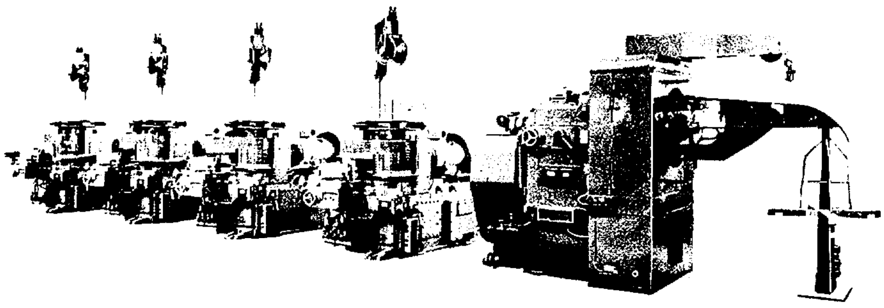
Wire rod used as a starting material is the small round bar with a diameter ranging from 5.5 to 19 mm. It comes in the shape of coil, with a bundle weighing about 300 to 1,000 kg.

In order to make wire rod into the thinner wire gauge required, it is put on a wire drawing machine for gradual reduction of the sectional area of the rod.

According to use, the diameter of the wire changes extensively whether it is wire or nail. Therefore, depending upon the dimension of the product, there arise great differences in the number of drawing machines required even though the tonnage of production may be the same.

When wire of the proposed size has been obtained through wire drawing, it is subjected to according to need, annealing, or galvanization. It is further able to make into barbed wire.

It is easy to omit the equipment for making of nail or barbed wire in this project, in which case about $US 580,000 may be cut from roughly total investment cost of $US 1,900,000. Therefore, the manufacturing plant of galvanized wire may be installed expenditure of $US 1,320,000.



Continuous wire drawing machine

Kinds of Products and Production Scale

The wire products which are manufactured from wire rod as the starting material, range over a wide field.

This project, however, is designed to turn out only wire, nail and barbed wire, which have the largest demand.

As the quality of the wire rod, which is the starting material for the manufacture of the above items, is mild steel, it is easy to procure wire rod and to manufacture it.

The production scale of this project has been set, for the time being, at 7,950 tons a year, namely 662.5 tons a month and 26.5 tons a day.

The manufacturing facilities of this industry in Japan are of extremely large capacity as indicated in the tables.

On the other hand, from the tonnage of exports of wire rod from Japan, it may be guessed that wire drawing plants in many countries, whether there are steel mill or not, are operating in a favourable condition.

Raw Materials and Locational Condition

The diameter of wire rod, as a starting material, is mostly 5 - 6 mm. In this project, it is presumed that wire rod having a diameter of 5.5 mm, which is most popular, is used.

As for the secondary materials required, they include chemical reagents for pickling – chiefly sulphuric acid – dies, lubricants, fuel oil and electric power for drawing, and a fairly large amount of industrial water.

As to the locational condition, about 1.7 acre for the plant site is required. However, the soil strength need not necessarily be large because the machinery to be installed is not very heavy. However, it is desired that water and electric power will be easily available, with easy transport of wire rod to the plant, and also the site located near the market for the products. In the case of mechanical descaler, the plant site area will be less 1.7 acre.

Table 1: Drawing Machine in Japan (1974)

Rated capacity: 8 hrs./day x 25 days x 12 months

Machine type	No. of factory	No. of machine	Rated capacity ton/year
Single	171	3,068 block	1,853,000
Continuous	205	1,639 line	2,177,000

Table 2: Production and Export of Japanese Wire Rod (1976)

(in thousands of ton)

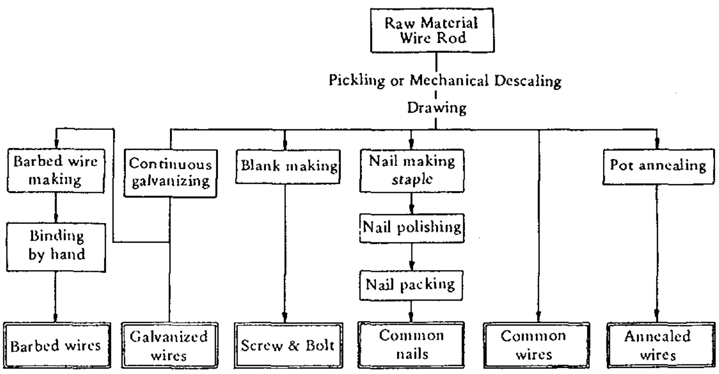
	Wire rod		Crude steel	
Quality	Production	Export	Production	Export
Mild	3,044	1,304		
Hard	1,737	547	107,000	37,000
Total	4,781	1,851		

Table 3: Export of Japanese Wire Rod (Mild) for Every Continent (1976)

(in thousands of ton)

Asia	Europe	N. America	S. America	Oceania	Total
910	61	259	65	9	1,304

Process Flow Sheet for Wire and Wire Product Making Plant



Process Description

1) Pickling operation

As stains and scale are attached to the surface of wire rod, pickling should be taken place prior to be drawn so as to obtain a brilliant surface as a result of their removal. If the condition of scale attached to the surface of wire rod are good, the mechanical descaler is applied as descaling method.

2) Drawing

One end of the bundle of wire rod is made narrower by the pointer so as to put it through the hole of the die, and the wire rod is drawn by a motor drived clamper.

The area reduction ratio per pass of the die is about 25 per cent on an average. If the diameter of wire rod is 5.5 mm, the sectional area is 23.7 mm^2.

As the diameter of the hole, corresponding to 25% reduction of the area, is about 4.76 mm, the wire rod is drawn through a 4.76 mm hole of die at first, narrowing it by drawing.

In the case of B.W.G. No. 12 of products, the number of drawings is five-six, while in the case of B.W.G. No. 16, it is eight-nine.

The area reduction ratio differs considerably according to the quality of the material used. This is to say that the less the carbon content, the larger the area reduction. Hence, the decrease in the number of passes.

There are two kinds of drawing machines, single and continuous. The single system consists of one die and one winding drum. There are cases where several sets of the single system are set.

The continuous system is a compact machinery in which several die blocks are set in one unit.

In this project, 13 units of the continuous system machinery are installed.

3) Annealing

Drawing brings about a change in the physical structure of steel, making it hard and brittle. Therefore, it is subjected by the metallurgical treatment by annealing so as to provide softness.

4) Galvanization

About 76 per cent of wire products are galvanized in order to prevent weathering. The wire is pickled on the occasion of galvanization because fair coating of zinc is unavailable without cleaning the surface.

The galvanization of wire is performed continuously, with several tens wires galvanized simultaneously and in parallel. The zinc pot is made into a long casing in order to increase the running speed of the wire for enhancement of productivity.

5) Nail making

The sizes of nails vary over a large range according to wire gauge and nail length. In making nails, the wire is set in the nail machine, and nails are made one by one by stamping of high frequency.

The machine for B.W.G. No. 6 conducts stamping 175 times a minute, while that for B.W.G. No. 17 for thinner wires conducts high speed stamping 550 - 800 times a minute.

The latter manufactures 1,100 - 1,600 of nails every minute, carrying out the cutting motion in two strands.

6) Barbed wire manufacturing

Several kinds of gauges are used in deciding on the size of the barbed wire. The pitch of the barb varies – 3, 4, 5 or 6 inches – according to use.

However, the barbing machine has considerably been mechanized providing full automatic operation by the mere setting of the galvanized wire.

Rough Description of Proposed Project

Production scheme

The project has been worked out on the assumption that the annual total production will be about 8,000 tons, which may be broken down as Table 4.

The scheme may easily be changed in the event it is necessary to match the market condition.

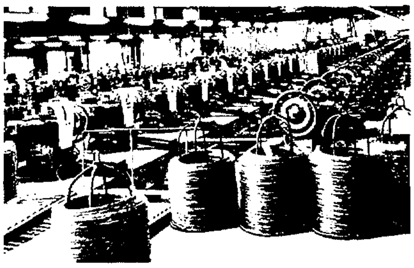
Table 4: Production Scheme

	t/day	t/month	t/year
Common wire	3	75	900
Annealed wire	3.5	87.5	1,050
Galvanized wire	10	250	3,000
Common nails	5	125	1,500
Barbed wire	5	125	1,500
Total	26.5	622.5	7,950

It has been presumed that the wire will be manufactured to the finished size of from B.W.G. No. 6 (5.16 mm dia.) to No. 16 (1.65 mm dia.). The figures for the rated capacity have been based on the presumption that the wire will be manufactured in B.W.G. No. 12 only.

Example of Wire and Wire Product Making Plant

With an annual production capacity of 8,000 tons, the required manpower and plant site area would be as the attached tables:



Nail making shop

Table 5: Required Manpower

Item	No.
Engineer	3
Skilled worker	8
Unskilled worker	40
Clerical worker	9
Odd job man	10
Total	70

Table 6: Required Plant Site Area

Item	
Factory area	4,428 m^2
Ancillery building area	489 m^2
Tank and others	189 m^2
Required land area	7,000 m^2

The processing equipment consists of a pickling line drawing equipment; annealing line; galvanizing line; nail making and barbed-wire making equipment. The FOB price of the required machinery and equipment is approximately $US 905,000. This figure does not include construction costs and that of the building structure nor that of ancillary and locally procurable machinery and equipment.

The principal requirements in way of raw materials and utilities include wire rod; sulphuric acid; chloric acid; heavy oil; spelter; industrial water; electricity and others.

As for the ideal location, large quantities of industrial water should be easily available. The same can be said in regard to electricity because of the high capacity requirements. Complete drainage facilities are also necessary.

How To Start Manufacturing Industries

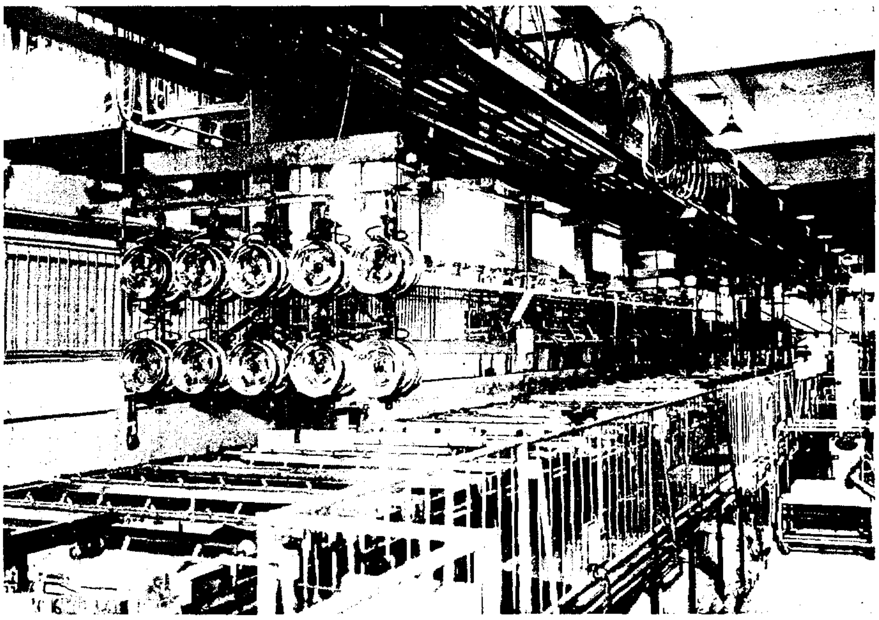
Electroplating Plant

Many modern living conveniences and transportation equipment made of iron are coated with paint or plating, since iron is corrosive in the air to moisture or chemical fumes. With the remarkable increase of iron products in recent years, the output of plating products is also increasing tremendously. As plating techniques have made great advances, the application of plating has come to be widely used in the industry.

It is, therefore, expected that plating will further be used not only for mechanical parts, but also for furniture, considering the place of zinc die-cast.

To meet the demand, as well as to cope with the problem of reducing labour, an electroplating plant must be so built and supplied as to be modern and automatic, taking future problems into consideration. The automatic equipment made in Japan is simple in construction, reasonably priced and easy to operate. Thus, maintenance cost are low and it does not require a long time for workers to master the operation. In this light, the plating equipment and plants to be introduced here are not only economical but excellent in operation, efficiency and durability, and can be recommended to any enterprises.

There are many kinds of electroplating such as copper plating, nickel plating, decorative and industrial chromium plating, zinc plating, cadmium plating, tin plating and precious metal plating.



Whole view of electroplating equipment

Process Description

1) Preliminary treatment

Since the surface of iron materials as received is oily, greasy or rusty, it must be degreased as the first step. Impurity or grease greatly affects efficiency in mechanical or chemical polishing. Degreasing and acid pickling are generally used in the preliminary treatment.

2) Polishing

Polishing improves the adhesion and finish of plating. Belt polishing, buffing, or barrel finish are commonly used.

Belt polishing is especially useful as rough polishing of material because of its powerful polishing ability. Since this belt is also easily replaceable, belt polishing is increasingly used replacing the conventional buffing.

Buffing is used in the following three processes—cutting down, intermediate, and finish buffing.

Barrel grinding is a process by which many small pieces are polished at the same time.

3) Prior treatment

The surface of the raw material is usually contaminated with impurities which should be completely removed by proper means to provide a smooth and clear plating surface. It is hardly necessary to say that the best plating surface can be obtained by the best prior treatment. Acid treatment and degreasing are carried out in the prior treatment.

Acid treatment is done by acid pickling, acid dipping or etching. After the metal is treated with acid, it is neutralized and washed with water.

A degreasing agent of the solvent type is mainly used to remove buffing waste, grease, machine oil, and rust proof-oil.

Alkali degreasing is a common degreasing method and has been widely used for a long period of time.

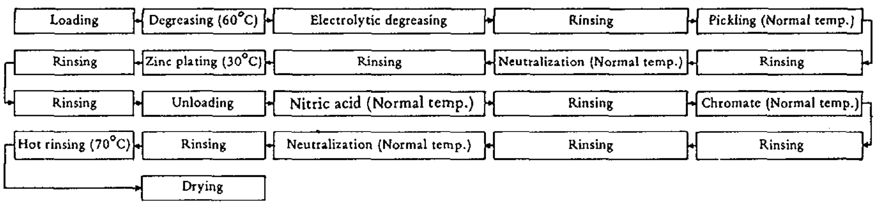
The electrolytic degreasing method which uses direct current has been widely used in recent years.

4) Plating

The buffed and degreased metal is next placed into the plating bath to be electroplated. The metal is finally placed in the plating barrel or hung on racks in the plating bath to be plated. The metallic ions provided in the plating bath are precipitated on the cathode which is a metal to be plated. All anodes are soluble plates, except those in chromium plating.

Different brightener are used to pro-

Process Flow Sheet for Electroplating Plant



vide smoothness and brightness to the surface of the metal plating, and they have been greatly developed in recent years.

5) Finish treatment

The plated metal pieces are next rinsed with hot water and then dried finally.

Example of Bolt-Nut Plating Plant

This electroplating plant example is designed for zinc plating with chromate treatment of iron bolts and nuts with a monthly output capacity of 40 tons and with thickness of eight microns or more after chromate treatment.

However, any metal pieces can be plated if they are of a size which can be placed in the barrel.

Barrel size and shape

Shape . . . . Hexagonal
Top dia. . . . . 400 mm
Length . . . . 800 mm
Capacity . . . . 30 kg
Current . . . . 400 A (max.)

Takt time

Daily output. . . . . 1,000 kg
Total No. of rack/day. . 54 pieces
Takt time . . . . 8.6 min.

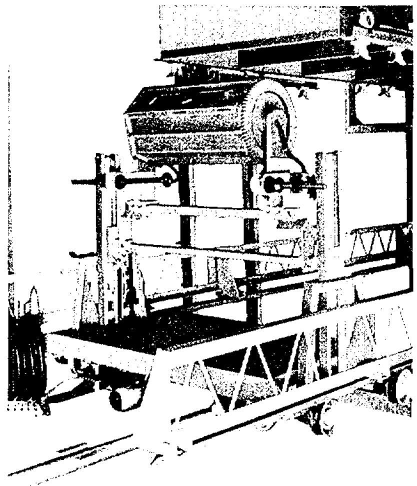
The plant is provided with zinc plating equipment and chromate treatment equipment separately because of plating convenience. Since equipment to be provided offers semi or full-automatic control, they are all controlled on the control panel for remote control. By further employing the program control system, labour will be curtailed. Tables 1, 2, 3 and 4 show respectively the machinery and equipment, raw materials, utilities, and manpower required for the above plant.

Locational Condition

(1) The plant should be lcoated in an industrial zone.

(2) Supply of water and drainage system should be sufficient.

For electroplating plants, hard water or one including iron cotents is not suitable. In addition, a considerable quantity of exhaust water is discharged from the plant. Therefore, consideration on complete drainage facilities and availability of a suitable water supply should be taken.



Carrier and barrel

(3) Plant site area.

The required floor area for the electroplating plant is approximately 144 m^2 including 104 m^2 for factory, 25 m^2 for office and 15 m^2 for warehouse.

For future expansion, an area is required to install an additional exhaust water treatment unit.

Table 1: Required Machinery and Equipment for Barrel Zinc Plating Plant

Item	Specification	No.
Semi-automatic barrel zinc plating apparatus		1
Control board		1
Barrel	400 dia. x 790 length	12
Net conveyor type dryer apparatus	Heavy oil	1
Rectifier	15 V, 500 A	1
Rectifier	15 V, 1,500 A.	1
Filter	4,000 ℓ/hr..	1
Filter	10,000 ℓ/hr..	1
Exhaust equipment	3.7 kW	1
Measuring instrument for plating thickness		1

FOB price of machinery and equipment . . . . . (approx.) $US 87,000

Table 2: Requirement of Raw Materials

Kinds of bathes	Quantity (ℓ)	Chemicals	Amount
Degreasing	890	Alkali cleaner	100 kg
Electrolytic degreasing	520	Sodium cyanide	15 kg
		Caustic soda	15 kg
Pickling	450	Sulfuric acid	45 ℓ
Neutralizing	450	Sodium carbonate	20 kg
Zinc plating	2,300	Zinc oxide	92 kg
		Sodium cyanide	200 kg
		Caustic soda	92 kg
Nitric acid treatment	110	Nitric acid	0.2 ℓ
Chromite	110	Chromic acid anhydride	20 kg
		Sulfuric acid	1.5 ℓ
		Nitric acid	1.5 ℓ
Neutralizing	110	Sodium carbonate	5 kg

Table 3: Monthly Requirement of Utilities

Electric power	16,000 kWh
Heavy oil for drying. . . .	1,000 ℓ
Water for rinsing	1,800 tons

Table 4: Required Manpower

Item	No.
Manager	1
Clerical worker.	2
Engineer.	1
Skilled worker	1
Worker.	5
Others	1
Total	11

How To Start Manufacturing Industries

Canning Plant

Preservation of foodstuffs has been conceived as an art of living ever since the dawn of human history. At present, various methods of preserving food can be cited, such as canning, refrigeration, drying, salt-pickling, sugar-preservation and smoking. However, from the viewpoint of preservation, transportation, sanitation and economy, canned food can be said to be the most ideal as compared with food prepared by other methods.

The canner is defined as a person who manufacures canned food for sale. In actuality, however, canners do not manufacture the food contents of cans nor do they sell the containers. What they produce is quite different from food which is merely put into cans. In other words, they incorporate the contents with the can by a special process to produce merchandise known as canned food, which is different from the mere food contents or the containers.

Manufactured goods represent a special function created by a new combination. What is sold as canned goods is nothing but the result of the function.

The main features of canned merchandise are: (1) ability to withstand long term preservation and transportation; (2) simplification and sanitation of cookery and (3) processing feasibility (canning adds to the taste of food, i.e., fruits, syrup-preserves).

In laying down the conditions for determining the scale of the plant, the following points should be taken into consideration.

(1) Whether the product is suitable for mass production from the technical viewpoint.
(2) Whether the purchase of the same or similar product can be carried out continuously and in a large quantity.
(3) Whether the sale of the same or similar product can be realized continuously and in a large quantity.

General Process

The canning process begins with the filling of food into a tin-can followed by the seaming of these containers, and the final process of sterilization under heat. In other words, seaming is done to prevent air-flow between the outside and the inside of the can, thus preventing bacteria from getting into the can. Whereas, sterilization under heat is designed to decimate any bacteria inside the can, thus repressing the action of bacteria in and out of the can, which causes decomposition of canned food. In the case of canning, air exhaust is a normal process interposing between the seaming and sterilization processes. In the case of bottling by machines, exhaust, heating and sterilization operations are done separately, while simplified bottling adopts, in normal cases, a single heating method in which air exhaust and sterilization are done at the same time. It is to say that the main process in canning and bottling can be summarized in the three processes of exhaust, seaming and sterilization.

The manufacturing process of canning is uniform except for some difference in the cooking process resulting from the kind of raw materials used.

Raw Materials

In manufacturing canned food, a wrong selection of raw materials may affect the final product, no matter how carefully the subsequent process is executed. In using marine food, it is necessary to judge the degree of freshness when processing because of the easy deterioration of the material.

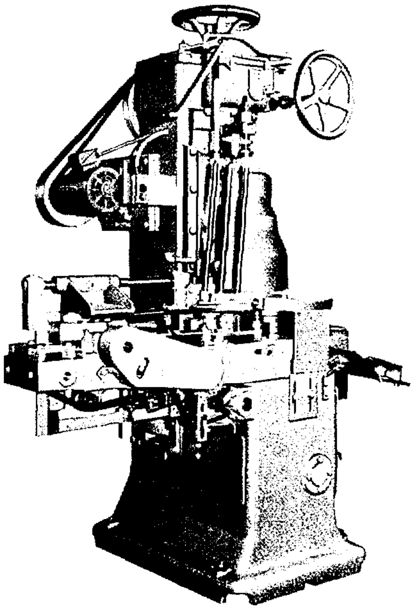
To cope with this, various physico-chemical studies have been conducted, such as refractive index measurement of the fixed quantity of decomposed product of meat albumen or eye-bal liquid.

With regard to agricultural raw materials such as fruits and vegetables materials of proper maturity must be used as they are indispensable for processing.

Example of Canning Plant

There are numerous kinds of canned foods, such as sea-food, fruits, vegetables, live stock products, soups and others. However, an example plant with a daily output capacity of 450 cans of boiled sardine (No. 4 can x 4 dozen) is taken up in view of the raw material collection situation.

The first factor which must be taken into consideration in the installation of a plant, is the collection of raw materials, and in particular, whether a supply of identical or similar types of fish can be obtained. It goes without saying



Vacuum seamer

that the supply and purchase of empty cans at a distant location is uneconomical in regard to freightage. In the case of a cannery, a plant having a production capacity of 450 cases per day falls in the medium and small-scale category.

Process Description

1. Adjustment of Materials
1) Cooking
Cut off the fish-head and pectoral fin along the dirsiventral line diagonally with a small carver, and take out the bowels gently so as not to tear off the bowel tip. Cut the fish from into 9–10 cm length for the No. 4 can, 8 cm for the small No. 1 can, 11–14 cm for the oval can starting from the neck.

2) Washing
After cooking, the fish is washed to remove blood and scales. Washing is done by water chute or a tank.

3) Salting
The fish is then drained, and soaked into salt water of B 18 . Fatty fish of 90 g in weight are soaked for about 25 min., while thin fish must be taken out of the water in good time. Salting has the effect of giving fish a salty taste, strengthening the skin, removing blood, and preventing the growth of curd in the product. After having been salted, the fish undergoes rough washing with plain water or weak salt water.

2. **Filling**

Prior to filling, the fish is weighed. When filling half-cut fish as in the case of the small No. 1 can, it is desirable to put in an equal quantity of head and tail, or to fill more head than tail.

When there is direct filling without undergoing the salting process, refined salt is added to the amount of 2–2.5 g for the small No. 1 can, on condition that the degree of freshness of the raw materials is exceedingly high. If freshness is low, salt water will tend to cause contamination.

3. **Steaming**

Materials seamed by a vacuum seamer do not usually go through this process, though many plants are accustomed to employing this process. Filled can are arranged in a steaming basket with an open work bottom. Baskets are piled one on top of the other in several layers, placed on a small rack, and then sent into a tunnel-like exhaust box. Most of the steaming baskets in use are made of wood, the size measuring 47 x 47 cm, and capable of accomodating 36 No. 4 cans or 725 small No. 1 cans. It is preferred that the edge of the steaming basket has a height about 1 cm higher than that of an oval No. 1 can.

4. **Seaming**

Before seaming, each can must be weighed in order to prevent shortage of weight.

After seaming, the cans are fed into a jet-spraying can washer for cleansing with a neutral cleanser. Then they are rinsed with plain water to be transferred to a basket type retort.

5. **Sterilization**

Seamed cans undergo sterilization immediately. Unsteamed cans must not be left untouched for long, because the quality of the product will deteriorate.

Sterilized fish is cooled in the water, and is filled in a clean-wiped can.

Table 1: Standard of Canning Boiled Sardine

Can type	Sardine weight (g)	Gross weight (g)
No. 4	350	425
Small 1	125	155
Oval 1	320	425
Oval 3	150	215

Required Amount of Raw Material

The required amount of raw material varies according to the size of the fish and the dehydration amount. The standard amount is as shown in Table 2.

Locational Condition

The cannery plant is usually built where raw material is produced. In any case, the site must have the condition of availability, in necessary amounts, of a cheap supply of high quality raw materials in terms of both freshness and maturity. However, as compared with perishable foods, canned-food products can be easily preserved and transported.

Factors constituting locational conditions can be roughly divided into natural, economic and other factors.

The total requirement of the plant site area is 4,180 m^2 including 1,913 m^2 of floor area.

Table 2: Required Amount of Raw Material

Can type	Raw material (kg)	Table salt (kg)
4 doz. of No. 4	30 – 32	0.3
100 cans of small No. 1	24 – 26	0.15
4 doz. of oval No. 1	30 – 32	0.3
4 doz. of oval No. 2	15 – 16	0.15

Table 3: Required Machinery and Equipment

Item	No.
Nobbing & cutting machine	1
Washing tank	4
Salt soaking tank	4
Empty can conveyor	2
Packing conveyor	1
Table for balance	2
Tray	300
Can assembling table	1
Cooking box (steamer)	1
Drainer	2
Can supplying table	2
Model MF-6M rotary filler	1
Model H53 rotary filler	1
Model 5 MA vacuum seamer	1
Model M18A vacuum seamer	1
Type 5P vacuum pump	1
Type 6P vacuum pump	1
Model 3 can washer	1
Chain hoist with trolley rail	1
Clutch door type horizontal retort	5
Basket cooler	40
Jacketted steam kettle	3
Stainless tank	2
Gear pump	1
Model H marker	1
Balance	15
Seaming micrometer	2
Seaming wire gauge	2
Seaming scale	2
Seam band saw frame	2
Seam band saw	10
Vacuum can tester	2
Hand can tester	2
Saccharimeter	2
Inspection bar	2
Tell-tail thermometer	10
Salinometer	2
Boiler	1

FOB price of machinery and equipment . . . (approx.) $US 476,000

Process Flow Sheet for Canning Plant

Cooking (head cutting, disposal of guts)
↓
Washing
↓
Salting
↓
Filling ◄- - - - - - - Empty can
↓
Liquid filling
↓
Seaming ◄- - - - - - Marking ◄ - Can ends
↓
Sterilization

Raw Materials and Utilities

Raw material fish should be delivered to the plant whenever they are used. When they must be stored, they are put into a freezer. It is desirable that the empty cans to be used should be supplied at the desired time. If they are not, however, it is desirable to maintain a close contact with the can making factory so that cans may be delivered on the previous day for storage in the cannery plant. Required amount of raw materials and utilities is shown in Table 4.

Table 4: Daily Requirement of Raw Materials and Utilities

Item	Quantity
Materials	
Sardine	15 tons
Table salt	500 kg
Empty can (No. 4)	450 c/s
Utilities	
Electric power	75 kWh
Fuel (C standard)	200 ℓ/hr.
Water	150 tons

Table 5. Required Manpower

Item	No.
Technician	3
Male worker	25
Female worker	80
Senior clerical worker	1
Assistant clerical worker	2
Total	111

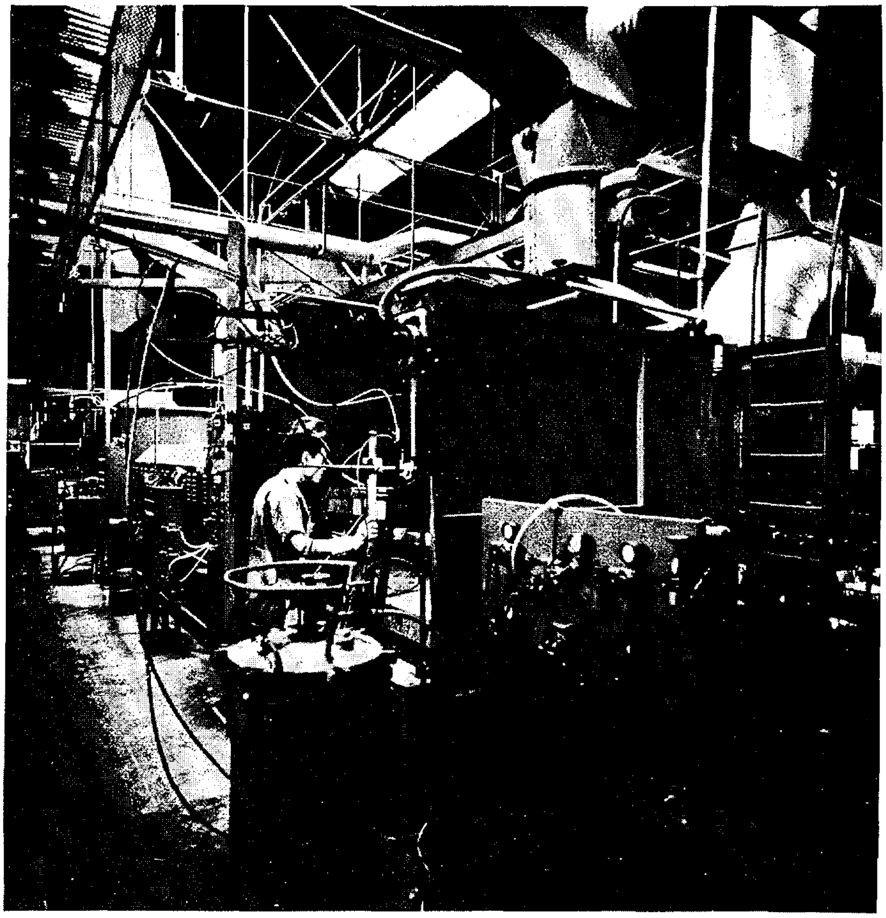
How To Start Manufacturing Industries

Aluminum Cooking Ware Making Plant

The aluminum industry in Japan has made a rapid advancement in the past few years. The production and demand are second only to the U.S.A. among free nations. Aluminum is used in all sorts of ways, old and new, but its use as household vessels is oldest and the makers have skill which has developed from long experience. The demand in this field has not developed so rapidly as the demand in other fields of aluminum product, but it has developed steadily year after year. Approximately 1,300 tons a month, or 16,000 tons a year, of aluminum vessels are being consumed, and there are nearly 70 large and small makers in this field. The scale of production is approximately 10 tons to more than 100 tons a month.

The product itself has improved. The practical side was stressed previously, but now the design has improved considerably and high grade products have appeared.

The standard thickness of the raw material sheet aluminum was 0.8 mm previously, but now the range of thickness has expanded and it is 0.7 mm to 3.0 mm. As a matter of course aluminum vessels are made not only from sheet aluminum but also by casting, and each has its special features. Products made from circle sheet, however, are most copious. The explanation here will be limited to a manufacturing plant using circle sheet aluminum as raw material.



Polishing machine

Outline of the Plant

The model plant is to manufacture representative kitchen vessels such as pans and kettles for boiling, and bowls and tubs. The plant, however, will be able to produce almost any other sort of household vessels. Table 1 shows the products which are to be manufactured in the model plant, and Fig. 1, 2 and 3 show the flow of the manufacturing processes. The plant has three lines: one is the pan body, bowl, and tub line; another is the kettle line; the third is the lid (cover) line. The details are shown in Fig. 1, 2 and 3. The process up to forming is general; the process thereafter (polishing and surface finishing), however, will differ depending on the demand and the custom and situation in various countries. That is, only buff polishing is required in certain situations and further chemical brightening to increase the gloss is required in other situations. (Here the explanation of chemical brightening will be omitted.) After polishing, too, only degreasing and washing are necessary in certain situation, and electrolytic anodizing treatment might be required in other situations. The latter treatment will improve the anti-corrosion property and the hardening of the surface, and this treatment is done on nearly all products made in Japan. The cost, of course, will be higher than simply degreasing, but the merit is certain.

Electrolytic anodizing treatment is done in an acid bath such as sulfuric acid or oxalic acid, so the building in which electrolytic anodizing treatment is done should be built separately. An apparatus to keep the products flowing, however, such as a conveyor, is actually being used.

In the finishing and packing process the body and lid will be fastened in one piece during the assembly process for products which require a lid, so two lines, on the whole, would be sufficient.

During the manufacturing process a side line would be desirable for surface treatment. That is, external damage, slight corrosion, or other defects will generally occur during manufacturing. Some of these defective products can be reprocessed. In order to reprocess the defective products, however, the surface layer of the vessel must be removed in most cases. Caustic soda is used to do the work. This line is called the alkaline treatment line. This line is generally attached to the vessels manufacturing plant.

The explanation made so far is the so called direct manufacturing line.

Besides the direct manufacturing line, a simple workshop or tool room would be necessary for a plant. That is, various sorts of dies would be necessary for forming. The repairing and correcting of these dies should be done in the plant itself. The dies, too, could be made in the plant, but it would be more economical to purchase them from a maker specializing in such goods. It is also common to repair or make simple parts of damaged machinery in the plant itself.

Again, there is the problem of how to obtain parts. Parts here mean the parts attached to the product, such as the flange which is used to attach the handle to the body, the rivet, the handle, the knob on the lid, etc. Also, bags and boxes would be necessary for packaging. Generally, from the point of volume, it would be uneconomical to make these parts and things in the plant itself. Accordingly, they should be purchased from makers specializing in such items.

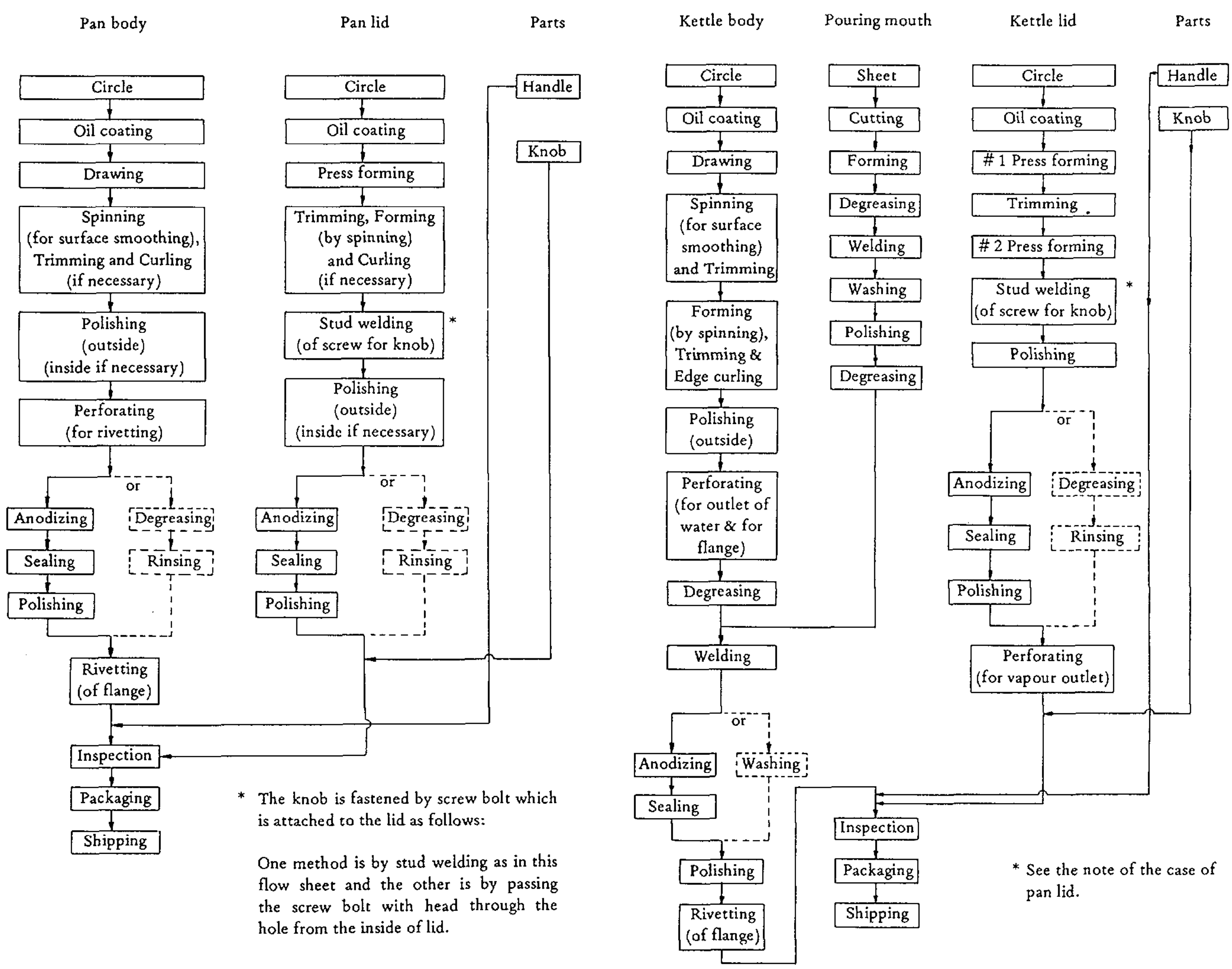
As a matter of course, the plant would require utilities such as electric power supply, boiler, water supply and drainage.

Table 1: Kinds of Products

Pan (dia.: cm)	Kettle (vol.: ltr.)	Bowl & Tub (dia.: cm)
14	1.3	16
16	1.5	|
18	2.0	|
20	2.5	|
22	3.0	36
24	4.0	
26		

Process Flow Sheet for Aluminum Cooking Ware Making Plant

Fig. 1. Fig. 2.



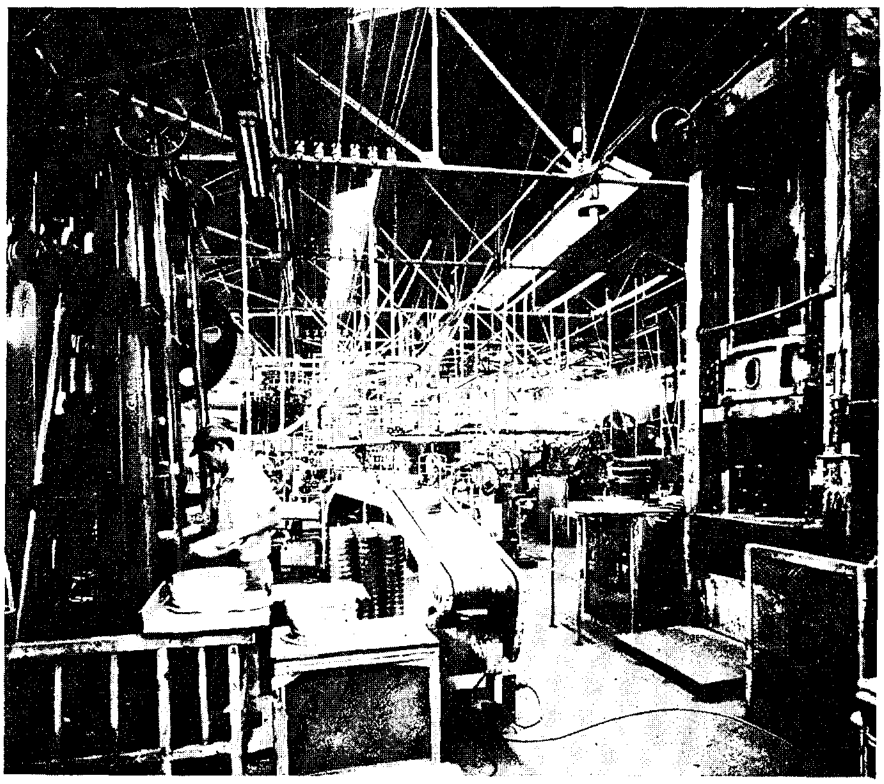
Example of Aluminum Cooking Ware Making Plant

Here is an outline plan for establishing a plant with a total monthly production of 50,000 to 70,000 pieces of the products shown in Table 1.

Required Plant Site Area

A rough estimate of the area of buildings of the plant is given below.

(1) Press, forming, polishing, and welding factory, 700 m^2
(2) Electrolytic anodizing treatment factory (including caustic soda treatment line), 600 m^2
(3) Degreasing treatment factory (including caustic soda line), 100 m^2
(4) Finishing and packaging factory, 250 m^2
(5) Storehouse (products and raw materials) 2,000 m^2
(6) Substation for electric power, 60 m^2
(7) Workshop, 200 m^2



Drawing press

Table 2-1: Manufacturing Facilities for Pan Body, Bowl and Tub

	Item	No. of set	Capacity
1)	Two-high roller for oil coating	1	5,000/8 hrs.
2)	80-ton drawing press (with auto-leader or by manual)	1	3,500/8 hrs.
3)	Spinning machine for surface smoothing (with auto-loader or by manual)	1	2,000 – 2,400/8 hrs.
4)	Trimming machine (including curling if necessary) (with auto or manual loading)	1	2,000 – 2,500/8 hrs.
5)	Outside polishing machine (full automatic machine is recommendable)	1	2,000 – 3,000/8 hrs.
6)	Perforating machine (auto or manual)	1	3,000 – 5,000/8 hrs.
7)	Anodizing line (including sealing) (automatic line except loading and unloading)	1	2,000 – 4,000/8 hrs.
8)	Degreasing line (by chemical agent) (auto or manual)	1	2,000 – 4,000/8 hrs.
9)	Finish polisher (manual or auto)	1	2,000 – 3,000/8 hrs.
10)	Rivetting machine (manual or auto)	4	500 – 1,000/set/8 hrs.
11)	Assembling & packaging conveyor line (usually by manual with tools)	1	
12)	Trimming & curling machine (for bowl & tub)	1	2,000/8 hrs.
13)	Inside polishing machine (auto or manual)	1	2,000/8 hrs.

Table 2-2: Manufacturing Facilities for Kettle Body

	Item	No. of set	Capacity
1)	Two-high roller for oil coating	1	5,000/8 hrs.
2)	80-ton drawing press (auto or manual loading)	1	3,500/8 hrs.
3)	Spinning machine for surface smoothing (including trimming) (auto loading or by manual)	1	2,000 – 2,500/8 hrs.
4)	Spinning machine (for body forming) (including curling)	2	350/set/8 hrs.
5)	Outside polishing machine (full automatic machine is recommendable)	1	2,000 – 3,000/8 hrs.
6)	35-ton power press for perforating of water outlet (auto or manual operating)	1	2,000/8 hrs.
7)	Degreasing line (by chemical agent)	1	2,000 – 3,000/8 hrs.
8)	Welding machine (auto operating)	2	400/set/8 hrs.
9)	Anodizing line (including sealing) (automatic line except loading and unloading)	1	2,000 – 3,000/8 hrs.
10)	Finish polisher (by manual)	1	2,000 – 3,000/8 hrs.
11)	Foot press (for rivetting of flange and handle)	2	500 – 1,000/set/8 hrs.
12)	Assembling & packaging conveyor line (usually by manual)	1	

Table 2-3: Manufacturing Facilities for Lid

	Item	No. of set	Capacity
1)	Two-high roller for oil coating	1	5,000/8 hrs.
2)	80-ton power press	1	4,000/8 hrs.
3)	Spinning machine (including curling if necessary)	1	2,000 – 2,500/8 hrs.
4)	Stud welder	1	3,000 – 3,500/8 hrs.
5)	Polishing machine (full automatic machine is recommendable)	1	2,000 – 3,500/8 hrs.
6)	Anodizing line (including sealing) (auto operating or manual operating)	1	3,000 – 4,000/8 hrs.
7)	Finish polisher (by manual)	1	2,500 – 3,500/8 hrs.

The total FOB price of Table 2-1, 2-2 and 2-3 is **$US 952,000 – $US 1,286,000** (depending on the extent of automation)

Table 2-4: Ancillary Facilities

	Item
1)	Belt conveyor lines and/or hanger conveyor lines
2)	Alkaline treatment line (10% NaOH solution (70°C) → Rinse → 10% HNO_3 solution → Rinse → Drying)
3)	Fork-lifters
4)	10 – 30-ton press
5)	Lathes
6)	Milling machine
7)	Borers
8)	Grinders
9)	Shear

Fig. 3.

Bowl & Tub

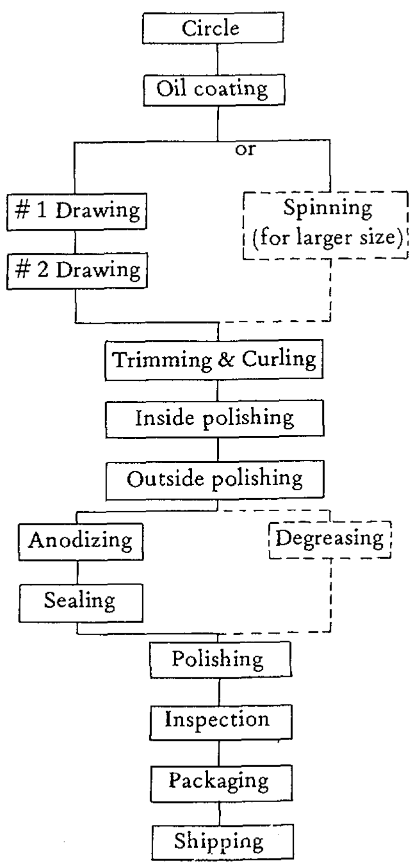


Table 3: Required Raw Materials and Subsidiary Materials

Item	Material	Thickness mm	Diameter mm
Pan body	99.0% up aluminum	0.7 – 3.0	230 – 450
Kettle body	99.0% up aluminum	0.7 – 1.2	300 – 420
Bowl & tub	99.0% up aluminum	0.7 – 0.8	240 – 500
Lid	99.0% up aluminum	0.7 – 1.2	130 – 340
Knob	Resin		
Handle	Resin or formed aluminum covered with resin		
Rivets	99.0% aluminum		4 – 5
Bolt	Stainless steel		5
Package case	Corrugated paper boards		

Table 4: Utilities

Item
Electric power supply
Boiler
Water supply
Waste solution treatment

Table 5: Required Manpower

Item	No.
Management	2 – 3
Clerical worker	4 – 6
Technician	2 – 4
Plain worker	40 – 80

(depending on the extent of automation)

How To Start Manufacturing Industries

Gabion Making Plant

Gabion has long been used as a transition method of construction and engineering for protecting river banks from erosion. In the beginning lumps of rock were stuffed in tubular shaped wire netting. Later the bed mattress type wire netting (rectangualr cube) was developed, and this has been used not only for river but also for hardening the shoulder of roads and the face of slopes to prevent landslide.

In Japan, both the tubular type wire netting and the bed mattress type wire netting are also used for woodland path in afforestation districts or buried in the ground of a golf course for drainage. Also, gabion is used for the foundation of water reservoirs of a housing complex. Recently, it has been used for oceanic development and ocean "fortress" for fish farming.

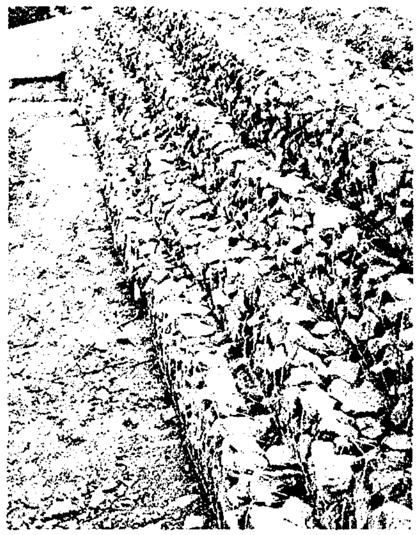
The plant itself is a simple one. The most important thing is power to move the machinery. Although a small amount of water would be necessary, the so called industrial water is unnecessary. The raw materials, too, are simple, and so the establishment of the plant would not be so difficult. However, when production of the gabion is completed, lumps of rock would have to be stuffed, and so some civil engineering knowledge would be necessary.

The foundation of an agricultural country is built upon afforestation and flood control, and the development of sturdy and safe roads would lead to the development of various industries. Herein lies the importance of this plant.

Process Description

A general description of the method of manufacturing will follow. Galvanized iron wire is set on an automatic wire netting machine and knitted into diamond shaped wire netting. In order to shape the wire netting into the designated tubular form or rectangular cube form, the backbone framework is made. This backbone framework is inserted in the central portion and outer edge of the wire netting to produce the desired tubular or rectangular cube form.

There are two types of automatic machine, the fully automatic type chain-link wire netting machine and the semi-automatic type wire netting machine. The latter type requires considerable skill, and so there will be quite a loss in the beginning. Therefore, the fully automatic type is recommended. The automatic type is desirable also from the point of low cost and mass production. The automatic type will also enable knitting of big or small mesh fence netting and rock-slide (landslide) prevention netting of various lengths.



The following is a general summary of the use of gabion:

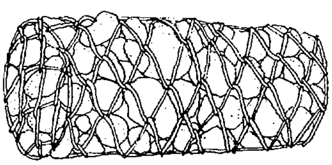
(1) Rivers

Example of Gabion Making Plant

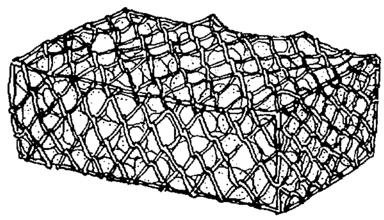
Product: Tubular gabion			
Wire used	Mesh	Diameter	Length
(#10) 3.2 mmφ	10 cm ⋮ 15 cm	45 cm ⋮ 90 cm	3 m ⋮ 8 m
(# 8) 4 mmφ	10 cm ⋮ 21 cm	45 cm ⋮ 120 cm	3 m ⋮ 8 m
(# 6) 5 mmφ	13 cm ⋮ 21 cm	45 cm ⋮ 120 cm	3 m ⋮ 8 m

Product: Rectangular cube gabion (bed mattress type)				
Wire used	Mesh	Height	Width	Length
(#10) 3.2 mmφ	10 cm ⋮ 15 cm	40 cm ⋮ 64 cm	120 cm ⋮ 200 cm	2 m ⋮ 4 m
(# 8) 4 mmφ	10 cm ⋮ 15 cm	40 cm ⋮ 64 cm	120 cm ⋮ 200 cm	2 m ⋮ 4 m
(# 6) 5 mmφ	13 cm ⋮ 15 cm	40 cm ⋮ 60 cm	120 cm ⋮ 200 cm	2 m ⋮ 4 m

Shape A



Shape B



(2) Harbours
(3) Roads
(4) Housing projects
(5) Sand arrestation
(6) Dams
(7) Prevention of landslide
(8) Preparation of golf course
(9) Railway construction work

Required Machinery and Equipment

Although the machinery and equipment required will differ depending on the sorts of product and the total output, the machinery and equipment given in Table 1 are for one set of automatic machinery used in combination to knit tubular and rectangular cube gabion. A different combination is possible, depending on requirements.

Required Ancillary Machinery and Equipment

Electrical equipment which will sufficiently operate the machinery listed in Table 1 would be necessary. However, only the motors and electric power receiving station will be given below. The prices have been omitted.

Electric power receiving station: more than 50 kW.

Motors for: automatic type wire netting machine (7.5 HP), rectangular cube frame manufacturing machine (5 HP), twisting machine (2 HP), straightening machine (7.5 HP) and reserve motor (several HP)

Transporting equipment: The weight might be heavy depending on the lot of the wire material, and so an indoor crane and an outdoor crane (approximately 2.5 tons capacity respectively) would be necessary to haul the material and products in and out of the building. Trucks, too, would be required depending on the volume of output and the distance of transport.

Table 1: Required Machinery and Equipment

Item	No.
Fully automatic chain-link wire netting machine	1 set
3 tons/day (8 hrs.) x 25 days = 75 tons	
Semi-automatic type wire netting machine	1 set
2 tons/day (8 hrs.) x 25 days = 50 tons	
Rectangular cube frame manufacturing machine	1 set
Circular ring frame manufacturing machine	2 sets
Frame twisting machine	2 sets
Circular ring frame and rectangular frame fixing machine	2 sets
Machine for straightening wire netting.	1 set

FOB price of machinery and equipment . . . . (approx.) $US 105,000

Table 2: Required Raw Material: galvanized iron wire

Item	Description
(#10) 3.2 mmφ . . .	$US 552 /ton
(# 8) 4 mmφ . . .	$US 523 /ton
(# 6) 5 mmφ . . .	$US 561 /ton

Table 3: Required Manpower

(only the factory empolyees, not including managerial officers and transporting workers)

Item	No.
Automatic type machine.	2
Rectangular cube frame manufacturing machine	1
Twisting machine Winding machine	3
Circular ring frame manufacturing machine Wire netting straightening machine	1
Others.	1
Total.	8

Table 4: Requried Plant Site Area

Item		
Building area	(approx.)	660 m²
Required land area. . . . . (including a products and materials storehouse)	(approx.)	2,000 m²

How To Start Manufacturing Industries

Pipe Fitting Making Plant

Pipe fittings are playing an indispensable part in pushing forward the improvement of our daily life and development of industries concerned.

Above all, pipe fittings which are used for connecting steel pipes have various uses, ranging from fittings in kitchen to those in numerous industrial fields, being used for changing the direction of air or liquid carried in a pipe or for prolonging the distance of the transportation.

In recent years, higher pressure resisting property is demanded for pipe fittings, and there are many unsatisfactory points in the usual cast iron. As a result, demand for malleable cast iron is on the increase year by year as the most suitable type of iron casting for pipe fittings. The optimum of malleable cast iron for is black heart malleable casting, of which the manufacturing process is described in the following.

With a wide scope of uses, there are many kinds of fittings such as elbow, union, tee, socket, cross, Y, cap, nipple, bushing, plug, lock-nut, etc.

The total variety of kinds and sizes comes approximately 1,500. However, 50–60 kinds are commonly employed.

One of the characteristics of plant, we are planning here, is the melting. Melting is the method commonly called duplex melting, where a cupola and an electric furnace are adopted according to the manufacturing process.

However, only the low frequency induction furnace is employed in this project. Compared with other furnaces, the biggest advantage of induction furnace is the easy adjustment of chemical composition of hot metal within the melting pot.

From the standpoint of expenses, it can be said that the expenses for the construction and machinery and equipment of this plant are comparatively high, but the running cost becomes cheap. The production scale is smaller than the standard economical production scale, but the layout is so designed that the scale may be easily expanded in future.

Steel scraps can be used regardless of the sizes. It is fully considered that the raw materials and auxiliary stuffs for the plant operation may be mostly procured locally to save expensive imported materials.

Generally speaking, foundry work is a kind of industry which tends to cause an unfavourable working environment and extreme fatigue to the workers. In this respect, mechanization is introduced in this plant as much as possible corresponding to the production scale in the main processes, such as melting, annealing and machining.

When the production scale of the factory is to be expanded in future, the existing machinery and equipment can be used as they are, and moreover, there will not be any unbalance of production.

Process Description

The manufacturing process of the pipe fittings is shown in the process flow diagram.

First, the various materials for the production of black heart malleable iron casting are weighed and charged into the low frequency induction furnace. It is desirable that the starting block should be employed in the first melting. After making sure that the chemical composition is within the range of black heart malleable iron casting, the metal is tapped into the geared crane ladle.

The ladle is carried to the pouring station, where the molten iron is shifted to 90 kg-trolley ladle to be poured into the sand mould previously made. After cooling for 5–10 minutes, the moulds are put on the conveyor to carry them to the shakeout, where sand and casting are separated.

After removing sand, the as-cast products are separated from sprues, runners and gates by hammering.

The products are then treated by shot blast and inspected.

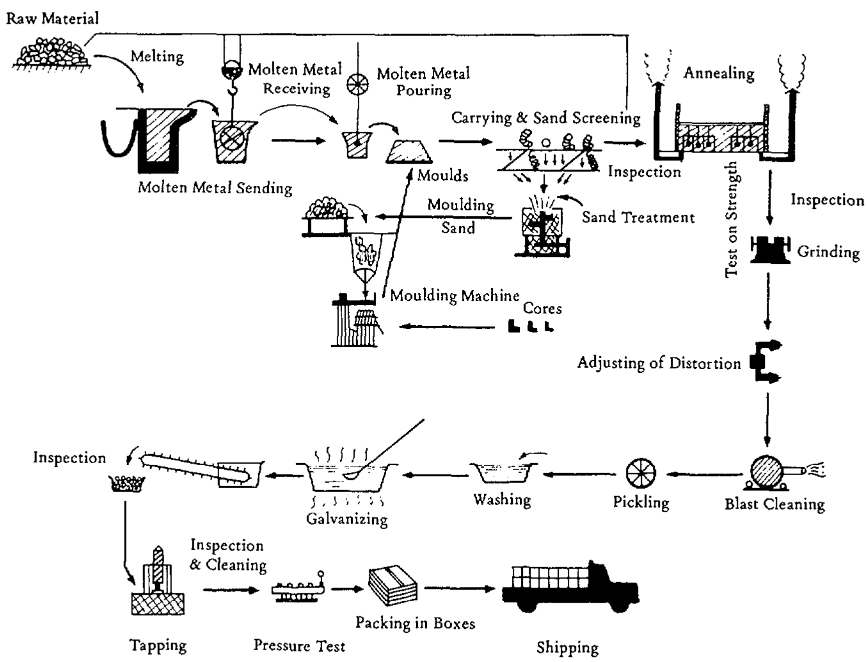
The sprues, runners and gates, on the other hand, are reclaimed for remelt. The products after passing the inspection, are packed in the annealing pot and sealed hermetically and charged into annealing furnace.

After being annealed completely at a proper temperature for a proper time, the casting is removed of gates and burrs by the cutting machine.

The distortion of casting is removed by the deformation corrector. Then, the castings are cleaned by shot blast and pickled to be galvanized. Then the castings are machined and threaded.

Every piece of casting is subject

Process Flow Diagram for Pipe Fitting Manufacturing Plant



to the pressure leakage test. Anti-corrosive oil is applied to the castings and packed for shipment.

Outline of Plant

A production scale of 100–150 tons/month is considered to be appropriate at the first stage, viewing the difficulty of sales, the amount of invested capital, and the skill in the manufacturing techniques.

This production scale can be increased by a little reinforcement of equipment according to the increase of demand.

The maximum capacity of the plant is 400 tons/year. And the working time is eight hours per day by one shift operation.

With 25 working days/month and daily production of four tons, the monthly production and yearly production will come up to 100 tons and 1,200 tons respectively.

In order to manufacture products of four tons per day, eight tons of molten iron are required due to the yield rate of 50%.

The operation time is eight hours per day for moulding and pouring, sand treating, inspecting and finishing, galvanizing, etc.

As for melting, extra operation for cold melting is needed with the low frequency induction furnace. Moreover, annealing should be conducted for 24 hours per day. The two shift system must be adopted for tapping.

Locational Condition

The first requisite for the location of the plant is the convenient procuring of high voltage electric power and water. The most suitable place should be chosen by taking this and other conditions into consideration.

For increasing the job orders, improving the productivity and reinforcing the equipment, the management should give attention to other products in addition to pipe fittings, such as automobile parts, electric parts, parts of industrial machinery, etc. in the near future.

Suggestions

The system of one shift operation, which we plan here, is to be transformed to two shift or three shift operation in the future so as to fully operate the installed machinery and equipment, when deduction of utility expenses and indirect personnel expenses will have to be conducted for the purpose of increasing the profitability.

Required Machinery and Equipment

Moulding machines
Sand conditioning plant
Melting furnace
Shot blasting machines
Annealing furnace
Galvanizing shop
Tapping machines
Testers etc.

Total FOB price . . . . (approx.) $US 1,667,000
Steel fabrications (local) . . . . FOB price (approx.) $US 190,000
Installation work, etc. . . . . FOB price (approx.) $US 190,000
Patterns and tools . . . . FOB price (approx.) $US 95,000

Required Utilities

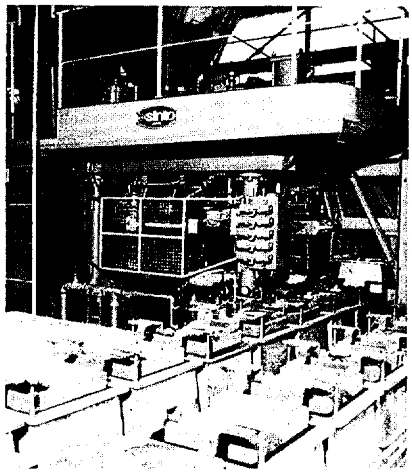
Electricity . . . . 2,000 kVA

Required Manpower

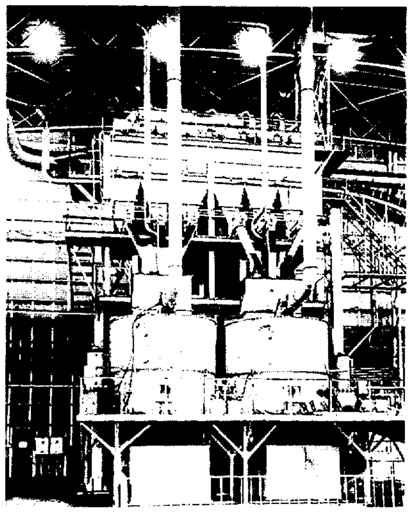
Foreman and engineer	5
Clerical worker	6
Maintenance	4
Direct worker	80
Total	95

Required Area for Plant Site

Building . . . . (approx.) 6,000 m²
Land . . . . (approx.) 15,000 m²



Automatic flaskless moulding machine



Sand conditioning plant

How To Start Manufacturing Industries

Can Making Plant

The tin plate can is a metal container which has the advantages of preventing deterioration and humidification of contents. Because of the great strength, tin plate cans offer no problems in maintaining contents reliably.

As a result of the recent development of printing techniques, printed cans as containers which require attractive outside appearance, are now available for drinks and foods.

The raw material tin plate for can is manufactured by steel makers employing the cold roll coil and electro-tinning process. Examples of the sizes are as follows:

For general use:

(mm)	(inch)
508 x 355.6	20 x 14
508 x 711.6	20 x 28

Usually, tin plate comes in thickness between BWG (Birmingham Wire Gauge) No. 30 (0.319mm) and No. 34 (0.18mm). Since the latter half of 1960, however, extremely thin tin plate (minimum 0.15mm) has been manufactured to compete with aluminium plate for Al-can.

The amount of tin coating according to JIS (Japanese Industrial Standard) is given in Table 1. Those below #50/25 have differential coating on both surfaces.

Table 1: The Amount of Tin Coating (JIS)

Code	Nomenclature	Nominal coating weight (g/m^2)	Minimum average coating weight (g/m^2)
SPTE	# 25	5.6(2.8/ 2.8)	4.9
	# 50	11.2(5.6/ 5.6)	10.5
	# 75	16.8(8.4/ 8.4)	15.7
	#100	22.4(11.2/11.2)	20.2
	# 50/25	5.6/2.8	5.05/2.25
	# 75/25	8.4/2.8	7.85/2.25
	# 75/50	8.4/5.6	7.85/5.05
	#100/25	11.2/2.8	10.1/2.25
	#100/50	11.2/5.6	10.1/5.05
	#100/75	11.2/8.4	10.1/7.85

There are other types of tin plate with different luster, different grade of steel sheet, and different strength or hardness depending on its purpose.

The world tin resources are declining, and so, although there is some restriction in the use, thin (0.015 micron) chrome coated tin free steel (T.F.S.) is being used extensively since 1970. This chrome coated T.F.S. is lower in price than tin plate.

Tin Plate Can

Tin plate can is widely used as a container for drinks, foods, petroleum products (light oil, gasoline, motor oil, lubricant), etc. There are various shapes and sizes depending on use.

Table 2 shows the amount of orders accepted by tin plate suppliers from can makers in Japan.

Table 2: Orders of Tin Plate in Japan (1977)

	Tin Plate (ton/y)	%
Food can	427,483	40.0
General can	272,336	29.3
18 liter can	197,783	21.3
Crown cap	31,253	3.4
Others	30	—
Total	928,885	100

1) Food Can

Can containing foodstuff must be heated to be sterilized. Can is also used as a container for beer, juice, and other drinks. These cans are called food can. As to the structure there is the three-piece can, which is composed of a body, top end, and bottom end. And there is the two-piece can in which deep drawing of the tin plate is done to form a body, and a lid is placed on the top end.

High grade tin plate is required for can containing specific contents and advanced technology is also required for such cans. Thus large scale facilities with high-speed production capacity (600 – 1200 cans/min) would be necessary, and a huge amount of investment would be required for the establishment.

2) 18 Liter Can

The thin tin plate of 0.32mm can be used satisfactorily for 18 liter can despite considerably heavy content, and so material cost of 18 liter can is not expensive. Much space is not required for storage of 18 liter can and the can has wide use because of its easy carriage by hand ring on top end. Most of the manufacturing lines have a speed of 30 – 40 cans/min. Some manufacturing lines have a speed of 60 cans/min. 18 liter can, like food can, is gradually shifting from tin plate to T.F.S., and merchandising is already under way. 18 liter can is manufactured by medium and small scale can making enterprises, where general can is also made.

3) General Can

The food can ordinarily requires heat sterilization whereas the general can (decorated can and miscellaneous can) does not require heat sterilization. The contents of the latter are dry foods, paint, chemicals, cosmetics, oil, etc. There are various shapes and sizes of general can, and the production lot is small; therefore, manufacturing is done on a small scale semi-automatic line.

Process Description

The plant described here has facilities which are capable of producing approximately 10,000 cans/day of 18 liter can (25 – 30 cans/min).

Can making process is shown in the process flow sheet.

1) Production of can body

The plate is placed on a roller table. When inserted in the fixed position of the sheet feeder, the plate rises automatically. One sheet at a time is attracted by vacuum suction and sent to the slitter. The sheet is cut in two. Then the sheets, in a right angle direction, are

sent to the body maker at regular intervals. The four corners of the plate are properly cut off, and two ends are bent. After going through the embossing, bending, interlocking, and bumping processes, the two ends are simultaneously flanged by the squeezer.

The bottom end and the top end made on a separate line are seamed by the respective seamers. The seamed portion of the bottom end and the top end to the body, are respectively soldered by subtense. Then, the side seamed portion of the body is soldered.

Flux remaining on the plate during the soldering process and oil adhering to the can surface are removed by water spray washing and brushing by the can washer.

Leakage test is done by air tester.

Then, the cans are drived in a drying oven.

The finished cans are bundled into six cans per pack, placed on a pallet by the palletizer, and stored in the warehouse.

2) **Production of bottom end**

The plate is cut to the proper size by the slitter and press-formed by the press machine to make the finished product.

3) Production of top end

The forming process is the same as the bottom plate, but a filling hole is made by the transfer press machine.

Galvanized wire handle made on a different machine and a tin plate clip are assembled together and spot-welded to the central portion of the top.

4) **Production of wire handle and clip**

Tin plate is cut to the proper size and formed by the press machine to make the clip.

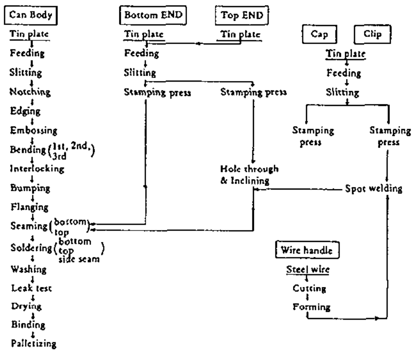
To make the wire handle, galvanized wire coil is straightened and cut to the fixed length by the straightener and cutting machine, then formed by the forming machine.

5) Production of cap

To make the cap, tin plate is cut to the proper size by the slitter and formed by the press machine.

Process Flow Sheet for 18ℓ Can Making Plant

(Production: 10,000 can/day, 25 ~ 30 can/min.)



Construction of the Plant

Preferably, the plant site should be near the can user or located in area which transportation facilities should be convenient.

The machinery and equipment necessary to manufacture approximately 10,000 cans/day of 18 liter can are shown in Table 3. The price of the machinery and equipment is approximately $US 943,000 F.O.B.

The cost of buildings, the construction expense, and engineering fee are not included in the price.

The site required for the plant is approximately $3,300m^2$.

The employees required to operate this plant are one engineer, two foremen, eleven skilled workers, and seven ordinary workers; the total of 21 empoyees. Also, several officers are required.

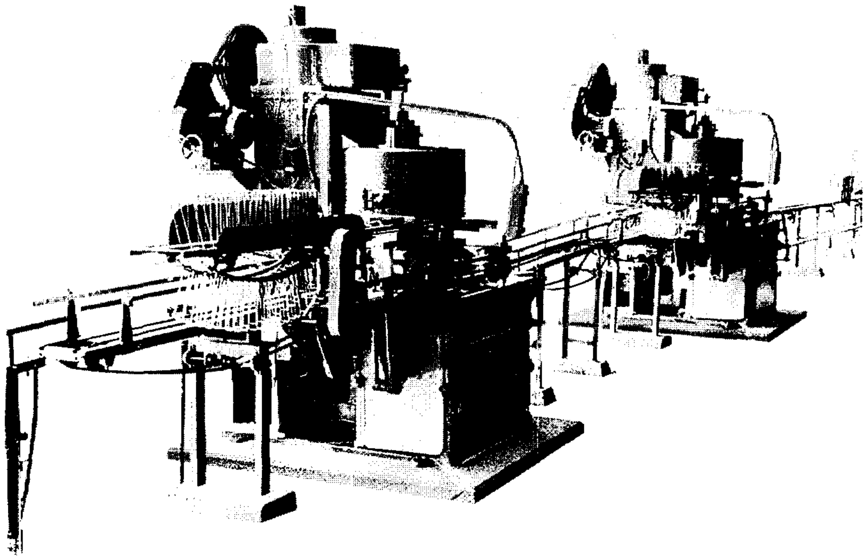
The raw materials required to manufacture 10,000 pieces of 18 liter can are shown in Table 4.

Table 3: Required Machinery & Equipment

Can Body Line	
Automatic can body maker (Roller table automatic feeder slitter)	1 set
Automatic double squeezer	1 set
Automatic double seamer (for top and bottom end)	2 sets
Electric control panel	1 set
Connecting conveyors	3 sets
Automatic soldering machine (for top and bottom end seam)	1 set
Automatic soldering machine (for side seam)	1 set
Automatic can washer	1 set
Multiple pin hole tester	1 set
Drying oven	1 set
Connecting conveyors	5 sets
Automatic binding machine	1 set
Automatic palletizing machine	1 set
Connecting conveyors	2 sets
End Line	
Sheet feeder	1 set
Single slitter	1 set
Automatic press	1 set
Blank lifter	1 set
Transfer press	1 set
Cap and Clip	
Sheet feeder	1 set
Single slitter	1 set
Press (for cap and clip)	2 sets
Wire Handle	
Automatic wire straightener and cutter	1 set
Automatic wire handle former	1 set
Wire handle spot welder	3 sets
Auxiliary Equipment	
1.5ton forklift	1
Hand forklift	3
Transfer car (for top and bottom end)	10

Table 4: Materials and Utilities for Making 10,000 18ℓ Cans

Item	Specification	Amount
Tin plate (JIS SPTE-C)		
Body	T-3, #50~#100, 0.32mm×927mm×711mm	5000 sheets
End	T-3, #50~#100, 0.32mm×518mm×771mm	3350 sheets
Clip	T-3, #75~#100, 0.32mm×508mm×711mm	50 sheets
Cap	T-3, #25~#100, 0.32mm×508mm×711mm	170 sheets
Wire (JIS3505 SWRM8)	Dia. 4.0mm (galvanized)	2000 m
Solder	60% Tin, 40% Lead	120 kg
Flux		12 kg
L.P.G.		75 kg
Water		26 m^3
Electric power		541 KWH



Automatic double seamer for top and bottom end.

Any inquiry about the information contained should be sent to: IO/COOP, Registry file No. ID/562/12, UNIDO, P.O. Box 300, A-1400 Vienna, Austria.

How To Start Manufacturing Industries

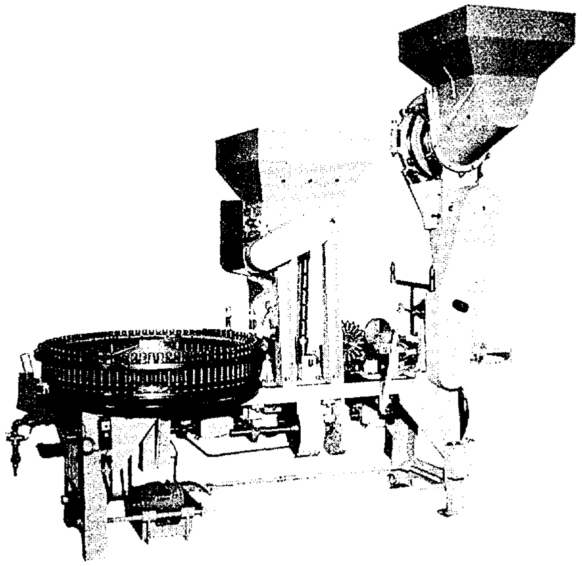
Crown-Cap Making Plant

Crown caps are indispensable for the bottling of beer and Cola, which use high-pressure gas, and that of juice, liquor and common foodstuffs which use low-pressure gas. The demand for crown caps is steadily increasing due to changes in the manners and customs of people.

This article is designed to introduce the crown cap manufacturing plant.

The plant consists of:

(1) Cork disc manufacturing section
(2) Tin plate printing section
(3) Crown cap manufacturing section



Fully automatic crown cap and cork gathering and bonding machine

Process

1) Cork disc manufacturing section

The country of origin of the material for the cork is Portugal. Supply from other countries cannot be considered stabilized due to quantitative and qualitative problems. Therefore, cork and cork manufacturing machine are imported from Portugal.

Imported cork is crushed into fine pieces, which are mixed with a special bonding agent and pushed into a thin pipe.

After its drying, the rod of cork is taken out of the pipe, and the outer circumference of cork is ground so as to give it a fixed diameter. It is then cut up into cork discs.

As the above process is a most primitive one, it is more economical to import cork discs from abroad, which is the general practice.

2) Tin plate printing section

In this section, trade marks, etc. are printed, first of all, on tin plate, the material for crown caps. For the printing of tin plate, it is necessary to set up a printing process line connected to a dryer.

This is because of the need to arrange automatic feed of printed tin plates into the drying oven for drying, without manual operation, as printed tin plates do not dry immediately.

In case of three-colour printing, it is only necessary to repeat the above process three times. When printing is over, it is necessary to apply varnish over the print.

Varnishing is necessary to prevent the shearing of print which would occur by the touch of a hand. It is also useful in giving glaze to print. After varnishing, the printed tin plates are passed onto the coating line via the drying oven.

In other words, the printing of tin plates for making crown caps requires two process lines—the tin plate printing line and the coating line. In selecting the printing press to be used for the above purpose, consideration should be given, as important problems, to:

(1) Feeding system of material

There are two systems – automatic and manual feed.

It is, however, hoped that the plant will adopt the automatic feed system in consideration of capacity, speed and safety for workers.

(2) Dimension of stamp or pattern of roll of printing machine

The dimension of the machine depends on that of the tin plate to be printed. In Japan, it is 28 1/8" or 20 5/8". In the event the dimension of the machine should be decided in accordance with the above dimension of plate, the sufficient dimension of stamp of the printing machine may be 28" x 20".

(3) Printing system

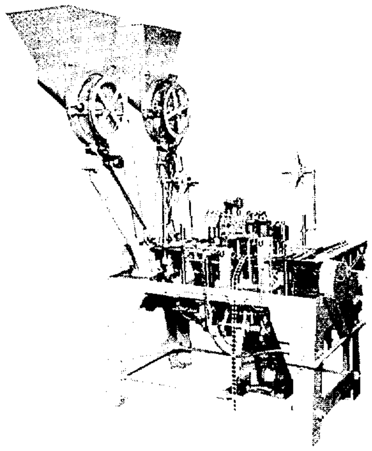
The question is which should be used – the flat bed system or the cylinder system. But in Japan, 90 percent of plates are printed by the cylinder press. The production capacity based on the above system will be:

3,600 sheets/hour (max.) x 8 hours/day x 300 days/year
= 8,640,000 sheets
288 pcs./sheet x 8,640,000
= 2,488,320,000 pcs./year

In the case of three-colour printing, the above capacity will be reduced to one-third, when the output will be 829,440,000 pcs./year.

3) Crown cap manufacturing section

The kinds of machines required in this section may differ according to the types of crown caps to be manufactured. But the machines generally required may be listed as follows:



Fully automatic aluminum foil spotting machine

(1) Automatic tin plate waxing machine.
(2) Shearing machine.
(3) Automatic press for stamping-drawing of crown caps. (5 piece-type)
(4) Fully automatic press for stamping-drawing of crown caps. (15 piece-type)
(5) Plane grinder for press.
(6) Fully automatic crown cap and cork gathering and bonding machine.
(7) Fully automatic aluminum foil spotting machine.

Manufacturing Description

1) Waxing on printed tin plates.

2) Cutting of tin plates by the shearing machine into fixed dimension for 5-piece (or 15-piece) stamping.

3) Crown caps are stamped and drawn on the fully automatic press for the stamping-drawing of crown caps. In the case of a tin plate measuring 28" x 20" for 5-piece stamping, the plate is put on the press after shearing it into pieces of five rows each. In the case of 15-piece stamping, the whole plate is pressed at one time.

4) Cork discs prepared separately and the crown caps manufactured by process 3) are respectively put into separate hoppers for adhesion.

5) Depending upon the kind of crown cap, aluminum foil, paper or PVC., etc. is glued after adhesion of cork. In such a case, the automatic aluminum glueing machine is used.

Description of Principal Machines

1) Automatic tin plate waxing machine
This is an indispensable machine for waxing tin plate.

2) Shearing machine
This machine is necessary for the shearing of tin plates. It is used for 5-piece stamping.

3) Fully automatic press for stamping-drawing of crown caps (5-piece stamping)
This is generally used by crown cap makers in Japan. Its largest capacity is 82,000,000 pcs./year. Excepting the case of mass-production in a single design, almost all plants adopt the 5-piece stamping system.
The durability of metal moulds is 3–4 years or so due to the utilization of a grinder. The cost of spare metal moulds is comparatively moderate.

4) Fully automatic press for stamping-drawing of crown caps (15-piece stamping)
This is the press that has the largest capacity in Japan. It provides an annual production capacity of about 189,000,000 pieces. This type of machine features matching mass-production in a single design.

5) Plane grinder for press
This machine is used for the grinding of metal moulds for the stamping-drawing of crown caps.

6) Fully automatic crown cap and cork gathering and bonding machine
Its capacity is 126,000,000 pcs./year (max.). The bonding agent for the above purpose is the white of egg, which is used in the form of powder. One kg of egg powder provides adhesion of about 20,000 pieces.
Egg powder is used in Japan in about 90% of cases.

7) Fully automatic aluminum foil spotting machine
This machine is for the glueing of aluminum, paper, PVC., etc. on cork which has bonded to crown caps.

Note: The above machine 7) is necessary to prevent the rust on tin plate and the dust of cork disc from penetrating into the liquid in the bottle.

Outline of Plant

1) Production Capacity
. . . . 82,000,000 pcs./year

2) Required Machinery and Equipment
(1) Printing plant
. . . . . . (approx.) $US 190,000
(2) Crown cap manufacturing plant
. . . . . . (approx.) $US 143,000
Total . . (approx.) $US 333,000

3) Required Manpower

	Printing	Crown cap mfg.
Chief engineer	1	1
Skilled worker	3	8
Clerical worker		1
Odd job man	1	1
Total	5	11

4) Required Floor Area
. . . . 18 m x 36 m = 648 m^2

Technical Assistance

For the construction of the plant, it is necessary to provide technical training at the printing and crown cap manufacturing sections.

Suggestion

At the crown cap manufacturing plant, it is suggested that the tin plate printing section be put on a structure for a large variety of printing services in addition to tin plate printing, and the section be considered as a semi-independent enterprise. For it may be able to carry on effective operation of the plant that way.

How To Start Manufacturing Industries

Coin Making Plant

The growing world economy has lately led to the development of numerous new products and, more recently, to the fabrication of various automatic vending machines which permit round-the-clock selling of these products at retail outlets. Meanwhile, automatic vending machines have also come to be used popularly for the sale of railway tickets, soft drinks and for many other articles.

Such development of a wide variety of automatic vending machines is causing in its wake a critical shortage of coins in many countries, called for appropriate measures to increase coin supplies.

The minting of coins, as in Japan and in some countries, is a monopolized function of the Finance Ministry or the Central Bank which almost always mints the nation's required volume of coins by means of its own minting facilities.

However, the urgent demand for vast amounts of coins lately has forced governments to commit the business of producing unstamped, dummy coins to civilian enterprises, with the stamping operation itself achieved by the central government that reserves the sole right to mint and issue the coins.

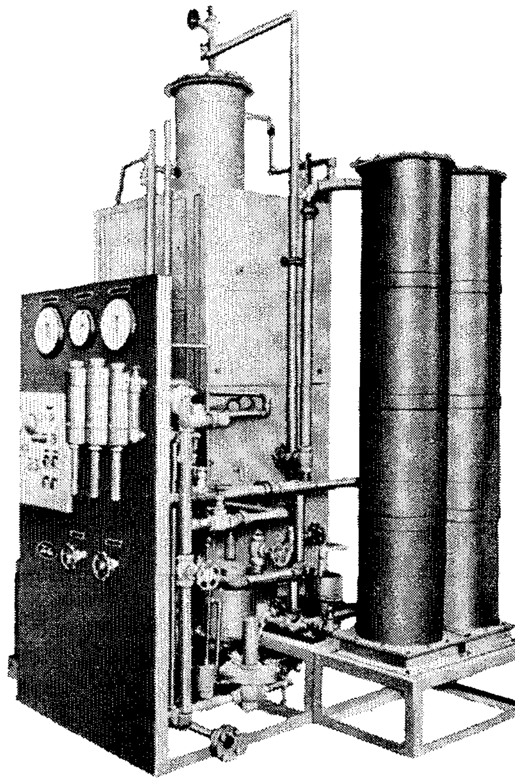
While the method of producing domestic currencies will differ with each country, with most governments minting their coins themselves and some governments committing the business of producing unstamped coins to civilian enterprises according to local situations, there is a growing trend lately for private firms to be vested with the work of producing unstamped coins as a means to cope with the critical coin shortage situation.

Process Description

First of all, material bronze sheet coils or nickel alloy sheet coils should be straightened out in the coil field, then fed to the punching press that punches out round, dummy coins from the strip coil. The dummy coins are next given circular flanges by means of a flanging press, then counted.

After this, the dummy coins are annealed in an electric furnace to soften the metal as a means to permit later stamping operations to be achieved easier. The annealing process is achieved at a temperature of about 650°C for bronze coins, and at a temperature of roughly 900°C for nickel coins.

Annealed coins are then given an acid bath pickling, dried an inspected, with inferior coins having imperfect roundness rejected from the production line.



Process Flow Sheet for Coin Making Plant

Strip Coil
↓
Coil Straightening
↓
Dummy coin punching
↓
Flanging
↓
Counting
↓
Annealing
↓
Acid pickling
↓
Drying
↓
Inspection
↓
Product dummy coin

Example of Coin Making Plant

Here, a coin making plant to produce round, unstamped coins shall be introduced, with the coins later stamped by the government's authorized minting organization.

The production capacity of the plant will be 4,400 coins/minute where bronze coins are involved, and 2,800 coins/minute where nickel-silver alloy is used.

Processing bronze coins and nickel-silver coins at the same time will be impossible. For this, another separate production line will have to be provided.

Operation schedule:

The plant is designed for single-shift operation under the following schedules:

8 hours/day
25 days/month
300 days/year

Since bronze coins or nickel coins can be produced by the batch system, these coins can be produced by matching the operation schedule to the required outputs of these coins. Where large outputs are proposed, operations may be advanced under a 2-shift work system.

Note: Tables 1 – 5 are based on the above scheme.

Table 1: Required Machinery and Equipment

Item	No.
1) Coil field	2
2) Punching press	2
3) Conveyor	1
4) Conveyor	1
5) Conveyor	1
6) Punching press	1
7) Conveyor	1
8) Elevator	2
9) Conveyor	1
10) Conveyor	1
11) Counting and feeding machine	2
12) Electric annealing furnace	2
13) Electric panel	2
14) Cooling water tank	1
15) Generator	2
16) Ex gas generator	1
17) Conveyor	1
18) Conveyor	1
19) Conveyor	1
20) Washing machine	1
21) Boiler	1
22) Acid tank	2
23) Acid tank control panel	2
24) Water pump	1
25) Drying furnace	1
26) Drying furnace control panel	1
27) Conveyor	1
28) Inspection table	5

FOB price of machinery and equipment .... (approx.) **$US 2,857,000**

Note: While the machinery and equipment cost indicated above is for a coin making plant having two production lines, the cost will be roughly **$US 1.9 million in** the event only one production line is involved.

Table 2: Required Raw Materials

Item	Quantity
(Assuming that bronze coins are produced for 4 hours a day, and nickel coins for the remaining 4 hours, the required volume of raw materials will be as follows:)	
Bronze	7,920 kg/day
Nickel	3,360 kg/day
Moulds	4 units

Note: The moulds will have to be replaced once every six months when punching out bronze coins, and once every three months when punching out nickel alloy coins.

Table 3: Required Utilities

Item	Quantity
Electric power	1,454 kWh/day
Water	50 m^3/month
Fuel (propane gas for boiler)	100 kg/day
Acid	4 m^3/month

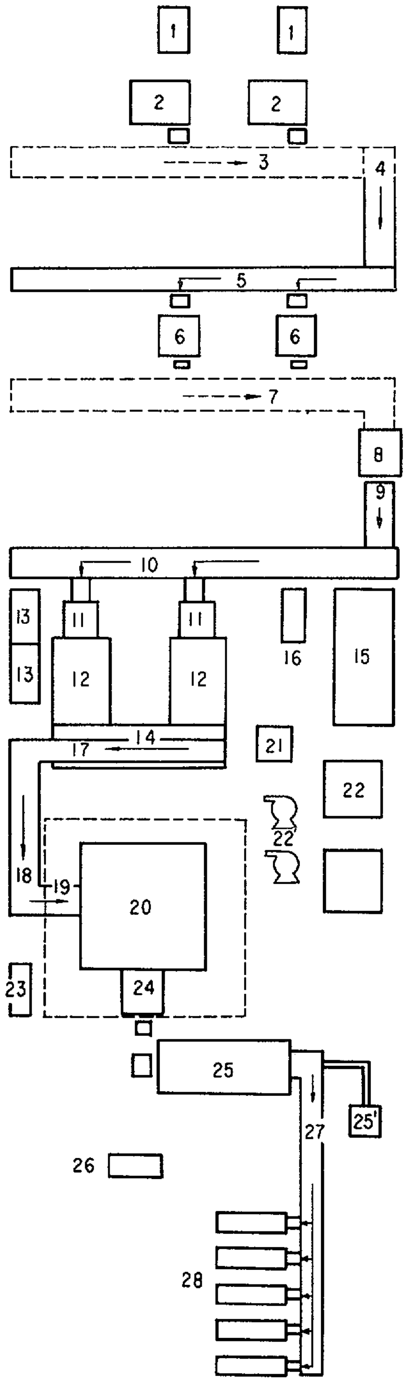
Table 4: Required Manpower

Item	No.
Engineer	2
Skilled worker	13
Total	15

Table 5: Required Area for Plant Site

Building	30m x 70m = 2,100m^2
Land	60m x 80m = 4,800m^2

Note: The buildings shall be of cold formed steel structure with slated covering.



Any inquiry about the information contained should be sent to: IO/COOP, Registry file No. ID/562/12, UNIDO, P.O. Box 300, A-1400 Vienna, Austria.

How To Start Manufacturing Industries

Wire Nail Making Plant

In 1977 approximately 24,000,000 tons of low carbon steel wire rods were put out in the world, of which 1,900,000 tons were consumed in making wire nails. An increasing quantity of nails is being consumed year by year, and various kinds of nails are being manufactured for special purposes.

Nail making does not require highly advanced knowledge or technique, and its making capacity can freely be fixed according to the demand in the locality. The plant can be built at any place without environmental restraint. The day, when a simple and single shape of nails was used, came to an end. Nails are now being used for fastening such things as wood, steel plate, aluminum plate, petrochemical panel, etc., and nails of special shapes and of high grade are being manufactured. The nail making plant can easily be expanded, rationalized, automated or can adopt a labour saving device.

The use of nails has recently been expanded and various shapes and sizes of nails are being produced.

Nail Making Process and Material

The wire rod in a coil, which is made at the hot rolling mill of the iron and steel works, usually contains 0.10 to 0.15% carbon, and has a 5.5 mm diameter. The maximum weight of one coil is 2,000 kg. Therefore, the wire rod is cut into a smaller wire rod (500 kg or 1,000 kg) according to the handling capacity of a wire drawing plant. The wire coil having the diameter requested by a nail making plant is produced by cold drawing in the wire drawing plant.

Fig. 3 shows the flow sheet of making nails out of the wire rod. The upper is the flow sheet of the wire drawing plant and the lower the nail making plant.

The wire coil, as mentioned above, is the main material for nail making. The wire coil, to which cold drawing was applied, has higher tensile strength than the mild steel wire, and prevents the nails from bending.

For the nails requiring greater strength is used a wire containing higher percent of carbon. In polishing nails, sawdust or rice bran is used.

1) **Nail making**

The essential point of the mechanism

Fig. 1: Kinds of Nails

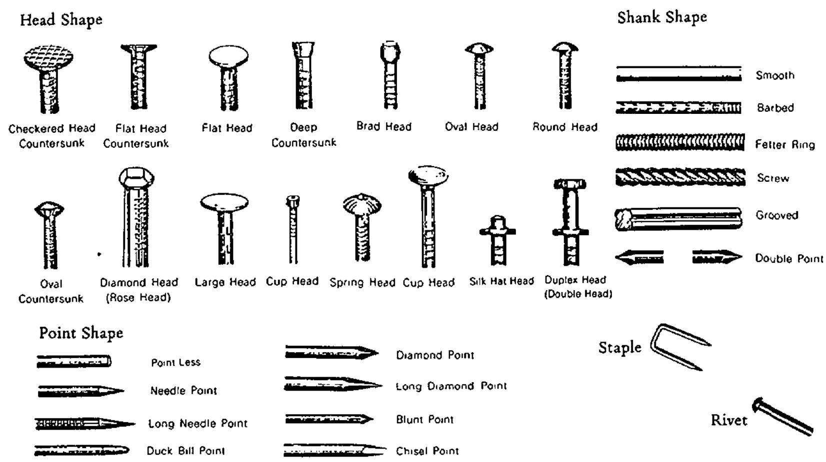


Fig. 2: Kinds of Special Nails

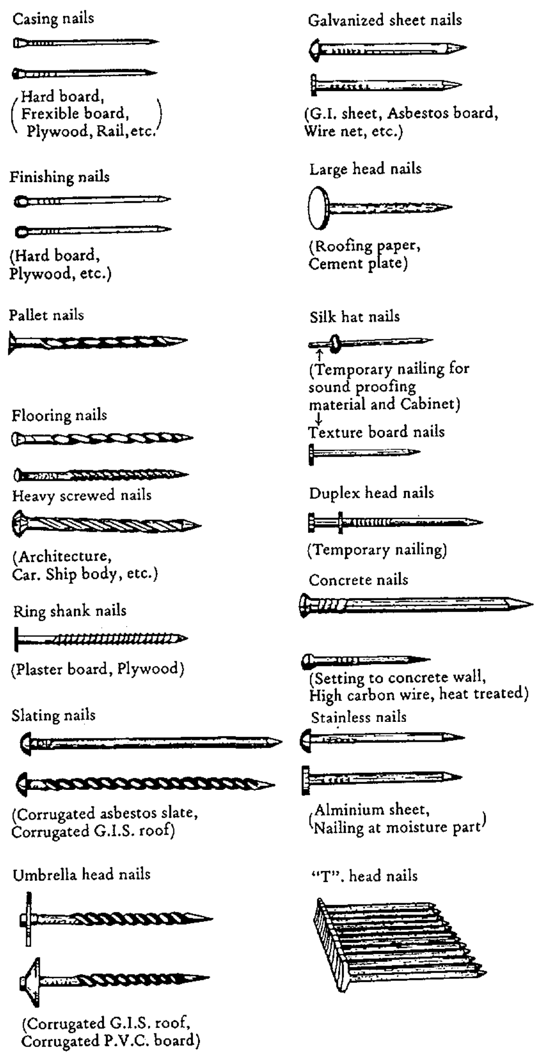
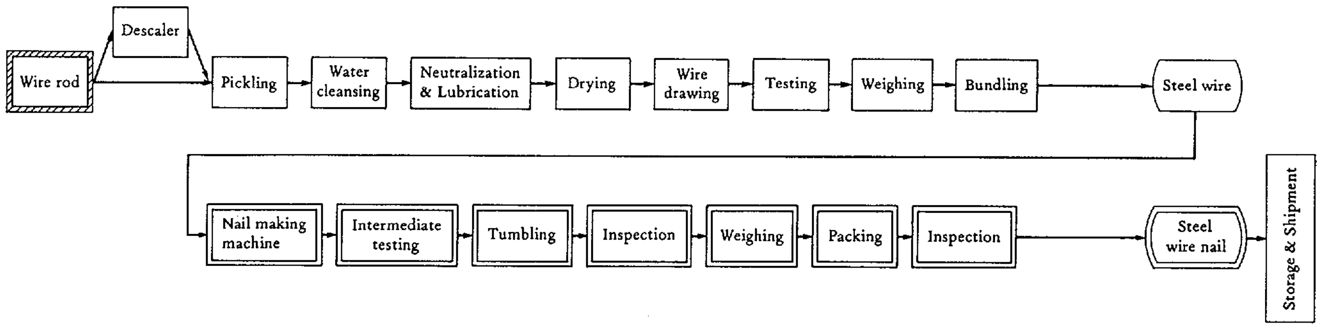


Fig. 3: Process Flow Sheet for Wire Nail Making Plant



of the nail making machine lies in a combination of crankshaft and cam, which performs the forming of the head of nail, feeding out of the preset length of the wire, the forming of bottom-tip portion of the nail, and cutting off operation. A series of such fabricating works are repeated, thereby producing the nails automatically.

Designations of each portion of the nail making machine are shown in Fig. A.

Principal parts of the nail making machine are:

Dies: The tool used for cramping the neck portion of the nail when the punch is to strike the tip of the wire to form the nail head.

Knife: The tool used for forming the tip portion of the nail, and cut down at the same time.

Punch: The tool used for forming the head.

Feeding unit:
The unit apparatus used to hold the steel wire and feed it out by a certain pre-arranged length.

The above described principal parts are designed to work in an interlocked mechanism, and the flow of work is illustrated in the figures shown below:

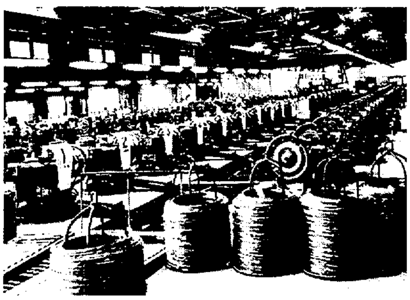
Fig. A The dies cramp the steel wire whose tip has been already cut off, meanwhile the punch comes forward, and then it strikes the tip of the wire to form the nail head.

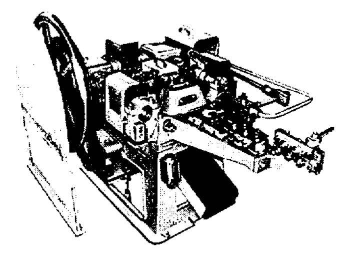
Fig. B The punch which has struck the head of the nail now withdraws itself, when the dies open apart. The steel wire which has been straightened is forced out to the front by a pre-set length. The knife then gradually closes.

Fig. C The knife closes up to form the tip portion of the nail; and then cuts off the remnant end of the wire; then and there, the dies start closing themselves.

Fig. D The knife starts opening just before the dies close themselves up, which causes the punch to come forwards. When the punch restarts for advancing, the nail is allowed to fall down. The dies close up, and the punch again strikes the end of the wire to form the head of the nail.

The above described course is regularly repeated with every one rotation of the crankshaft to produce the nails.





Nail making machine

Fig. A

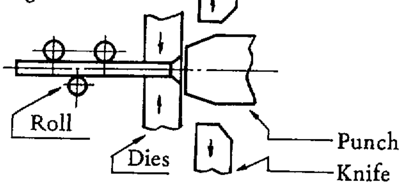


Fig. B

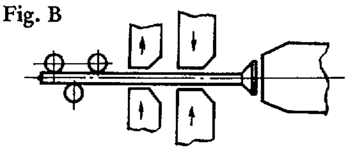


Fig. C

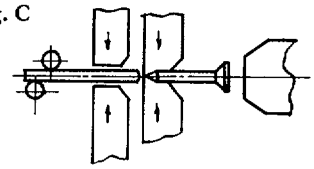
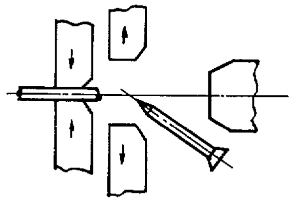


Fig. D



2) Nail polishing

As the nails stream from the machines, they are rough, whiskered, and burred, and have to be cleaned and polished in rotating drums, called tumblers, which hold from 500 to 800 kgs each. Into the tumblers with the nails go sawdust to pick up little slivers and oil and grease from the machines. By addition of proper quantity of rice bran, better polishing effect can be expected. The nails remain in the rotating tumblers from 45 minutes to an hour, after which the sawdust is sifted out and the nails are bright and clean. Those requiring fine points cannot be tumbled, so special care is exercised in their manufacture to prevent deposits of oil and grease.

When other than this bright finish is required, the nails undergo further treatment. They may be galvanized to retard rust, tinned, blued or "sterilized," or cement coated. The last process consists of dipping them in a resin mixture which fuses slightly under the heat generated when the nail is driven, and forms a bond between it and the wood.

3) Measuring and packing
The nails polished by a nail polishing machine are conveyed to a shaker type nail packer to be packed in a given carton or barrel, and then are measured.

4) Tools for nail making and maintenance
The four kinds of tools are subject to wear and tear, so the spare tools are to be always prepared. The size of each tools varies with the models of nail making machines.
There are two kinds of tool's qualities as being shown on the right illustration. One is made of high speed steel, another is tungsten carbide alloy. Unless specified, the tools of high speed steel are usually used.
Generally speaking, tungsten carbide alloy tools can bear longer use and also final products have higher accuracy. The tools can be used as long as they are by performing necessary repairing, unless they are damaged. The cutter and punch are repaired by using a polishing machine suitable for each of them.

5) Making of special nails
Of the special nails, some cannot be made by employing only the nail making machine, and the following machines and equipment must be used additionally.
- Form and thread rolling machine
- Electric gilding equipment
- Galvanizing equipment
- Heat treatment equipment
- Colour coating equipment
- Chemical etching equipment
- Binding agent coating equipment
- Dryer
- Others

Example of Wire Nail Making Plant

Here is outline of wire nail making plant with a 4-ton-per-day or 100-ton-per-month capacity.

Table 3: Required Raw Materials

Item	Quantity
Wire coil	103 tons/month
Oil	20 liters/day
Sawdust	300 liters/day
Rice bran	10 liters/day

1) Production Scheme

Table 1: Efficiency = 100%: 1 day = 8 hours

Size of nail	Machine model	Unit capacity (kg)	No.	Total output kgs/day
BWG = 17 x 19 (¾")	A	70	3	210
BWG = 16 x 25 (1")	A	110	2	220
BWG = 15 x 32 (1¼")	B	175	1	175
BWG = 14 x 38 (1½")	B	240	1	240
BWG = 13 x 45 (1¾")	B	385	1	385
BWG = 12 x 50 (2")	C	430	1	555
BWG = 11 x 65 (2½")	C	680		
BWG = 10 x 76 (3")	C	1,050	1	1,050
BWG = 9 x 90 (3½")	D	1,250	1	1,525
BWG = 8 x 101 (4")	D	1,800		
		Total	11	4,360

Table 2: Installation

Section		Machine and model	No.	Motor	Capacity
Nail making	1	A	5	1.5 kW x 4p	max. 1.8 ϕ x 38 ℓ
	2	B	3	2.2 kW x 4p	max. 2.4 ϕ x 50 ℓ
	3	C	2	3.7 kW x 4p	max. 3.4 ϕ x 90 ℓ
	4	D	1	5.5 kW x 4p	max. 4.2 ϕ x 115 ℓ
Nail polishing	5		1	7.5 kW x 4p	700 kg x 2
Nail packing	6	Hopper	1		1,000 kg/charge
		Nail packer	1	1.5 kW x 4p	
Others	7	Nail cutter grinder	1	0.4 kW x 2p	
	8	Double chamber electric furnace	1		1,350°C x 10 kW + 6 kW
	9	Tempering furnace	1		1,000°C x 10 kW
	10	Oil bath for heat treatment	1		100 ℓ
	11	Operation panel	1		
	12	Bench drill	1	1.5 kW x 4p	max. 12 ϕ
	13	Double head grinder	1	0.4 kW x 2p	

Table 4: Required Utilities

Machine with motors	No. of set	Unit motor	Total kW
A Nail making machine	5	1.5 kW	7.5 kW
B Nail making machine	3	2.2 kW	6.6 kW
C Nail making machine	2	3.7 kW	7.4 kW
D Nail making machine	1	5.5 kW	5.5 kW
Nail polishing machine	1	7.5 kW	7.5 kW
Shaking type nail packer	1	1.5 kW	1.5 kW
Nail cutter grinder	1	0.4 kW	0.4 kW
Others			35 kW
Total			71.4 kW

2) Total Price of Major Machinery and Equipment

The total FOB price of the major machinery and equipment shown in Fig. 4 and Table 2 is approximately $US 238,000 which also covers the price of spare parts. However, the costs of land, building construction, installation, wiring and piping are not included in that total FOB price.

Table 5: Required Manpower

Section	Position	Total No.
Nail making . . .	A.D. 2, B.C 2 . .	4
Nail polishing	1 . . .	1
Nail packing	2 . . .	2
Tool repair	1 . . .	1
Carriage	2 . . .	2
Total		10

Table 6: Required Area for Plant Site

Item		
Building	(approx.)	700 m^2
Land	(approx.)	1,400 m^2

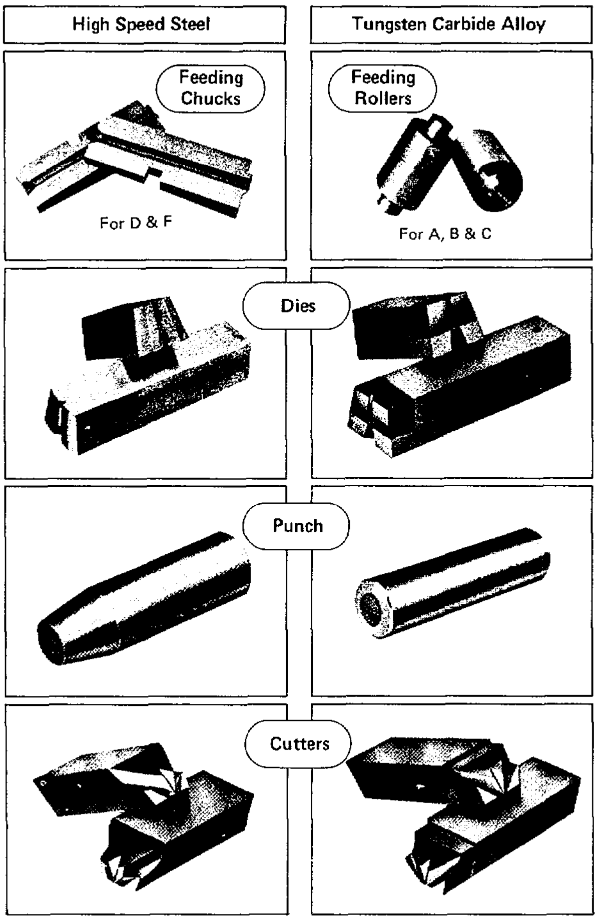
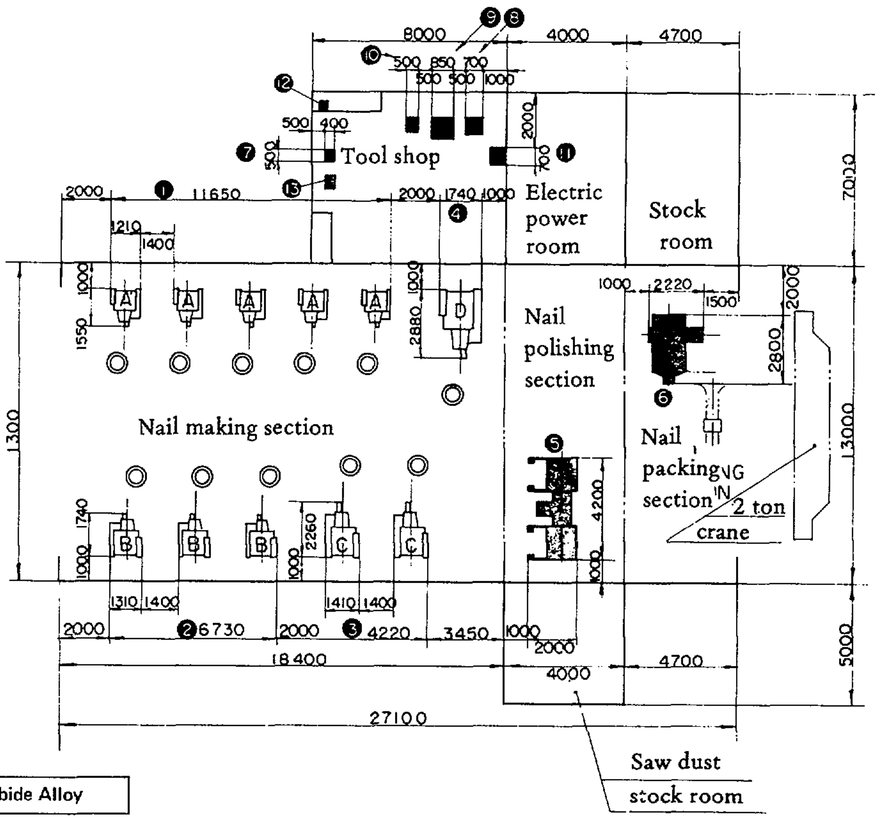


Fig. 4: Layout for 4 Tons/Day Wire Nail Plant (19 mm – 101 mm length)



P

ISIC 382 NON-ELECTRICAL MACHINERY

How To Start Manufacturing Industries

Pump Assembling Plant

With the increase in population centered around cities, and the improvement in living standards, there has been a considerable upsurge in the consumption of water, which necessarily calls for extension of facilities for distribution, purification and treatment of water.

On the other hand, facilities are required for control of floods which occur in heavy rains, for supply of industrial water which is indispensable for expanding industry, as well as for discharge of waste water from plants and treatment of such water.

No undertakings relating to water, which is directly connected to human life, can be achieved without pumps.

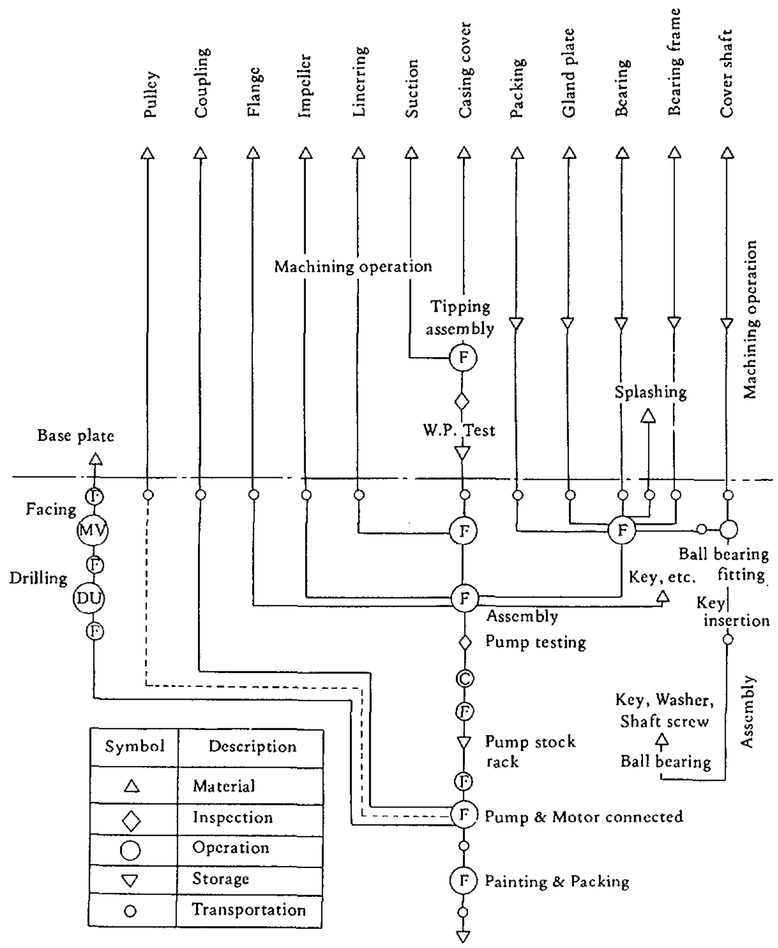
Since around 1925, centrifugal pumps have been used in waterworks in Japan for drawing water from the lower reaches of rivers or underground, and pressure-feeding of water to reservoirs at higher levels.

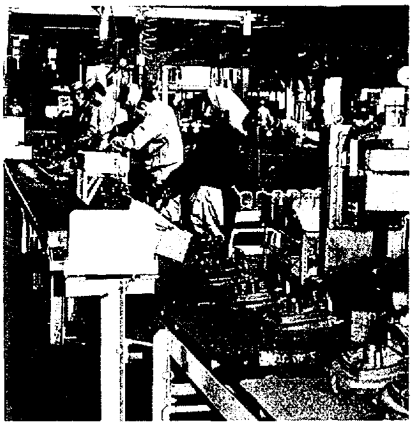
Among water pumps, the small-type centrifugal pumps enjoy a large demand being extensively used, in the fields of agriculture, civil engineering, chemical industry, waterworks, mining and air-conditioning, and for many other industrial purposes.

From the technical point of view, manufacture of pumps of the above type is comparatively easy. Accordingly, centrifugal pumps may constitute one of the industrial fields most suitable for development in newly emerging countries.

Developed through many years of research, centrifugal pumps feature complete standardization, a fact which makes possible a comparatively cheap cost of making while offering high performances.

Process Flow Sheet for Pump Assembling Plant





Assembling shop

Heavy investment would be required to inaugurate such a project if the operator tries to carry out integrated manufacture—from the manufacture of raw materials to pumps.

In this plan, therefore, it is proposed that the interested party makes pumps through machining and assembly of cast materials.

The required investment in fixed assets is estimated to amount to about **$US 476,000** for the building of a plant with a monthly production capacity of 300 – 400 pumps a month.

The above plant belongs to the small-scale plant group in Japan. However, the offered plan has been made with due consideration to enable the plant to smoothly meet the enlarging demand. Furthermore, the plan provides for manufacture of small-type pumps other than planned type as may be required.

The plant is designed to manufacture a total of nine types of pumps, parts of them being provided with common bases (120 units/month):

Self-priming type centrifugal pumps: size 50, 65, 80 and 100 mm—190 units/month (7 hrs. x 25 days)

End-suction small-type centrifugal pumps: size 50, 65, 80, 100 and 125 mm—150 units/month (7 hrs. x 25 days)

Features of Centrifugal Pumps

(1) Keeping favourable efficiency over a wide range of volumes of water, without causing overload.

(2) Small consumption of electric power and cost of fuels on account of high efficiency.

(3) Less troubles on account of the simple mechanism.

The self-priming pump is convenient for use because it does not require any water for priming.

Manufacturing Plan

(1) Some margin has been given in deciding on the size of the plant so as to enable future expansion of the factory.

(2) The equipment for manufacture, which has been selected, is the universal type.

(3) The plan calls for manufacture of single pumps, but not foot valves, instruments, etc.
However, cast materials should be purchased. Ball bearings, packings, bolts, etc. should also be purchased.

Process Description

As indicated in the machining and assembly process flow sheet, the manufacturing process begins from the turning of materials for pulleys, couplings, flanges, etc. at the machining shop.

Machining is followed by inspection, and, in accord with the materials, keywaying, drilling, etc., after which work pieces are stored in a warehouse.

The operation up to the above stage centered on work by machine tools of centered on work by machine tools of various kinds.

Then, the assembly process takes over, with required parts brought out of the warehouse for assembly. The assembled pumps are subjected to performance tests, and they are shipped out after painting and packing.

Locational Condition

Easy procurement of materials from neighbouring areas, and easy transport to the plant.

(1) Easy transport of products from the plant.

(2) Utilization of cheap electric power.

(3) Easy employment of skilled workers.

(4) Easy access to trunk roads and railways.

(5) Easy procurement of a sufficiently large plant site.

Example of Pump Assembling Plant

Table 1: Monthly Production Scheme

(Working hours: 7 hours/day, 300 days/year)

End-suction small-type centrifugal pumps	150
Self-priming type centrifugal pumps	190

Table 2: Required Machinery and Equipment

Description	Specification	No.
1) Vertical lathe (with accessories)	LV 600 mm x 4 – 400 rpm x 7.5 kW	1
2) Engine lathe (with accessories)	LG 750 mm x 20 – 1,500 rpm x 3.7 kW	2
3) Copying lathe (with accessories)	LC 500 mm x 20 – 1,500 rpm x 3.7 kW	1
4) Vertical milling m/c (with accessories)	MV No. 3, 5.5 kW	1
5) Multiple drilling m/c (with accessories)	MD 12 spindles, 3.7 kW	1
6) Tapping and milling m/c (with accessories)	TP DU 1,000 mm radial type	1
7) Slotter	PT Stroke 150 mm Number of strokes 120/min.	1
8) Key miller	MK 300 – 2,000 rpm, 1 kW	1
9) Cylindrical and grinding m/c (with accessories)	GB 800 mm x 250 mm, 2.2 kW	1
10) Testing equipment		1
11) Power receiving equipment		1
12) Others		

FOB price of machinery and equipment ..... (approx.) **$US 476,000**

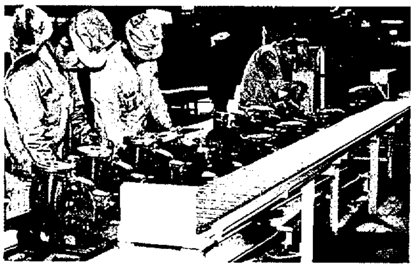


Table 3: Required Incidental Machinery

(Materials & products handling equipment)

1 ton forklift
Hand cart
Others

Table 4: Required Raw Materials and Utilities

Casts............. 190 tons/year

Steel, bolts, ball bearings, etc.

Electric power, industrial water, fuels, etc.

Table 5: Required Manpower

Item	No.
Engineer	2
Skilled worker	7
Unskilled worker	7
Clerical worker	2
Odd job man	1
Total	19

Table 6: Required Plant Site Area

Buildings
Area .... 220 m^2
Height........... 8 m

Note: Buildings are slate-roofed buildings with iron frames.

Substation and others
Area .... 36 m^2
Height........... 3.5 m

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ISIC 383 ELECTRICAL MACHINERY, APPARATUS, APPLIANCES AND SUPPLIES

How To Start Manufacturing Industries

Arc Welding Electrode Making Plant

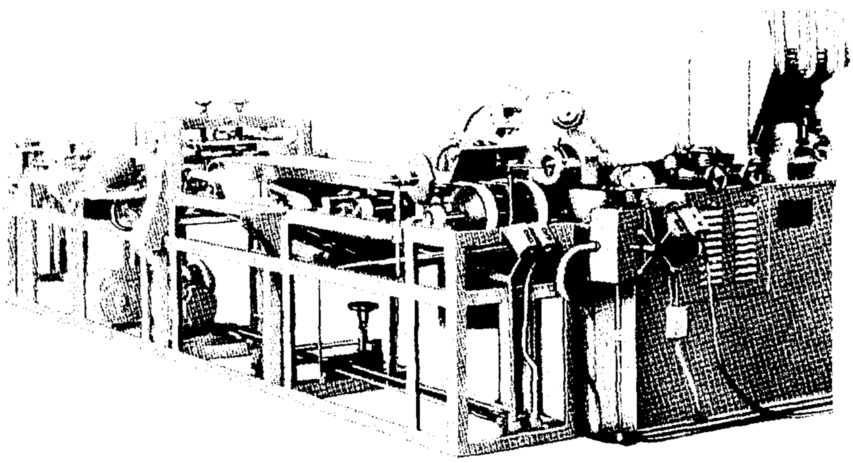
It is generally known that the quantity of steel consumed in a country can be utilized as a barometer for judging the economic growth or level of development of that country. In other words, this means that the iron and steel industry makes a great contribution to the economy of a country.

In a wide range of the related industries, welding material manufacturing is one of the most important sections, and is indispensable for the industry as we can see many welded steel products used for household appliances, bridges, machineries, pipelines, automobiles, railroad equipments, buildings, and so forth.

From this point of view, it is especially recomended to developing countries to construct an arc welding electrode making plant and consolidate their industrial foundation.

Of about 40 different welding processes being used today, arc welding process is the most versatile.

Shown here is a minimum yet highly efficient plant for 150 metric tons of arc welding electrode monthly. (Working hours: 8 hours/day x 25 days/month = 200 hours/month)



Coating unit

Process Description

1) **Descaling**
Mechanical descaler is used for descaling.

2) **Wire drawing**
Wire rod is drawn to a required diameter after descaling.

3) **Straightening and cutting**
Drawn wire is straightened and cut into a length of 350 mm or 400 mm generally.

4) **Flux annealing**
Premixed flux is annealed with a binder. (sodium silicate)

5) **Moulding**
Annealed flux is pressed and moulded into a cylindrical shape to make easier flux charging into extruder at a coating shop.

6) **Coating**
Cut wire is fed from wire feeder and coated with pressed flux in the extruder head. After passing through the coating die the coated electrodes are placed on the conveyor. While the coated electrode is running on the transfer conveyor, the coated flux is removed to make contact with a holder and arc end permitting easy arc striking when start welding. Thus the electrodes shaped are taken out by hand at the end of conveyor with frames.

7) **Drying**
The frames are mounted on a cart. The cart is put into the drying oven where hot air circulates and vaporizes the moisture in the binder.

8) **Inspecting**
Final products are subject to the visual inspection and other specific inspections (actual welding test, etc.).

9) **Packing and shipping**

Raw Materials

1) **Wire rod**
The wire rod to be used in this plant must strictly conform to the following requirements.
Specification: JIS * G3503 SWRY11 (generally 5.5 mm in diameter)
Chemical analysis: C; 0.09% max, Si; 0.03% max, Mn; 0.35–0.65%, P; 0.020% max, S; 0.023% max, Cu; 0.020% max.
(* JIS stands for Japanese Industrial Standard)

2) **Flux**
Flux to be coated on the core wire generally consists of 10–20 different kinds of raw fluxes, for example, rutile, fluorite, silica and iron powder. The origin, particle size and chemical composition of each raw flux determines the operational characteristics and the soundness of the welded metal, therefore, it is recommended to import the pre-mixed flux from Japan for the first one or two years before introducing flux mixing know-how.

3) **Binder**
Sodium silicate (or sometimes with potassium silicate)

Outline of Plant

1) **Production Capacity (monthly)**
150 tons
(working hours: 250 hours/month)

2) **Production Type of Electrode**
JIS D4313 (rutile type, conforming to AWS* E6012/E6013), general purpose electrode with a wide range of applications.
(*AWS stands for American Welding Society)

3) **Production Sizes**

Diameter (mm)	x	Length (mm)
2.6	x	350
3.2	x	350
4.0	x	400
5.0	x	400

4) **Required Manpower:**

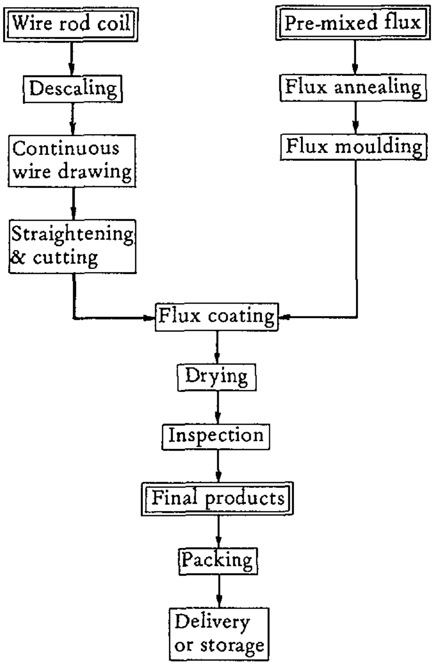
Process	Number
Drawing	2
Straightening & cutting	1
Flux annealing	1
Coating	5
Drying	2
Packing	6
Folk lift	1
Total	18

(Note: The above total does not include the number of supervisors and employees of indirect sections.)

5) **Monthly Requirement of Raw Materials & Utilities**

Wire rod:	115 tons
Pre-mixed:	35 tons
Flux binder:	5 tons
Electric power: (220 V, 60 c/s)	37,500 kW
Water:	250 m^3
Kerosene:	3,400 ℓ

Process Flow Sheet for Arc Welding Electrode Making Plant



Layout for Arc Welding Electrode Making Plant (150 T/M)

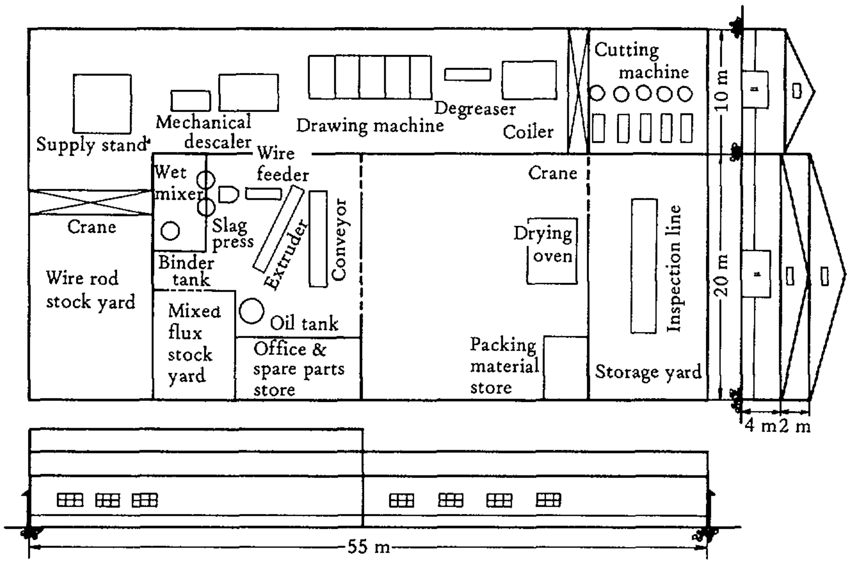


Table 1: Required Machinery and Equipment

Item	No.
Drawing	
Supply stand	1
Mechanical descaler	1
Wire washing unit	1
Degreaser	1
Drying room	1
Drawing machine	1
Pointer	1
Butt welder	1
Straightening & Cutting	
Supply stand	6
Straightening & Cutting machine	6
Flux Annealing	
Annealer (wet mixer)	2
Binder tank	1
Flux Moulding	
Slag press	1
Coating	
Extruder	1
Wire feeder	1
Transfer conveyor	1
Brushing conveyor	1
Drying	
Drying oven	1
Combustion chamber	1
Inspecting	
Eccentricity tester	2
1T hoist crane	2
Fork lift	1
1,000 kV transformer	1
Piping and wiring materials	1
Other (spareparts)	1

FOB price of machinery and equipment .... (approx.) $US 810,000 (excluding the price of land, building and the construction cost)

Engineering fee and know-how fee .... (approx.) $US 48,000 (excluding supervisors fee)

How To Start Manufacturing Industries

Dry Cell Making Plant

Today Japan is the world's second largest producer of dry cells following the U.S.A. and the Japanese-made products are rated first class both in quality and performance.

Today, by far the larger proportion of dry cells in use are manganese dry cells. Where Japan is concerned, for example, some 160 million units are being manufactured monthly for domestic use and for export.

The dry cell is an implement that converts into electric energy, for effective use externally, the free energy decrement caused by a chemical reaction of its constituent elements.

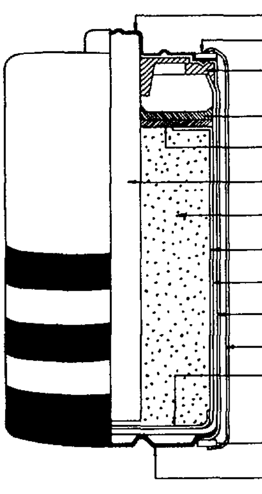
As for the principle of the chemical reaction involved, anodic active material and cathodic active material are mutually isolated and immersed in an electrolytic solution that reacts to generate electricity.

Dry cells meeting international standards for export primarily consist of main three kinds – R20, R14 and R6 which are equivalent to UM-1, UM-2 and UM-3 in Japanese Industrial Standards respectively – designed specifically for the following applications:

R20 (UM-1)
For lamps, radios, tape recorders, toys etc.

R14 (UM-2)
For lamps, radios, tape recorders, clocks and power source for miniature equipments

R6 (UM-3)
For lamps, radios, cameras, calculators, hearing aids and other miniature equipments.



The demand for dry cells has increased tremendously in recent years with the propagation of tape recorders, players and transistor radios in the wake of the development of the home electrical appliance industry.

While the demand for dry cells will differ widely according to the industrial level of the country concerned, the business of manufacturing dry cells appears as a highly promising industry, with production expected to increase rapidly with the propagation transistor radios, tape recorders and other electronic equipment as the living standard improve, not to mention the demand for dry cells for use in flashlights.

In Japan, the dry cell industry is already regarded as an industry in which maximum returns are directly proportional to scale, so the industry is oriented toward large-scale production. Manufacturing systems are being automated to provide the industry with a high potential for further development.

Roughly two processes are available for the manufacture of dry cells – pasting system and paper lined system. The former, an old manufacturing system, primarily consists of manual operations, while the latter or more recent manufacturing system is either semi-automated on fully automated.

Here, an introduction shall be given of a semi-automatic, paper lined system to produce 1 million units each of R20, R14 and R6 dry cells monthly. It is to be noted that the dry cell manufacturing industry is essentially an industry based on the assembling of constituent parts.

Accordingly, in areas where diverse sub-contracting industries proliferate, a comparatively small amount of capital investment will suffice. Otherwise, efforts will have to be directed at procuring the required materials and parts from foreign suppliers or facilities will have to be newly constructed for the manufacture of these materials and parts.

Process Description

As described earlier, two systems are available for the manufacture of dry cells – pasting system and paper lined system.

Basically, the pasting system involves the use of paste to insulate the internal part from external part. In this case, the thickness of the paste will be 1 mm – 2 mm, with the result that the volume of maganese filling will be reduced.

By contrast, a thin sheet of paper is used in place of paste where the paper lined system is concerned, resulting in the manufacture of dry cells displaying larger capacity and output.

The followings are brief explanation on the manufacturing process of the paper lined dry cells:

Assembling process

In assembling process of dry cells, it is used various raw materials and component parts such as electrolytic solution, cathode mix, separator, zinc can, metal jacket and other component parts which are prepared in other manufacturing processes.

Firstly bottom paper which follows separator is inserted into zinc can and this zinc can is fed to cathode mix tamping process where is tamped bobbin is inserted into zinc can.

Electrolytic solution is added and poured to tamped bobbin in the zinc can.

After bending of upper part of separator, paper washer is fitted and carbon rod is inserted into center of paper washer.

Moreover, melted wax is filled over paper washer and polyethylene seal is fitted onto upper part of zinc can. And shrinkable vinyl tube is covered around semi-assembled cell. Negative disc and insulating ring for minus side are inserted into this vinyl tube of bottom side and they are fitted to semi-assembled cell after shrinking by heat. Finally carbon zinc battery is assembled after fitting of cylindrical metal jacket which follows metal top and insulating ring for plus side etc.

Finishing process

This is process of preparation for delivery of aged products. The open and closed circuit voltages of products are examined. And inspected products are inserted in display case and put on anti-corrosive film on products and covered and sealed.

At this stage all processes are completed.

Example of Dry Cell Making Plant

We shall concern ourselves here with a model plant capable of turning out 1 million units of R20, R14 and R6 dry cells, respectively, per month, or a plant having a monthly production capacity of 3 million dry cells.

Operation schedule:

As the plant is designed for single-shift operation, the 8-hour work system is adopted, based on standard plant operation of:

25 days/month, 300 days/year

Note: Tables 1 – 5 are based on the above scheme.

Table 1: Required Machinery and Equipment

Water purifying equipment
Electrolytic liquid making equipment
Compound agent making equipment
Mix dolly making equipment
Assembling equipment
Finishing equipment
Zinc can making equipment
Metal jacket making equipment
Component parts making equipment
Seal injection press
Inspecting equipment
FOB price of machinery and equipment .... (approx.) $US 2,143,000/line

Table 2: Required Raw and Subsidiary Materials

Item	Quantity
Manganese	40 tons/month
Carbon rod	3,000,000 pieces/month
Zinc	39 tons/month

Table 3: Required Utilities

Item	Quantity
Electric power	900 kVA
Water	10 tons/hour
Steam	7 tons/hour
Air conditioning	

Table 4: Required Manpower

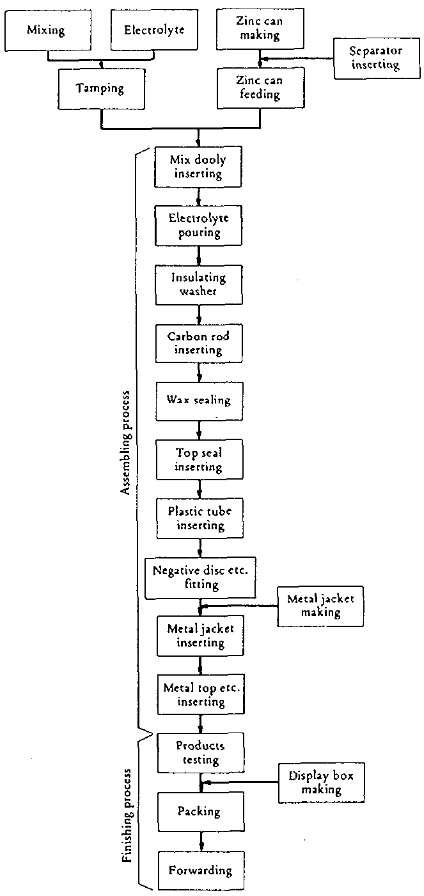
80 direct labours/production line under semi-automatic operation

Total .... 240 – 250 direct labours/three lines

Table 5: Required Area for Plant Site

Building	3,000 m^2
Land	10,000 m^2

Process Flow Sheet

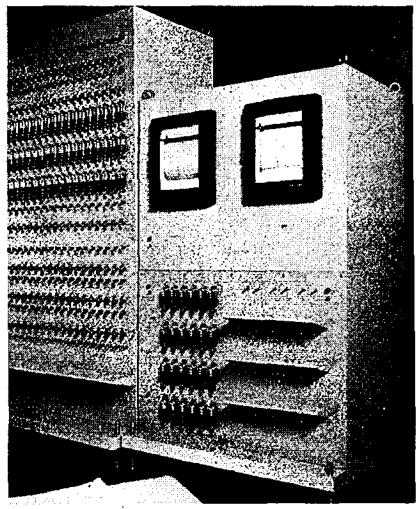


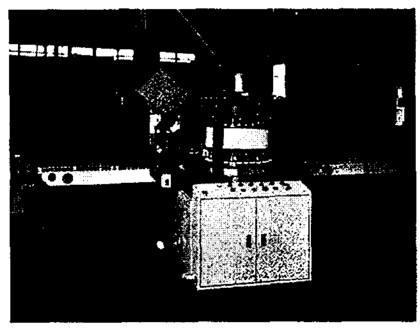
Locational Condition

Climatic and seasonal influences bear heavily on the manufacture of dry cells. Accordingly, a plant site located in some temperate region of more or less 20°C will be the most ideal.

Especially in regions characterized by high humidity or in countries where the temperature is high, the additional use of air conditioning or cooling facilities will be necessary if the required manufacturing conditions are to be wet.

This precaution must be needed particularly in the event the tropical zone is involved. Accordingly, a most careful selection of plant site is recommended first of all when drawing up any plans for the construction of a dry cell manufacturing plant.





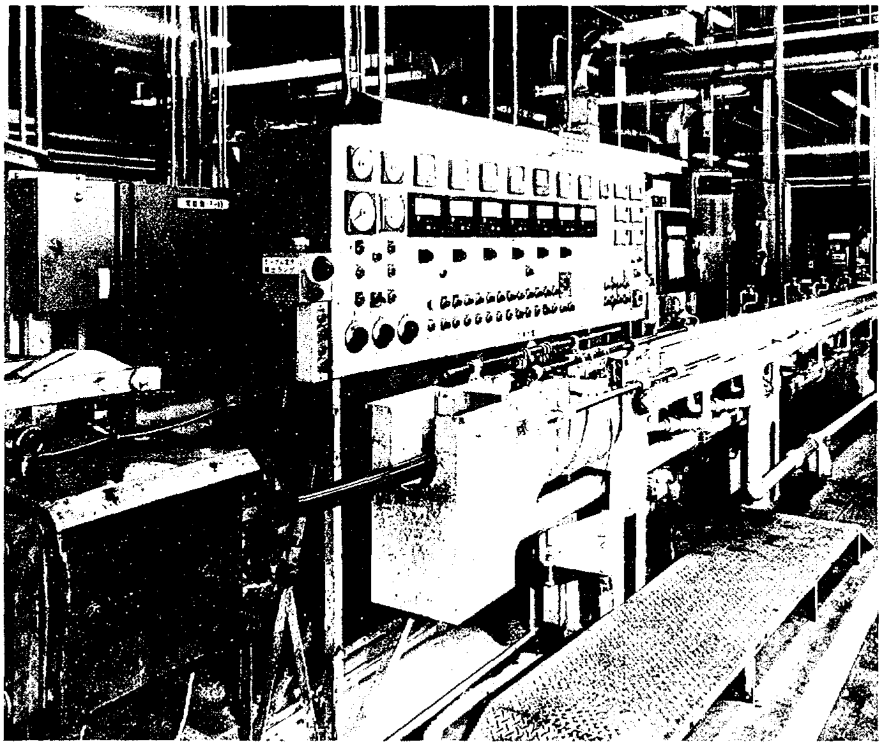
How To Start Manufacturing Industries

Wire & Cable Making Plant

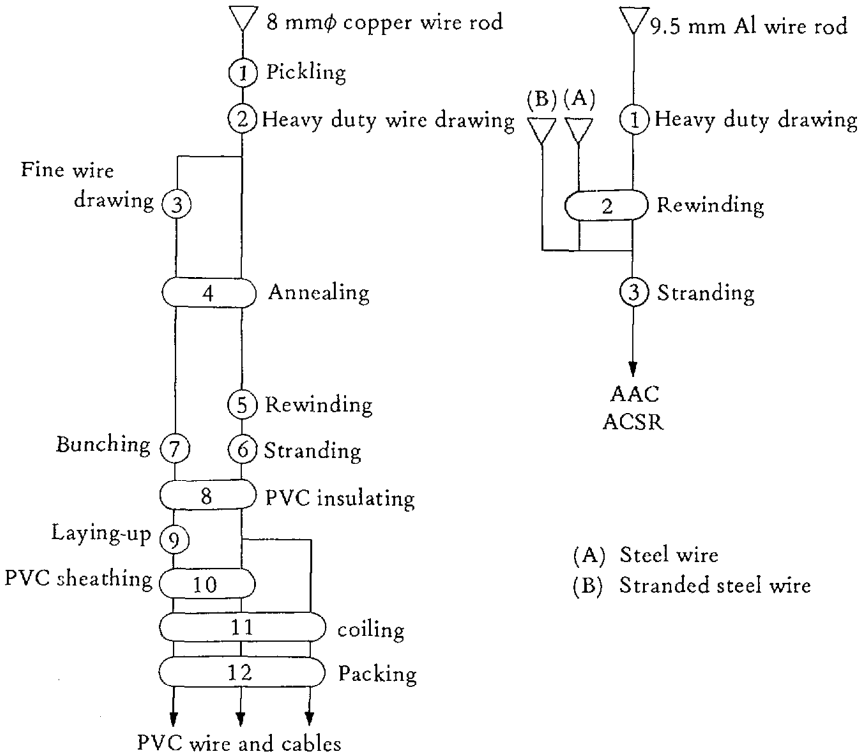
Before designing a plant, it is necessary to conduct a market survey in your country. Generally speaking, the following are possible demands for cables.

(1) Wires and cables required in construction of houses and factories.
(2) Distribution cables (overhead bare Al conductor or underground cables) for construction of new industrial areas and new residential areas.
(3) Power cables for transmission lines, incidental to construction of power generating stations.
(4) Telecommunication cables.
(5) Enameled wires.
(6) Others.

Which of the above wires and cables your projected plant should start with must be determined in consideration of the circumstances in your country. If your plant is to commence its operation on a small scale, we recommend a plant which will first produce chiefly small-size wires and cables in (1) above and, with addition of some more machines, overhead bare Al conductor (AAC and ACSR) in (2).



Process Flow Sheet for Wire and Cable Making Plant



Process Description

The 8 mm-diameter wire rod is first drawn by the heavy-duty drawing machine, and the rod for flexible conductor, is further drawn to about 0.15 - 0.32 mm by the fine wire drawing machine. It is then put in the annealing furnace. The annealed copper wire, either as it is or after being stranded (flexible conductor is bunched), is insulated by the PVC extruder. The insulated core is sheathed or, as in the case of flat wire, 2 - 4 insulated cores are arranged in parallel and sheathed. Sometimes 2-4 such cores are stranded in a circular form and sheathed. In this case, however, this plant cannot do any more than stranding for small-diameter cables by the use of the stranding machine because it does not have a large laying-up machine.

In the production of AAC and ACSR, the 9.5 mm-diameter Al wire rod is first drawn by the heavy-duty drawing

Example of Wire and Cable Making Plant

Table 1: Production Scheme

PVC insulated copper cables			
Single core		$1.5\ mm^2 - 25.00\ mm^2$	
Flat twin		$1.5\ mm^2 - 16.00\ mm^2$	
Flat 3-core		$1.5\ mm^2 - 4.00\ mm^2$	
Flexible cord		$0.5\ mm^2 - 0.75\ mm^2$	
		(Diameters in mm)	
		Steel	Al
ACSR	– Gopher	1/2.36	6/2.36
	– Skunk	7/2.59	12/2.59
	– Wolf	7/2.59	30/2.59
	– Panther	7/3.0	30/3.0
AAC	– Gnat		7/2.21
	– Ant		7/3.10

Table 2: Required Machinery and Equipment

Item	No.
Pickling equipment for copper rod	1 set
Heavy duty drawing machine for Cu	1 set
Heavy duty drawing machine for Al	1 set
Fine wire drawing machine	1 set
Bright annealing furnace	1 set
Rewinding machine for bobbin	1 set
Tubular type stranding machine	1 set
Planetary type stranding machine	1 set
Bunching machine	1 set
65 mm PVC covering machine	1 set
90 mm PVC covering machine	1 set
Coiling machine	1 set
Rewinding machine	1 set
Drum and bobbins	1 lot
Auxiliary equipment	1 set
Testing equipment	1 set

FOB price of machinery and equipment . . . . (approx.) **$US 1,990,000**

Table 3: Monthly Requirement of Raw Materials

Item	Quantity
Copper rod 8 mmϕ	(approx.) 50 tons
Al rod 9.5 mmϕ	(approx.) 25 tons
PVC compound	(approx.) 35 tons
Steel wire	(approx.) 20 tons

machine. ACSR is made by stranding drawn wires on steel wire or stranded steel core by the stranding machine. In the case of AAC, stranding is done all with Al wires without using steel wire.

Required Manpower

The required number differs according to the quality of workers available in the country. The following are the approximate numbers of personnel.

Direct workers . . . . about 50
Indirect workers . . . . about 10

The direct workers include inspectors and the indirect workers include in-plant carrying workers and machinery maintenance workers.

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ISIC 385 PROFESSIONAL, SCIENTIFIC, MEASURING AND CONTROLLING EQUIPMENT, AND OPTICAL GOODS

How To Start Manufacturing Industries

Absorbent Cotton Making Plant

Originally absorbent cotton was developed for the purpose of medical use. At present absorbent cotton is used for sanitary use and in surgical operation as well as for ordinary daily living.

Absorbent cotton is a material which comes in direct contact with the human body, so the quality of absorbent cotton is provided for in the pharmacopoeia of advanced countries.

The Pharmacopoeia of Japan describes absorbent cotton as "the deoiled and bleached tuft of the seed of the cultivated variety of Malvaceae family of plants." The fibre of absorbent cotton is very elastic; it consists of 98–99.5% α-cellulose which has a diameter of 16–30μ and a length of 12–40 mm. The colour of absorbent cotton is not pure white; when piled one upon another, the overlap has a slightly yellowish white colour.

The following points concerning absorbent cotton are provided by the respective item indicating their figures in the Pharmacopoeia of Japan.

(1) Remained acid or alkali
(2) Amount of water soluble substances
(3) Existence of colouring matter
(4) Existence of fluorescent whitening agent
(5) Sedimentation velocity after impregnating with water
(6) Water absorbing capacity
(7) Mixing of other fibres
(8) Degree of nepping
(9) Mixed amount of matters which come from cotton seed
(10) Other foreign matters mixed together

The above points are described in the Pharmacopoeia of Japan. The U.S. Pharmacopoeia and the British Pharmaceutical Codex are also nearly the same.

The smell of fat and soap is due to insufficient deoiling and water-rinsing. The smell of chemicals and mould is due to unsuitable storage.

Absorbent cotton is sterilized in accordance with the provisions in the pharmacopoeia. Ethylene oxide gas is effective for sterilizing and can be included in the plant if desired.

Process Description Based on Before Carding Method

There are two methods of operation: one is automatic and the other is the manual method, in which the facilities are made as simple as possible to keep the production cost low. In view of the simplicity of operation and maintenance, the manual method is taken up in this report.

The cost of the plant becomes much lower by the arrangement of cheaper machines, but this is not a wise policy from the standpoint of smooth operation, quality control of product, maintenance, and life of the machines.

Either virgin cotton or waste cotton can be used as raw material in this plant. Comber waste cotton is desirable in case of waste cotton. In case waste which contains a huge volume of short fibre and impurities is used, these substances should be removed repeatedly. Otherwise, the productivity will be low and the quality of the finished product will be inferior.

1) Opening and cleaning

First, the raw material is cleaned and opened sufficiently in the opening process. In case the raw material contains a lot of short fibre and impurities, this process should be repeated twice.

Next, the raw material packed in a wagon is transported to the filling process. Then, the lumps of cotton are stuffed evenly in a bucket type loose carrier for bleaching machine; water is added, and packing is continued by stamping with the feet. This work is done by manual labour.

2) Filling

The 200 kg of cotton lumps stuffed in the loose carrier are conveyed to the semi-automatic high temperature and high pressure bleaching machine. Without touching human hands, the cotton lumps are treated with chemicals such as caustic soda, hydrogen peroxide or sodium hypochlorite. The scouring and bleaching processes are completed in approximately four hours. In this case, the quality of the treated cotton in every loose carrier is about equal and uniform. Water rinsing, too, must be perfect.

3) Bleaching

There are two methods of manufacturing absorbent cotton: the bleaching before carding method and the bleaching after carding method. In the before carding method, the raw material cotton is bleached and dried first. Then, carding is carried out and the fibre is arranged. This method is employed in Europe. In the after carding method, carding is carried out prior to bleaching and drying. This method is employed widely in Japan.

Each method has respectively its merits and demerits, but the before carding method will be described here.

4) Hydro-extracting

The cylindrical cotton lumps taken out the electrical hoist are conveyed to the hydro-extracting process and is dewatered by the centrifugal hydro-extractor until the water content is approximately to 100% of cotton. The wet cotton is arranged in huge lumps on the stock conveyor for wet cotton of the opening process; and then, opening and drying are carried out automatically. In order to facilitate the subsequent carding process, the dried cotton is further loosened finely by the opening machine for dried cotton.

5) Opening, drying, opening and reserving

The cotton lumps are then sent automatically and pneumatically to the reserving process by a special fan. The cotton lumps are put in a bin which can reserve 500 kg of cotton lumps, and is conditioned thoroughly. By this treatment, the entire cotton lumps are made uniform and retain a suitable amount of moisture.

6) Carding

The cotton lumps which are in almost deoiled state are packed in a wagon and conveyed and supplied to the hoppers of the two carding machines. The 1,800 mm width roller card with metallic card clothing wrapped around it cards the cotton fibre, and produces a uniform web. The 1,800 mm width web is split in two at the outlet of the carding machine, and the split webs which are 900 mm wide of each travels to the same direction on the conveyor, changing its direction by 90 degrees. Accordingly, because there are two carding machines, there will be four webs piled one on top of the other, but the webs are pressed to make one web when they pass through the pressing roller at the outlet of the conveyor, and so they come out as one web.

7) Winding, cutting and packing
When the web is wound as it is in the winding process, a thin but wide lap which is 900 mm wide can be marketed. Depending on use, however, there are winding machines with special cutting devices which can freely prepare cotton tapes which are 20–200 mm wide and which weigh 180–1,200 g/m^2.
These can be selected by the client.

Outline of Plant

A substantial example of an absorbent cotton making plant is given below

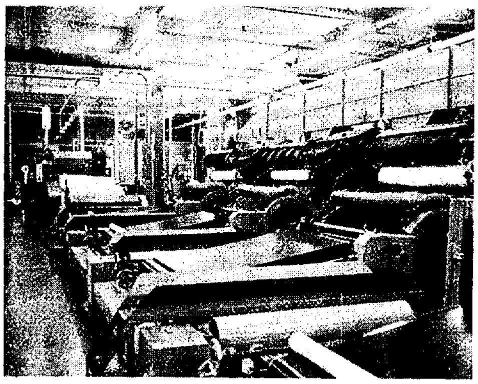
Table 1: Production Scheme

1) Production capacity	10 tons/month (400 kg/day)
2) Working hours	16 hours/day (2 shifts) 25 days/month

Table 2: Required Machinery and Equipment

Item	No. of set
Opening and cleaning unit	1
Filling unit	1
Bleaching unit	1
Hydro-extracting unit	1
Opening (for wet cotton)	1
Drying unit	1
Opening unit (for dried cotton)	1
Reserving unit	3
Carding unit	2
Winding and cutting unit	1
Packing machine	1

FOB price of machinery and equipment ...... (approx.) $US 714,000



Carding process

Required Manpower

Operation is carried out at two shift operation a day. The total number of labour required is 26 including maintenance, quality control, and testing sections.

Raw Material and Subsidiary Raw Materials

The raw material is to be virgin cotton or waste cotton. There will be a loss of approximately 25%, depending on the contents of short fibre and foreign matters; therefore, approximately 13 tons/month of raw material will be required to manufacture 10 tons/month of finished goods.

Various chemicals for bleaching and packing materials are necessary as subsidiary raw materials.

Building

The required floor space for machinery and equipment, excluding the warehouse, the cafeteria, the laboratory, and the dressing room for employees, will be 50 m x 25 m = 1,250 m^2. The height of the building is to be more than 4 m.

Process Flow Sheet for Absorbent Cotton Making Plant, "Before Carding Method"

Raw material
↓
Opening & Cleaning
↓
Filling
↓
Bleaching
↓
Hydro-extracting
↓
Opening (for wet cotton)
↓
Drying
↓
Opening (for dried cotton)
↓
Reserving
↓
Carding
↓
Winding & Cutting
↓
Packing

Auxiliary Machinery and Equipment

The auxiliary machinery and equipment are generally different depending on the scope of the plant to be constructed. Ordinarily, the auxiliary facilities required are as follows:

(1) Air conditioning equipment
(2) Boiler (3 tons/hr., 10 kg/cm^2), 2 sets
(3) River or well water treatment of facilities for fresh water (50 tons/day)
(4) Electric power transforming station (200 kW/hr.)
(5) Testing equipment
(6) Tools

Any inquiry about the information contained should be sent to: IO/COOP, Registry file No. ID/562/12, UNIDO, P.O. Box 300, A-1400 Vienna, Austria.

FILE: R2
ISIC 3851

Sanitary Napkin Making Plant

Sanitary napkin is a product used by women during the menstrual period to treat menstruation. It is one of the daily necessities for women.

Previously, in Japan, absorbent cotton was used for the purpose. But the use of absorbent cotton limited bodily movement considerably.

Because of intensive improvement and progress of sanitary goods after World War II, sanitary napkin is replacing absorbent cotton in many countries today since it is clean and it can be carried around easily, and since it is thrown away after once used.

A plant with integrated production of sanitary napkin which is to be used as sanitary goods for treating menstruation of women will be described here.

The manufacturing machinery and manufacturing processes of sanitary napkin will differ depending on the raw materials used, the shape of finished product, the size, etc. Therefore, there is no fixed method of manufacturing and processing.

Generally absorption paper, waterproof paper, crushed pulp, and nonwoven cloth or rayon paper are used as raw material.

The prime requisite of sanitary napkin as a product is cleanliness. Sanitary napkin must also meet the following conditions:

(1) It must have good absorption, and the retention must be great.
(2) It must be strong against leak.
(3) It must have a fine feeling to the touch, and it must not stick to the skin.
(4) It must have stability and adaptability to bodily movement.
(5) It must not break or get out of shape.

In order to manufacture sanitary napkin which is hygienic and highly functional it is necessary to select the proper kind of material for the chosen type of finished goods, and also the right sort of machinery should be selected to get the expected result.

A model plant based on machinery and equipment for manufacturing ordinary sanitary napkin will be given here.

Production Capacity

Assuming that the plant is operated 8 hours/day x 25 days/month to manufacture the product shown in Fig. 1, the production capacity per machine will be 3,600,000 pieces.

Note: There will be some difference depending on the quality of raw material which will be procurable locally.

1) Main Machinery and Equipment
Sanitary napkin manufacturing machine . . . . 1 set
FOB price
. . . . (approx.) $US 119,000

2) Auxiliary Equipment
(1) Small coveyor
(2) Hoist
(3) Sealing machine
(4) Others

Note: The auxiliary equipment will differ depending on the number of sanitary napkins which are packed in a box or a polyethylene package.

3) Required Manpower
Direct worker . . . . 15 persons

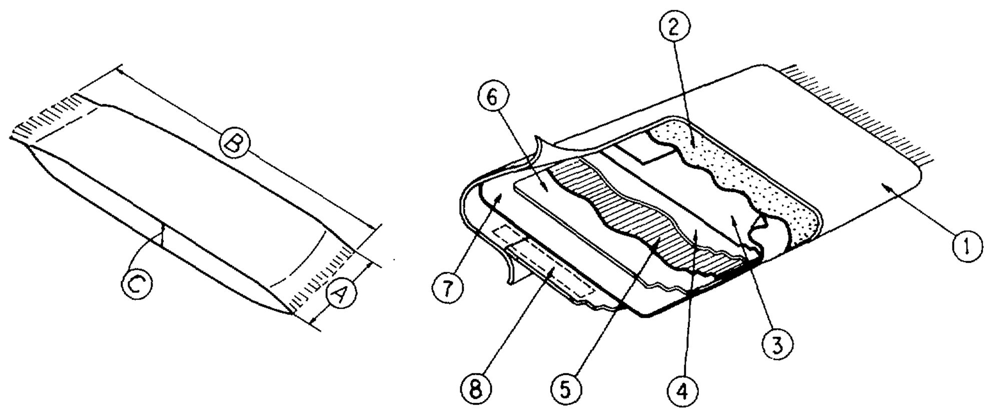
4) Required Area for Plant Site
Building . . . . 800 m²

Suggestions

Thorough survey and study should be done in advance concerning the things listed below before beginning construction of the plant.

(1) There must be a good prospect in the demand of the goods.
(2) The site must be conveniently located for transportation and sales of the goods.
(3) Suitable raw material must be easily procurable.
(4) Cheap and abundant labour should be available.
(5) The product must be competitive with imported goods.

Fig. 1: Composition of Sanitary Napkin



Ⓐ Width: 70 mm
Ⓑ Length: 190 mm
Ⓒ Thickness: 8 mm or more
Weight: ± 6 g

① Rayon paper for surface
② Rayon paper
③ Water resisting paper
④ Crushed pulp (roll pulp)
⑤ Absorption paper
⑥ Water-proof paper
⑦ Laminated paper
⑧ Adhesive tape

Fig. 2: Layout for Crushed-Pulp Type Napkin Making Plant

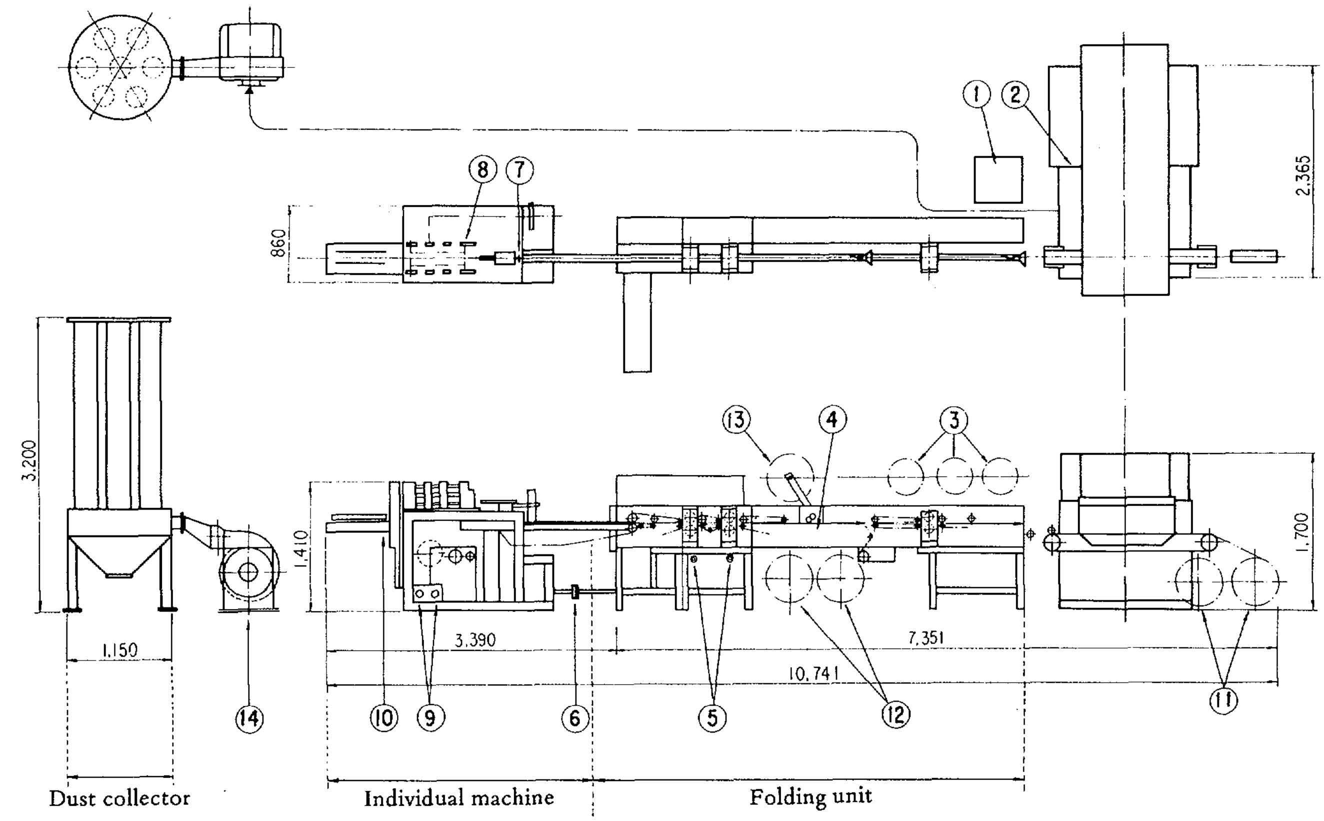


Table 1: Required Raw Materials for Crushed-Pulp Type Napkin

Materials	Standard size of materials	Roll		Required quantity for 3 months	Required quantity per napkin	
		Diameter	Weight		Dimension	Weight
1) Rayon paper for surface 2) Rayon paper	175mm x 1,000m x 2 ply [Item 1) + 2)]	550mm	6.84kg	1,750 rolls	175mm x 190mm	1.19g
3) Water resisting paper	175mm x 1,400m	450mm	4.17kg	5.0 tons	175mm x 160mm	0.48g
4) Roll pulp	960mm x 600m	1,000mm	380.00kg	30.0 tons	65mm x 160mm	2.94g
5) Absorption paper	175mm x 800m	500mm	3.50kg	7.5 tons	175mm x 160mm	0.70g
6) Water-proof paper	105mm x 525m x 2 ply	450mm	2.76kg	9.0 tons	105mm x 160mm	0.84g
7) Laminated paper	65mm x 1,000m	360mm	1.69kg	1,700 rolls	65mm x 160mm	0.27g
8) Adhesive tape	40mm or 45mm x 500m	260mm	3.50kg	400 rolls	40mm x 10mm	0.08g
9) Polyethylene film	205mm x 1,500m	270mm		750 rolls	205mm x 101.6mm	

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How To Start Manufacturing Industries

Water Meter Making Plant

The demand for living water, industrial water and water for various other purposes is increasing steadily throughout the world due to higher living standards and greater development of various industries. And to meet surging demands for water, countries all over the world are now faced with the necessity of developing new sources of water, also with the need to devise measures permitting reuse of water, conservation of water, and utilization of water more effectively and efficiently.

The water meter introduced here enables the volume of water used by general households to be grasped addurstely, and will allow for a more effective and efficient use of valuable water.

Today, where water meters are concerned, the world's countries may be divided into countries where water meters are still unused, countries where water meters are used only in large blocks of users, and countries in which water meters are provided with each household.

In the United Kingdom, for example, the block water meter system is adopted. Namely, the volume of water used by a block of households is measured with a single water meter, with the water service charge divided evenly by the households comprising the block.

Where this particular system is concerned, there is the problem of water being used in different volumes by the households concerned, with the result that grievances are raised on the service charges to be borne by each household.

To cope with the situation, the use of water meters was tried out experimentally in the United Kingdom. The results of the experiment showed that when water meters were provided separately by households, the volume of water consumed decreased conspicuously by roughly 30% as compared with when water meters were provided by residential blocks.

The experiment is a good illustration that the use of a water meter in each household not only permits an accurate recording of the actual volume of water used by the household concerned but also leads to conservation of water, or to far better utilization of water.

Process Description

The water meter essentially consists of the upper case and the inner parts.

As for the process of manufacture of water meters, the upper case is first produced in a foundry, with the upper case produced here further machined in the machine shop. In the machine shop are produced a number of other parts necessary for the water meter as well as for other purposes.

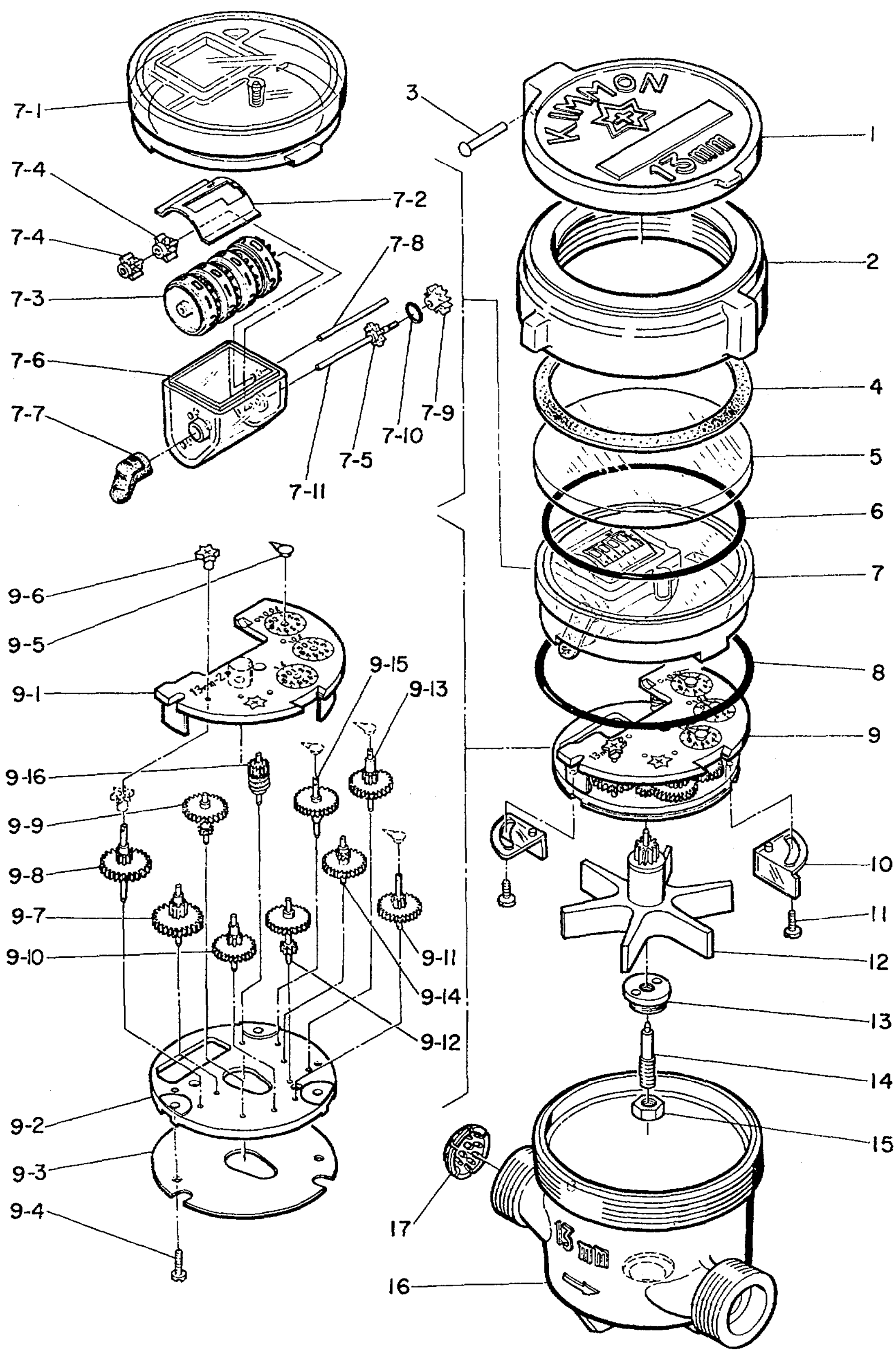
Meanwhile, plastic moulding is done in the plastics shop to produce the inner parts of the water meter, which are mostly plastic parts. Next, the upper case and its inner parts are assembled together to obtain the water meter in the assemly shop.

Water meters produced in this manner are then inspected and tested, with the meters passing these tests painted in painting shop to obtain the finished product.

Table 1: Required Machinery and Equipment

Item	No.
1) Foundry factory	
Low frequency induction furnace	2 sets
Sand reclamation equipment	1 set
Sand moulding machine	1 set
Shell core moulding machine	1 set
Band saw	1 set
Shoot blusting machine	1 set
2) Machining factory	
Bench lathe	1 set
Automatic lathe	5 sets
Single purpose machine	4 sets
Milling machine	3 sets
Automatic threading machine	4 sets
Precision lathe	4 sets
Bench drilling machine	3 sets
3) Plastic moulding factory	
Injection moulding machine	2 sets
Hot printing machine	2 sets
Bench lathe	1 set
Automatic tapping machine	1 set
Bench drilling machine	1 set
Ultrasonic cleaner	1 set
4) Assembling and testing factory	
Supersonic welder	1 set
Liquid filling equipment	1 set
Testing equipment	
a) Tanks and bench 500 liters	3 sets
b) Tanks and bench 120 liters	1 set
Leakage testing equipment	1 set
Spray unit	1 set
Water booth with purifying equipment	1 set
Air compressor	2 sets
Bench drilling machine	2 sets
5) Inspection section	
Single purpose gauge	80 kinds
Measuring gauge	12 kinds
Leakage test equipment	1 set
Air compressor	2 sets
FOB price of machinery and equipment	(approx.) $US 4,048,000

MODEL PART ILLUSTRATION



The processes involved in the manufacture of water meters is shown in the accompanying process flow diagram.

Example of Water Meter Making Plant

1) Production Capacity
Here, an introduction shall be given of a water meter making plant designed with a production capacity of 50,000 pieces of water meters having gauges of 13-mmϕ, 20-mmϕ, and 25-mmϕ.
By gauge, the meters will be produced in the following volumes:
13-mmϕ water meter . . . . 42,500 pcs./year
20-mmϕ water meter . . . . 4,500 pcs./year
25-mmϕ water meter . . . . 3,000 pcs./year

2) Operation Schedule
The plant is designed for operation under an 8 hours/day schedule for foundry operation, machining operation, assembling and testing operation and inspection section. The plastic moulding operation is designed for 24 hours/day.
8 hours/day:
Foundry factory, Machining factory, Assembling and testing factory, Inspection section
24 hours/day:
Plastic moulding factory
25 days/month, 300 days/year

Note: Tables 1 – 5 are based on the above scheme.

Table 2: Annual Requirement of Raw Materials

Item	Quantity
Bronze	
BC6 ingot	116,000 kg
Zn ingot	5,000 kg
Phospheric copper	500 kg
Stainless steel	1,600 kg
PBB bar	1,300 kg
PBB wire	28 kg
BsMB	640 kg
Ebonite	900 pcs.
Fibres	200 pcs.
Plastics	
ABS natural	1,750 kg
ABS blue	1,250 kg
ABS black	325 kg
AS clean	3,500 kg
AS white	1,125 kg
AS natural	1,000 kg
POM natural	125 kg
PE red	125 kg
PE natural	200 kg
POM blue	275 kg
Others	
Paint	640 kg
Adhesive	1 kg
Register liquid	350 liters
Varnish	250 liters

Table 3: Required Utilities

Electricity	150 kVA

Water will be required only for drinking sanitation and testing tanks purposes, and fuel will not be specially required.

Table 4: Required Manpower

Section	Manager	Worker	Total
Foundry	1	15	16
Machining	1	17	18
Plastic moulding	1	12	13
Assembling and testing	1	13	14
Inspection	1	5	6
Total	5	62	67

Table 5: Required Area for Plant Site

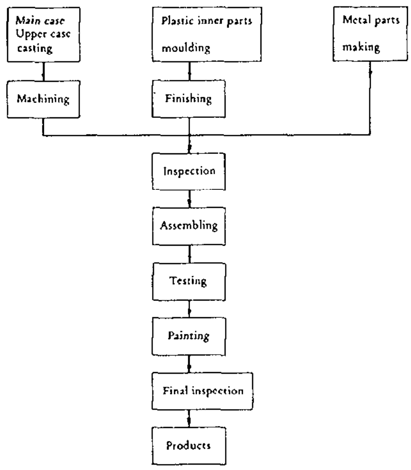
Building		2,592 m^2
Foundry factory	18 m x 36 m = 648 m^2	
Machining factory	18 m x 36 m = 648 m^2	
Plastic moulding factory	18 m x 24 m = 432 m^2	
Assembling and testing factory	18 m x 24 m = 432 m^2	
Inspection section	18 m x 24 m = 432 m^2	
Land		(approx.) 12,000 m^2

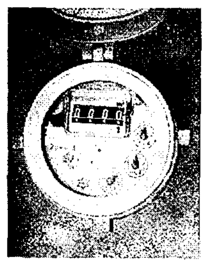
Note: The building should be of light gauge section structure with slated roofing.

Locational Condition

As this plant is designed with a frequency induction furnace for foundry, there will hardly be any fear of environmental disruption. In general, any location near sales markets and easy to gain a higher labours shall be suitable.

Process Flow Sheet for Water Meter Making Plant





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ISIC 390 OTHER MANUFACTURING INDUSTRIES

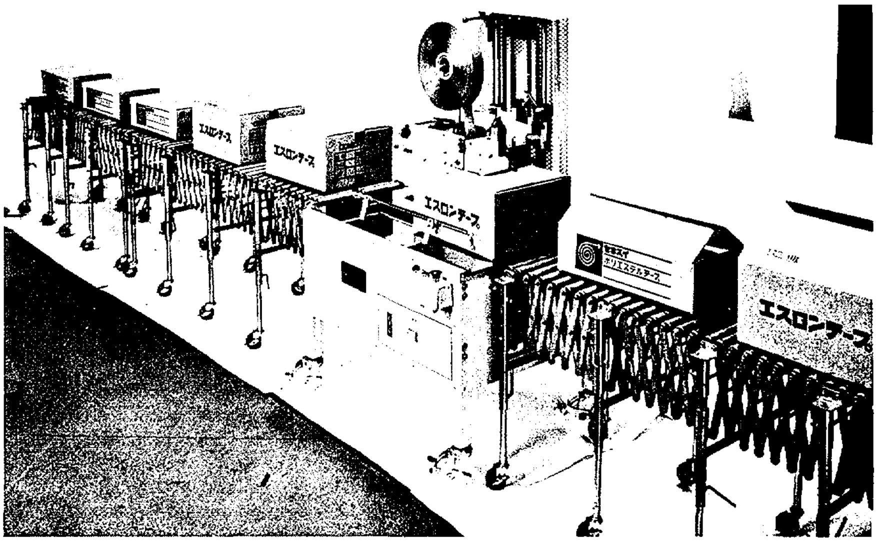
How To Start Manufacturing Industries

Cellophane Tape Making Plant

Cellophane adhesive tape was produced as a first adhesive tape, more than 30 years ago, in Japan and, since then, many other kinds of adhesive tapes have also been developed and produced such as soft-PVC tape, cloth tape, kraft-paper tape, OPP tape and so on. With its convenience in modern life, these adhesive tapes have now been widely used in such various fields as packaging, electric insulation, in business, pharmaceutical and other industrial use. Table 1 shows annual production of various adhesive tapes in 1976 in Japan.

These adhesive tapes are designed to have adhesion in a normal state and to maintain adhesive property after having been attached with only light finger pressure, so they should be called formally "pressure sensitive adhesive tapes."

All adhesive tapes are made by a considerably similar method; by coating adhesives on the various material webs such as cellophane or plastic films; drying of solvent in adhesives;



Cellophane tape packing machine

Fig. 1: Structure of Cellophane Tape

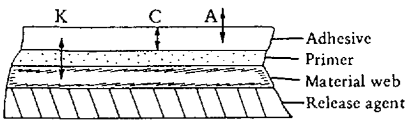


Fig. 2: Process Flow Sheet for Cellophane Tape Making Plant

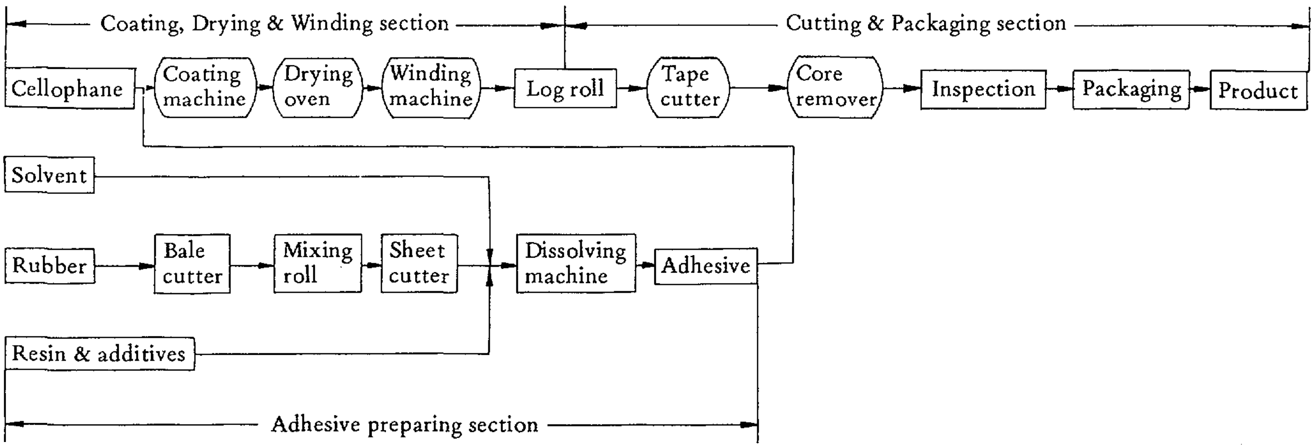
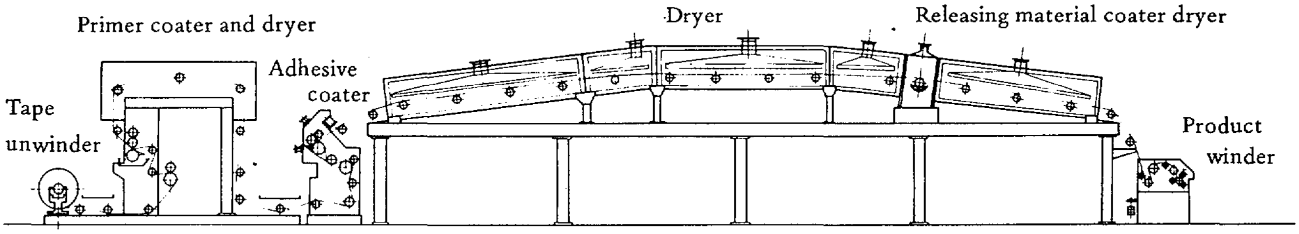


Fig. 3: General Arrangement for Cellophane Tape Making Plant



winding into log rolls with a certain length and cutting into pieces in a certain width.

Process Description

The standard manufacturing process of adhesive tape consists of three sections: adhesive preparing section; coating, drying and winding section; and, cutting and packaging section.

1) Adhesive preparing section
Adhesives are prepared by mixing and dissolving of rubber, tacky resins and additives in solvent. Rubber is cut into blocks with a bale cutter, kneaded with a mixing roll and cut into small strips with a sheet cutter. Rubber strips, tacky resins and additives are dissolved thoroughly in solvent with a dissolving machine. The adhesive thus made is then sent to a storage tank ready to be fed to a coating machine after filtering. Primer and release agent are also prepared in this section.

2) Coating, drying and winding section
Cellophane film is unwound and sent to a coating machine, where adhesive is coated on the film. The coated film is then led through a drying oven, where solvent is evaporated by hot air. After drying, it is wound into rolls with predetermined length. Only this section is continuously operated in two or three shifts. In a bigger plant, it is advisable to install a solvent recovery equipment to recover the evaporated solvent to use again.

3) Cutting and packaging section
Log roll, that is semi-finished product, is cut into pieces in a certain width with a cutting machine. These pieces of adhesive tape are inspected and packed into finished products.

Table 1:

Kind	(million m^2/year)
Kraft tape	253
Cellophane tape	97
Paper tape	60
Cloth tape	47
Plastic tape	
PVC	55
OPP	26
Others	11
Double-faced tape	14
Miscellaneous	8
Total	571
Sales amount (million $/year)	252

Typical structure of adhesive tape, that is cellophane tape, is briefly shown in Fig. 1.

Adhesion "A" is an adhesive force between adhesive layer and the object to be attached. Cohesion "C" is an intermolecular force of adhesive layer, and anchor "K" is an adhesive force between adhesive layer and material web. These forces are required to be:

$$K > C > A$$

and this is the reason we can unwind adhesive tape without any deposit of adhesive on the backside of tape or breaking of adhesive layer, before use. In order to manufacture a good adhesive tape, it is necessary to satisfy the above-mentioned condition and also to select excellent compositions of primer, adhesive and release agent.

Cellophane adhesive tape is very popular and simple. It has so many advantages in transparency, strong adhesion, balanced tensile strength and elongation, moderate cost and so on, in comparison with various other adhesive tapes.

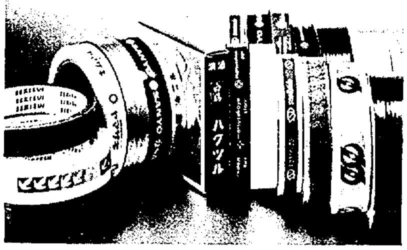
Table 2: Required Machinery and Equipment

Item	No.
Bale cutter	1
Mixing roll	1
Sheet cutter	1
Dissolving machine	1
Storage tank	2
Coating machine	1
Tape cutter	4
Core remover	2
Accessories	1
Inspection equipment	1

FOB price of machinery and equipment .... (approx.) $US 467,000

This price does not include the following items:

(1) Utility equipment
(2) Foundation and installation works and materials
(3) Piping and wiring works and materials
(4) Solvent recovery equipment
(5) Know-how fee and/or royalty



Cellophane tape (small size)

Outline of the Economical Plant

Production capacity of 100,000 m^2/month (24 hours/day x 25 days/month) is considered to be a minimum economical scale of cellophane tape plant.

Tables 2, 3, 4 and 5 show respectively the machinery and equipment, raw materials and utilities, manpower, and plant site area for the above-mentioned plant.

Table 3: Monthly Requirement of Raw Materials and Utilities

Item	Quantity
Cellophane	120,000 m^2
Adhesives	15 tons
Steam	100 tons
Electricity	30,000 kWh

Table 4: Required Manpower

Item	No.
Engineer	1
Skilled worker	5
Unskilled worker	24
Clerical worker	3
Total	33

Table 5: Required Plant Site Area

Item	
Building area	800 m^2
Required land area	2,650 m^2

Buildings where solvent is used and treated should have fire-proof construction.

How To Start Manufacturing Industries

Pencil Making Plant

Pencils are indispensable for our daily lives. Other writing implements do not possess the pencil's unique characteristics of letting us erase and rewrite what we have written. Trial and error will help us grow as a human being. We trust that pencils will always have their particular role in the future.

1,000 million pencils were produced in Japan in 1976, making the country the world's second largest producer after the United States. 10 percent of them was exported and the remaining 90 percent was consumed domestically. This means that the annual consumption of pencils was nine pieces a person (900 million of pencils/100 million of population) in Japan.

All kinds of pencils are produced in Japan, such as black lead pencils including a high quality pencil ranked with the best pencils in the world, coloured lead pencils in a great number of variety, copy pencil, water colour pencil, erasable colour pencil, small pencil for pocket note book, etc.

The Japanese technique for pencil manufacturing plant is available for overseas clients in full automatic system. The plant can also be adapted for such purposes as a household industry where more manual labour is used, and any kind of pencil required can be produced.

An integrated pencil manufacturing plant is independently divided into three divisions: pencil lead making plant, saw mill, pencil making plant.

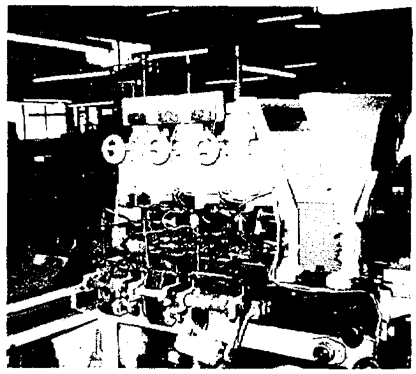
The pencil lead making plant should be equipped with a furnace for the baking of lead, which requires a large amount of investment. In addition, high level of manufacturing technique is necessary.

The saw mill also needs a big investment and its production capacity is too big for domestic demand in general. If there is a saw mill on the spot, the matter is simplified because the mill can be utilized to advantage. All that would be left to be installed are machines and equipment for cutting wood blocks to slats and equipment for subsequent processes, namely, deresination, colouring and paraffin soaking, and drying.

The pencil making plant consists of the following processes: making uncoated pencils, lacquering, stamping, attaching of eraser, final treatment, and packaging.

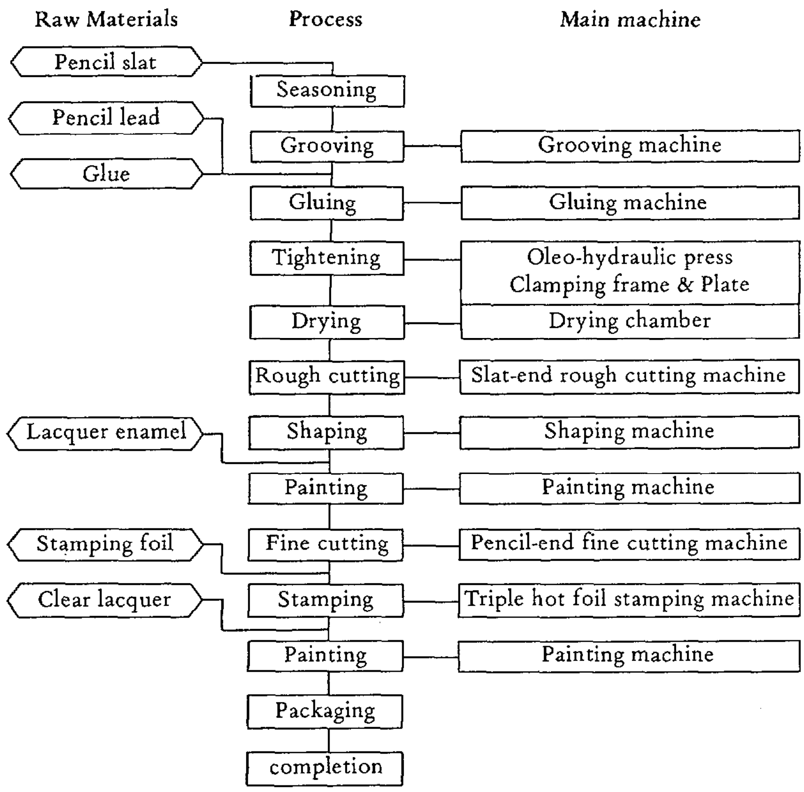
In starting a pencil industry newly, it is recommended that initially only the pencil making plant should be established.

As for raw materials, it would be better to import completely manufactured pencil slat, lead, and lacqure enamel until the business is on the go. Then imported items should be switched gradually to domestic materials one by one, starting with items for which domestic materials can be used safely. Essentially, it is desirable that timber of a quality suitable for pencil making should be available locally.



Stamping machine

Process Flow Sheet for Pencil Making Plant



Special machines	Sub machines
Eraser tipping machine	Exhaust fan
Packaging machine	Cutter grinder
Dipping apparatus	

Process Description

1) Woodworking process

The pencil slat is shaved into a fixed size, and a semicircular groove is made on the surface with a grooving machine.

The grooved slat, which is half a pencil, is coated with glue and the leads are placed in the groove and then covered with a second slat. The resulting block is tightened with iron frames and dryed in a drying chamber. The dryed block is passed through a shaping machine that shapes the raw pencils.

2) Lacquering process
The raw pencils are then lacquered in a painting machine which is made to apply three to ten times of lacquer coating depending on the quality of finish desired.

3) Final treatment
After the final coat of lacquer, the pencils are placed in heading and sizing machine (pencil-end fine cutting machine) which sands off excess wood and paint from the ends of the pencils and trims the pencils to their exact finished length. The tipping process for making eraser tipped pencil consists of several steps. First, the pencils are sent to a rounding-off and sharpening machine. This machine rounds the end of the pencil to just the right diameter to receive the ferrule. The ferrule and the eraser are fitted to the pencil and, with the aid of a punching device, steel needless are plunged through the ferrule to pierce the ferrule to both pencil and eraser.
The manufacturer's brand name, the hardness number of lead, and any other desired information are imprinted on the pencil by means of a stamping machine.
The finished pencils are then inspected and graded, and are packaged first in one dozen packs, and then in bigger one gross cartons.

Incidental Machinery and Equipment

The incidental machinery and equipment which would be locally procurable include cyclon, duct and others.

Table 1: Required Machinery and Equipment

Item	No.
Woodworking line	
Automatic grooving machine & feeder	1
Automatic gluing machine & connector	1
Oleo-hydraulic press	1
Clamping frame & plate	500 sets
Automatic slat-end rough cutting machine and feeder	1
Automatic shaping machine & connector	1
Cutter grinder	1
Glue stirrer	1
Exhaust fan	1
Painting process	
Automatic painting machine & conveyor system	4
Lacquer stirrer	1
Final treatment	
Automatic pencil-end fine cutting machine	1
Automatic triple hot foil stamping machine & connector	1
Automatic eraser tipping machine	1
Exhaust fan	1
Foil cutter	1
Spare parts (cutter, etc.)	1 set
Inspecting apparatus	1 set

FOB price of machinery and equipment ..... (approx.) $US 238,000

Table 4: Required Plant Site Area

Item	
Office, factory, & warehouse	1,000 m^2
Warehouse for combustible materials	30 m^2
Drying chamber	60 m^2
Required land area	3,000 m^2

Table 2: Annual Requirement of Raw Materials and Utilities

Item	Quantity
Pencil slat	150,000 gross
Lacquer enamel	2,850 kg
Black lead	128,800 gross
Coloured lead	25,800 gross
Foil	550 rolls
Glue	8,300 kg
Ferrule	25,750 gross
Eraser	25,750 gross
Dozen box	154,500 gross
Gross box	154,500 gross
Sub materials	150,000 gross
Electric power	200,000 kWh
Water	small amount

Table 3: Required Manpower

Item	No.
Engineer	2
Skilled worker	6
Unskilled worker	30
Clerical worker	8
Odd job man	2
Total	48

Example of Pencil Making Plant

In this case the variety of pencils includes: (1) 9H - H, F, HB, B - 6B; (2) eraser tipped HB, and (3) coloured lead pencil of 12 colours and that for business use in vermillion and prussian blue.

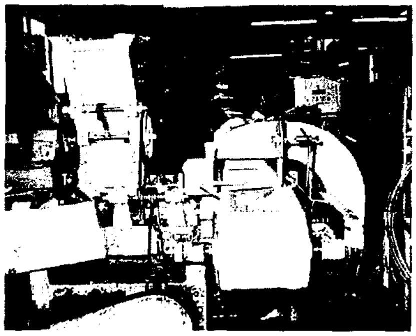
Production capacity is 500 gross/day, namely, 150,000 gross/year (8 hours/day x 300 days/year). Detailed annual production is as follows:

Ordinary	100,000 gross
Eraser tipped	25,000 gross
Colour	25,000 gross

Tables 1, 2, 3 and 4 show respectively the machinery and equipment, raw materials and utilities, manpower, and plant site area required for the above projected plant.

How To Start Manufacturing Industries

Sign Pen Making Plant



Stamping machine

Sign pen is a sort of writing tool called marking pen. It is, together with pencil, pen, ball point pen, and mechanical pencil, one of the most widely used writing tool.

Using felt tip and oily, quick drying ink, the marking pen was put on the market in 1951 as a writing tool. This felt tip pen was called felt marker. The felt marker has a broad writing tip and is used for writing on paper as well as glass, wood, plastics, cloth, metal, painted surface, and almost any other sort of material. Moreover the writing is water-resistant and will not go out easily; therefore, it has rapidly gained popularity as a convenient marker.

Research of a pencil type or fountain pen type fine-writing marking pen was made, developed, and put on the market in Japan in 1961. This marking pen was called sign pen. Sign pen is used mainly as a writing tool for writing on paper. It is suitable for writing letters, signing, taking memos, drawing graphs, and writing addresses on envelopes, and it can be used in the same way as a pencil, fountain pen, or a ball point pen. It has a light touch, and it is cheap; therefore, it has rapidly gained popularity as a writing tool. As a marking pen, it now ranks on the top.

Sign pen started with fine-writing water-ink type pen. Later, water-resistant ink sign pen, fine-writing oil-ink sign pen, extra fine-writing sign pen, medium-broad nib sign pen of various colours for artists, sign pen for the electronic computer, sign pen of various colours for projectors, vinyl colour which can be erased easily with a wet cloth when written on a vinyl board or white board, fluorescent ink sign pen for underlining, and sign pen for special purposes have been developed and put on the market to meet the demand of users.

As you can see from the above description, there are all sorts of sign pen now. All sorts of ink are being used, and the nib also is made of various kinds of fibre or are moulded. These are used suitably in various combinations.

Although sign pen and felt marker are different products, there are all sorts of sign pen on the market now and felt marker has been improved, too, so the standard for distinguishing between the two has become difficult.

Approximately 700 million marking pens were manufactured in Japan in 1976, and the production is growing year after year. Approximately 70 percent have been water-ink marking pen and approximately 30 percent have been oil-ink marking pen. 40 – 50 percent of sign pen produced in Japan are exported to more than 120 countries.

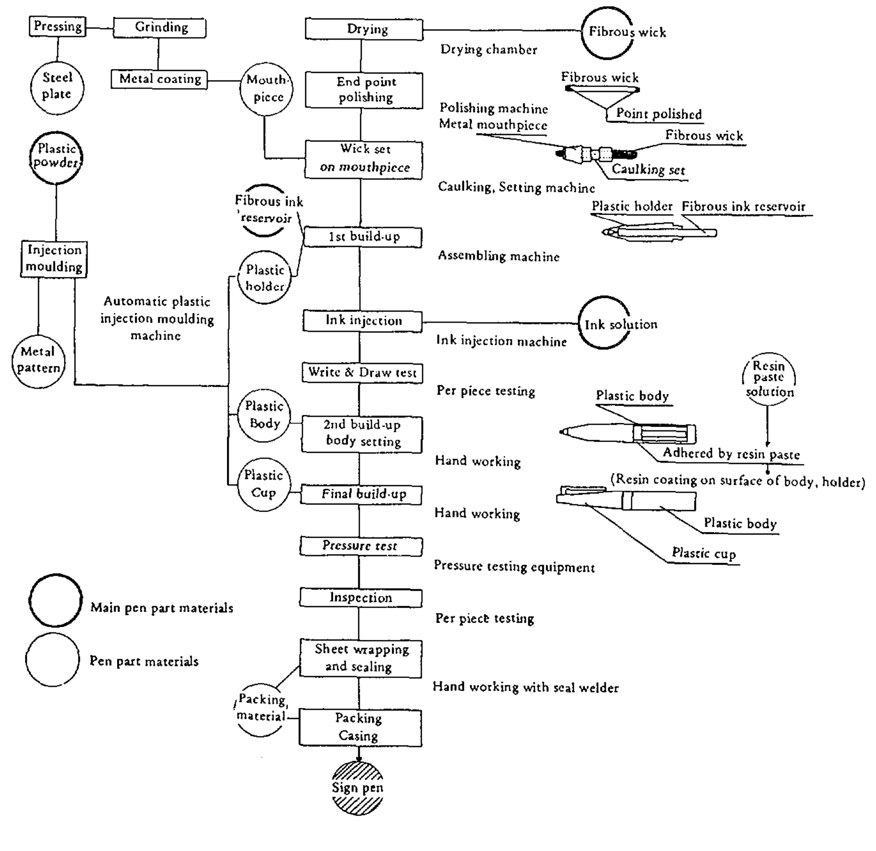
The construction of a sign pen is as follows: A wick saturated with ink is inserted in the core of the pen holder, and the root of the nib is inserted in the wick. The ink will flow from the wick to the nib. The cap should be attached securely to the pen holder so that there will be no drying of the ink.

The nib is made of bundled fibre with sharpened end or of Delrin moulded goods, and is used for bold writing, medium writing, fine writing, or extra-fine writing.

The wick is made of felt or cut synthetic fibre. It is wrapped in a vinyl tube. There are various sizes and shapes.

The general colours of ink are black, red, and blue. Besides, there are six colour set and twelve colour set for

Process Flow Sheet for Sign Pen Making Plant



artists. There are all sorts of ink: water, oil, water-resistant, etc.

The pen holder can be broadly classified into the pencil type and the fountain pen type, and each marker has his own distinctive design (material, shape, size, etc.). Generally, the pen holder used for sign pen is cheaper than that used for fountain pen. Extruded plastic is used for the holder of cheap pencil type sign pen, and injection moulded plastic is used for the holder of high class pencil type or fountain pen type sign pen.

Frequently, metal is used to attach the nib. This metal is brass, and it is formed by a press or a lathe and then plated.

When attaching a clip to the pen holder the whole thing is injection moulded, or only the holder is moulded first and a metal clip is attached afterwards. The whole matter is decided by design policy of the pen holder.

When all the parts for the sign pen are gathered the wick is saturated with ink and is inserted in the holder, the nib is attached to the wick, and the holder is sealed and capped. A sign pen has been completed. The assembly can be done manually and does not require any special machine. If there is need of saving labour, a special automatic assembling machine which will conform to the shape of the holder should be ordered to be manufactured. This automatic assembling machine is designed and manufactured in accordance with the shape of the holder, so the cost will differ depending on the holder.

Self-made ink is possible. The manufacturing equipment is simple, but there is a know-how for manufacturing ink and a fee is necessary for this know-how.

Self-making of the nib and wick is unsuitable. It would be better to purchase ready-made products.

The pen holder can be self-made by purchasing a plastic injection moulding machine or an extruder. This, however, would become a plastic moulding industry, and all sorts of supplementary equipment would be necessary. A large investment in the facilities would be required. Therefore, in the beginning, it would be better to import the pen holder in a knock-down state or order a plastic moulding plant in one's own country to have the part be made to order. When making the holder in one's own country, a hot stamping machine would have to be installed in order to stamp the brand and other indications on the surface of the holder. Also, if metal parts are used for attaching the metal clip or nib, it would be more economical to utilize metal press plants or automatic lathe plants and plating plants in one's own country if there are any. Manually operated machine would be sufficient to attach the clip to the holder; a simple equipment would be enough.

Example of Sign Pen Manufacturing Plant

The simplest example of a model sign pen plant will be given. The production output in the beginning will be 10,000 pcs/8 hrs (20,800 dz/25 days).

What sort of sign pen is to be manufactured is decided first. Then, the pen holder is designed. The simplest way is to import ready-made pen holders. For a distinctively original design, however, the holder must be self-designed. A metal mould based on the design is made, and the holder is manufactured from the mould. This designing of the holder is difficult technically, so it would be better to entrust it to a professional designer.

Self-production of the holder is possible. However, the cost will be high when the output of production is small; therefore, it would be better to import the holder or procure it from domestic sources.

The nib and wick of the sign pen are selected by giving consideration to the type of sign pen required and the shape and size of the holder. They should be imported.

The ink, too, is decided by what sort of sign pen it is to be used for. The ink can be self-made from the beginning, but there will be little profit when the production is small. Therefore, it would be better to import the ink.

At any rate, localizing the production of pen holder and ink should be done gradually as business activities get more and more brisk.

Assembling of sign pen can begin when the necessary tools, working bench, workers, and assembly supervisor are ready.

Table 1: Required Machinery and Equipment

Stamping machine	FOB price (approx.)	$US 9,500
Assembling tools	FOB price	$US 7,150

Table 2: Annual Requirement of Raw Materials

	8 hrs/day x 25 days/month
Nib	3,100,000 pcs.
Wick	3,100,000 pcs.
Ink	5,500 kg.
Pen holder	3,100,000 pcs.

Table 3: Required Manpower

Assembly	Supervisor	1
	Ordinary worker	30
Ink plant	Engineer	1
	Worker	1
Hot stamping	One worker per machine	

Table 4: Required Plant Site Area

	10,000 pcs./8 hrs.
Assembly plant	100 m^2
Ink plant	30 m^2
Hot stamping plant	40 m^2

How To Start Manufacturing Industries

Chalk Making Plant

The plant described here manufactures plaster chalk for educational use and industrial use. The demand is approximately 80% for educational use, 15% for industrial use, and 5% for office use.

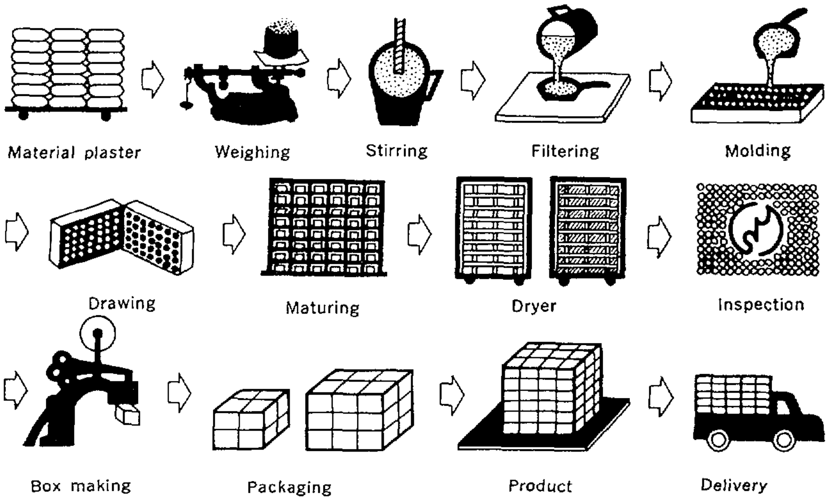
At present the two representative types of chalk are:

(1) Plaster-calcium chalk.
(2) Carbonic acid calcium chalk.

Because of the simplicity of the manufacturing facilities and because of the mass production possible, 80% of chalk manufacturing is done by plaster-calcium chalk plants. Therefore, a plaster-calcium chalk plant has been given as a model here.

Twenty-five employees or less are sufficient as required operational workers of this plant, and, viewing from the standpoint of efficiency of production and sales, the plant is economically feasible as an industry.

Process Flow Sheet for Chalk Making Plant



Raw Material

The main raw material which is to be used in the plant is JIS (Japanese Industrial Standard) grade B calcined plaster for moulding. This raw material is high grade, and is used extensively; however, the plaster is for chalk use and it is not for building use. The use of good quality raw material is very important chalk manufacturing.

Process Description

Although a portion of the drying equipment is automatic, automation of the entire process has not been accomplished yet. Automation is in progress and is expected to go into operation in near future; the cost of automation facilities, however, will be high.

1) Measuring of water and calcined plaster
   3,300 grams of water is correctly measured with a ladle and poured into the stirring tank.
   2,350 grams of raw material calcined plaster is correctly measured on a 5 kg scale and is poured into the stirring tank.
   The above mixture is stirred for 30 – 40 seconds.
   The volume of the mixture is sufficient to fill one moulder of 504 pieces of chalk.

2) Mould releasing agent
   Mixed oil is painted with a brush on the inner side of the mould beforehand. The milky slurry mixture is passed through a 80 mesh filter and filled into the mould. The slurry mixture remaining on the top surface of the mould frame is wiped off with a metal spatula, then the top surface of the mould is rapidly finished off with a finishing spatula. The work from stirring the raw material up to finishing the moulding should be done in 60 – 80 seconds.
   In order to minimize the bubble in the mixture which has been poured into the mould, the moulder is given a slight jar to release the air bubbles from the top. Then, a finishing spatula is used for the finishing touch.
   The ratio of mixed oil used as mould releasing agent is 200 liters of kerosene to 3 liters of whale oil.

3) Drawing the chalk out of the mould
   The time to draw out the chalk is approximately four minutes after moulding; i.e., the best time is when the chalk is hardened to about the hardness of the lobe of the human ear. When the length of time is prolonged, drawing out from the mould would become impossible, so precaution is necessary.
   When the chalk is ready to be drawn out of the mould, a drawing frame is placed on top of the mould frame; the drawing stopper is set firmly; the mould is inclined 90 degrees toward the operator; the chalk will automatically fall into the drawing frame; the drawn chalks are then taken away and put in a designated place.
   A description of the moulding process has been given above, but the various stages of the moulding process are difficult to describe in writing. The technique must be mastered by training.

4) The drawn chalks are arranged in a drying frame and put in the drying room for drying.

5) The chalks are stored away to await delivery.

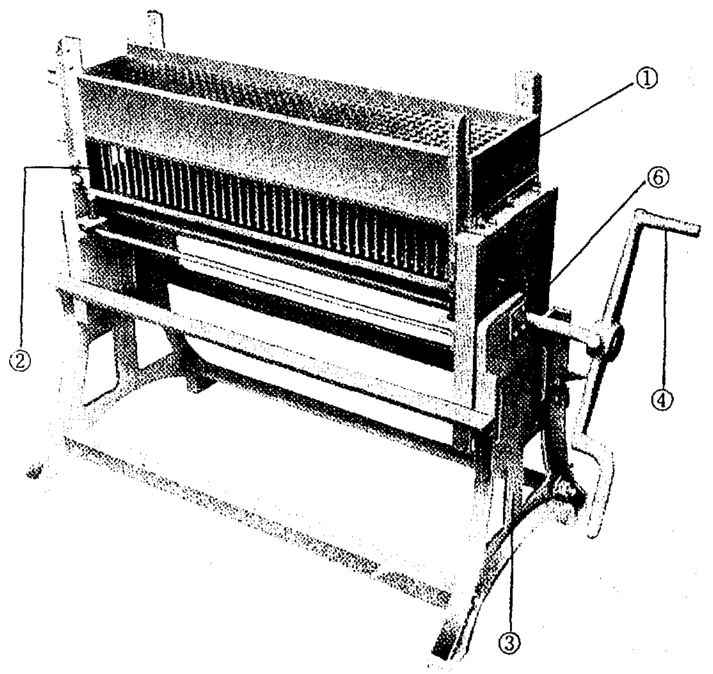
Outline of Plant

1) Production Capacity
   2,400 cases/day (100 pieces/case)
   Working hours: 8 hours/day, 25 days/month

2) Required Raw Material and Utilities
   Main raw material: 30 tons/month (25 kg/bag x 1,200 bags)

Table 1: Machinery and Equipment			
Item	Number of unit	Specification and accessories	FOB price
Moulder	5	504 pieces per unit (cylidrical type) 5 stirring tanks, 10 pipe cleaning brushes, 3 filters, 5 small size oil cans, 5 metal spatulas, 5 finishing spatulas, 3 oil brushes, 3 small ladle, one 5 kg scale, 3 stirring rods	$US 19,000
Drying room	2	Concrete block construction 4 2HP motors, 4 fans, shutter in two places, 4 hand cars	$US 48,000
Dryer	2	Kerosene type with accessories	$US 24,000
Automatic regulating equipment	1	Regulater with thermocouple, etc. for drying, and accessories	$US 17,000
Other accessories		100ℓ service oil tank: 1 set Gear pump: 2 sets Ignition plug: 2	$US 24,000
		Total	$US 132,000

Note: Expenses other than the above would be required for establishing the office and workshop.
If the land, building, and storehouse are ready, installation of the machinery and equipment and trial running can be done in approximately one – two months by dispatching five – six engineers.



Moulder

① cylinder ② Pistons ③ Base
④ Pushing handle ⑤ Chalk receiving frames
⑥ Revolution shaft

(In case of JIS grade B raw material, the price will be FOB $US 28.6/ton; 1,200 bags for export use would be required per month.)
Water: 50 m^3/month
Electricity: 3,500 kWh/month

3) Required Manpower
The manpower required to run the plant is given below.

Management	3 persons
General affairs section	3 persons
Business section	3 persons
Delivery section	3 persons
Manufacturing section	3 persons
Drying section	2 persons
Finishing section	8 persons
Total	25 persons

4) The land area required for the site is approximately 1,000 m^2.

5) Machinery and Equipment
The detail of machinery and equipment for the Plant is as Table 1.

Locational Condition

The plant site should be located near the area of demand of the product, and should be easily accessible to transportation of the product, water, electricity, etc.

How To Start Manufacturing Industries

Carbon Paper Making Plant

A product similar to the carbon paper which is being used today had been used in Europe in the 18th century. In the 19th century the method of mass production of carbon paper was developed in the U.S.A. and, with the popularization of the typewriter, the use of carbon paper spread to various countries of the world.

In Japan, handmade carbon paper was produced at the end of the 19th century. Technical improvement was made early in the 20th century, and the method of mass production using machinery was developed. This replaced handmade products, and the volume of use of carbon paper as a stationery gradually increased.

Carbon paper used today is classified as writing and typing from the standpoint of use, and as wax type and solvent type from the standpoint of variety.

Carbon paper must be strong and pliable; therefore, tissue paper made from 100% wood pulp or tissue paper made from wood pulp blended with manila hemp or jute is used as raw material. The weight is $15 - 28$ g/m^2.

The ink to be coated on the tissue paper is manufactured by blending carbon black or anilin dyes with Japanese wax, carnauba wax and fats or oils.

The size of carbon paper for typewriter use is generally 216 mm x 330 mm (8-1/2" x 13"). Products which are 8-1/2" x 13-1/2" or 8-1/2" x 11-1/2" are used in some countries.

Ordinarily, carbon paper is sold 100 pieces packed in a dressy box.

Process Description

As explained previously, carbon paper is classified as writing and typing from the standpoint of use, and as wax type and solvent type from the standpoint of variety.

The model plant given here is to manufacture the typewriter use wax type carbon paper, size 8-1/2" x 13", approximately 450 thousand boxes (100 pieces to a box) per year. Operation of the plant will be seven hours per day, 300 days per year.

The process flow of manufacturing carbon paper is generally as follows:

1) Receiving base paper
2) Manufacture of ink
3) Coating of ink
4) Rewinding and inspecting of goods
5) Cutting
6) Aging
7) Packaging and boxing

The paper used should have a "tight" surface without pinholes.

The ink is manufactured by blending carbon black, or anilin dyes with wax and fats or oils. The manufacture of ink, however, requires experience and technical know-how. Therefore, when manufacturing carbon paper for the first time, it would be better to purchase ink from the market. Accordingly, the ink manufacturing equipment has been eliminated from the plant given here.

Coating of ink is the most important process in the manufacture of carbon paper, and it requires skill and experience. Ink is coated evenly to the fixed thickness by a coating machine. Ink is coated only on one surface of the raw tissue paper.

After coating with ink, the carbon paper is rewound and inspected in the rewinding and inspecting process.

After inspection, the carbon paper is cut into large size in the cutting process; then, the cut paper goes through the guillotine cutter to be cut into the finished size.

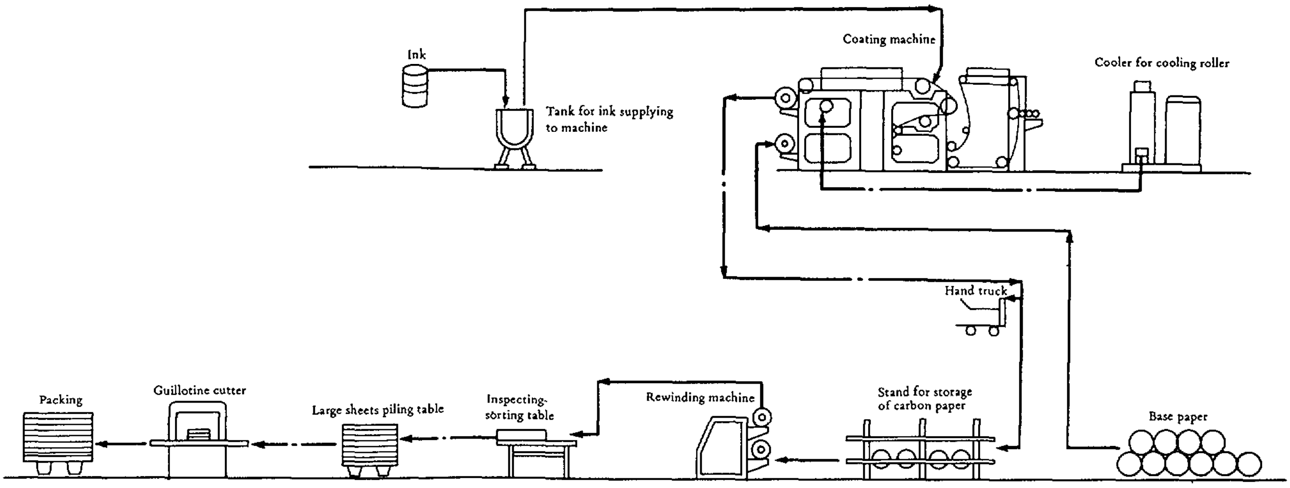
In order to obtain products of uniform quality the crude product, which has been cut to the fixed size, is kept in the aging room under a fixed condition.

After the aging process is completed the carbon paper is packaged 100 pieces to a dressy box; then, the dressy boxes are packed in carton boxes for delivery.

Required Machinery and Equipment

1) Coating machine with printing press (specifications)
   Working width:
   Min. 400 mm
   Max. 710 mm
   Max. diameter of unwinding roll: 550 mm

Fig. 1: Process Flow Diagram for Carbon Paper Making Plant



Max. inside diameter of unwinding mandrel: 120 mm
Max. diameter of reeling roll: 550 mm
Max. diameter of reeling mandrel: 200 mm
Working speed:
variable up to 100 m/min.
Types of coating machine:
Wire wound scraping rod type or scraping rod type
Printing method:
Anilin dye printing
Weight of coating agent:
Max. 12 g/m²
Min. 4 g/m²
Weight of coating agent:
Max. 12 g/m²
Min. 4 g/m²
Weight of backside coating wax:
Max. 6 g/m²
Min. 4 g/m²

2) Re-reeling machine with cutter (specifications)
Working width:
Max. 710 mm
Min. 400 mm
Diameter of reel:
Max. 550 mm
Min. 250 mm
Working speed:
Max. 160 m/min.
Min. 30 m/min.
Size of cutting:
Max. length, 1,350 mm
Min. length, 850 mm
Max. width, 710 mm
Min. width, 400 mm

3) High speed guillotine cutter (specifications)
Working width: 920 mm
Cutting length: 920 mm
Cutting height: 130 mm
Cutting speed: 34 r.p.m.
Pressure:
Min. 200 kg/cm²
Max. 3,000 kg/cm²

The weight of each machine is given below.

Coating machine . . . . 4,500 kg
Re-reeling machine . . . . 330 kg
Guillotine cutter . . . . 2,000 kg

The power required to operate the machines is shown below.

Coating machine: 3.7 – 2.1 kW
Re-reeling machine: 0.75 – 0.2 kW
Guillotine cutter: 0.75 kW

The voltage of each machine is A.C. 100 V

Requirements of Raw Materials

Base paper: 1,285 rolls/year (width 674 mm, length 3,000 m; weight 15 – 28 g/m²)
Carbon ink: 36,000 kg/year
Backside ink: 25,700 kg/year

Required Manpower

The labour force which directly engages in manufacturing is 10 persons.

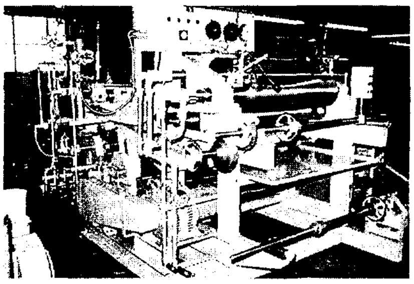
Required Factory Area

20 m x 13 m . . . . 260 m²

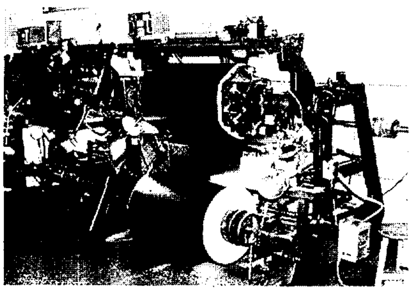
Price of Machinery and Equipment

(1) FOB price of main machinery and equipment for coating, re-reeling and cutting processes . . . . (approx.) $US 160,000

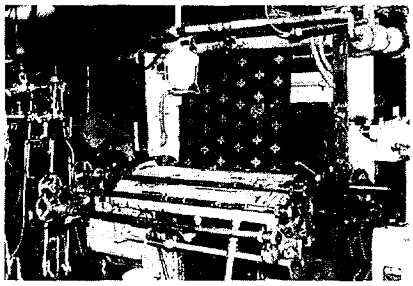
(2) FOB price of auxiliary equipment . . . . (approx.) $US 11,000



Coating machine



Rewinding machine



Coating machine (under operation)

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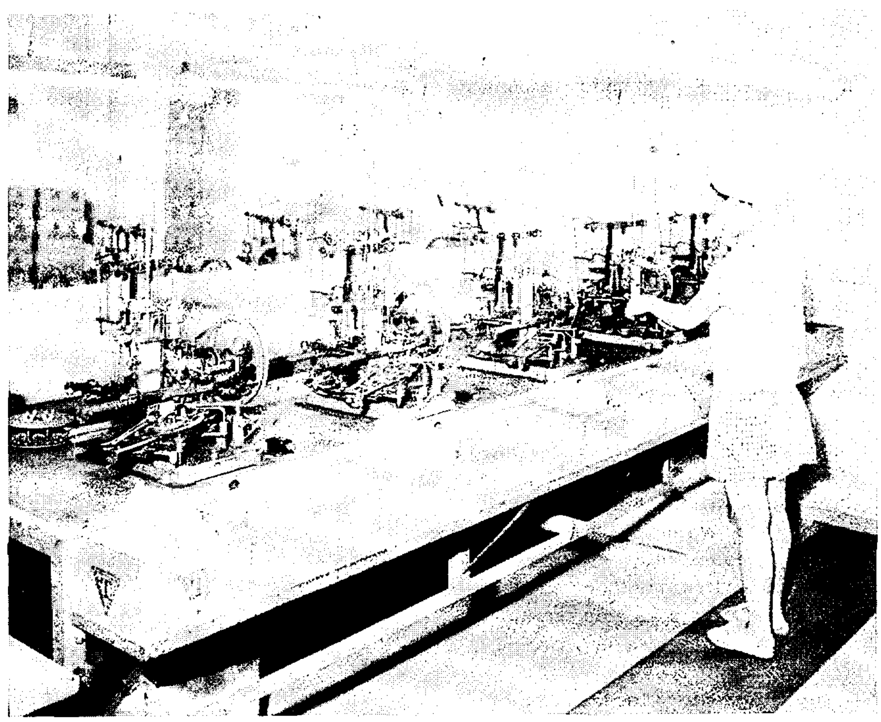
How To Start Manufacturing Industries

Toothbrush Making Plant



Before the advent of plastics, a product of the petrochemical industry, most of the toothbrushes had been made of bamboo and the pig's hair, and for high-grade toothbrushes was used the badger's and the like. However, bamboo and those animal hairs being the natural substances, they posed many problems concerning the uniform of quality and prices.

With the appearance of such petrochemical products as synthetic resin and synthetic fibre, it was found that they were suitable for making toothbrushes from the technical, industrial and economical points of view; and many countries have begun massproducing the uniform-quality toothbrushes out of synthetic resin and synthetic fibre. Consequently, the natural substances, which had so far been employed for making toothbrushes, have almost been replaced by those petrochemical products.

In this way, for toothbrush handles are now used ABS, AS, PS or PP resin; and for bristles, 66 or 10-nylon monofilament; and for fixing the bristles is used the brass flat wire.

Process Description

The toothbrush making process consists of the following eight stages.

1) Drying of resin
Resin, the raw material, which is to be supplied to the injection moulding machine, is dried by hopper dryer.

2) Metal mould
Toothbrush handles are moulded by metal mould attached to the injection moulding machine. This mould can produce various shapes of toothbrush handles.

3) Annealing
The toothbrush handles thus moulded are cooled in water or in warm water.

4) Separating
The sprue runner on the moulded toothbrush handles is separated.

5) Tufting
Nylon bristles are tufted onto the toothbrush handles.

6) Trimming
The bristles thus tufted being not uniform in the length, they are trimmed in either of the following shapes: straight, concave, grooved, trimming and rounding, etc.

7) Hot stamping
When tufting and trimming were finished, the company name, brand name, etc. are put on the toothbrushes.

8) Packaging
In packaging the final products, there are various ways, namely the plastic bag package, blister package, hard container package, etc.

Policy on Toothbrush Manufacturing

1) Monthly output
The manufacturing schedule will be determined by the working hours (the number of workdays x daily working hours).

2) Design
shape
tufting hole: number, diameter, depth
bristle: length, colour(s), shape of trimming

3) Use
for adults or for children
portable or for household use
one-time (throwaway) . . . . with/without paste

4) Material
handle: PS, AS, PP, etc.
bristle: nylon, PP, pure (natural)
anchor wire: brass, aluminum

5) Naming

6) Packaging . . . . . various
The method should be determined according to the use and the price of the finished product.
paper: box, sack
plastics: soft case, hard case . . . with/without fastener
others: blister pack, skin pack, etc.

Required Machinery and Equipment

1. Toothbrush Handle

1) Injection moulding machine
There are more than 20 injection moulding machine manufacturers in Japan alone and each of them offers several models. It is not easy to find one which completely satisfies the user's requirements.
In-line screw type injection machines are generally multi-purpose and are the most widely used for moulding the toothbrush handles. As they can also be used for moulding other products, such as the hard cases to contain the toothbrushes, it would be wise to adopt the ones of larger injection capacity.

2) Metal mould for toothbrush handle
According to the customer's design, we will manufacture the mould with enough cavities to cover their planned output.
The mould will have holes for bristle tufting to eliminate the need of drilling holes into the products (=handles) after moulding.
We can always offer you the mould which fits right with your machine.

3) Material to be used for brush handle
The material for the handle to be selected in such a way as the brush manufactured is best fit for its use. Below, we will pick out AS, PS and PP among the plastic resins commonly used for handles and will explain about each of them.

AS (or SAN; abbreviations of Acrylonitryl Styrene)
This resin is the most expensive among the three, yet the most popular material for toothbrush handles.
shrinkage: 0.2% – 0.7%; specific gravity: 1.08 – 1.10

PS (Polystyrene)
PS can be divided broadly into two groups, i.e., the ones for general purpose (GP) and high-impact (HI) polystyrene. They have been used separately or together as a mixture.
GP costs about the same as PP.
shrinkage: 0.1% – 0.6%; specific gravity: 1.04 – 1.09
GP is rigid and transparent but has poor resistance to bend or oil.

RI costs about 20% higher than GP.
shrinkage: 0.2% – 0.6%; specific gravity: 0.98 – 1.10
HI is semitransparent or opaque. It is shock-resistant and does not easily break but its resistance to oil or solvents is poor.

Note: The differences is shrinkage and specific gravity are due to the different gradation by each resin maker.

Usually, high-or-medium quality products are made of AS while PS is used for standard and PP for one-time.

2. Tufting of Bristle

1) Bristle tufting machine
Good tufting is vital to manufacture good brushes. It is essential that the machine tufts the correct number of bristles firmly and neatly into the tufting holes.

2) Bristle material
Both natural (pure) and synthetic bristles have been used for toothbrushes. Generally, high quality brushes have natural bristles including the badger for the invalids and the aged people.
China is the chief supplier of natural bristles.
Among the synthetic bristles, nylon is the most commonly used. PP bristle, which has been used for one-time brush, is low in price and light in specific gravity. This means that PP bristle can be tuft twice more than nylon bristle.

3) Anchoring wire
The anchoring of bristle can be done either by round wire [(1)-anchoring] or by flat wire (bar anchoring). In this project, flat wire is used.
There are two kinds of flat wires. One is made of brass and has been used for standard brushes and the other is of aluminum for one-time brushes. The main difference between the two is in their fixing strength or the strength to hold the bristle in its hole. Their prices are subject to change according to the market price of the material.
There is little difference between them as far as their prices per pound are concerned, but in terms of specific gravity, the difference is great. Consequently, it may safely be said that aluminum used for one brush costs half as much as brass or less.

3. Trimming of Bristle

1) Bristle trimming machine
After tufting, the bristles have to be trimmed to correct the irregularity in length. They should be cut according to the customer's design.
Our model has a sharp blande which easily trims the bristles to any shape at the rate of 3,900 pcs. per hour.
With the use of spare blades, the bristles can be shaped flat (straight), uneven, grooved, convex, concave, etc.

The toothbrushes will be manufactured through the above process. Then, you will have to give them names and pack them before you put them on the market.

4. Stamping on the Handle

1) Hot stamping presses
There are many models available both for manual and automatic operations. In the initial stage, a manual system might be enough.

2) Foil for stamping press
Metal foils and plastic foils are available, and the former cost more than the latter.

5. Packaging
The method of packaging varies so greatly that we dare not explain in detail.

Example of Toothbrush Manufacturing Plant

The quantity appropriate for making toothbrushes is generally said to be about 5,000,000 pieces a month, but here a plant producing 200,000 pieces a month, which is the minimum economical size, has been taken up.

1. Basis of Designing

Colour tufting:	Two-colour
Tufting hole:	66 holes
Trimming shape:	Straight
Purpose:	Adults type
Naming:	Stamping
Packaging:	Blister package
Necessary material:	
	Parts of handle . . . AS resin
	Bristle . . . Nylon (6, 6 – 10 type)
	Anchor wire . . . . Brass flat wire
Output:	200,000 pcs/month
Working days:	25 days/month
Operating hour:	8 hours/day

The machinery and equipment, raw materials, manpower, and plant site area required for the above plant are as shown in the attached tables.

Process Flow Sheet for Toothbrush Manufacturing

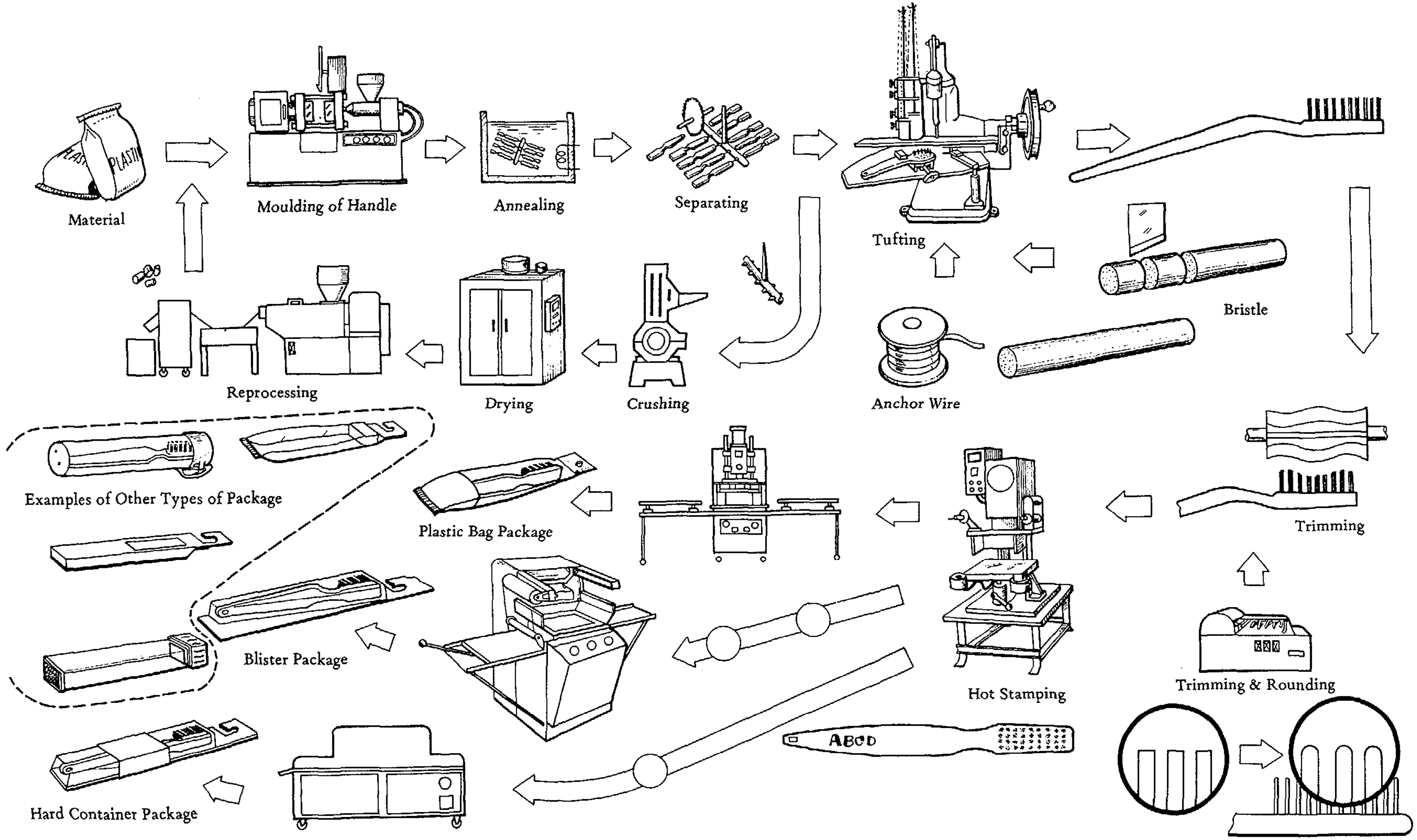
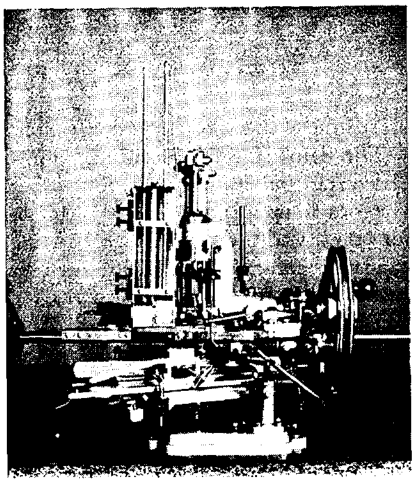


Table 1: Required Machinery and Equipment

Item	Quantity	Capacity	Electric power	Weight (net)
Hopper dryer	1 set	50 kg/hr.	4.6 kw/hr.	60 kg
Injection moulding machine	1	8.6 OZ	21.7	6,500
Metal mould	1	8 cavity	–	350
Automatic extractor for injection moulding machine	1	–	0.15	100
Annealing bath	1	–	5.0	30
Separating cutter	1	–	0.3	25
Portable crusher	1	80–160 kg/hr.	2.2	350
Toothbrush tufting machine	2	550 holes/min.	0.5	700
Bristle bundle cutter	1	–	–	20
Trimming machine	1	3,900 pcs/hr.	0.2	200
Hot stamping machine	1	80 pcs/min.	0.8	80
Foil slitter	1	–	–	25
Punching press for blister	1	20 tons	1.5	1,500
High frequency welder	1	7 kw	5.0	520

FOB price of machinery and equipment . . . . (approx.) $US 119,000



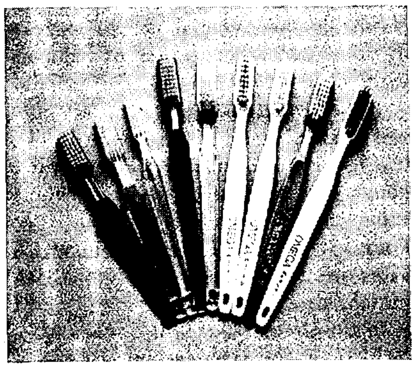


Table 2: Required Raw Materials and Utility

Item	Quantity/Month
Raw material:	
AS resin	2,000 kg
Nylon bristle	500 kg
Brass flat wire*	50 kg
Metallic foil	30 rolls (60 m/l roll)
Utility:	
Electric power	8,390 kWh/month

Table 4: Required Area for Plant Site

Building	(approx.) 350 m^2
Land	(approx.) 1,000 ~ 1,500 m^2

Table 3: Required Manpower

Item	Engineer	Skilled worker	Unskilled worker	No. of shift	Total man/day
Injection moulding machine	1	1		1	2 x 1
Separating cutter			1	1	1 x 1
Toothbrush tufting machine	1	2		2	3 x 2
Trimming machine	1		1	1	2 x 1
Hot stamping machine		1			1 x 1
Punching press for blister		1			1 x 1
High frequency welder		1			1 x 1
Total	3	6	2		14

Any inquiry about the information contained should be sent to: IO/COOP, Registry file No. ID/562/12, UNIDO, P.O. Box 300, A-1400 Vienna, Austria.

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ISIC 951 REPAIR SERVICES

How To Start Manufacturing Industries

Automobile Repair Plant

As is well-known, automobiles today play a vital role in traffic and transport in the cities as well as in out-of-the-way places throughout the world. It is said that the number of cars constitutes a barometer of the culture and economy of the area containing them.

In order to maintain the high performance of cars, it is necessary to overhaul them periodically, and repair them completely in the event of trouble.

Auto repair is not an enterprise which does business only when a car has gone out of order. Its ideal form of service is preventive maintenance, which provides inspection, adjustment or repair before cars run into trouble.

This enterprise is bound to grow in proportion to the increase in demand for cars. As a matter of fact, even if there should be a slow-down in the demand for cars, the demand for repair can be expected to increase.

The plan in question consists of two stages – the inaugural and expansion stages. The former capacity is for 500 cars a month and the latter, 1,000 cars a month.

Auto repair is undertaken by filling stations and car dealers.

It is possible for an auto repairer to operate a filling station in parallel, rationally embracing a repair service among his facilities.

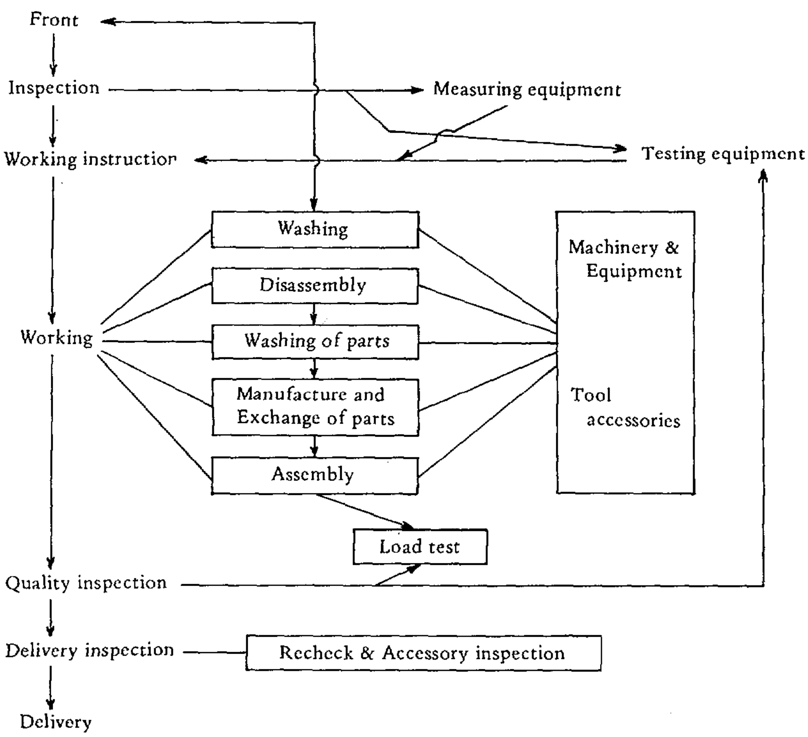
In recent years, there has been a trend for increase in the number of repair shops which sell gasoline on the side.

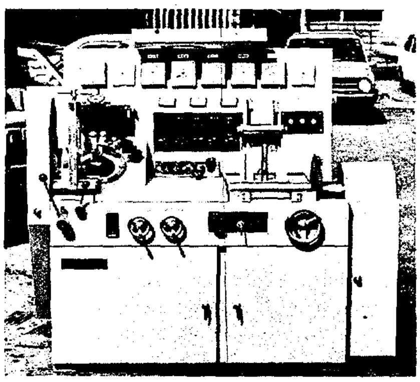
Automobile repair service is undertaken at several levels – ranging from small shops to larger ones employing scores of workers with a complete assortment of inspection and testing machines and tools in the shop, reliably performing technical service.

The medium-sized repair shop is suggested to include, in its lines, the repair of engine and chassis, as its main job, machining, repair of electrical equipment, repair of metal sheet, painting and repair of tires.

However, the appropriate scale of operation should be decided with consideration of the demand for car repair in the area.

Process Flow Sheet for Automobile Repair Plant





Universal test bench

Process Description

An automobile consists of thousands of parts which have been assembled in an integrated manner. Thus, the substance of repair work, decided upon after inspection of the car delivered, is not locally limited. It has rather to be a continual or expanded repair work, involving a probe into the cause of malfunction.

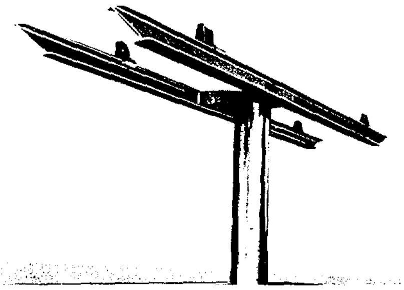
Therefore, repair starts with a diagnosis of the car and determination of the trouble, and it should be carried out in a multilateral manner.

In repairing an engine that is out of order, repair should be pursued section by section – gasoline system, electrical system and other related parts. The reassembly process should be conducted in the order of assembly.

Auto repair service features a need for high-level technicians to inspect cars brought in for repair and inspect cars ready for delivery, because technical diagnosis and direction of work for cars in trouble should be done properly.

In the inspection of repaired cars, it is necessary for the repair shop to

Portable flow detector



Auto lift

technically guarantee no trouble in driving through use of such measuring and testing equipment as brake tester, headlight tester, etc. to check whether the measured values conform with the construction and performance of the cars.

Outline of the Plant

The scale of auto repair plants generally differs according to the kinds of cars to be repaired.

For example, (1) in case of chiefly handling large cars and special cars, repair is available down to compact cars, while compact car repair shops are unavailable to large cars.

The operation of this plan features manual work by service men using precision machines and measuring tools and constituting the bulk of the repair work.

Decision on the appropriate scale of an enterprise is the basis, which is not only necessary for establishment of a new plant but also for improvement in business such as reconstruction of an existing shop.

Accordingly, a decision on the appropriate scale should be made in full consideration of the following factors:

(1) The number of cars in the area
(2) The kinds of cars to be repaired
(3) Extent of repair
(4) Method of repair and its substance
(5) Plan for incidental enterprises
(6) Geographical and locational condition of the site

Plant Capacity

It is desirable to organize the enterprise around the repair plant and to set up a filling station and car sales section as auxiliary services to the repair business.

This plant consists of two sections – one for inaugural work and the other for expansion.

The inaugural floor area is 1,000 m^2 with 10 working lots and a daily (8 hrs.) repairing capacity of 20 cars, or 500 cars a month.

The floor area for expansion is 500 m^2 with working lots of 20 m^2. The expanded plant is capable of repairing 40 cars a day, or 1,000 a month.

Table 1: Required Inaugural Plant Site Area

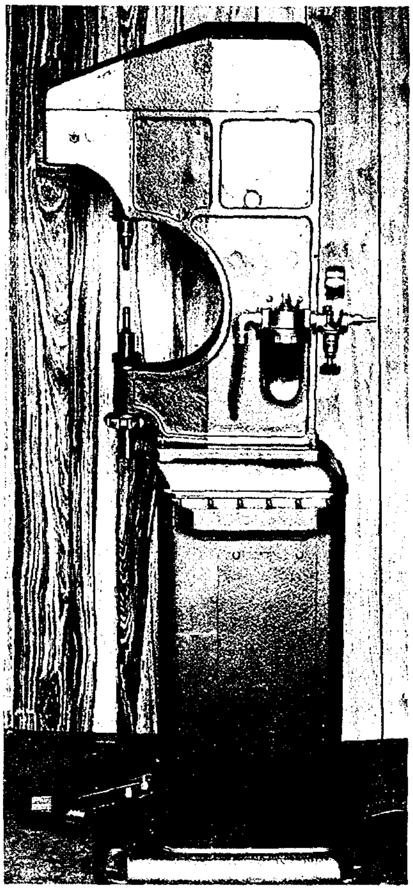
Item	
Shop	3,150m^2
Office	900m^2
Filling station	450m^2
Total	4,500m^2

Table 2: Monthly Requirement of Utilities for Inaugural Work and Expansion

Electric power	7,000kWh
Water	150m^3

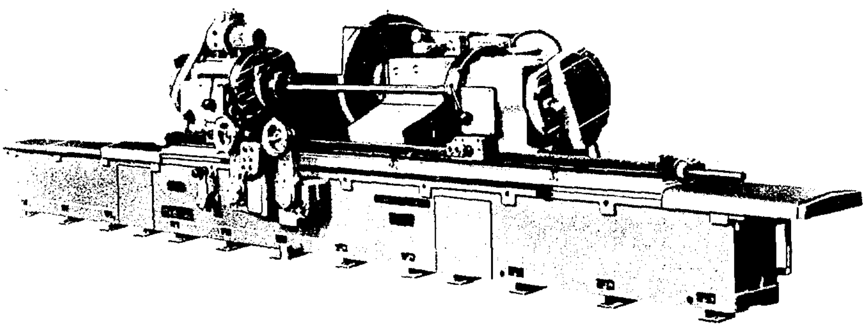
Table 3: Manpower When Expanded

Item	No.
Engineer	4
Skilled worker	6
Unskilled worker	18
Senior clerical worker	2
Junior clerical worker	4
Man at counter	2
Total	36



Air power rivetter

Machinery and equipment required for the repair shop consist of those for the engine repair shop, electric parts repair shop, chassis and body repair shop, wheel and brake repair shop washing and lubrication shop, painting shop, inspection shop, and garage equipment. Machinery and equipment for the primary setup would cost $US 290,000 and $US 114,000 for expansion, in FOB prices respectively.



Crank shaft grinder

U

V

W

X

Y

Z