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HOW TO START MANUFACTURING INDUSTRIES

Technological and Investment Perspectives

Volume III

UNIDO

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

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* International Standard Industrial Classification number
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How to Start Manufacturing Industries

CASHEW JUICE AND KERNEL PROCESSING PLANT*

Cashew trees, which are native to Brazil, are relatively tall and grow well separated from each other. The nut, known and accepted world-wide, consists of a seed covered with a shell containing a very corrosive oil and this unit, which is properly called the fruit, is attached to the bottom of a large, juicy pseudo-fruit or apple (see figure I). The fruit is only 10% of the weight of the fruit plus pseudo-fruit or peduncle.

Most cashew-producing countries process only the cashew nut and not the pseudo-fruit, mainly on account of the latter's weight and fragility.

Cashew nuts were first exported from India in 1920 and by 1925, more than 1,000 tonnes a year were being exported. Today the cashew nut has become an important item in world trade and close to 100,000 tonnes are exported yearly. The main producers are India, the United Republic of Tanzania, Kenya, Mozambique, Brazil and Nigeria. The main buyers are the United States of America, the Union of Soviet Socialist Republics, the United Kingdom of Great Britain and Northern Ireland, Eastern Europe, Australia, Canada and the Federal Republic of Germany.

The pseudo-fruit is seldom processed, although it has a very exotic flavour and, compared with other fruit juices, one of the highest contents of vitamin C. Whereas orange juice contains only 50 mg of vitamin C, 100 ml of cashew juice contains 200 mg of vitamin C. The technology required for the production of cashew juice is simple and the product is well accepted in both internal and external markets. It can be commercialized, in its natural or a concentrated state (up to 60° Brix).

The cashew apple should be harvested when it is completely ripe so that the kernel is fully developed for processing. The cashew apple is ripe when it falls from the tree. The cashew apple is then transported immediately from the field to the processing plant. The juice should be extracted in less than six hours after harvesting, otherwise, owing to microbial contamination, deterioration may begin, which brings about a significant change in flavour. The yield of juice extracted from the cashew apple is about 80%, with soluble solids of approximately 12° Brix. The juice is very rich in tannin and therefore should only be extracted from fully ripe apples, which have a lower tannin content.

Process decription

A. Cashew juice

Reception. Cashew juice should be extracted no later than six hours after the cashew apples have fallen from the trees, and transported in wooden boxes, with rounded corners, in order to avoid damage.

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*This information was prepared for UNIDO by CONSULTEC Comercial e Serviços Técnicos Ltda., Brazil. Inquiries should be sent to: Department for Industrial Promotion, Consultations and Technology, Registry file no. ID/562/12, UNIDO, P.O. Box 300, A-1400 Vienna, Austria.

Separation of nuts. Upon arrival, the apples are unloaded from the wooden boxes on to a conveyor belt, where the nuts are manually separated from the peduncle. This is done by using two fingers, protected by rubber gloves, to twist and pull the nut from the apple. The apples and nuts then pass over a vibrating screen, where the nuts fall through the screen while the apples are conveyed to the next stage.

Washing. Because of their contact with the soil and the separation of the nuts by hand, cashew apples are dirty and must be thoroughly washed with chlorinated water (5 ppm), initially by soaking and finally by rinsing under jets of water at high pressure.

Juice extraction. The cashew apples are directed to a juice extractor on a rubber conveyor belt and are then pressed against a perforated stainless steel plate. Fibre falls through an outlet at the end of a helical screw and the extracted juice is collected at the bottom of the extractor. This juice is rich in suspended microfibres. Those fibres that fall through the screw outlet can be passed through a second juice extractor in order to increase yield. Water may also be added before the second extraction.

Refining. If wished, excess pulp in the juice can be removed by centrifugation through a de-sludger.

Pasteurization and aroma recovery. The extracted juice is pasteurized in a heat exchanger at a temperature of 85°-90 °C for a few seconds and immediately pumped to a flash evaporator attached to an aroma recovery system where, due to the low temperature, the volatiles condense at the end of the condenser. These volatiles are responsible for the delicate aroma of the cashew apple. In this process the juice is pasteurized, undesirable enzymes are inactivated and the aroma from the juice, which otherwise would be lost through evaporation, is recovered. The concentration of the recovered aroma is 500-1,000 times greater than that of the natural juice.

Evaporation. Juice can be evaporated from 12° to 60° Brix by using a scraped surface evaporator, a forced circulation evaporator or a centrifugal evaporator. These types of evaporators, with agitated or turbulent flow, are necessary in order to prevent the heat from damaging the juice, which is viscous on account of its high pulp content. In order to save steam, double-effect evaporators are more suitable.

Cooling. The concentrated cashew juice must be cooled as soon as it leaves the evaporator, because high temperatures can alter the flavour. Cooling is carried out in double-walled tanks with agitators that have direct refrigerant expansion in the double wall. These tanks are also used to separate different lots of juice that are packed, using the same lot numbers, in 200-litre drums. Each lot has the same Brix/acid ratio, the same pH and the same flavour.

Additional cooling in scraped surface heat exchangers. Juice from the double-walled tank is pumped through a scraped surface heat exchanger where it is further cooled to -8 °C.

Packaging. Concentrated cashew juice at -8 °C is packed in a 200-litre polyethylene-lined steel drum. The drums are mounted on a scale and filled up to a final weight of 250 kg. The polyethylene bag is then closed, the drum lid placed in position and closed. A tag on each drum marks the final weight, Brix/acid ratio, pH, Brix and lot number.

Drying of fibres. The fibre left in the juice extractor should be dried and pressed in block form in order to be used as cattle feed.

B. Cashew nut

Storage. Cashew nuts that have already been separated from the apples in the fields must be dried if they are not intended for immediate processing. Drying is done by laying the nuts, in layers of less than four inches, on drying grounds in the sun. Drying takes longer than one full day, and allows nuts to be stored between seasons.

Cleaning and sizing. Nuts must be cleaned before they are separated and grouped according to size. Each group is stored in a different bin and is processed separately thereafter.

Conditioning. If the nuts are stored and classified by size, they must be conditioned before further processing. Conditioning is done by adding water for 10 minutes and then draining. This operation is repeated several times until the nuts have absorbed the required moisture. Conditioning is not necessary if the nuts are not stored, as they are processed immediately after separation from the apples at the plant site.

Roasting and centrifuging. Nuts are roasted according to size, in order to achieve uniform roasting of all nuts. Otherwise, smaller nuts would be over-roasted or burnt before the larger nuts reached the ideal roasting stage.

Roasting can be done in cashew nut shell liquid (CNSL), extracted from the nut itself when heated. Roasting is carried out at temperatures of 185 °C-190 °C for 1 1/2 minutes, and the ratio CNSL to cashew nut must be approximately 30-50.

After roasting, the nuts must be cooled, using a cold water spray, and then centrifuged, in order to remove excess liquid.

Shelling. Shelling is the removal of the dry roasted shell. By striking the head-end of the nut, the natural line of cleavage is broken. An average sheller produces 15 lb of whole kernels per day, which corresponds to 60 lb of roasted nuts per day, or 70 lb of raw nuts per day, or 10 nuts per minute. It is important, when shelling the nut, that the kernel is not broken, as whole nuts command a higher price on the market. Wood ash should be applied to the hands and to the equipment to prevent damage to the kernels and injury to the hands from the shell liquid. Unlike shell liquid, excess wood ash can be removed easily from the kernels.

Drying and peeling. To facilitate the removal of the testa from the kernel, the nut should be well dried so that the testa is only loosely adherent and can be manually removed by a wooden or metal knife or, alternatively, by mechanical means.

Drying is carried out on tray driers, using hot air. The drier is heated by burning cashew shells.

The cashew nut shell liquid extracted during roasting can be saved and stored. It can be sold for a good price and is used as a raw material in the production of resin for vehicle brakes.

Grading and packing. Cashew nuts have different grades and are classified according to colour, size and the percentage of broken kernels. They are packed in tin containers, each holding 25 lb. The containers are then evacuated and sealed under an atmosphere of carbon dioxide.

Example of a cashew juice and nut processing plant

Table 1 sets out the equipment necessary for a plant with a production capacity of 170 tonnes of concentrated (60° Brix) cashew juice per month and 140 tonnes of cashew nuts per month, operating 8 hours per day, 25 days per month and 70 days per year for juice production and 150 days per year for nut processing.

The investment required (f.o.b. price) is approximately $US 600,000 in 1984 values.

Tables 2-5 give an idea of the amount of raw material, utilities, manpower and area required. Figure II is a process flow-sheet for a cashew nut processing plant and figure III a process flow-sheet for a cashew juice processing plant.

Table 1. Machinery and equipment required

Item	Quantity
Boiler	1
Conveyor belts	4
Universal washer	1
Juice extractor	1
Heat exchangers	2
Aroma recovery equipment	1
Evaporator	1
Double-walled tanks	2
Scraped surface heat exchangers	2
Drum filling equipment	1
Pumps	3
Cold room	1
Sizer	1
Roaster and cooler	1
Centrifuges	2
Drier	1
Grader	1

Note: Price of machinery and equipment f.o.b. (approximately) $US 600,000 (1984 values).

Table 2. Requirement of raw and subsidiary materials
(Per month)

Item	Quantity
Cashew apples (tonnes)	1 200*
Cashew nuts (tonnes)	150
Tins	12 880
Drums	650
Polyethlene bags	1 400

*120 tonnes of nuts

Table 3. Utilities required
(Per tonne of processed apples)

Item	Quantity
Electricity (kW)	25
Steam (kg)	150
Process water (m^3)	10
Fuel (kg)	5.0
Refrigerant (kg)	0.1

Table 4. Manpower required

Item	Number
Manager	1
Food engineer	1
Skilled workers	6
Unskilled workers	80
Maintenance workers	5
Total	93

Table 5. Area required for plant site

Item	Area (m^2)
Buildings (plant building, warehouse, laboratory, workshop, cold room)	1 200
Land	5 000

Figure I. Cashew fruit

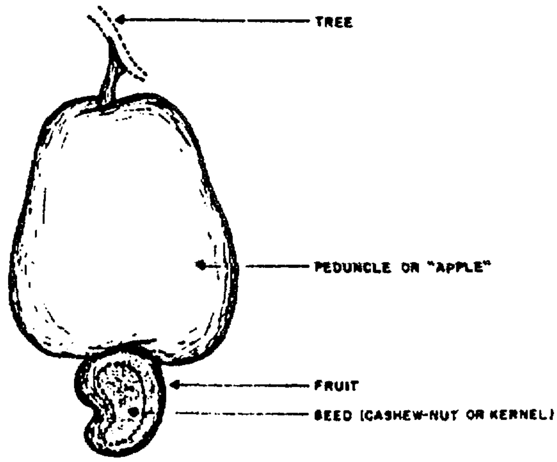


Figure II. Process flow-sheet for a cashew nut processing plant

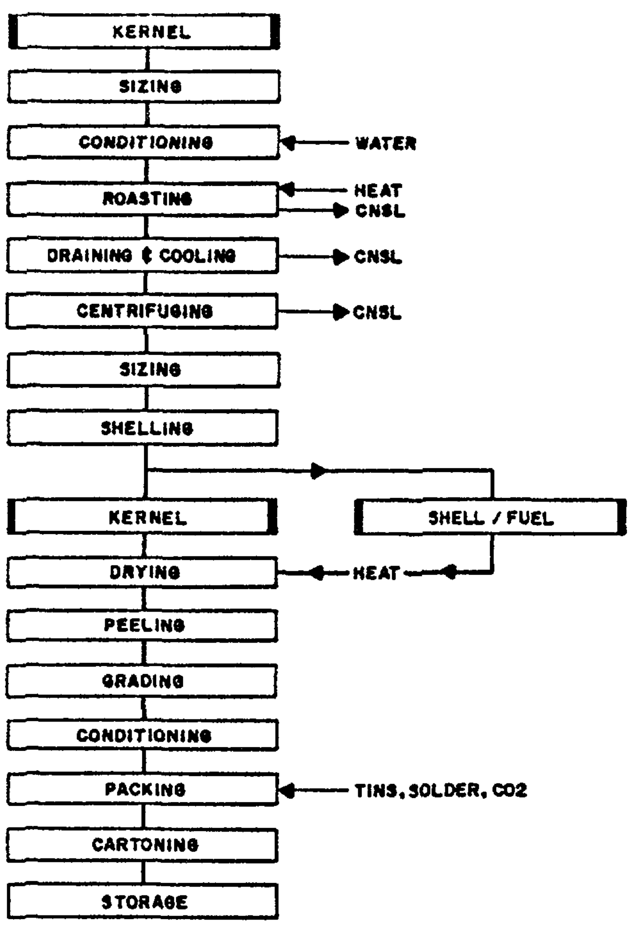
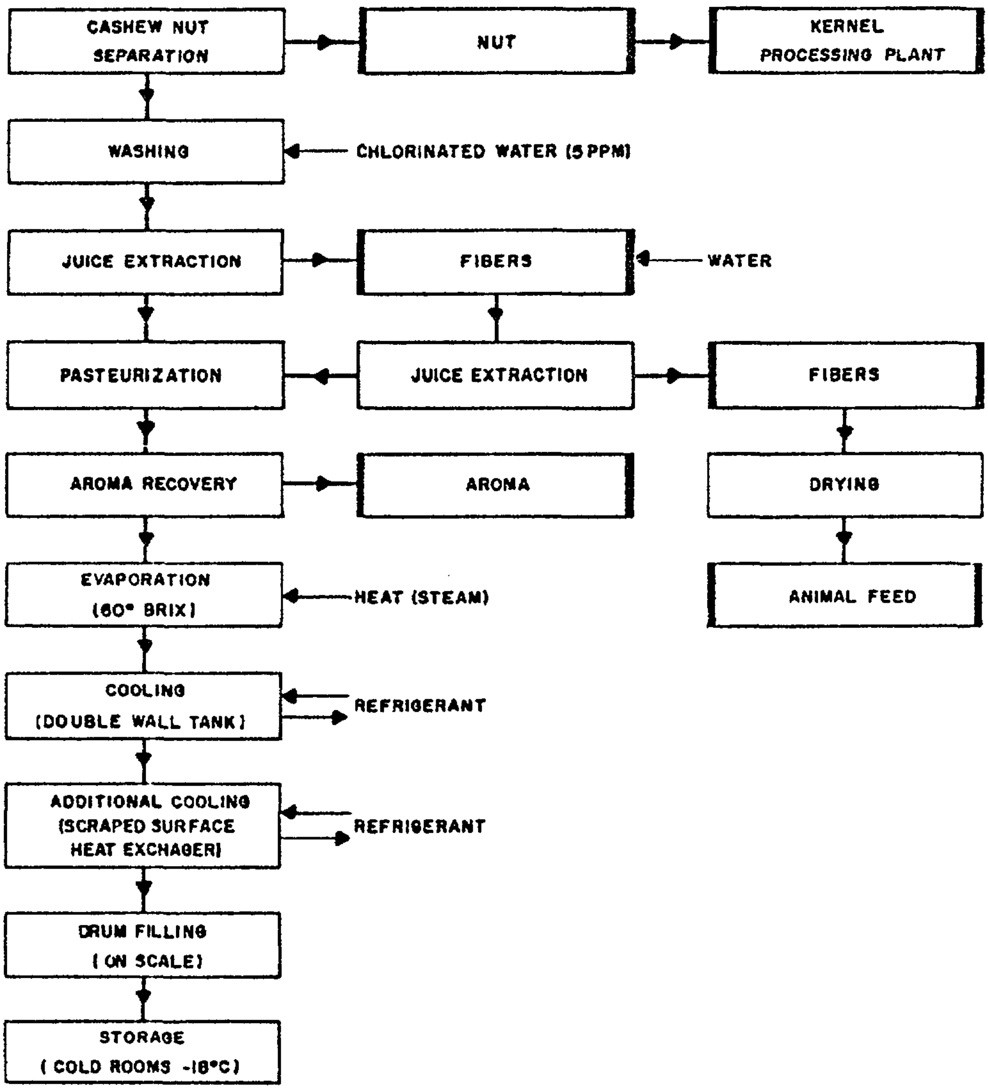


Figure III. Process flow-sheet for cashew juice processing plant



How to Start Manufacturing Industries

CASTOR OIL AND POMACE PLANT*

Castor oil and castor pomace are the products obtained by milling castor seeds (Ricinus communis).

Castor seeds are borne in capsules, clustered on spikes. When ripe, the capsules pop and drop the seeds. Usually the spikes do not all mature at the same time, so that many harvestings are required as soon as the crop starts to mature. In harvesting, the spikes are cut by hand and, if necessary, allowed to dry further in the sun. The spikes are then threshed to separate the seeds from the capsules.

Castor seeds vary considerably in size, depending upon the variety and growing conditions of the plant. A typical weight range is from 0.3-0.5 grams per seed, which consists of hull and kernel (on average 75% of the seed) and has about 45% oil.

The seeds contain a very active lipase, which increases the free fatty acids of the oil, when the moisture content is high or the seed damaged. Thus, very careful storage conditions and handling are recommended to avoid problems in quality. Castor seeds also contain toxic (ricin, ricinine) and allergenic components, which may affect workers and the vicinity when milled inadequately.

Castor oil has a distinct character and a peculiar composition that makes it very versatile when it is used as a raw material. Compared with other oils, it has a greater viscosity (about 1,000 cP at 20 °C), greater specific gravity (0.956-0.970 at 15 °C) and greater solubility in alcohol and polar solvents.

This distinctive character can be attributed to the presence of a large amount of ricinoleic acid in the composition of castor oil, representing 86-94% of total fatty acids, the remaining being oleic (up to 7.4%), linoleic (up to 5%), dihydroxystearic (up to 0.6%) and other saturated acid (2-3%). Castor oil is a basic raw material for many basic industrial chemicals.

The main uses of castor oil are: in hydraulic fluids (due to its solubility in polar solvents); in paints and varnishes (as a drying oil obtained by dehydration); in surfactants (as sulphated or sulphonated oil); and in the manufacture of synthetic fibres (as a starting point for nylon 12) and dibasic acids (by oxidation and cleavage).

The commercial grades of castor oil are designated as no. 1 and no. 3. Besides these two kinds, a medicinal grade is also specified in pharmacopoeias. The main differences between no. 1 and no. 3 grades are:

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	No. 1	No. 3
Acid value (pH)	3	12
Unsaponifiable content	0.7%	0.8%
Colour (Gardner)	3 maximum	8 maximum

Castor pomace is the residual solid obtained in castor seed milling. Typical pomace obtained in milling contains 35-41% protein, 34% crude fibre, 7% ash, 10% moisture, 1% oil and is rich in calcium and phosphorus.

However, the toxic protein ricin, the toxic alkaloid ricinine and the strong allergenic (CB_1A) (a protein-saccharidic compound) are found in this pomace. Despite the substantial reduction in the toxics ricin and ricinine that occur in heat treatment during the milling, the residual amounts present are high enough to make the pomace unsuitable for feed formulation. Thus, castor pomace is used only as fertilizer. Special heat treatment in the presence of added moisture can be applied for a further reduction of the ricin and ricinine levels, without damage to the protein. Rigorous biological controls are required if the heat-treated castor pomace is to be used as feed meal. It cannot be used as animal feed unless it is fully detoxicated and de-allergenized.

Process description

The steps involved in castor-seed milling to produce castor oil and castor pomace are enumerated on the process flow-sheet below. They include cleaning, conditioning, pressing, solvent extraction, oil degumming and cleaning, oil clarification and pomace milling.

Cleaning. The whole seeds are cleaned in shaking screens or similar equipment so as to remove sand, dirt and other foreign matter.

Conditioning. Conditioning of the whole and cleaned seed is performed in cookers similar to those used in vegetable oil plants. The usual equipment is stack cookers in multiple stages, heated by steam.

Pressing. Pressing is performed in continuous screw presses (expeller cages), with V-shaped bars in the cages. In small plants that produce medicinal oil, hydraulic cage presses are sometimes used.

When expellers are used for mechanical extraction, it is difficult to reduce the oil content of the pressed cake to below 8-10%. A two-stage procedure, where a first cake (15-18% oil) is re-pressed on a second press, may reduce the oil content to 5-6%. The usual procedure, however, is to pre-press the seeds, producing a fatty cake (12-15% oil content), which is sent to a solvent extraction plant where the residual oil can be reduced to 1% or less. When the commercial expellers available are used in pre-pressing, they can process up to 100 tonnes per 24 hours of seeds, and there are smaller sizes processing 30 and 60 tonnes per 24 hours.

Solvent extraction. Solvent extraction of press cakes with 15-18% oil content can be performed in continuous or semi-continuous (battery) plants.

Semi-continuous extraction

In semi-continuous extraction, a battery of four to six pressure vessels (extractors) are operated according to a defined procedure and time tabulation, permitting a counter-current extraction in three to five stages.

The extraction is performed by immersion and percolation followed by the draining of the liquid and the removal of solvent with steam under vacuum. The semi-continuous plant involves a frequent manual operation of valves.

In continuous extraction, the whole operation is automatic. The installation therefore requires additional care and maintenance. The extraction is performed mainly by percolation at atmospheric pressure.

In continuous and semi-continuous plants, the extraction efficiency as well as the solvent losses may be practically the same, if the plants have been constructed properly. The steam consumption is higher in semi-continuous plants. The power consumption is higher in a continuous plant.

The choice between a continuous or semi-continuous plant is mainly an economical problem. Continuous plants cost one and a half times to twice the price of the semi-continuous plants, and therefore savings in operational costs, which depend on local conditions, must justify the larger capital investment. Usually, for a capacity of up to 100 tonnes of press cake per day, a semi-continuous plant is a better choice, and for amounts of over 300 tonnes/day, a continuous plant is more suitable.

In solvent extraction, hexane is the usual solvent, and it has to be used hot (above the critical solubilization point) in order to achieve good and quick extraction. Heptane, if available, is a better choice, especially in continuous plants, when higher temperatures may be used in extraction. In semi-continuous plants, as the extraction is usually performed under pressure (1-3 kg/m^2), the use of hexane presents no problem.

The use of ethyl alcohol should be considered, as it is a better and less hazardous solvent for castor oil, however a problem to take into consideration is the higher steam consumption during oil recovery.

Degumming. Castor oil obtained by mechanical and solvent extraction contains gums, which precipitate upon hydration. It is therefore necessary to degum the oil in order to meet commercial standards.

Degumming is performed by heating the oil with added water (or live steam) for a period, followed by separation of the hydrated gums that have become insoluble in the oil.

In small plants, the oil from mechanical extraction, mixed or unmixed with oil from solvent extraction, passes through settling tanks. The settled oil is then hydrated in open tanks and filtered. In larger plants, the hydration step can be performed continuously with separation in centrifuges (decanter-type). The solid residue, composed of fine oil and gums separated in filters or in centrifuges, is usually added to the press cake and sent to solvent extraction.

Bleaching. Degummed castor oil sometimes does not reach the colour standards and a bleaching step is required.

Bleaching is done by bringing the oil into contact with appropriate absorbents (activated earth, active carbon etc.) under vacuum and at temperatures of 80-90 °C, followed by filtration to separate the used bleaching materials.

Bleaching materials represent 1-2% of the oil. The residue, which contains 30-40% oil, is usually added to the extracted pomace, or mixed with press cake and sent to solvent extraction.

Alkaline washing. If, owing to seed characteristics or poor storage conditions, the oil obtained has a high colour and contains free fatty acids, an alkaline washing, using dilute caustic soda and sodium chloride, may be used to improve its quality.

Example of castor oil and pomace plant

Capital investment

The total investment required for a typical castor seed plant with a capacity of 60 tonnes of seed per day may be estimated at $US 4,000,000 for the battery solvent process and $US 6,000,000 for the continuous solvent process, with the distribution shown in table 1. Tables 2-5 give an idea of the amount of raw material, utilities, manpower and area required. The investment required is estimated in 1984 values.

Table 1. Distribution of total capital investment
(Percentage values)

Item	Percentage
Process equipment	24
Ancillary equipment	12
Valves and tubulations	7
Electrical components	5
Lagging	1
Painting	0.25
Instrumentation	0.75
Buildings and yard improvements	30
Engineering	6
Contingencies	5
Labour for erection and supervision	9

Table 2. Typical material balance

Mechanical extraction	Oil	Moisture	Solids	Total
+Seed	45	10	45	100
-Press cake	7.5*	3.2*	43	53.7
-Oil	37.5	0	0	37.5
-Loss	0	6.8	2	7.0

*14% oil and 8% moisture in press cake.

Solvent extraction	Oil	Moisture	Solids	Total
+Press cake	7.5	3.2	43	53.7
-Extracted cake	0.5*	4.8*	43	48.3
-Extracted oil	7.0	0	0	7.0
+Gain	0	0	1.6	1.6

*1% oil and 10% moisture in extracted cake.

Table 3. Consumption of seeds
(Per tonnes)

Utilities	Units	Method of milling "A" Pre-press + battery extraction + batch degumming + batch bleaching	Method of milling "B" Pre-press + continuous extraction + continuous degumming + batch bleaching
Steam	kg	520	310
Electric power	kWh	46	65
Process custer	kg	5	5
Solvent loss	litre	3 max.	2 max.
Cooling custer/ circulated	m^3/h	24	18

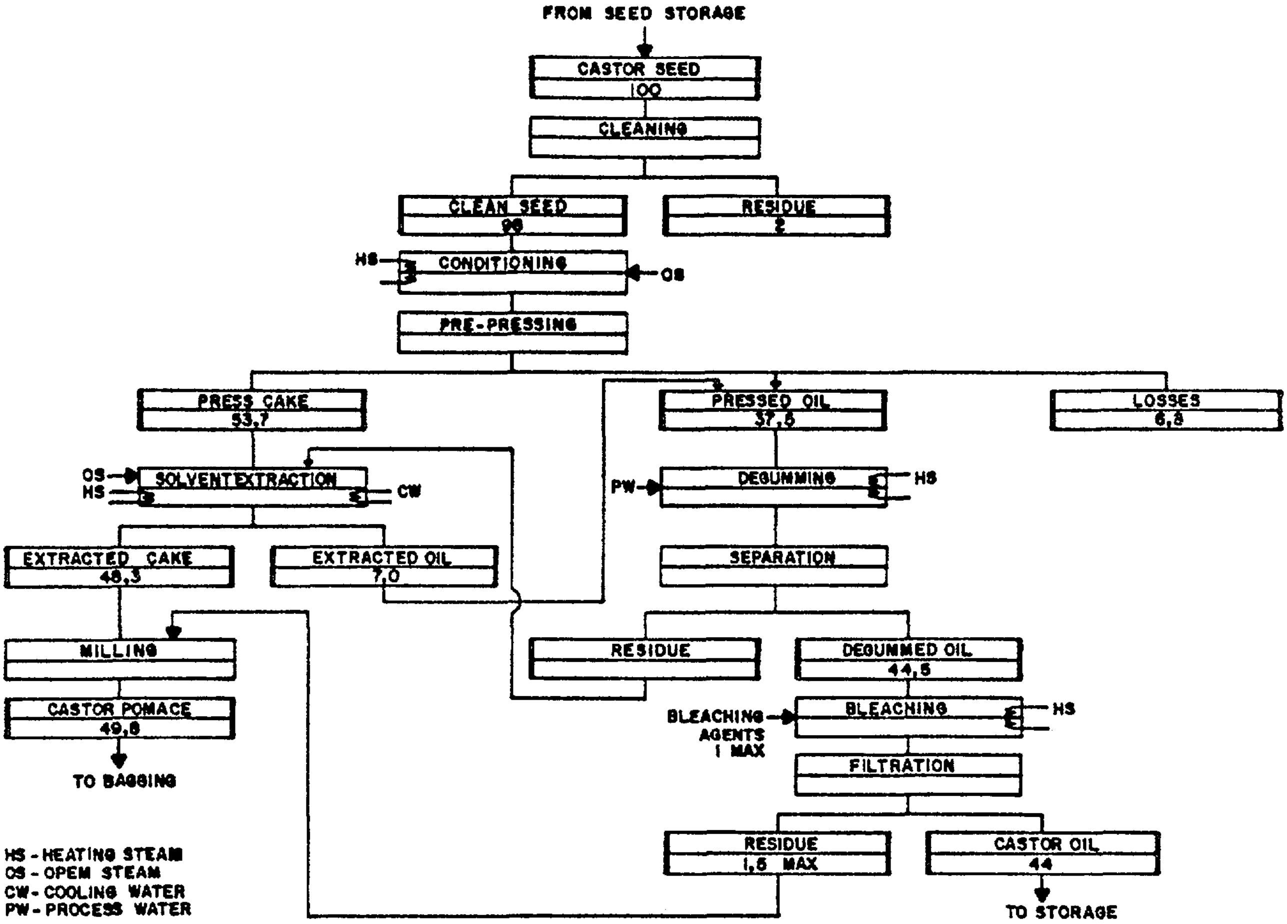
Table 4. Manpower required
(Per 60-200 tonnes/24 hours of seed)

Item	Method of milling "A"	Method of milling "B"
Engineers	1	2
Technicians	3	3
Skilled workers	9	9
Miscellaneous duties	15	5
	28	19

Table 5. Area required for plant site
(Per 60-200 tonnes/24 hours of seed)

Item	Area (m^2)
Storage buildings for seed and pomace	3 000
Process and utilities building	1 200
Offices and personnel facilities	400
Total	4 600
Land area	12 000-20 000

Process flow-sheet for castor oil and pomace plant



FILE: A-28
ISIC: 3118

How to Start Manufacturing Industries

CANE-SUGAR PROCESSING PLANT*

Sugar can be produced from sugar-cane and from sugar-beet. Sugar-cane is a crop grown in tropical regions, mainly in developing countries, while sugar-beet is a crop grown in temperate regions, mostly in developed countries. The world-wide production of sugar is an important sector of the food industry and recently the total yearly production has been almost 95 million tonnes. Until 1915, the amount of sugar obtained from sugar-beet was greater than that obtained from sugar-cane. After 1915, cane-sugar surpassed beet-sugar and today accounts for almost 60% of world sugar production.

Each tonne of sugar-cane produces about 100 kg of centrifuged sugar, meaning that 10% of the total weight of the sugar-cane can be transformed into crystal sugar. An average yield per hectare of sugar-cane is 60 tonnes. However in some well developed regions, where technical methods of agriculture are practised, an average yield of 80 tonnes of sugar-cane per hectare can be obtained. Eighty tonnes of sugar-cane produce 8 tonnes of sugar per hectare, which compares favourably with a production of 2 to 3 tonnes of sugar per hectare of cereals.

In order to be competitive on the export market, sugar must be processed in relatively large factories, producing about 500,000 to 2 million 60-kg bags per year or a minimum of 30,000 tonnes per year of crystal sugar. The production of 500,000 sixty-kg bags of sugar per year means harvesting 3,750 hectares of cane per year.

A cane-sugar processing facility is self-sufficient in its energy requirements. After the cane juice has been extracted from the sugar-cane plant by crushing and washing, the plant becomes bagasse, a cellulosic material that produces heat through combustion. This heat is used to produce steam at high pressure in special boilers. The steam generated is used for special crushing boilers and for crushing, heating, evaporation, drying and also for producing electricity.

Non-crystallized sugars, which are reducing sugars separated in basket centrifuges, are used in the production of alcohol after fermentation and distillation. Each 60-kg bag of crystal sugar produces 25-30 kg of molasses, which, after fermentation and distillation, result in 1 litre of 95-96% alcohol.

The use of molasses for producing alcohol according to the combined process described above is common in Brazil. Molasses can also be used for making a variety of products, such as fodder yeast, bakers' yeast rum, or directly for animal feed, or as a good source of carbohydrates for a number of other fermented products. Bagasse, in addition to its use as a boiler fuel, can also be used for various products such as bagasse board, pulp and paper, animal feed, furfural and producer's gas.

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*This information was prepared for UNIDO by CONSULTEC Comercial e Serviços Técnicos Ltda., Brazil. Inquiries should be sent to: Department for Industrial Promotion, Consultations and Technology, Registry file no. ID/562/12, UNIDO, P.O. Box 300, A-1400 Vienna, Austria.

Process description

Crushing. As soon as the cane reaches the mill, it is sliced and shredded in order to facilitate juice extraction in the crushing process that follows. Generally three or more sets of three-roller mills are used to press juice out of the cane. The woody fibre left as residue is called bagasse and is used as fuel in the boilers, producing steam and electricity.

Purification of the juice. The purpose of this step is to remove the largest possible number of impurities at the beginning. Clarification is done by adding sulphur dioxide and lime and heating them. At the first stage, sulphur dioxide is added to the juice and then lime, and heat applied. The final pH is adjusted to 8-8.5. The chemically treated juice is left to precipitate in a continuous decanter and the precipitate (sludge) is filtered through a vacuum filter. Clarified juice from the decanter and clear juice from the vacuum filter are mixed together.

Evaporation. Clear juice is concentrated in multiple-effect vacuum evaporators to a concentration of 55-65% sucrose. Steam is generated by the boilers, which use bagasse as fuel.

Crystallization. The concentrated juice or syrup is further evaporated until it is saturated with sugar. This process is also carried out in vacuum pans. As the syrup becomes saturated, sugar crystals are formed. As water evaporates, more syrup is added to the pan and sugar is deposited on the crystals that have already formed. The final mass of syrup and sugar crystals is known as massecuite.

Centrifuging. The massecuite is centrifuged in a basket-type centrifuge. Crystals of sugar remain in the basket, while the liquid (molasses) is thrown out through the perforations in the sides of the basket by centrifugal force. The sugar crystals are brown and still contain some syrup. This sugar, known as raw sugar, can be prepared further for consumption by refining.

The molasses still contain crystallizable sucrose, which is again mixed with syrup and returned to the vacuum pans. The new massecuite is centrifuged and the molasses returned to the vacuum pan once more to be treated as before. After the centrifugal treatment has been repeated three times, higher quality "A" and "B" sugars are ready to be bagged, after drying, and the "C" (lower grade) sugar is returned to the vacuum pans as a base for more "A" and "B" sugars.

Molasses with such a low sucrose concentration that the removal of sucrose is uneconomical are used as a raw material for alcoholic fermentation for the production of alcohol.

Distillation. Alcohol produced by yeast fermentation is distilled from wine in column stills with a production of 95-96% alcohol and 12-13 litres of vinasse per litre of alcohol produced. Vinasse is very rich in organic matter and, because of its high biochemical oxygen demand, it cannot be emptied into rivers. It can be used as fertilizer, however, as it adds nitrogen, potassium and phosphorus to the soil.

Example of a cane-sugar processing plant

In the following example two plants are compared, a small one and a medium-sized one. The production capacity and operation hours of the plants are as follows:

	Small plant	Medium-sized plant
Production capacity	4 000 tonnes per month	16 000 tonnes per month
Hours of operation	8 hours per day 25 days per month 120 days per year	24 hours per day 30 days per month 150 days per year

Tables 1-5 are based on the above plants. A process flow-sheet is also given below.

Table 1. Machinery and equipment required

Item	Quantity	
	Small plant	Medium-sized plant
Boilers	1	1
Washers	1	1
Knives	1	1
Shredders	1	1
Mills tandem	1	1
Tanks	5	8
Decanters	1	1
Vacuum filters	1	1
Heat exchangers	4	6
Vacuum evaporators	1	1
Vacuum pans	1	1
Crystallizers	1	1
Centrifuges	1	2
Fermentation tanks	4	6
Pumps	6	10
Column still	1	1
Driers	1	1
Electricity generators	1	1
Fork lifters	2	4
Alcohol tanks	3	6
Molasses tanks	1	2

Note: Price of machinery and equipment f.o.b. small plant (approximately) $US 1,500,000; medium-sized plant (approximately) $US 5,400,000 (1984 values).

Table 2. Requirement of raw and subsidiary materials
(Per month)

Item	Quantity	
	Small plant	Medium-sized plant
Sugar-cane (tonnes)	45 000	105 000
Bags (60 kg)	72 000	180 000
Sulphur (tonnes)	20	80
Lime (tonnes)	50	200

Table 3. Utilities required
(Per tonne of sugar)

Item	Quantity Small plant	Quantity Medium-sized plant
Process water (m^3)	10	10
Steam (tonnes)	6.0	5.6
Electricity (kW)	15.0	14.0

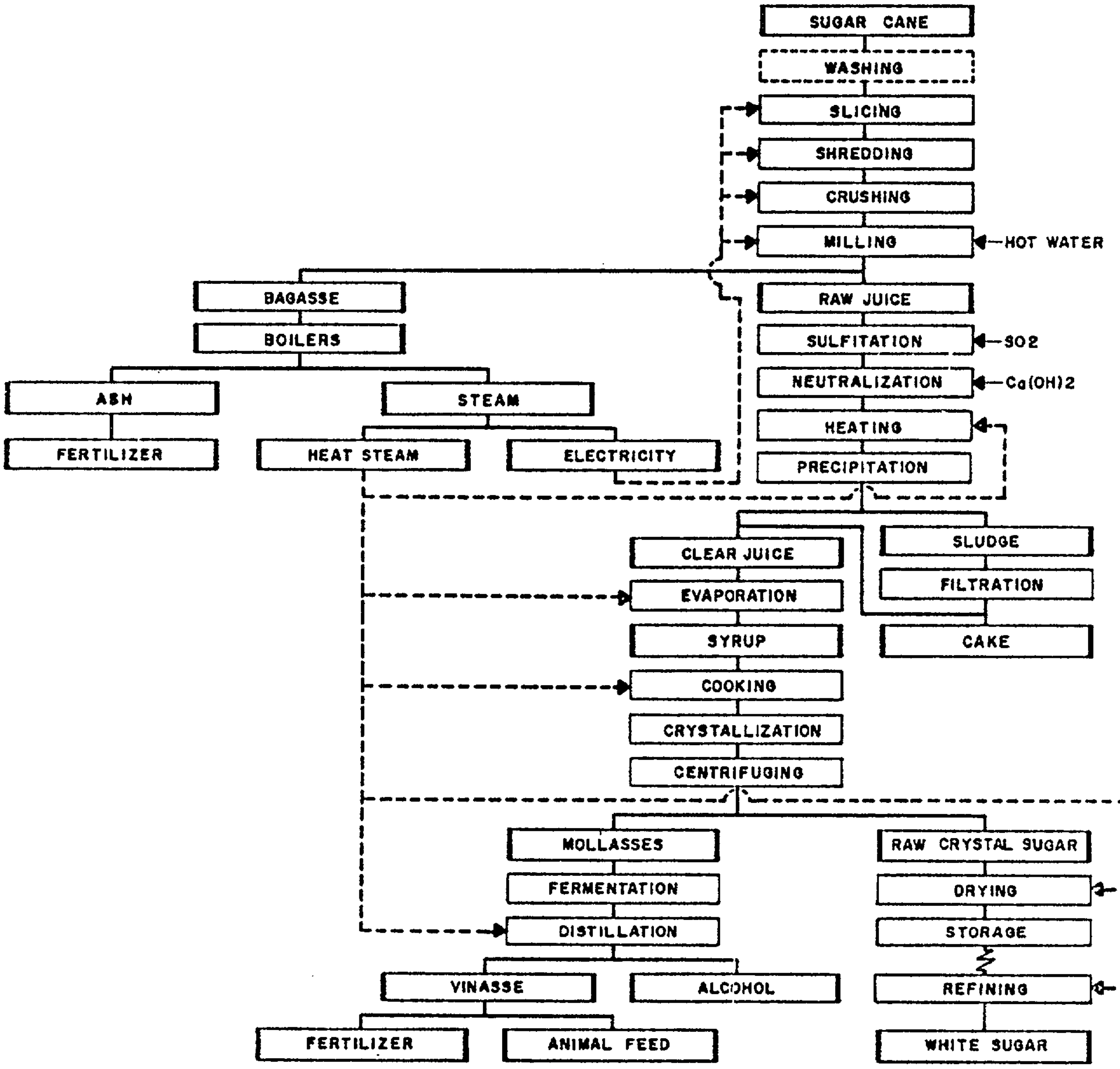
Table 4. Manpower required

Item	Number Small plant	Number Medium-sized plant
Manager	1	1
Chemist	2	2
Food engineer	1	1
Office workers	10	10
Skilled workers	8	12
Unskilled workers	100	200
Maintenance workers	10	16
Total	132	242

Table 5. Area required for plant site

Item	Area (m^2) Small plant	Area (m^2) Medium-sized plant
Buildings (plant building, warehouse, laboratory, workshop)	24 000	48 000
Land	46 000	96 000

Process flow-sheet for production of cane-sugar



FILE: A-29
ISIC: 3113

How to Start Manufacturing Industries

ASEPTIC BANANA PUREE PROCESSING PLANT*

Banana is grown in tropical countries all the year round at a low cost compared with its price in developed countries with temperate or cold climates. Banana purée began to be marketed in developed countries when the United Fruit Company installed a plant with the trade name Chiquita Banana in La Lima, Honduras, 20 years ago. Banana is normally grown on the coast, at sea-level, with a yield of 18-20 tonnes per hectare. A typical bunch of bananas weighs approximately 22 kg; therefore each tonne consists of 42-45 bunches. All these figures are based on the Nanicao variety or Gros Michel variety, which are the most commercialized and produce the best purée.

When the fruit is intended for export, it is harvested in bunches that are still at a green, ripening stage or three quarters ripe stage.

The selection and classification of fruits for export is one of the most important tasks of a packing house. Only perfect bunches, with no mechanical injuries or spoilage, are selected. All bunches that are not good enough for export are rejected, which makes it necessary to use them in some way in order to reduce costs and make the export of bananas profitable and competitive.

The production of banana purée is a possible solution, as it requires good quality raw material as regards flavour and texture, but at a reasonable price.

The principal world exporters of banana are:

	Approximate quantity (tonnes)
Ecuador	1 600 000
Costa Rica	1 000 000
Honduras	1 000 000
Panama	600 000
Philippines	700 000
Spain (Canary Islands)	400 000
Other countries	2 500 000
Total	7 800 000

The principal world importers of banana are:

	(tonnes)
United States of America	2 000 000
Japan	1 000 000
Germany, Federal Republic of	700 000

continued

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France	500 000
Italy	500 000
United Kingdom of Great Britain and Northern Ireland	300 000
Canada	200 000
Netherlands	150 000
Argentina	100 000
Total	5 450 000

Process description

Selection. After banana bunches have been selected for export, the rejected bunches, which must be in good sanitary condition with no mechanical injuries, are separated into groups of banana fingers. These groups of banana fingers of about one to two dozen bananas are then packed carefully into wooden crates.

Filling of wooden crates. Green bananas are packed in wooden crates that hold around 20 kg. They are not tightly packed so as to allow ventilation. The corners of the crates should be rounded in order to avoid mechanical bruising of the bananas. After each use, the crates must be well washed and sanitized in order to avoid the contamination of fresh lots of bananas.

Ripening. Bananas must be ripened under controlled conditions of temperature and atmosphere. For uniform ripening, ethylene oxide is used.

Temperatures should always be round 20 °C. Since the banana ripening process produces heat, refrigeration and extraction of air are necessary in order to keep carbon dioxide, produced during the respiration process, at a low concentration. Ethylene oxide is introduced into the ripening room at a concentration of 0.001 ppm in nitrogen. Acetylene (1 m^3) can also be used and produced directly in the ripening room by combining water (5.32 g) with CaC_2 (2.66 g). This is applied three times a day at eight-hour intervals during ripening.

Ripened bananas are removed from the ripening room once a yellow colour is well distributed all over the skins, except on the tips, which should still be green. The air should be extracted 12 hours after the first gas has been introduced and every day at 24-hour intervals. Ripening at 20 °C takes about five days, and at the ripened stage, the starch content for purée production should be over 1% in order to obtain a good purée texture.

Washing. The ripened bananas are removed from the ripening room and are washed by soaking them in chlorinated water (10 ppm) and then spraying them with a jet of water at the outlet of the washer. Chlorine should be used to sanitize the surface of the fruit and decrease its initial bacterial count.

Peeling. The ripening and washed bananas are normally skinned over a sanitary conveyor belt. Each worker skins around 100 kg per hour. Skins are discarded since their moisture content is around 95% and therefore dehydration is uneconomical.

Ascorbic acid bath. In order to prevent any browning of bananas before enzyme inactivation, they are treated with a 0.5% solution of ascorbic acid for 30-60 seconds.

Disintegration. Disintegration is accomplished by a Rietz-type disintegrator with a very wide opening in the perforated plate (0.5 in.).

Enzyme inactivation. Using a positive displacement pump the crushed bananas are pumped to a scraped surface heat exchanger, where the fruit should be kept at a temperature of 95 °C for two minutes.

Pulping. At a temperature of 95 °C the purée is pulped in two pulping machines, the first with a 0.033-inch opening plate and the second with a 0.020-inch opening plate. Through this process, seeds and fibres are eliminated and the purée becomes free of dark seed spots, and takes on a very fine texture.

Deaeration. With the temperature still high (90 °C), the purée is deaerated in a centrifuge-type deaerator under vacuum and deposited for a short time in a holding tank, under vacuum.

Sterilization. The purée is pumped to a scraped surface heat exchanger and heated at 140 °C for a sufficient time to obtain a value for F_0 of 5.0.

Cooling. At a temperature of 140 °C the purée is pumped under pressure to a cooling sector where the same type of scraped surface heat exchangers are used and where all rotating parts are of sanitary design to avoid any kind of contamination. At the first aseptic cooling sector, water is used as a cooling medium and in the second stage a refrigerant, directly expanded in the double-walled heat exchanger. This aseptically lowers the temperature of the purée to a temperature of 15-20 °C.

Aseptic filling. The sterilized and aseptically cooled purée is aseptically filled into 200-litre drums, which have been previously sterilized by dry steam at 65 psi. The drums are aseptically filled under vacuum with up to 220 kg of banana purée and finally sealed before the filling autoclave is opened.

Storage. Banana purée that has been aseptically filled is microbiologically stable at room temperature and is therefore stored and transported at room temperature.

Example of aseptic banana purée processing plant

Tables 1-5 are based on a plant with the following production scheme:

Production capacity:	3,000 kg per hour = fifteen 200-litre drums per hour
Operating hours:	8 hours per day
	25 days per month
	300 days per year.

A process flow-sheet is also given below.

Table 1. Machinery and equipment required

Item	Quantity
Boilers	1
Ripening rooms	5
Sanitary conveyor belts	3
Washing bath	1
Disintegrator	1
Positive displacement pumps	2
Horizontal pulper	1

continued

Table 1 (continued)

Item	Quantity
Scraped surface heat exchangers	4
Deaerator	1
Tanks	3
Aseptic drum filler	1
Vacuum system	1
Compressors	2
Fork lifter	1

Note: Price of machinery and equipment f.o.b. (approximately) $US 600,000 (1984 values).

Table 2. Requirement of raw and subsidiary materials (Per month)

Item	Quantity
Bananas (tonnes)	1 200
Ascorbic acid (kg)	20
Steel drums (200-litre drums)	3 000

Table 3. Utilities required

Item	Quantity
Electricity (kW)	50
Steam (kg)	400
Process water (m^3)	15
Fuel (kg)	35
Refrigerant (kg)	0.01
Ripening gas (kg)	0.1

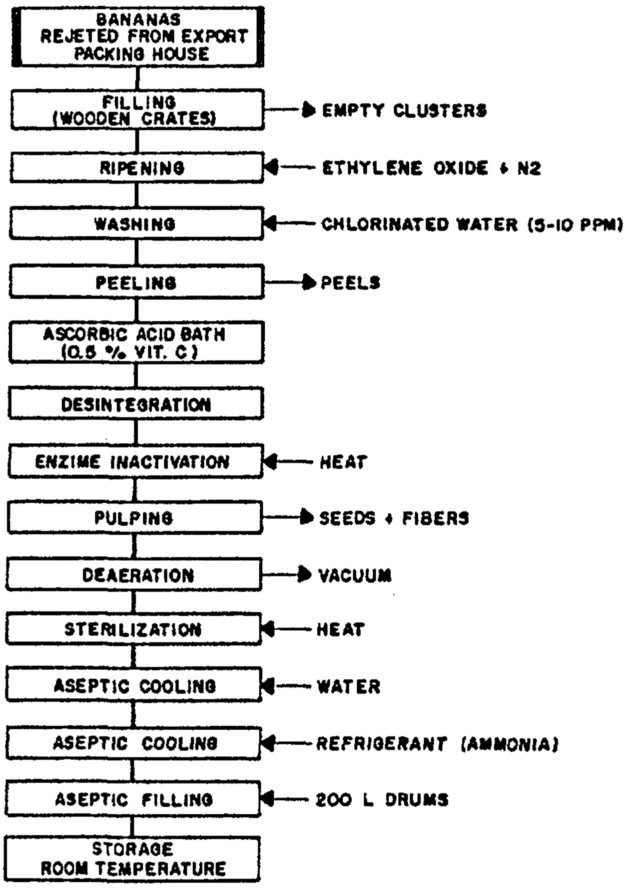
Table 4. Manpower required

Item	Number
Manager	1
Chemist	1
Food engineer	1
Office workers	3
Skilled workers	6
Unskilled workers	60
Maintenance workers	3
Total	75

Table 5. Area required for plant site

Item	Area (m^2)
Buildings (process plant, warehouse, laboratory, workshop, ripening rooms etc.)	600
Land	2 400

Process flow-sheet for an aseptic banana purée processing plant



FILE: A-30
ISIC:3113

How to Start Manufacturing Industries

TROPICAL FRUIT NECTAR PROCESSING PLANT*

Developing countries are generally located in regions with a tropical climate, and therefore have a variety of tropical fruits, such as banana, papaya, guava, cashew and mango, which, if processed, can result in delicious fruit nectars.

Tropical fruits are both expensive and popular in developed countries because of their exotic flavour. It is difficult for developing countries to export fresh fruits, however, because of their delicacy and sensitivity to handling and also because of the lack of the technology required for the growing, harvesting, transporting, packing, ripening etc. of fresh fruits. When fruit is transformed into pulp or nectar, its external appearance is no longer important; only the edible part of the fruit is important for producing nectar. Even when a fruit is damaged in some way, its flavour, texture, appearance and colour may be perfect for the production of pulp or nectar.

Tropical fruit nectar is produced in a very high yield because the pulp is diluted with an acidified syrup, usually in a ratio of 1 to 1.

The fruit is usually peeled manually, and many workers are required. Factors such as the availability of good quality raw material for pulp production, the existence of cheap, unskilled labour, the availability of cheap, arable land and the proximity to seaports, all contribute to the success of a fruit nectar processing industry. Other key factors for the success of the investment are the existence of foreign distributors and good marketing. The main advantage, however, is the fact that developed countries can never compete, as they cannot produce tropical fruits economically.

The equipment used in the production of fruit pulp is very simple, requires little maintenance and consumes little electricity and fuel. The equipment can operate all year round, at full capacity, and factory workers can be hired on a permanent basis since there are a variety of fruits that can be processed and that are harvested at different times of the year.

Process description

The basis for the process described here is a continuous supply of raw material (tropical fruits) throughout the year. In tropical climates, there is no significant change of weather between seasons. Bananas and papayas are harvested for several months of the year, and cashew, guava and mango are usually harvested during a two-month period at different times of the year.

Reception and ripening. Fruit can be used either in its natural state or as pulp that has already been extracted from the fruit and preserved. Fruit can be classified as: (a) climacteric, and (b) non-climacteric.

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When fruit is used as a raw material, ripeness is important. While cashew and guava are harvested when ripe, banana, papaya and mango need to be ripened after harvesting. They should therefore be kept in a ripening room with a controlled atmosphere into which gas can be injected to accelerate the ripening process, and from which the heat produced during the respiration process of the fruit can be removed. Controlled ripening is important in order to develop a good flavour and to achieve a uniformity of raw material, with all fruits ripening at the same time.

Washing and selection. The ripe fruits are washed with chlorinated water (5 to 10 ppm) first by soaking and then by spraying with jets of water.

The washed fruits are then sorted and all the damaged, rotten, overripe and green fruits are rejected.

Peeling and seed removal. Fruits are peeled manually using a stainless steel knife and are transported on a sanitary, rubber conveyor belt. A knife is also used to separate most of the pulp from the seed, but a pulper is necessary to remove the seed completely.

Pulp separation. In this operation all undesirable fibres are removed, as well as the stone cells. The first pulping mill has an opening of 0.033 inches while the second one has an opening of 0.020 inches. After passing through these mills the pulp is very homogeneous and thin.

Formulation. The homogenized pulp is then pumped into formulation tanks where sugar (sucrose), water and citric acid are added. Cashew and guava have a high vitamin C content. But banana, mango, and papaya have a very low vitamin C content, which means that an antioxidant must be added to the pulp to avoid oxidation, which alters the flavour and the colour of the product.

The Brix/acid ratio of the nectars is normally in the range 18-20, but this depends on consumer preference. The final formula of the product should be developed according to the consumers' taste. The final pH should always be under 4.0.

Sterilization. Formulated nectars are continuously sterilized at 95 °C, using a plate-type heat exchanger. This heat exchanger has other stages where the nectar is aseptically cooled under pressure.

When glass bottles are used as containers, the minimum filling temperature of the nectar should be 85 °C. After filling, the bottles are immediately sealed by crown corks.

Sterilized containers such as the Tetra Brik type can also be used, in which case the plate-type heat exchanger aseptically cools the nectar and aseptically fills the sterilized containers.

Cooling. If glass containers are used, the cooling process must be carried out in water baths at 70 °C, 50 °C and at room temperature. Cooling must be gradual to avoid glass breakage owing to thermal shock.

Aseptically filled containers require no cooling because the nectar will have already reached room temperature.

Storage and distribution. The fruit nectar is packed in wooden boxes or cartons, which hold approximately 24 bottles or 30 Tetra Brik containers. Fruit nectar is distributed and stored at room temperature, and has a shelf-life of one year, if it is not exposed to sunlight.

Example of a tropical fruit nectar processing plant

The production capacity of the plant described below is 720,000 litres per month, operating 8 hours per day, 25 days per month and 300 days per year.

The following equipment is necessary:

(a) Universal fruit washer

(b) Sanitary conveyor belts

(c) Pumps

(d) Disintegrator

(e) Pulpers

(f) Tank with agitators

(g) Plate-type heat exchanger

(h) Fillers

(i) Coolers

When aseptically filled containers are used, items (g), (h) and (i) are replaced by an aseptic plate-type heat exchanger and an aseptic filler.

In the first case, the f.o.b. price of the equipment is estimated at $US 300,000. If an aseptic filling is used, the investment required is practically doubled and the f.o.b. price of the equipment is approximately $US 600,000. Both prices are in 1984 values.

Tables 1-4 give an idea of the amount of raw material, utilities, manpower and area required. A process flow-sheet is also given below.

Table 1. Requirement of raw and subsidiary materials
(Per month)

Item	Quantity	
Banana (tonnes)	2 000	
Cashew (tonnes)	1 000	(2 months)
Mango (tonnes)	1 000	(2 months)
Guava (tonnes)	1 000	(2 months)
Papaya (tonnes)	1 000	
Preserved fruit pulp (tonnes)	1 500	
Sugar (tonnes)	900	
Citric acid (tonnes)	7.5	
Ascorbic acid (tonnes)	0.3	
Bottles or	30 000 000	
Tetra Brik containers	15 000 000	

Table 2. Utilities required
(Per 1,000 litres)

Item	Quantity
Electricity (kW)	10
Steam (kg)	160
Process water (m^3)	10
Fuel (kg)	14
Refrigerant (kg)	0.1
Ripening gas (kg)	0.1

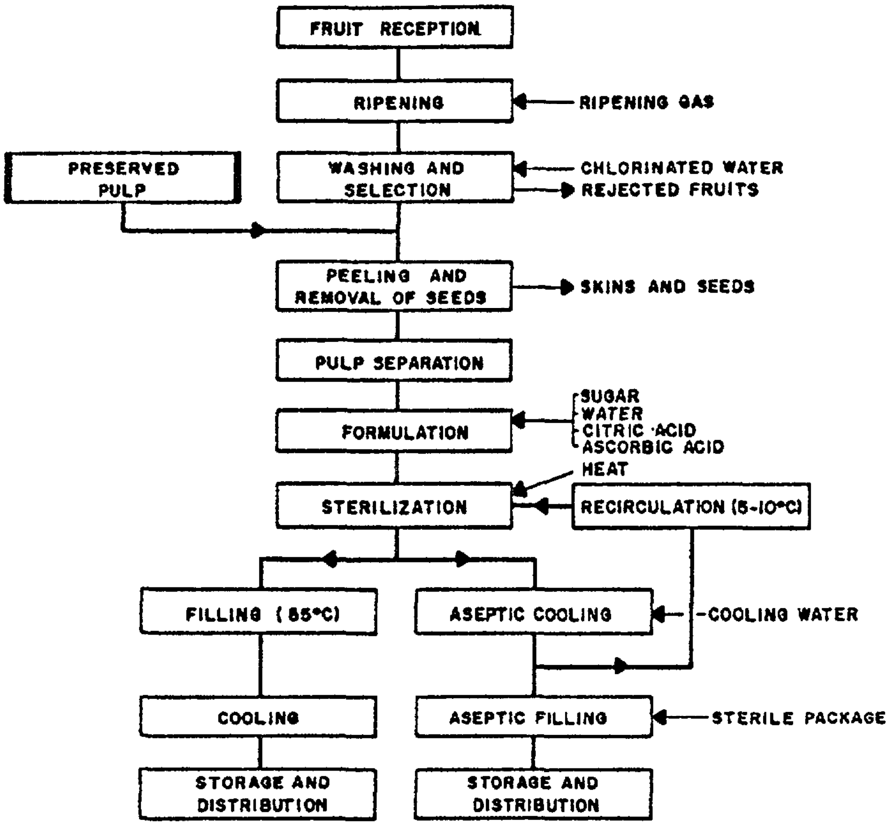
Table 3. Manpower required

Item	Number
Manager	1
Food engineer	1
Skilled workers	5
Unskilled workers	50
Maintenance	3
Total	60

Table 4. Area required for plant site

Item	Area (m^2)
Buildings (process plant, warehouse, laboratory, workshop, ripening room etc.)	1 500
Land	5 000

Process flow-sheet for tropical fruit nectar processing plant



FILE: A-31
ISIC: 3116

How to Start Manufacturing Industries

PROCESSING PLANT TO PREPARE MEALS FROM PREGELATINIZED FLOUR*

Developing countries generally lack, or are deficient in, facilities for distributing food to schoolchildren and especially children of pre-school age. In all developing countries, therefore, authorities emphasize their pre-school and school-lunch programmes to complement insufficient food consumed at home owing to poor economic conditions.

There are special and particular problems concerning school lunch programmes in developing countries. In developing countries, schools normally lack cold storage facilities and are sometimes located far out in rural areas where transportation is precarious. Schools also lack the personnel and the kitchen facilities necessary for the preparation of regular meals. All these difficulties together point to the necessity of including a meal in the school lunch programmes that is:

(a) Easy to prepare;

(b) In dry form;

(c) Easily soluble in water;

(d) Balanced nutritionally in order to meet children's needs;

(e) Palatable for the children;

(f) Able to satisfy at least 20% of a child's daily nutritional requirements in an amount that can be easily eaten and digested in a single meal.

All these requirements indicate that the use of pregelatinized flour could offer a solution. Furthermore, it is less costly than other materials.

A combination of cereal flour with leguminous flour makes the best balance of essential amino acids and satisfies energy requirements. Most developing countries have corn or rice, cereal flours and soy or lupinous leguminous flours that are easily available which, when combined in the right proportions, will provide a balanced meal.

In the last five years, developing countries have recognized the importance of the extrusion and pregelatinization of flour and have begun helping local entrepreneurs to start flour processing industries. Using pregelatinized flour, tasty, balanced, low cost meals can be prepared easily.

Process description

Storage of pregelatinized flour and other raw materials. The plant must have storage facilities, such as silos or warehouses, on the site.

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Pregelatinized flour is sensitive to insect attack and it is therefore essential to ensure that it is free of insects and eggs. Silos must be hermetically sealed to avoid insect contamination.

Formulation. Meals prepared from dry, pregelatinized flour must be formulated with a view to meeting the amino acid and caloric requirements of children. The net derived protein calories % is usually calculated as 6-8; the meal must have a protein content of 10-12% and each portion must weigh from 100 to 150 grams.

Mixing. After the formulation has been determined, all raw materials are transferred to a mixer, which stands on a scale. The mixer receives the pregelatinized cereal and leguminous flours, the pre-mix of essential vitamins and mineral salts, salt or sugar (depending on the flavour of the meal), condiments or flavouring agents and other necessary ingredients and additives.

After the meal has been mixed, it must be analysed in the laboratory to ensure that all the ingredients have been properly mixed and homogenized before packing.

Packaging. The dry meal is given a lot number, which should be labelled on the package. Packaging is done by automatic machines, which weigh the correct amount in a self-sealing pouch. The packages are closed by heated bars. Schools usually prefer to receive 2-kg or 1-kg packages, which are the ideal quantity for preparing meals at school facilities.

Boxing. Individual packages are put together in cardboard boxes, which hold twenty 1-kg bags or ten 2-kg bags. Care should be taken to avoid tearing the protective outer film of the plastic bags, because a damaged plastic film can permit contamination of the bag's contents by micro-organisms or by insects, besides possibly permitting an increase in the moisture content of the product, which would cause spoilage.

The shelf-life of the prepared meals is approximately six months, a time span that should always be observed in order to ensure that the product is palatable for the schoolchildren.

Example of composition of meals prepared from pregelatinized flour

Specific formulations of pregelatinized flour		(Percentage)
(a)	Texturized soy flour (150 mesh)	14.5
	Pregelatinized corn flour	74.0
	Sucrose (refined)	11.0
	Soybean oil (refined)	0.5
(b)	Texturized soy flour (200 mesh)	20.0
	Pregelatinized corn flour (200 mesh)	40.0
	Lecithin (60% acetone insolubles)	1.0
	Molasses (82% total solids)	6.0
	Sucrose (refined)	30.0
	Flavour, colour, pre-mix (vitamins and minerals)	3.0
(c)	Texturized soy flour (200 mesh)	10.0
	Wheat bran (100 mesh)	34.0
	Refined soybean oil	3.5
	Lecithin (60% acetone insolubles)	3.0
	Molasses (82% total solids)	5.0
	Sucrose (refined)	43.0
	Flavour, colour, pre-mix (vitamins and minerals)	1.5

Tables 1-5 show different aspects of production for a plant producing 200 tonnes of pregelatinized flour per month, operating 8 hours per day, 25 days per month and 300 days per year. A process flow sheet is also given below.

Table 1. Machinery and equipment required

Item	Quantity
Silos	4
Screw conveyors	8
Mixing machine on scale	1
Packaging machine	1
Conveyor belts	5
Boxing belt	1

Note: Price of machinery and equipment f.o.b. (approximately) $US 80,000 (1984 values).

Table 2. Monthly requirement of raw and subsidiary materials (According to a specific formulation)

Item	Quantity
Extruded soy flour (tonnes)	30
Pregelatinized corn flour (tonnes)	65
Pregelatinized rice flour (tonnes)	65
Sugar (tonnes)	30
Salt (tonnes)	0.2
Vitamin pre-mix (tonnes)	0.4
Mineral pre-mix (tonnes)	0.4
Flavouring agent (tonnes)	3.0
Colour (tonnes)	1.0
Oil (tonnes)	5.0
Polyethylene bags	100 000
Cardboard boxes	10 000

Table 3. Utilities required (Per tonne of dry meal)

Item	Quantity
Electricity (kW)	12
Process water (m^3)	0.2

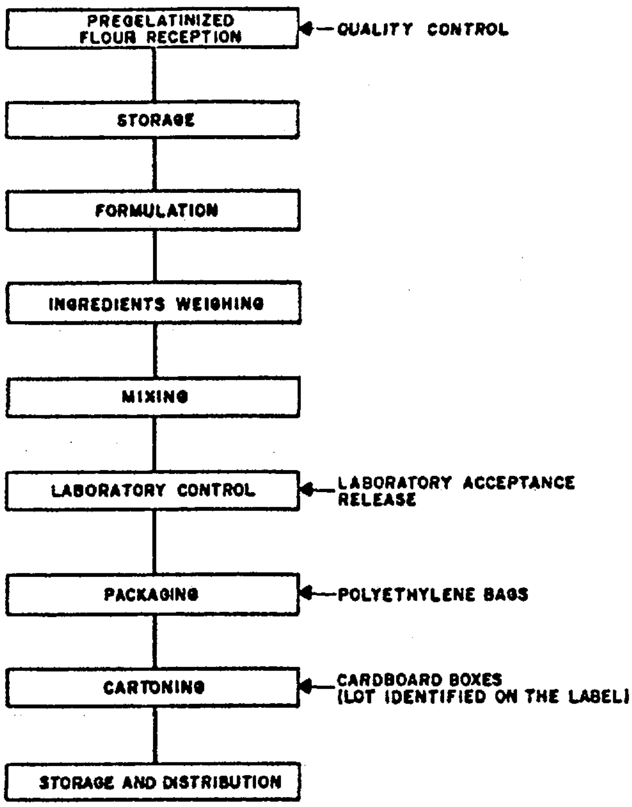
Table 4. Manpower required

Item	Number
Manager	1
Chemist	1
Food engineer	1
Office workers	2
Skilled workers	2
Unskilled workers	8
Maintenance worker	1
Total	16

Table 5. Area required for plant site

Item	Area (m^2)
Buildings (plant building, laboratory, warehouse, maintenance shop etc.)	600
Land	2 000

Process flow-sheet for a plant to prepare meals in powder form from pregelatinized flour



FILE: A-32
ISIC: 3115

How to Start Manufacturing Industries

SOY MILK PROCESSING PLANT*

Over the last 10 years, the production of soybean has been increasing worldwide. At present, world production is around 70 million tonnes per year. The production of soybeans is expanding in developing countries and is very significant in Argentina, Brazil, Colombia, Mexico, Paraguay and Uruguay. The United States of America is the biggest producer, and accounts for one third of the world's production. Prices of the soybean are governed by international market forces and its commercialization is easy.

The soybean is used mainly for edible oil. Because of its protein content, the soybean is used in China in different foods and beverages. In terms of protein production per hectare, the soybean has the highest yield (800 kg) at the lowest price and, compared with all other vegetable proteins, its amino acid composition is one of the best. Soybeans have a content of approximately 40% protein and 20% oil, and can be considered to be a concentrated protein food, such as cows' milk. Significantly, one kilogram of soybeans produces eight litres of milk, with a protein content equal to that of cows' milk. The difference is that cows' milk requires special storage conditions, whereas soybeans can be stored easily and cheaply. If the beans are cleaned and dried to a moisture content of less than 12%, they can be stored for a year without any significant loss of quality.

The soybean has been used as a food in the East for a long time. There are consistent and credible indications that even as long ago as 5,000 years, the soybean was being used as a principal source of nutrients and was considered to be a holy food by priests.

Up to 15 to 20 years ago, the technology used for producing soy milk was so primitive that, in the West, people would not drink the milk because of its disagreeable flavour. In the Orient, people are used to this flavour, caused by the oxidation of the oil during the disintegration process at room temperature. It was discovered later that by disintegrating soybeans at higher temperatures (over 83 °C), the beany flavour disappeared and the taste of the milk became acceptable to Western consumers.

Process description

Cleaning and selection. Soybeans must be cleaned and sorted before they are stored in silos or in bags, and there are machines that have been specifically built to perform these tasks. The beans should not be damaged or split mechanically; they must be whole, and clean. Moisture content should be continuously controlled, and should always remain under 12%.

Washing and soaking. Soybeans must be carefully washed in order to remove all particles of dirt. After washing, the beans are soaked for five hours in running water at room temperature. The beans absorb water, thereby increasing their weight 2-3 times.

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Grinding. The soaked beans are disintegrated in hot water in the following proportions: 2.3 parts of soaked soybeans to 7.7 parts of hot water (98 °C). In this way, the grinding temperature is over 80 °C, which is too high for enzymatic activity. After grinding, a slurry is formed with particles smaller than 1.0 mm.

Milk separation. A continuous centrifugal process (using a 200 mesh stainless steel cloth) separates the slurry into two phases: milk and insoluble bean particles. The better the grinding is, the higher the yield of protein extracted from the soybean will be. Each 10 kg of slurry produces 8 litres of milk and 2 kg of insolubles with a moisture content of 80%.

Formulation. The milk is then heated to 80 °C and sugar, salt, flavour and stabilizing agents are added in a formulation tank with an agitator. Different flavours can be used, for example: banana, guava, chocolate, strawberry, caramel, butter, coconut or coffee. The amount of sugar added can vary between 4% and 15%, according to taste. Stabilizing agents, such as locust bean gum and caraginate, and approximately 0.1% of salt are also added.

Sterilization. Formulated soy milk, with 3% protein, is sterilized in a heat exchanger at 140 °C for a few seconds, and is then immediately cooled, first at room temperature and afterwards, at the end of the cooling process, at 2-5 °C. Both processes, sterilization and cooling, are carried out in a plate-type heat exchanger in four stages. The heat is utilized efficiently, the same heat being used to raise the temperature of the water to be used in the grinding process to 98 °C.

Packaging. The sterilized and cooled milk is filled into one-litre polyethylene pouches. The temperature of the milk during filling should be in the range of 2-5 °C. The pouches are then packed in plastic containers with a capacity of 10 pouches. All plastic containers are of the auto stack type and are stored under refrigeration.

In order to avoid spoilage, soy milk must be consumed no later than two or three days after processing.

Example of a production scheme for a soy milk processing plant

Tables 1-5 are based on a plant with a production capacity of 300 to 400 thousand litres of soy milk per month, operating 12 hours per day, 25 days per month, 300 days per year. The plant can operate with two shifts of 8 hours per day. Figure I shows a simplified set of equipment and figure II is a process flow-sheet.

Table 1. Machinery and equipment required

Item	Quantity
Washer	1
Soaker	1
Grinder/centrifugal filter	1
Tanks with agitators	3
Pumps	3

continued

Table 1 (continued)

Item	Quantity
Plate-type heat exchanger	1
Filling machine for pouches	1
Cold room	1
Isothermic truck	1
Drier	1
Boiler	1

Note: Price of machinery and equipment f.o.b. (approximately) $US 200,000 (1984 values).

Table 2. Requirement of raw and subsidiary materials (Per month)

Item	Quantity (tonnes)
Soy beans	38
Sugar	25
Salt	0.25
Flavour	0.80
Stabilizer	0.80
Packaging (one-litre packages)	300 000

Table 3. Utilities required (Per 1,000 litres)

Item	Quantity
Electricity (kW)	150
Steam (kg)	30
Process water (litres)	3 000
Fuel (kg)	2.5
Refrigerant (NH_4) (kg)	0.5
Caustic soda (kg)	12.5
Sodium hypochlorite (kg)	1.2

Table 4. Manpower required

Item	Number
Manager	1
Food engineer	1
Skilled worker	1 a/
Unskilled workers	6 a/
Maintenance worker	1 a/
Total	10

a/ For one shift.

Table 5. Area required for plant site

Item	Area (m^2)
Buildings (plant building, warehouse, laboratory, workshop, cold room, garage etc.)	500
Land	5 000

Figure I. Simplified set of equipment for soymilk processing plant

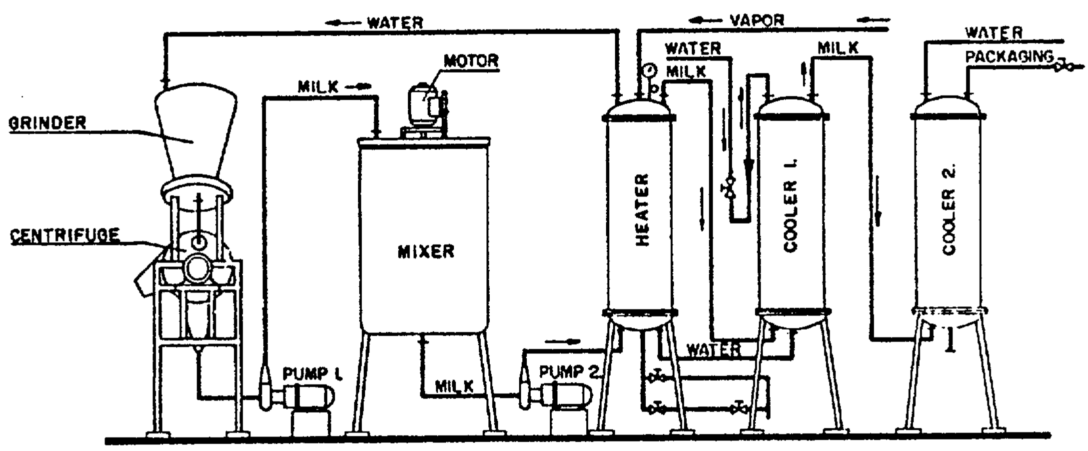
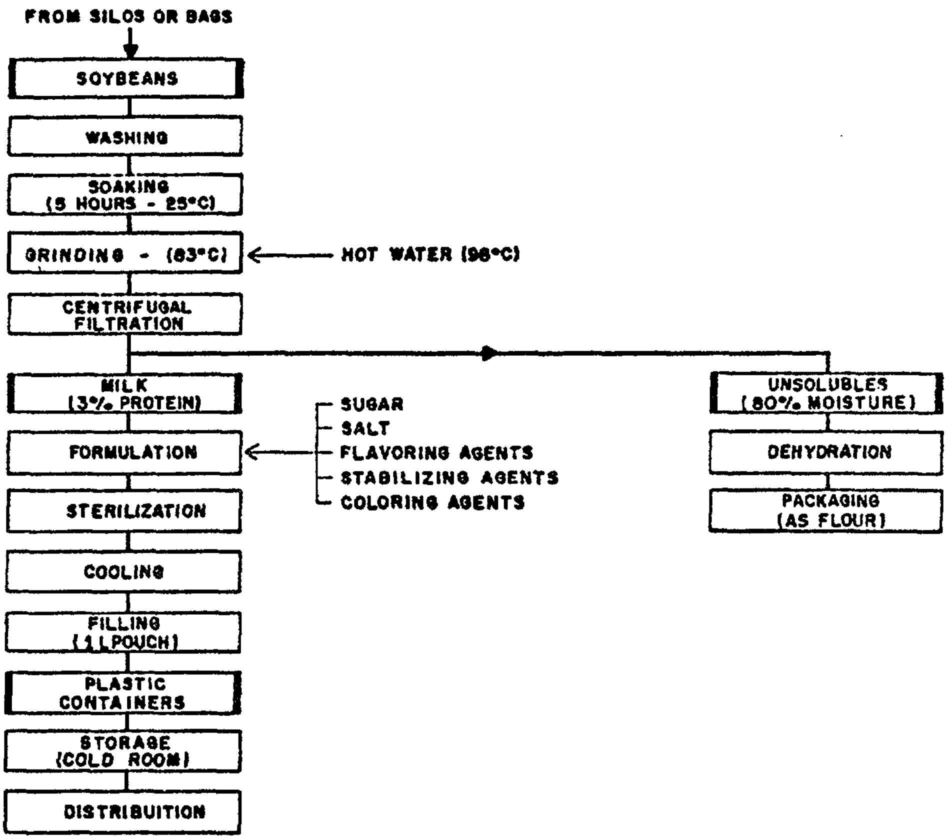


Figure II. Process flow-sheet for soymilk processing plant



FILE: A-33
ISIC: 3121

CASSAVA FLOUR AND STARCH PROCESSING PLANT*

Cassava root is very susceptible to spoilage and can only be used as a food if it is consumed within one to three days of harvesting. There are several methods of preserving cassava roots, such as covering them with earth or immersing them in water under refrigeration, but these procedures are not efficient and only preserve the raw product for a short period of time.

Nevertheless, cassava root can be transformed into food products that can be conserved for a long time. It can also be used as a raw material for other industries. The following products can be obtained from cassava root: flour, starch (sweet or fermented), pellets, flakes and alcohol.

After the grey pellicle that covers the cassava root has been eliminated, it has the following composition:

65–75% water

2–5% crude protein

0.5–0.5% cellulose

0.1–1.5% fat

18–23% starch

0.5–1.9% ash

The composition varies with the age of the root and the variety of the plant.

Starch content is the most important factor in industrial yield, and can vary between 2% and 40%. An average yield of 21–23% of starch can be assumed for industrial purposes, as these amounts of starch are those most frequently obtained by industries when the roots are harvested at the right stage of development. Harvesting should be carried out when the crop yield and starch content are likely to be highest. Nevertheless, several other factors also influence production and the understanding and observation of them directly affects industrial yields and production costs.

The sanitary condition of cassava roots and their hygienic conservation are very important for the success of the industry and for good product quality.

A good harvesting plan is important to ensure a continuous supply of raw material for uniform production and also to avoid the accumulation, and risk of spoilage, of raw material. The supply of roots should never exceed a production capacity of 24 to 30 hours. The basis suggested for calculating storage facilities for roots is 600–700 kg of roots per cubic metre.

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Process description

A. Flour production

Peeling, washing. Roots may contain up to 10% of stones and soil on arrival from the field. The roots are then washed and peeled in a peeler-cum-stone-remover, for which a good deal of water is needed, and, through rotation, soil particles and the greyish pellicle are removed. Perfect washing and peeling increase the quality and uniformity of the final product resulting in a flour that is whiter and cleaner, with a lower cellulose content. Between 5% and 10% of the initial weight of the root is lost in the washing and peeling process.

Selection. The washed and peeled roots are sorted and any aerial parts of the plant, as well as parts with skin, are discarded. Only well washed and peeled roots are kept.

Grinding. Grinding is done by special machines that scratch the roots in the same way as Parmesan cheese is ground. Usually the grinders either consist of alternately moving parallel saws, which disintegrate the roots into a mass, or of rotating cylinders, which rotate at 1,200-1,500 rev/min, with internal parallel saws.

Pressing. After disintegration, the cassava is very moist. Significant amounts of water can be removed through pressing, which also eliminates internal air pockets, thereby decreasing oxidation.

Pressing is carried out in double vertical hydraulic presses that operate intermittently. Each set can process 10 tonnes of roots per day (15 h/day), eliminating 20-30% of the water content. This water contains 5-7% starch, which can be recovered through centrifugation.

Disintegration. Using a regular disintegrator, rotating at 600 rev/min, the pressed cake is disintegrated and then passed through a vibrating screen of fine mesh, which retains fibre, skin and pieces of root, and also facilitates mass disaggregation. Material retained by the screen, after drying, is a by-product used mostly as animal feed.

Toasting. Toasting is a very delicate operation and the most important one, determining the quality of the cassava flour and the flavour, colour and shelf-life of the final product. Toasters are basically horizontal steel plates that rotate over a heat source. The moist flour is distributed over the rotating plates by means of a vibrating screen. After one or two rotations, the flour is dried and formed into flakes. It is then brushed off the plates into a storage box where it is cooled.

Disintegration. The flakes are disintegrated in a hammer mill or a disk friction mill. The agglomerated pregelatinized starch is ruptured and a fine flour can be obtained.

Sifting. The disintegrated flour is sifted through a horizontal, vibrating set of screens, usually divided into four sections of different meshes, which separate the following products according to mesh:

Product	Mesh (mm)
Very fine flour	0.17
Fine flour	0.17-0.50
Medium flour	0.50-1.00
Coarse flour	1.00

Each screen is four metres long.

Packaging. Flour is packed in polyethylene bags with a capacity of 0.5 and 1 kg. The yield is usually 25 to 35 kg of flour from 100 kg of raw cassava root.

B. Starch production

This size of plant can process 45 to 50 tonnes of cassava root per day with 20% of starch.

Peeling, washing. This operation is similar to that used in flour production, but uses washers of a greater capacity.

Grinding. The smaller grinders are replaced by more sophisticated grinders, which first grind the root into pieces of 3-5 mm in size and then disintegrate them into a fine slurry.

Separation. Slurry from the disintegrator is separated in a conical separator. Starch is separated from the fibre by a 125-mm mesh screen that rotates at high speed. Additional separators can be placed in series so that the fibres can pass from one separator to another until the starch is completely washed out of the cellulosic fibres.

Purification. The separated starch is washed with water and centrifuged in a decanter. The starch milk is concentrated to 22-25 °C Bé and then passed through a vacuum filter, which removes water until the final moisture content is 45%.

Drying. The starch (with a moisture content of 45%) is dried by hot air, at 100-110 °C, flowing parallel to the starch, or else by air-lift driers. The starch powder is very fine and does not require further milling. Good yields are obtained and more than 90% of the original starch in the root can be recovered through the processes described above.

Example of a production scheme for a cassava flour and a starch processing plant

Tables 1-5 are based on:

(a) A flour plant with a production capacity of 150 tonnes per month, operating 15 hours per day, 25 days per month, 120 days per year;

(b) A starch plant with a production capacity of 250 tonnes per month, operating 24 hours per day, 25 days per month, and 120 days per year.

A process flow-sheet is given below.

Table 1. Machinery and equipment required

Item	Quantity	Item	Quantity
Flour		Starch	
Peelers-washers	1	Peelers-washers	1
Conveyors	2	Grinder	1
Grinders	1	Separators	2

continued

Table 1 (continued)

Item	Quantity	Item	Quantity
Presses	2	Centrifuges,	
Grinders	1	Super-D-canter	1
Toasters	1	Vacuum filter	1
Disintegrators	1	Drier	1
Sifters	2		
Packing machine	1		

Note: Prices of machinery and equipment f.o.b. Flour plant (approximately) $US 90,000; starch plant (approximately) $US 400,000 (1984 values).

Table 2. Requirement of raw and subsidiary materials
(Per month)

Item	Quantity	
	Flour	Starch
Cassava roots (tonnes)	540	1 250
Packages (1 kg)	162 000	250 000
Sulphur dioxide (kg)	-	420

Table 3. Utilities required
(Per tonne of product)

Item	Quantity	
	Flour	Starch
Electricity (kW)	80	1 650
Water (m^3)	40	40
Wood (m^3)	30	18

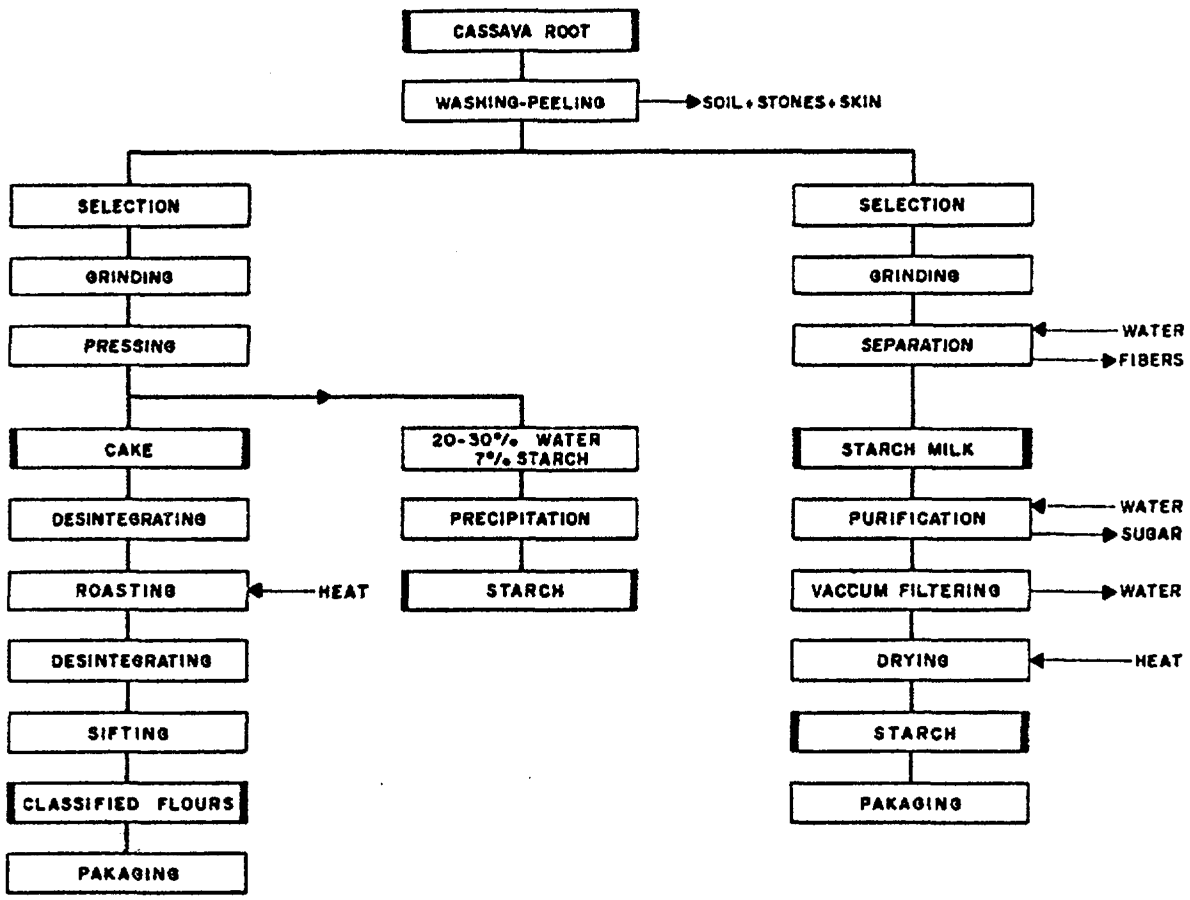
Table 4. Manpower required

Item	Number	
	Flour	Starch
Manager	1	1
Food engineer	1	1
Supervisors	1	2
Office workers	2	3
Unskilled workers	10	4
Maintenance workers	2	2
Total	17	13

Table 5. Area required for plant site

Item	Area (m^2)	
	Flour	Starch
Buildings (plant buildings, warehouse, laboratory, workshop etc.)	800	400
Land	3 000	2 000

Process flow-sheet for production of cassava flour and starch



FILE: A-34
ISIC: 3116

How to Start Manufacturing Industries

SOY FLOUR PROCESSING PLANT*

Soy proteins are available on the market in the form of defatted flours, protein concentrate, protein isolate but seldom as whole flour, which includes the seed oil with all its vitamin E, phospholipids and micronutrients intact, essential compounds that are rarely found in regular daily diets. By refining soybean oil, essential micronutrients are eliminated: extracted soybean oil is separated from phospholipids (lecithin) through the degumming process and, in the deodorization process, part of the vitamin E is also lost.

The production of whole soybean flour has the significant advantage that the micronutrients are preserved. The diets of all pre-school and school children should normally contain vitamin E and lecithin, since these compounds are essential for the development of the brain and the nerve-cells.

As soybean flour, when defatted, is very rich in protein (50%), its consumption alone is not recommended, since a balanced food must contain approximately 2-3 g of protein for every 100 calories.

Whole soybean flour, however, is a more balanced meal than defatted flour because oil has a calorific value 2.2 times higher than sugar or other carbohydrates.

Using today's technology, it is possible to produce whole soybean flour with a much better and more stable flavour than was possible some years ago. Through extrusion, enzymes and anti-nutritional factors found in the soybean are inactivated, the beany flavour is practically eliminated, and the lipolytic enzymes that can turn the oil rancid are denatured.

The fact that the oil is left in the flour makes the business more profitable, because 20% of the flour is oil, which is sold together with the proteins at a higher price than pure oil. Soy flour has a higher sales value than refined soybean oil.

Process description

Storage. Soybeans must be dried immediately after harvesting. Whole beans should be stored only after removing soil, stones, leaves and broken and split beans. Moisture content should not exceed 12% and storage temperatures must be kept under 30 °C.

Drying and dehulling. When processing whole flour, soybeans should be well dried to make the hulls brittle. After being broken into 8-10 parts in the roller mill, the brittle hulls separate from the cotyledons.

Separation of hulls from the cotyledons. Using ventilation, the lighter hulls are removed. Sometimes, by combining ventilation and aspiration, a better separation of the hulls is possible. The separation is made by

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dropping the broken beans counter to the direction of the air flow. The hulls are thus expelled through a tube together with the air, leaving the heavier cotyledons to fall.

Preconditioning. The cotyledons are pre-humidified until their moisture content is 25-30%, using water and steam in a horizontal cylinder with agitation paddles in a helical distribution on an axle. The solid parts are agitated while water and steam are injected and in this way absorbed by them.

Extrusion. Pre-conditioned solid particles are extruded through an extruder that lightly compresses the mass. Friction also occurs inside the screw cylinder increasing the temperature and destroying the antitrypsin factor. Flavour is bland and neutral.

The product leaves the extrusion cylinder through a die and the pressure drops drastically with a corresponding expansion in volume, breaking the cells. This releases the oil from the tissues but it is immediately reabsorbed after the extrusion process ends.

Drying and cooling. Part of the moisture is lost in the extrusion process because the temperature rises to 120-130 °C at the end of the process. The low external pressure outside the die causes immediate water evaporation, which expands the soybean particles. A belt-type drier with hot air under the bed moves the product in the first drying stage. Cold air finishes the drying process and reduces the temperature, which facilitates milling. The final moisture content is approximately 5-6%.

Milling. The Alpine type of pin-mill is used for milling whole soy flour. This type of mill requires low temperatures and consequently there are no fat plastering problems.

The final mesh can be reduced to 100-150. The final composition of the flour is approximately:

	Percentage
Protein	40
Fat	20
Fibre	3.5
Carbohydrates	28
Ash	4-5
Moisture	5

Example of a production scheme for a whole soy flour processing plant

Tables 1-5 are based on a plant with a production capacity of 75 tonnes per month, operating 12 hours per day, 25 days per month and 300 days per year. A process flow-sheet is also given below.

Table 1. Machinery and equipment required

Item	Quantity
Boiler	1
Drier	1

continued

Table 1 (continued)

Item	Quantity
Dehuller	1
Grinder	1
Extruder	1
Drier-cooler	1
Pin mill	1
Packaging machine	1

Note: Price of machinery and equipment f.o.b. (approximately) $US 200,000 (1984 values).

Table 2. Requirement of raw and subsidiary materials (Per month)

Item	Quantity
Soybeans (tonnes)	80
Polyethylene bags (1-kg units)	40 000
Polyethylene bags (50-kg units)	700

Table 3. Utilities required (Per 1,000 kg)

Item	Quantity
Electricity (kW)	300
Steam (kg)	480
Process water (m^3)	0.5
Fuel (litres)	40

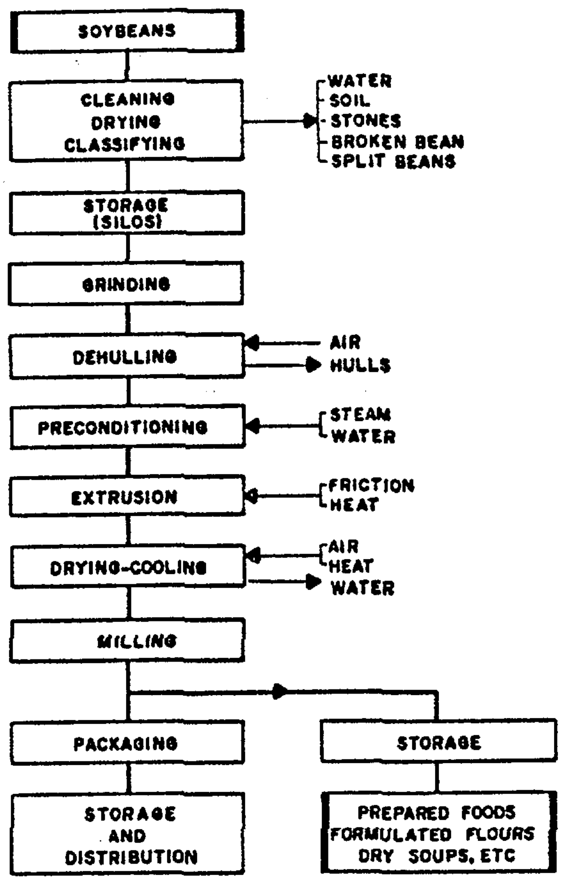
Table 4. Manpower required

Item	Number
Manager	1
Chemist	1
Skilled workers	2
Unskilled workers	6
Maintenance worker	1
Total	11

Table 5. Area required for plant site

Item	Area (m^2)
Buildings (plant building, warehouse, laboratory)	500
Land	2 500

Process flow-sheet for production of whole soybean flour



FILE: A-35
ISIC: 3111

How to Start Manufacturing Industries

POULTRY PROCESSING PLANT*

In the last 20 years, the consumption of poultry has increased considerably owing to the speed at which fowl mature and to the small amount of feed required per kilo of meat produced. Depending on climatic conditions, particularly the temperature and the type of technology used, broilers may be raised and processed in small and cheap buildings. For instance, 12,000 broilers can be raised in an area of 1,200 square metres and it is possible to obtain a final weight of 1.5 kg per bird. Thus, one tonne of broiler meat can be produced in an area of 65 to 67 square metres in 45 to 50 days on 2.2 tonnes of animal feed.

Poultry processing has an industrial yield of 75-78% and all residue is transformed into valuable raw material for animal feed, which can be used by the broiler producers.

This type of food industry is successful when the following requirements are met:

(a) Suppliers of poultry feed must work in perfect harmony with the broiler producers, providing well-balanced feed at competitive prices;

(b) The producers must have suppliers of chicks nearby who provide good genetic material;

(c) A good technical team must be created, with responsibility for programming broiler production, so that there is a continuous and uniform supply of chicks. The team may also advise producers on disease control, hygienic practices etc. A good understanding between the technical team and the production manager of the plant must exist;

(d) Good manufacturing and hygienic practices and control must be adhered to in the processing plant;

(e) Good refrigeration capacity must be available.

The main raw materials used in animal feed are corn and soybeans, which can be whole or defatted, but only defatted meal is used. These two raw materials represent 90% of the broilers' feed, the other 10% being broiler-processing residues, vitamins and mineral pre-mix and possibly other raw materials, depending on market availability and costs. Animal feed represents approximately 70% of the final cost of the frozen broiler meat.

Process description

Hanging. The birds are manually taken from the wooden or plastic transportation crates and hung upside down by their feet on a transporting chain.

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*This information was prepared for UNIDO by CONSULTEC Comercial e Serviços Técnicos Ltda., Brazil. Inquiries should be sent to: Department for Industrial Promotion, Consultations and Technology, Registry file no. ID/562/12, UNIDO, P.O. Box 300, A-1400 Vienna, Austria.

<u>Bleeding</u>. The birds, hanging upside-down, are bled by the jugular vein.

<u>Feather removal</u>. The birds pass through a tunnel where they are sprayed with hot water (at a temperature of 60-65 °C) in order to facilitate feather removal. The birds then pass through a series of rotating "fingers" that beat them, removing all feathers.

<u>Decapitation</u>. A special hook removes the heads of the birds.

<u>Evisceration</u>. By opening the anus, the lungs are aspirated by a vacuum device and the entrails are removed by special forks. This operation is carried out under a shower of water.

<u>Washing</u>. After evisceration, the birds are internally and externally washed with a shower of clean water.

<u>Cooling</u>. The eviscerated, washed birds are then cooled in a continuous counter-current cold water bath. The body temperature of the birds must drop to 8-10 °C.

<u>Feet cutting</u>. Feet are cut in a continuous process after the broilers have been hung on a continuously moving chain by a double-disc knife device.

<u>Neck cutting</u>. Necks are cut by an automatic knife. Afterwards, the birds are finally ready for weighing.

<u>Classifying</u>. The cooled broilers are classified by weight on automatic weighing scales that separate the birds into several lots with weight differences of up to 50 grams.

<u>Packing</u>. Broilers in the same weight lot are placed on a sanitary conveyor belt and manually stuffed with bags containing the stomach, liver and heart. On the same belt they are then manually packed into polyethylene pouches and tightly closed by wire clips. The packed broilers are placed in groups of 10 in waterproof cardboard boxes, which are sealed manually and marked with a label containing the final net weight, the production date, lot identification, and other necessary information.

<u>Freezing</u>. Boxes are continuously frozen on a conveyor belt, which carries them through a cold room at a temperature of -35 °C with a very intensive circulation of air. The final temperature of the birds must be around -15 °C.

<u>Cold storage</u>. After the boxes have been frozen in the freezing tunnel, they are stored on pallets inside the freezing rooms at a temperature of -20 °C. The shelf-life of frozen broilers produced with this technology is 12-18 months, provided that the storage temperature is always maintained at -20 °C.

<u>By-products</u>

Blood is collected on a collecting tray under the continuously moving hanging chain and, together with the lungs, is transported by the blow tank process to the by-products department to be dried.

The feathers, entrails, heads and feet are transported to the by-products department by the water used for washing. The feathers are transported in a channel, by gravity, to the by-products department where they are first separated from the water and then cooked in an autoclave in order to hydrolize the proteins in the feathers. After cooking, the mixture is drained and dried.

The necks are frozen and the meat is mechanically separated from the bones. Meat must be frozen immediately to avoid microbial growth.

The liver, heart and gizzard are manually separated from the entrails, washed, refrigerated, packed in polyethylene bags and frozen. Later they are stuffed into the broiler cavity, before final packing (see the paragraph entitled "Packing" above).

Example of a production scheme for a poultry processing plant

Tables 1-5 are based on:

(a) A small plant with a production capacity of 250 tonnes per month working 10 hours per day, 25 days per month and 300 days per year;

(b) A medium plant with a production capacity of 1,000 tonnes per month, operating 12 hours per day, 25 days per month, 300 days per year.

A process flow-sheet is also given below.

Table 1. Machinery and equipment required

Item	Quantity: Small plant	Quantity: Medium-sized plant
Boiler	1	1
Compressors	2	4
Water treatment	1	1
Hanging chains	1	1
Conveyors	2	4
Feather-removing equipment	2	3
Vacuum lung aspirators	1	1
Washing showers	4	4
Cooling water tank	2	2
Automatic weighing scales	1	1
Freezing tunnel	1	1
Freezing room	1	1
Autoclaves	1	2
Digestor	1	2
Silos	1	3
Edible entrail lines	1	1

Note: Price of machinery and equipment f.o.b. Small plant (approximately) $US 230,000; medium-sized plant (approximately) $US 600,000 (1984 values).

Table 2. Requirement of raw and subsidiary materials
(Per month)

Item	Quantity: Small plant	Quantity: Medium-sized plant
Birds (1.5 kg each)	375 tonnes	1 620 tonnes
Polyethylene bags (1 kg)	260 000	1 050 000
Polyethylene bags (edible entrails)	260 000	1 050 000
Cardboard boxes	26 000	105 000

Table 3. Utilities required
(Per tonne of final product)

Item	Quantity: Small plant	Quantity: Medium-sized plant
Steam (tonnes)	1.8	1.6
Fuel (kg)	150	125
Process water (m^3)	30	30
Electricity (kW)	380	365
Refrigerant (kg)	0.1	0.1

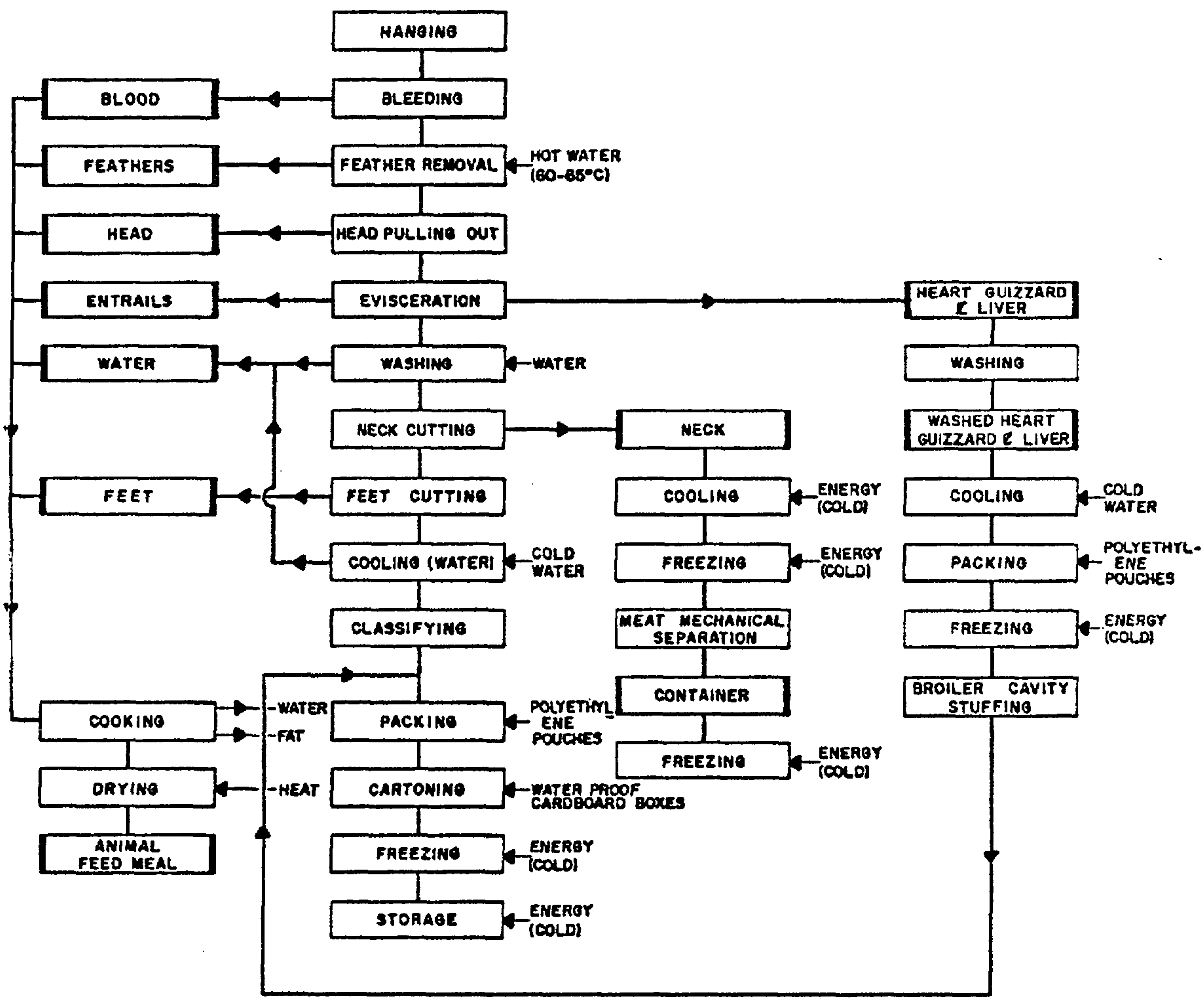
Table 4. Manpower required

Item	Number: Small plant	Number: Medium-sized plant
Superintendent	1	1
Managers	1	2
Food engineers	1	3
Chemists	1	2
Supervisors	7	7
Unskilled workers	100	300
Skilled workers	6	30
Maintenance workers	3	5
Total	120	350

Table 5. Area required for plant site

Item	Area (m^2)	
	Small plant	Medium-sized plant
Buildings (plant building, boiler plant, laboratory, workshop, freezing rooms etc.)	1 500	3 500
Land	4 000	10 000

Process flow-sheet for poultry processing plant



CATTLE SLAUGHTERHOUSE

Small slaughterhouses equipped for complete processing are well suited for small towns and daily supply of the population with fresh meat in countries with extensive cattle breeding.

Generally such slaughterhouses can only be built on well drained terrain which is not susceptible to floods and pollution from other sources. Care must be given to the pens and sheds in the slaughterhouse which must be easy to clean and disinfect. Main and other buildings must be fenced to prevent the uncontrolled entrance of animals and must be located in such a way that the paths in the clean and nonclean areas do not intersect. Lastly, slughterhouse refuse must be eliminated and passed into adequate vessels and containers.

The slaughterhouse for the slaughter and processing of cattle described here is of medium capacity.

The technological process and operation guarantee maximum sanitary conditions.

The process alllows for the organized input of cattle, slaughtering, storage and output of finished products. Besides buildings the slaughterhouse also requires electrical energy and clean water. A small quantity of the clean water is heated for cleaning and washing purposes.

PROCESS DESCRIPTION

The slaughtering line is designed to provide for complete processing of cattle in a suspended position. The small capacity of the line does not require the incorporation of conveyers and transportation at the lines is done manually. For the same reason blood processing is not included.

Cattle supplied to the slaughterhouse are weighed on a cattle balance and then unloaded along the reception ramp into pens for rest.

They are stunned by a gun in a box and afterwards slaughtered and removed to the bleeding line where blood is collected in a basin. The carcasses are loaded by electric

This information has been prepared for UNIDO by the Institute for Developing Countries, Yugoslavia. Inquiries should be addressed to: IPCT/II/PROM, Registry file No. ID/562/12, UNIDO, P.O. Box 300, A-1400 Vienna, Austria.

hoist from the slaughter line to the processing line. Loading, spreading of rear legs and dehiding are carried out on a three level platform, and final dehiding done on a two level platform by means of a pneumatic knife.

The horns are removed by electric saw, and the heads inspected and washed. The brisket is opened by electric saw, the entrails inspected and extracted. Inspection takes place on an inspection table. Stomach and casings are transported for cleaning. Carcasses are split into halves which are washed and inspected by a vet. After inspection the halves are quartered and transferred to a low rail. Before transfer to the storage room the meat is weighed on a suspended rail balance.

Hides are transported to the hide storage from where they are despatched to the processing hall or casing room, depending on the kind of hide.

The meat is cut on tables in the cutting room by means of electric or hand operated saws and knives. Cold storage then provides for the complete cooling of the meat at 0°C, while half the capacity may be frozen at -35°C. Meat from 500 cattle can be frozen.

Staughter and processing of cattle is a continuous process.

PRODUCTION CAPACITY

On the basis of an eight hour day the capacity of the slaughterhouse is 60 cattle a day.

REQUIRED MACHINERY AND EQUIPMENT

I t e m	No.
Electric hoists	4
Stunning box	1
Stunning gun	1
Platforms for cattle processing	7
Electric saws for cutting and splitting	4
Pneumatic knive	1
Hooks for various purposes	260
Pneumatic spreader	1
Carts for various puposes	26
Stand by spreader	1
Sterilizers for slaughtering tools	5
Processing and inspection tables	13
Pipe rail with supporting construction	650 m
Rail balances up to 500 kg	2
Cattle balance up to 2 000 kg	1
Floor balances up to 200 kg	5
Machine for washing and cleaning of stomach	1
Device for casing processing	

Wash basins for washing hands	5
Hand sprayers	12
High effect pumps for washing	2
Pumps for discharging manure	2
Laboratory equipment	1 set
Other slaghtering equipment	1 set

FOB price of equipment and project is 180 000 US dollars (in 1985).

REQUIRED RAW MATERIALS

Cattle .... 60 per day
Salt .... 10 kg per day

REQUIRED MANPOWER (for two shifts)

Qualification	No.
Veterinarians	2
Butchers	37
Workers	10
Clerks	1
TOTAL:	50

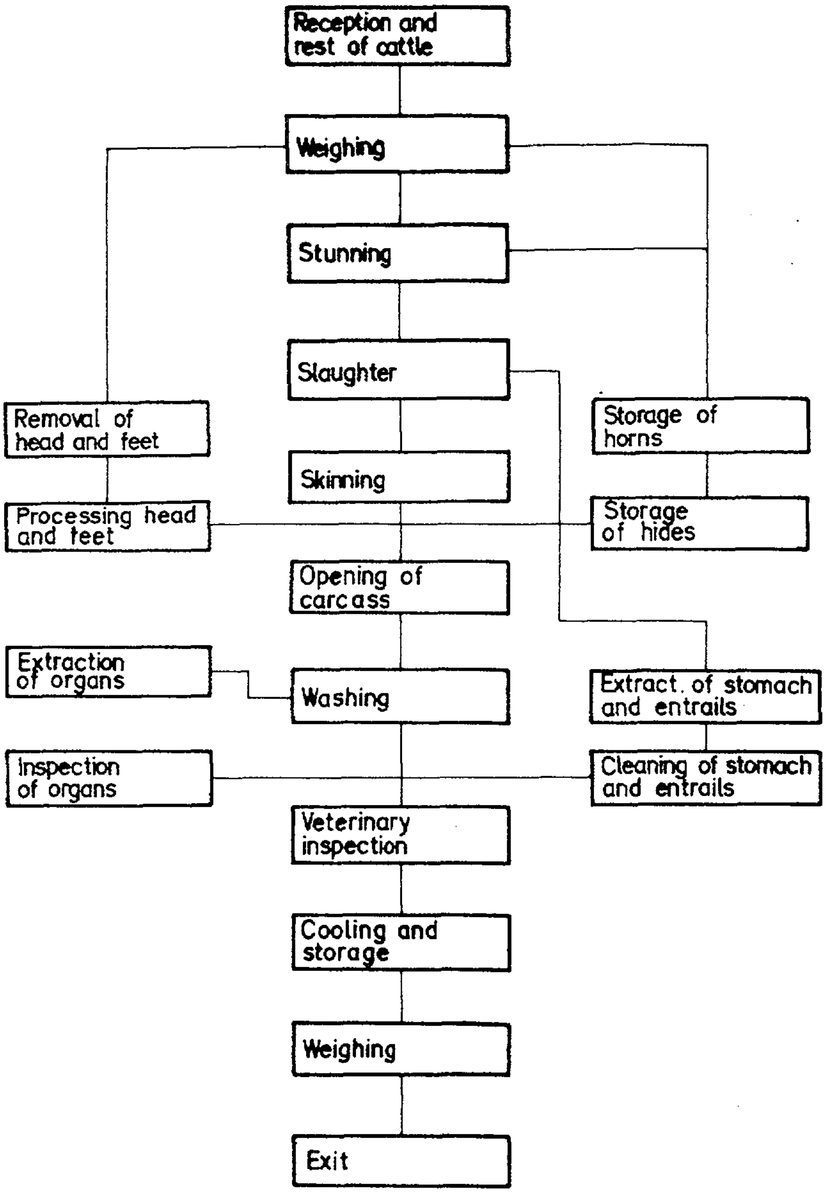
REQUIRED UTILITIES

Electric power .... 5 kWh per animal
Water .... 2 tons per animal

REQUIRED AREA OF PLANT SITE

The area of the building and cold storage area is 2,450 m^2.

FLOW SHEET FOR CATTLE SLAUGHTERHOUSE



B

Polyester Fabrics Making Plant

The polyester fiber is one of the synthetic fibers which has high strength and excellent resistance to chemicals, not to speak of being weather-proof. Compared with other fibers, it is characterized by a variety of excellent, elastic properties coupled with high heat-resistance.

Among synthetic fibers, it is next to nylon in its durability, resistance to tear and wear as well as to crimp. The polyester fiber is much more superior than natural or acrylic fibers in many respects.

In tactile feeling, it gives a warm feeling since polyster is high in its elasticity but low in specific heat and heat conductivity in terms of thermal properties. Particularly, it is superbly soft in case of mixed spinning with wool, also having a superior property of mixed spinning with other fibers, in most cases in the ratio of more than 65 percent of polyester.

The licensor of this technology is capable of delivering a consistent package of technologies together with plant facilities fully covering the entire process. It was abundant techniques and experiences based on a long history.

Products and Specifications

- 100% Polyester dyed woven fabrics 44″
- 100% Polyester dyed woven fabrics 60″
- 100% Polyester printed woven fabrics

Contents of Technology

1) Process Description

Texturing process

This is giving a special mechanical heat-setting treatment namely a crimpt to thermo-plastic filament fibre such as nylon or polyester. These textured yarn provide consumers with the variation in fabric properties such as bulky handle, elasticity and warmth as wool. This adopts the false twist method because it is more economical and superior in view point of cost and quality than any other method.

Twisting process

This is done to promote the weaving ability as well as to offer fabric the necessary strength and elasticity.

Sizing process

This is to align and prepare the weaver's beam in specified number of ends and length for weaving and to add the sizer on the warps in order to make the warps smooth and strong for easy weaving.

i) Leasing:

To separate each yarn one by one not to be mixed each other during weaving.

ii) Setting:

This process is employed to set the yarn shape by vacuum heat. Usually, polyester yarn is liable to be raveled above 300 T/M and therefore, the setting is necessary to prevent it.

Weaving process

i) Weaving preparation:

Reaching in: To insert each warp through each heald in order.

Reed drawing: To insert 2-6 of warps through the reed hole in order.

Dropper pinning: To pin the droppers onto the warps so as to stop the loom automatically when the warp is broken.

Weft pirn winding: To wind the yarn on the shuttle bobbin by automatic winder.

ii) Weaving

This uses the automatic shuttle looms, with weaving width 63 inch and 76 inch. (in case of new machining, 75 inch instead of 76 inch).

iii) Inspection of greige

To inspect the quality of greige.

Scouring and relaxing process

i) Scouring

To remove all the compound and stains on the greige in hot alkaline solution.

ii) Relaxing

To recover the original properties of the yarns lost during weaving by shrinking the greige. Scouring and relaxing are attained simultaneously in the same machine.

iii) Drying

We dry relaxed greige by using 3 or 5 step short loop dryers under free tension.

iv) Pre-setting

To stabilize the relaxed greige prior to dyeing in order to promote dyeing reaction. It is essential to pre-set property of products.

v) Intermediate inspection

Dyeing

It employes several piece dyeing methods either under high or normal pressure. Most of it are dyed under pressure in either rope or open width. It also has hank-dyeing and cheese dyeing machines for yarn dyeing.

Finishing Process

i) Dyeing

It also dries the dyed fabrics by short loop dryers.

ii) Final setting and finishing

This is to finish the dyed fabrics in accordance with the specified width, length, density and handle etc. by heat setting and adding chemical agents such as:

Anti-static agent
Soffening agent
Waterproofing agent
Water repellent
Antiflaming agent
Other resins and agents

iii) Final inspection & packing

2) Equipment and Machinery

Dyed fabrics

Texturing process
False twisting m/c
Crimping m/c

Twisting process
Two-for-one twister
Ring twister
Throwing m/c
Fancy twister

Sizing process
Sizing m/c
Sectional warping m/c

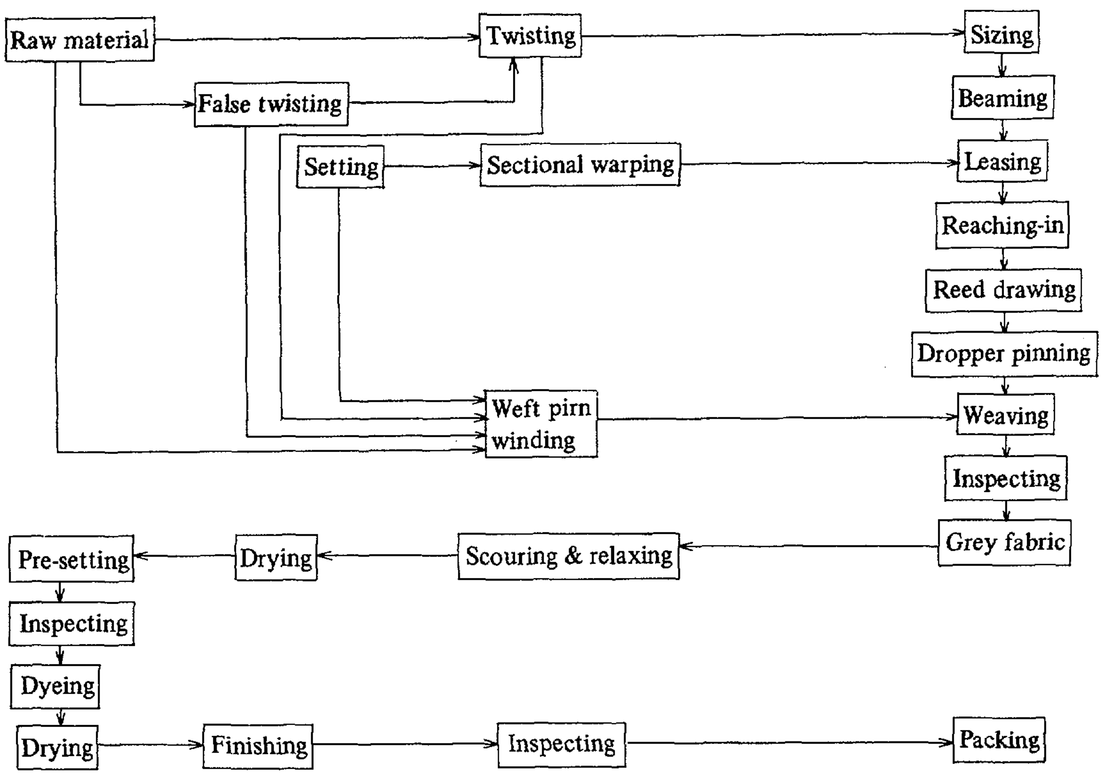
Weaving process
Auto-shuttle loom
Sulzer loom
Water jet loom
Jacquard loom

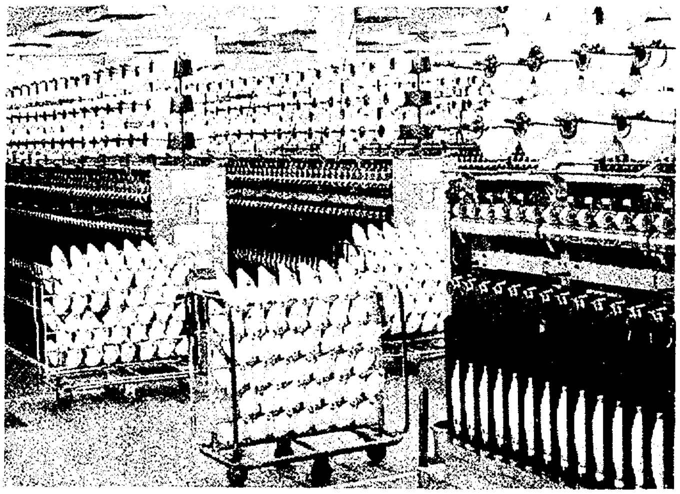
Scouring & relaxing process
Relaxer
Rotary washer

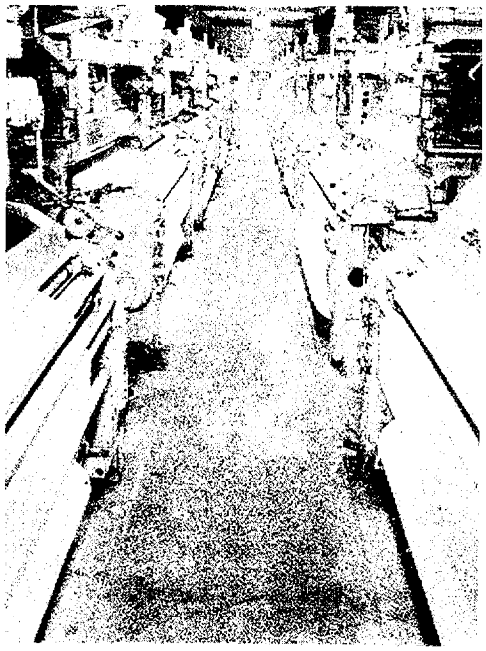
Dyeing process
Rapid dyeing m/c
Jigger m/c
Cheese dyeing m/c
Beam dyeing m/c
Circular dyeing m/c

Finishing process
Dryer
Tenter

Polyester Fabrics Manufacturing Process Block Diagram




Weaving Machine


Twisting Machine

Calendering m/c

Printed fabrics

Screen making process
Screen making m/c

Printing process
Hand printing board
Automatic printing m/c

Finishing process
Star steamer
Washing m/c
Dryer
Tenter

Inspecting & packing process
Inspection m/c
Selvedge stamping m/c

3) Raw Materials

Raw materials	Requirement (per yard of product)	
	60″	40″
Polyester filament	200 g	100 g
Dyestuff	4.8g	2.4g
Sizer	9.8g	6.5g
Auxiliaries	14.9g	10.3g

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Cotton Yarn and Fabric Plant

Of various yarns in the world at present, the cotton yarn is predominant not only because it has many excellent properties in use but because it can be produced and supplied at stable and reasonable prices.

Therefore, with a long history and accumulation of technical know-how as the largest textile industry of the world, the cotton yarn spinning industry has greatly improved its productivity based on modernized facilities.

Since the specific weight of cotton yarn itself is 1.54, cotton fabrics are relatively heavy and have high strength. However, it might be rather weak in water.

With an official moisture content of 8.5 percent, its hygroscopic property is pertinent. In recent years, quality products with excellent properties have been produced on a large scale by mixed spinning with other synthetic yarns.

Products and Specifications

- o Spinning: Cotton yarn, Blend yarn
- o Weaving: Cotton fabrics, Blend fabrics

Contents of Technology

1) Process Description

Cotton yarn

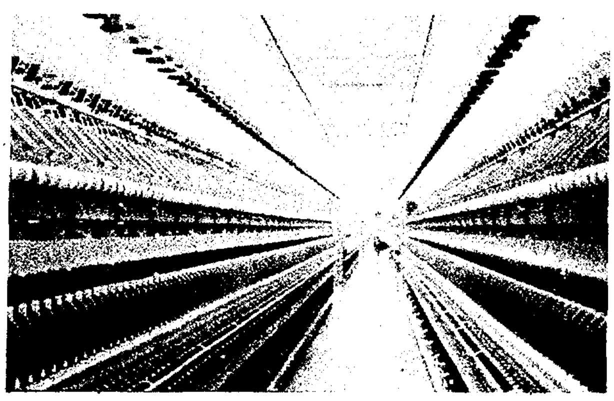
- o Blending and opening: Opening and mixing of compressed raw material
- o Carding: Combing of raw material fiber (textile) strands
- o Drawing: Polymerization and drawing of raw material
- o Combing: A process for high-quality yarns in which raw material is combed to remove filaments
- o Roving: Extension of raw material
- o Spinning: A process giving the form to yarn and twisting at a fixed interval
- o Winding: Quality sorting
- o Setting: High-temperature steaming to bring an end to curled state
- o Packing: Packing in accordance with types of sale

2) Equipment and Machinery

- o Spinning mill
  - Blending and opening m/c
  - Carding m/c
  - Drawing m/c
  - Combing m/c
  - Roving m/c
  - Spinning m/c
  - Winding m/c
  - Packing m/c
- o Weaving factory
  - Warping m/c
  - Sizing m/c
  - Reading m/c
  - Pirn winding m/c
  - Weaving m/c
  - Shearing m/c
  - Inspection table
  - Folding m/c
  - Packing m/c

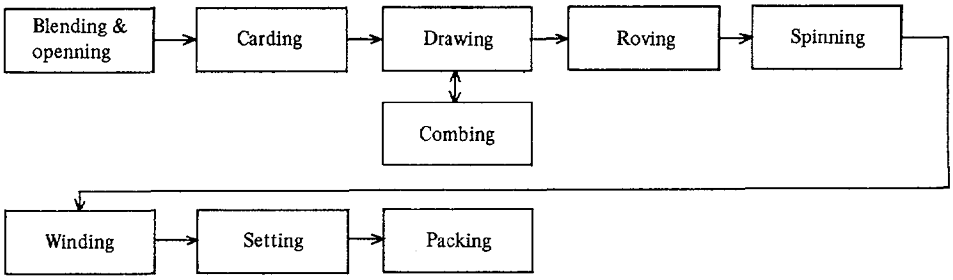
3) Raw Materials and Utilities

Raw materials and utilities	Requirement
(Cotton yarn)	Per ton of product
Cotton	1.075 ton
Electric power	2,040.90 kwh
Bunker-C oil	10.58 ℓ
(Cotton fabrics)	Per one thousand yds of product
Cotton yarn	230.47 kg
Electric power	7,734.75 kwh
Bunker-C oil	1,004.57 ℓ

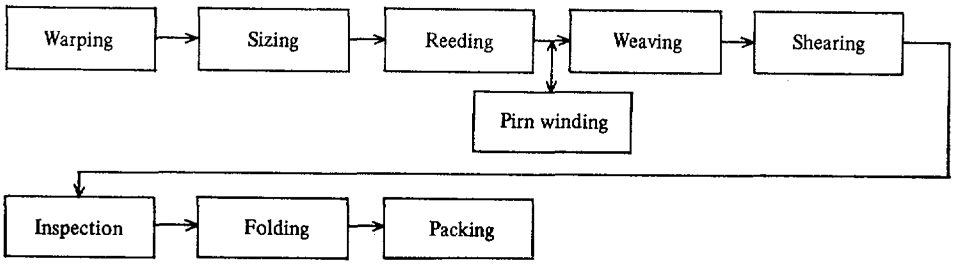


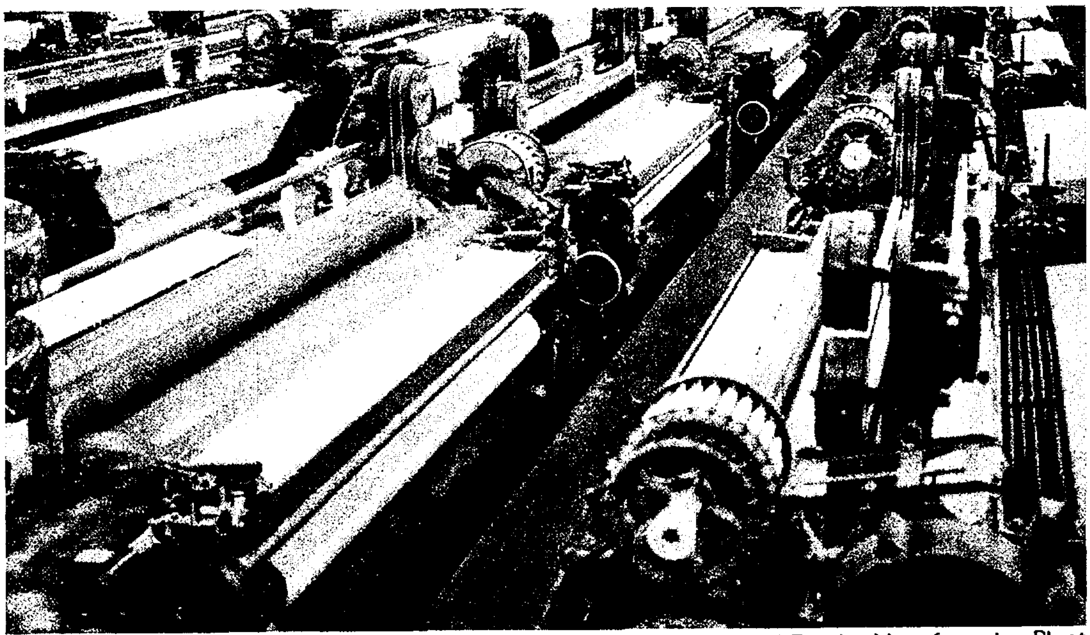
View of Yarn Making Plant

Cotton Yarn Manufacturing Process Block Diagram



Cotton Fabrics Manufacturing Process Block Diagram





View of Fabrics Manufacturing Plant

Nylon Tire Cord Fabric Plant

Nylon tire cord fabrics based on the licensable technology are superior in product quality and widely recognized by many tire manufacturers worldwide.

Its excellent property was duly recognized by such world-famous tire manufacturers as Firestone, BF Goodrich, General Tire and Yokohama Rubber in 1974, by Goodyear in 1976 and also by Bridgestone in 1977. The prospective licensor of this technology has also developed and produced polyester tire cord fabrics since 1979.

Products and Specifications

Products	Specifications	End use	Remarks
Tire cord yarn	420D/70F 840D/140F 1,260D/210F 1,680D/280F 1,890D/310F		
Tire cord fabrics	420D/1 840D/1 840D/2 1,260D/1 1,260D/2 1,260D/3 1,680D/2 1,890D/2	Auto & cycle tires	Raw & dipped

Contents of Technology

1) Process Description

Polymerization

Monomer preparation process

The main feedstock caprolactam is heated and melted, and then pumped by a metering pump after mixing with a constant amount of catalyst.

Polymerization process

The caprolactam-catalyst mixture is fed by a metering pump the constant rate into the atmospheric, continuous polymerization tower, in which the polymer is formed by the polymerization reaction.

Chip manufacturing and treating process

The molten polymer extruded through nozzles and cooled in water, and then cut into chips and fed into the extraction tube. The unreacted substance is extracted and removed by hot water in the extraction tube, and the chips are dried in a dryer to the moisture content below 0.1 percent. The dried nylon chips are conveyed by means of high purity nitrogen gas to a chip silo for storage.

Spinning (spin draw process)

This process is an improvement from the previous nylon filament yarn manufacturing process consisting of the melt spinning, take-up and drawing. Nylon chips fed into the spinning machine by a chip feeder are heated and melted, and then extruded by a spinning pump into the air in the form of filament yarns through nozzles. They are solidified by cooling and wound onto a take-up bobbin while being treated with a finishing agent and drawn 4~5 times simultaneously. Advantages of this process are:

- The shortened process reduces investments on machinery and other facilities.
- Required process time as well as personnel are reduced.
- The productivity is greatly enhanced by an increase in the production efficiency.

Tire cord fabrics manufacting

Yarn twisting

This process involves the direct process simultaneously performing the primary and secondary twists by shortening the previous process of two-stage twisting to one-stage process.

Nylon filament yarns wound onto bobbins are left alone for a considerable length of time and twisted while twining in accordance with required product specifications.

Weaving

The twined and twisted yarns are arranged according to weft counts and woven by a weaving machine with the warp separately supplied. The woven fabrics are taken up onto wooden rolls.

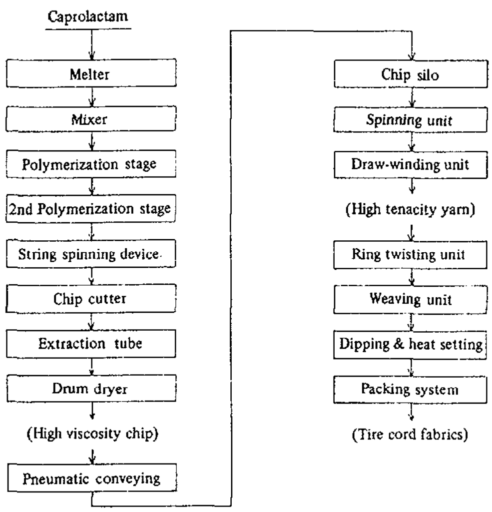
Heat treatment (heat setting)

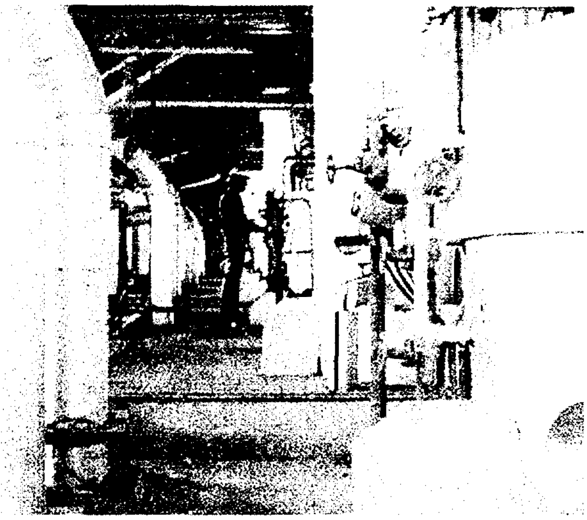
After treating with coating liquid by unrolling fabrics wound onto a wooden roll, the product is heat set by heating in a heating chamber under constant tensions, and then it is wound onto a wooden roll and baled in a water-proof packing.

2) Equipment and Machinery

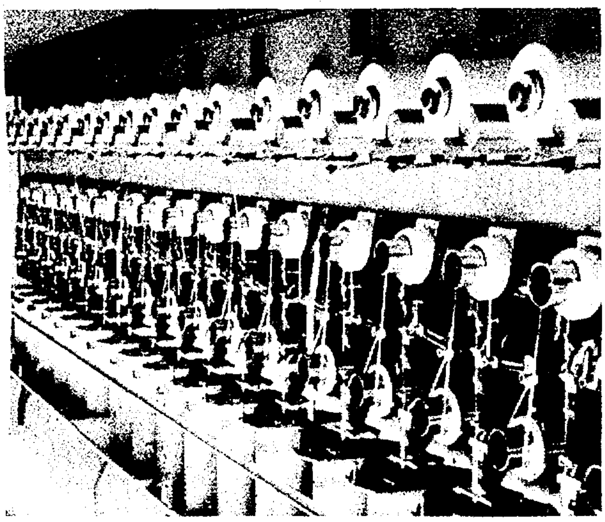
Polymerization
VK-tube

Nylon Tire Cord Fabrics Manufacturing Process Block Diagram

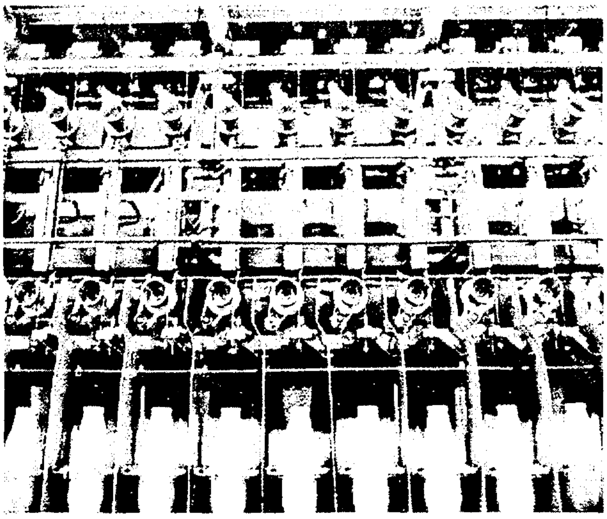




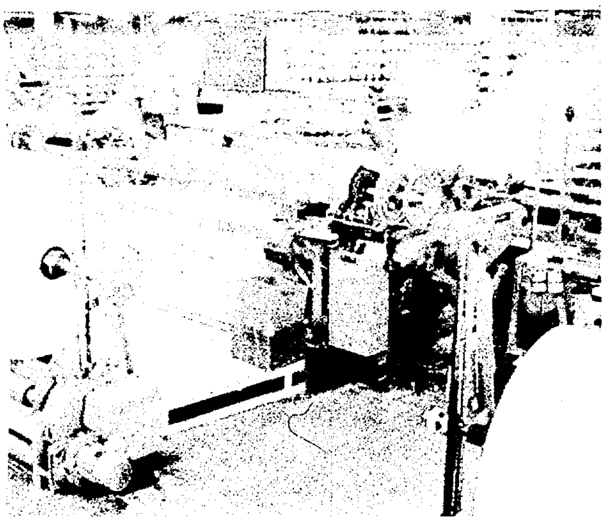
Polymerization Tower



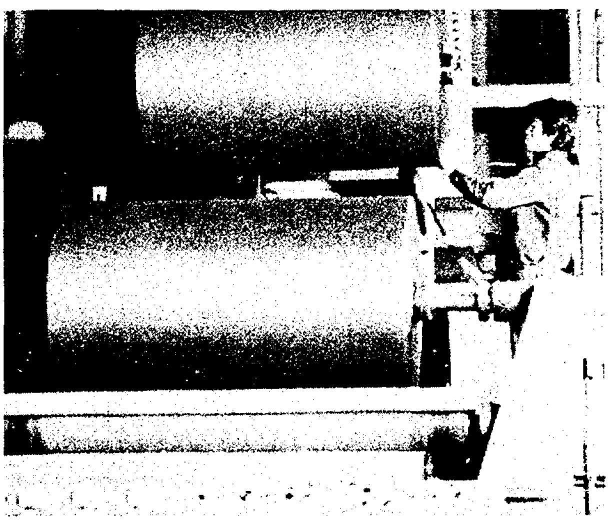
Take-up M/C



Draw Twisting M/C



Weaving M/C



Dip & Heat Setting M/C

Vac. dryer
Centrifugal pump
PIV gear drive
Spinning pump
Level gauge
Chip feed pump
Chip cutter
Slide valve
DC geared motor
L/C Feed pump
Agitator
Water seal Vac. pump
Centrifuge
Roots blower
Rotary feeder
Hopper scale
Homogenizer
Metering pump
Polymer filter
Non seal pump
Pneumatic conveyor
Extraction tube
Lactam mixer
Dephlegmator
Heat exchanger
Centrifugal pump
Lactam filter
Lactam intermediate vessel
Residual condenser
Vent condenser
Universal joint shaft
Mixing condenser
Spinning head
Cooling vat
Dripping vessel
Housing for draw-off device
Stainless lined roller
Chip miscutting checking device
Bucket trap
Chip discharge chute
Chip water separator

Spinning
Spinning M/C
High speed drawing M/C
Relax roller
Nozzle cleaning facility
Rewinder
Steam super heater
Turbo fan
Pack preheater
Floor conveyor
Chip bunker
Cyclone separator
Dust separator
Main Chip Silo
Vent condenser
Water tank
Emulsion preparation tank
Oil storage tank
De-Water tank
Creel car
Cop truck
Raw oil preparation tank
Immersion vessel
Suction filter
Chip intermediate tank

Finishing
Ring twister
Loom
Pirn winder
Dipping M/C
Rewinder
Lift truck
Sepiy recorder
Flanged bobbin repair M/C
Flanged bobbin
Bobbin truck
Creel stand for loom

3) Raw Materials and Utilities

Raw materials and utilities	Requirement (per ton of product)
Caprolactam	1.010 ton
Finishing oil	0.012 ton
Dipping agent	0.055 ton
Electric power	4,802 kwh
Bunker-C oil	774 ℓ
Kerosene	119 ℓ

Example of Plant Capacity and Construction Cost

1) Plant capacity : 4,000ton/year
   * Basis : 24 hours/day, 350 days/ year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$10,000,000
o Utility facility	:	US$ 2,000,000
o Installation cost	:	US$ 1,000,000
Total	:	US$ 3,000,000

3) Required Space

o Site area	:	60,000 m^2
o Building area	:	15,000 m^2
Total	:	75,000 m^2

4) Personnel Requirement

o Manager	:	3 persons
o Engineer	:	25 persons
o Operator	:	160 persons
Total	:	188 persons

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Socks Knitting Machine

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 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 or 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 a rapid progress. The reasons have been as follows:

- The change in everyday clothing pushed socks up to the realm of fashion.
- New synthetic fiber which consecutively appeared after World War II markedly improved the knitting performance and quality of fashion.
- 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 31/2-4 inches. Generally, there are 350 needles or less.

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

Contents of Technology

1) Process Description

Delivery of raw materials

The raw material yarn comes in various forms: Cheese, Cone and Pirn. The raw material yarns can also be classified by yarn count and denier, which are sizes of yarn. The classification can also be made by colors. These raw materials are arranged neaty and kept in the raw materials storeroom.

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.

Knitting

The yarn wound on the cone is set on the designated socks kitting 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 separated method.

In the double cylinder knitting machine one piece of the socks is completed; Then, a drawn thread makes its entry and kitting begins continuously from the welt of the next piece of socks.

Therefore, socks will continuously run through the knitting machine in a cylinderical 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.

First inspection

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

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.

Second inspection and mending

Inspection of the socks is done again after linking is completed, and socks with knitting damages are mended.

Mending is done so that the damage would be unrecognizable. Socks which pass the inspection will go to the next process.

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.

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 it will have a good look.

Generally, finishing of the socks is done by steam setting.

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 in pairs by matching the size, color, and pattern. They are packed in boxes and shipped out.

2) Equipment and Machinery

Socks knitting machine
Winding machine
Linking machine
Setting machine
Dyeing machine
Steam iron
Boiler for steam

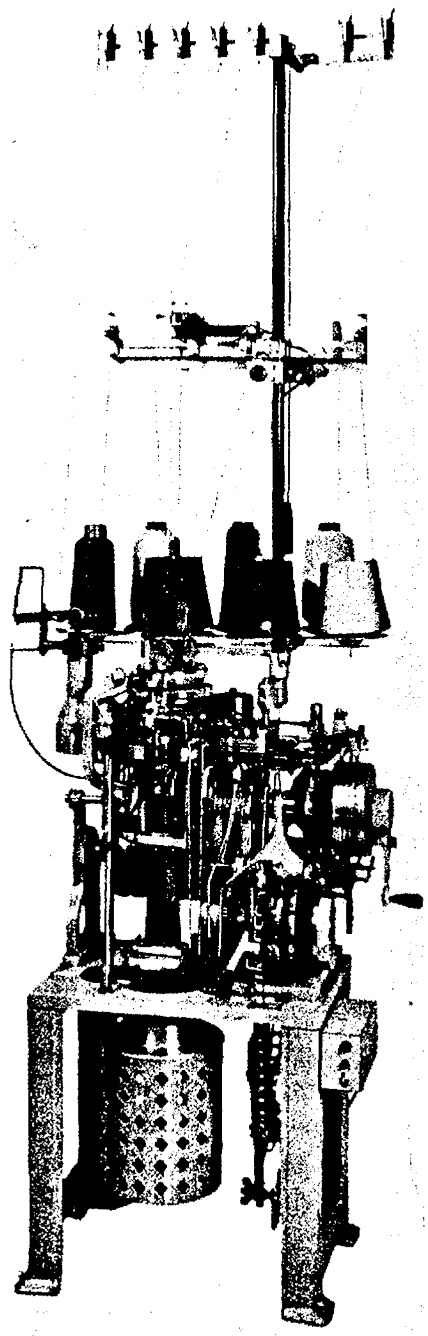
3) Raw Materials and Utilities

Yarn (Wool, Acryl, Nylon, Cotton)
Latex rubber yarn
Dyestuff

Water
Electric power
Bunker-C oil
Steam
Compressed air

Socks Manufacturing Process
Block Diagram

Arrival of raw materials → Winding → Knitting → First inspection → Linking the toe → Second inspection and mending → Soaping and dyeing → Setting and finishing → Final inspection and packing



Example of Plant Capacity and Construction Cost

1) Plant capacity : 600,000 dvz/year
 * Basis : 24 hours/day, 300 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$700,000
o Utility facility	:	US$ 60,000
Total	:	US$760,000

3) Required Space

o Site area	:	4,800 m^2
o Building area	:	1,600 m^2
Total	:	6,400 m^2

4) Personnel Requirement

o Manager	:	3 persons
o Engineer	:	10 persons
o Operator	:	85 persons
Total	:	98 persons

Twine and Rope Making Plant

Twin and rope have so far been made of natural fibers for uses in 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 when handling, they must be dried in the sun when wet and the supply of natural fibers was on the decrease.

In addition, the recent rapid development in petrochemical industry has caused the twine and rope to be made of such synthetic fibers as nylon, polyethylene, polypropylene and the like. In contrast to natural fibers, these chemical products have conspicuously reduced the liability to rot and improved various other defects. As a result, the light, strong and handy synthetic fiber twine and rope are widly in use now.

Products and Specifications

Twin is classified by the kind of fiber (nylon, kuralon, polyester, polytex, polyethylene, polypropylene, saran and others), twine number, direction of twist ("Z" or "S"), degree of twist and make-up (spool or hank).

Rope is also classified by the kind of fiber, diameter, length or weight per coil, degree of twist and colour.

Contents of Technology

1) Process Description

Manufacturing of synthetic yarn filament

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 on a 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 7.5g/denier. With these filaments as basic materials, fishing net, fishing string, rope, casting net, spoon net, brush, etc. are manufactured.

Manufacturing of ropes

One hundred and fifty pieces of monifilament, 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.

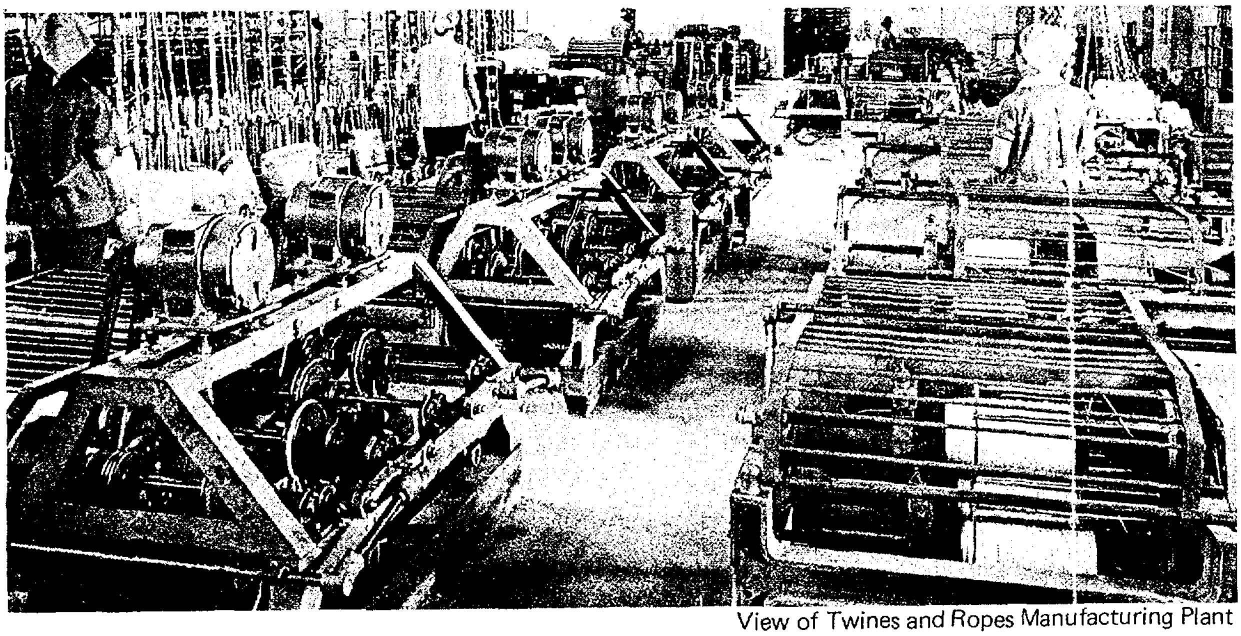
The stretched monofilaments are annealed in the subsequent annealing bath, and become 400 denier monofilaments. Each filament is wound round the winder bobbin. The thickness of a monofilament is decided on according to its use, and is also controlled by the extruding rate of the extruder and by the stretching 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 2.5mm 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 5mm 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 then, a fixed number

Twine and Rope Manufacturing Process Block Diagram

Resin → Spinning → Raw filament → Downward twisting → Upward twisting → Winding → Packing


View of Twines and Ropes Manufacturing Plant

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 12mm 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 32mm 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 32mm diameter are produced. These being produced in the shape of coiled ropes, no coiling machine is required.

2) Equipment and Machinery

Twister
Winder
Spool winder
Dyeing machine
Dehydrater
Heat-set machine
Hank machine
Packing machine

3) Raw Materials

Raw materials	Requirement (per ton of product)
Polyethylene resin (Polypropylene resin)	1,060kg
Pigment	5.85 kg

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MANUFACTURE OF SHOULDER PADS FOR THE GARMENT INDUSTRY

Shoulder pads are garment elements used in the manufacture of clothing to give shape to the shoulder and facilitate insertion of sleeves. It is necessary to adjust the form, size, design and production process of shoulder pads for each part of clothes and for each size, because the whole commercial success and outlook of clothes depends on it.

Among hundreds of models of men's, women's and children's shoulder pads, one can distinguish those covered with the same material as clothes and those with round or ball shapes with various thicknes and weight.

The most frequently used shoulder pads are made by needling which means that, fitting and shaping is achieved by getting fibers through all layers of the shoulder pad. This kind of shoulder pads is very flexible in shaping and forming the shoulder, its production is very simple and does not require many machines.

The manufacture of shoulder pads can be organized as an independent activity and it can cater for the requirements of one or more garment industries, depending on its capacity.

The process of production outlined here is adequate for an annual capacity of three million pairs of shoulder pads.

PROCESS DESCRIPTION

Unwoven textile is used in production of shoulder pads: a) white, grey or black fibers for the upper part of shoulder pads layers, b) a soft material made by needling for the underlying part of shoulder pads. Small pillows made of cutton wool are used as stuffing. All the above mentioned materials are rolled up in bales.

Shoulder pads manufacturing includes:

- a handy storage of textile materials
- unrolling textile materials and arranging it into layers
- cutting blocks of textile with piercing knife
- cutting or stamping of the required shapes of shoulder pads

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- cotton pillows forming
- finishing shoulder pads
- needling
- separating the left shoulder pad from the right
- control and packing

The fabric used for the manufacture of shoulder pads is rolled up in bales and has to be unrolled on an appropriate table. Spread out in a given number of layers the fabric is cut by means of a punching machine into sections which are then fashioned into the desired form, i.e. that of a shoulder pad, by means of a band saw or a cutting machine.

The padding is manufactured by a pad making machine. The fabric is rolled up in a bale 25 cm broad. For thicker shoulder pads cotton wool cut on a band saw is added.

During the next phase the cut fabric is set together according to a previously fixed order so that the cotton wool is inserted as a filler between the other fabric enfolidng it.

The fixing and fashioning of the shoulder pad to fit the shoulder is now done by needling. The right and left shoulder formed one piece so far. Now they are separated by means of a cutting machine to form a pair of shoulder pads, the right and the left one now being two separate pieces. Such pairs of shoulder pads are inspected, counted and packed into cardboard boxes.

If the technological process is to run smoothly it is desirable that the manufacturing take place on the same premisses, with space allocated for raw materials in a quantity adequate for a weekly production. There should be also provided space for shelving of material between two production phases and for storing of finished products until production of the entire quantity ordered by a customer is completed.

A specially shaped trolley is used for transporting the material between phases of production.

Production is continuous.

PRODUCTION CAPACITY

The plant's production capacity is 3,000,000 pairs of shoulder pads per year (about 60 t of goods).

Based on an 8 hour working day, 270 days per year

MACHINES AND EQUIPMENT

	I t e m	Quantity
1.	Arranging table + piercing knife	1+1
2.	Band saw	2
3.	Punching machine	1

4.	Cottonwool pads production machine	2
5.	Assembling table	3
6.	Needling machine	2
7.	Cutting machine	3
8.	Inspection and packing table	3
9.	Pallets trolley	8
10.	Pattern shelf	2
11.	Trolley	2

FOB price of equipment and technology about 294,000 US dollars.

REQUIRED RAW MATERIAL

Item	Quantity
Non-woven interlining (Vlieseline)	270,000 m^2 per year
Cotton wool	300,000 m^2 per year
Non-woven interlining (Helseline)	190,000 m^2 per year

REQUIRED MANPOWER

Qualifications	Number of employees
Garment manufacturer (engineer)	1
Germent manufacturer (technician)	1
Skilled tailors	4
Skilled mechanic	1
Semi-skilled workers	26
TOTAL:	33

REQUIRED UTILITIES

Electric power 20 kWh/hour

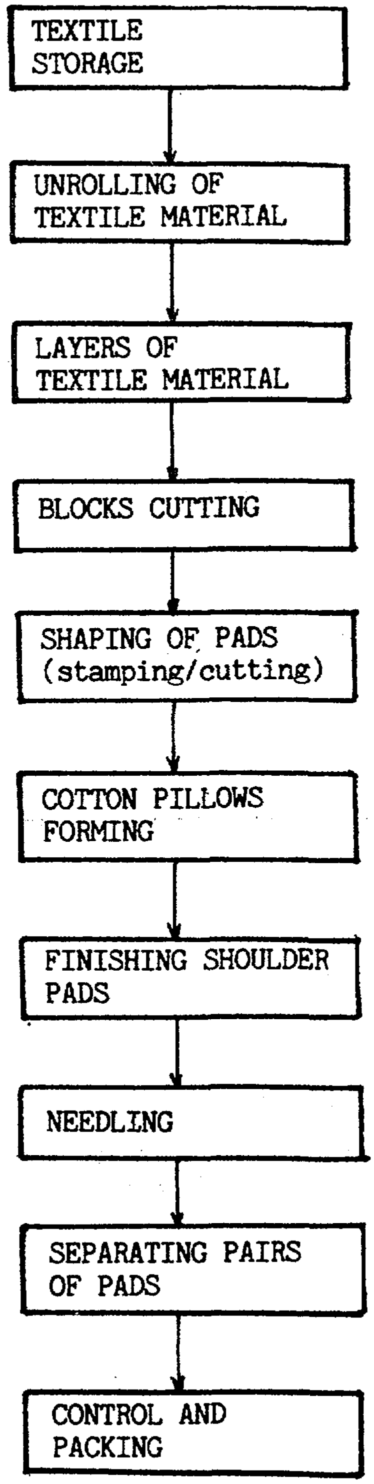
REQUIRED AREA FOR PLANT SITE

The entire space requirements are 1,200 m^2 including plant, storage, office, auxiliary premises.

SPECIAL SAFETY AND PROTECTION MEASURES

Fire prevention measures are required.

SHOULDER PADS MANUFACTURE (GARMENT INDUSTRY)
BLOCK DIAGRAM



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FILE: C-12
ISIC: 3220

Men's Shirts Making Plant

Shirts are intermediary clothes for gentlemen made by cutting and sewing fabrics. They are usually worn under the evening dress, tuxedo or morning coat but can on also be used as outer garments depending upon seasons.

Shirts are generally grouped into dress shirts, sports shirts, work shirts and military shirts, the collars and sleeves being main points that determine all designs.

The size of shirts depends on the collar size as well as on the sleeve length. Many sizes are produced out of these correlations, totaling 40 to 50 different kinds.

Products and Specifications

- Dress shirts (White shirts)
- Sports shirts
- Work shirts
- Military shirts

Contents of Technology

1) Process Description

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.

Drawing

A paper pattern is placed on the cloth and the pattern is copied on the cloth.

Cloth laying

The cloth is spread and piled on the cutting table.

Cutting

The cloth is cut by a knife-type cutting machine or a die cutting machine.

Arrangement

The cut cloth and interlining are inspected, assorted, and bundled, and a slip is attached to the bundle.

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 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 sewes for the sewing process.

Finishing process

In the finishing process the compltely sewn shirt is inspected, pressed for body finishing and collar finishing, ironed to the proper shape, and then bolded and packaged.

2) Equipment and Machinery

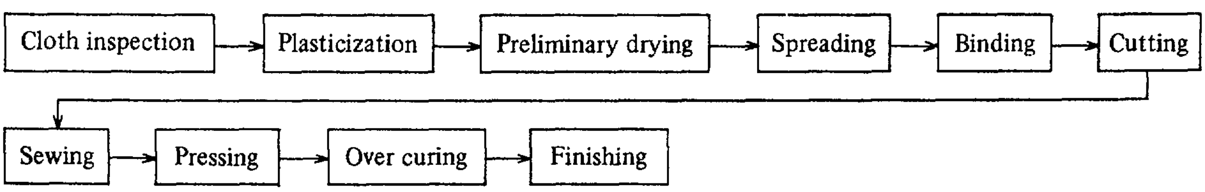
Cutting process

Cutting table
Straight knife cutting m/c
Band knife cutting m/c
Cutting press

Sewing process

Single needle lock stitch m/c
2 needles 5 thread interlock m/c
Single needle double chain stitch m/c
Single needle chain stitch button sewing m/c
Tack needle lock stitch blind buttonhole m/c

Men's Dress Shirt Sewing Process Block Diagram



Overlock m/c
Label setter
Collar top sewing m/c
Pocket bolding and setting m/c
Double-head automatic buttonhole machine for cuff
Automatic buttonhole machine for front
Electric iron
Ironing stand
Sleeve slit cover folder
Cuff forming press
Collar turning machine
Press for collar
Stamping machine
Workbench
Fusing press for interlining
All-round press

Finishing process

Press for collar and cuff finishing
Press for front finishing
Press for neck finishing
Folder

3) Raw Materials

Raw materials	Requirement (per doz. of product)
Raw clothes	21.5 yds
Sewing thread	1,400 m
Button	–

Example of Plant Capacity and Construction Cost

1) Plant capacity : 465456 (DOZ)/year
  * Basis : 9.5 hours/day, 300 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$820,157,723
Total	:	US$820,157,723

3) Required Space

o Site area	:	4,066.2 m^2
o Building area	:	9,804.24 m^2
Total	:	13,870.44 m^2

4) Personnel Requirement

o Manager	:	1 persons
o Engineer	:	23 persons
o Operator	:	235 persons
Total	:	259 persons

D

E

F

G

FILE: G-98
ISIC: 3513

PVC Paste Resin Making Plant

PVC paste resin differs mainly in particle size and structure from PVC suspension resin which are used in extrusion, injection, blow molding, etc. The specific properties of paste resin can be described as follows:

- Particle diameters lie between 0.1 and 2.0 microns.
- Particle size distribution preferably follows the distribution of the spheres in the closest-packing arrangement.
- Particles are spherical and compact.

Those differences significantly alter the behavior of the polymer when mixed with a plasticizer at room temperature. The PVC paste is mixed with PVC dispersion resin, plasticizer and other additives and can be changed to sol or gel.

This paste resin is used widely due to the ability to be processed in fluid form in less expensive equipment and at lower operating fusion pressure, even though this resin is currently sold at a substantially higher price than general-purpose, or suspension-polymerized, reins due to the greater difficulties encountered in their manufacture and the more extensive quality control required.

And this resin is processed by a variety of techniques including dipping, rotational casting, and slush molding and various products, including toys, internal plastic parts of automobile, leather, adhesives, metal coatings, electric parts, hose, PVC wall covering, flooring, etc., can be made of this resin.

The plant introduced here adopts the emulsion polymerization process and such polymerization is conducted either by seeding prepolymers or by adding emulsifiers during the polymerization.

Although this polymerization method is known to be complicated and moreover difficult in controlling the particle size, this process has overcome such disadvantages and the initiator gives an economical merit and constitutes an important portion of the process technology.

Products and Specifications

This plant can make various grades of high quality products and, the representative paste resin and its general properties and characteristics can be briefly outlined as follows:

The paste resin shows low plastisol viscosity from low shear range to high shear range and viscosity stability when stored as its sol. Accordingly, when its sol is used for molded goods with a required harndess, it must be formulated with less amount of plasticizer.

Furthermore, the resin is excellent in water repelling property, electrical insulation, clearness of gelled sheet and especially in the top-coating of leathers and floorings according to its good rheological and mechanical properties. One grade has been available in Korea for top-coating of leathers and flooring, waterproof cloths, rigid materials with hard formation, sealing materials and interior materials of car such as headrests, armrests, etc. Other different grade is excellent in air release and in foam cell formation, notwithstanding its high plastisol viscosity. Also, it has been available for plastic foam materials, pencil erasers and water proof cloths, and there are many other different grades.

The detail grades of product and uses of PVC paste resin are shown in table 1.

Table 1. Products and Uses of PVC Paste Resin

Type	Degree of Polymerization (P)	K-Value	Uses
Straight polymer KH-10	1,700 ± 50	75–77	For general purposes, slush, rotational moldings, dip-coatings, adhesives for leather
KH-20	1,700 ± 50	75–77	Hose expanded vinyl leather
KH-31	1,700 ± 50	75–77	Metal coatings, adhesives for leather, wall linings
KM-30	1,300 ± 50	70–72	Hoses, laces, foaming materials
KM-31	1,300 ± 50	70–72	Foam, wall covering
KL-10	1,000 ± 50	65–68	Nearly the same application as KH-10 and for the cases required better gelation than KH-10.
KL-31	1,000 ± 50	65–68	Floor covering, wall coverings, foaming materials.
Copolymer KCM-12	1,000 ± 50	65–68	High gelation rate purpose, carpet backings, adhesives
Straight Polymer KBM-10	1,000 ± 50	65–68	Blending resin for viscosity adjusting (particle size about 20μ)
Copolymer KBM-11	1,000 ± 50	65–68	Blending resin for viscosity adjusting (particle up 50 μ)

(P) : 0.4gr. Polymer in 100cc nitrobenzene solution at 30°C (JIS K6721 or equivalent method)
K : According to Fikentscher's formula (Cyclohexanone 1% solution)

Contents of Technology

1) Process Description

VCM receiving &storage

VCM is received from VCM tanker or tank lorry to spherical monomer storage tank. Measurement of received VCM is performed by oval type flow meter located in pipeline, and it is pumped to the monomer weighing tank located at polymerization section.

When VCM stored precautionary measures are necessary to prevent contamination by water or air. Contaminants interfere with polymerization or lower the quality of PVC paste resin product. Sometimes free water separated from VCM led to the formation of natural polymerization. Furthermore VCM can form an explosive mixture with air.

VCM recovery

Unreacted VCM gas is recovered from polymerizer to gas holder. The crude VCM gas is liquefied by dehydration and condensation and transferred to rectifier.

VCM purification

The crude VCM is continuously fed to rectification tower by crude monomer feed pump, and the feed rate is kept at the specified value by means of FRC. At the bottom of tower the liquid VCM is vaporized through reboiler by adding steam. The vapor rises toward the top of tower and is led to VCM total condenser where it is condensed by cooling water.

The condensed VCM is divided into two streams, one is returned to the tower as reflux and the other is led to pure VCM storage tank.

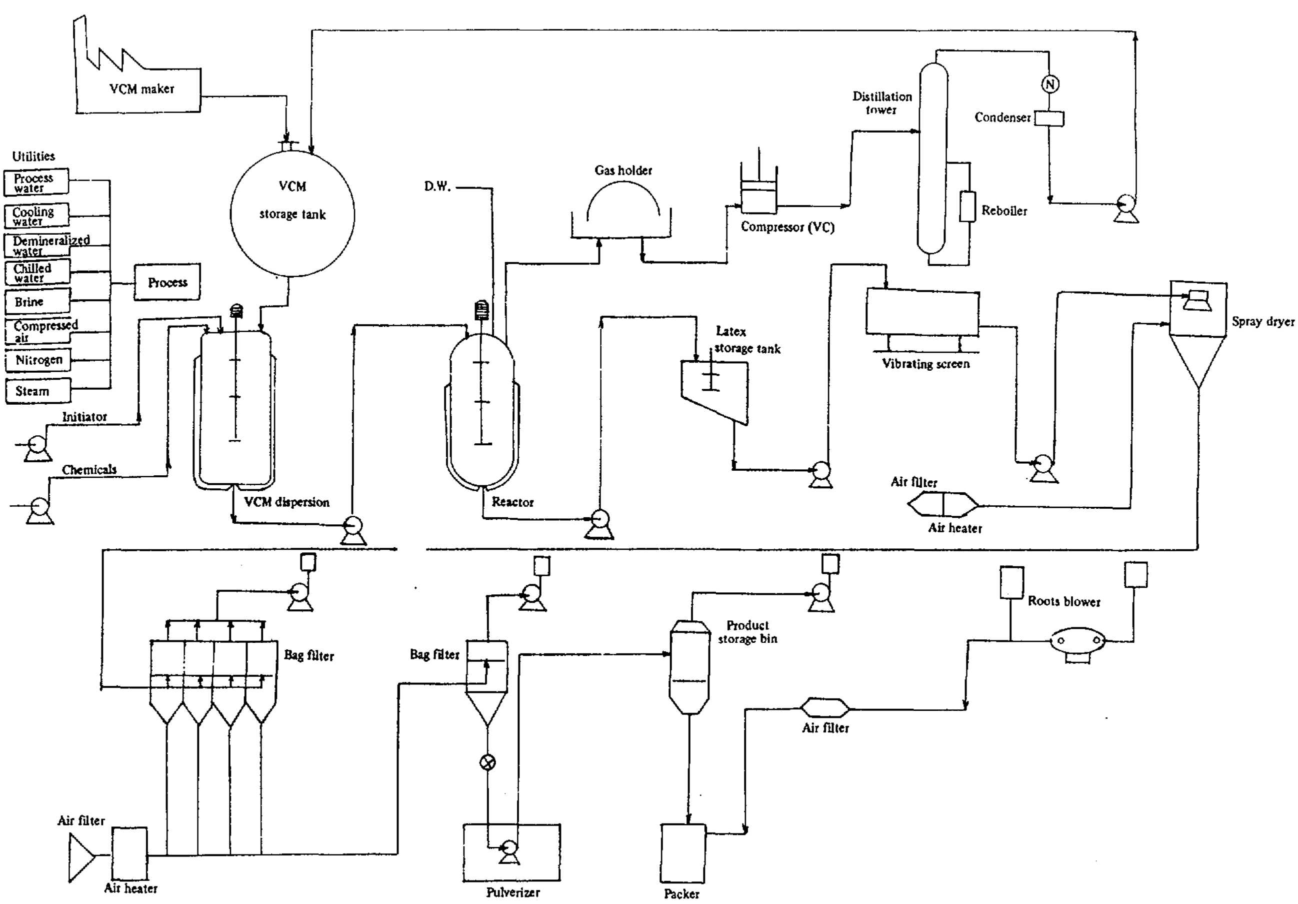
Dispersion process

The process is preliminary to polymerization. In this process, monomer is homogeneously dispersed to obtain monomer droplets with suitable particle sizes and distribution suitable for the dispersion resin. Emulsifier and ingredients are dissolved in this process.

Polymerization process.

In this process, the VCM is polymerized and the unconverted monomer is recovered. These procedures are conducted automatically. The polymerization is

PVC Paste Resin Manufacturing Process Flow Sheet



carried out at some ranges of temperature and requires about 16 hours.

When the conversion reaches to a proper degree the monomer recovery begins. The latex, after monomer recovery, is transferred from the reactor bottom to the latex storage tank. The coarse particles are to be removed by screen.

Drying process

In this process, the latex is dried by spray drying system and powdered resin is collected by the bag filter. It is then crushed and finally stored in the storage bin.

2) Equipment and Machinery

Raw material storage and reaction section
- VCM storage tank
- VCM disperser
- Reactor
- Latex storage tank
- Gas holder
- VCM liquefaction compressor
- VCM distillation tower

Product drying and recovery section
- Vibrating screen
- Spray dryer
- Air filter 1
- Air heater 1
- Bag filter 1
- Air filter 2
- Air heater 2
- Bag filter 2
- Pulverizer
- Product storage bin
- Air filter 3
- Root blower
- Packer

3) Raw Materials and Utilities

Raw materials and utilities	Requirement (per ton of product)
Process water	9.5 tons*
Vinylchloride monomer	6.2 tons*
Initiator	1.2 kg*
Other additives	80-120 kg*
Demineralized water	290 tons
Cooling water	45 tons
Steam (8kg/cm^2 G)	7 tons
Nitrogen	1 nm^3
Electric power	840 kwh

* Required amount per batch (5.5 tons/batch)

Example of Plant Capacity and Construction Cost

1) Plant capacity : 12,000 ton/year
   * Basis : 12 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$3,600,000
o Utility facility	:	US$ 15,000
Total	:	US$3,615,000

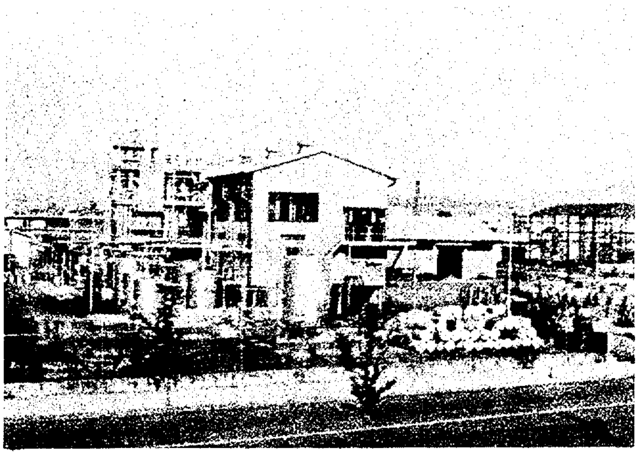
3) Required Space

o Site area	:	40,530 m^2
o Building area	:	4,625 m^2
o Other	:	35,905 m^2
Total	:	40,530 m^2

4) Personnel Requirement

o Manager	:	1 persons
o Engineer	:	4 persons
o Operator	:	36 persons
o Other	:	26 persons
Total	:	67 persons

Sodium Chlorite Making Plant



View of Sodium Chlorite Plant

Sodium chlorite, first commerciallized in the 1940's by Mathieson Alkali Co. of the United States, is a high grade bleaching agent.

The available chlorine content of sodium chlorite with 80% $NaClO_2$ is 125% and the one with 25% is 39%, compared to 30 to 35% of bleaching powder and 60 to 70% of highest hydrochlorite. So the sodium chlorite is a powerful and unique bleaching agent applicable to wide uses.

The market demand of sodium chlorite increases steadily every year due to its excellent bleaching power and the growth of industries using sodium chlorite. A large amount is used in bleaching textiles and the use of sodium chlorite can eliminate the refining process in bleaching of cotton, rayon or soupe. Also desired flexibility and whiteness can be achieved without suffering any degradation or damage to the bleaching material. Moreover, sodium chlorite can make good bleaching result even if the quality of water used is slightly inferior, because it will not affect the bleaching.

Particulary, the sodium chlorite is the most effective one in bleaching of synthetic fibres which are in the nature of water repelling and a material of difficult bleaching. There will be no disparity of bleaching solidity nor change of coloring (come back to the original colour shade).

Besides the above mentioned uses, sodium chlorite can also be used in the bleaching of paper, pulp, fats, tallow and wooden materials.

Products and Specifications

The product of sodium chlorite which was made in this plant is an aqueous solution with 25% purity and 39% available chlorine contents. The product is easy to handle and safe from danger compared to other products of bleaching agent of solid form, and thus is much favored by all customers.

In general, sodium chlorite itself is weak for bleaching action, and thus for the practical results of the effect it needs to be activated by inorganic or organic acid.

The specification of sodium chlorite is as follows:

- Gravity (15%) 1.215
- Available chlorine content 30%
- Purity (as $NaClO_2$) 25%

Contents of Technology

1) Process Description

The sodium chlorite manufacturing process largely consists of three unit processes of SO_2 gas generation, ClO_2 generation and $NaClO_2$ synthesis.

The SO_2 generation process is designed to produce gas containing SO_2 by burning sulfur. That is to say, flake-like sulufr is melted in the sulfur melting tank and pumped to the sulfur combustion furnace for combustion with fuel. The combustion furnace usually comprises two stages.

Since the combustion gas generated in the primary combustion furnace is approximately 800°C, the sulfur still unburnt is subject to a complete combustion in the secondary furnace. The combustion gas is quenched by water in two cooling towers to eliminate still remaining sulfur mist. The gas with the temperature of 40°C at the outlet of the cooling tower is supplied to ClO_2 generation process as reduction agent.

In the ClO_2 generation process, $NaClO_3$ is reduced to generate ClO_2, obtaining hereby $NaHSO_4$ as by-product. Sodium chlorate is dissolved in water to generate ClO_2 gas by continuous decomposition of $NaClO_3$ when SO_2 as reducing agent and sulfuric acid are added.

ClO_2 gas is sent to the water-washing tower together with induced air and finally to the $NaClO_2$ synthesis tower. In $NaClO_2$ synthesis process, ClO_2 gas is absorbed in caustic soda solution with simultaneous addition of hydrogen peroxide to increase the conversion rate of 50% to 100%. The pH and high initial concentration of the product are adjusted prior to filtration and filling for delivery.

2) Equipment and Machinery

Tanks and receivers
- Sodium chlorate solution storage tank
- Sodium hydroxide solution storage tank
- Sulfuric acid storage tank
- Sodium chlorite solution storage tank
- 1st and 2nd washing tank
- Dissolving tank
- Sodium chlorate mixing tank
- Receiver for washing tank
- Receiver for reaction liquor
- Receiver for scrubber
- Receiver for hydrogen peroxide

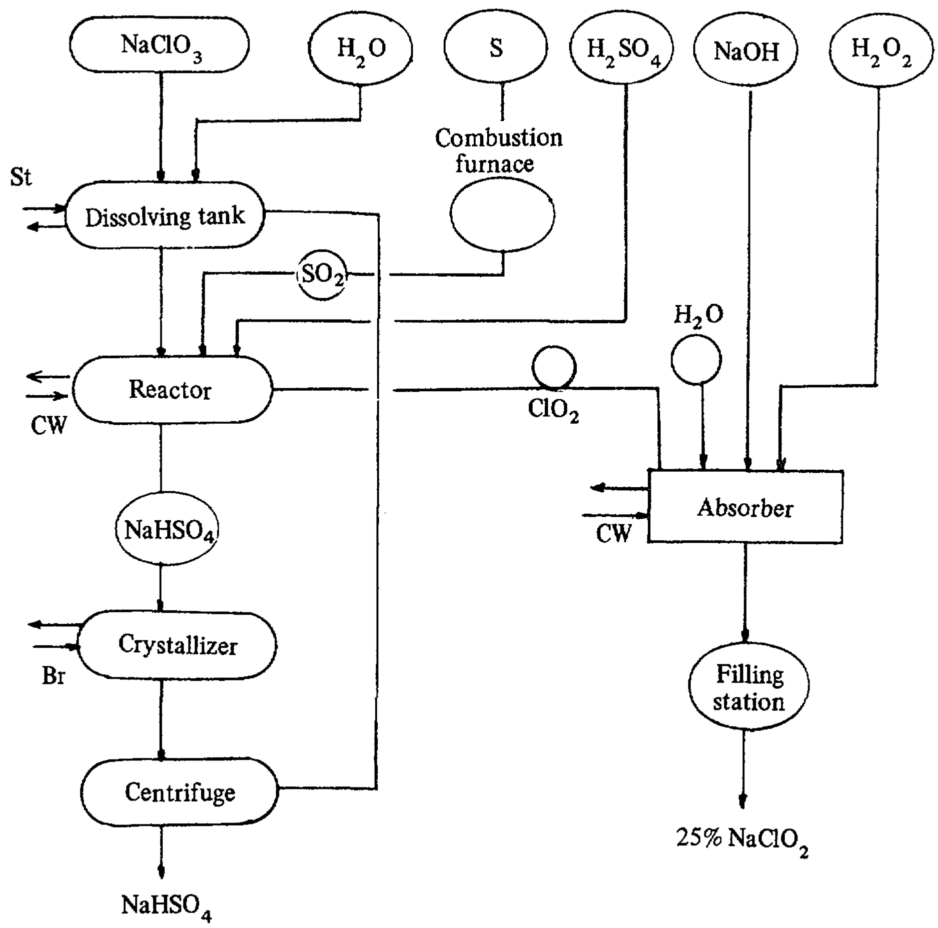
Reactor and crystalizer
- Chlorine dioxide reaction tank
- Crystallization tank

Gas generator and absorbers
- SO_2 gas generator
- Absorber
- Stripper
- Vent gas absorber

Filters
- Sodium hydroxide solution filter
- Sodium chlorate solution filter
- Sodium chlorite solution filter

Pumps, blowers and compressors
- Sodium chlorate pump
- Recycle pump for washing tower
- Recycle pump for absorbent
- Sodium hydroxide filter pump
- Sodium chlorite pump
- Feed pump for sulfuric acid
- Scrubber pump

Sodium Chlorite Manufacturing Process Diagram



Brine pump
Sodium hydroxide feed pump
Hydrogen peroxide feed pump
Air blower
Vent gas blower
SO_2 gas blower
Air compressor

Condenser and refrigerator
Condenser
Brine cooler
Refrigerator

3) Raw Materials

Raw materials	Requirement (per ton of product)
Sodium chlorate	321 kg
Sodium hydroxide	262 kg
Sulfuric acid	258 kg
Hydrogen peroxide	145 kg
Sulfur	67 kg

Example of Plant Capacity and Construction Cost

1) Plant capacity : 13,000 mt/year
   * Basis : 24 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$3,500,000
o Utility facility	:	US$ 500,000
o Installation cost	:	US$1,000,000
Total	:	US$5,000,000

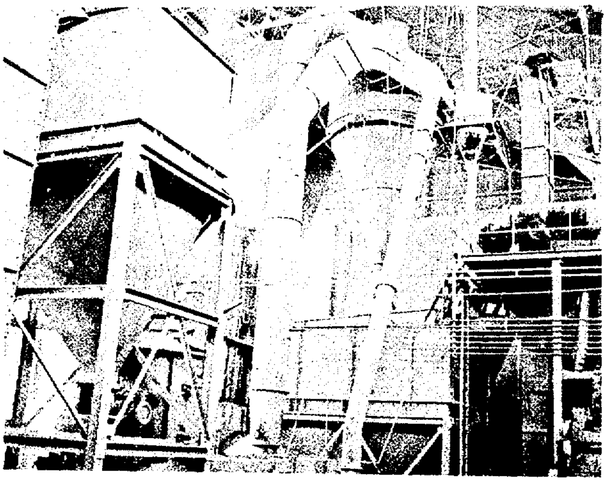
3) Required Space

o Site area	:	1,000 m^2
o Building area	:	700 m^2
Total	:	2,700 m^2

4) Personnel Requirement

o Manager	:	3 persons
o Engineer	:	10 persons
o Operator	:	20 persons
Total	:	33 persons

Phosphate Fertilizer Plant



View of Superphosphate Plant

Furnace of Fused Phosphate Plant

The need for phosphorus in plant growth has been known for a long time. But its highly important function was identified only recently, by the discovery that certain high-energy phosphate bonds are involved in the respiratory and photosynthetic processes. These bonds apparently are necessary for the transfer of energy in some of the plant metabolic processes without which the plant would not live. Phosphorus is also necessary for the health of the plant; it is a constituent of nucleic acid, phytins, and phospholipids, and in the early life of the plant contributes to the formation of the reproductive parts. It is also essential to seed formation and is found in large quantities in seed and fruit.

Although most soils contain large reserves of phosphate in the form of apatites (complex calcium phosphate), iron and aluminium complexes, and organic compounds, such sources are so insoluble that plants can make little use of them. Therefore, there is a need for phosphate to be supplied to the plants to increase the growth and to maintain the health of them.

Generally, phosphates are supplied to the plant in two major form, such as calcium phosphate or ammonium phosphate. Among these two types, the calcium phosphate is the older type, and, in the form of superphosphate, was the first commercial fertilizer of importance.

The plant which is to be introduced here is one which produces calcuim phosphates, such as superphosphate, fused phosphate and the complex fertilizer which was made by mixing superphosphate and fused phosphate. And this plant has some specific characteristics as follows:

- Require low plant cost.
- Can make fertilizers with various composition.
- In case of fused phosphate plant, furnace life is four times longer than that of furnaces used in other similar process.

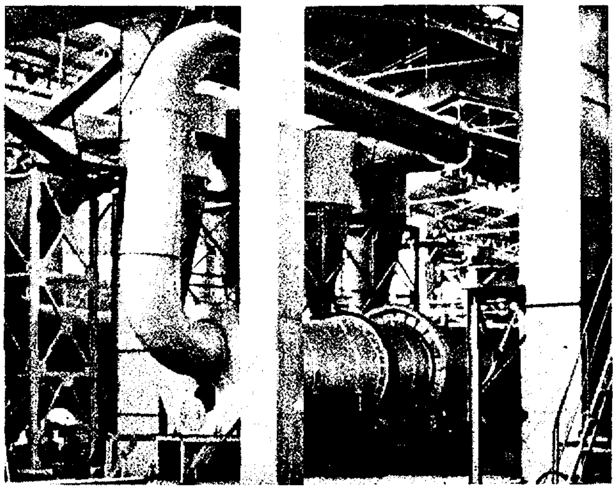
Products and Specifications

Phosphate fertilizers produced in this plant include superphosphate, fused phosphate and complex fertilizer of fused phosphate and superphosphate. Respective characteristics and components are as follows (Generally, fused phosphate is blended and used in the form of fused and superphosphate fertilizer. It will be included in the fused and superphosphate complex fertilizer):

○ Superphosphate

Characteristics

- Since it is granular, the fixation of phosphorus



View of Fused and Superphosphate Plant

is relatively low with high fertilizer effect.

- Being quick-releasing, it is essential for short-term crops.
- The use of quick-releasing superphosphate will bring the satisfactory phosphorus effect since the growth period of rice seedling, particularly in the bed for mechanical transplantation, is short.
- When used in a vinyl house, there will be no damage by ammonia gas.
- It prevents sulfur deficiency and increases the sweet taste.
- It increases volatile matters of such spice vegetables as garlic, onion, ginger and mustard.
- When mixed with compost, its maturation is quickened.
- It improves leaves, stems and branches of all crops. And it makes them resistant to damages by blight and harmful insects and increases the yield.
- Chemically acidic fertilizer, but it becomes physiologically neutral when used.

Component

It contains 20% of soluble phosphorus as well as gypsum (sulfur and limestone) as auxiliary component.

o Fused and superphosphate complex fertilizer

Characteristics

- Fused and superphosphate fertilizer is gray-white colored granule phosphatic fertilizer which is the admixture of slowly responding fused phosphate and quick responding calcium superphosphate.
- Contains not only ortho-phosphate but also metapyrophosphate being necessary for the growth of crops.
- Contains not only phosphorus but also magnesium, calcium, silicate, sulfur and trace elements. Moreover, the granulated product provides much convenience for the farmers to apply this fertilizer.
- Reacts close to the neutral and has a low hygroscopies.
- Granules prevent the soil adsorption and eventually improve phosphate effect.

Effects

- Since this fertilizer contains both of quick releasing water soluble phosphate and slow releasing citric acid soluble phosphate, the nutrients can be utilized more or less evenly from the early growing stage to the later period to paddy rice, barley, vegetables and all other crops.
- Fused and superphosphate fertilizer helps to form the strong tissue of root, stem and leaf of the plant and reduces damages from lodging and insect-disease infection and it also protects from the nitrogen excess symptoms.
- Calcium and magnesium help to reduce harmful substances in the soil or plant and the magnesium, which is part of chlorophyll, activate carbon assimilation process.
- The nutrients contained in this fertilizer such as phosphate, calcium, magnesium, silicate, sulfur and trace elements help to improve soil fertility when it applies consecutively to the acid soil, degraded paddy soil, newly reclaimed soil, tidal land and ill-drained paddy soil.

Component

Citric acid soluble phosphate	:	20.2%
Water soluble phosphate	:	8.0%
Magnesium	:	4.50%
Calcium	:	33.5%
Silicate	:	9.3%
Sulfur	:	6.5%
Other component	:	Trace

Contents of Technology

1) Process Description

This calcium phosphate plant consists of superphosphate plant, fused phosphate plant and fused and superphosphate complex fertilizer plant where two fertilizers are blended.

(a) Superphosphate plant

The raw material phosphate rock is finely crushed in the Reynold's mill so that about 90% can pass 200-mesh screen. It is collected in a cyclone. The collected phosphate rock powder is transported by screw and bucket conveyors to an automatic weighing machine.

In the meantime, sulfuric acid from a tank is diluted to 60-70%, an optimum concentration for reaction, and weighed in suitable quantity and put into the screw conveyor type mixer together with phosphate rock powder.

The feedstock mixed for 2-4 minutes in the screw conveyor is then transferred again to the Den conveyor, which is a continuous curing equipment, where it is cured for about 70 minutes. When cured and hardened, it is cut by a slicer at the outlet of the conveyor.

Since much toxic gas is generated in the reaction, the equipment should be tightly sealed and also so designed to enable eliminate the toxic gas effectively.

The reaction product cut by the slicer is transported back by means of conveyor to the curing tank, where it is subjected to a long curing to allow complete reaction. It is crushed to give required particle size prior to packing as product.

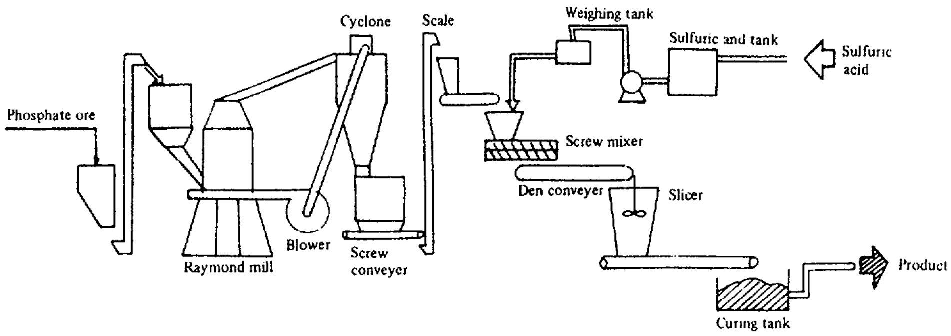
(b) Fused phosphate plant

The fused phosphate is produced by mixing phosphate rock with a variety of materials followd by fusing. It is characterized by not using sulfuric acid in the manufacture.

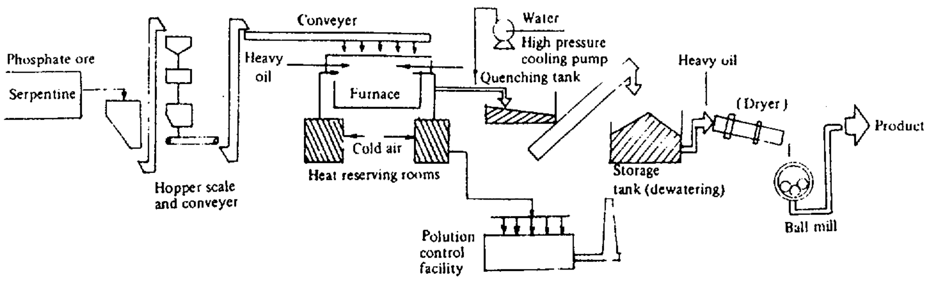
The raw material phosphate rock and serpentine are supplied by bucket conveyor to a hopper scale for weighing in a constant blending ratio and then put into the furnace by neans of conveyor. The raw material is fused by burning Bunker-C oil as heating source. The fused substance is sent to the quenching tank through the outlet of the furnace.

The fused phosphate is usually so corrosive that most of the refractories cannot be used, requiring

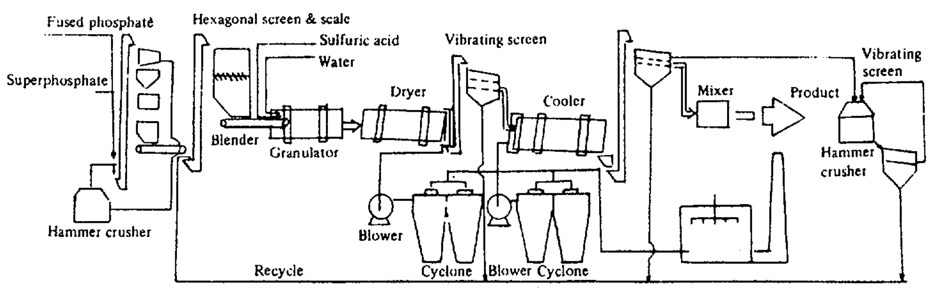
Superphosphate Manufacturing Process Flow Sheet



Fused Phosphate Manufacturing Process Flow Sheet



Fused and Superphosphate Fertilizer Manufacturing Process Flow Sheet



particular industrial technology to prevent such a corrosion. In the quenching tank, the fused substance is sprayed with high-pressure cooling water with the function of quenching as well as partial crushing. The quenched semi-product is dried again in a dryer after dehydration. It is crushed in a ball mill to become the final product.

(c) Fused and superphosphate complex fertilizer plant

The fused phosphate and superphosphate respectively manufactured in the plant mentioned above are crushed, screened, weighed and put into a mixer.

The mixing is sufficiently carried out to uniformly disperse respective components. The mixture is then transferred to a drum-type granulator with the addition of sulfuric acid and water. Granules are dried in a rotary dryer, dried by hot air and screened. In a mixer, anti-caking agent is added to the screened granules for the prevention of caking prior to final packing as product.

2) Equipment and Machinery

- Superphosphate plant

  Raw material storage tank
  Raymond mill
  Blower
  Cyclone
  Screw conveyer
  Bucket elevator
  Automatic scale
  Screw mixer
  Den conveyer
  Slicer
  Product conveyer
  Curing tank
  Sulfuric acid tank
  Sulfuric acid measuring tank

- Fused phosphate plant

  Raw material storage tank
  Hopper scale
  Conveyer and bucket elevator
  Furnace
  Quenching tank
  High pressure cooling water pump
  Storage tank
  Dryer
  Ball mill

- Fused and superphosphate fertilizer plant

  Hammer crusher
  Screen
  Automatic scale
  Bucket elevator
  Raw material mixer
  Granulator
  Dryer
  Blower
  Vibrating screen
  Cyclone
  Cooler
  Aditive adding mixer

3) Raw materials and Utilities

- Superphosphate

Raw materials and utilities	Requirement (per ton of product)
Phosphate rock	0.6 ton
Sulfuric acid (100%)	0.36 ton
Electric power	30-40 kwh

- Fused phosphate

Raw materials and utilities	Requirement (per ton of product)
Phosphate rock	0.6 ton
Serpentine	0.52 ton
Electric power	40-50 kwh
Bunker-C oil	160-200ℓ

- Fused and superphosphate fertilizer

Raw materials and utilities	Requirement (per ton of product)
Fusedphosphate	0.30 ton
Superphosphate	0.76 ton
Sulfuric acid	0.201 ton
Bunker-C oil	10 ℓ

Example of Plant Capacity and Construction Cost

1) Plant capacity : 120,000 m/t
   * Basis : 24 hours/day, 300 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$1,160,000
o Utility facility	:	US$ 4,800
o Installation cost	:	US$ 348,000
Total	:	US$1,556,000

3) Required Space

o Site area	:	3,600 m^2
o Building area	:	13,758 m^2
o Other	:	800 m^2
Total	:	18,158 m^2

4) Personnel Requirement

o Manager	:	1 persons
o Engineer	:	4 persons
o Operator	:	33 persons
Total	:	38 persons

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Mixed Xylene Separation Plant

Depending upon boiling points, mixed xylene is separated into ortho-xylene and para-xylene. All ortho-xylene is used as raw material for phthalic anhydride while para-xylene is used as raw material for PTA (pure terephthalic acid), an intermediate product for polyester fiber.

The mixed xylene separation process consists mainly of a combination of low-temperature separation and isomerization. There are known processes of UOP Isomar, Esso, Standard Oil, Phillips and Maruzen. In our case, UOP process, most widely employed in the world at present, is adopted as manufacturing process technology.

Products and Specifications

Ortho xylene, Liquid, Purity 99.5%
Para xylene, Liquid, Purity 99.5%

Contents of Technology

1) Process Description

Xylene fractionation process

Ortho-xylene as a component of the mixed xylene and with slightly higher boiling point is fractionated into ortho-xylene by the boiling point difference and the remaining components are pumped to adsorption process (Parex process).

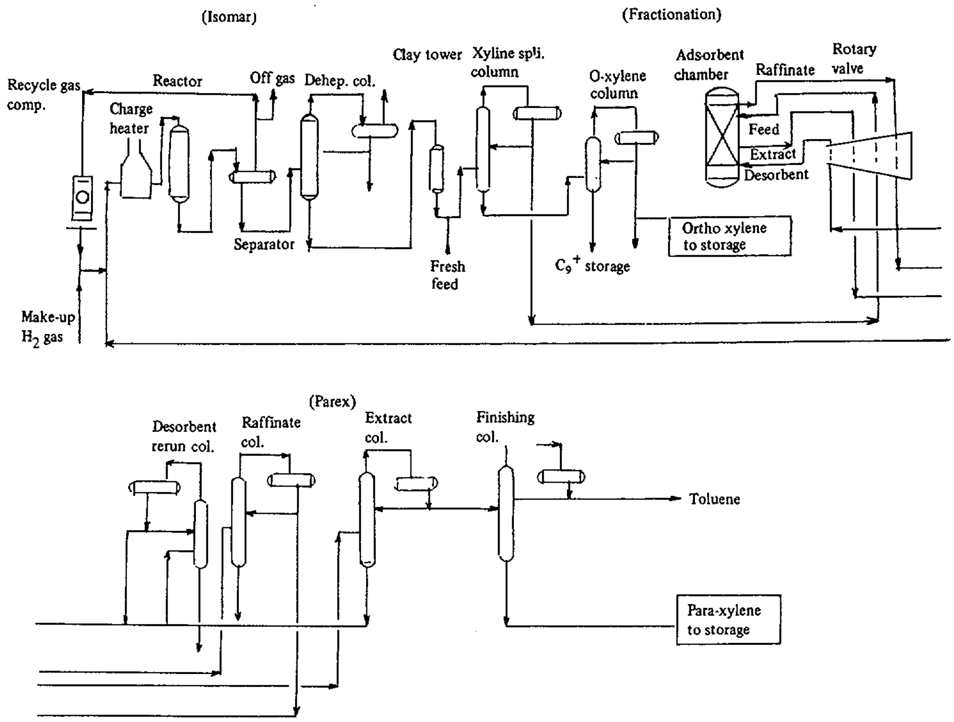
Parex process:

Only para-xylene of the components pumped from the xylene fractionation process is selectively adsorbed in the adsorption column. It is stripped again together with adsorbent, which is separated by fractional distillation to produce para-xylene, with the rest of components charged to Isomar process.

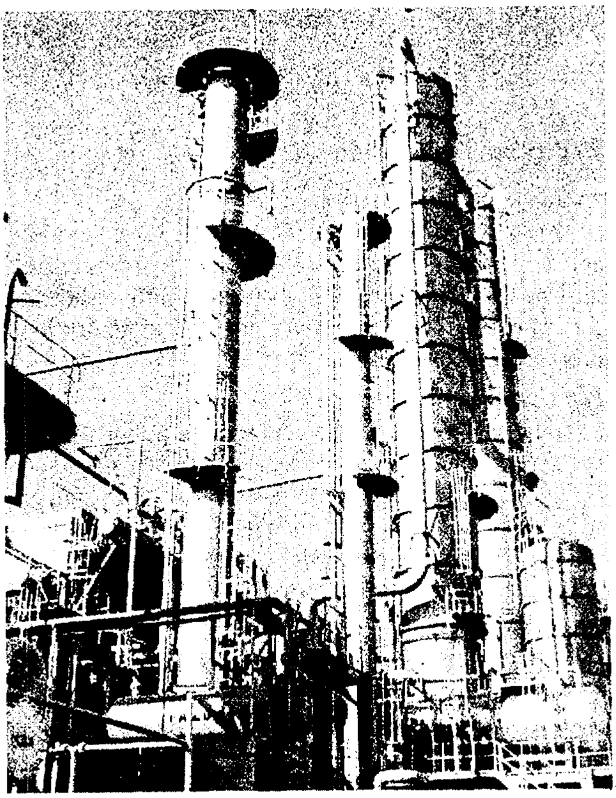
Isomar process:

Being a process converting meta-xylene as well as

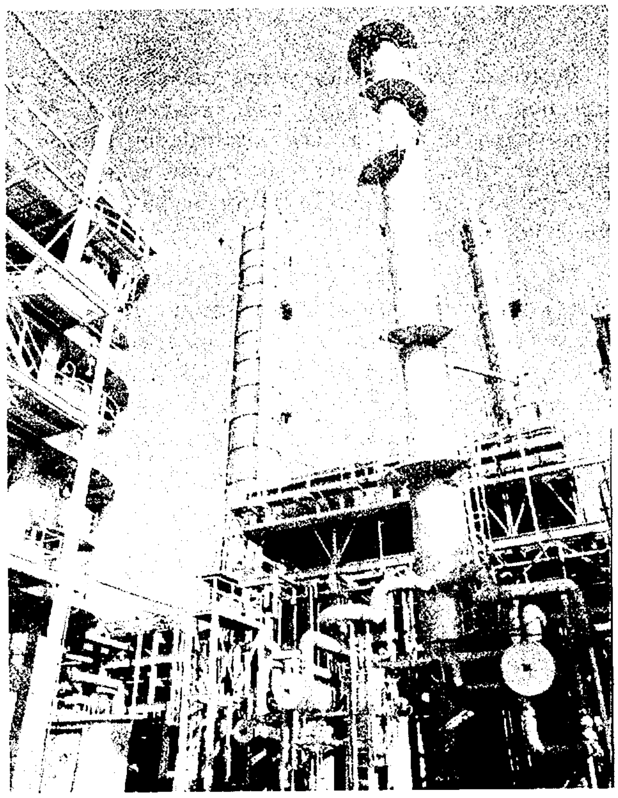
Mixed Xylene Separation Process Flow Sheet



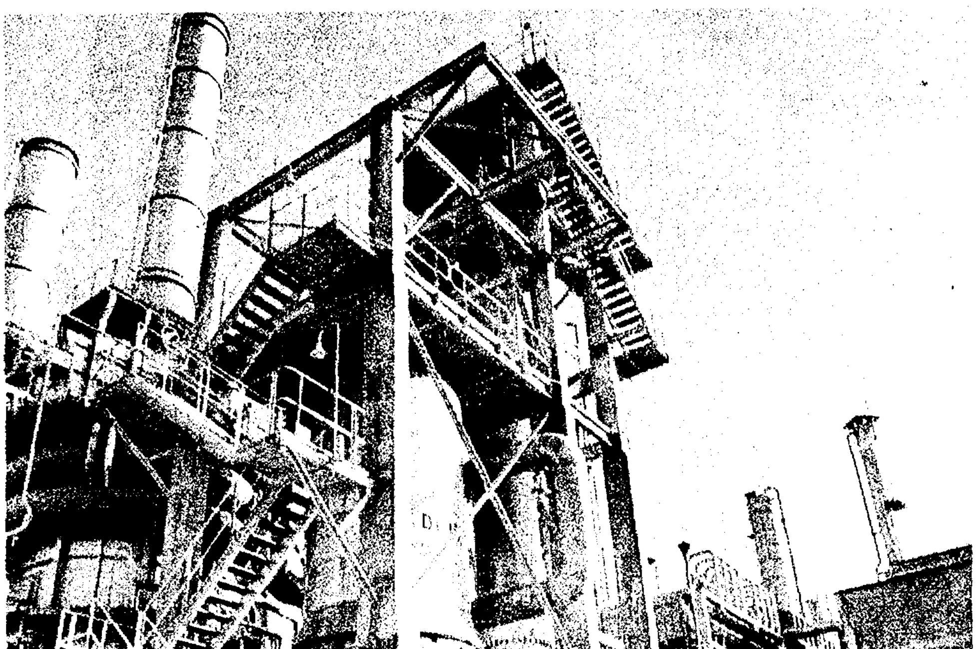
ethyl-benzene of the mixed xylene components to necessary para-xylene and ortho-xylene, the conversion takes place by isomerization reaction with the addition of hydrogen in the reactor filled with platinum catalyst.



Fractionation Process



Parex Process



Isomar Process

2) Equipment and Machinery

Isomar reactor charge heater
Dehaptanizer column
Net gas caustic scrubber
Clay tower
Isomar reactor
Combined feed exchanger
Reactor product trim cooler
Dehaptanizer reboiler
Dehaptanizer OVHD trim cooler
Dehaptanizer charge exchanger
Net liquid stripper bottoms cooler
Reactor products condenser
Dehaptanizer OVHD condenser
Steam surface condenser
Steam jet ejector
Product separator
Dehaptanizer receiver
Chemical injection tank
Net gas K.O. drum
Make up water tank
Condensate surge tank
Caustic day tank
Reactor charge pump
Dehaptanizer OVHD pump
Vacuum condensate pump
Chemical injection pump
Caustic circulation pump
Caustic make up pump
Water make up pump
Recycle gas compressor
Catalyst handling equipment
Compressor bypass cooler
Xylene splitter reboiler heater
Xylene splitter
Ortho-xylene column
Drying column
Clay tower
O-xylene column reboiler
O-xylene column net bottom cooler
O-xylene column product cooler
Drying column reboiler
Clay tower feed heater
Xylene splitter OVHD condenser
O-xylene column OVHD condenser
Drying column OVHD condenser
Xylene splitter receiver
O-xylene column receiver
Drying column receiver
Feed surge drum
Adsorbent chamber
Raffinate column
Extract column
Finishing column
Desorbent reurn column
Feed preheater
Raffinate column reboiler
Extract column reboiler
P-xylene cooler
Finishing column steam reboiler
Finishing column reboiler
Desorbent rerun column reboiler
Desorbent rerun column condenser
Desorbent pump out cooler
Raffinate feed bottom exchanger
Raffinate column vent condenser
Extract column feed bottom exchanger
Vent tank pump out cooler
Bezene vaporizer
Benezene superheater
Finishing column feed bottom exchanger
Finishing column net OVHD cooler
Desorbent rerun column vent condenser
Raffinate column condenser
Extract column condenser
Extract column condenser
Finishing column condenser
Steam jet ejector
Raffinate column feed mixing drum
Raffinate column receiver
Extract feed mixing drum
extract column receiver
Raffinate column vent receiver
Isomar feed surge drum
Parex sump tank

3) Raw Materials and Utilities

Raw materials and utilities	Requirement (per ton of product)
Mixed xylene	1.2 ton
Electric power	310 kwh
Bunker-C oil	0.442 ton

Calcium Carbide Making Plant

Calcium carbide production with electric furnaces on a commercial basis was revealed about 1892 by Moissan in France. And, thereafter, the production of calcium carbide expanded rapidly over the past several decades based mainly on the growing use of acetylene in the synthesis of organic chemicals.

Recently, the continued expansion in the calcium carbide industry seems to be problematical. Because present plant produces acetylene as a chemical building block at cost which are continually rising due to the relatively high labor cost, increasing cost of coke and increasing freight cost on raw materials. In the country with abundant petroleum and natural gas resources, the use of alternative chemicals, based on petroleum and natural gas, permit lower capital and plant cost. So a number of calcium carbide facilities have been scrapped.

But the production of calcium carbide may be competitive for a country with low-cost labor, cheap electric power and abundant limestone.

This calcium carbide has the largest use in the production of acetylene which can be used in the synthesis of organic chemicals such as acetaldehyde, acetic acid, vinyl acetate, polyvinyl compounds, butanol and chlorinated derivatives. Also some part of this acetylene is used for oxyacetylene cutting and welding.

Another important use of calcium carbide is in the production of cyanamide, where it serves as a nitrogen fixative. Cyanamide, $CaCN_2$, is used as a fertilizer and as a raw material for the production of a series of nitrogenous compounds of which dicyanamide, guanidine and melamine are the most important.

Calcium carbide is also used in metallurgy as a desulfurizing and deoxidizing agent, as a nodulization agent in the production of nodular graphite in iron, and as a finishing slag component in ferrous and non-ferrous refining.

Products and Specifications

Sizes of the calcium carbide produced in this plant breaks down into the king size, medium size and small size. The gas yield, which is one of the most important factors in determining the quality of carbide, is 280 ℓ/kg for the product.

The acetylene gas from calcium carbide contains respectively 0.06 vol. % of phosphine and 0.2 vol. % of hydrogen sulfide in case of the first class.

Table 1. Specification of Calcium Carbide

1. Size of carbide

Kind	Lump size (mm)	Lump amount(%)	Powder content
King size	150 – 80	85%	5%
Medium size	80 – 30	85%	5%
Small size	30 – 5	85%	5%

2. Gas generating

Class	Gas generating (ℓ/kg)
First class	280
Second class	260
Third class	230

3. Impurity

Class	PH_3 (volume %)	H_2S (volume %)
First	0.06	0.20
Second	0.10	0.20

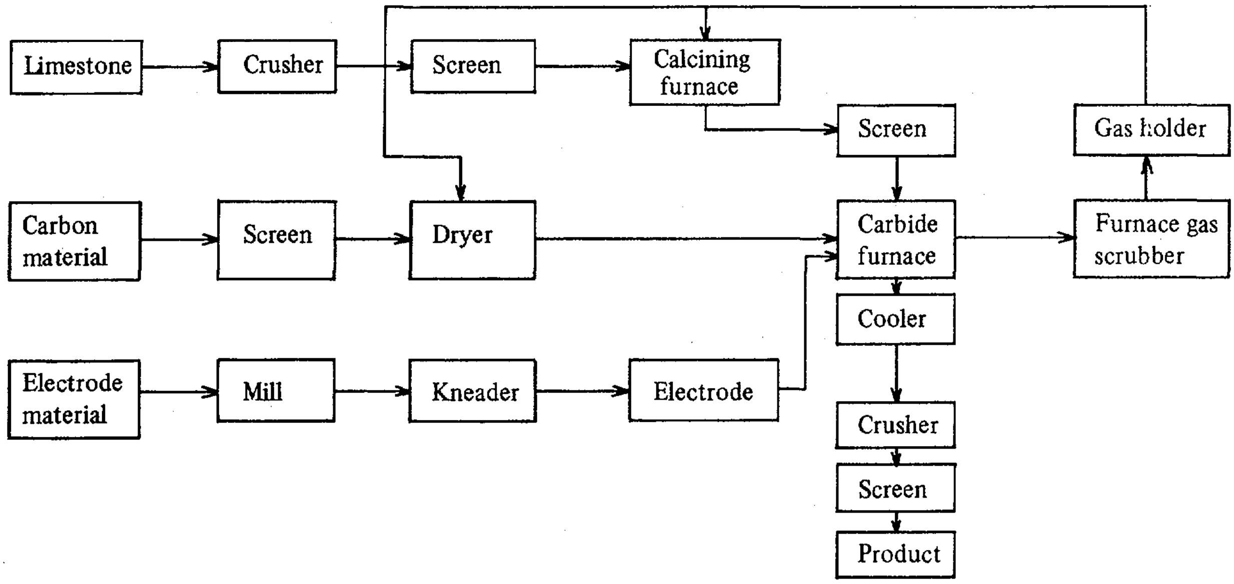
Contents of Technology

1) Process Description

Carefully-selected limestone is put into a jaw crusher by means of apron feeder for crushing. It is then transferred to a rotary screen by belt conveyor to obtain raw material with pertinent sizes.

Mixed with 0.1-0.12% of carbon material, limestone is heated and calcined at the temperature of approximately 900°C. If the temperature is too high, the lime becomes hard and high in specific gravity, not readily reacting with water. At lower calcination temperature, it becomes highly activated but is liable to weather and easily reacts with water.

Calcium Carbide Manufacturing Process Block Diagram



Besides, when sodium chloride is added in 0.1-0.3 vol. % of limestone, the calcined lime is white and homogeneous, being quicklime with easy hydration.

The carbon material includes anthracite, cokes and charcoal. In case of lump coal, it is so crushed and screened to have a little smaller particle size than limestone powder. Dust coal is used in part for the lime furnace after mixing and briquetting. The remainder is supplied to the carbide furnace.

The prepared lime and carbon material is weighed in an automatic weighing scale with simultaneous mixing. The mixing ratio of lime and carbon material is determined by the purity and characteristics of the furnace as well as by the grade of calcium carbide to be produced.

The mixture is put into the electric furnace and starts reacting when reaching the point 10-20 inches below electrodes to form calcium carbide. The reaction occurs until reaction product reaches the tap hole and the produced calcium carbide accumulates in the bottom of the electric furnace.

As an appropriate amount of calcium carbide is collected in the bottom, it is tapped as molten carbide by piercing the tapping hole with a steel bar at intervals of a certain time. When the tapping is difficult, a tapping electrode is used to sufficiently heat the carbide blocking the tapping hole to break open a hole. If the tapping of carbide is repeated on one side of the furnace, impurities accumulate on the other side and the tapping becomes difficult later, aggravating operating conditions in the furnace. Therefore, care should be taken to alternate the tapping on both sides.

Thus, for smooth operations of the furnace, the tapping should be carried out frequently and adequately and in particular the electric power maintained constant, with carbon-lime blending ratio also kept constant all the time. The tapped carbide is directly put into a water-cooled rotary cylinder. The cooled carbide is crushed by a jaw crusher for packing as product.

2) Equipment and Machinery

Limestone calcining and carbide making section
- Apron feeder
- Jaw crushers
- Belt conveyers
- Rotary screen
- Lift towers
- Lime kiln
- Electric furnace

Electrode making section
- Flat mill
- Carbon kneader
- Blower
- Screw mixer

Formed coal making section
- Powdered coal hopper
- Belt conveyors
- Pin crusher
- Bucket elevators
- Formed coal kneader
- Masek roller
- Dryer

Coal lump treating section
- Coal lump hopper
- Belt conveyors
- Vibrating screens
- Jaw crusher
- Coal tank

Others
- Overhead crane
- Packing machine

3) Raw materials

Limestone and carbon material are two feedstocks in manufacturing calcium carbide, and electrodes serve as auxiliary material.

Lime is first obtained by calcining limestone and used for the production of calcium carbide. Limestone generally should be compact and hard in structure not breaking easily when calcined with the purity of more than 96% calcium carbonate.

If such impurities as magnesium oxide, aluminum oxide, silicon oxide and ferric oxide are contained in limestone, the furnace operations are made difficult, resulting in a reduced product quality. In other words, it brings an explosion hazard when more than 3% magnesium oxide, which rapidly evaporates at higher temperature, is contained. Aluminum oxide reduces the viscosity of molten carbide to make the tapping difficult while silicon oxide reacts with ferric oxide to produce Fe-Si precipitate, thus elevating the level in the bottom of furnace.

Since there is a possibility that many impurities other than described above are supplied with raw materials, efforts should be made to use not only limestone but also carbon material and electrodes containing little impurities as far as possible, also taking care not to allow any impurities to come into the process when working.

As coal material, one of the important materials together with limestone, anthracite or cokes, high in fixed carbon and low in ash and volatile matter content, can be preferably used. In most cases, carbon electrodes are used with no particular requirement on high quality, but electrodes with less oxidation consumption are preferred because the furnace temperature reaches around 2,000°C.

Example of Plant Capacity and Construction Cost

1) Plant capacity : 50 metric tons/day
   1,800 metric tons/year
   * Basis : 24 hours/day, 360 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$1,200,000
o Utility facility	:	US$ 300,000
o Installation cost	:	US$ 100,000
Total	:	US$1,600,000

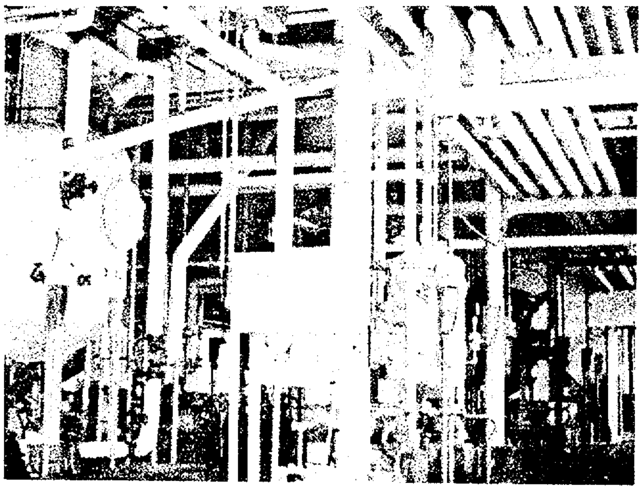
3) Required Space

o Site area	:	40,000 m^2
o Building area	:	500 m^2
o Other	:	500 m^2
Total	:	41,000 m^2

4) Personnel Requirement

o Manager	:	5 persons
o Engineer	:	7 persons
o Operator	:	72 persons
Total	:	81 persons

Epoxy Resin Making Plant



View of Reactor

Epoxy resins were first introduced shortly after World War II with technological advantages over other thermosetting resins including phenolic and polyester resins. They can duplicate performances of most other thermosetting plastics and even exceed them in a variety of specialized applications.

So the production of epoxy resins has been accelerated during the last decades, growth being assisted by periodic reduction in prices. The demand for epoxy resins is expected to sharply increase in the future due to their versatility and the development of related industries.

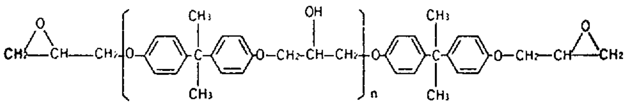
The main applications of epoxy resins are as follows:

- Surface coatings: Air drying, baking, powder coating, etc.
- Electrical field : Casting, dipping, encapsulation, laminates, PCB and so forth.
- Mechanical and metal industries : Tools, tooling aids, foundry equipment, etc.
- Adhesives : As structural adhesive and general purpose.
- Linings : Various storage tank and reaction vessel.
- Others : FRP, stabilizer for PVC, etc.

The epoxy resin plant introduced here has good merits. The process can be controlled automatically by computer system and the products are of high quality. Also basic and special grade products can be produced to serve client's purposes at the lowest cost.

Products and Specifications

The epoxy resin which is produced in the plant in a series of copolymer of epichlorohydrine and bisphenol–A has an undermentioned chemical structure.



The characteristics of products can be described as follows:

- Good stability of quality.
- Non-volatility and minimum shrinkage in reaction.
- Ability to mix with pigments and large quantities of such fillers as inorganic, organic and metallic powders as well as sand (in case of liquid resins).
- Excellent solubility in common solvents.
- Good compatibility with other resins.
- Good stability in storage.
- Excellent mechanical and electrical properties because of minimum residual chlorine and dimension stability.
- High waterproofness, chemical resistance and wear resistance.
- High adhesion with metals, cement and plastics.

Table 1. Specifications of Liquid Type Epoxy Resins

Grade	Color	Viscosity (cps., 25°C)	Specific Gravity/(20°C)	Epoxy equivalent(g/eq)	Epoxy contents (eq/100g)	Chlorine contents
YD-115	1 max.	700 ~ 1,100	1.14	180 ~ 194	0.52 ~ 0.55	0.1% max.
YD-115CA	1 max.	800 ~ 1,600	1.15	195 ~ 215	0.47 ~ 0.51	
YD-127	1 max.	8,000 ~ 11,000	1.16	180 ~ 190	0.53 ~ 0.55	0.1% max.
YD-128	1 max.	11,000 ~ 14,000	1.17	184 ~ 194	0.52 ~ 0.54	0.1% max.
YD-128S	1 max.	19,000 ~ 24,000	1.17	205 ~ 225	0.44 ~ 0.49	
YD-134	1 max.	P–U*1	1.18	230 ~ 270	0.37 ~ 0.43	0.1% max.
YD-172	10 max.	Semi solid	1.05	600 ~ 700	0.14 ~ 0.17	

*1 Measured on butylcarbitol solution of 70% resins

In this plant, various grades of epoxy resins are produced, fully serving customer's purposes in a variety of uses. Typical grades are liquid type, solid type, solution type and special type with respective specifications as are shown in tables 1, 2 and 3.

Table 2. Specifications of Solid Type Epoxy Resins

Grade	Color *2	Softening point°C	Solution *2 viscosity @ 25°C	Sp. gr. @ 20°C	Epoxy equivalent (g/eq)	Esterification equivalent weight *3
YD-011	1 max.	64 ~ 74	D-F	1.17 ~ 1.20	450 ~ 500	145
YD-014	1 max.	95 ~ 104	Q-U	1.16 ~ 1.20	900 ~ 1,000	190
YD-014E	1 max.	95 ~ 104	"	1.16 ~ 1.20	800 ~ 950	190
YD-017	1 max.	122 ~ 131	Y-Z_1	1.17 ~ 1.20	1,750 ~ 2,100	220
YD-019	1 max.	144 ~ 158	Z_3-Z_5	1.17 ~ 1.20	2,400 ~ 3,300	230

Remarks:

*2 Measured on butylcarbitol solution of 40% resins

*3 Only for reference

Color .... Gardner method
Viscosity .... BH type rotary viscometer
Solution viscosity (*1, *2) .... Gardner-Holdt method
Epoxy equivalent .... Dioxane-HCl method
Softening point .... Durran's method
Chlorine contents .... Hydrochloric acid back titration

Polyamide resin, which meets 60% of the total demand for hardeners used in curing epoxy resin, can also be produced in this plant. This resin is made by condensation of dimer-acid and polyamines with the amine group reacting with the epoxides. It is less toxic, less volatile and easy to handle. It also has long pot-life and can be combined and mixed in large quantities as well. The type and specification for polyamide resin are shown in table 4.

Table 3. Specifications of Solution Type Epoxy Resins

Grade	Color	Viscosity @ 25°C	Non-volatile %	Epoxy *4 equivalent	Solvent
YD-011X75	1 max.	Z_4 ~ Z_6	74 ~ 76	450 ~ 500	Xylene
YD-017 MT55	6 max.	X ~ Z_2	54 ~ 56	1,750 ~ 2,100	MIBK: Toluene (1:1)
YD-172X75	8 max.	X ~ Z_1	74 ~ 76	600 ~ 700	Xylene

*4 These values are those of solid contained in solution.

Note: According to user's requirement, it is possible to make up special grade with other solvents in various concentrations.

Table 4. Specifications of Polyamide Resins

Type	Equivalents to other firms: Versamid	Equivalents to other firms: Tohmide	Amine values	Viscosity (CPS)	Colors	Specific gravities	Acid values	Uses
5022	115	215X	200-240	40°C 50,000-70,000	< 12	0.95-0.99	< 3	Two-component type epoxy coatings
0930	125	225X	280-320	40°C 8,000-12,000	< 12	0.95-0.99	< 3	Coating, adhesive
1034	140	235X	310-370	25°C 10,000-20,000	< 12	0.96-0.99	< 3	Adhesive and any other kinds of uses
0331	–	2400	290-330	2,500-4,500	< 12	0.95-0.99	< 3	Ordinary adhesive, civil works, construction
0240	G-250	245	380-420	1,500-3,000	< 12	0.95-0.99	< 3	Ordinary adhesive, civil works, construction
5022XB-65	–	415	140-160	S-V	< 10	–	< 3	Xylene/buthanol solution of 5022 NV=65 ±2%
0930XB-65	–	–	185-205	–	< 10	–	< 3	Xylene/buthanol solution of 0930 NV = 65 ±2%

* Read by adding O's to the figure ends

Example: a) 5022–50220 The last three figures shows that amine value is 220.
Five figures shows that viscosity is 50,000 CPS.

b) 0930–09300 The last three figures shows that amine value is 300.
Five figures shows that viscosity is 9,300 CPS.

Contents of Technology

1) Process Description

This process description relates to explanations on epoxy resin and polyamide resin as its curing agent.

(a) Epoxy resin

Epichlorohydrine and bisphenol-A as respective raw materials are fed into the reaction process. These are melted and undergo the first-stage reaction with the temperature maintained constant.

In this first-stage reaction, which is exothermic, epoxy radical is separated from epichlorohydrine to be attached to hydroxy radical, thus producing chlorohydrine ether.

In the second-stage reaction, the produced chlorohydrine ether causes a dechlorination reaction to occur in the presence of sodium hydroxide, producing a terminal epoxy radical. It is characterized by an endothermic reaction with remarkable high reaction velocity.

The monoglycidyl ether of bisphenol-A produced as a result continues to react with bisphenol-A and epichlorohydrine and gradually forms a high polymer. However, to produce low molecular epoxy resin, an excess epichlorohydrine is added to terminate the condition of polymerization. On completion of polymerization, the polymer is transferred through a storage tank to the epichlorohydrine separation evaporator, where epichlorohydrine is separated under vacuum of 5 torr.

The polymer, from which epichlorohydrine is eliminated, is containing reaction by-products and unreacted substance. To eliminate the reaction by-product and complete the reaction of unreacted substance, it is fed to the refining reaction process.

In this refining reaction process, sodium hydroxide is added for a repeated reaction, in which the chlorine component combined at the end of epoxy radical is eliminated to the maximum extent.

Methylisobutylketone is used to eliminate sodium chloride and the reaction by-product by the difference in specific gravity, with its acidity adjusted. The polymer with adjusted acidity is evaporated under vacuum of 2-3 torr in the methylisobutylketone recovery process to eliminate MIBK, thus obtaining epoxy product.

The quality of the product thus manufactured is generally not uniform, requiring to make the final product by blending and adjusting with other products in accordance with specifications.

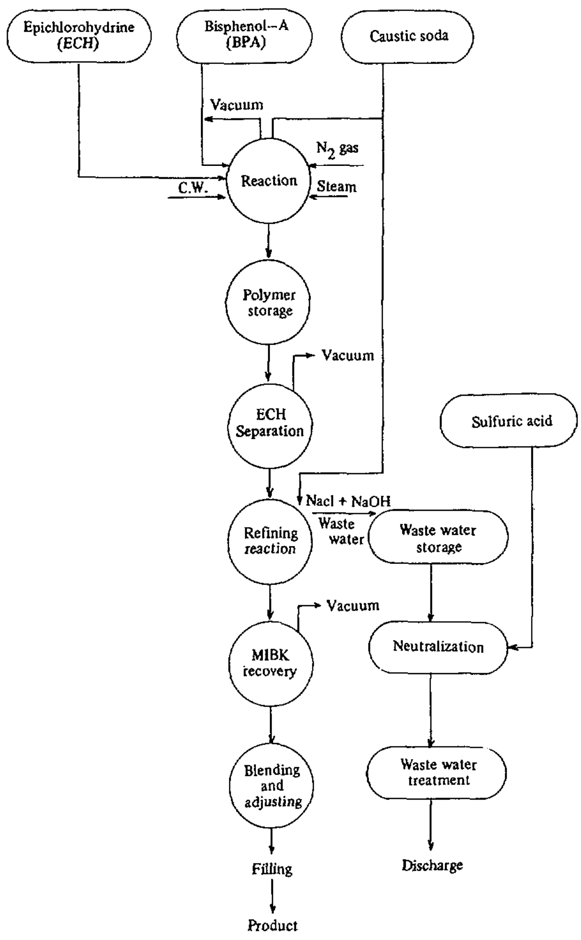
(b) Polyamide resin

Aminopolyamide is basically synthesized by the condensation reaction between polymerized fatty acids obtained by thermal polymerization of natural vegetable oil fatty acids and ethylenediamines. That is to say, the first-grade amine existing at the end of ethylenediamine and carboxyl radical in polymerized fatty acids primarily form the salt. This reaction takes place at normal temperature and releases approximately 13 kcal/mole of heat, remarkably increasing in viscosity as the formation of salt progresses.

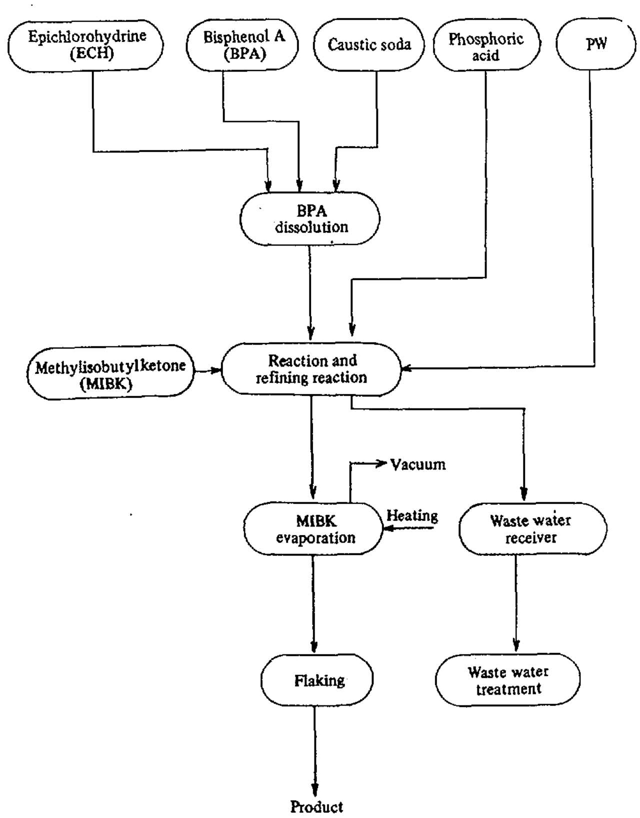
The formed salt, as the temperature is raised by heating, produces a dehydration phenomenon, and at the same time, it causes the amide combination to occur, completing the reaction. The viscosity drops again due to the amide combination.

In order to improve the water solubility, operations are carried out in reduced-pressure reaction under high vacuum and at high temperatures, producing imidazolin ring in molecules and terminating all reactions. The product, with its reaction terminated, is adjusted in the product adjustment tank to be filled in vessels, packaged and put on sale as the finished product.

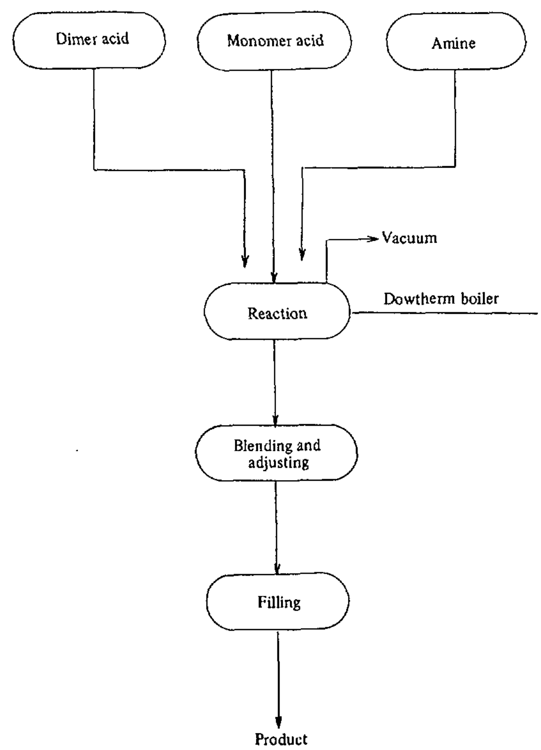
Liquid Type Epoxy Resin Manufacturing Process Diagram



Solid Type Epoxy Resin Manufacturing Process Diagram



Polyamide Resin Manufacturing Process Diagram



2) Equipment and Machinery

- Epoxy resin manufacturing plant

  Tanks
  - Epichlorohydrine storage tank
  - MIBK storage tank
  - NaOH storage tank
  - Bisphenol–A storage tank
  - Recovery water tank
  - Recovery epichlorohydrine tank
  - Salt solution tank
  - Recovery solvent tank

  Reactor and evaporator
  - Evaporator
  - Condensing separator
  - Reactor condenser
  - Reactor
  - Purifying tank

  Filter and pumps
  - Filter
  - MIBK supply pump
  - NaOH supply pump
  - Bisphenol–A solution pump
  - Salt solution pump
  - Reactor vacuum pump
  - The first vacuum pump
  - The second vacuum pump

- Polyamide resin manufacturing plant

  Tanks and reactor
  - Amine measuring tank
  - Mixing tank
  - Amine neutralization tank
  - NaOH tank for neutralization
  - Gas absorbed liquid tank
  - Expansion tank
  - Waste water tank
  - Drum type heating tank
  - Reactor

  Pumps and condenser
  - Drum pump
  - Dimer acid injection pump
  - Monomer acid injection pump
  - Reactant pump
  - Absorbing liquid pump
  - Narotherm pump
  - Vacuum pump
  - Recycle condenser

3) Raw Materials

o Epoxy resin

Raw materials	Requirement (per ton of *product)
Bisphenol–A	677 kg
Epichlorohydrine	566 kg
45% NaOH	560 kg
Methylisobutylketone	18 kg
N_2 gas	30 kg

* YD–128

o Polyamide resin

Raw materials	Requirement (per ton of *product)
Dimer acid	720 kg
Monomer acid	78 kg
Triethylenetetramine	289 kg
N_2 gas	3 kg

* G–5022

Example of Plant Capacity and Construction Cost

1) Plant capacity : 5,475 t/year
  * Basis : 24 hours/day, 350days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$ 950,000
o Utility facility	:	US$ 150,000
o Installation cost	:	US$ 100,000
Total	:	US$1,200,000

3) Required Space

o Site area	:	350,000 m^2
o Building area.	:	900,000 m^2
o Other	:	350,000 m^2
Total	:	1,700,000 m^2

4) Personnel Requirement

o Manager	:	1 persons
o Engineer	:	3 persons
o Operator	:	13 persons
Total	:	17 persons

Hexane / Cyclohexane Solvent Plant

Most solvents are usually produced by directly separating naphtha or from desulfurized naphtha. However, the solvent produced in this plant makes use of the raffinate from naphtha cracking unit as a raw material. This raffinate is the residual hydrocarbon obtained after processing naphtha into ethylene, propylene, butadiene and BTX by means of several treating processes, such as thermal decompsotion, desulfurization and hydrogenation, and aromatic compound extraction. So the solvent produced here has some characteristics as follows:

• Containing almost no toxic aromatic compounds, this solvent does not cause such an occupational disease as chronic anemia even in case of heavy inhaling. The anemia is caused by aromatic hydrocarbons.

• Completely desulfurized, it does not cause any atmospheric pollution ascribable to solvents.

• Containing much hydrocarbons of naphthene with the strong extraction capacity, it can be used as solvent substituting for benzene. It can be used for extracting perfume and vegetable oils.

• It is colorless and odorless.

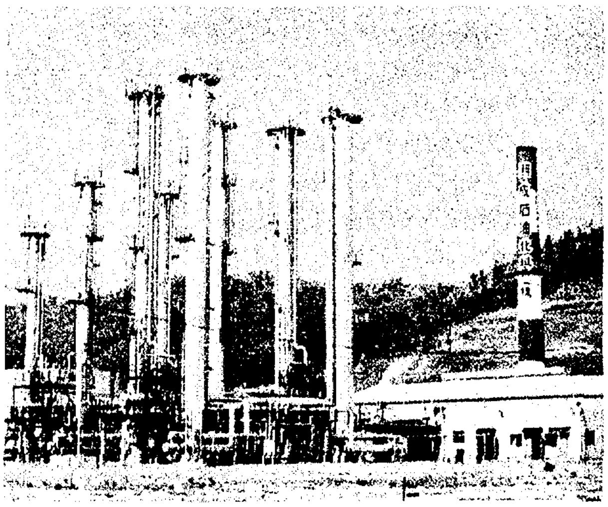
This solvent with much characteristics is for use in vegetable oil extraction, adhesives, agricultural chemicals, paint thinner, mucilage and solvent for cleaning machines.

Products and Specifications

Raw materials used in this plant include various aromatics, small amount of naphthene and paraffin. These are separated by differences in boiling point into various solvents as follows:

- Light aliphatic solvent
- n-Hexane solvent
- Methyl-cyclopentane solvent
- Cyclohexane solvent
- Medium aliphatic solvent
- n-Heptane solvent
- Heavy solvent product

The products differ depending upon supply sources of raw materials. In the case of this plant in Korea, for example, the breakdown in terms of mole ratio shows 9.8% light aliphatic solvent, 16.9% n-hexane, 24.6% methyl-cyclopentane, 18.8% cyclohexane, 8.8% medium aliphatic solvent, 9.8% n-heptane and 11.3% heavy solvent product.



View of Solvent Plant

Specifications of three typical solvents are as shown in table 1.

Contents of Technology

1) Process description

The raffinate as raw material from a storage tank is preheated while passing through a heat exchanger and then enters the light aliphatic solvent column which is the first distillation tower.

The feedstock in the distillation column is distilled on the basis of differences in boiling point, low-boiling solvent moving upward in vapor to the top of column and high-boiling solvent moving downward in liquid to the bottom of column.

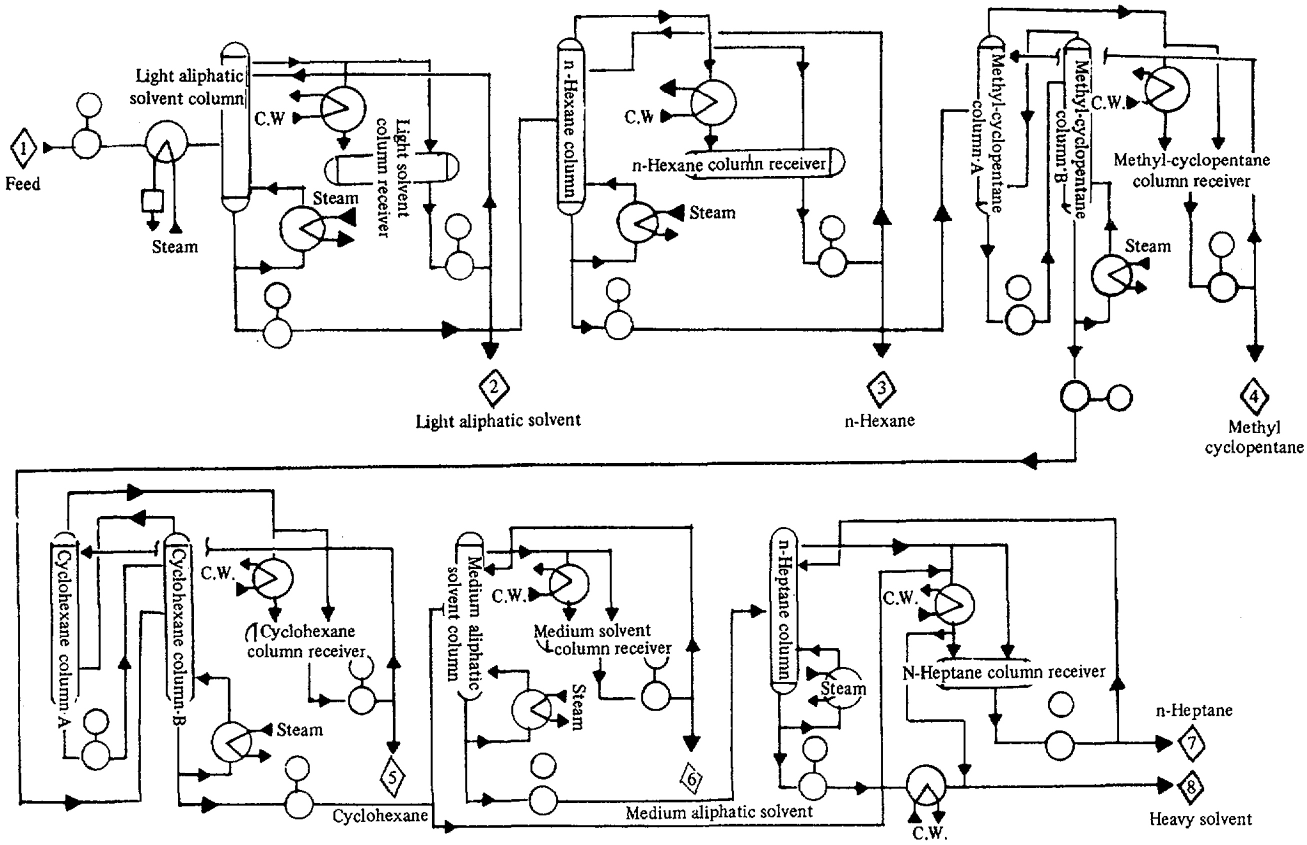
In this way, the low-boiling light aliphatic solvent in vapor from the top of column is converted to liquid while passing through a condenser and stored in a storage vessel on the ground. By pumping, part of the solvent is recycled as reflux to the top of column and the remainder is transferred to the light aliphatic solvent storage tank.

On the other hand, the high-boiling solvent in the bottom enters the horizontal thermosyphon reboiler by natural circulation to be vaporized and recycled to the bottom of column in gas-liquid mixed phase. The remainder is pumped to the next distillation column, n-hexane solvent column, as its feedstock.

Table 1. Specifications of Solvents

Test item \ Product	n-Hexane	n-Heptane	Cyclohexane
Specific gravity (15.6°C/15.6°C)	0.665–0.687	0.70–0.72	0.780–0.784
Distillation (°C)			
I.B.P.	66	94	80.0 min.
E.B.P.	69	98	82.0 max.
Saybolt colour	+30		+30
Benzene, vol. %	0.03		
Benzene, wt. %			0.1 max.
Cyclohexane, wt. %			99.8 min.
Saturated hydrocarbon, mol. %		94.0–97.7	
High boiling hydrocarbons, wt. %			0.1 max.
Phenols, wt. ppm			1.0 max.
Aromatic compound (as toluene), mol. %		2.3–6.0	
Sulfur, wt. ppm	1 max.	1 max.	5.0 max.
Water soluble, wt. ppm			1.0 max.
Bromine value, g/100g		0.05 max.	
Doctor test	Neg.		
Copper strip, at 50°C, 3hrs.			Pass No. 1
Non-volatile matter, g/100ml	0.0005 max.	0.0005 Max.	0.001 Max.
Water content, wt. ppm	Free		

Solvent Manufacturing Process Flow Sheet



The feedstock entering the n-hexane column is distilled as in the previous column, n-hexane vapor leaving the top of column to be converted to liquid while passing through a condenser. It enters a storage vessel on the ground and is recycled in part as reflux to the top of column, and the remaining product enters the storage tank.

The solvent liquid in the bottom of column is recycled in the same manner and the remainder is pumped to the methyl-cyclopentane column A as feedstock. The feedstock entering the methyl-cyclopentane column A is distilled as in the previous column, and methyl-cyclopentane vapor leaves the top of column to be converted to liquid by a condenser and enters a storage vessel. Part of solvent is recycled as reflux to the top of column and the remainder is pumped to the methyl-cyclopentane storage tank as product.

In the meantime, the solvent in the bottom of column A is pumped to the top of column B. The solvent vapor from the top of column B enters the bottom of column A by natural circulation. Part of the solvent liquid in the bottom of column B passes through the horizontal thermosyphon reboiler by natural circulation and is vaporized. This vapor liquid mixture is recycled to the bottom of column B. The remainder is pumped to the cyclohexane column B, which is the next distillation column.

The feedstock in the cyclohexane column B is separated in the same way. The solvent vapor in the top of column B enters the bottom of column A by natural circulation and separated in the same manner. The solvent liquid in the bottom of column A is pumped to the top of column B. The cyclohexane vapor from the top of column A is condensed while passing through a condenser. It is stored in a storage vessel to be pumped in part to the top of column in reflux, and the remainder is stored as product in the cyclohexane tank.

On the other hand, part of the solvent liquid in the bottom of column B enters the horizontal thermosyphon reboiler by natural circulation and is evaporated. The vapor-liquid mixture is recycled to the bottom of column B, and the remainder is pumped as feedstock to the medium aliphatic solvent column, which is the next distillation column.

The feedstock in the medium aliphatic solvent column is separated in the same way, and the medium aliphatic solvent vapor from the top is condensed while passing through a condenser and collected in a storage vessel. It is then pumped in part to the top in reflux and the remainder is stored in the medium aliphatic solvent storage tank as product. The solvent liquid in the bottom is recycled in the same manner and the remainder is pumped to the n-heptane column as feedstock.

The feedstock in the n-heptane column is separated in the same way and n-heptane gas from the top is condensed and stored. It is partially pumped in reflux to the top and the remainder is collected in the n-heptane storage tank as product. The solvent liquid in the bottom is recycled in the same way and the remainder is transferred to the heavy solvent storage tank after passing through a cooler.

2) Raw Materials and Utilities

The raw material is a raffinate which contains mainly n-hexane, methyl-cyclopentane and cyclohexane. The detail composition and requirement of this raw material are shown in table 2 and 3.

Table 2. Composition of Raw Material

Component	Mole percent
120°F-156°F Distillate	10.6
N-Hexane	13.4
Methyl-cyclopentane	25.9
174°F-177°F Distillate	0.003
Cyclohexane	20.9
178°F-201°F Distillate	9.2
N-Heptane	6.6
Methyl-cyclohexane	4.9
Ethyl-cyclopentane	0.006
221°F-349°F Distillate	8.5
Total	100

Table 3. Raw Materials and Utilities

Raw materials and utilities	Requirement (per ton of product)
Raffinate	1 ton
Steam	4.12 tons
Bunker-C oil	0.28 ton
Cooling water	86.6 tons
Instrument air	13.8 m^3
Electric power	89.4 kwh

FILE: G-103
ISIC: 3512

Complex Fertilizer Making Plant

The fertilizer is a kind of material externally supplying in the appropriate form deficient components of essential elements for the growth of plants. Generally it contains more than one of three essential elements of nitrogen, phosphorus and potassium.

Such kinds of fertilizer are grouped according to the variety depending upon the criterion of classification. But they are divided into single fertilizer and complex fertilizer when classifying on the basis of the number of main elements contained in the fertilizer.

Of the two, such as ammonium sulfate and superphosphate of lime, the single fertilizer is the one manufactured centering on one of the three elements. The complex fertilizer is so manufactured as to contain more than two kinds of effective elements by combining these single fertilizers.

The compelx fertilizer also breaks down into two depending upon manufacturing methods. One is mixed fertilizer produced by simple physical blending respective element fertilizers and the other is compound fertilizer prepared by manufacturing compounds having the fertilizer effect by chemical reaction.

The fertilizer plant introduced here is for manufacturing the type of mixed fertilizer among the complex fertilizers mentioned above. In this plant, more than two different kinds of fertilizer are blended and processed into one of the forms of powder, granule and briquette for saving labor and time in applying the fertilizer. Its effect is further improved by blending fertilizers to conform to characteristics of variable properties of soil and crops.

This mixed fertilizer plant, based on the production method of merely mechanically blending various element fertilizers, enables to produce varied products with small scale and capital requirement, being the most suitable plant as a small and medium type plant.

Products and Specifications

In this plant, ammonium sulfate, urea, potassium sulfate, potassium chloride, conc. superphosphate, superphosphate of lime and other organic fertilizers are appropriately blended to suit various uses, supplying products of diverse specifications.

In consideration of the ease of application and extension of the fertilizer effect, products can be manufactured and processed in such varied forms as blending type, granule type and briquette type.

Typical fertilizers produced in this plant at present are the complex fertilizer for vegetables (blend type), the complex fertilizer for beans (granule type), the briquette complex fertilizer for forest (briquette type), the briquette fertilizer for field crops and the complex fertilizer for horticulture (granule type). Their characteristics and components are as follows:

o Complex fertilizer for vegetables

Characteristics:

- Being a base fertilizer, nitrogen, phosphorus, potassium and other organic matters are properly blended.
- Improves the taste, quality and appearance of vegetables.
- Other organic matters contained in the complex fertilizer have a strong sustaining power and prevents chemical fertilizer components from being washed away. They also help invigorate activities of soil microorganisms disintegrating not readily utilized nutrients in the soil, thus helping vegetables grow. The organic matters also have a big capacity to hold moisture and minimize damages by the dry spell. They are helpful to vegetables that have to survive during the winter (onoin, garlic, oil vegetables and barley) since they contribute to raising the soil temperature.

Component:

Nitrogen	9 %
Phosphate	12 %
Potassium	9 %
Organic component	40 %

o Complex fertilizer for beans

Characteristics:

- Three elements of nitrogen, phosphorus and potassium are appropriately contained for the cultivation of beans.
- Magnesis and boron contained help strengthen the vitality of roots and increase chlorophyll, preventing fall of flowers and increasing beans.
- Can be used for other field crops with effectiveness.

Component:

Nitrogen	8 %

Phosphate	14 %
Potassium	12 %
Magnesis	8 %
Boron	0.3 %

○ Briquette complex fertilizer for forest

Characteristics:

- Nitrogen, phosphorus and potassium are properly contained for the growth of trees.
- Being in the briquette form, the fertilizer is sustained for a long time.
- Can be used as base fertilizer or additional fertilizer in afforestation.
- Weighing about 15 grams per one, the briquette is the size of a peach seed and saves labor in use.

○ Briquette complex fertilizer for field crops

Characteristics:

- In the form of a peach seed, nitrogen, phosphorus, potassium are properly contained.
- Labor is saved when applying.
- Absorption and utilization rates are relatively high, saving10-20% of the amount used.
- Fertilizer dissolves slowly with sustained effectiveness.
- Crops increase by 13-22 percent.

Component:

Nitrogen	13 %
Phosphate	10 %
Potassium	11 %
Boron	0.3 %

○ Compelx fertilizer for horticulture

Characteristics

- As a base fertilizer for orchard and vegetables, three elements of nitrogen, phosphorus and potassium are properly contained and helps the healthy growth of fruits and vegetables.
- Containing boron and manganese, it prevents physiological diseases and enhances the harvest as well as quality.
- Containing organic matters as auxiliary components, it invigorates activities of soil microorganisms and also increases the sustaining capacity for moisture and nutrients.
- Being a reasonable complex fertilizer, it is convenient to spray and enhances its effectiveness as fertilizer.

Component:

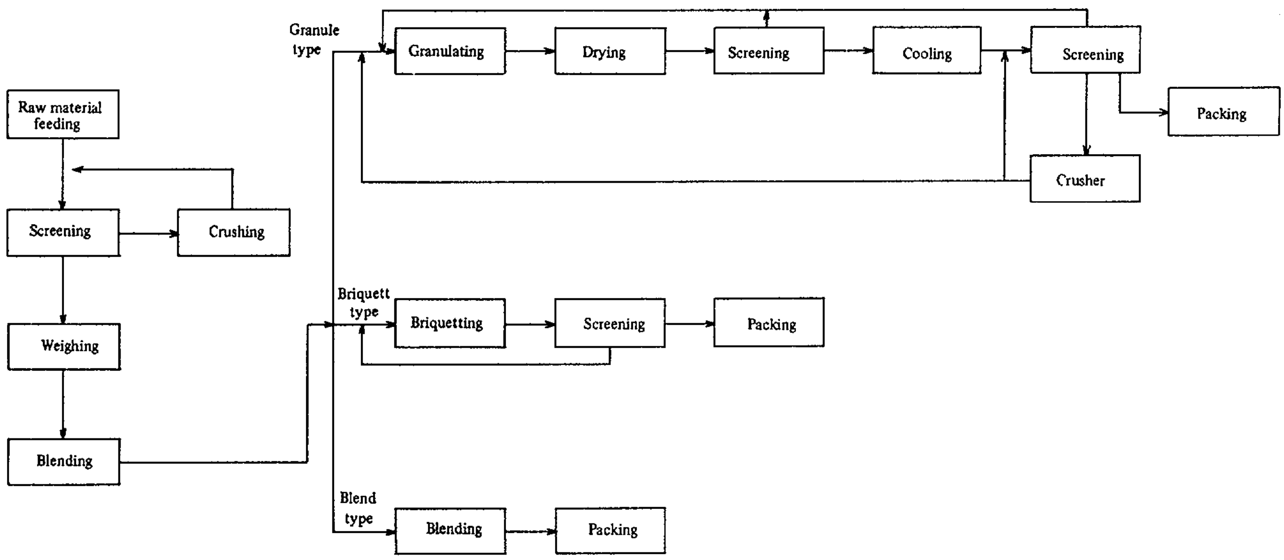
Nitrogen	11 %
Phosphate	10 %
Potassium	10 %
Magnesis	3 %
Boron	0.3 %
Organic material	3-4 %

Contents of Technology

1) Process Description

First, ammonium sulfate, urea, potassium sulfate, potassium chloride, conc. superphosphate, superphos-

Complex Fertilizer Manufacturing Process Block Diagram



phate of lime and organic fertilizer necessary for blending are weighed to suit the type of fertilizer to be produced.

Raw materials thus weighed are so blended in a mixer as to have a fixed component distribution and the maximum possible homogeneous state.

The uniformly blended mixture is conveyed to each of granulation, briquetting and blending processes depending upon desired form of the product.

In granulation process, the blended mixture is granulated in a drum-type granulator to have required granule size by using granulation liquid or other viscous liquids. It is then dried by hot air in a rotary dryer and goes through screening and cooling processes to be finished product.

In briquetting process, the blended mixture is fed into a briquetting machine and pressure is applied to form a fixed form.

In blending process, the blended mixture is blended again in a blending machine prior to packing.

2) Equipment and Machinery

Granulating section
- Hammer crusher
- Screens
- Bucket elevators
- Hopper scale
- Granulator
- Dryer
- Blower
- Cooler
- Vibrating screen
- Cyclones

Briquetting section
- Bucket elevators
- Screen
- Hopper scale
- Mixer
- Briquetter
- Vibrating screen
- Hammer crusher

Blending section
- Crusher
- Screw conveyor
- Dryer
- Fan
- Cyclone
- Hoppers
- Belt conveyors
- Bucket elevators
- Raw material storage tank
- Hopper scale
- Hammer crusher
- Screens
- Mixer
- Packing machine
- Heat sealer
- Chain conveyor

Example of Plant Capacity and Construction Cost

1) Plant capacity : 225,000 m/t
   * Basis : 24 hours/day, 300 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$687,000
o Utility facility	:	US$ 40,000
o Installation cost	:	US$200,000
Total	:	US$927,000

3) Required Space

o Site area	:	1,000 m^2
o Building area	:	8,200 m^2
o Other	:	1,800 m^2
Total	:	11,000 m^2

4) Personnel Requirement

o Manager	:	1 persons
o Engineer	:	4 persons
o Operator	:	60 persons
Total	:	65 persons

Any inquiry about the information contained should be sent to:
IPCT/II/PROM, Registry file No. ID/562/12, UNIDO, P.O. Box 300, A-1400 Vienna, Austria

KAP Making Plant

Cabbage Armyworm (Larvae)

Generally speaking, the organophosphorous insecticide has a strong insect killing power and a wide variety of applications against harmful insects. It has contact, stomach and gas poisoning effect. Besides, it has strong permeability and osmosis. It is thus exceptionally effective against insects harmful to rice, fruits and other agricultural crops which can hardly be destroyed by other insecticides.

KAP, developed by Monte Catini of Italy, belongs to the dithiophosphoric acid type of organophosphorous insecticide. Because parathion, the typical organophosphorous insecticide, is harmful to men and animals though it has an extensive insecticidal effect, KAP was developed as parathion's replacement with reduced poisoning effect of parathion. KAP is about one tenth of prathion in toxicity.

KAP has contact and stomach poisoning effect, thus having applications against a wide variety of crop pests.

Products and Specifications

The chemical name of KAP is 0,0-dimethyl-S-(α-ethoxycarbonylbenzyl)-phosphorodithioate. But it is usually called by the name of Cidial, Elsan, Papthion or PAP.

Table 1. Specification and Available Formulations

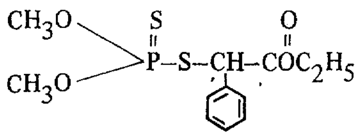
o **Technical grade**

Active ingredient	90% min.
Appearance	Reddish yellow oily liquid
Odor	Aromatic
Density	$d_4^{25} = 1.22$
Melting point (pure)	17.5 ±0.5°C
Boiling point	70–80°C (2.5×10^{-5} mm Hg)
Solubility	Soluble in methanol, ethanol, benzene and most organic solvents, soluble 0.02% in water at 20°C
Corrosivity	Corrosive to iron, non-corrosive to aluminium and polyethylene coated iron

o **Formulation available**

KAP 60 EC	60% Emulsifiable concentrate
KAP 50 EC	50% Emulsifiable concentrate
KAP 40 WP	40% Wettable powder
KAP 3 D	3% Dust
KAP 2 D	2% Dust

It is aromatic, oily liquid, and easily soluble in alcohol, aceton, ether and benzene but hardly soluble in petroleum and more hardly in water. Its structural formula is as follows:



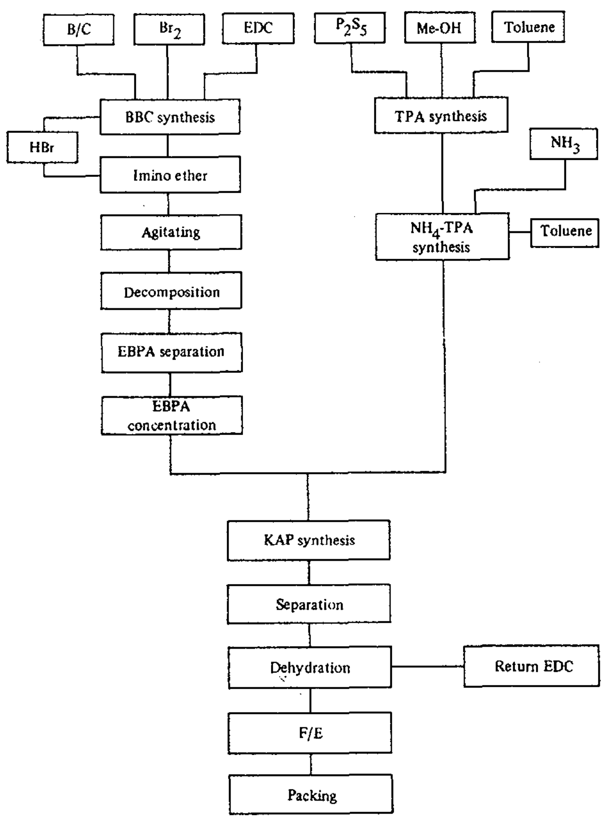
KAP is available in 2% and 3% powder or 40%, 50% and 60% emulsifiable concentrate. Their available formulations and specifications are shown in table 1.

Contents of Technology

1) Process Description

Benzyl cyanide and benzene are fed into a reactor for reaction with brome and nitrogen to obtain bromo benzyl cyanide (BBC). The HBr gas resulting from this process is acted upon by caustic soda to produce NaBr, which is also acted upon by HC1 to recover brome.

KAP Manufacturing Process Block Diagram



The BBC thus synthesized is mixed with sulfuric acid and ethanol to obtain ethyl bromo phenyl acetate (EBPA). In the meantime, P_2S_5 is dissolved in toluene, and the solution is further mixed with methanol to obtain 0,0-dimethyl dithiophosphoric acid (TPA). The H_2S gas resulting from this process is acted upon by caustic soda.

The TPA thus obtained is acted upon by NH_3 gas to obtain ammonium salt of TPA, which is further acted upon by EBPA in methanol solution for the production of KAP. This is then refined into the finished product.

2) Equipment and Machinery

SUS reactor
Vacuum pump
Centrifuge
Vacuum dehydrator
Dryer
Reactor (glass)
Condenser (glass)
Condenser (carbon)
Condenser (SUS 304)
Receiver (SS + GL)
Receiver (SUS 304)
Filter SS-Teflon
Steam ejector
Purification equipment

3) Raw materials and Utilities

Raw materials and utilities	Requirement (per ton of product)
EBPA	0.89 ton
P_2S_5	0.715 ton
CH_3OH	0.7 ton
Toluene	0.35 ton
Electric power	800 kwh
Fuel	400 ℓ
Water	10 tons

Example of Plant Capacity and Construction Cost

1) Plant capacity : 500mt/year
* Basis : 24 hours/day, 250 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$2,428,000
o Utility facility	:	US$ 220,000
o Installation cost	:	US$ 810,000
Total	:	US$3,510,000

3) Required Space

o Site area	:	1,000 m^2
o Building area	:	480 m^2
Total	:	1,480 m^2

4) Personnel Requirement

o Manager	:	1 persons
o Engineer	:	2 persons
o Operator	:	(15/shift) persons
Total	:	48 persons

HOW TO START MANUFACTURING INDUSTRIES

LIQUID PESTICIDES MANUFACTURING PLANT

Pesticides are chemical compounds used, in certain formulations and forms, to control plant disease, pests and weeds, as well as parasites on animals and humans. The damage caused by agricultural pests is enormous, amounting to as much as US $ 55-75 billion per year. Damage in countries with a highly developed agriculture ranges from 15 to 20%, while in developing countries it amounts to 30-50% of the total crop value. Enormous quantities of pesticides are used worldwide to protect over 3,000 plant species from about 10,000 pest species. The largest quantities of pesticides are used to protect maize, rice, cotton and fruit orchards. An annual increase in pesticide consumption of 14% is expected in the future.

Pesticide production can be devided into base and formulation production. Base production is the production of active substances; in general, it involves complex processes of organic synthesis requiring very expensive plants. The aim of formulation production is to give pesticides a form suitable for application. The types of formulations most frequently used today are wettable powders (WP) and emulsion concentrates (EC). The plant described here produces liquid pesticides.

PROCESS DESCRIPTION

Raw materials are subjected to physical/chemical tests prior to production process. This refers also to the finished products which are subjected to physical/chemical tests prior to packing.

Liquid pesticides are composed of solid or liquid active substances to which auxiliaries and solvents are added. Production takes place in two reactors of 4,000 litres each.

A part of the solids is melted in melting chambers. The reactor is charged with the solvents by means of a pump through a flowmeter. The melted materials and the liquid ingredients are fed into the reactor by means of a vacuum. The solids are then added through a special opening in the reactor. When the reaction has been completed the product is transported by means of compressed air into two reservoirs of 10 m^3 each.

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Packaging into cans and drums is carried out on scales, while bottles of 0.1 - 1 lit. are filled on an automatic packaging line consisting of two rotary tables, a filling machine, a machine for closing the bottles and a labeling machine. The bottles are put into carton boxes and palletized. The palletized finished products are taken to the warehouse by fork-lift trucks.

NOTE: The active pesticide components, as well as the finished products, are often very strong poisons. Additionally they are rather aggressive chemicals. Solvents are inflammable and explosive. For this reason in the process of pesticides production special precaution and safety measures are required. All engines and electrical equipment have to be explosion-proof. All machinery and equipment must be grounded. All equipment that may come in contact with raw materials and finished products must be made of stainless steel.

The plant must be ventilated. The waste water shall be subjected to special treatment (boiling and neutralization) prior to exhaust into the sewerage.

Special attention must be assigned to safety at work. In the process of manipulation of raw materials and finished product workers must obligatorily wear protection masks, special clothes and footwear.

In liquid pesticides manufacture a batch method of production is used.

PRODUCTION CAPACITY

The production capacity of the plant is 4,800 tons of finished products per year. This can be broken down as follows:

- herbicides	1,920 t/year
- instectisides	2,400 t/year
- fungicides	480 t/year
TOTAL:	4,800 t/year

This calculation is based on 8 hours per day and 300 days per year. Work in two or three shifts would double or treble the production capacity.

REQUIRED MACHINERY AND EQUIPMENT

I t e m	No.
Melting chamber	1
Reactors	2
Filling machine	1
Machine for closing the bottles	1
Labeling machine	1

Rotary tables	2
Compressors	2
Vacuum pumps	2
Solvent tanks	2
Tanks for the finished product	2
Compressed air tank	1
Vacuum station tank	1
Scales	6
Ventilation equipment	2
Internal transport equipment	2
Other equipment: electrical equipment, pneumatic equipment, laboratory equipment, firefighting equipment.	

FOB price of machines and equipment	US dollars	850,000
Project documentation	US dollars	50,000
Know-how and start-up	US dollars	70,000
TOTAL:	US dollars	970,000

REQUIRED RAW MATERIALS

The following approximate quantities of production materials are needed to produce 4,800 tons of liquid pesticides:

Active substances (concentrates).......... 2,600 t
Auxiliaries .... 650 t
Various solvents .... 1,400 t

REQUIRED MANPOWER (for two shifts)

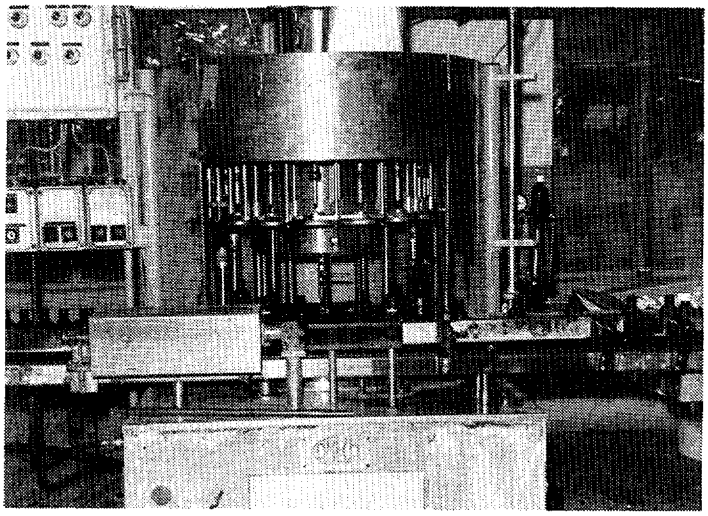
Qualification	No. of employees
Engineers	3
Foreman	1
Technicians	3
Skilled workers	15
Semi-skilled or unskilled workers	10
TOTAL:	33

REQUIRED UTILITIES

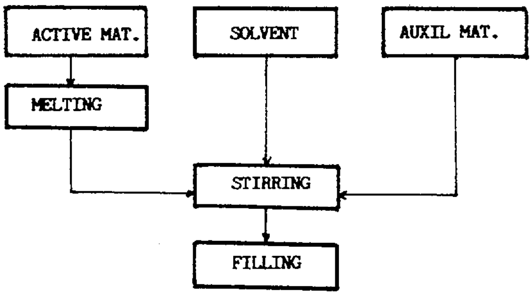
Electric power	100 kWh/ton of product
Steam	500 kg/ton of product
Water	10 m^3/ton of product

REQUIRED AREA FOR PLANT SITE

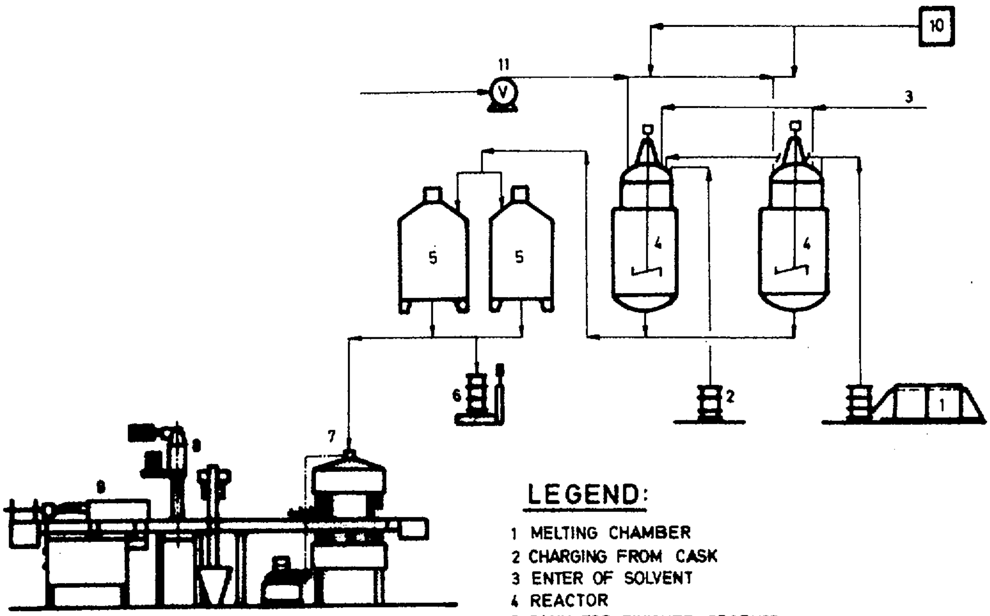
The plant occupies a total area of 10,000 m^2 including a building of 3,100 m^2 (production area, warehouses, offices, service facilities).



LIQUID PESTICIDES PRODUCTION
BLOCK DIAGRAM



PROCESS FLOW SHEET FOR LIQUID PESTICIDE PRODUCTION



LEGEND:

1 MELTING CHAMBER
2 CHARGING FROM CASK
3 ENTER OF SOLVENT
4 REACTOR
5 TANK FOR FINISHED PRODUCT
6 BIG PACKAGES
7 FILLING MACHINE FOR SMALL PACKAGES
8 CAPPING MACHINE FOR SMALL PACKAGES
9 LABELLING MACHINE FOR SMALL PACKAGES
10 COMPRESSOR
11 VACUUM PUMP STATION

FILE: G-106
ISIC: 3512

HOW TO START MANUFACTURING INDUSTRIES

PRODUCTION OF POWDERED PESTICIDES

All agricultural crops are to a greater or smaller extent subjected to various diseases, weeds and insects. Some of these can significantly lower the crop yield, the quality or both.

Pesticides are chemical compounds which are used in certain formulations and forms to control plant disease pests and weeds as well as parasites on animals and humans. Due to the importance of chemical prevention of pests large quantities of pesticides are used today. They protect over 3 000 species of plants. Most pesticides are used on corn, rice, cotton and fruits. The majority are herbicides (approx. 43%) while the others are insecticides (approx. 35%) and fungicides (approx. 18%).

In the production of pesticides two aspects must be distinguished. The first concerns the basic production and the second their formulation. The basic production manufactures the active ingredients, i.e. chemical compounds which have pesticidal activity. The formulation is the preparation of the pesticides for use.

The main formulations are the following:
- wettable powder (WP)
- powder (P)
- emulsion concentrates (EC)
- water soluble concentrates (WSC)
- fluid suspension (FW)
- granules (G)

Today the consumption of wettable powder and emulsion prevails. The demand for pesticides and the technologies of their production is rising continuously in the developing countries. It is, however, realistic to speak only of the second aspect of production. Certain formulations usually require distinct machines for their production, but the powders and soaking agents can be produced by the same equipment. In the plant offered only the manufacturing of powdered pesticides will be considered.

PROCESS DESCRIPTION

Powdered pesticides are produced with compact or fluid

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ingredients which are combined with fillers and additives. Certain proportions of active ingredients, fillers and auxiliaries are put in a mixer for about 20 minutes. This is the time required to produce a homogenous mixture. The contents of the mixer is 3 m^3 and it is equipped with a mechanism for dispersing liquid components.

If the active ingredient is sensitive to temperature it is first melted or soaked in a highly evaporating solvent. The liquid component thus derived is then dispersed under pressure in the mixer into the powdered carrier during the mixing.

When the mixing is over the mixture is transported over a stream of air. After grinding the mixture is again homogenized in a mixer.

The finished product is packed by machine into smaller packages of 0.1 to 2 kg or larger packets of 10 to 20 kg on a semi-automatic weighing machine.

The powder usually contains 1 to 5 per cent of active ingredients. The process is such that first a highly concentrated premix is made with a 50 to 80 per cent share of active ingredients which is later diluted with a filler.

PRODUCTION CAPACITY

The yearly capacity is 3 500 tons of product of which 2 500 tons are powder and 1 000 tons are wettable powder. The calculation is made on the basis of a 320 day year and a 8 hour day.

REQUIRED MACHINERY AND EQUIPMENT

I t e m	No.
Storing vessels	7
Various filters	8
Scales	7
Equipment for dispersing liquid component	1
Mixer 3 m^3	2
Air stream mill	1
Feeder	1
Packaging machine for large packages	1
Packaging machine for small packages	1
Equipment for airborne transport of fluid	1
Local ventilating equipment	1
General ventilating equipment	1
Compressor	2
Pressurized air tank	1
Vessel for melting raw materials	1
Elevator	1

Equipment for internal transport	8

Other equipment: Electrical installations, pipes, valves, maintenance equipment, laboratory equipment, fire and safety protection equipment.

FOB price of equipment and machines approx. 700 000 US dollars.
Accessory equipment approx. 60 000 US dollars.
Laboratory equipment approx. 100 000 US dollars.
Project documentation approx. 50 000 US dollars.
Know-how and running in approx. 70 000 US dollars.
Total price approx. 980 000 US dollars.

REQUIRED RAW MATERIALS

Active ingredients	530 t/year
Fillers	3 000 t/year
Auxiliary additives	70 t/year

REQUIRED MANPOWER (for two shifts)

Qualification		No.
Engineers		4
Foremen		3
Technicians		6
Skilled workers		30
Assistent workers		10
Others		11
	TOTAL:	55

REQUIRED UTILITIES

Electrical energy	200 kWh per ton of product
Water	5 m^3 per ton of product

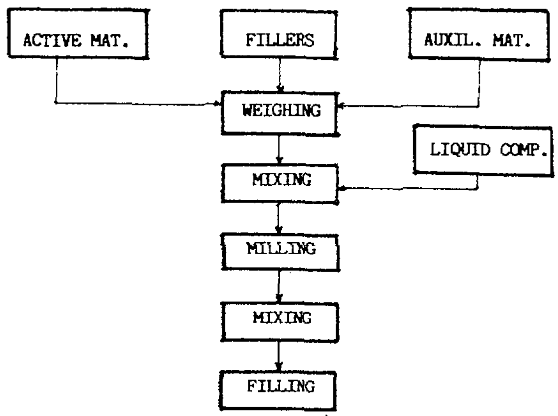
REQUIRED AREA FOR PLANT SITE

The total area requirement is approx. 8 000 m^2 of which 3 500 m^2 are used by the plant, warehouses, laboratory, restaurant, and offices.

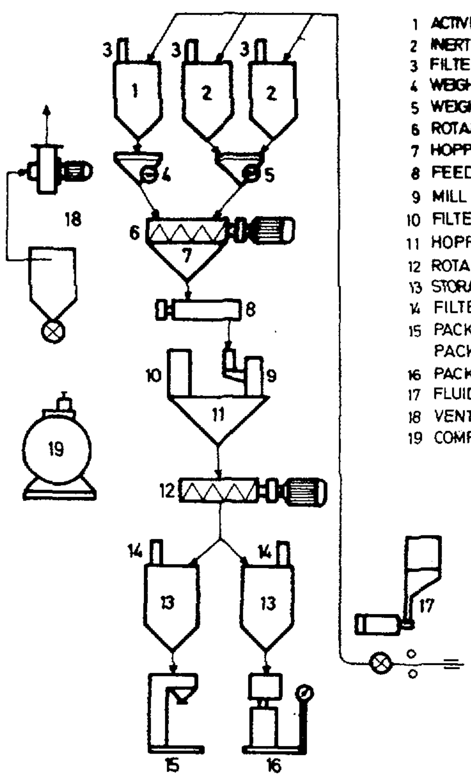
SAFETY MEASURES

During production personnel protection equipment is necessary and it is necessary to treat surplus water.

POWDER PESTICIDES PRODUCTION BLOCK DIAGRAM



PROCESS FLOW SHEET FOR PRODUCTION OF POWDERED PESTICIDES



LEGEND

1 ACTIVE INGREDIENT STORAGE BIN
2 INERT MATERIAL STORAGE BIN
3 FILTER
4 WEIGH HOPPER FOR ACTIVE MATERIAL
5 WEIGH HOPPER FOR INERT MATERIAL
6 ROTARY MIXER
7 HOPPER
8 FEEDING SYSTEM
9 MILL
10 FILTER
11 HOPPER
12 ROTARY MIXER
13 STORAGE BIN FOR FINISHED PRODUCT
14 FILTER
15 PACKAGING EQUIPMENT FOR SMALL PACKAGES
16 PACKAGING EQUIPMENT FOR BIG PACKAGES
17 FLUID TRANSPORT SYSTEM
18 VENTILATION EQUIPMENT
19 COMPRESSOR

BPMC and MIPC Making Plant

White Back Planthopper

Derivatives of carbamic acid have been known to be poisonous to mammals since long time ago. Physostigmine, currently in use as medicine, is an alkaloid compound of carbamic acid origin, being known as adversely affecting cholin esterase.

With this point in mind, carbamate was first developed as an insecticide in Switzerland around 1952. In the beginning, it was put on sale by Geigy for use as a repellent against plant lice and flies under the names of Pyrolan, Isolan and Dimetan but failed to spread because these products turned out to be unusually poisonous to men and beasts.

A variety of improved carbamate products were subsequently developed, BPMC or MIPC also being an insecticide as one of the carbamate products.

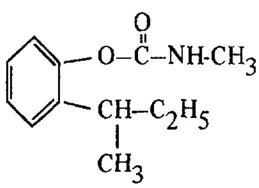
These carbamate products are characterized by being strongly obstructive to cholin esterase, low in toxicity to men and beasts and chemically stable. Quickly metabolized in the human body, there is no fear of being accumulated nor causing chronic poisoning symptoms unlike in the case of organochloro insecticide. There are yet no particularly harmful insects with resistance because these insecticides have not been long in use.

BPMC is a contact poisoning insecticide and highly effective against leaf hoppers, plant hoppers and major pests of paddy rice. An aerial pest control is possible because its toxcity to human beings and animals is almost negligible.

MIPC is a low mammlian toxic carbamate insecticide with high insect-killing effect against leafhoppers, planthoppers or bugs in rice and cacao.

Products and Specifications

BPMC, with the chemical name of 2-sec-butylphenyl-n-methylcarbamate, is also called by the names of Bassa, Osbac, Baycarb, etc. This product is yellowish and in liquid state. It is soluble in chloroform and acetone but insoluble in water, with the following structural formula:



In the plant, MIPC (2-isopropylphenyl-n-methylcarbamate) with the structure similar to BPMC is also manufactured and is white crystalline powder or flake.

Table 1. Specifications and Available Formulations

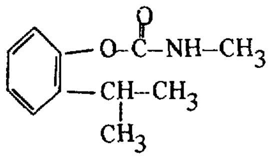
o Technical grade

Items	BPMC	MIPC
Active ingredients	90% min.	95% min.
Appearance	Pale yellow or red liquid	White crystalline powder or flake
Density	D_4^{25} = 1.04	-
Melting point	32°C	88 – 93°C
Boiling point		128 – 129°C (20mm Hg)
Solubility	At 30°C, solubility in water is 660 ppm, but easily soluble in acetone and BTX.	Easily soluble in acetone and ethanol. Slightly soluble in aromatic solvent. Insoluble in water and petroleum.
Stability	Unstable to alkali and strong acid.	Unstable to alkali and strong acid.

o Formulation available

BPMC		MIPC	
HOP 60 EC	60% emulsifiable concentrate	MIPC 50 WP	50% wettable powder
HOP 50 EC	50% emulsifiable concentrate		
HOP 40 WP	40% wettable powder		
HOP 3 D	3% dust		
HOP 2 D	2% dust		

It is soluble in acetone, methanol and ethanol but insoluble in petroleum. The structural formula of this product is as follows:



Specifications and formulations of these products are given in table 1.

Contents of Technology

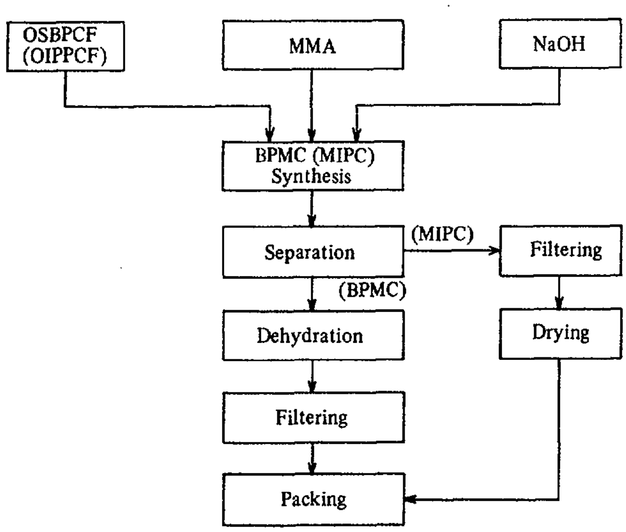
1) Process Description

BPMC is manufactured with o-sec-butylphenyl-chloroformate (OSBPCF) and MMA as main materials while MIPC is manufactured with o-isopropylphenyl-chloroformate (OIPPCF) and MMA as main raw materials in the same process as BPMC.

OSBPCF is added to MMA for the primary reaction. On completion, caustic soda is added to the reactant for neutralization and separation of hydrochlorate. To the produced MMA is added OSBPCF again for completion of the secondary reaction.

The reaction product is aged and aqueous solution layer is separated from organic compound layer. Water contained in BPMC is dehydrated by distillation to be followed by filtration to obtain finished product.

BPMC(MIPC) Manufacturing Process Block Diagram



In case of MIPC, OIPPCF is used instead of reactant OSBPCF, with organic compound layer separated on completion of the reaction and filtered. The product in powder state is obtained when MIPC is dried to eliminate moisture.

2) Equipment and Machinery

SUS reactor
Vacuum pump
Centrifuge
Vacuum dehydrator
Dryer
Reactor (glass)
Condenser (glass)
Condenser (Carbon)
Condenser (SUS 304)
Receiver (SS + GL)
Receiver (SUS 304)
Filter SS-Teflon
Steam ejector
Purification equipment

3) Raw Materials and Utilities

Raw materials and utilities	Requirement (per ton of product)
OSBPCF	1.1 tons
MMA	0.49 ton
NaOH (45%)	0.45 ton
Electric power	200 kwh
Fuel	150 ℓ
Water	2 tons

* In case of BPMC

Example of Plant Capacity and Construction Cost

1) Plant capacity : BPMC: 1,250mt/year
* Basis . 24 hours/day, 250 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$100,000
o Utility facility	:	US$ 50,000
o Installation cost	:	US$ 30,000
Total	:	US$180,000

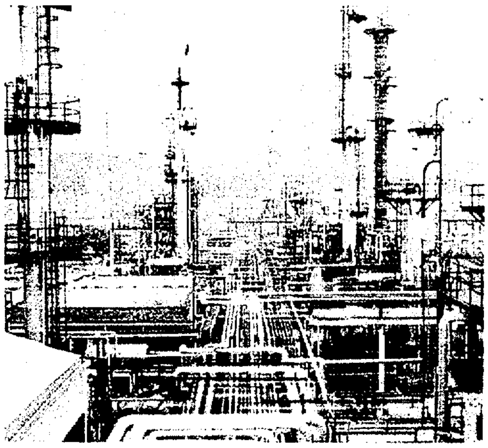
3) Required Space

o Site area	:	200 m^2
o Building area	:	150 m^2
Total	:	350 m^2

4) Personnel Requirement

o Manager	:	1 persons
o Engineer	:	1 persons
o Operator	:	(5/shift) persons
Total	:	17 persons

Linear Alkylbenzene Plant



View of LAB Plant

The synthetic detergent was developed as replacement of soap in Euro-American advanced countries following World War II, and the detergent industry has since been growing very quickly mainly because of the limited natural fat and oil resources. In 1968, the world synthetic detergent production surpassed that of soap made of natural fat and oil, and this trend has become conspicuous in recent years.

The most important raw material of detergent is alkylbenzene sulfonate, and the production of alkylbenzene sulfonate detergent now accounts for about 60 percent of the total detergent production in the world. This is because alkylbenzene sulfonate has excellent performance as a cleansing agent and because it is easily available at a low cost from the petrochemical industry.

In general, alkylbenzene sulfonate is divided by alkyl group into two families; ABS made up of propylene tetramer joined with benzene and soft-type LAS made up of linear alkyl radical joined with benzene. The former has a highly branched alkyl radical which causes water pollution because it is not easily degraded by bacteria in sewage. In other words, when it is used in cleansing it remains undegraded in sewage to cause river pollution. Until recently, the detergent industry had used ABS with this hard-type alkyl radical as a major material, but, since the development of soft-type LAS which is easily degraded by bacteria, the industry has switched to the soft type LAS.

Linear alkylbenzene is a major raw material of LAS and as demand for soft type detergent is increasing so is demand for linear alkylbenzene. In addition, in view of the need to prevent water pollution by detergents, the linear alkyl benzene's demand of the detergent industry will continuously increase in the future.

The plant to be introduced here produces linear alkylbenzene having 12 to 13 carbons in alkyl radical. And the manufacturing process consists of two unit processes, such as dehydrogenation of N-paraffin and the alkylation of benzene by the produced olefin. This process is lower in construction and maintenance cost, and higher in yield than other processes.

Products and Specifications

The alkylbenzene produced by this plant has a high

Table 1. Typical Property of Linear Alkylbenzene

Bromine number	0.01
Saybolt color	+30
Alkylbenzene content, wt-%	97.4
Doctor test	Negative
Unsulforatable content, wt-%	1.0
Water, wt-%	0.1
Specific gravity at 60°F	0.8612
Refractive index, n_D^{20}	1.4837
Flash point(ASTM D-93), °F	280
Average molecular weight	240
Distillation (ASTM D-86), °F	
IBP	538
10 vol-%	547
30 vol-%	550
50 vol-%	554
70 vol-%	559
90 vol-%	569
95 vol-%	576
EP	589
Saybolt color of a 5% sodium alkylbenzene sulfonate solution	+26
Normal alkylbenzene, wt-%	93
2-Phenyl isomer, wt-%	20.0
Paraffin, wt-%	0.1
Biodegradability (ASTM D-2667), %	95.0

biodegradability, and its alkylbenzene content is 97.4 percent and normal alkylbenzene content is 93 percent. Other properties of the product are shown in table 1.

Contents of Technology

1) Process Description

The alkylbenzene plant which is to be introduced here has two unit processes. The first one is a dehydrogenation process which is to convert the linear C_{10}-C_{13} normal paraffins to the corresponding n-mono-olefins by means of catalytic dehydrogenation.

This dehydrogenation process is a relatively new technique with the high selectivity in dehydrogenation of high boiling normal paraffins to straight-chain olefins. And it does not require inclusion of chlorine feed in the production procedures. This not only eliminates the problem of disposal of the HCl by-product, but it also allows the use of more conventional materials of construction, thus reducing erection and maintenance costs. It is estimated that maintenance costs for this process will be 25% less than that for maintenance of other competitive process unit. Also this process operates at low pressure and side reaction are minimal.

The second one is a alkylation process which is designed to carry out the manufacture of the biodegradable detergent product through alkylation of benzene with normal olefin feed from the dehydrogenation unit.

This process is also a highly developed process for catalytically alkylating olefins with benzene. Desired alkylation takes place in the presence of hydrofluoric (HF) acid under conditions selected to maximize alkylate yield and quality. For optimum conditions, the carbon number range is limited to a maximum of 4 which allows for an economic plant based on yield and quality when producing LAB.

Dehydrogenation process

The C_{10}-C_{13} normal paraffins feed, recycle hydrogen and recycle paraffins are passed through heat exchanger to the charge heater and then to the reactor where olefin conversion takes place. Reactor effluent exchanges heat with the feed, further cooled and goes to the product separator. The separator gas is used for recycle hydrogen and excess is vented to fuel gas or made available to other hydrogen consuming processes. The separator liquid is charged to the stripping drying column along with detergent alkylation unit make up benzene. This latter column removes any traces of dissolved gasses from the olefin stream and dries the alkylation unit feed.

Alkylation process

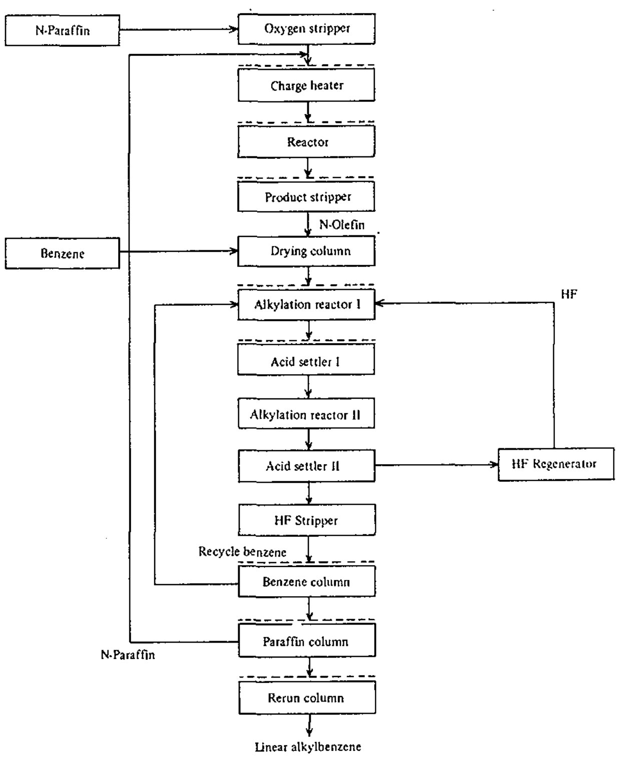
The dried effluent from the dehydrogenation process is combined with recycle benzene and recirculated reactor effluent. The combined feed is cooled and charged to the first series connected reactor in the 2-reactor system. Net effluent passes to the separator drum where the HF acid settles out and is returned to the reactor. The hydrocarbon layer from the separating drum is heated and charged to the HF stripper. Stripper vapors are combined with regenerator vapors, condensed, and recycled to the reactor. This condensed liquid also serves as regenerator reflux.

HF stripper bottoms are charged to the benzene column where recycle benzene is taken as an overhead product and returned to the reactor. A small portion of this benzene (the drag stream) is drawn off to prevent build-up of any impurities which may be introduced with the feed streams. The quantity of this drag stream is very small and depends to a great extent on the quality of the benzene feed.

The benzene column bottoms product is passed through alumina treaters for removal of combined fluorides, then charged to the paraffin column. Normal paraffins are taken overhead and recycled to the dehydrogenation unit.

A small drag stream of acid returning to the reactor is charged to the "HF" regenerator. The regenerator

Linear Alkylbenzene Manufacturing Process Block Diagram



bottoms, consisting of heavy aromatics and polymers are sent to a neutralizing pit and disposed to fuel. The paraffin column yields finished detergent alkylate (LAB) as overhead and heavy alkylate as bottom products.

2) Equipment and Machinery

Heaters
- Hot oil heater
- Charge heater

Vessels and columns
- Oxygen stripper column
- Reactor
- Paraffin alumina treater
- Product stripper
- Alkylation reactor
- HF stripper
- HF regenerator
- Benzene column
- Paraffin column
- Rerun column
- Vessels including overhead receiver, surge drum
- Tanks

Heat exchangers
- Shell an tube type exchanger
- Double pipe type exchanger
- Air fin cooled exchanger

Machinery
- Hydrocarbon transfer pumps
- Cooling water pumps
- Hydrant pumps
- B-C oil transfer pumps
- Acid transfer pumps
- Vacuum pumps
- Compressors

3) Raw Materials and Utilities

Raw materials and utilities	Requirement (per ton of product)
N-Paraffin	0.829 ton
Benzene	0.344 ton
Electric power	460 kwh
Cooling water	8 m^3
Fuel	5.5 kcal
Steam	–

MTX Making Plant

Green Peach Aphid

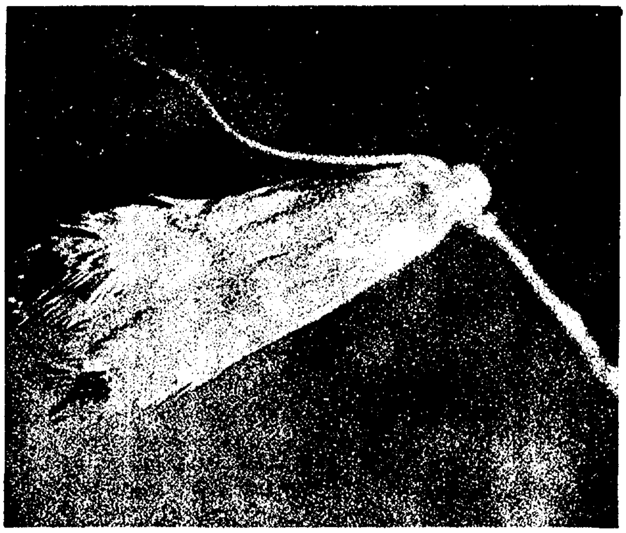
Damage of Citrus Leaf Miner

The systemic insecticide is an agricultural chemical against specific insects harmful to crops, which, when applied to leaves, stems or roots of a plant, is taken by the plant for translocation in the quantity necessary for insecticidal effect throughout the plant.

Some organophosphorous chemicals have strong permeability and osmosis, and the systemic insecticide is a chemical which was developed by improving such characteristics of organophosphorous chemicals.

The systemic insecticide has, in general, the following characteristics.

- When applied to leaves, stems or roots of a plant, it is quickly absorbed by the plant for translocation throughout the plant.



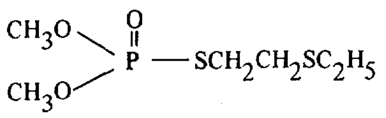
Citrus Leaf Miner

- Insecticidal effect lasts two to six weeks.
- Not harmful to the natural enemy of harmful insects.
- Danger of residual poison, because the poisonous effect remains long in the plant.
- Effective against sap-sucking insects but not effective against insects eating up leaves, stems or roots of a plant.

MTX is a variety of systemic insecticide developed by Schrader in 1952. It has weaker insecticidal effect and mammal poisoning effect than Systox, and therefore it is widely applied to agricultural and horicultural crops.

Products and Specifications

The chemical name of MTX is O, O-dimethyl-S-2 (ethylthio) ethylphosphorsthioate, and it is also called by the names of Demeton-S-methyl and Metasystox. Appearing pale yellow oily liquid, it is more soluble in most organic solvents than in water. Its structural formula is as follows:



After permeating into a plant. this chemical com-

Table 1. Specification of MTX

○ **Technical grade**

Active ingredients	50% min.
Appearance	Pale yellow oily liquid
Density	$d_4^{20} = 1.207$
Boiling point	89°C/0.15 mmHg
Solubility	At room temp., solubility in water is 3.3 g/ℓ, and soluble in most organic solvents

pound is oxidized for relative stability. Thus it exists in the form of sulfoxide or sulfone to remain effective against insects for 20 to 30 days. Because of the fast permeation speed in the plant, its insecticidal effect is not affected by rain if it falls two hours after its application.

It is available in the form of 25% emulsifiable concentrate.

Contents of Technology

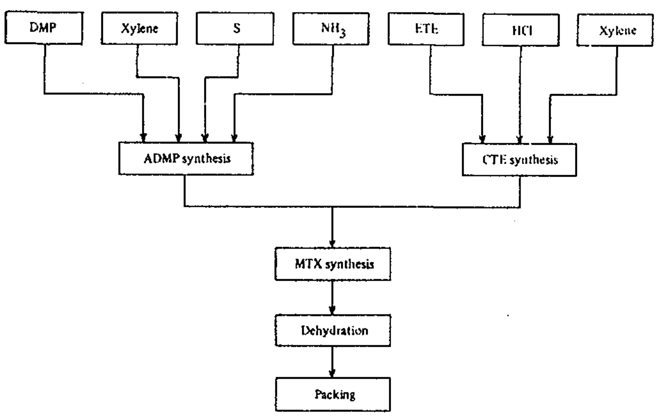
1) Process Description

Sulfur and dimethyl phosphite are put into xylene for solution, to which ammonia gas is added to obtain ADMP (ammonium salt of dimethyl phosphite).

ETE (ethylthio ethanol) and HCl is fed into xylene and the mixture is then stirred to synthesize CTE (ethyl-thio-ethyl-chloride).

Then the synthesized ADMP and CTE are condensated to get crude methyl demeton, and it is refined into the finished product.

MTX Manufacturing Process Block Diagram



2) Equipment and Machinery

SUS reactor
Vacuum pump
Centrifuger
Vacuum dehydrator
Dryer
Reactor (glass)
Condenser (glass)
Condenser (carbon)
Condenser (SUS 304)
Receiver (SS + GL)
Receiver (SUS 304)
Filter SS-Teflon
Steam ejector
Purification equipment

3) Raw Materials and Utilities

Raw materials and utilities	Requirement (per ton of product)
ETE	0.3 ton
DMP	0.4 ton
Xylene	0.5 ton
Electric power	700 kwh
Fuel	350 ℓ
Water	10 tons

Example of Plant Capacity and Construction Cost

1) Plant capacity : 100mt/year
  * Basis : 24 hours/day, 250 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$1,500,000
o Utility facility	:	US$ 200,000
o Installation cost	:	US$ 500,000
Total	:	US$2,200,000

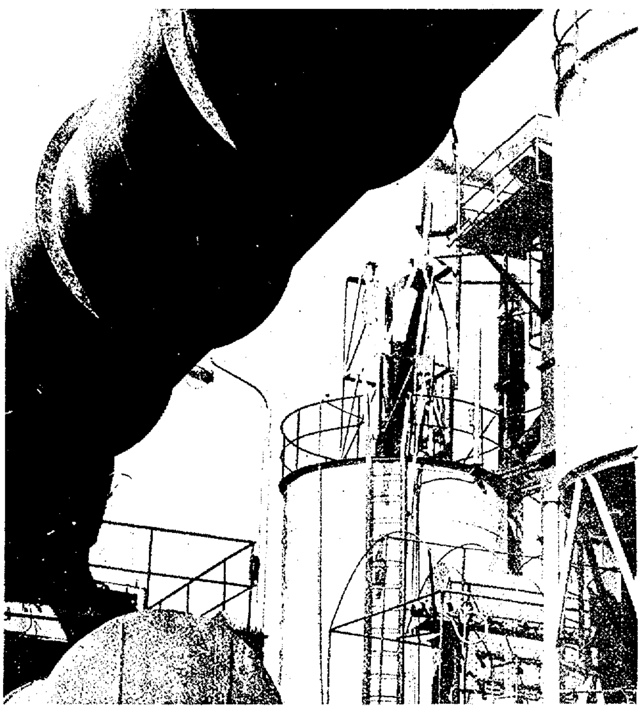
3) Required Space

o Site area	:	800 m^2
o Building area	:	400 m^2
Total	:	1,200 m^2

4) Personnel Requirement

o Manager	:	1 person
o Engineer	:	2 persons
o Operator	:	(10/shift) persons
Total	:	33 persons

Tricalcium Phosphate Plant



View of TCP Plant

Although the inorganic salts, commonly called minerals, make up a small percentage of total body weights, they are important to the well-being as the proteins, carbohydrates and fats that provide energy. Because it is impossible to obtain energy from feed without the mineral elements.

And calcium and phosphorus are also most essential minerals because they are present in living organisms in the largest quantities of all the minerals. So the animal require calcium and phosphorus for nomal growth, maintenance and replacement. These two components are incorporated in the skeleton, blood and tissues. Calcium in blood and tissues is associated with protein and its defficiency in animal body results in stunting of growth, bone malformation and poor quality bones and teeth. Phosphorus functions as a portion of the overall buffering system in the body as well as in the mechanism of energy transfer during metabolism of feed.

Therefore, to achieve increase in the productivities of livestocks in terms of more weight, more fleshes and more eggs, it is necessary to supplement the feed with calcium and phosphorus components through the addition of calcium phosphate.

In this connection, the supply of good quality phosphorus and calcium as tricalcium phosphate comes up as a matter of great concern for the rapid growth of one nation's livestock industry.

Products and Specifications

The tricalcium phosphate produced in this plant has some advantageous features:

- Contains more available components.
- Being an inorganic material, it doesn't contain salmonella germs or other harmful matter.
- Quality is uniform since production is under the surveillance of strict quality inspectors in modern factories.
- It is tasteless and odorless.
- Low cost per unit of phosphorus and calcium.
- Phosphorus and calcium are easily assimilated and absorbed.

The general properties of tricalcium phosphate is as follows:

- Appearance : A tasteless and odorless powder
- Particle size : 100 mesh sieve pass 77% min.
- Constituents : P 18% min.
  Ca 31% min, 34% max.
  F 0.18% max.

Analysis :

Ingredient	Percentage
P_2O_5	43.30
(P)	18.88
CaO	45.08
(Ca)	32.20
F	0.04
Moisture	0.10
Igloss	0.17
Na_2O	6.10
SiO_2	1.15
Al_2O_3	2.98
Fe_2O_3	1.28
MgO	1.30
K_2O	0.06

Contents of Technology

1) Process Description

Tricalcium phosphate involves essentially the following process steps:

- Rock grinding and pelletization
- Calcination

Grinding and pelletization

Grinding phosphate rock of low moisture content (2 to 3%) and sodium carbonate utilizes a ball mill or a tube mill. All oversized particles separated by the mechanical separating system is recycled to the mill for further grinding. Any accumulated dust venting from mechanical separating system is also collected by the bag filter.

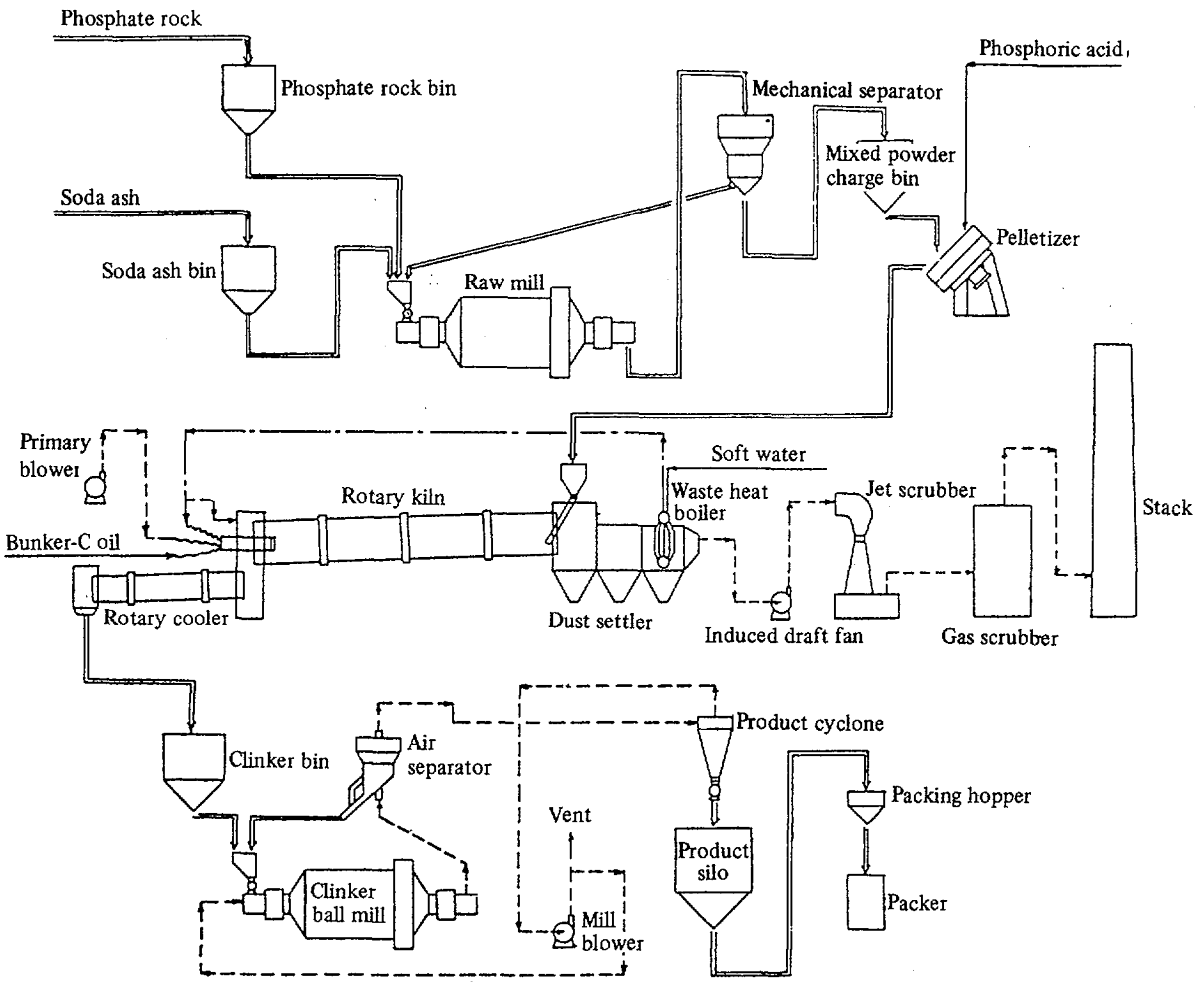
Dry, unground phosphate rock and soda ash from battery limits are conveyed to a feed bin. Rock and soda ash to be ground flows through a rotary shut-off gate to the constant feed weigher which discharges to the tube mill at a controlled rate.

In the mill, the particles of rock mixed with soda ash are reduced in size by a rolling bed of steel balls or tube. The crushed rock mixed with soda ash is then discharged to a bucket elevator and is mechanically conveyed to a mechanical separator. Oversize particles are returned from the mechanical separator to the mill.

From the mechanical separator, the ground mixed powder passes through a rotary shut-off gate to a raw powder bin. This bin is vented through the bag filter to the atmosphere.

The ground mixed powder flows the bottom of its raw powder bin to the pelletizer through constant feed weigher and then mixed with phosphoric acid from battery limits. This mixture, after pelletization, is calcined and defluorinated in the rotary kiln.

Tricalcium Phosphate Manufacturing Process Flow Sheet



Calcination

The rotary kiln is specially designed as a calciner to promote defluorination of phosphate rock. The most critical points of process control are defluorination and conversion phosphate rock into the citrate-soluble condition. The internal design and the process control of the rotary kiln are such as to provide the operator optimum control of the production of tricalcium phosphate. The kiln is the most economical and efficient method of defluorination and recovering the heat of combustion. In the presence of sufficient water vapor, heating the pelletized rock for 30 to 60 minutes at 1,350°C to 1,400°C volatilizes 95 to 100 percent of the fluorine contained in the rock and converts the phosphorus into the citrate-soluble condition; as sintered or semifused product is obtained. The volatilization of fluorine from phosphate rock increases with the moisture content of the furnace atmosphere.

The pelletized mixed powder is discharged to the rotary kiln through a belt conveyor and calcined to defluorinate the rock in the presence of water vapor.

The combustion gas is dedusted in the dust chamber and is utilized to generate steam by the waste heat boiler, which is used to atomize fuel oil and defluorinate the rock. And then the exit gas from the waste heat boiler is scrubbed in order to reduce fluorine content by the water scrubbing system. Fresh water is used to remove the fluorine. The water scrubbing system is equipped with a jet scrubber, a gas washing tower and a circulating pump.

2) Equipment and Machinery

Rock grinding and pelletization
- Phosphorus rock bin
- Soda ash bin
- Raw mill
- Mechanical separator
- Mixed powder charge bin
- Pelletizer

Calcination and product treatment
- Primary blower
- Rotary kiln
- Dust settler
- Waste heat boiler
- Induced draft fan
- Jet scrubber
- Gas scrubber
- Stack
- Rotary cooler
- Clinker bin
- Clinker ball mill
- Air separator
- Product cyclone
- Mill blower
- Product silo
- Packing hopper
- Packer

3) Raw materials and Utilities

Raw materials and utilities	Requirement (per ton of product)
Phosphate rock	0.092–0.90 ton
100% P_2O_5 Phosphoric acid	0.115–0.120 ton
Soda ash	0.125 ton
Fuel oil	250–270 liters
Water	2.0 tons
Electric power	270 kwh

* Raw material condition

Phosphate rock	BPL 75% min.
Soda ash	
Sodium carbonate	99.0% min.
Moisture	0.5% max.
Others	0.5% max.
Phosphoric acid	
P_2O_5	38% min.
Gypsum sludge	1.5% max.
Fuel (B-C oil)	
Calorific value	9,400 kcal/kg

* Note: The use of stronger acid, P_2O_5 – 45%, is more preferable for easy and smooth start up of the plant.

Example of Plant Capacity and Construction Cost

1) Plant capacity : 15,000 mt/year
  * Basis : 24 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$4,500,000
o Utility facility	:	US$ 300,000
o Installation cost	:	US$1,200,000
Total	:	US$6,000,000

3) Required Space

o Site area	:	21,000 m^2
o Building area	:	4,000 m^2
Total	:	25,000 m^2

4) Personnel Requirement

o Manager	:	2 persons
o Engineer	:	10 persons
o Operator	:	43 persons
Total	:	55 persons

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H

Petroleum Solvent Making Plant

Of the various fractions obtained from the crude oil, the lowest-boiling fraction breaks down into gasoline for use as fuel and naphtha as main industrial solvent.

Among them, naphtha is of no toxicity with good dissolving property and in particular it can be used as solvent as it is or can be usefully employed as raw material for other petroleum-based solvents.

Usually, as petroleum-based solvent, kerosene is also used along with naphtha mentioned above. In order to conform to the characteristics of various industrial uses, these two fractions are properly blended and redistilled within the distillation range of required solvents, producing diverse types of solvents suitable for various uses.

In the petroleum solvent manufacturing plant introduced here, naphtha and kerosene, directly produced in the oil refinery as petroleum-based solvents described above, are blended and redistilled to produce numerous kinds of solvents.

Uses of these products are for extraction, washing, rubber industry, paint, cleaning, petroleum industry, adhesive, insecticide and herbicide.

Products and Specifications

Petroleum-based hydrocarbon solvents are generally have the following characteristics:

- It is typically non-polar material with no hydrophilic radical, dissolving such non-polar materials as oil, fat, wax, resin and rubber, but not polar materials such as cellulose derivatives and shellac.
- Flash point is relatively low.
- It is appropriate to use by mixing with solvents of other components.
- It is chemically stable.
- It is of no toxicity nor bad-smelling.
- It is not corrosive.

The solvents produced in this plant can be arranged to have characteristics suiting their uses or customer's requirements. Currently, 12 kinds of products are manufactured (table 1). Typical solvents are as follows:

○ Solvent for extraction
- It is an intermediate between petroleum ether and petroleum benzine and colorless. With

Table 1. Specifications of Solvents

Classification	Test item / Product	Distillation range(°C) I.B.P.(°C)	Distillation range(°C) E.P.(°C)	Aniline point(°C)	Flash point(°C)	Specific gravity	Saybolt	Copper corrosion	Doctor's test	Reaction test
Aliphatic solvent	S-100	45	90	62	-45	0.663	+30	1 >	Negative	Neutral
	H-V	80	160	56	-5	0.732	+30	1 >	Negative	Neutral
	S-400	145	215	55	33	0.774	+30	1 >	Negative	Neutral
	V-1	150	210	55	38	0.775	+30	1 >	Negative	Neutral
	SD-1	155	210	55	40	0.776	+30	1 >	Negative	Neutral
	S-201	25	50	65	-55	0.624	+30	1 >	Negative	Neutral
	S-203	40	160	50	-50	0.708	+30	1 >	Negative	Neutral
	S-V	40	130	62	-40	0.672	+30	1 >	Negative	Neutral
	V-2	180	260	66	60	0.790	-		Negative	Neutral
Odorless solvent	OL-200A	160	215	66	40	0.774	+30	1 >	Negative	Neutral
	OL-500	165	255	70	45	0.787	+30	1 >	Negative	Neutral
	KP-500	210	270	70	87	0.796	+21	1 >	Negative	Neutral

low flash point and high volatility, it is mainly of hexane.
- It freely mixes with acetone, ether, ethylacetate, amylacetate and ethanol.
- It dissovles fatty acid but not oxyacids.
- It dissolves such resin as rosin, mastic and elemi gum.
- Uses: Oil and fat industry, precision machine cleaning, torch lamp.

o Solvent for rubber industry
- It is colorless, inflammable liquid belonging to ligroin and mixes with alcohol and benzene.
- Uses: Rubber industry

o Solvent for cleaning
- It is a colorless intermediate of petroleum benzine and ligroin. Of low flash point, its main components are heptane and octane.
- It mixes well with alcohol, benzene, chloroform and ether.
- Uses: Laundry, solvent for cleaning soap, removal of oil and fat from wool, perfume extraction.

o Solvent for paint
- It is colorless, transparent solvent corresponding to mineral spirits with pleasing smell, low flash point and high volatility.
- Uses: Paint

o Solvent for dry cleaning
- It has the highest flash point compared with other solvents and excellent volatility.
- Uses: Dry cleaning, base material of insecticide and herbicide.

o Others
- Printing ink, agricultural chemicals, household and other industrial solvents.

Contents of Technology

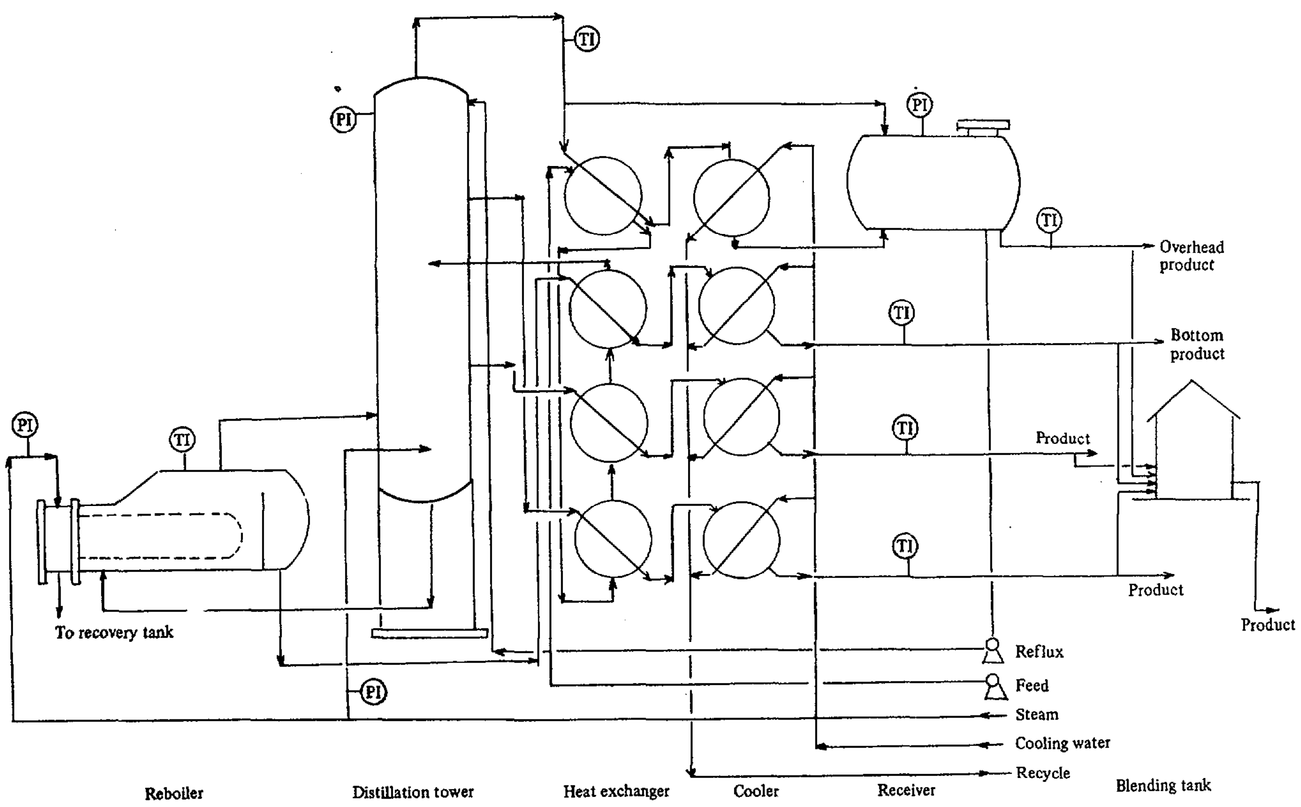
1) Process Description

The waste heat of the fractions from an distillation tower is recovered by the heat exchange with raw material.

It is finally heated to a temperature suitable for the distillation by the bottom product from the reboiler, and the heated naphtha is fed into the distillation column for separation into various fractions.

In the distillation column, the feed naphtha is distilled into a total of four fractions depending

Petroleum Solvent Manufacturing Process Flow Sheet



upon distillation temperatures. Part of the overhead product is recycled to the distillation column as reflux and the remainder is sent to the blending tank for preparation of the product.

The bottom product is partially vaporized in the reboiler and recycled to the distillation column, the remainder being sent to the blending tank.

In the blending tank are collected the overhead product, bottom product and other two fractions. The product is so blended in a constant ratio as to conform to the specification customers of the solvent require, and then delivered as finished product.

2) Equipment and Machinery

Reboiler
Distillation tower
Heat exchanger
Cooler
Distillate receiver
Blending tank
Pump & other utility facility

3) Raw Materials

Raw materials	Requirement (per ton of product)
Treated naphtha	0.855 ton
Toluene	0.045 ton
Kerosene	0.100 ton

Example of Plant Capacity and Construction Cost

1) Plant capacity : 500kl/day
   * Basis : 8 hours/day, 300days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$375,000
o Utility facility	:	US$ 75,000
o Installation cost	:	US$250,000
Total	:	US$700,000

3) Required Space

o Site area	:	40,000 m^2
o Building area	:	5,000 m^2
Total	:	45,000 m^2

4) Personnel Requirement

o Manager	:	1 persons
o Engineer	:	9 persons
o Operator	:	180 persons
Total	:	190 persons

HOW TO START MANUFACTURING INDUSTRIES

PAINT AND VARNISH MANUFACTURING PLANT

Paints and varnishes are materials for the protection of hard surfaces (metal, wood, building materials) against negative atmospheric, climatic and other influences and for the aesthetic finishing of these surfaces. Their uses are numerous and varied in many branches of industry.

The composition and chemical and physical properties of paints and varnishes depend on the purpose for which they are intended. Thus, there are paints resistant to atmospheric agents, high temperatures, chemical agents, etc.

The natural start in the manufacture of paints and varnishes is the establishment of a manufacturing plant for simpler types of products, while paints and varnishes used in the metal and wood manufacturing industries come later, at which point preparations can begin for the manufacture of synthetic and water emulsion resins.

The present technology covers the first manufacturing stage only, i.e. the manufacture of paints used in building construction and alkyd paints for anti-corrosive protection of metal structures. The manufacturing process at this first stage is relatively simple, and the initial investment is considerably smaller than in other chemical industries.

The plant building is planned and built from the beginning for an output that is larger than the first stage. However, the equipment is initially installed only for the economically profitable first-stage production of 3,000 tons annually in a single shift. Later, additional equipment can be installed to increase the production capacity to 10,000 tons annually in the final stage of the project.

PROCESS DESCRIPTION

The basic technological production process involves mixing of the various raw materials, using mixers mainly of the disperser type, and dispersing pigments and extenders in the binder solution using mainly machines of the sand mill type, if the product has to be coloured. Finishing is carried out in tanks with mixers and involves adding the remaining liquid raw

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materials to the batch and adjusting the quality by adding small quantities of raw materials and semi-finished products.

Transparent products (lacquers, varnishes), which do not contain pigments, involve the following processes: dissolution of film-forming components, adding and mixing of other liquid components, quality improvement, quality control, filtering, packing.

Pigment products (paints, enamels) involve the following processes: dissolution of film-forming components, premixing of the film-forming solution with pigments, dispersion, mixing of other liquid components, quality improvement, quality control, filtering, packing.

The liquid raw materials (resin solutions, organic solvents, additives) are stored in drums, while some of the most important ones are stored in tanks outside the plant building. Powdered raw materials (pigments, extenders) are in paper bags and are stored in closed warehouses or storerooms.

The equipment is universal, so that almost all types of organic coatings can be made on one production line. Since the solvents are inflammable and the mixture of their vapours with air is explosive, all the production equipment is specially constructed so as to be safe; firefighting installations are built into the plant.

In the manufacture of paints and varnishes a batch system of production is used.

PRODUCTION CAPACITY

I t e m	First stage tons/year
Water emulsion paints	1,500
White alkyd paints	600
Coloured alkyd paints and primers	600
Facade paints based on acrylic resins in organic solvents	100
Thinners	100

Basis: 8 hours/day, 280 days/year

REQUIRED MACHINERY AND EQUIPMENT

I t e m	No.
Dissolvers	2
Wall mixers	2
Pearl mills	2
Mixing tanks	10

Scales	5
Filling equipment	2 sets
Pumps	5
Movable vessels	20

Other equipment: transport vehicles, fire-fighting equipment, ventilation or heating (depending on the climate), electrical equipment, tubes and fittings, maintenance equipment, laboratory equipment.

FOB price of machinery and equipment: approx. US dollars 800,000 (1984)

REQUIRED RAW MATERIALS (first stage)

Item	tons/year
Emulsion resins, 50%	400
Alkyd resins, 70%	500
Acrylic resins, 50%	40
Pigments, white	330
Pigments, coloured	70
Extenders	560
Additives	50
Solvents	400
Water	250

REQUIRED MANPOWER (for two shifts)

35 operators are needed for the annual production capacity of 3,000 tons.

Qualification	No.
Engineers	2
Technicians	3
Skilled workers	25
Unskilled workers	10
TOTAL:	40

REQUIRED UTILITIES

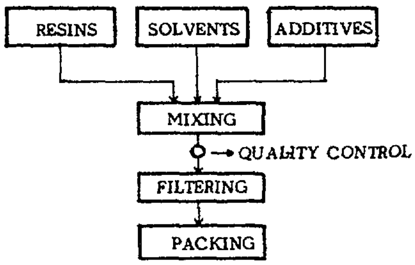
Electric power	100 kWh/ton of product
Cooling water	1-3 tons/ton of product

REQUIRED AREA FOR PLANT SITE

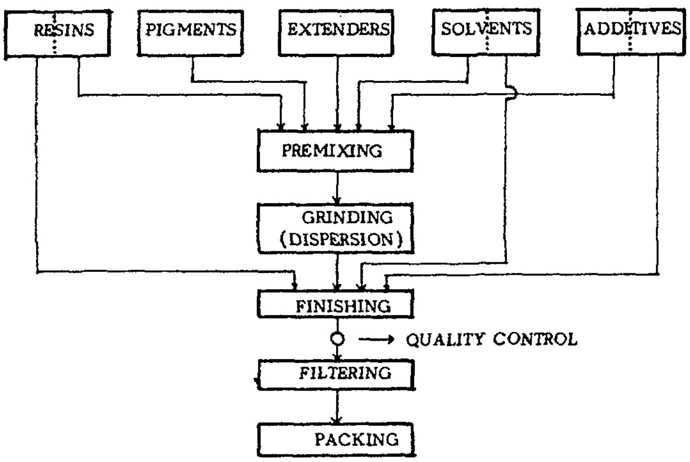
Production area	500 m^2 (final stage)
Storage space, raw materials, and packing	500 m^2 (first stage)
Storage for finished products	300 m^2 (first stage)
Dressing rooms	200 m^2 (first stage)
Laboratory	120 m^2 (first stage)
Office space	as required.

VARNISHES, PAINTS AND ENAMELS PRODUCTION BLOCK DIAGRAM

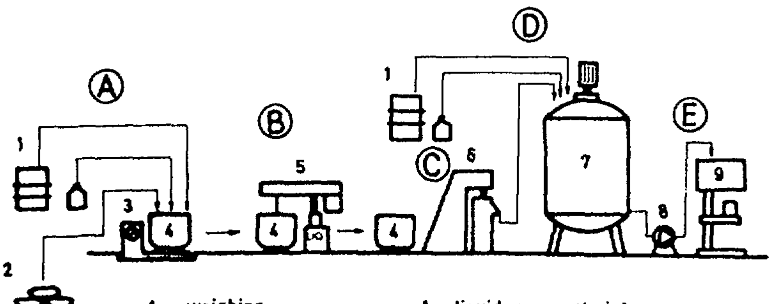
VARNISHES



PAINTS, ENAMELS



PRODUCTION OF ALKYD AND INDUSTRIAL PAINTS SCHEME OF BASIC PRODUCTION PROCESS



A weighing
B premixing
C grinding
D finishing and tinting
E filling and packaging

1 liquid raw materials
2 pigments
3 scales
4 movable vessel
5 disperser
6 pearl mill
7 mixing tank for finalization
8 pump
9 filling machine

PRODUCTION OF LIGHT SENSITIVE (DIAZO) PAPER

Light sensitive diazo-materials are well known for being irreplaceable in the multiplication of all kinds of documents, especially plans, charts and texts, when contact copying paper is used with highly intense lighting on light sensitive paper, film or folios. This method is also called heliographic printing.

PROCESS DESCRIPTION

The process of producing light sensitive (diazo) paper includes the following phases:

- preparation of the solutions to be applied to the base,
- applying the solutions to the base and drying in a stream of warm air,
- packaging into rolls and sheets.

Three solutions are applied to the paper base, two are applied to the front and one to the back side. The front side is covered with a precoating, which is, after drying, covered with the main coat. When the latter is dry, the required solution is applied to the back side.

The preparation of the solutions must be done in a separate, well ventilated room which must be equipped with electricity, cold and hot water and cooling equipment. The prepared solutions are brought in vessels to the machines used for coating the paper base. The application of the precoating, the main coat and the back coat on the paper base is carried out by a machine in a continuous process. The paper base is 120 cm wide and is unrolled at a speed of 50 m a minute. The solutions are applied one after another at a speed which allows the previous coating to dry in a stream of warm air. After the third solution has been applied and the paper base, now already a diazo-material, has dried it is again rolled into a bale which is then taken for packaging. The packaging requires the unrolling of the large rolls and their rolling into smaller ones 10,20,50 or more meters long or alternatively the diazo-material is cut into standard sized sheets. Thus prepared the material is packed into protective wrapping paper and put into cardboard boxes for

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transportation to the market.

The production process is continuous.

PRODUCTION CAPACITY

The capacity of the plant is 1 500 000 rolls whose length is 10 meters which equals 1 200 tons a year.

The calculation is based on a 250 day year and a 24 hour day.

REQUIRED MACHINERY AND EQUIPMENT

I t e m	No.
Vessel with mixer	5
Duplicator with mixer	3
Duplicator without mixer	3
Various vessels	5
Filtering equipment	3
Machine for applying the three layered coating and drying with warm air	1
Rerolling machine	1
Machine for cutting rolls to size	1
Laboratory equipment	5
Equipment for de-ionization of water	1
Accessories (tables, shelves, laboratory table)	

The FOB price of the equipment and know-how is approx. 1 000 000 US dollars.

REQUIRED RAW MATERIALS

I t e m	Quantity
Untreated heliographic paper	1,200 t/year
Chemicals necessary for the precoating solution (silicate dioxide, barium sulphur, starch, pvc)	72 "
Chemicals necessary for the main coat (diazo compounds, aluminium sulphate, phosphoric acid, couplers, thiourea, acetic acid)	56 "
Water de-ionizer	512 "

REQUIRED MANPOWER

Qualification	No.
University graduates (engineers)	3
Operatives	15
TOTAL	18

REQUIRED UTILITIES

Electrical energy	200 kWh/t of product
Gas	400 m^3/t of product

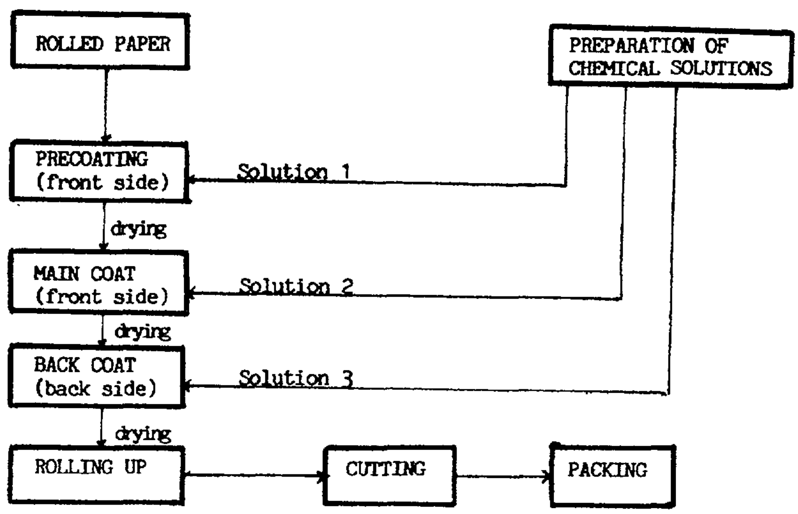
REQUIRED AREA FOR PLANT SITE

The total land requirement is 2 000 m^2 which includes the building, warehouses, laboratory, office and other rooms.

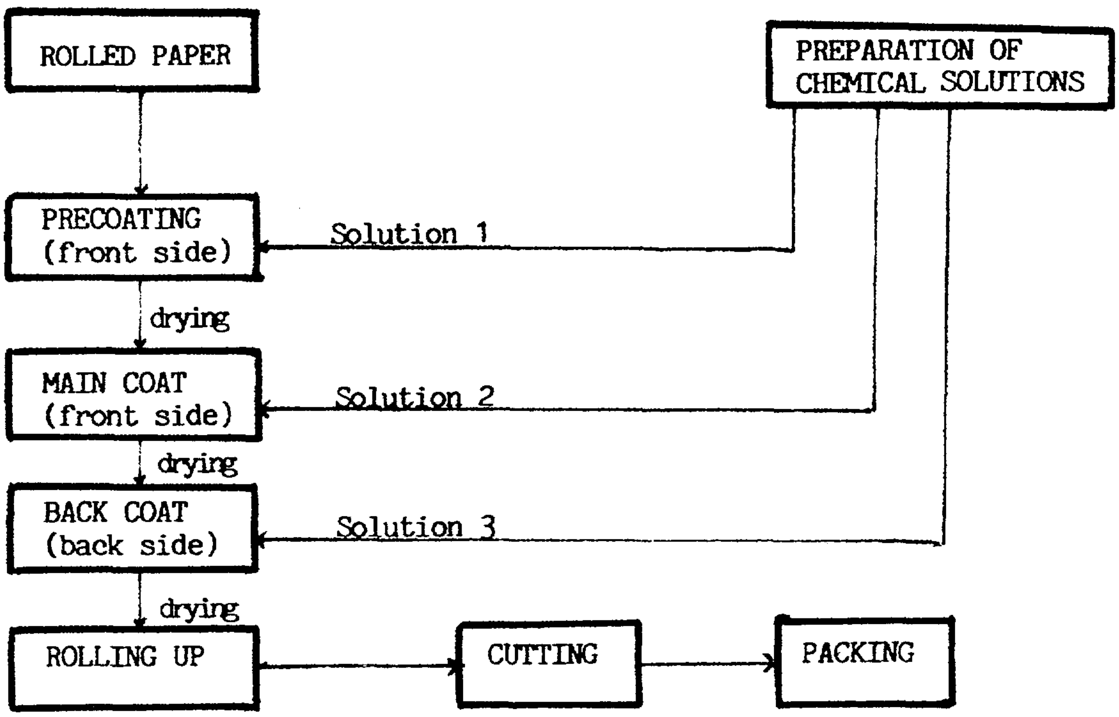
SAFETY MEASURES

No special safety precautions for the workers are necessary but special attention must be given to the prevention of fire.

PROCESS FLOW SHEET FOR PRODUCTION
OF LIGHT SENSITIVE (DIAZO) PAPER



PROCESS FLOW SHEET FOR PRODUCTION
OF LIGHT SENSITIVE (DIAZO) PAPER



FOOTWEAR GLUES MANUFACTURE

Glues are substances used for joining surfaces by means of elastic film which firmly clings to the glued surfaces and is not broken off under the impact of shear stress. Glueing has long been an important way of joining wood, leather, ceramics, textiles, paper and rubber. The theory of glueing process is highly complex, because a number of factors are involved relating to the nature of the glued surfaces and the characteristics of the glue solution and adhesive film.

Glues are almost always highly molecular, natural or synthetic colloidal substances, dissolved in organic solvents.

Glue used for shoe manufacturing is applied during the manufacturing process to bound the inside of footwear as well as the upper and lower parts.

The application of rubber soles in shoe industry throughout the world, as well as the usage of glues for binding the uppers of the leather footwear has stimulated the consumption of polymeric glues. Beside classical glues, which are a solution based on caoutchouc mixtures, there exist an increasing demand for one-component and two-component glues based on polyurethane, latex and polyvinylacetate, as well as for the thermoplastic glues.

The technology presented ancompasses the entire assortment of the footwear glues. Polyurethane glue is used for gluing soles made of vulcanized rubber based on natural and synthetic caoutchouc, PVC and PUR. It is also used for gluing leather on the face of the footwear made of natural or synthetic materials. The same glue is used for gluing soles made of thermoplastic caoutchouc. This glue is transparent and does not spoil the shoe.

Latex glue is applied for gluing leather, textile and embellishing parts of the footwear as well as the gluing of the paper with textile at bookbinder's shop.

PROCESS DESCRIPTION

In the footwear manufacturing process polymer materials (caoutchouc) are used. These materials are dissolved in organic

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solvents or dispersed in water to which various resins and additives have been added to improve the adhesiveness and bonding strength.

The manufacturing process usually begins with the mastication of caoutchouc on double rollers, with the addition of additives. After this the polymer mixtures to which resin has been added are dissolved in a mixture of organic solvents. This is performed in kneaders or mixing tanks.

Production phases are:

1. Weighing of components

The weighing of solid and pulverized components is carried out manually on scales of required precision; the weighed material is packaged into suitable boxes. The liquid components are directly fed into the mixer or disperser.

2. Mixing of solid and pulverized components

Mixing of all solid and pulverized components is carried out on a two-roll mill. The mixture is granulated.

3. Mixing of the glue

Mixing of the glue is done in mixers or dispersers until the required homogeneousness and viscosity is achieved. After being controlled for quality, the glue is packaged into tubes or barrels and transported to the storage for finished products.

The glue is packed in disposable containers of various sizes, depending on its assignment.

Glue manufaturing process is shown shematically in the block diagram.

Production is carried out in batches.

PRODUCTION CAPACITY

I t e m	Quantity
Polyurethane glues	400 t/year
Polychloroprene glues	1,300 t/year
Thermoplastic glues	100 t/year
Polyvinylacetate glues	200 t/year

Based on 16 working hours per day (2 shifts) and 300 days per year.

REQUIRED MACHINERY AND EQUIPMENT

I t e m	No.
Mixing tank, 1000 l,	8
Mixing tank, 600 l,	1
Disperser, 265 l,	2

Disperser vessels	4
Two-roll mill 550 x 1500	1
Two-roll mill 300 x 600	2
Palletizer	1
Transport and storage equipment (Dosing pumps, tanks with pumps, etc.)	complete set
Laboratory and control equipment	complete set
Other technological equipment (installation, ventilattion, etc.)	complete set
Maintenance equipment	complete set

FOB price for equipment and machinery about US dollars 650,000.

REQUIRED RAW MATERIALS

I t e m	Quantity
Polymers (PUR, CR, TR, PVAC)	400 t/year
Additives (fillers, resins)	300 t/year
Organic solvents (toulene, MEK, acetone, petrol, etc.)	1300 t/year

REQUIRED MANPOWER (for two shifts)

Qualification	No.
University degree	3
Secondary school degree (technicians)	4
Skilled workers	24
TOTAL:	31

REQUIRED UTILITIES

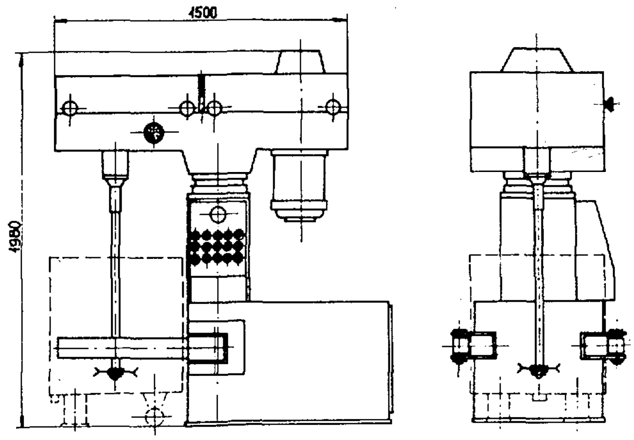
Electric energy	205 kWh/t of product
Water (technological)	600 cu.metres/t of product

REQUIRED AREA FOR PLANT SITE

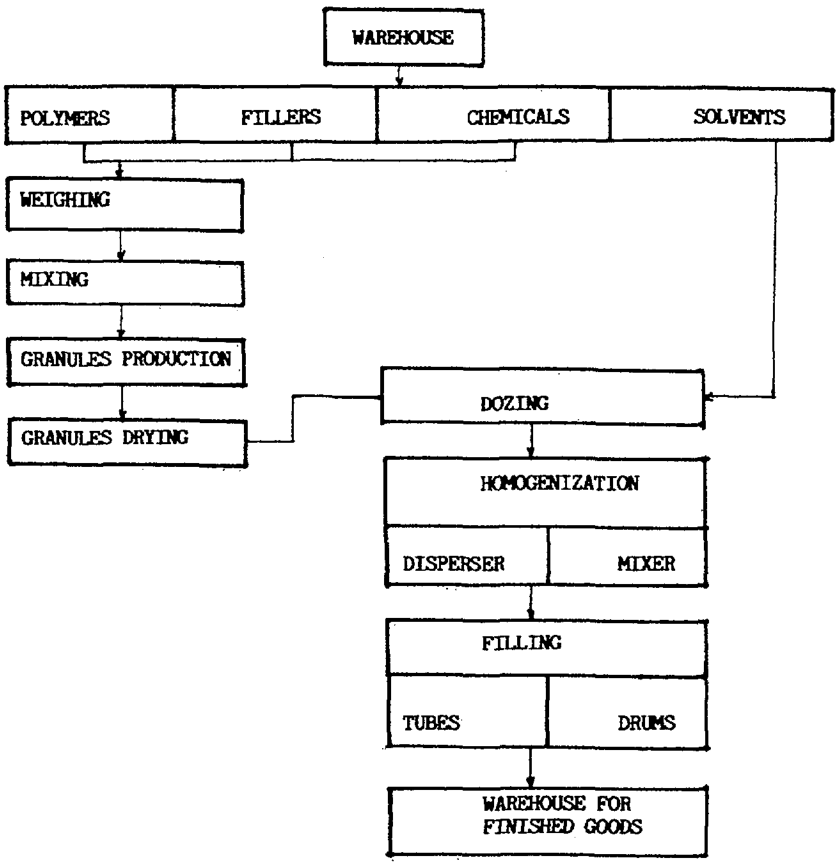
I t e m	Area
Storage	800 sq metres
Laboratory	30 sq metres

Production area	750 sq metres
Office space	50 sq metres
Service utilities	70 sq metres
TOTAL:	1700 sq metres

DISPERZER DM 11



GLUE MANUFACTURE BLOCK DIAGRAM



HOW TO START MANUFACTURING INDUSTRIES

PVAC (POLYVINYL-ACETATE) WALL COATING

The manufacture of final coating mixture for interior and exterior walls (made of concrete, siporex and mortar) is a discontinuous process in which production cycles follow continuously and one production cycle (mixing of components) takes 45 minutes. The principal technological requirement for this type of production is the successive addition of ingredients in to the vessels for mixing; two vessels are necessary for continuous weighing and mixing operations.

The coating consists of white pigment dispersed in water and of a binder based on PVAC (polyvinyl-acetate), with the addition of fillers, flame retardants and preservatives, and is used as a protective and decorative final coat for outdoor and indoor walls. It may be thinned by the addition of water and is applied to walls with a roller or a brush.

The coating may be used to paint and protect walls in homes, offices and industrial buildings. It may be applied to concrete and to mortar. If necessary, the surfaces should be smoothed before applying the coating.

PROCESS DESCRIPTION

The process of production of final cratings is very simple and does not require highly skilled labour. It involves the following stages:

1. Weighing the raw materials
2. Mixing the raw materials in a mixer
3. Packaging in plastic cans

The raw materials are weighed precisely and put, in the proper order, into a vessel containing water in which they are mixed. The mixer is a combination of a planetary mixer (30-60 rotations per minute, giving a semidispersion) and a dissolver (1400 rotations per minute, giving a dispersion). Mortars and other products of a greater viscosity may also be produced by changing the granulometric composition of the filler or the formulation.

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Composition of final coating mixture for interior and exterior walls is determined in accordance with the requirements for particular coating procedure (brush, roller and spray). The following materials may be used as fillers in the above mentioned procedures: quartz, natural and sedimented calcium carbonates, calcium/magnesium carbonates, magnesium silicates (chalk), magnesium/aluminum silicates and aluminum silicates (kaolin). Final coating mixture is diluted by addition of water depending upon the particular bed and the desired type of coating. Additives are added to the mixture depending upon particular climatic conditions. The shelf-life of the product is six months at temperatures between +5 and +60°C.

The product range may be extended by combining methods of mixing, changing the ingredients and adding pigments.

In manufacture of final coatings for outdoor and indoor walls batch method of production is used.

PRODUCTION CAPACITY

The annual capacity is 2100 tons.

This calculation is based on 8 working hours per day and 300 days per year.

REQUIRED MACHINERY AND EQUIPMENT

I t e m	No.
Planetary mixer	1
Scales for weighing the raw materials	1
Fork-lift truck	1
Tanks	2

FOB price of equipment US dollars 115,000.

REQUIRED RAW MATERIALS

I t e m	Quantity
PVAC binder	400 t/year
Flame retardant	7.5 "
Pigment	100 "
Kaolin	150 "
Calcite	525 "
Preservative	3 "

REQUIRED MANPOWER

Qualified workers		2
Unqualified workers		11
	TOTAL:	13

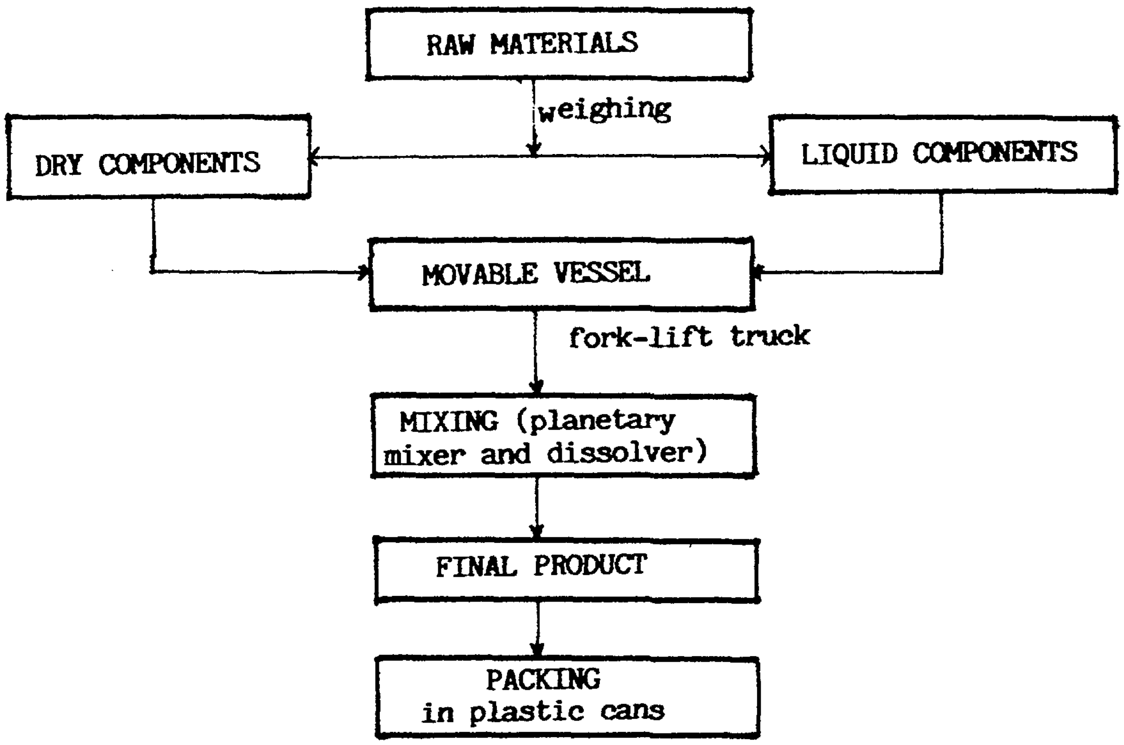
REQUIRED UTILITIES

Electric power	15 kWh/ton of product
Water (technological)	0.5 m^3/ton of product

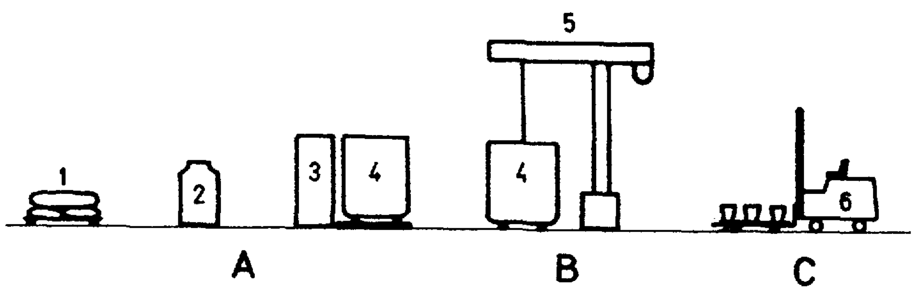
REQUIRED AREA FOR PLANT SITE

The total area occupied by the plant is 300 m^2 including the production area, werehouses, laboratory, office and service facilities.

FINAL COATINGS PRODUCTION BLOCK DIAGRAM



PROCESS FLOW SHEET FOR PRODUCTION OF FINAL COATINGS FOR OUTDOOR AND INDOOR WALLS



A Weighing the raw materials
B Mixing the raw materials
C Emptying the vessel and packaging

1. Filters and pigments
2. Liquid ingredients
3. Scales
4. Tank for the raw materials after
5. Mixer
6. Fork-lift truck

Coal Tar Distillation Plant

View of Coal Tar Distillation Plant

The carbonization of coal is now carried out for three distinct purposes. The first one is to make hard coke which is suitable for use in blast furnace for the reduction of iron ore. The second one is to make town gas when the by-product gas from metallurgical coke oven is insufficient to satisfy the demand for town gas or when natural gas is unavailable. The third objective of coal carbonization is to make a very reactive coke suitable for use as a smokeless fuel in open fires.

This coal carbonization industry provides the raw material for the tar-distilling industry. The crude tars recovered from above-mentioned carbonization industry were at first used as a fuel, particularly at steel works. But this practice has largely been abandoned and recently 98% of tar made in Britain and West Germany and 85% of the tar produced in U.S. is distilled.

Coal tars contain various organic compounds, such as phenol, cresol, naphthalene, anthracene oil, pitch and other hydrocarbon compounds and these organic compounds can be used to synthesize various fine chemicals and other coal tar related products as can be shown in tree of coal chemicals.

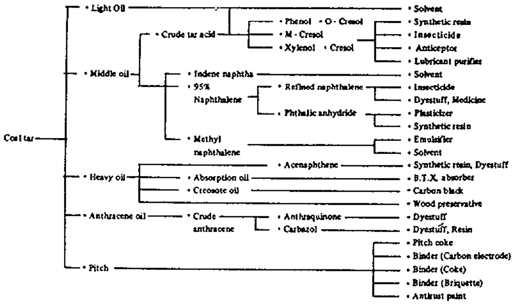
So the construction of coal tar distillation plant is the first step to open a coal chemical industry. Moreover, as the price of petroleum oil goes up rapidly and the shortage of petroleum is anticipated in the near future, coal chemical industry becomes more and more important, especially for the country without petroleum resources.

The coal tar distillation plant introduced here is a plant which can fractionate coal tar recovered from coke making plant and has many good points.

Typical merits of this plant can be mentioned as follows:

- The process is designed to minimize the corrosion of equipment.
- Plant cost is low and yield is high.
- The process is energy conservative and has no problems in polution control.

Tree of Coal Chemicals



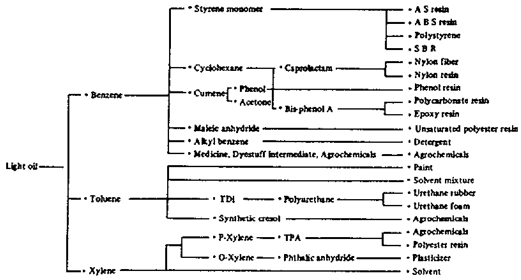


Table 1. Coal Tar Products and Its Uses

o Coal tar derivatives

Products	Uses
Middle pitch	Pitch coke, Binder for carbon products
Soft pitch	Binder for electrodes, Paving, Pitch coke
Hard Pitch	Binder for electrodes
Creosote oil	Carbon black, Floating agents, Reinforced cement binder, Benzene absorber
Anthracene oil	Anthraquinone, Dyestuffs, Carbazol

o Naphthalene & tar acid products.

Products	Uses
95% Naphthalene	Phthalic anhydride
Refined naphthalene	Insecticides, Resin, Plasticizer, Explosives
Absorption oil	BTX absorber
Phenol	Disinfectant, Resin, Plasticizer
Cresol	Disinfectant, Varnish, Plasticizer

Table 2. Specifications of Coal Tar Products

o Coal tar derivatives

Product		Specification	
Pitch	Middle pitch	Softening point	80 – 90°C
		Fixed carbon	55 – 58 %
		Ash	0.3 % max.
		Sulfur	0.6 % max.
	Soft pitch	Softening point	30 – 40°C
		Fixed carbon	48 % max.
		Volatile component	52 % min.
		Ash	0.2 % max.
		Sulfur	0.6 % max.
		Quinoline insoluble component	4.0 % max.
		Toluene insoluble component	21.0 % max.
	Hard pitch	Softening point	94 - 100°C
		Fixed carbon	55 % min.
		Specific gravity	1.305 min.
		Ash	0.4 % max.
		Sulfur	0.5 % max.
		Quinoline insoluble component	8–12 %
		Benzene insoluble component	32 – 38 %
Creosote oil		Specific gravity	1.03 min.
		Water	3 % max.
		Distillation point	– 210°C: 5% max. – 355°C: 60-85 %
Anthracene oil		Specific gravity	1.805 min.
		Water	0.5 % max.
		Toluene insoluble component	0.5 % max.

o Naphthalene & taracid products

Product		Specification	
Naphthalene	95% Naphthalene	Solidification point	77.5°C min.
		Water	0.5 % max.
		Non-volatile component	0.2 % max.
	Refined naphthalene	Solidification point	79.5°C min.
		Acid washing color	2 max.
Absorption oil		Specific gravity	1.025
		Viscosity	1.4 max.
		Sulfur	0.5 % max.
		Phenol	1.0 % max.
		Naphthalene	5.0 % max.
		Anthracene	8.0 % max.
		Water	1.0 % max.
		Average molecular weight	193 max.
Mixed cresol		Colour (Gardner)	5 max.
		Phenol	40±5 %
		O - cresol	12±3 %
		M, P - cresol	42±7 %
		Xylenol	6±4 %
		Other	1.5 max.

Products and Specifications

Coal tar differs widely in its constituents depending upon operating conditions at the carbonization plant or types of coal as raw material. Accordingly, in the coal tar distillation plant where coal tar is distilled into products, types of products differ depending upon raw materials selected and structure of the distillation process.

In the coal tar distillation plant introduced here, such products as carboric oil, naphthalene oil, washing oil, anthracene oil, heavy oil, pitch and light oil are separated. Coal tar from the cokes manufacturing plant is used as raw material. The products are processed to suit the customer's market prior to delivery.

Contents of Technology

1) Process Description

This process is roughly divided into dehydration and distillation. In the dehydration process, the raw material coal tar is first heated and part of its moisture is removed in a flash drum, and then it is reheated and sent to the dehydration column. The vapor from the top of the dehydration column is separated in a condensate separator into liquid and light oil. In the bottom of the column is produced coal tar free from moisture.

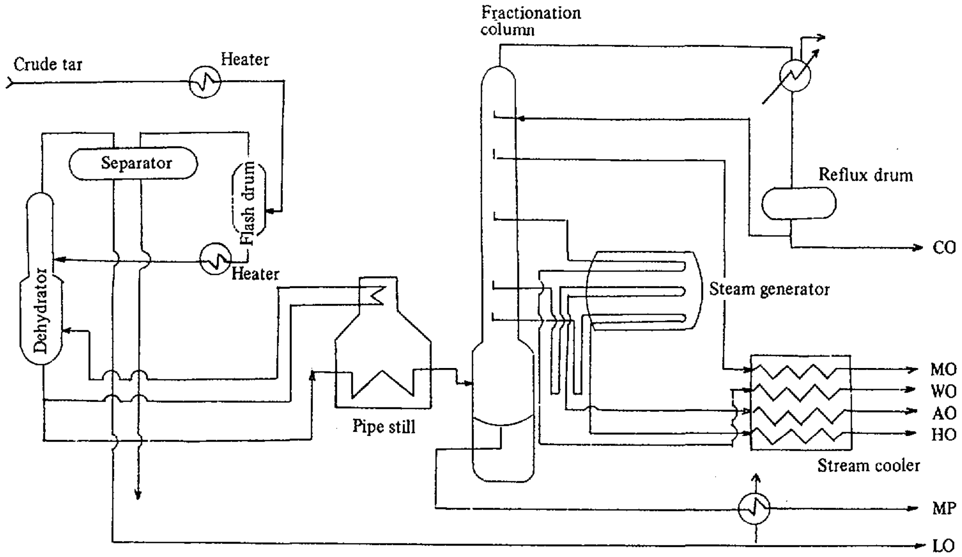
In coal tar is contained ammonium salts (mainly ammonium chloride) which usually corrodes the equipment severely. This salt, dissolved in this liquor partially remaining in coal tar, decomposes to produce highly corrosive hydrochloric acid, which corrodes the equipment, as the temperature of coal tar rises. In order to prevent such a phenomenon, caustic soda or sodium carbonate of approximately 15% concentration is added to the raw material coal tar.

Dehydrated coal tar in the dehydration process is transferred to the furnace to be heated to the temperature at which distillation takes place. After heating to about 330°C by burning Bunker-C oil, the coal tar is sent to the fractionation column for separation into desired oils by distillation.

The coal tar heated in the furnace is unstable to heat, and when the temperature rises beyond a certain point, coke is formed and causes the trouble of plugging furnace tubes to occur. Precautions should be taken in the design and operation of the furnace not to cause phenomena of partial overheating.

In the fractionation column, distillation temperature ranges from 100°C to 320°C for oil components. Carboric oil is obtained from the top of the column while four oil components including naphthalene oil, washing oil, anthracene oil and heavy oil are produced

Coal Tar Distillation Process Flow Sheet



as side streams. Pitch is obtained from the bottom of the column as residue.

Oils from the fractionation column, with relatively high boiling points, are used as waste heat source for generating steam in the side stream steam generator. Cooling water is also used to cool products prior to storage as finished products.

2) Equipment and Machinery

Dehydration section
- Dehydrator
- Flash drum
- Separator
- Crude tar heaters
- Condenser
- Steam generator
- Heat exchanger
- Feed pump
- Reflux pump
- Transfer pump
- Dehydration circulation pump
- Dehydrator bottom pump

Fractionation section
- Fractionating column
- Pipe still
- Side stream steam generator
- CO condenser
- CO cooler
- Side stream cooler
- CO reflux drum
- Transfer pumps
- CO reflux pump

3) Raw Materials and Utilities

Raw materials and utilities	Requirement (per ton of product)
Raw coal tar	1.0 ton
Caustic soda	1.9 kg
Sulfuric acid	0.3 kg
Diesel oil	3.8 kg
Electric power	20 kwh
Steam	0.8 ton
Water	3.0 tons

Example of Plant Capacity and Construction Cost

1) Plant capacity : 255,000mt/year
* Basis : 24 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$7,000,000
o Utility facility	:	US$ 900,000
o Installation cost	:	US$ 960,000
Total	:	US$8,860,000

3) Required Space

o Site area	:	10,000 m^2
o Building area	:	650 m^2
o Other	:	20,000 m^2
Total	:	30,650 m^2

4) Personnel Requirement

o Manager	:	4 persons
o Engineer	:	9 persons
o Operator	:	31 persons
Total	:	44 persons

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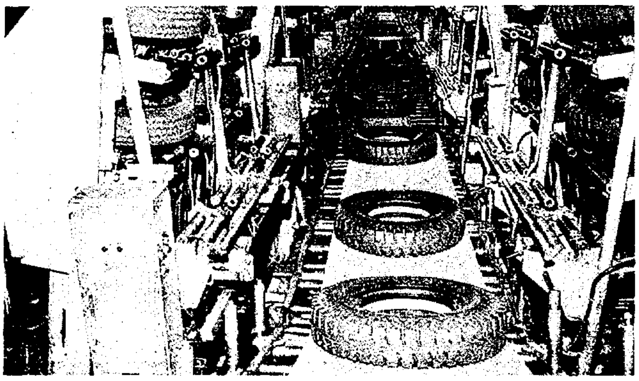
Tire Making Plant



Conveyer of Tire Press

Since the development of practical cars at the end of the 19th century, the automobile industry has attained a rapid advancement, resulting in the realization of a great revolution in the means of transportation.

In the 20th century, in particular, the car industry has developed as an essential part of the overall machinery industry of a nation, occupying a weighty position to the extent that the life of people in modern times is unthinkable without cars.

On the other hand, the development of car industry owes greatly to the emergence of rubber tires, with the growth of the car industry naturally linked to the growth of the tire industry. The tire industry now has formly rooted as one of the important key industries worldwide.

In the meantime, the tire industry occupies an absolute weight from the standpoint of rubber industry. In Korea, for instance, it accounts for approximately one-third of the total turnover of the rubber industry with the prospect that its weight will greatly expanded as the car industry continues to develop.

The importance of the tire industry is understandably conceivable in view of its being a labor intensive and basic industry with a weighty position in the industries of developing and underdeveloped countries.

The tire industry is in the limelight not only in domestic market but also in export markets. In Korea, for instance, since its initial export of tires in 1962, a rapid export growth of 40 to 50 percent was recorded during the 1970s. It is foreseen that such a rapid export growth will be sustained with the expansion of the car industry worldwide.

Consequently, the tire industry not only plays a vital role in fostering and developing the basic industry of a nation, but also contributes greatly to the advancement of the export industry. It is rated as an industry to be inevitablly fostered for the economic development of a nation in recognition of the importance of the tire manufacturing plant from this viewpoint.

Products and Specifications

In this plant, various tires of varied patterns and specifications are produced, breaking down into the following categories on the basis of respective uses:

- Passenger car tires
- Light truck tires
- Truck and bus tires
- Snow tires
- Off the road tires
- Industrial tires
- Agricultural tires

By types, general tires as well as radial tires making use of such materials as steel, fiber glass, polyester and nylon are being produced now. Also included in the production list are wide treaded tires with added sense of comfort.

Contents of Technology

1) Process Description

The manufacturing processes for products (tire, tube and flap) are divided into the mixing process, treating process in which component parts required for building products are prepared, building process where component parts (semi-products) are collected for fabrication of products and vulcanizing process in which vulcanized rubber is produced by means of thermal vulcanization reaction (see process diagram).

Compound mixing process

The mixing process breaks down into mastication and mixing work. Crude and synthetic rubbers as raw materials are accurately weighed.

Mastication is necessary to improve the rubber prior to mixing as to its calendering and extruding properties. Mixing takes place in a Bambury or open mill batchwise with a fixed volume for prescribed hours. The temperature is kept constant by means of cooling water. The green stock (blended rubber) with various uniformly-mixed blending materials are left alone for an appropriate length of time depending upon its uses (calendering and extruding).

Treating and building process

In this process, the blended rubber (rubber sheet), prepared in the mixing process, is calendered (cord) and molded as component part required for subsequent building. The required number of topped cord sheets are pasted together and beads are fixed on its both sides, with cushion rubber pasted together in the center. When the tread rubber is pasted, the building work is completed to be called the green tire (crude tire).

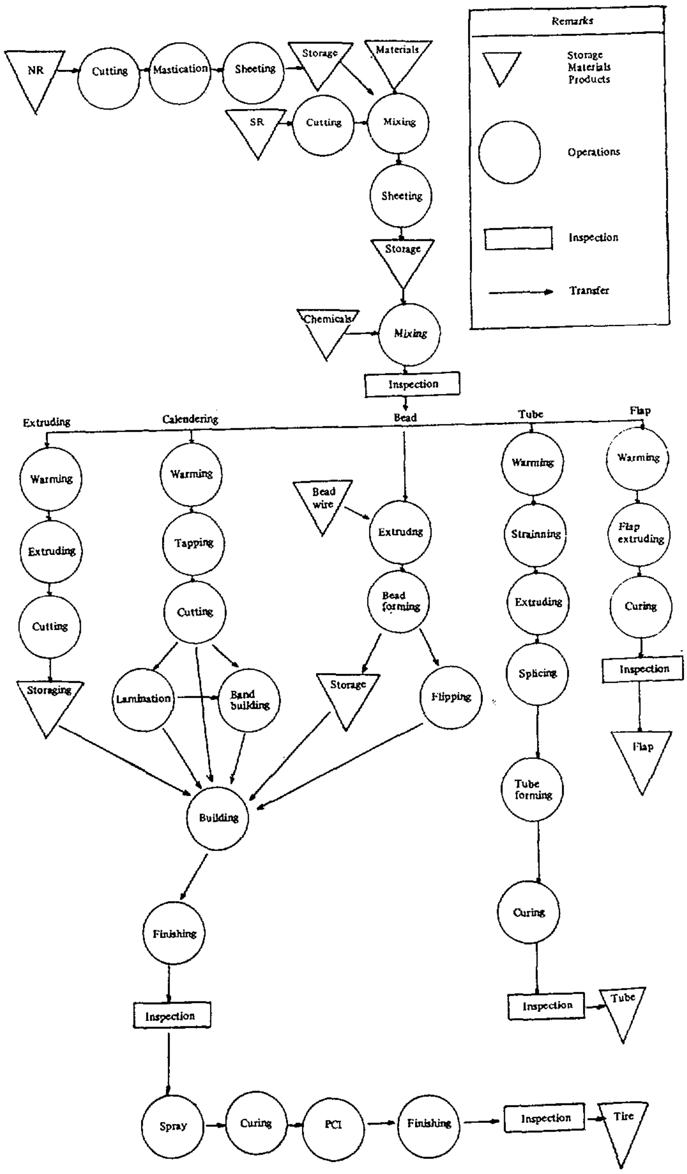
Vulcanizing process

The green tire, that is to say the built tire, is inserted into "Autoform" for an automatic vulcanization. The mold is already in the "Autoform" and the vulcanizing work takes place for a fixed length of time in the mold by heating and vulcanizing.

By supplying high-temperature and high-pressure steam or hot water into the bladder attached to the "Autoform", the external form of a tire is molded in accordance with the fluid of rubber. The tire is automatically expanded on completion of the vulcanizing work to be followed by cooling to form the final product.

Tubes and flaps are extruded, cut, spliced and cured in the same way as tires. After completion of the vulcanizing reaction at constant temperature for a fixed length of time in vulcanizing work, the product is

Tire Manufacturing Process Digram



taken out immediately for cooling. The finished product is inspected and stored.

2) Equipment and Machinery

- o Tire plant

Mixing section
- Bumbury mixer
- Single mill
- Batch off machine
- Dust collector
- Carbon auto batching unit
- Stock feeder
- T-mixer
- Truck scale

Calendering section
- Calender and train
- Twin mill
- Conveyors
- Hoist unit
- Air conditioning unit
- Gum calender and train
- 2 Roll calender
- Twin mill
- Single mill

Extruding section
- Tread extruder & line
- Cold feeder
- Cushion calender
- Liner & final scale
- Conveyors
- Blowers
- Twin & single mills
- Dual tuber
- Skiver

Cutting section
- Fabric bias cutter
- Steel cutter
- Sliter machine
- Rewinding machine

Beading section
- Bead train
- Hexagonal bead train
- Bead wrapping machine
- Apex applicator

Banding and building section
- Band builder
- Bias PC building machine
- Bias LT building machine
- Bias TB building machine
- Radial PC first building machine
- Radial PC second building machine
- Radial TB first building machine
- Radial TB second building machine

Curing section
- PC tire press
- LT tire press
- TB tire press
- PC bladder press
- TB bladder press
- Cold blander

Finishing section
- Trimming cutter
- Tire uniformity machine
- Balance tester
- X-ray tester
- W.S.W. grinder
- Endurance tester
- Conveyors

- o Tube & flap plant
  - Mill
  - Strainer
  - Extruder & line
  - Tube curing press
  - Flap press
  - Splicer

3) Raw Materials and Utilities

- o Tire, tube & flap plant

Raw materials and utilities	Requirement (per ton of product)
Natural rubber	260.2 kg
Synthetic rubber	231.9 kg
Carbon	240.9 kg
Cord	90.3 kg
Accelerator	28.2 kg
Softener	54.4 kg
Others	92.1 kg
Bunker-C oil	1.32 drum
Electric power	828.0 kwh

Note: Based on tire plant capacity, 350 tons/days, and tube and flap plant capacity, 40 tons/days.

Example of Plant Capacity and Construction Cost

1) Plant capacity : 1,560,000 pcs/year
  * Basis : 24 hours/day, 320 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$34,080,487
o Utility facility	:	US$ 3,658,536
o Installation cost	:	US$ 3,408,000
Total	:	US$41,147,023

3) Required Space

o Site area	:	108,658 m^2
o Building area	:	32,132 m^2
o Other	:	76,526 m^2
Total	:	108,658 m^2

4) Personnel Requirement

o Manager	:	4 persons
o Engineer	:	35 persons
o Operator	:	144 persons
Total	:	183 persons

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BOPP Film Making Plant

BOPP film is a polypropylene film which is stretched both in the machine direction and transverse direction. The properties of polypropylene film are remarkably improved by this stretching process which change the arrangement of molecules.

So this film possesses superior mechanical properties, excellent transparency, improved gloss of surface, low moisture and gas permeability, good resistance to chemicals, good impact and tensile strength at lower temperature and good electric insulating properties.

Due to above-mentioned improved properties, this film is widely used in packaging, followd by electrical insulation and printed and decorative materials.

In packaging industry, this BOPP film has replaced large amount of cellophane market because of its better physical properties and economics. BOPP film gives longer preservation of freshness, a fresh feel, better resistance to tearing than cellophane or folding the film, preservation of flavor and storage under refrigeration without becoming brittle.

So, now, this film has general applications as follows:

o Preformed bags
- One side sealed bag: Textiles, socks, underwear and others
- Ultrasonic sealed bag : Textile, underwear and other clothings
- Partly sealed bag : Candies, cookies, seasonings and other foodstuffs

o Automatic packing
- Form and fill : Ice cream, processed marine product
- Over wrapping : Processed marine food, cigarette, chocolate, biscuit, snack food, medicines and cane sugar

o Lamination
- BOPP/adhesive/ PE(BOPP/PE) : Pickles, cookies, dry food, seasonings and frozen food
- BOPP/adhesive/ PT : Pickles and vacuum package
- BOPP/cellophane/PE : Processed meat
- BOPP/adhesive/ CPP : Rice cakes, candies and dry food
- BOPP/PE/AL/ PE : Chocolates and candies

Products and Specifications

In this plant, three types of BOPP film is produced and their features and specifications are as follows:

o Diaphane P-type

This type has the following excellent features so that it can be used as substitute of cellophane or other plastic films.

- The lowest density ($0.91 g/cm^3$) and higher yield.
- Very good impact strength even at low temperature.
- This is a crisp, excellent film and optically comparable to the best packaging films available.
- Has low moisture permeability (dry products remain dry, moist products retain their moisture).
- Has much less gas permeability compared with low-density PE and cast PP.
- Specification

  Thickness : 20 – 60μ
  Width : 50 – 4,000 mm
  Lengths

20μ – 25 μ	4,000 m
30μ – 50 μ	2,000 m
60μ	1,000 m

- Corona and antistatic treatment: Corona and antistatic treatment is done on this film.

o Diaphane KOP

This film is both side heat sealing possible type, the base of which is diaphane P-type. KOP has all of the desirable physical properties of diaphane P-type such as high tensile strength, flex-crack resistance over a wide temperature range and outstanding moisture-proof property.

In addition, KOP is sealed well by heating and is suitable for over wraping uses.

- Equivalent heat sealing capability as MST cellophane.
- Excellent water and moisture proof properties so that contents keep their natural quality for a long time.
- The contents looks nice owing to excellent transparency and gloss of surface, and beautiful prints can be applied.
- Keep its quality for any seasons.
- Perfect antistatic property.

- Specification
  - Thickness : 20 – 30 μ
  - Width : 50 – 1,000mm
  - Length : 2,000 – 4,000m/roll

○ Diaphane OH

This film is the one side heat sealable type film. This has many excellent features, such as the capability of high speed wrapping with usual horizontal pillow type automatic wrapping machine for PE coated cellophane and the excellent sealing potentialities.

- Wide heat-sealing range and good adaptability to automatic wrapping operation.
- Outstanding heat-sealing strength.
- Excellent moisture-proof property.
- High strength at low temperature.
- Both side printing is possible, and beautiful printing is available.
- Specification
  - Thickness : 20 – 30 μ
  - Width : 50 – 1,000mm
  - Length : 2,000 – 4,000m/roll

Contents of Technology

1) Process Description

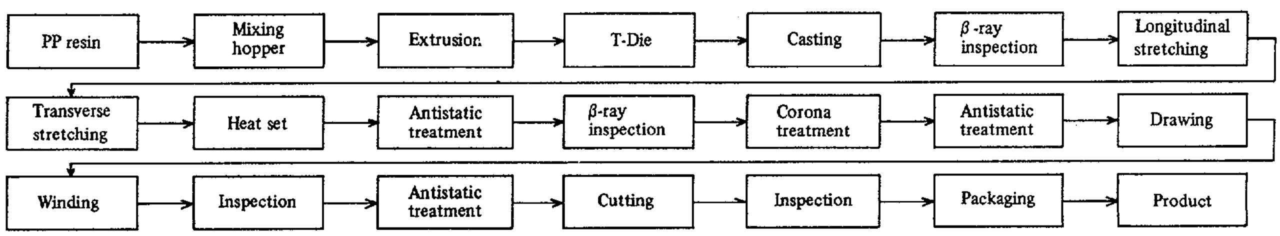
The pelletized PP polymer is fed into a screw type extruder. Here it is heated and made into a viscous fluid in a cylinder by means of a revolving, helical screw, having feed, compression and melting section to bring the polymer to a condition necessary for forcing it through the flat extrusion die.

The flat sheet emitted from the die is normally quenched on a temperature-controlled rotating roll. The thickness of the film at the die lip is usually greater than at the quenching surface because of the greater speed of the film relative to the linear velocity at the die lip. And the thickness of film is checked before the film enter the Dancer roll unit.

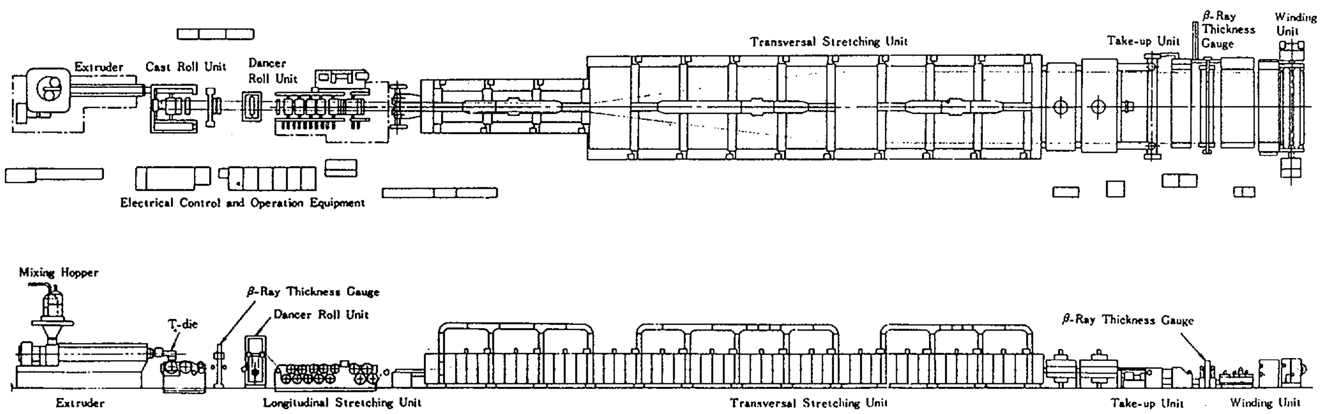
This film next passes through the longitudinal stretching unit where stretching takes place in the machine direction. The longitudinally stretched film is fed into the tender frame. In this frame, a series of chips grasps both edges of the sheet. These clips are about 3 inch long and are mounted side by side on endless chains. This tender frame is devided into three sections. The first section is for temperature conditioning of material and the clips proceed parallel to one another. In the second section, the track diverge and cause the sheet to be stretched in the transverse direction. Thereafter, the film is subiected to heat setting and is stabilized.

And the antistatic treatment is done on the film. For improvement of adhesiveness and better printing on its surface, this film can also be treated with

BOPP Film Manufacturing Process Block Diagram



BOPP Film Manufacturing System



corona on one or both sides. Finally, the treated film is passed to the take-up and winding unit.

2) Equipment and Machinery

Extruder
Cast roll unit
Dancer roll unit
β-Ray thickness gauges
Longitudinal stretching unit
Transversal stretching unit
Take-up unit
Anti-static and corona treatment unit
Winding unit
Cutter
Electrical control and operation equipment

Example of Plant Capacity and Construction Cost

1) Plant capacity : 50 ton/day
   * Basis : 12 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$6,000,000
o Utility facility	:	US$2,000,000
o Installation cost	:	US$1,500,000
Total	:	US$9,500,000

3) Required Space

o Site area	:	600 m^2
o Building area	:	1,500 m^2
o Other	:	300 m^2
Total	:	2,500 m^2

4) Personnel Requirement

o Manager	:	1 persons
o Engineer	:	3 persons
o Operator	:	17 persons
Total	:	21 persons

FILE: K-17
ISIC: 3560

ROTARY THERMOFORMING OF PLASTOMERS

Rotary thermoforming is a plastomers processing method used to produce hollow objects of a volume ranging from several cm^3 to 20 m^3, with a wall thickness ranging from 2 to 10 mm and more.

Rotary thermoforming has numerous advantages over other methods of polymers processing, the foremost of which is the very short period needed to make the moulds and dispatch the first sample, usually within 15 to 60 days of the order and even less for simple products. The mould itself is about 10 times cheaper compared to moulds for blow moulding or injection moulding, so that very small series can be made.

A series of 1000 pieces is thought to be optimal if the moulds are made of sheet steel, and of 10,000 pieces if they are cast in aluminium or made of galvanoplastics.

The product walls are free of strain, they are relatively thick in comparison to products made by blow moulding or injection moulding, and the polymers used for rotary thermoforming are generally stable in the temperature range of -40 to 120°. In this temperature range they are highly impact resistant and resistant to aggressive media (acids, alcali) and other chemicals with the exception of aromatic compounds and some petroleum derivatives.

A wide range of products for various applications is produced by this process. The most frequently produced are various containers for chemicals (liquids and powders) and transportation vessels for the chemical, textile, food and other industries. Various objects used in agriculture can also be produced: transportation vessels, storage bins, tanks, etc. Other products include toys, light fittings, furniture and a variety of household objects.

The material to be processed depends on the required properties of the finished product. The materials most frequently used are polyethylene of all densities, cross-linked and linear polyethylene, polystyrene, polyamide, polyvinylchloride and nylon.

PROCESS DESCRIPTION

Mixing

Mixing is needed when the finished product has to be

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coloured. The plastomer powder and pigments are mixed in exact proportions in mixers of a standard type until the mixture becomes completely homogenous so that the finished product is coloured evenly.

Dosing

The plastomer, which is in bags or containers, is put into vessels of a certain size, weighed and taken to the rotary thermoformer.

Moulding

Moulding (rotary thermoforming) of plastomers includes the following steps:

- Pouring the plastomer into the mould
- Closing the mould
- Putting the mould into the machine
- Heating the mould and plastomer
- Cooling the mould and the product
- Taking the mould out of the machine
- Taking the mould apart
- Taking the product out of the mould.

The process consists in melting the plastomer powder in a mould which rotates around two mutually perpendicular axes, or rotates around one axis while swinging around the other. The mould is heated most often with an open plame so that the powder melts and the plastic is evenly distributed around the inner walls of the mould. When the melting process is completed (after 2-6 minutes) the heating is cut off and the mould cooled by air circulation while still rotating. When the product has cooled to about 60°C the mould is removed from the machine, opened, and the product is taken out.

Finishing

When the product has been taken out of the mould it often has to be finished by cutting, planing, drilling, milling, etc.

The rotary thermoformer consists of a power generator which rotates the mould, a gas burner for heating the mould and a control panel for operating the machines.

The moulds are relatively simple. They are usually made of steel sheets 1-3 mm thick. Their low cost means that they can be made in small series or even piecemeal.

A batch system of production is used.

PRODUCTION CAPACITY

Approximately 200 t/year

This calculation is based on 16 hours/day (two shifts) and 270 days/year.

REQUIRED MACHINERY AND EQUIPMENT

Item	No.
Gas tanks (4 m^3)	2
Mixers	2
Rotary thermoformers	6
Cooling ventilators	12
Finishing equipment and tools	2 sets
Scales	4
Moulds	12
Also: vehicles, firefighting equipment, ventilation, maintenance equipment, and, if required, a 500 kg crane.	

The total FOB price of machines and equipment is estimated at US dollars 92.000.

REQUIRED RAW MATERIALS

High density polyethylene or LHDPE (powder)	100 t/year
Low density polyethylene (powder)	100 t/year
Pigments	0.1 t/year

REQUIRED MANPOWER (for two shifts)

Qualification	No.
University degree	2
Technicians	1
Skilled workers	4
Unskilled workers	13
TOTAL:	20

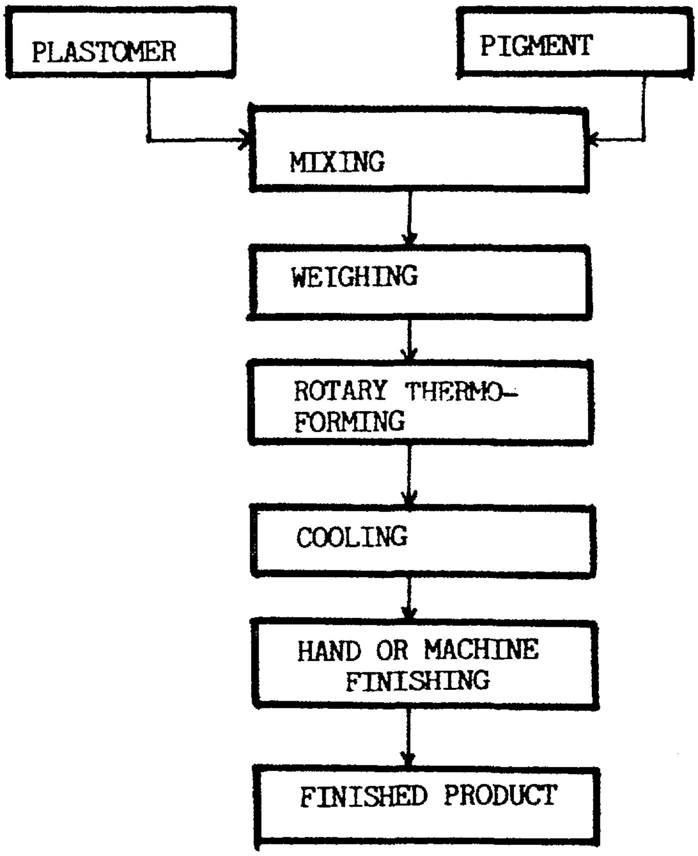
REQUIRED UTILITIES

Electric power	200 kWh/t of product
Gas (liquid)	250 kg/t of product

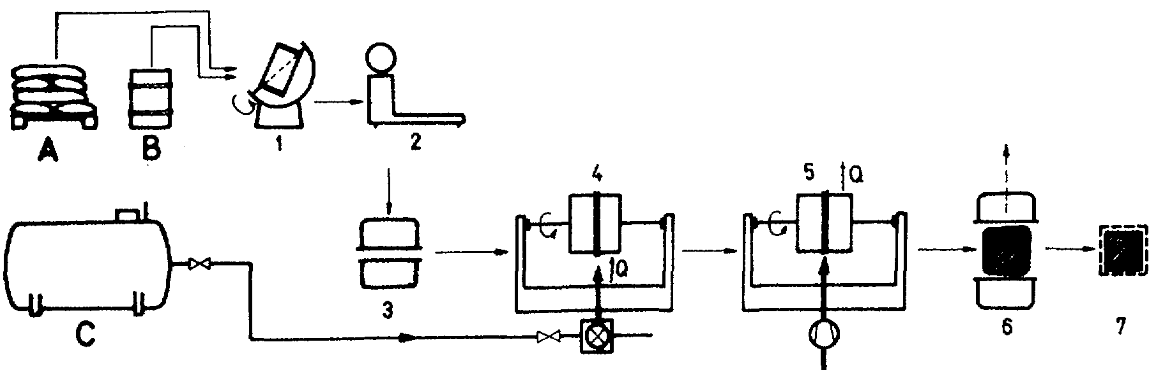
REQUIRED AREA FOR PLANT SITE

The total area occupied by the plant is about 1000 m^2 including the plant building, warehouse, offices and service facilities.

PROCESS BLOCK DIAGRAM FOR
TERMOFORMING OF PLASTOMERS



PROCESS FLOW SHEET FOR ROTARY THERMOFORMIG OF PLASTOMERS



A Plastomer
B Pigment
C Fuel gas

1 Mixing
2 Weighing
3 Filling the moulds
4 Rotary thermoforming

5 Air cooling
6 Opening the mould
7 Hand or machine finishing

FILE: K-18
ISIC: 3560

HOW TO START MANUFACTURING INDUSTRIES

PLASTIC BOTTLE PRODUCTIOM

Plastic bottles are used more frequently nowdays for packing different products, since they are cheaper and easier to handle than any other packing material.

The suggested technology is not bound to a fixed programme, it can be easily adjusted according to the raw material available and according to the demands on shapes and the quantity of production.

This technology for processing of plastic materials is assigned for production of small plastic containers using the blowing technique mainly for needs of the pharmaceutical industry. The production programme is very elastic and it can be relatively easily changed according to the demands of the market. Production has been concentrated on the manufacture of bottles up to 1 litre of volume.

The final product (bottles) can be used not only in pharmaceutical industry but for packaging of all kinds of liquid products, various powders and similar materials as well.

Production is relatively simple: except for a few keypoints in the course of the production process and for equipment maintenance no specially qualified manpower is required.

PROCESS DESCRIPTION

Raw material - plastic granules - is brought to the special silo. After drying the material is transported from the subsidiary silo directly into dissolver/homogenizer; transportation to machines is automatized, while internal material handling is carried out by means of fork-lift trucks and pallets.

Bottles are manufactured on blowing machines and the stoppers are produced by using injection machines. If necessary, bottles can be decorated by impressing on an automatic line. Finished products ready to be delivered are transported to the warehouse.

When defining the production programme and when deciding upon the technology which is to be applied, it is necessary to

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determine strictly for what purpose will the product be used; proper material must be selected (in a way the mode of production depends upon raw material); special supplements for apparatus and tools have to be ensured. A very strict control procedure must be carried out constantly and continuously - from the moment the raw material enters the plant, during the production and finally at the end of production (quality control).

As to the utilities, it should be emphasized that the quantity of technological water applied in the cooling process during the production circulates in a closed system - with an additional cooling system supplied. Therefore, the water consumption is small and additional amounts are added only for refilling.

In technology of manufacture of small plastic containers/ bottles a continuous production process is used. The necessary manpower can be trained in the production plant of the technology supplier.

PRODUCTION CAPACITY

Annual production capacity is 18,000,000 bottles of various dimensions.

Basis for calculation: 15 hours/day, two shifts, 275 days per year.

REQUIRED MACHINERY AND EQUIPMENT

I t e m	No.
1. Automatic equipment for manufacture of bottles by blowing:	
- Type Edex 50/2	3
- Type Edex 60/2	2
2. Automatic equipment for manufacture of plastic products by injection:	
- Type Belmatik 150/80 E	2
- Type 250/130 E	3
3. Equipment for decoration	
4. Material supply equipment	
5. Accessory equipment	

FOB price for machinery and equipment: 260,000 US dollars approx.

REQUIRED RAW MATERIAL

I t e m	Quantity
Plastic granules (PE, PVC, PS)	550 t/year
Dyes for plastics	10 t/year
Diverse dyes	1 t/year

REQUIRED MANPOWER

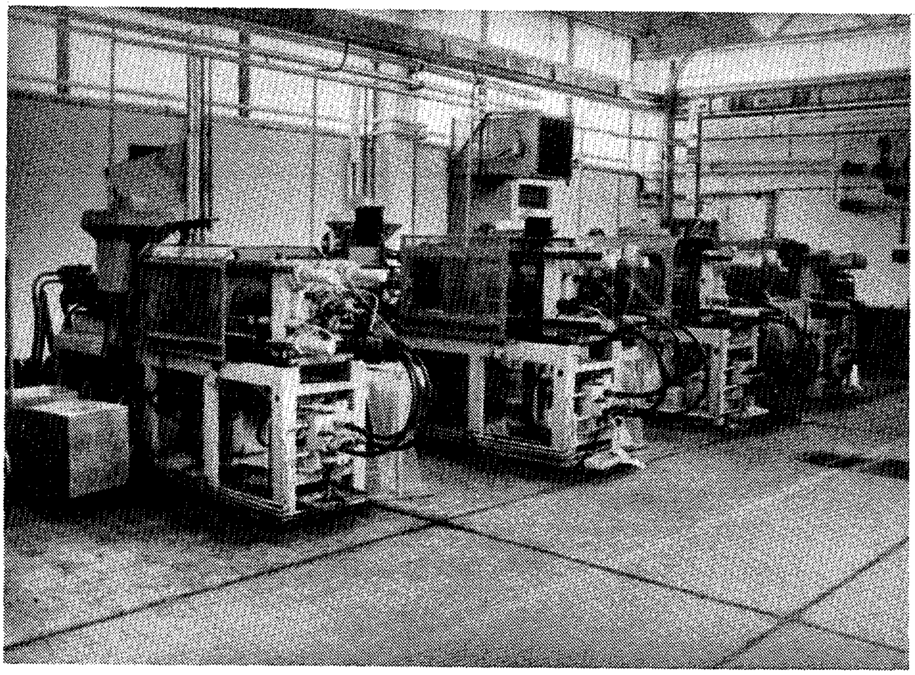
Q u a l i f i c a t i o n	No. of persons (two shifts)
University education	2
Technicians	2
Highly skilled workers	8
Skilled-workers	4
Semi - or unskilled workers	15
TOTAL	31 (18 in the first shift)

REQUIRED UTILITIES

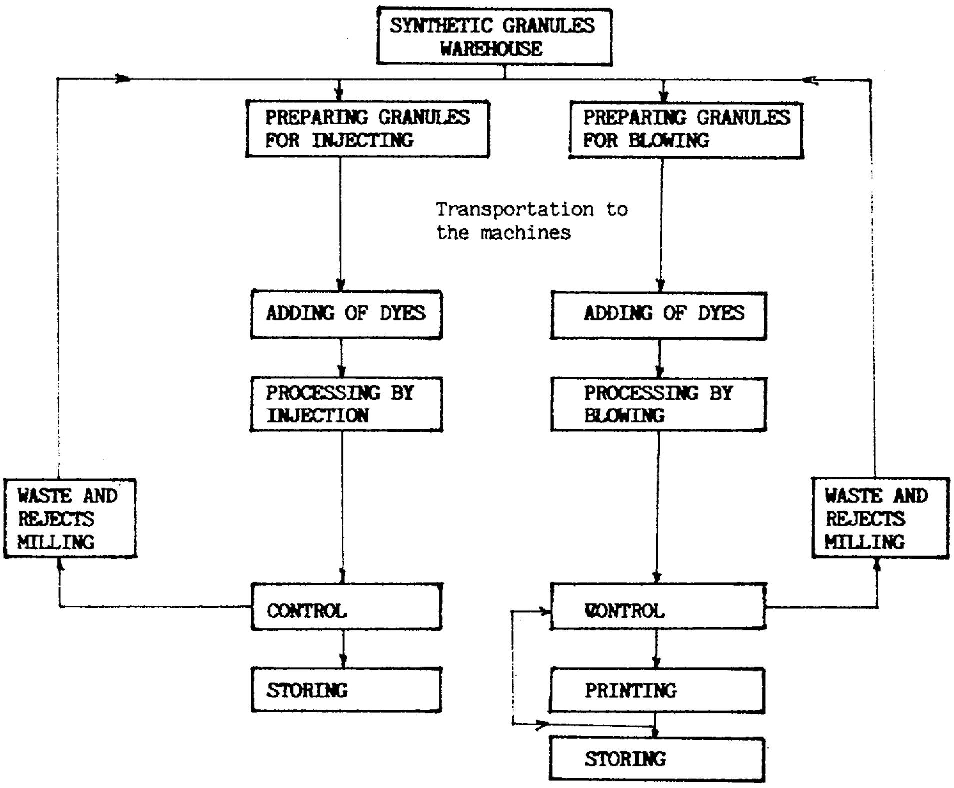
Electric energy .... 1.815 kWh/t of product
Compressed air (8 bars).... 300 m^3/hour
Water .... 57 m^3/t of product

REQUIRED AREA FOR PLANT SITE

Total area necessary for production is 1,200 m^2, which includes: building, warehouses, offices, laboratory, auxiliary rooms.



SMALL PLASTIC CONTAINERS MANUFACTURE
BLOCK DIAGRAM



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Tube and Bulb Glass Making Plant

Tube Glass Sleeve

The glass processing technology has a very long history, but it was not until after the turn of the 20th century that its development to a modern glass processing industry was finally realized.

In other words, the productivity has rapidly increased as a result of the mechanization of the glass processing procedure ascribable to the development of glass processing machinery. An accumulation of both physical and chemical know-how regarding the glass has helped make processed glass products varied and sophiscated.

Processed tube and bulb glass products, occupying an important position in such a glass processing industry, are widely in use as parts for electric, electronic, medical and chemical industries, not to speak of household uses. Therefore, the development of these related industries has greatly increased the demand for processed tube and bulb glass products. Particularly, the demand for glass products for illumination as well as for electronics use shows a trend of rapid increase

In the meantime, processed tube and bulb glass products are characterized by generally easy domestic procurement of raw materials and also the ease of its industrialization in view of the character of the products. In addition, processed products are diverse in type and used as raw materials and component parts for various industries. Those small and medium industries manufacturing varied products on the basis of these component parts can play a significant role in expanding the employment effect.

Accordingly, as a key industry for the national industrialization and also as an import-substitution industry, the tube and bulb glass manufacturing industry should be essentially cultivated. Furthermore, the importance of this tube and bulb glass manufacturing industry should be fully recognized.

The plant introduced here is capable of molding precision products, being suitable for the production of a small quantity products in varied types. It particularly suits developing or underdeveloped countries where markets are relatively small for respective types of products.

Products and Specifications

In this plant, super quality tube glass is drawn by fully automatic tube drawing system so a variety of quality tube products of precision O.D. and I.D. are receiving wide reputations from the illumination and pharmaceutical industries.

Also another conspicuous phase of tube drawing operation is the production of high quality glass tubes

Table 1. General Uses of Tube and Bulb Glasses

Products	Uses
Soda-lime glass tube	Chandeliers, fluorescent lamp.
Borosilicate glass tube	Vial tube, tip, laboratory glass ware, pharmaceutical containers.
Lead glass tube	Circline, neon tube, stem tube.
Bulb glass	Incandescent lamp, chandelier.

for incandescent lamps and chandeliers, which has brought forth a far-reaching innovation to the heretofore out-moded manufacturing technics in the industry.

The uses and a variety of glass tubes vary according to the physical property of glass used, viz., soda-lime glass, borosilicate glass and lead glass. (table 1)

The detail specifications of tube glass and glass bulb are shown in table 2.

Table 2. Specifications of Tube and Bulb Glass Products

Soda-lime glass (S.G.)

Symbol	Size			Remarks
	Outside diameter	Thickness	Length	
FL–65	38.0 ± 1.50	0.82 ± 0.10	1,572 ± 1.0	Tube for fluorescent lamp 65W
FL–40	38.0 ± 1.50	0.82 ± 0.10	1,572 ± 1.0	Tube for fluorescent lamp 40W
FL–20	38.0 ± 1.50	0.82 ± 0.10	650 ± 1.0	Tube for fluorescent lamp 20W
FL–15	26.0 ± 1.00	0.72 ± 0.08	510 ± 1.0	Tube for fluorescent lamp 15W
FL–10	26.0 ± 1.00	0.72 ± 0.08	400 ± 1.0	Tube for fluorescent lamp 10W
C–7	13.25± 0.35	0.725± 0.05	1,650 ± 3.0	Tube fox x-max decorative lamp

Lead glass (L.G)

Symbol	Size			Remarks
	Outside diameter	Thickness	Length	
FLS–1	12.5 ± 0.35	0.90 ± 0.10	1,200	Stem for fl. lamp 65w, 40w, 20w
FLS–2	10.0 ± 0.35	0.90 ± 0.10	1,200	Stem fl. lamp 15w, 10w
FLE–1	4.0 ± 0.20	0.80 ± 0.10	1,200	Exhaust tube for fl. lamp 65w, 40w, 20w
FLE–2	3.4 ± 0.15	0.65 ± 0.08	1,200	Exhaust tube for fl. lamp 15w, 10w
CS–7	6.2 ± 0.20	0.60 ± 0.08	1,250	Stem for x-mas decorative lamp
CS–9	6.6 ± 0.25	0.65 ± 0.08	1,250	Stem for x-mas C-7, C-9
CE–7	2.2 ± 0.15	0.54 ± 0.08	1,250	Exhaust tube for x-mas deco. lamp
CE–7	2.2 ± 0.15	0.54 ± 0.08	1,250	Exhaust tube C-7, C-9
N–14	14.0 ± 0.50	0.95 ± 0.10	1,665	Tube for neon lamp
CL–30	32.0 ± 1.50	1.10 ± 0.10	600	Tube for circline 30w
CL–20	32.0 ± 1.50	1.10 ± 0.10	540	Tube for circline 20w
M–5.25	5.25 ± 0.20	0.38 ± 0.08	1,250	Tube for miniature lamp

Borosilicate glass

Symbol	Size			Remarks
	Outside diameter	Thickness	Length	
2cc	11.2 ± 0.35	0.45 ± 0.03	1,820	Ampoule 2cc
20cc	24.5 ± 0.50	0.60 ± 0.06	1,520	Ampoule 20cc
1,000cc	5.3 ± 0.20	0.70 ± 0.10	1,250	Ringel 1,000cc
5cc Outer tube	14.9 ± 0.30	1.40 ± 0.07	1,820	Injector
5cc Inner tube	12.4 ± 0.30	1.40 ± 0.07	1,820	Injector
10cc Outer tube	18.4 ± 0.30	1.60 ± 0.07	1,820	Injector
10cc Inner tube	15.5 ± 0.30	1.60 ± 0.07	1,820	Injector
Physical and chemical tube	18.0 ± 0.60	1.20 ± 0.07	1,820	Test tube, physical and chemical equipment
"	24.0 ± 0.80	1.20 ± 0.07	1,820	"
"	36.0 ± 1.50	1.50 ± 0.10	1,820	"
For vial	22.0 ± 0.70	1.00 ± 0.06	1,520	Vial

Glass bulb

Symbol	Outside diameter	Remarks	Symbol	Outside diameter	Remarks
A–55	55mm	Glow lamp 40W	C–36	36mm	Decorative lamp
A–60	60mm	Glow lamp 60W	C–40	40mm	Decorative lamp
A–70	70mm	Glow lamp 100W	C–50	50mm	Decorative lamp
A–30	30mm	Decorative lamp	S–40	40mm	Decorative lamp
A–32	32mm	Decorative lamp			

* Size of tube glass available on buyer's orders

Contents of Technology

1) Process Description

(a) Tube glass

Raw materials put into the furnace are melted and refined. The molten glass flows to the rotating sleeve through a trough of the feeder installed at the end of the furnace.

The molten glass is wound on the rotating sleeve and moves toward the other end. At the same time, the tube is formed when the molten glass reaches the end of the sleeve. It is drawn while the blowing air is blown in through holes in the sleeve.

The tube is continuously drawn by the tube drawing machine at the end of the annealing lehr, while the molten glass continues to flow through the trough and sleeve to be cooled and molded.

An annealed tube in the annealing lehr is cut by the cutting machine in appropriate sizes and then checked for outer diameter. Defective tubes are picked up and discarded while the passed tubes are moved to the other table for recutting to conform to specifications. The cut part is heated and polished prior to final inspection and packing.

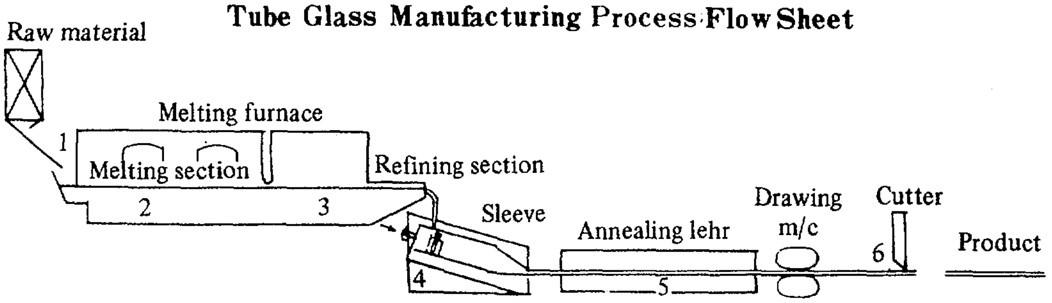
Depending upon the composition of raw materials, various types of glass tubes including those of soda-lime, borosilicate and lead are produced.

(b) Bulb glass

The molten glass produced by melting raw materials is supplied by a plunger pump to the orifice installed in the spout at the end of the feeder to form a gob. The formed gob is placed in the mold to be molded in the form of mold by blowing in air. The molded bulb is annealed in the annealing lehr to be followed by inspection and packing for delivery.

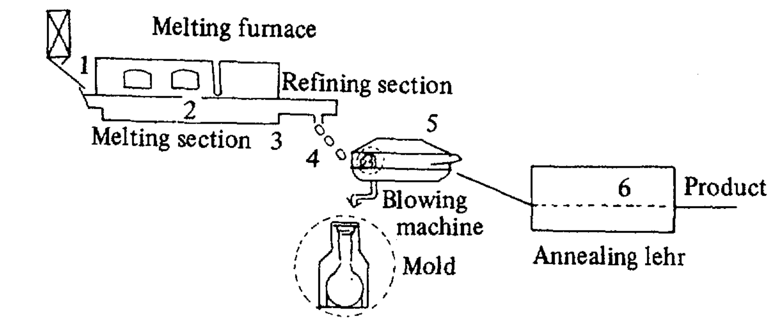
In this process, diverse products including bottles, tumblers, jars and electric bulbs are manufactured depending upon the form of mold in the blowing machine.

Tube Glass Manufacturing Process Flow Sheet



Raw material → Weighing → Mixing → (1) Feeding → (2) Melting → (3) Refining → (4) Drawing → (5) Annealing → (6) Cutting → Inspection → Packaging → Storing → Shipping

Bulb Glass Manufacturing Process



Raw material → Weighing → Mixing → (1) Feeding → (2) Melting → (3) Refining → (4) Gob forming → (5) Blowing → (6) Annealing → Inspection → Packaging → Storing

2) Equipment and Machinery

- Tube glass
  - Crushing equipment
  - Sand refining equipment
  - Raw material storage tower
  - Batch weighing room
  - Mixer
  - Conveyer and elevator
  - Batch feeder
  - Furnace
  - Combustion and controle system
  - Cooling system
  - Feeder (for tube drawing machine)
  - Trough
  - Sleeve
  - Maffle
  - Controle system
  - Annealing lehr
  - Danner machine
  - Cutting and glazing equipment
  - Utility facility
- Bulb glass
  - Crushing equipment
  - Sand refining equipment
  - Raw material storaging tower
  - Batch weighing room
  - Mixer
  - Conveyer and elevator
  - Batch feeder
  - Furnace
  - Combustion and control system
  - Cooling system
  - Feeder (for blowing machine)
  - Spout section
  - Controle system
  - Blowing machine
  - Annealing lehr
  - Utility facility

3) Raw Materials for Tube Glass

Raw materials	Requirement (per ton of product)
Sand	0.6 ton
Limestone	0.1 ton
Dolomite	0.1 ton
Soda ash	0.3 ton
Feldspar	0.1 ton
Others	Small quantity

Example of Plant Capacity and Construction Cost

1) Plant capacity : 10W : 18,000ea/day
15W : 7,000ea/day, 30W: 15,000ea/day
40W: 15,000ea/day 8.2ton/day,
2,800ton/year
* Basis : 24 hours/day, 340 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$3,614,800
o Utility facility	:	US$1,776,600
o Installation cost	:	US$ 584,800
Total	:	US$5,976,200

3) Required Space

o Site area	:	4,400 m^2
o Building area	:	6,700 m^2
o Other	:	34,400 m^2
Total	:	45,500 m^2

4) Personnel Requirement

o Manager	:	1 persons
o Engineer	:	16 persons
o Operator	:	83 persons
Total	:	100 persons

Glassware Making Plant

This technology covers the whole range of manufacturing process for glassware, which breaks down to bottles, tableware and crystal glassware.

Included in glass bottles are food containers, liquor bottles, soft-drink bottles and pharmaceutical bottles, while tableware include cups, kitchenware, ashtrays and the like. Crystal glassware include cups, kitchenware, ashtrays and other accessories.

The licensor of these products is rich in experiences of erecting manufacturing plants with its own technology which is already officially authorized by Coca Cola and Pepsi Cola. It places particular emphasis on further developing new products on the basis of accumulated production know-how coupled with highly-skilled technical personnel over the past 25 years since starting its business in this field.

Contents of Technology

1) Process Description

After removing foreign matters and pieces of iron contained in the raw material, it is weighed in proportional mixing ratio with auxiliary material. Then the mixture is processed into molten, refined glass in the furnace at the temperature of approximately 1,500°C. It is molded by bottle forming machine and cooled slowly and uniformly in the annealing furnace. Going through inspection, the annealed product is packed and delivered. When necessary, the bottle is automatically printed in ceramic colors by multi-color decorating machine. After glazing, it is inspected for delivery.

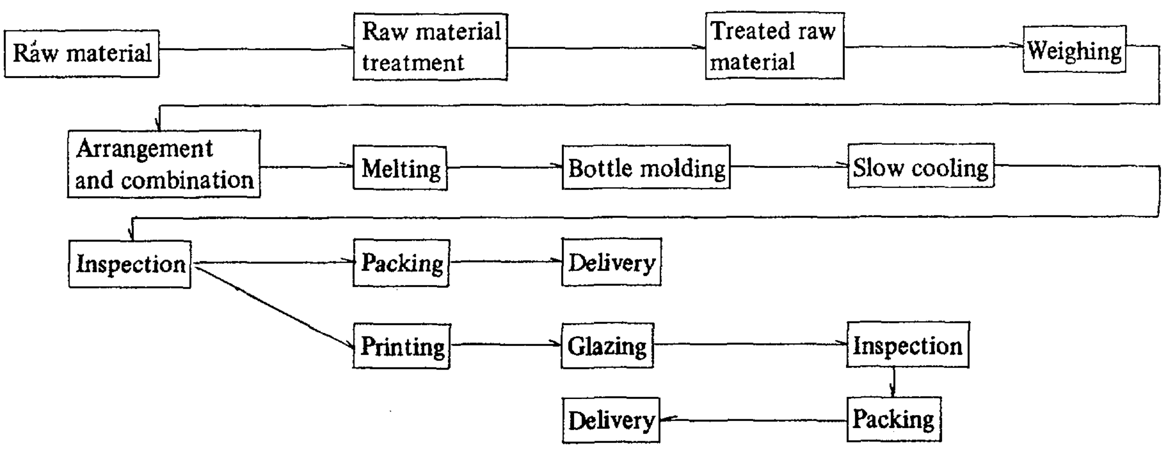
2) Equipment and Machinery

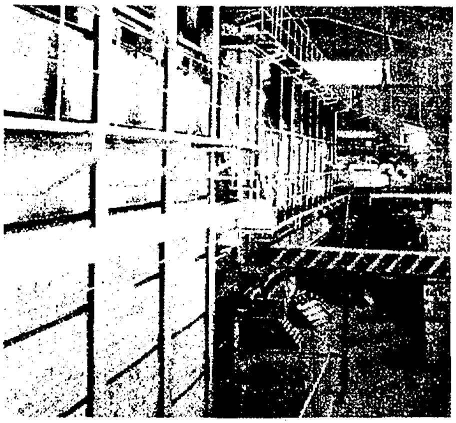
Batch plant
- Cullet treatment equipment
- Sand treatment equipment
- Limestone treatment equipment
- Silo loading equipment
- Weighing equipment
- Mixing equipment
- Conveyers
- Storage hoppers
- Batch charger
- Dust collector

Pelletizing and shrink-wraping
- Pelletizer
- Shrink-wrapper
- Box
- Pallet

Utility
- Electric installation
- Bunker-C oil system
- LPG system
- Boiler

Bottles and Tableware Manufacturing Process Block Diagram





Furnace
Refined raw materials are processed into molten glass at a super- high temperature of about 1,500°C

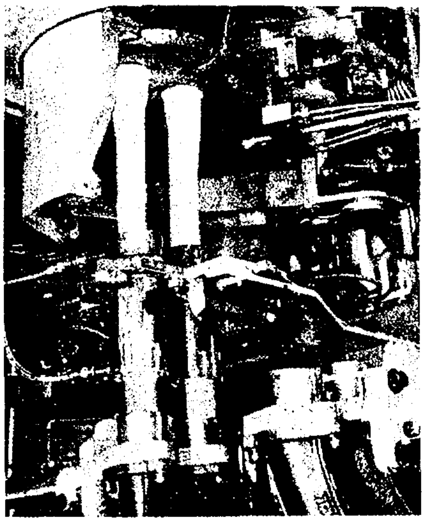
Cooling water
Generator
Compressor

Laboratory and quality control equipment
Spectro photometer
Preston density comparitor
Polarizing microscope
Standard sieves
Optical pyrometer
Softening point apparatus

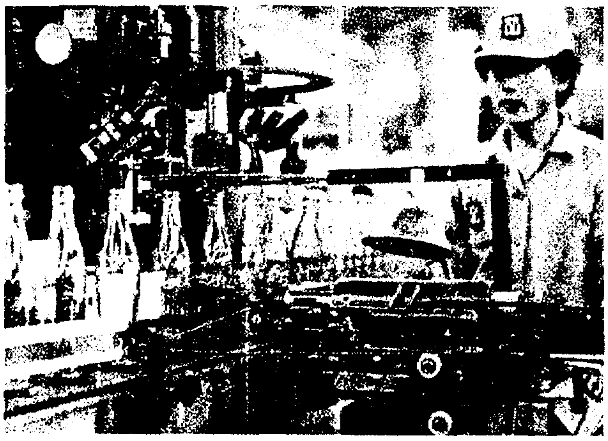
Machine shop equipment
Drill
Lathe
Mold polishing machine
Grinder
Welder
Blasting machine

3) Raw Materials and Utilities

Raw materials and utilities	Requirement (per ton of product)
Silica	610 kg
Limestone	168 kg
Soda ash	192 kg
Broken glass	170 kg
Additive materials	32 kg
Ceramic colour	0.5kg
LPG	30 kg
Bunker-C oil	150 ℓ
Electric power	200 kwh
Steam	350 kg
Water	2 ton
Compressed air	25 m^3



Feeder
Proper glass gobs for forming are mechanically fed to the bottle-making machine.



Inspection
Finished products undergo a strict examination by expert inspectors to check that they conform with a 50-point list of standards.

Example of Plant Capacity and Construction Cost

1) Plant capacity :
   (1) Designed capacity of furnace: 80m/t/day
   (2) 2 straight feeder attached 2 six section double gob I.S M/C
   * Basis : 24 hours/day, 350days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$ 7,200,000
o Utility facility	:	US$ 2,700,000
o Installation cost	:	US$ 1,500,000
Total	:	US$11,400,000

3) Required Space

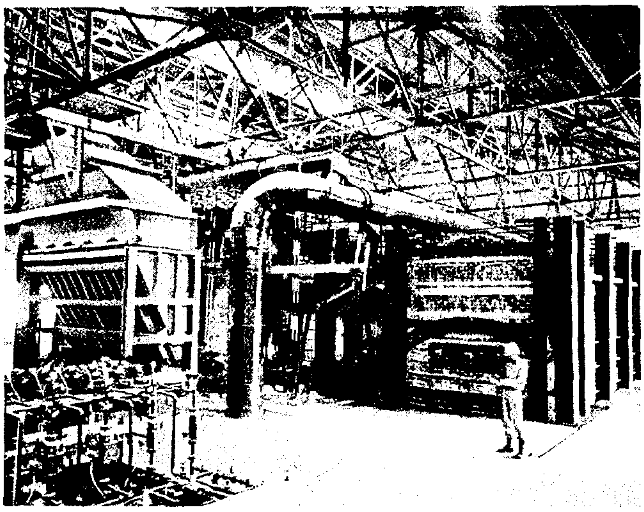
o Site area	:	33,000 m^2
o Building area	:	10,000 m^2
o Other	:	23,000 m^2
Total	:	33,000 m^2

4) Personnel Requirement

o Manager	:	5 persons
o Engineer	:	10 persons
o Operator	:	100 persons
Total	:	115 persons

FILE: L-9
ISIC: 3620

Sheet Glass Making Plant


View of Sheet Glass Plant

As the society becomes more civilized, the weight glass occupies also increases. Particularly, the modernization in architecture and westernization in life pattern have greatly expanded the sheet glass market, also increasing the demand for such high-quality glasses as large-size sheet glass and thick heavy-duty glass.

Besides these, the high-rise buildings resulting from the concentration of population in urban areas and rapid development of means of transportation due to the car industry combine to greatly enlarge the market for such special glasses as reinforced glass and heat-absorbing glass.

Viewed from the aspect of industrial development, in the meantime, the sheet glass industry can be said to be linked to the maximization in the utilization of such available resources as sand and limestone of a country. In particular, in the case of underdeveloped nations, the sheet glass manufacturing is one of the important key industries to be cultivated for the national industrialization.

The sheet glass plant to be introduced here is based on Pittsburg process, which is most suitable when having in mind the first sheet glass production or a small or medium plant in scale. It is characterized by a long life of machinery and quick production speed to ensure high productivity. It also facilitates production of thick heavy-duty sheet glass as well as high-quality glass.

Products and Specifications

In this plant, the clear sheet glass, tempered glass and heat-absorbing glass on the basis of soda-lime glass products are manufactured.

Table 1. Products and Its Uses

Items	Special features and uses
Clear sheet glass	2mm to 12mm, For windows, green house, show cases, mirrors, etc.
Tempered glass	Free from fragility and hazard. For safety uses in automobiles, *steamships*, aquariums, larger windows, etc.
Heat absorbing glass	Suitable for colorful and comfortable interior conditioning. For modern buildings, patio doors, hospital windows, ships, high-grade cars, etc.

Table 2. Specifications of Sheet Glass

Clear sheet glass			
2mm	3mm	5mm	5mm Large
24 x 36	36 x 72	48 x 72	36 x 96
24 x 30	36 x 60	48 x 60	60 x 72
18 x 36	32 x 60	36 x 72	72 x 72
16 x 32	36 x 52	36 x 60	48 x 96
12 x 36	24 x 60	32 x 60	60 x 96
	30 x 50	36 x 52	72 x 96
	24 x 48	24 x 60	72 x 84
	24 x 36	30 x 50	84 x 84
	20 x 36	24 x 36	84 x 96
		24 x 30	
		18 x 30	

Remarks: Various cut sizes are available from 6mm to 12mm on buyer's orders.

Heat absorbing glass and thick clear sheet glass		
Thickness (mm)	Maximum size	
	Inch	mm
5	84 x 120	2,134 x 3,048
6	84 x 120	2,134 x 3,048
8	84 x 108	2,134 x 2,438
10	84 x 96	2,134 x 2,438
12	84 x 96	2,134 x 2,438

The tempered glass is produced by heating a superb quality sheet glass first to its softening point and quenching both sides to strengthen with cooling air, having the strength several times greater than that of ordinary sheet glass against a strong shock, heavy load or sudden change in temperature. Should it be broken, it is shattered momentarily to extremely small particles with no edge due to its strong cracking energy, thus preventing damages to be caused by pieces of broken glass.

The heat-absorbing glass is manufactured by adding some additives to the soda-lime glass and is stained whitish or bronzy. Absorbing more visible rays, infrared rays and ultraviolet rays than ordinary glass, the heat-absorbing glass assures pertinent temperature, lighting and comfortable state. When used, it plays the role of reducing air-conditioning load in summer and preventing the drop of room temperature in winter.

Uses and specifications of the products manufactured in the plant at present are shown in table 1, table 2 and table 3.

Table 3. Specifications of Tempered Glass

Shock resistance

	Tempered glass			Ordinary flat glass	
Thickness	5	6	8	5	6
Average drop hight	3.0	3.5	4	0.5	0.7

* Shock resistance tested by dropping a 225g steel ball on 30cm x 30cm flat glass.

Heat resistance

Full tempered			Zone tempered		
Item	Thickness	Critical temp. diff.	Item	Thickness	Critical temp. diff.
Tempered glass	6mm	250°C	Tempered glass	6mm	555°C
Ordinary flat glass	5mm	60°C	Ordinary flat glass	5mm	150°C

Strength under concentrated load

Item	Ordinary flat glass	Tempered glass		
Thickness	5	5	6	10
Concentrated load	7	28	41	114

Fragment test

Item	Flat tempered	Bending tempered
Pieces	65	45

* KS L2002

Contents of Technology

1) Process Description

(a)Clear sheet glass and heat absorbing glass

The ordinary sheet glass is produced by the vertical drawing method. Its manufacturing process consists of appropriately weighing respective specified raw materials and feeding uniformly the mixed batch into the furnace by appropriate means.

The batch is melted by heating system, and the molten glass is homogenized as it slowly flows through the refining vessel, and then its viscosity gradually drops, and the molten glass, with pertinent viscosity suited for drawing, reaching a tank.

This molten glass is drawn by a drawing machine installed at the end of the tank. From one to four drawing machines are installed depending upon production scale.

The drawn glass ribbon is supported by rotating rolls as it continues to be drawn. It is slowly cooled and cut when completely cooled down. After cutting to required sizes, it is delivered as finished products.

In this type of drawing, refractories called "draw bars" are immersed in the molten glass in the pit and it is so arranged that the molten glass around the draw bars is drawn. Unlike Fourcault type, there is no deterioration of quality due to reduced function of refractories and service life of the draw bars is semi-permanent with high operation rate of the plant. Stained glass can also be produced by this type of process.

(b)Tempered glass

There are three processes for manufacturing tempered glass depending upon types of products. There are namely B.T.S. (Bending tempered single) tempering furnace (Sagging process), press tempering furnace and F.T.C. tempering furnace. In case of B.T.S. tempering furnace, the installation is relatively simple and appropriate for tempering large-size curved surface, while it is difficult to mold accurate curved surface and characterized by a slow production speed.

In case of press tempering furnace, it is continuous with high productivity and is capable of tempering both plane surface and curved surface. This type is used when products are small in sizes.

In case of F.T.C. tempering furnace, it is also continuous with high productivity but is capable of tempering only plane surface.

o B.T.S. (Bending tempered single)

In pretreatment process, the clear glass is cut to necessary forms and the cut surface is polished to be washed and dried. The pretreated glass is placed on a frame tailored to required form of curved surface. It is placed together with the frame in a furnace to be heated by electric heating system up to its softening point.

The glass heated to the softening point is remolded on the same curved surface of the frame after sagging down in the frame by its own load. The glass thus molded is taken out of the furnace and quenched by blowing air to achieve the tempering in the molded form.

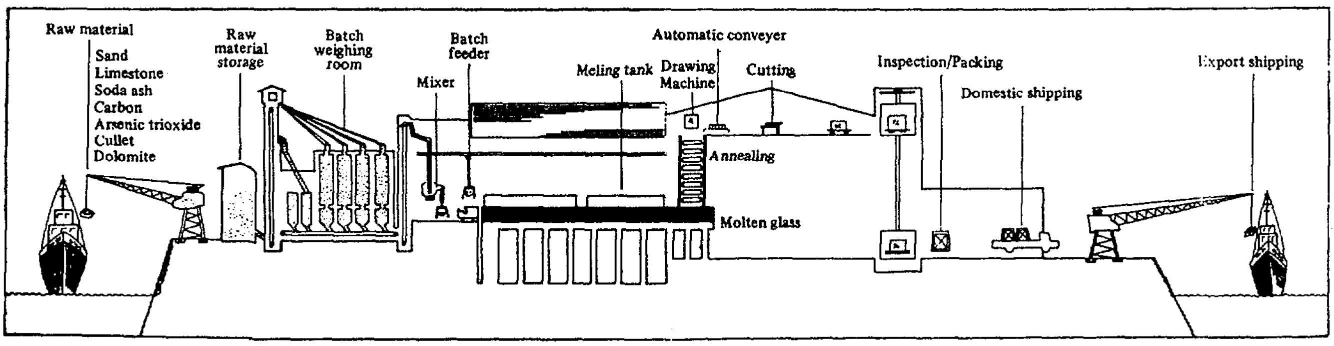
o Press type tempering

The furnace with an electric heating system consists of three sections. The pretreated glass is heated respectively in these sections by the first, second and third heatings to its softening point. After pulled out of the furnace, it is pressed by the die with a mold of required curved surface to be molded. It is quenched in the subsequent process, thus being made into tempered, curved surface glass.

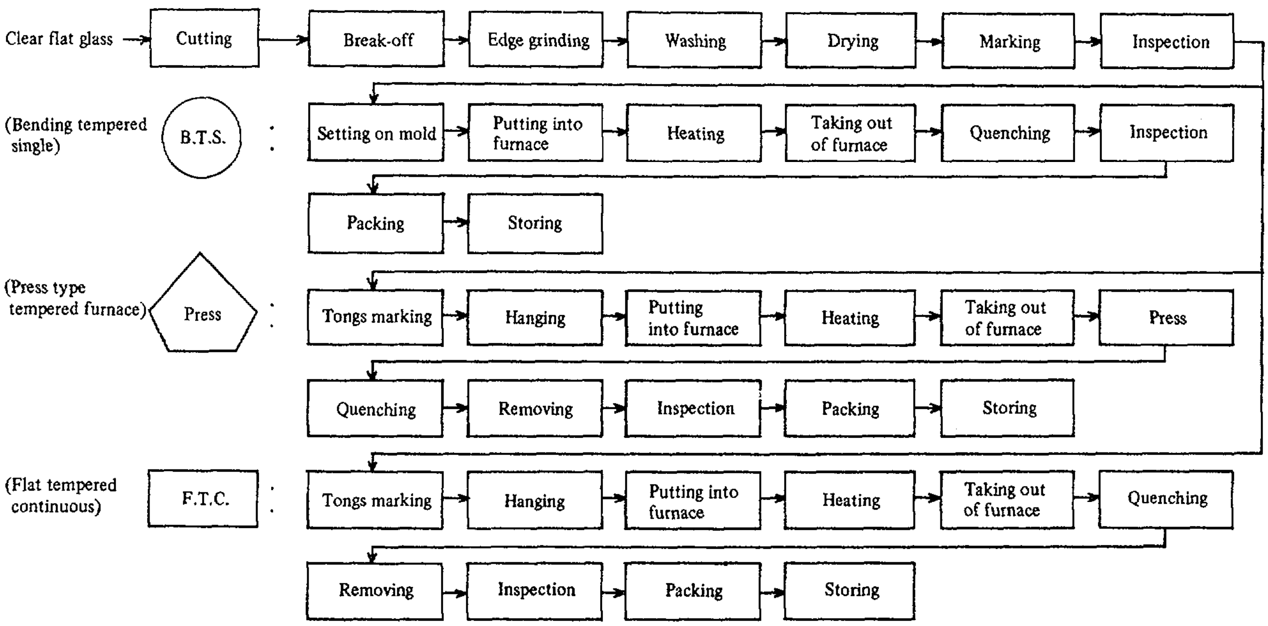
Such processes are continuous. The pretreated glass, hung in a trolley, enters the furnace and heated through three sections to be molded on a curved surface and quenched.

Merely hung in a trolley, it is tempered through

Sheet Glass Manufacturing Process Flow Sheet



Tempered Glass Manufacturing Process Block Diagam



continuous processes. Plane surface tempering is also possible.

o F.T.C. (Flat tempered continuous)
Being a continuous system similar to the press tempering process, F.T.C. tempering furnace has two heating sections. This is designed for only the plane surface tempering.

2) Equipment and Machinery

- o Clear sheet glass plant
  - Crushing equipment
  - Sand refining equipment
  - Raw material storage tower
  - Batch weighing room
  - Mixer
  - Conveyer & elevator
  - Batch feeder
  - Furnace
  - Combustion & control system
  - Cooling system
  - Debiteuse & draw bar
  - Drawing machine
  - Cutter
  - Laydown machine
  - Transporting conveyer
  - Shipping elevator
  - Inspection equipment
  - Utility facility
- o Tempered glass plant
  - B.T.C. tempering system
  - Press tempering system
  - F.T.C. tempering system

3) Raw Materials

Raw materials	Requirement (per ton of product)
Sand	0.9 ton
Limestone	0.1 ton
Soda ash	0.2 ton
Dolomite	0.2 ton
Others (salt cake, arsenic trioxide, etc.)	Small quantity

Example of Plant Capacity and Construction Cost

1) Plant capacity : 50ton/day, 17,000ton/year
  * Basis : 24 hours/day, 340 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$14,633,000
o Utility facility	:	US$12,661,000
o Installation cost	:	US$ 4,455,825
Total	:	US$31,749,825

3) Required Space

o Site area	:	3,600 m^2
o Building area	:	14,200 m^2
o Other	:	38,900 m^2
Total	:	56,700 m^2

4) Personnel Requirement

o Manager	:	2 persons
o Engineer	:	23 persons
o Operator	:	228 persons
Total	:	253 persons

M

FILE: M-14
ISIC: 3691

HOW TO START MANUFACTURING INDUSTRIES

BRICK FACTORY

Bricks are used in the building trade for the construction of various projects. Along with wood and stone, they were used in building already in the ancient world. Their utilization expanded rapidly in the 12th century, but especialy in the 19th century, when Hoffmann invented the rotating kiln. Since then, bricks have remained the most widely used products of the ceramics industry. There are several kinds of bricks, depending on purpose: common wall bricks of standard dimensions (25 x 12 x 6.5 cm); according to strength, there are bricks class I, class II and highly burned bricks. Clinker bricks are made from a better material, which is partly sintered. Light (porous) bricks are made from common materials with addition of sawdust, coal or tailings. Hollow bricks are manufactured in various shapes and dimensions; they are light and have good insulating properties. Brick products also include roof tiles.

The basic raw material for fabrication of bricks is clay which composition and properties can be very different. Brickyards are usually built in the vicinity of the clay excavations. Excavation and transportation of raw material depends upon actual conditions for each plant.

PROCESS DESCRIPTION

Brick manufacture involves several operations, depending on the kind of bricks made. Certain types of bricks can only be manufactured from a particular kind of clay.

The production process consists of the following phases:

1. Raw material excavation and transportation
2. Preparation of the raw material (grinding and mixing)
3. Brick shaping
4. Transport of semi-finished products
5. Drying of semi-finished products
6. Burning of semi-finished products
7. Classifying and packing the finished product.

The process begins with the excavation of clay. The excavated clay is inserted into the box feeder that ensures

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uniform and continuous feeding; raw material is partly wetted.

Clay is transported from the box feeder to the roller crusher where it is wetted again, crushed and mixed. Clay is transported on a conveyer from the roller crusher to differential rollers where it is further crushed.

Upon crushing the raw material is conveyed to the vacuum press with mixer where further mixing and final wetting is carried out. Clay is conveyed from mixer to the press vaccum chamber where air is extracted (in order to obtain a more compact mix). It is extruded into the moulded clay batch that is cut by automatic cutter into raw product of wanted dimensions. The product is conveyed to the batch drying chamber, by double deck car driven by an electric motor.

The drying process is based upon blowing-in of warm air and expelling of humid air with intensive fanning. The dried semi-finished product is conveyed on a carrier to the kiln. Bricks are baked with fuel fed through the openings at the top of the flame chamber; in the kiln the bricks rest in place while the flame travels in a circle. Upon completion of baking the finished product is transported to the location for storage where the preliminary sorting is made.

For drying and baking procedure coal, crude oil or gas can be used as technological fuel depending upon set requirements. In selection of technologies the type of fuel must be decided upon first, because the entire equipment selection dependes on it.

In the manufacture of bricks the production process proceeds continuously the year round.

PRODUCTION CAPACITY

The capacity of the plant offered amounts to 20,000 - 25,000 t/year, or 8 - 12 million bricks of conventional shape, depending on the range of products.

Based on: 8 h/day and 300 day/year.

REQUIRED MACHINERY AND EQUIPMENT

I t e m	No.
Dredge bucket	1
Bulldozer	1
Dump trucks	2
SD-8 box feeder	1
Conveyer (apron or belt)	1
Roller crusher	1
Fine differential rollers	2
Vacuum press with mixer	1
Conveyers	5
Semi-automated equipment for brick cutting, composing and transportation to drying kiln	1

Equipment for drying-kiln (ventilators, shelves, etc.)

Additional heat sources for drying-kiln

Furnace equipment; equipment for heating; flue gases removal system; system for removing surplus heat from drying-kiln; for the kiln

Transformer station; control boxes; electric motor supply network

---

FOB price for machinery and equipment approximately 1,050,000 US dollars.

REQUIRED RAW MATERIALS

The quantities of raw materials depend on their kind and moisture and the variety of products, and range from 30,000 to 35,000 t/y, or approximately 1.5 t/t of finished product.

REQUIRED MANPOWER (for two shifts)

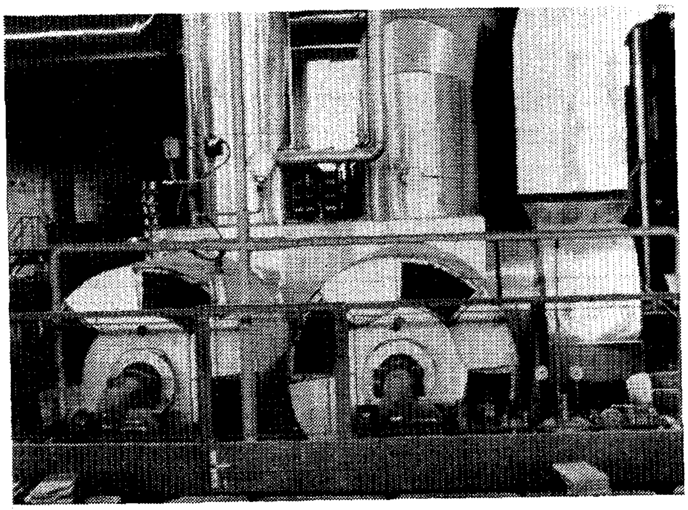
Semi-skilled workers	35-40
Engineers/technicians	2- 3
TOTAL:	37-43

REQUIRED UTILITIES

- Electric power: about 25 kWh/t of products
- Technological fuel for drying and burning: 2,000,000 - 2,300,000 kJ/t of product
- Water: envisaged consumption is for technological, sanitary and fire-fighting needs 0.2 to 0.5 t/t of product, depending on climatic conditions, habits, etc.

REQUIRED AREA FOR PLANT SITE

Altogether about 3,000 sq.m. (including the rotating kiln shop and auxiliary premises).



BRICK PRODUCTION BLOCK DIAGRAM

EXCAVATED CLAY

↓

WETING IN BOX FEEDER

↓ conveyer

ROLLER CRUSHER
(with wetting)

↓ conveyer

DIFFERENTIAL ROLLER
(particles 3-4 mm)

↓ conveyer

FINE DIFERENTIAL ROLLER
(particles 1,5-2 mm)

↓

VACUUM PRESS WITH MIXER
(air removal)

↓

EXTRUDING AND FORMING
(clay removal)

↓

BRICKS CUTTING

↓

DRYING

↓

BRICK-KILN
(furnace)

↓

COOLING

↓

STACKING AND CLASSIFYING

FILE: M-15
ISIC: 3699

CONCRETE BLOCKS FACTORY

Stone and bricks can be successfully replaced by concrete elements (blocks). Great hardness, resistance to atmospherics and a simple production process are only a few advantages of concrete blocks which rank them among greatly appreciated materials for the construction of buildings and industrial and other projects.

The products are hollow blocks of various dimensions (according to moulds mounted on vibrating presses).

The basic raw materials used in the manufacture of concrete blocks are cement and aggregate of various grades.

PROCESS DESCRIPTION

The plant includes:

1. Concrete batch plant with the capacity of 18 m^3/h
2. Mobile equipment for moulding of concrete blocks of different shapes (self-propelled vibration press with the capacity of 15 m^3/h)
3. Auxiliary equipment for transportation of raw concrete mix from the location of preparation to the moulding equipment for blocks and equipment for transportation of finished dried blocks to the temporary storage of finished goods.

Gravel and broken rock material is transported by dumpers from the excavation site to the starlike distributor of four aggregate fractions. Aggregate fraction is separated at the place of exploitation. The scraper with an arm for aggregate feeding is mounted on the starlike distributor. The scraper is mounted on the turning support so that it can feed the dump piles located in a fanlike fashion around the turning support. The aggregate is feeded by a conveyer belt of special construction. Outpouring of the aggregate from the starshaped distributor is interrupted pneumatically.

Concrete is prepared in the concrete batch device. Maximally six types of rock material and two types of cement can be used. In special circumstances it is possible to use more types of cement.

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Concrete is mixed in a vertical forced high capacity mixer. Cement is stored in telescopic cement silo. At the bootom section of the silo there is an opening fo the outpouring of cement and corresponding connection to the screw conveyer. Filling of the silo with cement is completed pneumatically from the cement-carrying container. The cement blasting equipment is located at the top section; the device for spraying is located in the silo. The plant with the capacity of 18 m^3/h has two silos with the capacity of 50 t.

Cement is transported to the precise scale located above the mixer. The scale chamber is opened by hydraulic cylinder.

Water is fed to the mixer over the contact watermeter and controlled by the electromagnetic valve.

Fresh prepared concrete mix outpoured from the mixer is taken by the fork-lift trucks with mounted hydraulic buckets and conveyer to the self-propelled novable vibrating press for manufacturing of blocks. Dried blocks are transported from the batch site to the storage by fork-lift trucks.

The work of the concrete plant is supervised by means of the control panel; one operation cycle lasts 3-4 minutes.

PRODUCTION CAPACITY

1,100 unit/h
15 cu.m./h or 105 cu.m./day of liquid concrete
31,500 cu.m/year, which corresponds approximately to 65,000 t/year.

This production capacity has been calculated on the basis of work in one shift, with 7 h/d of effective work and 300 working days a year.

REQUIRED MACHINERY AND EQUIPMENT

I t e m
1. A concrete plant, capacity 18 cu.m./h, consists of:
- Forced high-capacity mixer
- Aggregate feeding automatic scale
- Cabinet feeding automatic scale
- Water feed meter with electric magnetic control
- Starlike distributor with four sections
- Belt conveyer
- Electric control cabinet (assures programme control of the process)
- Scraper with arm for aggregate feeding
- Screw conveyer
- Telescopic cement silos
- Cement fluidization device
2. Fork lift truck with mounted hydraulic bucket

3. Self-propelled vibrating press
4. Dump truck
5. 150 kWA electric power generator

FOB price for machinery and equipment approximately 230,000 US dollars.

REQUIRED RAW MATERIALS

For 2,400,000 concrete blocks a year: 56,700 tons of aggregate a year, or 23.6 kg of aggregate/unit, 11,025 t cement/year or 4.6 kg cement/unit.

REQUIRED MANPOWER

Semi-skilled workers	20
Technicians	2
	TOTAL: 22

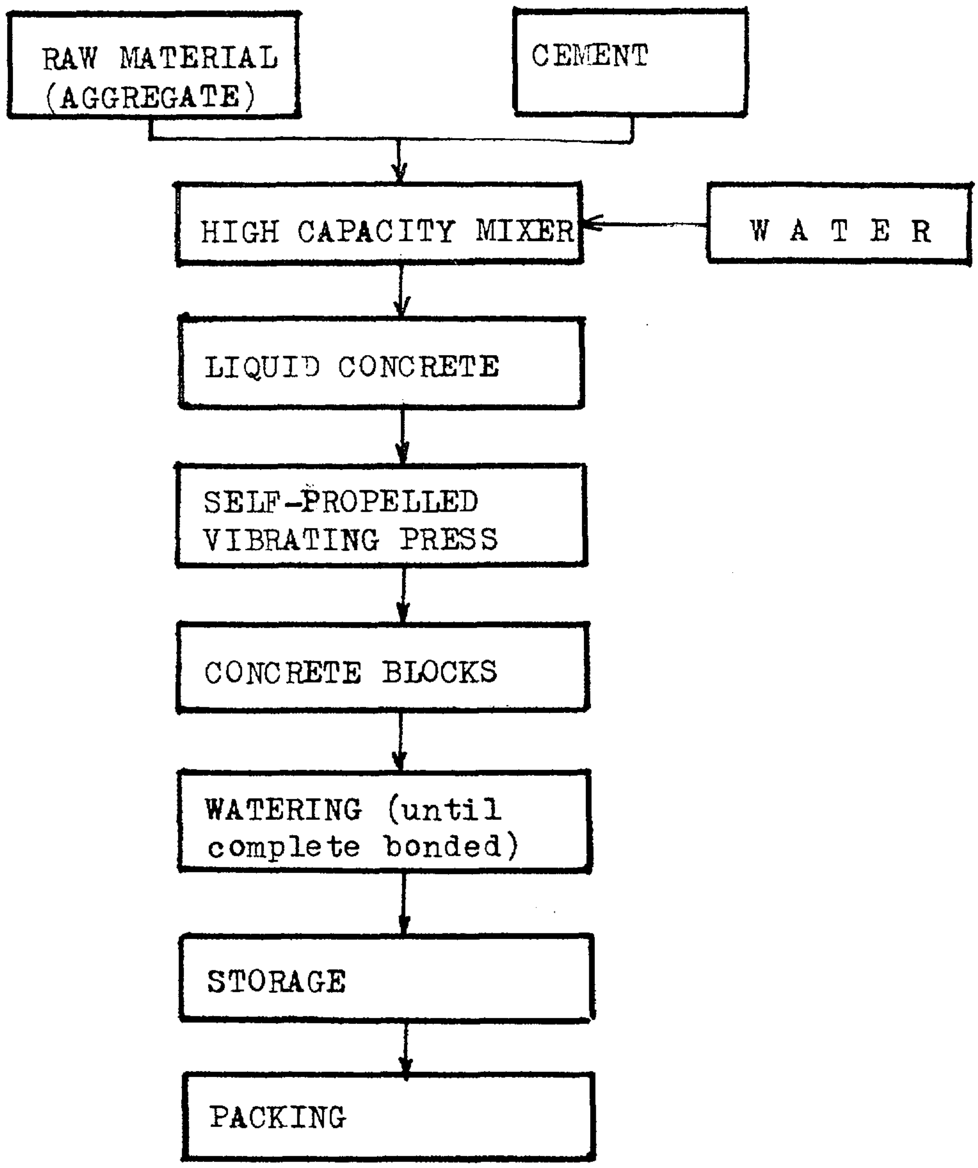
REQUIRED UTILITIES

Electric power	1.8 kWH kg/t of product
Fuel oil	1.33 kg/t of product
Technological water	0,5 t/t of product

REQUIRED AREA FOR PLANT SITE

A total of about 8,000 sq.m. is required, which includes a plateau, a storehouse, a site for raw materials, a liquid concrete plant, an auxiliary building, etc. The working area should be concreted.

FLOW SHEET FOR CONCRETE BLOCKS MAKING PLANT



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FILE: O-24
ISIC: 3819

HOW TO START MANUFACTURING INDUSTRIES

STEEL BUILDING MATERIALS

The requirement for quick and high quality assembly and dismantling of prefabricated houses has induced the development of industrial production of panels for roofing, outer and dividing walls, ceilings as well as for various kinds of connecting components. These allow for a wide range of combinations in the assembly. Their use premits the assembly of one or two floor units by the application of a modular system with dimensions 1x1 meters and a variation of size and internal lay-outs of units which depend on the designed use of the house.

PROCESS DESCRIPTION

The production process is composed of the following subprocess:

- panel production
- steel structure elements production
- sheet-metal profiling
- production of connecting elements

The panel producing process uses molds for producing three types of panels designated as "TR", "PU" and "PS" panels. The thermal isolation in all three types of panels is made of hard polyurethane foam 30-50 mm thick.

The "TR" type panels have an outer layer of profiled and lacquered varnished steel and the inside is made of chip--board and connected plates.

The "PU" and "PS" type panels have an outside and inside layer of connected chip-board plates or of some other processed wood plates. The profiling process line produces "TR TRIMOTERM" and "TP 38/750 TRIMOVAL" plates.

For all four process' production is continuous. The designed technology allows for the production of 150 000 sq. m. of panels which are sufficient for the construction of 500 single floor houses of the type TH-80 (80 sq.m.) which are compossed of four rooms, kitchen and bathroom with an inside area of 76 sq.m. and a 10 sq. m. covered terrace. The dimensions of the house are 8x10 meters and the inside height is 2.45

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meters. The assembly of the houses is simple and quick which implies low construction costs.

Houses of the TH-80 type represent only one way in which the products of the described process can be used.

PRODUCTION CAPACITY

The yearly production capacity, calculated on the basis of a 8 hour day and a 250 day year, is 150 000 sq.m. of panels.

REQUIRED MACHINERY AND EQUIPMENT

I t e m	No.
1. Panel producing line	
- sheet depot	8
- crane	1
- beam with vacuum holders	1
- beam for crane	1
- beam with hooks	1
- moulds for panels	2
- machine for applying polyurethane	1
- transporter with rollers	1
- saw	1
- system for the regulation of the cutting length	1
- tools for profiling	2
2. Sheet-metal profiling, "TR TRIMOTERM" and "TP 38/750 TRIMOVAL" profiling line	
- machine with rollers for profiling sheet-metal	1
- sheet-metal cutters	1
- transporter with rollers	1
- command panel	1
- tools	2 sets
3. Steel structure elements production line	
- welding machine	1
- machine cutters, 500 kN	1
- punching machines, SB 4	3
- cutting machines	3
- excentric press	1
- transformers for welding, 13 kVA	8
- welding aggregates, 11.5 kVA	12
- manual drilling machines	3
- 46 m transporter with rollers	1
- worker's stools	14
- benches with working plans	11
- baskets for components	8
- manual grinding machines	6
- grinding machine	1
- set of handtools	8

- tool cupboards	14
- universal plane	1

4. Production of plastic connecting elements

- complete production line for PVC profiles with tools	1 set

FOB price for machinery and equipment: approx. 999.500 US dollars

NOTE: The price does not include: - construction of buildings, - required utilities (electricity, gas, air, water), - transporters (fork-lift trucks, crane), - costs of transport and assemply, - materials, raw materials and energy for experimental production, know-how, personnel training.

REQUIRED RAW MATERIALS

- galvanized and painted sheet-metal, 0.6-0.7 mm thick	1000 t/y
- polyurethane	130 t/y
- chipboard 4, 10, 18 and 25 mm thick	2800 m^3/y
- soft wood, juniper	400 m^3/y
- PVC granules	200 t/y
- metal-sheet, steel profiles, screws	700 t/y
- welding materials	20 t/y
- anticorrosion protection coatings	20 t/y

REQUIRED MANPOWER

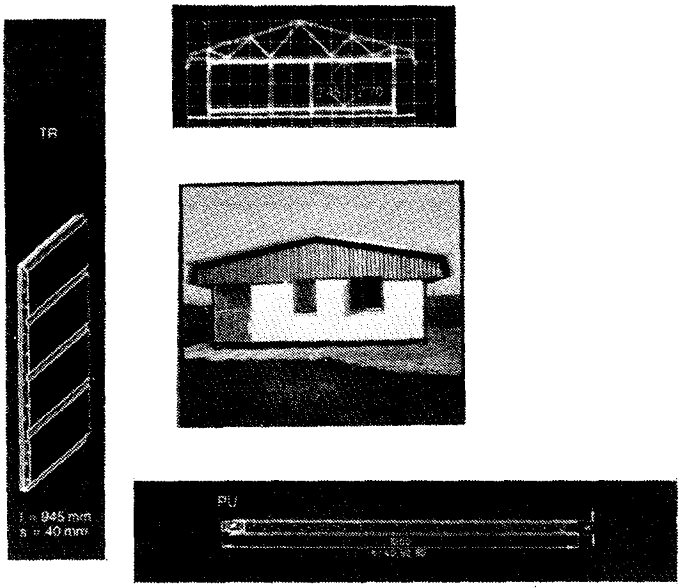
University graduates	8
Skilled or on-the-job trained workers	118
Total labour requirement	126

REQUIRED UTILITIES

Electric energy	829 000 kWh/y
CO_2 (gas)	16 000 l/y
Oxygen	11 650 l/y
Buthane	3 350 l/y
Water (technological)	787 m^3/y

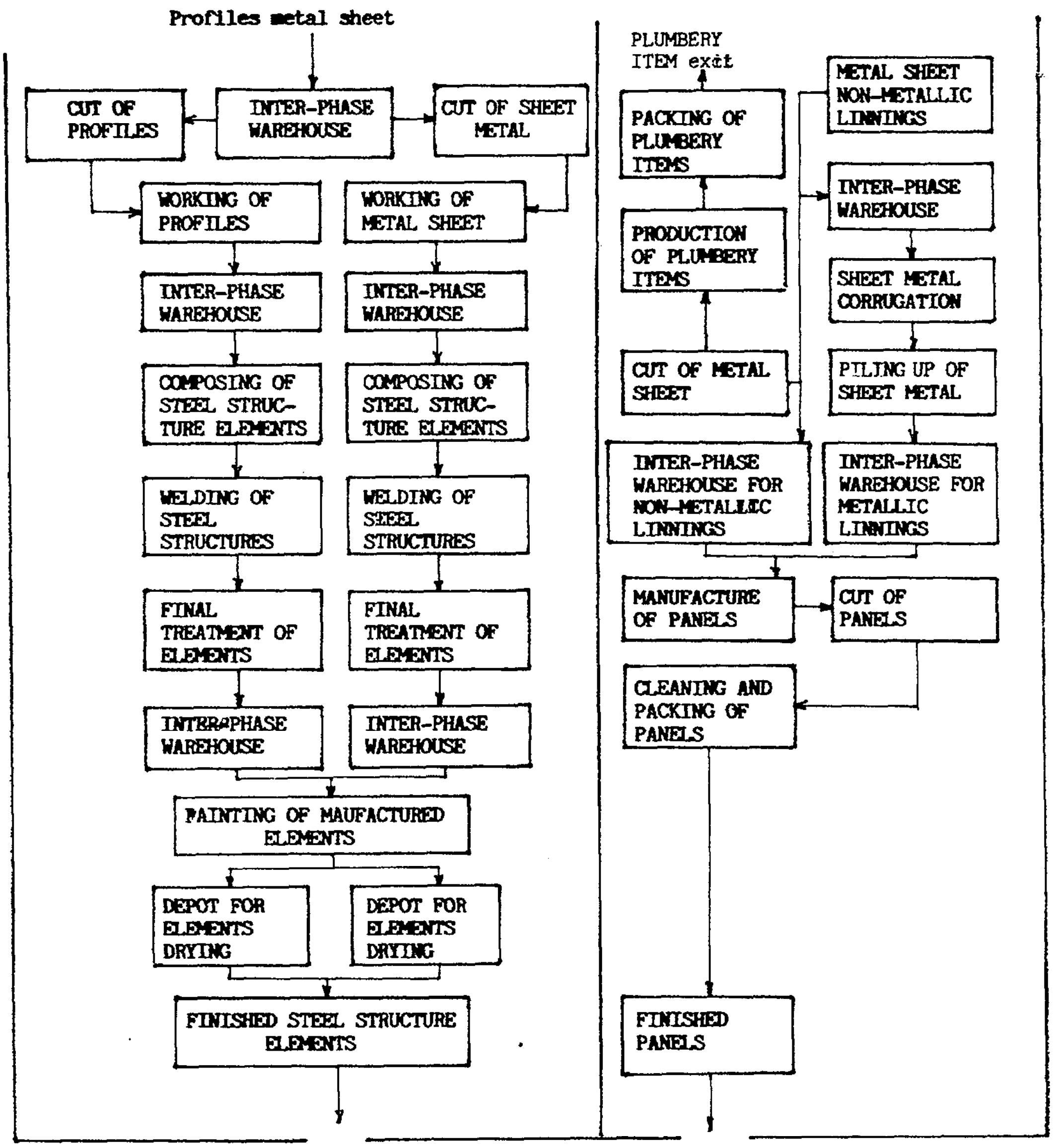
REQUIRED AREA FOR PLANT SITE

The plant, warehouse, offices and other premises require a total area of 6 400 m^2.



PANELS FOR RESIDENTIAL HOUSES ASSEMBLING

**ELEMENTS FOR RESIDENTIAL BUILDINGS PRODUCTION
BLOCK DIAGRAM**



FILE: O-25
ISIC: 3811

HOW TO START MANUFACTURING INDUSTRIES

PRODUCTION OF HAND TOOLS

In the process of producing hand tools, such as carpenters pliers (pincers), adjustable spanners and bench hammers, the first part of the process requires forged pieces of certain sizes. These are the raw materials of the manufacturing process on offer. Depending on the forged pieces the process as its final product produces hand tools of various sizes, i.e.:

- carpenters pliers from 127 to 254 mm
- adjustable spanners of 150, 200, 250 and 300 mm
- bench hammers with weights from 0.15 to 2 kg

The programme can be extended to the production of other hand tools within the given dimensions. The itemized products involve simple final processing which makes it easy to master the process and extend it to other products.

PROCESS DESCRIPTION

The final processing of forged pieces into hand tools of various sizes requires the following operations:

- reception of forged pieces: forged pieces are sorted, and the accompanying documentation completed.
- preparation for machine processing (grinding): forged pieces are ground according to contoures. The final form is shaped and forged pieces are prepared for machine processing.
- machine processing (turning, milling, dragging and polishing): according to constructional documentation, processing is done on the machines according to the given schedule of processing.
- thermal processing (tempering and cooling): it is done according to the procedures intended to give the needed hardness to the tools edge and the toughness to the core, thus assuring long lasting exploitation. The qualities mentioned are attained by induction tempering, and cooling in electric furnace.
- production of handles (wood turning): wood handles for hammers are made, by wood turning procedure.
- assembling (rivetting and locksmiths operations): thermal processing is followed by the process of tools assembling which consists of rivetting of pliers, adjusting of

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cutting edges, putting handles on hammers and assembling of T-wrenches.

- quality control: upon the completion of assembling finished products undergo quality control.
- protection (coating the finished product): coating with water resistant dyes provides corrosion protection, and lengthens the usage of tools.
- storage of finished products: packed in appropriate packages, finished products are sent to warehouse.

In the manufacture of hand tools a batch or a continuous system of production can be used.

PRODUCTION CAPACITY

The capacity is 315 tons a year or approx. 355 000 items. The calculation is based on a 275 day year and a 8 hour day.

REQUIRED MACHINERY AND EQUIPMENT

Item	No.
Horizontal grindstones	4
Turning lathes for metal	13
Milling machines	2
Boring machine	1
Polishing machines	3
Rivetting machine	1
Sanding machine	1
Turning lathe for wood	1
Thermal processing equipment	1
Painting room	1
Machine for cutting the thread on screws	1

The FOB price of the required machinery and equipment is approx. 815 000 US dollars.

REQUIRED RAW MATERIALS

Basic raw materials (forged pieces)	315 t/year
Wood, size 40 x 400	120 m^2/year
Water resistant paint	500 kg/year
Sandpaper: sheets	300 pieces/year
bands	6,500 pieces/year
Oil for tempering	400 l/year

REQUIRED MANPOWER (for two shifts)

Q u a l i f i c a t i o n		No.
Highly skilled workers		4
Skilled workers		30
Unskilled workers		12
	TOTAL:	46

REQUIRED UTILITIES

Electric energy 4 057 kWh per ton of product
or
0.8 tons of special light oil per ton of product
or
1 000 cubic meters of gas per ton of product.

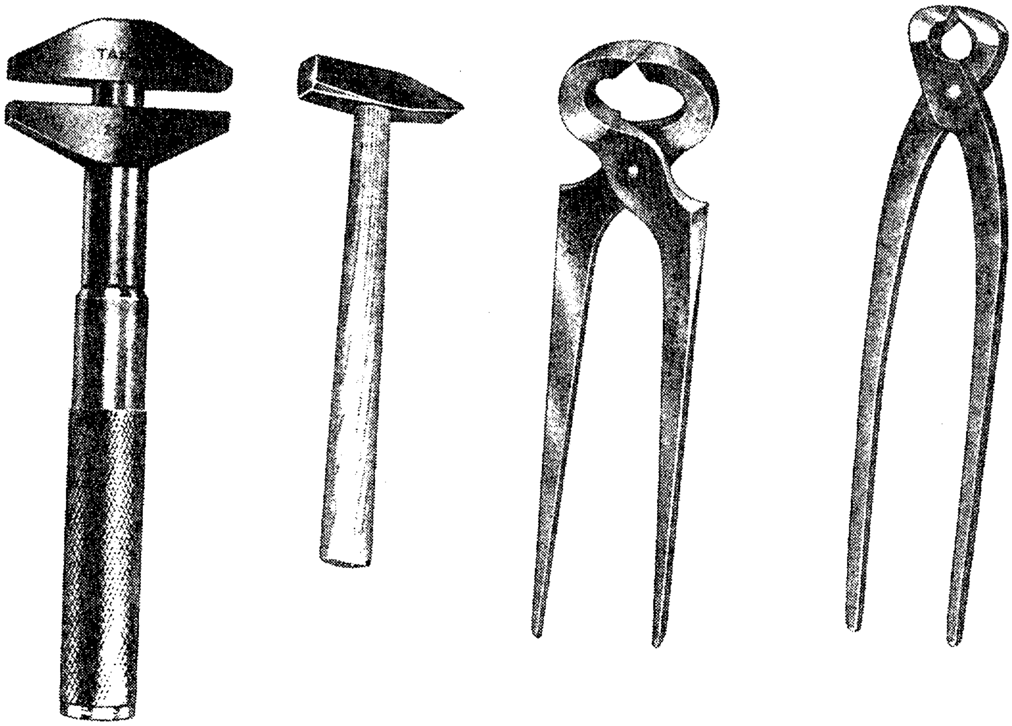
REQUIRED AREA FOR PLANT SITE

The total area required is 600 m^2 which includes the main building, warehouse and accessory buildings.

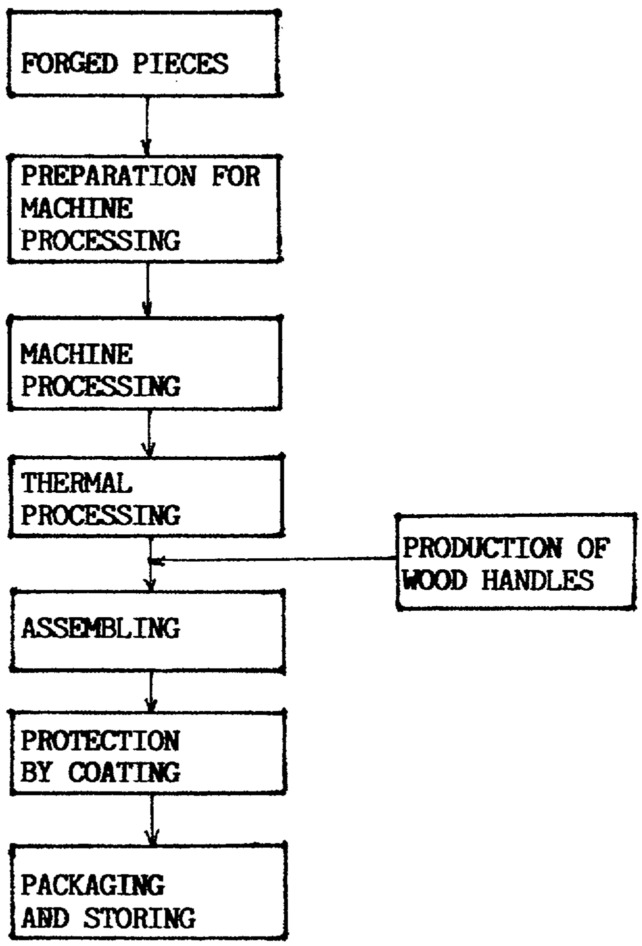
OTHER RELEVANT DATA

The offered hand tool production technology is conceived to ensure several possibilities: completion of equipment provided by the supplier of this technology; permanent technological development by adoption of new products manufacture; supply of semi-manufactured goods guaranteed by the supplier of technology who also figures as a buyer of finished products; joint appearance on the world market.

HAND TOOLS



HAND TOOLS PRODUCTION BLOCK DIAGRAM



HOW TO START MANUFACTURING INDUSTRIES

MANUFACTURE OF STUDDED TUBES

Studded tubes are nowadays often utilized in the manufacture of power generating and processing equipment. They are actually the steel tubes with a large number of iron studs welded onto their external surface. The studding increases the surface of tubes over which the heat is transferred so that consequently the equipment fitted with studded tubes is of smaller and lighter design. This becomes particularly significant in case of ship boilers. This equipment must be of smaller and lighter design, so that more space is left for useful cargo. In the past the finned tubes were used instead of ordinary tubes in the process of manufacture of ship boilers. Originally fins had been wound round the tubes and subsequently welded onto the tube structure. Nowadays the ship boilers are for the most part fitted with the studded tubes with studs closely packed together. The stud diameter is 5-8 mm while the distance between the studs is 11-15 mm in radial and axial direction.

The boilers of 20 t/h steam output are fitted with approximately 50-70 tubes 1000-2000 mm long and 200 mm in diameter. This means that for instance in the boiler-room of a big utensil there are tubes with 700,000-1.000,000 welded studs. Considering this number of studs the studding procedure should be fully automated.

Presented technology includes a brief description of a simple and cost efficient manufacturing of studded tubes by electric resistance welding.

PROCESS DESCRIPTION

After unloading the iron tubes by the fork-lift truck (carrying capacity of 2 t; it can be used for transportation of tubes inside the plant as well) and after subsequent quality and quantity control the tubes are placed in the roofed werehouse or in a lay-down area. Tubes may be unloaded also by a portal crane of adequate carrying capacity.

Prior to the beginning of manufacture the tubes have to be mechanically cleaned by grinding tools or if feasible, by

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sand-blasting. Tubes are cut to required size by a plane saw. The head sides of tubes are processed with the machine for head lathing.

The studs can be manufactured either in the (own) plant, by means of special automatic press or procured from another manufacturer. Prior to feeding to the automatic studding equipment the studs have to be degreased. Degreasing is completed in the rotating drum by means of sawdust.

Individual tube, when cleaned and processed in the above described procedure, is placed on the automatic studding equipment; a number of studs is put into the welding heads connected to the transformer with flexible lines. The type and dimensions of tubes, the number, type and dimensions of studs as well as their density depend upon the requirements specified by the customer. After pressing the stud points onto the tube, the current of great intensity is fed over a short time so that a homogeneous welded joint is obtained. The procedure is fully automatic and continuous.

Upon customer's request the studded tubes can be processed for anticorrosive protection. This operation is completed in a separate section of the shop or in a separate facility.

At the end of the production cycle the studded tubes undergo visual inspection.

In the manufacture of studded tubes a continuous system of production is used.

PRODUCTION CAPACITY

The annual production capacity is 500 t of studded tubes. The projection is based upon 16 hours work day (two shifts) and 300 work days per year.

MACHINERY AND EQUIPMENT

I t e m	No.
Studding equipment	1
Automatic studs press	1
Fork-lift truck	1
Head lathing equipment	1
Stud degreasing drum	1
Vertical grinding equipment	1
Plane saw	1

FOB price of equipment is approximately 500,000 US dollars.

REQUIRED RAW MATERIALS

I t e m	Quantity
Iron tubes	250 t/year
Ring iron	250 t/year

REQUIRED MANPOWER

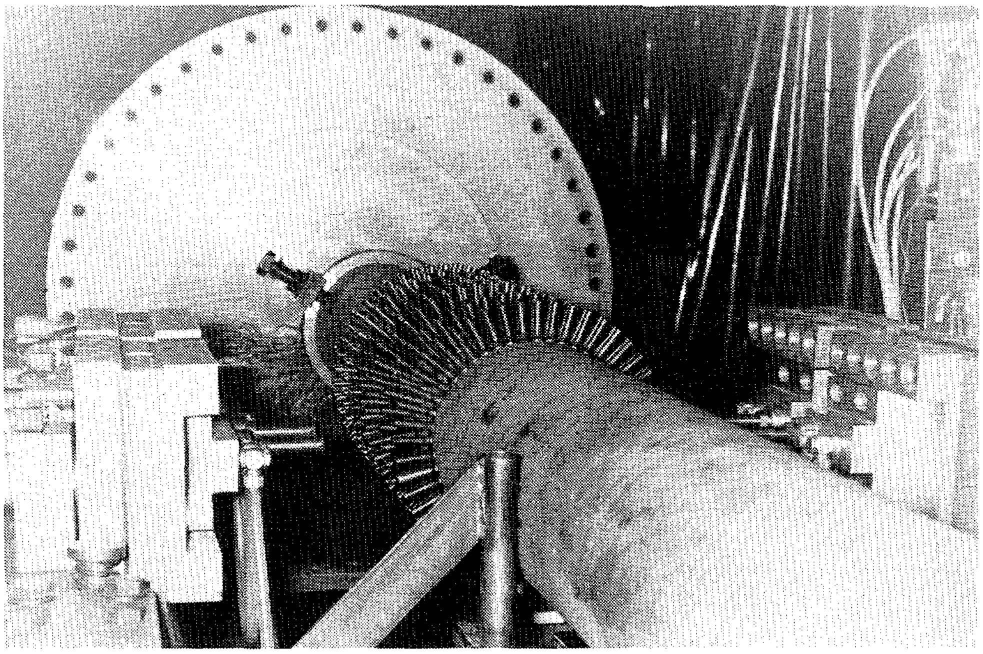
Qualification	No. of personnel (1 shift)
Secondary school qualification	1
Semi-skilled workers	1
TOTAL:	2

REQUIRED UTILITIES

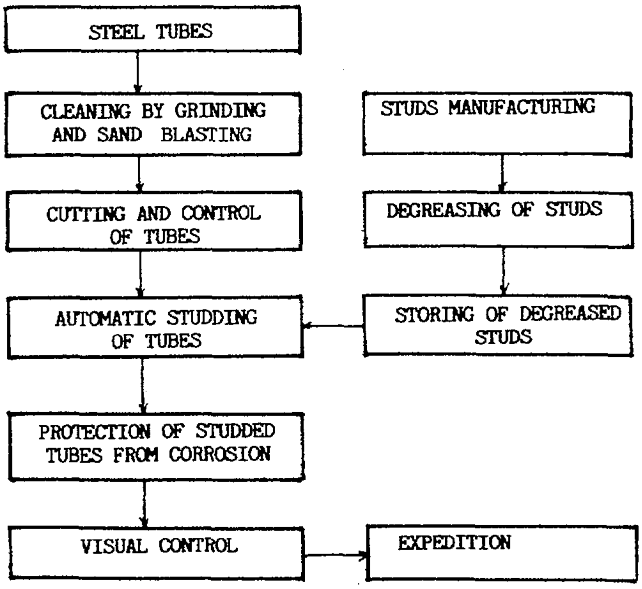
Electric power	700 kWh/t of product
Compressed air	200 m^3/t

REQUIRED AREA FOR PLANT SITE

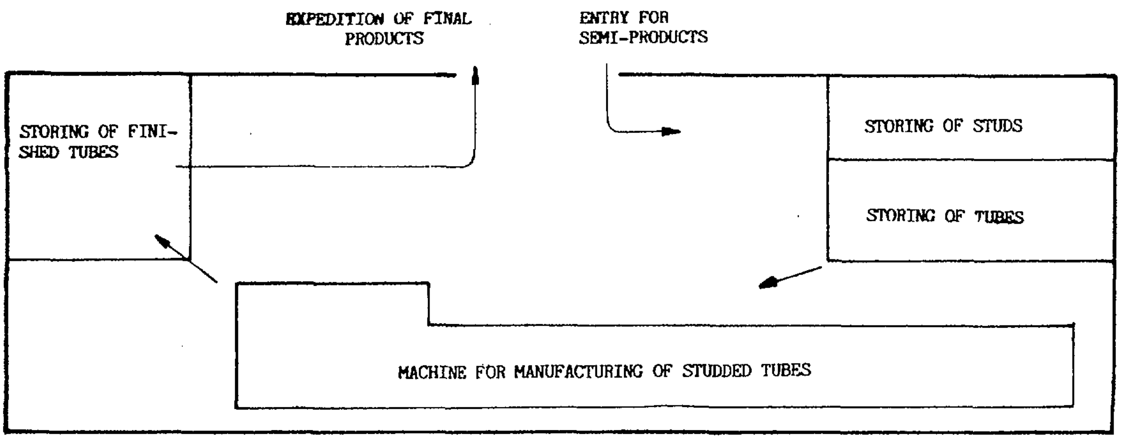
The total area for the plant site of approx. 500 m^2 is required including the production area of 50 m^2, a werehouse for finished products of approx. 24 m^2, and storage for raw materials of approx. 48 m^2.



STUDDED TUBES MANUFACTURING BLOCK DIAGRAM



LAYOUT FOR STUDDED TUBES MANUFACTURING PLANT



HOW TO START MANUFACTURING INDUSTRIES

MANUFACTURE OF LOCKS

Locks for all types of doors, from interior to entrance or balcony doors as well as ancillary parts are considered for production. The lock must grant secure and easy opening and closing of doors. The manufacturer is required to construct the lock that shall serve the purpose over the years without any difficulties or special maintenance. For this reason the exposed parts of the device are protected from adverse impact of climatic conditions; steel or iron parts are protected by galvanizing or paint coating that extend the life of the device and add additional quality to its design.

The particular technology refers to the manufacturing of mechanical fastening devices for doors. The assortment shall depend upon the current housing standards, current standards for locksmith articles for carpentry items, schedules of housing projects and adaptation projects. The offer refers to the technology of manufacturing of six types of mechanical locks, that may be of interest to the manufacturer.

The entire technology covers: A) the shop for manufacturing of original models of universal locks and B) galvanizing plant. The galvanizing plant many be used for zinc coating of other iron items.

PROCESS DESCRIPTION

The six universal mechanical locks, that may be of interest to the manufacturer are as follows:

Original model No. 1	8 cm universal lock with tumbler bits for the key (item 17.15)	100,000 items/year
Original model No. 2	8 cm universal lock for cylinder casing with lever (item 17.17)	100,000 items/year
Original model No. 3	6.5 cm universal lock (item 17.00)	600,000 items/year

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Original model No. 4	6.5 cm universal lock for cylinder casing (item 17.01)	100,000 items/year
Original model No. 5	6.5 cm universal lock for cylinder casing with lever (item 17.06)	100,000 items/year
Original model No. 6	6.5 cm universal lock with closed locker (device for toilets and bathrooms)	100,000 items/year

These six original models refer to the locks designed for entrance doors and interior premises; locks for entrance doors are protected from unauthorized operation/access with safety cylinder bits.

The technological process for the selected original models of locks has been elaborated based upon the existing procedures. The manufacturing shop required for this line of products is organized in the following manner:

a) production of mechanical parts
b) storage of semi-products
c) assembly line and packing
d) assortment line and dispatch

These functional units however are not separated by walls or panels, what ensures the possibility of maximal straight-line movement of the material. Only the drums for mechanical cleaning of casted parts and grinding of sharp edges are located in separate hall because of noise caused by rotating parts in drum.

The entire assortment of locks may be obtained by essentially the same manufacturing procedure. It consists of the following operations:

1. Preparation of material, cutting
2. Moulding
3. Finishing of parts
4. Assembling of components
5. Galvanization
6. Assembling of locks
7. Quality control
8. Packing

The technological process starts with delivery of iron material from the consignment storage to the workshop where the material is processed. The workshop equipment ensures processing: bending, cutting, and cold forming of materials by adequate tools for selected items. Upon completion of cleaning in drums the semi-finished items are obtained that are assembled in semi-products. After galvanization, final assembling and quality control the finished products are packed in adequate boxes.

PRODUCTION CAPACITY

The production capacity is based upon the processing of 800 tons of iron yearly or. 1.000,000 items yearly.

Computing base: 8 hours work day, 269 work days year

MACHINERY AND EQUIPMENT

A) LOCKS MANUFACTURING SHOP

I t e m	No.
Eccentric presses 100 to 125 t	4
Eccentric presses 63 t	6
Eccentric presses 32-60 t	6
Friction press 75-80 t	1
Eccentric presses 10-20 t	3
Point welding machine	1
Electro-pneumatic rivetting machine	11
Boring machine	4
Grinding machine	1
Pressure casting machine, 40 MP	1
Fork-lift truck	3
Turning lathe self-acting units	4
Hardening furnace	1
Endless belt of 0.1-0.6 m per sec	2
Milling machine ALG 200	1
Turning lathe	1
Circular sawing machine	1
Planning grinding machine	1
Tool boring machine	1
Column grinding machine	1

B) GALVANIZING PLANT

Complete automatized galvanizing plant

C) OTHER EQUIPMENT

Compressor station, 4 m^3 per min	1
630 KW Distribution	1

MACHINERY AND EQUIPMENT COST

A) LOCKS MANUFACTURING PLANT (without supports for machinery) approximately US dollars 1.584,000

B) AUTOMATIZED GALVANIZING PLANT - entire line approximately US dollars 800,000.

REQUIRED RAW MATERIALS

I t e m	Quantity
Strip iron	660 t/year
Rod iron	10 t/year
Iron for springs	20 t/year
Zinc alloy for moulds	110 t/year
Other: screws for carpentry and boxes for paking (procured from other manufacturer) approx.	50 t/year

REQUIRED MANPOWER

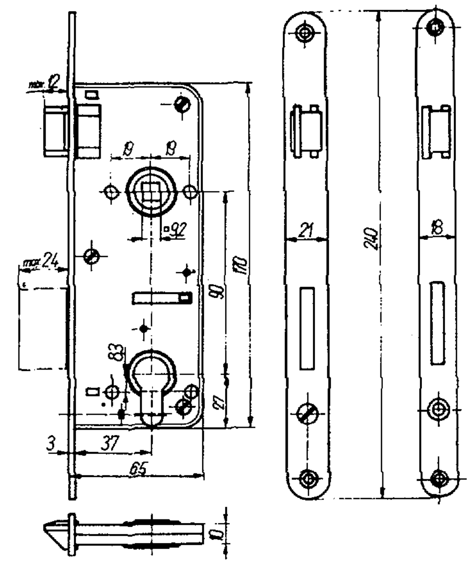
Qualification	No. of personnel
Mechanical engineers	3
Skilled workers (production process)	90
Other employees	up to 26
TOTAL:	up to 119

REQUIRED UTILITIES

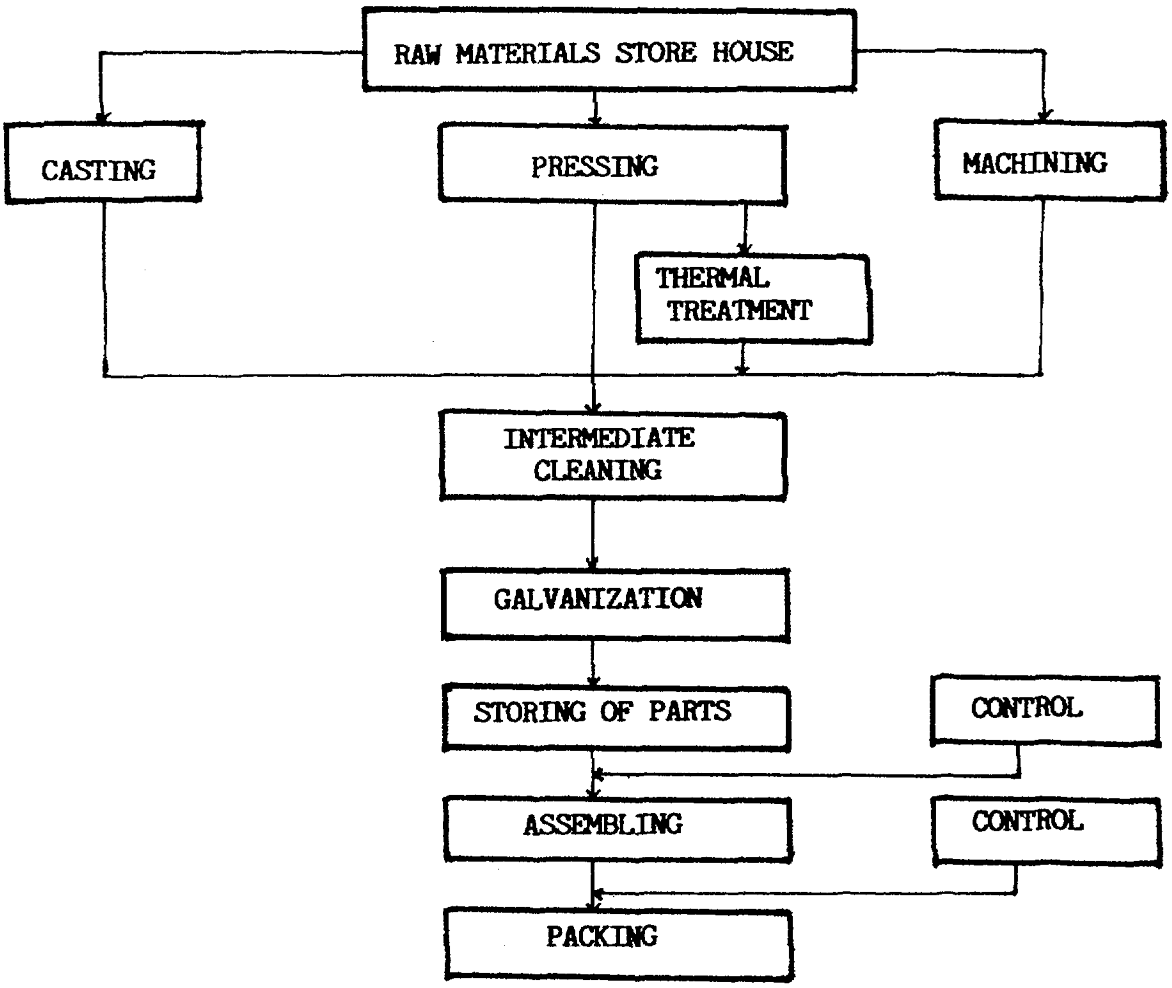
Electric power	111 kWh/t of product
Water	1,3 t/t of product
Compressed air	645 m^3/t of product

REQUIRED AREA FOR PLANT SITE

Total required area for plant site is 1,870 m^2



LOCKS MANUFACTURING BLOCK DIAGRAM



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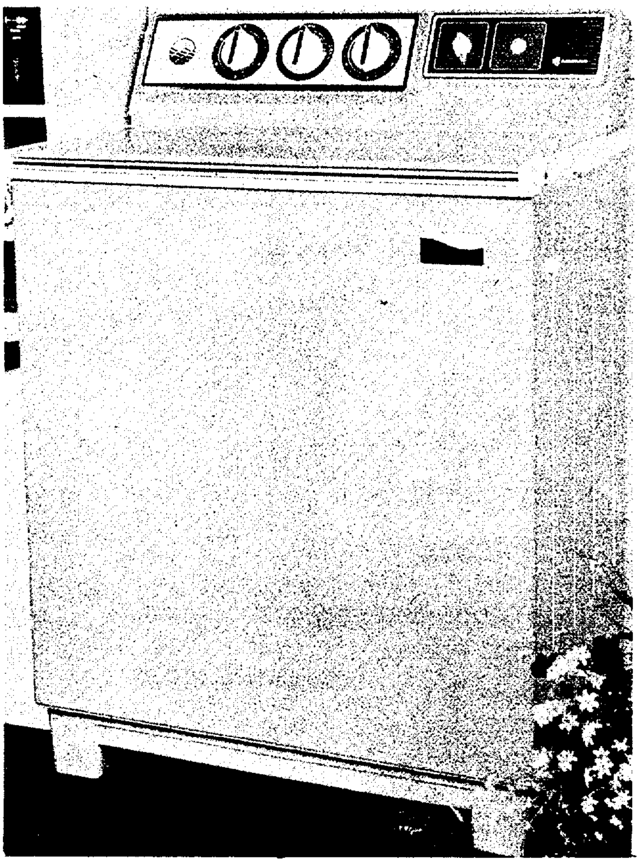
Washing Machine Making Plant



View of Product

With the improvement and change in the living standard, household care and cleaning as well as its maintenance have become an important part of the daily chores, requiring much work on the part of housewives.

It inevitably necessitated the mechanization of household work to help make the life of housewives comfortable and convenient. In this sense of meaning, the electric washing machine can be said to be a machine playing the greatest role in the household work.

It is a machine doing washing by rotating the laundry in the washing vessel with water on a rotating plate. Such an electric machine performs a series of actions of water supply, washing, draining and rinsing making use of a timer and cork.

The washing machine manufacturing plant is a relatively labor-intensive industry which is feasible with no requirement for a sophisticated technology or large investment in facilities. Therefore, it is one of the most promising industries for the economic progress in developing countries.

Products and Specifications

Two types of electric washing machine, respectively 2.3kg and 3.5kg, are manufactured in this plant, however, variations are possible depending upon customer's requirements. In washing method, this product uses the reverse turn whirlpool washing method, while the centrifugal drying is employed in the spin dry method. Its characteristics are as follows:

- According to the quality and kind of laundry, water flow can be properly controlled for normal or heavy flow rate.
- A buzzer rings when washing cycle is completed.
- Spinning basket is stopped by switch and brake when spinning cover is opened.
- Spin dry rate is at least 60 percent.
- Direct ironing of the thin cloth is possible.
- Much lather occurs in rinsing but is easily eliminated.
- Strong steel cabinet with P.E.M. powder coating, and also rustproof and unbreakable stainless steel and polyethylene tubes are used.

Specifications of products are shown in table 1.

Table 1. Specifications of Electric Washing Machine

Power source	All local voltage and cycle	All local voltage and cycle
Capacity	5.1 lbs (2.3kg)	7.8 lbs (3.5 kg)
Washing method	Reverse turn whirlpool washing	Reverse turn whirlpool washing
Spindry method	Centrifugal drying	Centrifugal drying
Water levels	High : 9.51 gal (36 liters) Middle : 8.19 gal (31 liters) Low : 6.84 gal (26 liters)	High : 11.1 gal (42 liters) Middle : 8.45 gal (32 liters) Low : 7.7 gal (28 liters)
Washing motor	Input : 250W, Output: 90W	Input : 350W, Output: 150W
Spindry motor	Input : 110W, Output: 25W	Input : 150W, Output: 50W
Dimensions	Height : 40.2 inch (1,021mm) Width : 28.27 inch (718mm) Depth : 18.27 inch (464mm)	Height : 38 1/2 inch (979mm) Width : 33 7/64 inch (841mm) Depth : 18 7/16 inch (469mm)
Loading quantity	80 sets/20' cont. 166 sets/40' cont.	52 sets/20' cont. 114 sets/40' cont.
Weight (net)	57.3 lbs (26 kg)	74.9 lbs (34 kg)
Tub material	Polypropylene	Polypropylene

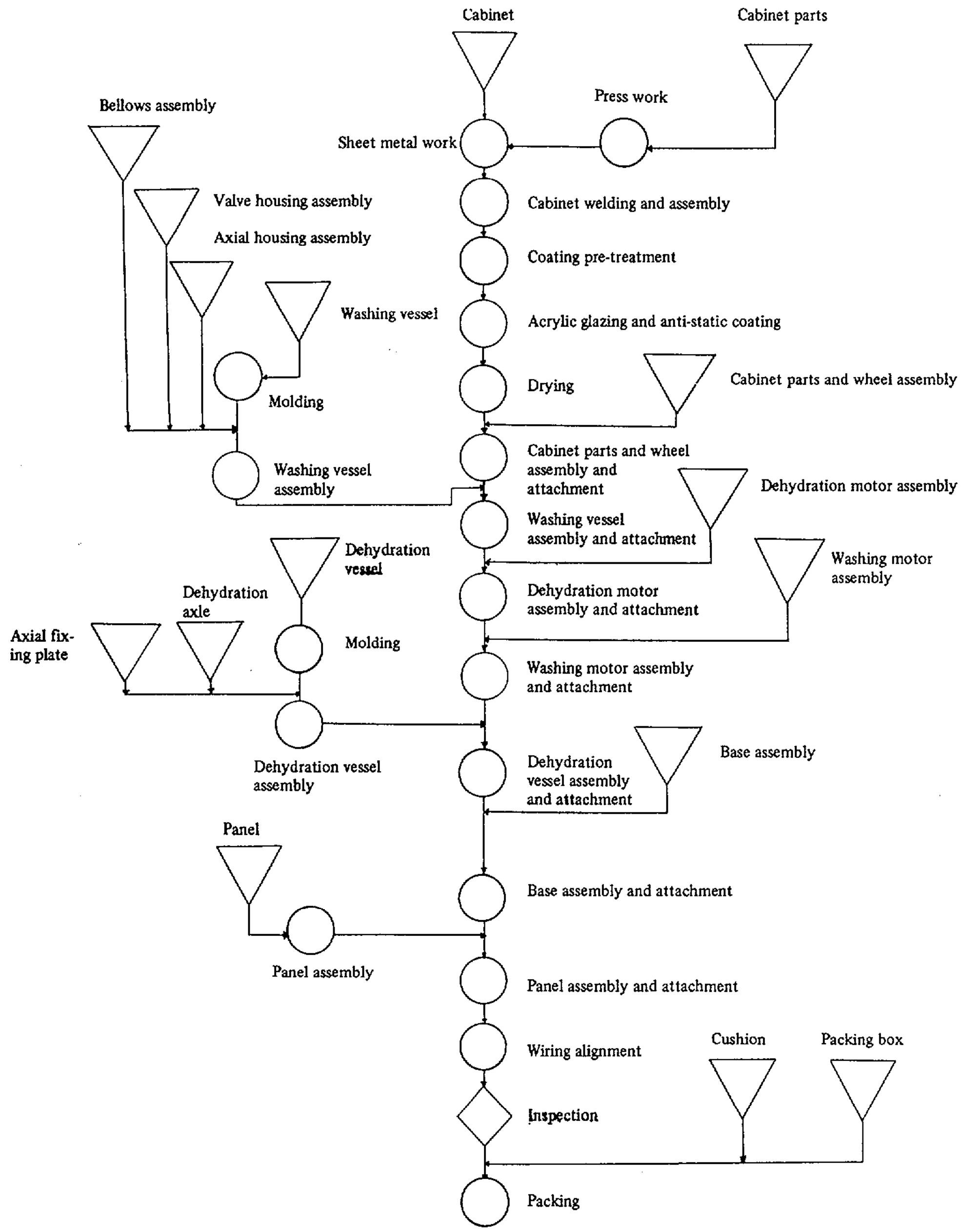
Contents of Technology

1) Process Description

A steel plate first undergoes shearing, notching, piercing, burning, forming and bending to be welded and assembled with press-formed cabinet parts. The cabinet is thus assembled and conveyed on a trolley to the painting line where it undergoes degreasing, coating, demineralized water washing, anti-static painting, glazing and drying. After painting it is transported by the trolley conveyor to the washing machine assembly section. The cabinet is unloaded at the washing machine line for inspection and loaded on the main line conveyor.

The washing vessel is molded in the injection molding room and transported on a trolley to the washing machine assembly section. The washing vessel is assembled and attached to the cabinet. The centrifuge motor, washing motor, centrifuge and panel are also assembled and attached to the cabinet. After wiring and arranging various lead lines, the washing machine is inspected for the appearance, performance and structure prior to packing and banding by an automatic packing machine for delivery.

Electric Washing Machine Assembling Process Diagram



2) Equipment and Machinery

Shearing machine
Oil press machine
Crank press machine
Spot welder
Tapping machine
Slot conveyor
Trolly conveyor
High-speed precision press
Die casting machine
Lathe
Drilling machine
Grinding machine
Heat treatment furnace
Large-size injection molding machine
Motor manufacturing equipment
Power press

3) Raw materials

Raw materials	Requirement (per unit of product)
Steel plate	3.6 kg
Resin	6.5 kg
Silicate steel	5.7 kg
Timer	2 pcs

Note: Based on the product of 3.5kg capacity

Example of Plant Capacity and Construction Cost

1) Plant capacity : 100,000sets/month
* Basis : 8 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$4,000,000
o Utility facility	:	US$1,000,000
Total	:	US$5,000,000

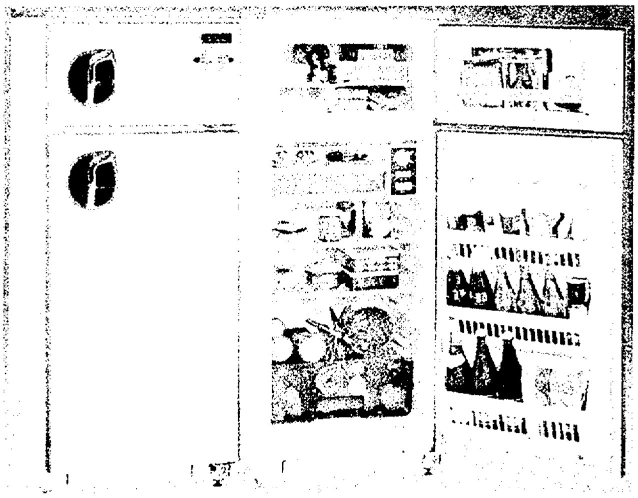
3) Required Space

o Site area	:	20,000 m^2
o Building area	:	8,000 m^2
Total	:	10,000 m^2

4) Personnel Requirement

o Manager	:	6 persons
o Engineer	:	38 persons
o Operator	:	70 persons
Total	:	114 persons

Refrigerator Assembling Plant



View of Product

With the improvement in the living standard, there has been conspicuous changes in the improved dietary life surrounding our living. In particular, the desire to preserve fresh vegetables, fruits and meats in the household and enjoy eating them for a long time is quite natural, necessitating to have refrigerators in almost all individual houses.

As alcohol absorbs the heat of evaporation when evaporating, the refrigerator makes use of the property of absorbing the heat from outside when liquid vaporizes. Such a cooling action is carried out by the refrigeration cycle consisting of a compressor, radiator, capillary tubes and cooler.

The high-pressure refrigerant gas compressed by a compressor radiates its heat when passing through thin pipes of a radiator. The freezer is a small compartment surrounded by the compressor and speciallv closed by a separate door and capable of keeping the temperature as low as -20°C.

It is based on the principle that the naturally formed frost is deforsted by a heater or it is automatically removed because the high-pressure refrigerant at high temperature directly flows to the refrigerator instead of passing through the condenser by means of a change-over cock.

The plant manufacturing such refrigerators requires relatively large investments and high-level technology, but its contribution to the national economy as a result of the investment is not only significant but also enhances the people's living standard.

Table 1. Specification of Refrigerator

Model	Volume (ℓ)	Product dimension (W x D x H)	Net weight (kg)	Gross weight (kg)	40 Ft container (sets)
TR 607	48	18.5" x 19.6" x 18.9"	21	22	384
TR 140	112	505mm x 570mm x 934mm	43	51	128
TR 183 E	167	20.7" x 24.4" x 53.1"	56	65	64
TR 203 E	173	20.7" x 24.4" x 50.4"	57	66	64
TR 232 C	194	520mm x 620mm x 1,437mm	62	71	64
TR 272 C	236	540mm x 641mm x 1,513mm	65	74	60
TR 320 F	294	650mm x 672mm x 1,611mm	76		51

Products and Specifications

Refrigerators produced in this plant range from 48 to 500 liters in capacity including three-door types. They are of European style with the use of clean pipes requiring no cord heater in addition to being economical of electric power.

The refrigerator is characterized by its quick freezing time of only 30 minutes with no frosting as well as by being capable of an automatic control, providing the maximum capacity in a cabinet made of the steel plate with minimum thickness.

Contents of Technology

1) Process Description

The cold-rolled steel plate (SPCC) first undergoes shearing, multi-notching, cold rolling and forming, and bending to be welded and assembled with such press-formed cabinet component parts as a front plate, bottom plate, angle structure and other components into a cabinet.

The cabinet moved by a conveyor enters the coating lines, where it is degreased, coated, washed with demineralized water, pre-dried, coated with anti-static agent for glazing and dried to be moved to the assembly section by a conveyor again.

Interiors are made of the plastic sheet by vacuum forming and further processed for assembly. The back plate is first prepared by pressing and forming, and welded with radiator pipes prior to assembly. It is then coated with acrylic antistatic agent for glazing for further assembly. The freezer and evaporator are argon-welded to be assembled with a cooler, undergoing thorough leak tests by a helium leak tester.

On completion of assembling interiors, cooler, back plate and the like, the cabinet is preliminarily treated with urethane and placed in a preheating furnace. Since the foaming jig is already heated, the urethane liquid is foamed by means of the high-pressure foaming

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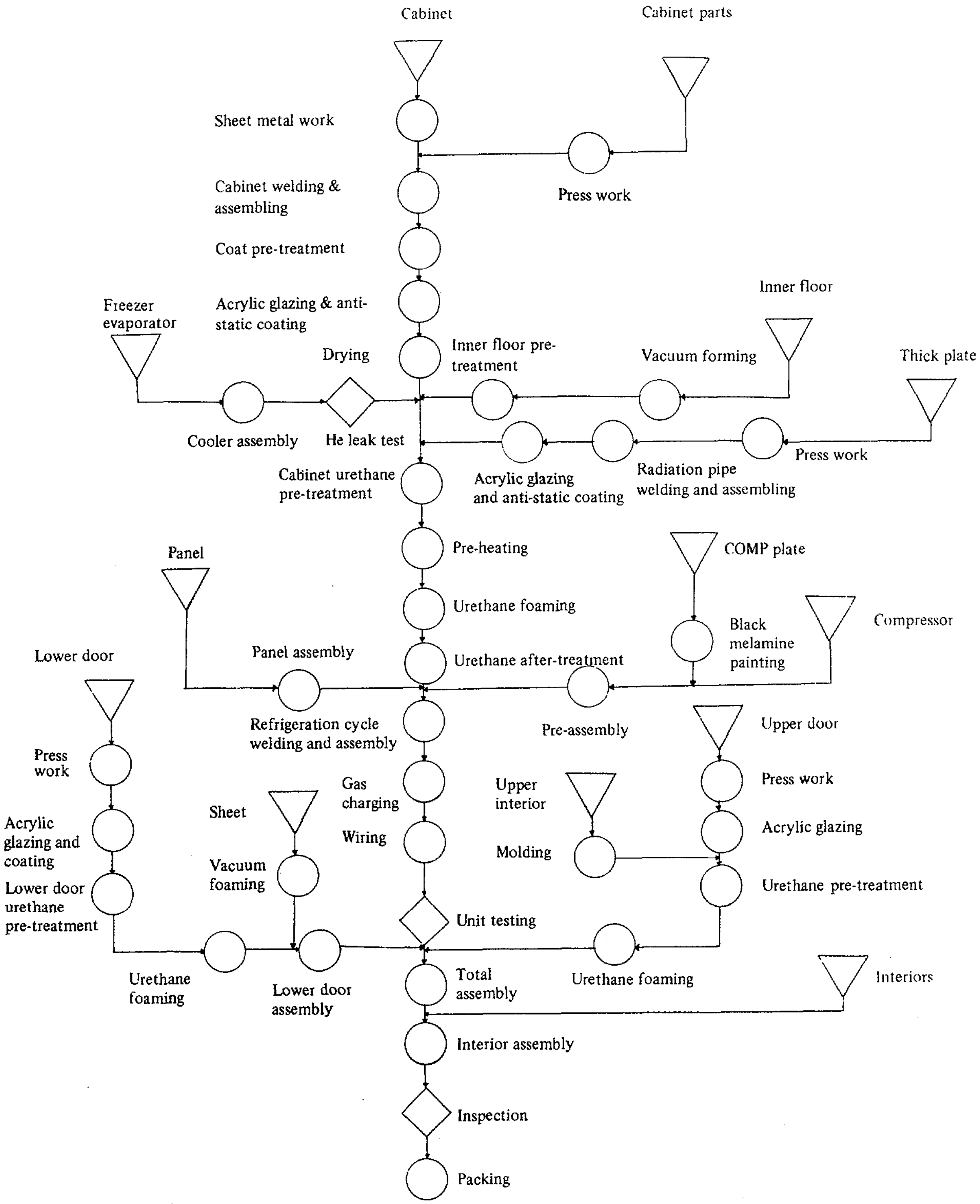
Refrigerator Assembling Process Diagram



device for the cabinet. It is placed then in a cure-heating furnace and assembled with welded refrigeration cycle system along with a compressor.

The welded and assembled refrigerator is vacuum dried and filled with R-12 freon gas to be followed by wiring. In the unit laboratory after the elapse of 20 minutes, the B-point temperature is measured, and deforosting and ampere are confirmed following high-pressure leak tests. A start-up test with 88 percent power source as well as low-pressure leak test are also conducted. The upper and lower doors are press-formed, coated with acrylic resin for glazing. The doors are fixed with inside component parts and also insulated by urethane foaming for the final assembly, and then assembled to the cabinet.

Other component parts are assembled and interiors are inserted prior to such final tests as insulation resistance test, start-up test and leak test. The refrigerator thus finished is packed by an automatic packing machine including PP banding.

2) Equipment anu Machinery

Spot welder
Trolly conveyor
Slot conveyor
Belt conveyor
Tapping machine
Power press
Vacuum forming machine
Urethane foaming
Helium leak tester
Lathers
Die casting machine
Injection molding machine
Grinding machine
Projection welder
Shearing machine
Cold rolled forming machine
High speed precision press
Compressor manufacturing facilities
Painting equipment
Crank press
Oil press
Compressor assembly facilities

3) Raw Materials

Raw materials	Requirement (per unit of product)
Steel plate	2.3 kg
Resin	0.8 kg
Silicate steel plate	5 kg
Urethane A liquid	2.5 kg
Urethane B liquid	2.5 kg

Note : Base on the product of 200ℓ capacity

Example of Plant Capacity and Construction Cost

1) Plant capacity : 60,000sets/month
* Basis : 8 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$1,000,000
o Utility facility	:	US$ 400,000
o Installation cost	:	US$ 500,000
Total	:	US$1,900,000

3) Required Space

o Site area	:	22,000 m^2
o Building area	:	7,600 m^2
Total	:	29,600 m^2

4) Personnel Requirement

o Manager	:	6 persons
o Engineer	:	20 persons
o Operator	:	290 persons
Total	:	316 persons

SIEVE FOR BUILDING MATERIALS

The mobile equipment for sieving building material consists of an inlet hooper and a mobile belt conveyer with wheels and vibrating screen.

The iron net is mounted on the screen body; the net can be replaced by any other suitable screen having holes ranging from 2 mm up to 40 mm. The sieving capacity depends on the mesh and on the granulation of the building material to be sieved.

The belt conveyer can be inclined as required by means of a hydraulic system, the inclination depending on the stockpile or the type of transportation. Transportation on the field can be accomplished by a road truck or by any other vehicle.

A very useful device is the combination of a dumper and a filling separator in which one operator handles the complete system of feeding, sieving and transporting to the place of final utilization.

The complete equipment is mobile and suitable for all types of terrain and materials.

PROCESS DESCRIPTION

The mobile equipment for sieving building material described in this offer has a capacity of 40 m^3 of sieved building material per hour. It weighs 1000 kg and the electromotor power is 6.2 kW. It consists of a sheet metal hooper V=5 m^3, a conveyer 500 mm wide and 15 m long and a vibration sieve 700 mm wide and 2 m long.

Since the mobile sieving equipment consists of three main parts, i.e. a sheet metal hooper, a conveyer and a vibration sieve, production involves the following processes:

1. Hooper construction
- sheet metal cutting with shears
- steel profiles cutting with a crosscut saw
- profile and sheet welding

2. Conveyer construction
- tubes and steel profiles cutting on a crosscut saw

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- structure welding
- belts turning in turning-lathes
- conveyor assembling

The belt drive, the driving drum and the reducer are supplied along with the technology.

3. Vibration sieve construction
- sheet metal cutting with shears
- steel profile cutting with a crosscut saw
- turning of the axis, of the bearing housing, of the lid and of the belt

4. Construction of a detachable box with electric switches

5. Assembling the three main parts

6. Electrical cables assembling

7. Painting with a primer and a final coat of protective paint

8. Testing of equipment.

The sieving equipment is produced in small series, piecemeal.

PRODUCTION CAPACITY

About 20 working hours are needed to produce one piece of equipment according to the technology described here. The annual production capacity is 100 pieces based on 8 hours per day, 250 days per year.

REQUIRED MACHINERY AND EQUIPMENT

I t e m	No.
Turning lathes 250 x 1000 mm	2
Milling machine 400 mm x 1200 mm (workbench)	1
Shears for cutting sheet metal	1
Crosscut saw for cutting profiles and tubes 100 mm	1
Console cranes, carrying capacity up to 1 t	2
Fork-lift truck, carrying capacity up to 2 t	1
Manual electric drills	2
Manual electric grinders	2
Autogenous cutting machines	2
Electrowelding machines 400 A	6
Compressor and painting gun	1 set
Manual tools	1 set

FOB price of equipment: 100,000 US dollars
Cost of plant building: 50,000 US dollars.

REQUIRED RAW MATERIALS

- Sheet metal, thickness 4 mm and 6 mm
- Steel tubes, Ø 2.54 cm and 1.9 cm
- Steel profiles 40 x 40 mm and 60 x 60 mm
- Various construction materials

A total of approximately 100 t of raw materials per year is required.

REQUIRED MANPOWER

Qualification	No. of persons
Highly skilled workers:	
- elecricians	1
- welders	3
- lathe operators	1
- milling-machine operators	1
- assembly workers	2
Skilled workers:	
- varnisher	1
- welders	3
- lathe operators	1
- machinists (fork-lift truck operators)	1
- assembly workers	2
Semi-skilled workers	1
Technologist engineer	1
TOTAL:	18

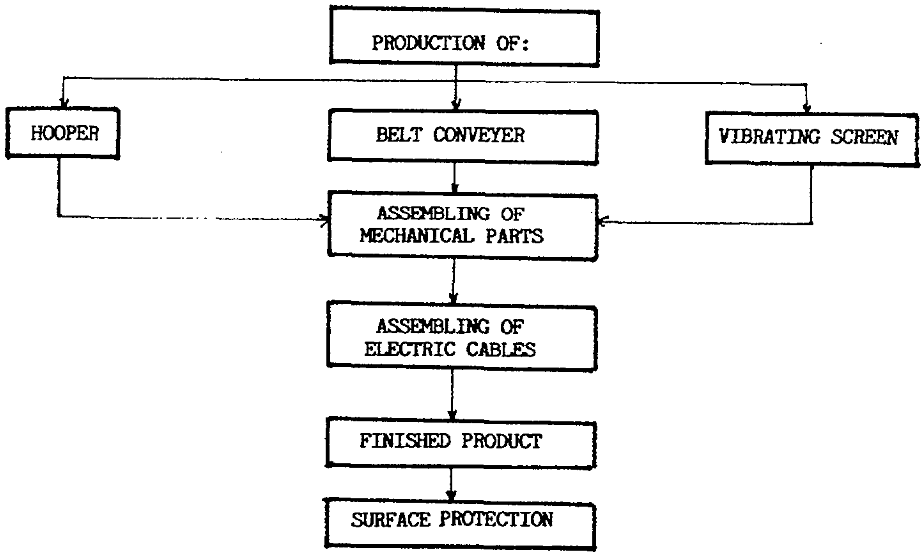
REQUIRED UTILITIES

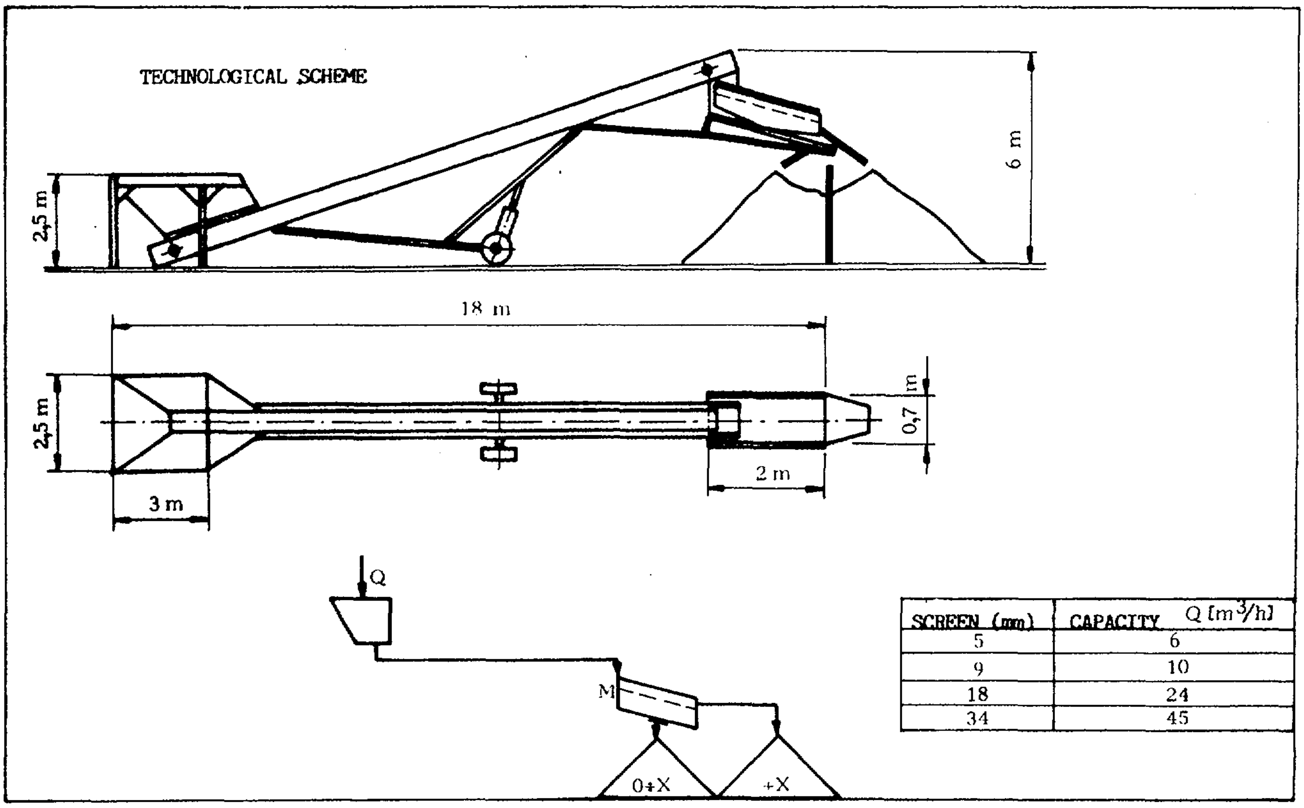
Electric power 150 kWH/equipment

REQUIRED AREA FOR PLANT SITE

The plant covers a total area of 500 m^2 including the workshop and warehouse areas.

MOBILE BELT CONVEYER PRODUCTION
BLOCK DIAGRAM





SCREEN (mm)	CAPACITY Q [m^3/h]
5	6
9	10
18	24
34	45

FILE: P-15
ISIC: 3829

HOW TO START MANUFACTURING INDUSTRIES

ASSEMBLY OF WHEEL TRACTORS

The offered technology includes all technical assistance for complete assembly and testing of tractors using assembly of delivered components (CKD) and assembly of delivered tractor parts and assembly elements (PKD) as well as the first phase of production of wheel tractors of the above mentioned power.

Tractor components loaded in warehouses are transported to the assembly line where different assemblies and subassemblies make parts of the tractor or engine, and the whole tractor is assembled on the main assembly line.

This production process offers the workers many possibilities to acquaint themselves with the tractor both with its construction and the function of its assembly. This forms the bassis for further advancement in the production of tractors.

All tractors in this programme have Perkins engines of the latest design with reduced fuel consumption and low air pollution. Engines are adapted to all climatic conditions.

Wheel tractors show good performance with all kinds of attached agricultural implements. The tractor's gearbox has 10 forward and 2 reverse gears. The clutch is of a dual type. A PTO shaft provides 720 r.p.m., at an engine speed of 2250 r.p.m. The steering mechanism is hydrostatic or mechanical. The hydraulic system operates at a pressure of 175 bars.

The tractors can be equiped with various units and accessories depending on the programme accepted.

PROCESS DESCRIPTION

With this technology the assembly of complete tractors and a part production of tractor components is envisaged. Know-how and technical assistance are included.

The processes involved in the assembly and production of tractor components may be roughly divided in the following activities:

- Complete assembly of tractors and engines from delivered SKD and PKD elements,

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- Production of tractor components (metal cutting and forming, heat treatment, surface protection of finished components)
- Organization of tractor components production through local co-operation (engaging all available machine capacities in local industries showing interest in co-operation).

With the proposed investment about two hundred various tractor components can be produced in local factories.

The assembly and production of wheel tractors is a one-shift continuous process (with the exception of a few machines which would run in two shifts).

PRODUCTION CAPACITY

The production capacity is 3,000 assembled wheel tractors per year. This calculation is based on 7,5 working hours per day and 275 days per year.

REQUIRED MACHINERY AND EQUIPMENT

I t e m	
1.	Copying gas cutting machine with photocell
2.	Sheet metal shearing machine 2500 x 10 mm
3.	Eccentric press 100 t
4.	Trimming press 100 t
5.	Arc welding sets
6.	Metal sawing machine
7.	Lathe 1500 x 200
8.	Lathe 100 x 150
9.	Turret lathe
10.	Radial drilling machines - (4 pcs.)
11.	Horizontal milling machine
12.	Vertical milling machine
13.	Column drilling machine
14.	Bench type drilling machine
15.	Tool grinding machine - universal
16.	Heat treatment oven
17.	Oil hardening bath
18.	Heat treatment salt bath
19.	Tempering salt bath
20.	Oil and water hardening bath
21.	Complete galvanization line (zinc plating, phosphating, passivating)
22.	Cranes 500 kp/5 m
23.	Front-operated diesel fork lift truck
24.	Storage equipment (racks)
25.	Mechanized engine assembly line

26. Universal lathe 1000/150
27. Engine testing table
28. Bosch pumps testing table
29. Diesel engine automiser testing table
30. Bracket electric hoist 125 kp
31. Bracket electric hoist 250 kp
32. Bracket electric hoist 500 kp
33. Transmission assembly line
34. Transmission test table
35. Rear axle assembly line with rotary carriage
36. Engine preparation line
37. Tractor parts degreasing unit using trichloroethylene vapours
38. High pressure hot water washing machine
39. Main assembly line - mechanized floor conveyor
40. Tractor body painting plant (rinsing, painting, baking of paint)
41. Tractor filling pumps (oil, naphtha, water)
42. Mono-rail crane 1 t
43. Tractor sheet metal parts painting plant (130°/30')
44. Compressor station with air tank
45. Pneumatic installation in the whole factory
46. Pneumatic tools for assembly
47. Various accessories for assembly
48. Several hundred items of special and standard tools and accessories for assembly
49. Work benches 100 x 800 and 1500 x 800 mm (40 pcs)
50. Control tools and accessories
51. Equipment for mechanical and electrical maintenance of machines and units
52. Office furniture
53. Workshop racks, metal and wooden pallets etc.
54. Other equipment intended for normal production

FOB price of machinery and equipment: US $ 740.000

REQUIRED RAW MATERIALS

I t e m	Quantity
Carburized steel of guaranteed quality	120 tons/year
Carburized steel of non-guaranteed quality	350 tons/year
Low-alloyed steel	150 tons/year
Cast iron GG quality	80 tons/year
Electric cables, various	135 km/year

REQUIRED MANPOWER

Qualification	No.
(a) Operating staff	
Qualified mechanics (tractor assembly shop)	75

Qualified mechanics (tractor parts manufacture shop)	50
Qualified workers (heat treatment and surface protection)	15
Unskilled workers	30
	TOTAL: 170
(b) Administration and management	as necessary

REQUIRED UTILITIES

Electric power	350 kWh per tractor
Naphta	28 l per tractor
Technological water	18 t per tractor

REQUIRED AREA FOR PLANT SITE

A total area of 30,000 m^2 is needed, including 4,000 m^2 for the plant, warehouses and auxilliary accommodation.

TRACTOR MODELS

FILE: P-16
ISIC: 3823

HOW TO START MANUFACTURING INDUSTRIES

MANUFACTURE OF WELDING MACHINES

Application of welding is important for many branches of industry and craft. A great number of machines with various capacity-from the big ones for industry welding to small portable ones applicable for assembling of metal parts - make the application of these apparatus possible. With very little knowledge and with only a short training one can achieve the necessary experience.

The programme of production contains:
- Portable welding transformers up to 135 A
- Welding transformers from 135 to 300 A
- Welding rectifiers up to 250 A
- Semi-automatic welding sets up to 250 A
- Welding tongs
- Welding accessories

A complete assortment of devices for manual welding is also available. The total annual capacity of production is 115 t of finished producs.

PROCESS DESCRIPTION

The entire manufacturing process proceeds in phases in the following succesion:

1. transformer core steel-sheat cutting; it is carried out on a special equipment for cutting and packing in boxes. The cutting can be also done with special shears and manual sorting.
2. coil winding; it is carried out on special automatic or manual equipment.
3. shavings removal (turning, milling, drilling, grinding); it refers to all mechanical parts which are not available on the market.
4. metalworking and welding; serves for fabrication of components and sub-units that ensure the functioning of welding equipment and their design.
5. manufacturing of steel sheat parts; serves for fabrication of components and sub-units that ensure the functioning of welding equipment.

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6. coating; includes the preparation of surfaces and external protection of steel equipment parts as well as the make up.
7. manufacturing of plastics parts; they are fabricated mostly by means of high pressure injection moulding.
8. mechanical assembly; this refers to the assembly of individual parts into a functional whole.
9. electrical assembly; refers to the joining of electrical parts into a functional whole.
10. testing and inspection; refers to the type testing in a special location and to the functional testing within the scope of mechanical and electrical assembly.
11. packing; refers to the final procedure that ensures safe transportation from the manufacturer to customers.

The manufacturing technology is based predominantly on standard equipment, while manpower qualifications to the largest part need not exceed the lower educational background. The above phases of operation are technological units, which makes the manufacturing process flexible.

The assortment of products requires continuous manufacturing with facilities for intervening storage.

PRODUCTION CAPACITY

115 tons per year
Based on a 2 x 8 hours working day, 250 working days per year, at 80% of total capacity.

REQUIRED MACHINERY AND EQUIPMENT

I t e m	No.
Transformer strip shears	1
Metal plate shears	2
Profile shears	1
Corner cutting device	1
Excentric press EP 50 - EP 100	4
Saw	1
Plastics injection machine	2
Monitor lathe	3
Milling machine	2
Grinding device	1
Column drill machine	3
Impregnation unit	1
Drying kiln	2
Winder	4
Insulation manufacturing machine	1
Colouring equipment	1 set

FOB price of machinery and equipment + know-how approx. US dollars 1,000,000.

REQUIRED RAW MATERIALS

I t e m	Quantity
Transformer strip	0.40 t/t of product
Steel sheet	0.03 t/t of product
Steel profiles	small/t of product
Round-wires and stream-lined wires	0.30 t/t of product
Insulating materials	0.02 t/t of product
Impregnating agent	small/t of product
Artificial raw materials	0.10 t/t of product
Degreasants and paints	0.02 t/t of product
Connectors	0.10 t/t of product
Subsuplier's components	0.03 t/t of product

REQUIRED MANPOWER (for two shifts)

Qualifications	No.
University qualifications	2
Technicians	8
Lower educational background	5
Highly skilled workers	11
Skilled workers	23
Unskilled workers	92
TOTAL:	130

REQUIRED UTILITIES

Electric power	6400 kWh/t of product
Fuel oil	0.31 t/t of product
Water	20 m^3/t of product

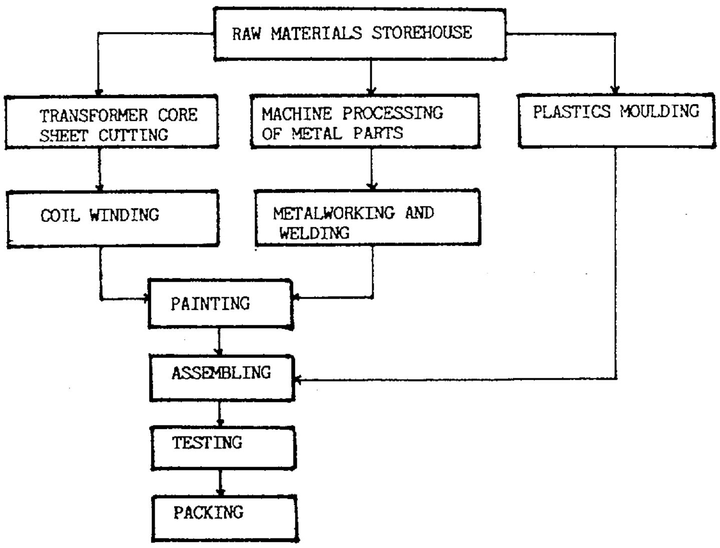
REQUIRED AREA FOR PLANT SITE

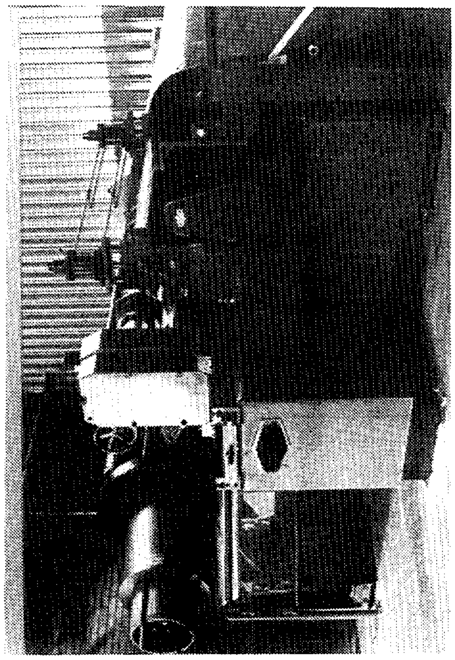
The total work space requirements including workshops and intervening storage is 2000 m^2.

SAFETY MEASURES

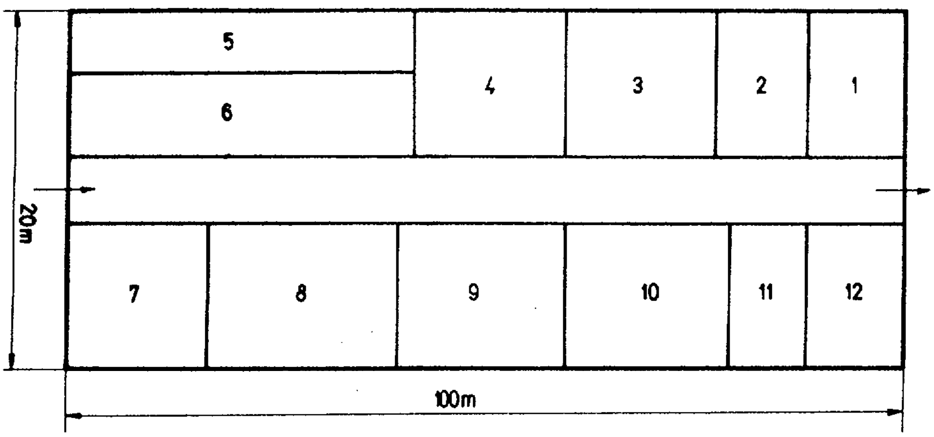
Because of the dyeing process waste water treatment is required.

PROCESS BLOCK DIAGRAM FOR MANUFACTURE OF WELDING MACHINES





MANUFACTURE OF WELDING MACHINES: OUTLINE OF TECHNOLOGICAL ZONES



1 Welding
2 Artificial raw material parts
3 Black plate parts
4 Metalworking and welding
5 Shavings removal
6 Transformer strip cutting
7 Coiling
8 Impregnation
9 Colouring
10 Mechanical assembly
11 Electrical assembly
12 Testing and inspection

FILE: P-17
ISIC: 3823

HOW TO START MANUFACTURING INDUSTRIES

SPARE PARTS MAKING PLANT FOR MACHINE TOOLS

Projects for machine tools manufacturing considered here are suitable for developing countries because they permit permanent development and expansion of production. The start of production could be done with minimal finances, with basic knowledge and experience, which could be developed successively. In fact, there is no country that could ensure it`s development without a lower or higher level of machine tools manufacture. Industrial development depends on production level of machine tools manufacture, because of its fundamental importance for all industries. It is also essential for developing countries.

Therefore it is advisable to start machine tools manufacture gradually and in phases. Such a way of mastering the production is the only possible and rational one in conditions when it is not realistic to expect a high concentration of finances and trained personnel.

The gradual realisation of machine tools production will be rational and economical if the following phases are considered:

Phase I - Production of spare parts for the existing fund of various machine tools and for a greater number of customers.

Phase II - Production of elements and components for manufacture of machine tools and cooperation with other produces; it ensure the production of complete machine tools.

Phase III - Maintenance of selected types of machine tools, which is important and necessary in all countries, but especially in developing countries. This phase does not require great financial support, and helps to gain necessary knowledge for later complete production of machine tools.

Phase IV - Independent machine tool production of most frequently used type - universal lathe.

It is possible to realise each of the stated phases separately.

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PROCESS DESCRIPTION

Here is considered, the first phase of machine tools production i.e. the production of spare parts for the existing fund of machine tools, for a larger market.

The simpliest machine tools like bow-frame saws, bench drills, tool sharpeners and similar machines can be manufactured with simple technical means: saw, plane, milling-machine, grinder and welding equipment, even without foundry.

Regarding the heat treatment of produced tools, the offered equipment represents the optimum concerning the range and level of production. However, depending on particular conditions and needs, the task of the heat treatment (surface hardening, induction hardening etc.) can be solved flexibly, with internal or external cooperation, depending on disposable funds, desired productivity and required technological level.

With the same equipment, personnel and knowledge and by using the same raw material, the spare parts can be manufactured for:

- agricultural mechanization
- vehicles
- food industry
- energetics
- soil-conservation mechanization
- mining industry
- process industry, etc.

Production of spare parts for machine tools includes activities shematically shown on Machine tool spare parts production block diagram. The spare parts can be produced as single parts or in small series.

PRODUCTION CAPACITY

Total capacity is 31 t of spare parts per year.
Base for calculating: 8 hours/day, 250 days/year.

MACHINERY AND EQUIPMENT

Pos.	I t e m	Type	Quantity (pcs)
1.	HORIZONTAL BAND SAWING MACHINE	Ultra-RH 360	1
2.	BOW-FRAME SAW	UD-210	1
3.	CIRCULAR SAWING MACHINE	HKT-810	1
4.	CIRCULAR SAWING MACHINE	HKT-1250	1
5.	CENTRE LATHES (L=1500)	PA-631P	2
6.	CENTRE LATHES (L=2000)	PA-900M	1
7.	CENTRE LATHES (L=1000)	PA-561S	2
8.	CENTRE LATHES (L= 750)	PA-501M	10

9.	EXTERNAL PRODUCTION GRINDING MACHINE	C 12 U-1100	1
10.	INTERNAL GRINDING MACHINE	3216 BRYANT	1
11.	HORIZONTAL SPINDLE SURFACE GRINDING MACHINE	PRB 500/1500	1
12.	GANG DRILIS	TSRB-13	1
13.	PILLAR DRILLING MACHINE	TSB-32	2
14.	RADIAL DRILLS	RB-40-SPA	1
15.	KNEE-TYPE VERTICAL MILLING MACHINE	GVK-3	2
16.	KNEE-TYPE UNIVERSAL MILLING MACHINE	GV-3	2
17.	UNIVERSAL MILLING MACHINE	GK-3P	1
18.	HYDRAULIC STRAIGHTENING PRESS	HP-1000	1
19.	UNIVERSAL TOOL SHARPENER	GEOMETRIC 431A	1
20.	DRILL SHARPENER	OSK-36	1
21.	CIRCULAR SHARPENER	3D-692	1
22.	TOOL SHARPENER	OAT-200	3
23.	ANNEALING FURNACE	KRK-100	1
24.	SALT FURNACE	ETP-35/60	1
25.	SALT BATH	TK-100/80	1
26.	WET SANDER	MP-3	1
27.	DIAMOND PYRAMIDE IDENTOR (HRC)	HP-250	1
28.	BALL HARDNESS TESTER (HB)	HPO-3000	1
29.	MECHANICAL DESK WITH VISE/VICE		10
30.	ELECTRIC FORK-LIFT TRUCK 12 KN	VAE 4/12	2
31.	ELECTRIC FORK-LIFT TRUCK 25 KN	VAE 5/25	3
32.	CRANE		1

FOB price of equipment: approx. 500,000 US dollars.

COMMENT: The offer includes know-how,equipment and training of all personnel. It does not include the construction of buildings and installations, acquisition of cutting, tightening or measuring tools; this can be the object of another offer. The investor could do it himself with the consulting help from the offerer.

REQUIRED RAW MATERIAL

Rolled steel 100 t/year

REQUIRED MANPOWER

Qualification	Number of performers
Mechanical engineers	5
Mechanical technicians	20

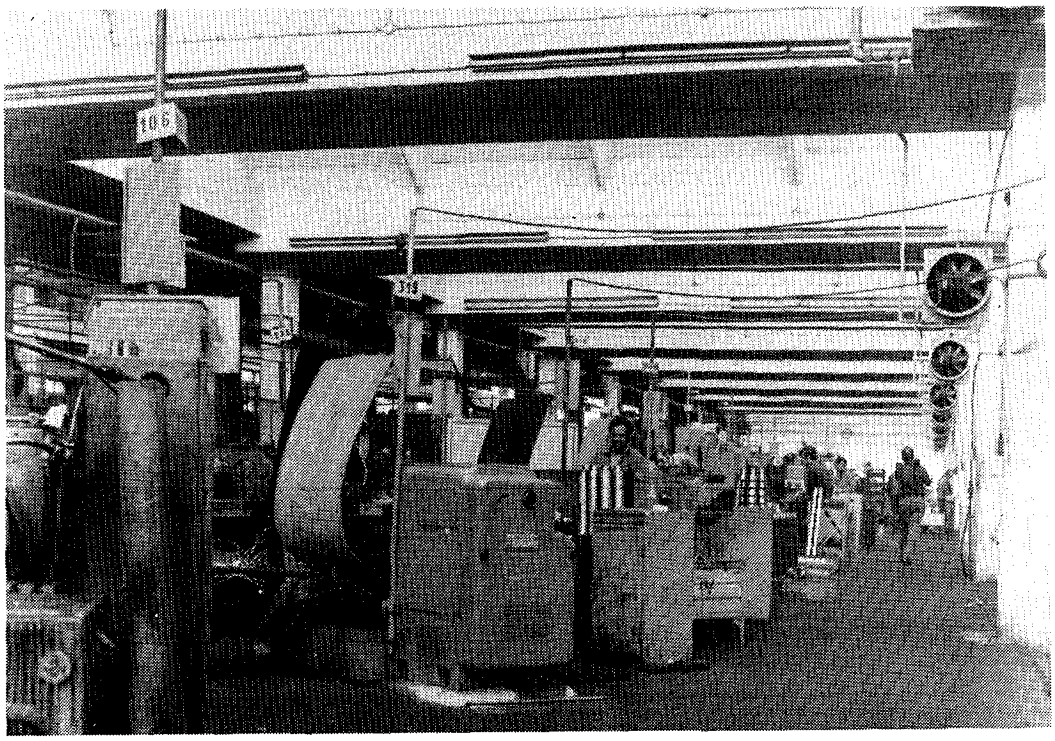
Economists	2
Economic technicians	5
Skilled workers	70
Semiskilled workers	20
TOTAL:	122

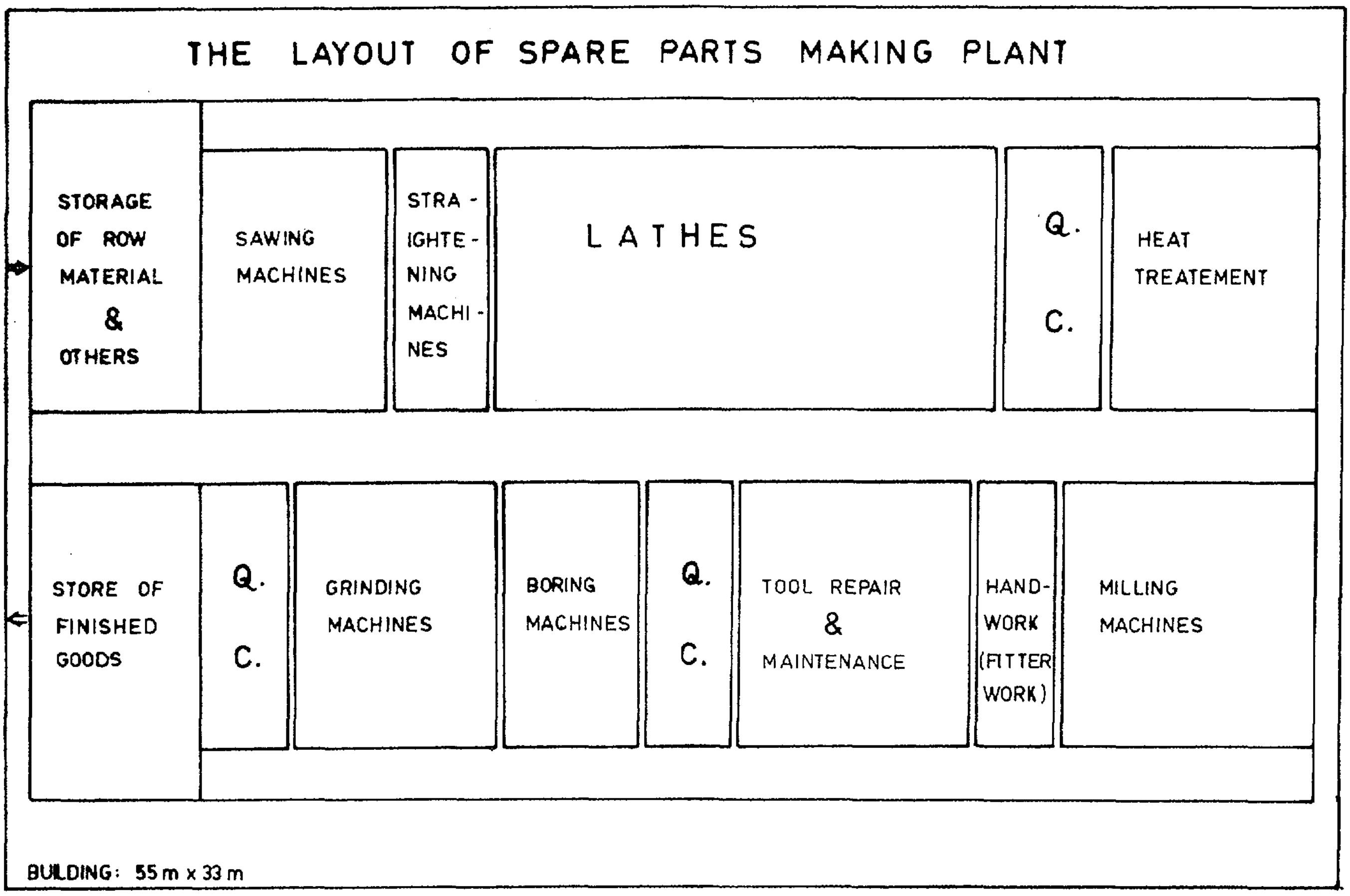
REQUIRED UTILITIES

Electric energy	500.000 kW/year
Water	57.600 l/8 hours

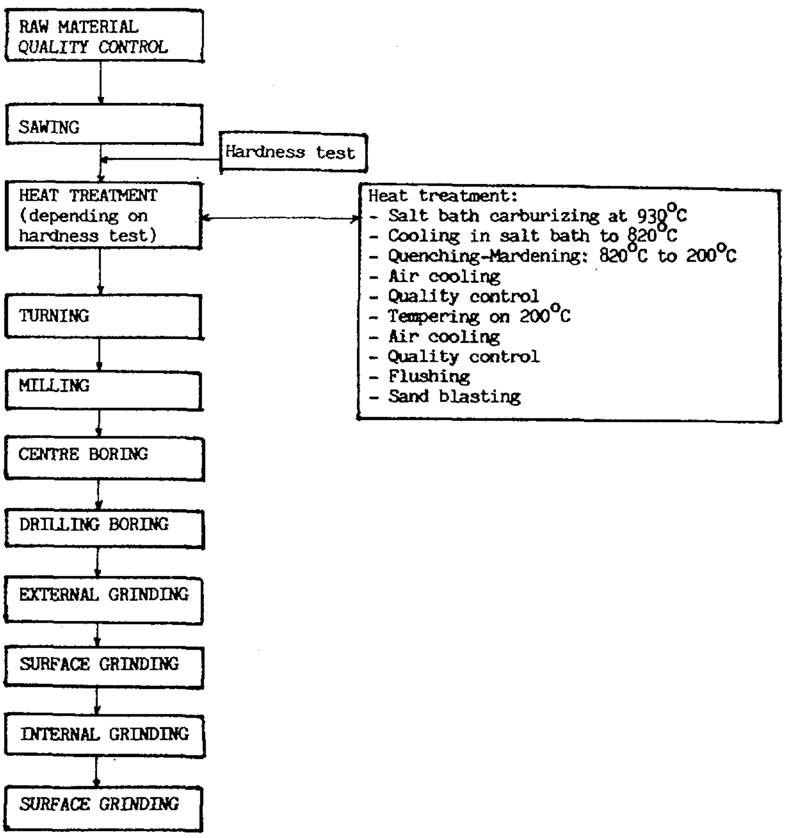
REQUIRED AREA FOR PLANT SITE

Total area of 2000 m^2 is required and it includes: manufacturing area, storage, offices, auxiliary rooms.





MACHINE TOOL SPARE PARTS PRODUCTION BLOCK DIAGRAM



Power Tiller Making Plant

To produce power tiller, first of all, all the fields of machine industries must be developed at similar level.

Various component parts of power tiller are similar to those of auto-mobile industry in that speed control of power, various connections, and equipments are divided at mission part with engine being installed on the power tiller.

This power tiller is useful for agricultural uses such as smashing soil, tilling soil, and carrying on a land less than 5 ha.

Power tiller has three types which are traction use, driving use and traction-driving use according to the drive type.

Power tiller may be classified into walking type tiller and riding type tiller according to the use method.

According to fuel of engine, power tiller is calssified into gasoline type, kerosene type and diesel type.

And, according to the horse power, power tiller is calssified from 2-3 H.P to 14-15 H.P.

Usually, 5-10 H.P power tiller is used for preparing soil and 3-5 H.P. power tiller is used for cultivation and administration.

Because there are so many kinds of power tillers like above, to produce power tiller, first of all, cultivation method, cultivation type and size of cultivating land should be considered carefully.

In case of improper conditions, cultivation method should be promoted according to working type of the machine.

And so, the most important thing is to decide what kind of machine to produce. Once a type of power tiller is decided, first of all, you should decide to produce what company's model in what country, and after negotiating about technology introduction with technical staff of concerned country and company, production should be led toward promotion localization.

Power tiller should be produced under precise plan because power tiller is assembled 2,000 components by 1,000 kinds of components.

Manufacturing facilities are casting facility, forging facility, cutting facility, press facility, welding facility, processing facility such as drilling, grinding and cutting, heattreatment facility, plating facility, painting facility and inspection facility.

Besides, bearing injection pump, nozzle and electric devices of magnetic should be made by existing facilities or should be imported.

Moreover, raw materials and semi-manufactures must be easy to purchase, and to start manufacture economically it should be a market of 500 power tillers a month at least.

In all respects of economy, 1000-2000 power tillers a month should be sold.

Power tiller has various type according to classification methods.

(a) Classification according to fuel of engnie
- Gasoline type
- Kerosene type
- Diesel type

(b) Classification according to engine cycle
- 2 Cycle engine type
- 4 Cycle engine type

(c) Classification according to cooling method
- Air cooling type
- Water cooling type

(d) Classification according to horse power
- 2 H.P Type
- 5 H.P Type
- 6 H.P Type
- 8 H.P Type
- 10 H.P Type

(e) Classification according to use method
- Walking Type
- Riding Type

(f) Classification according to usage
- Tilling Type
- Cultivation and Administration Type
- Carrying Type

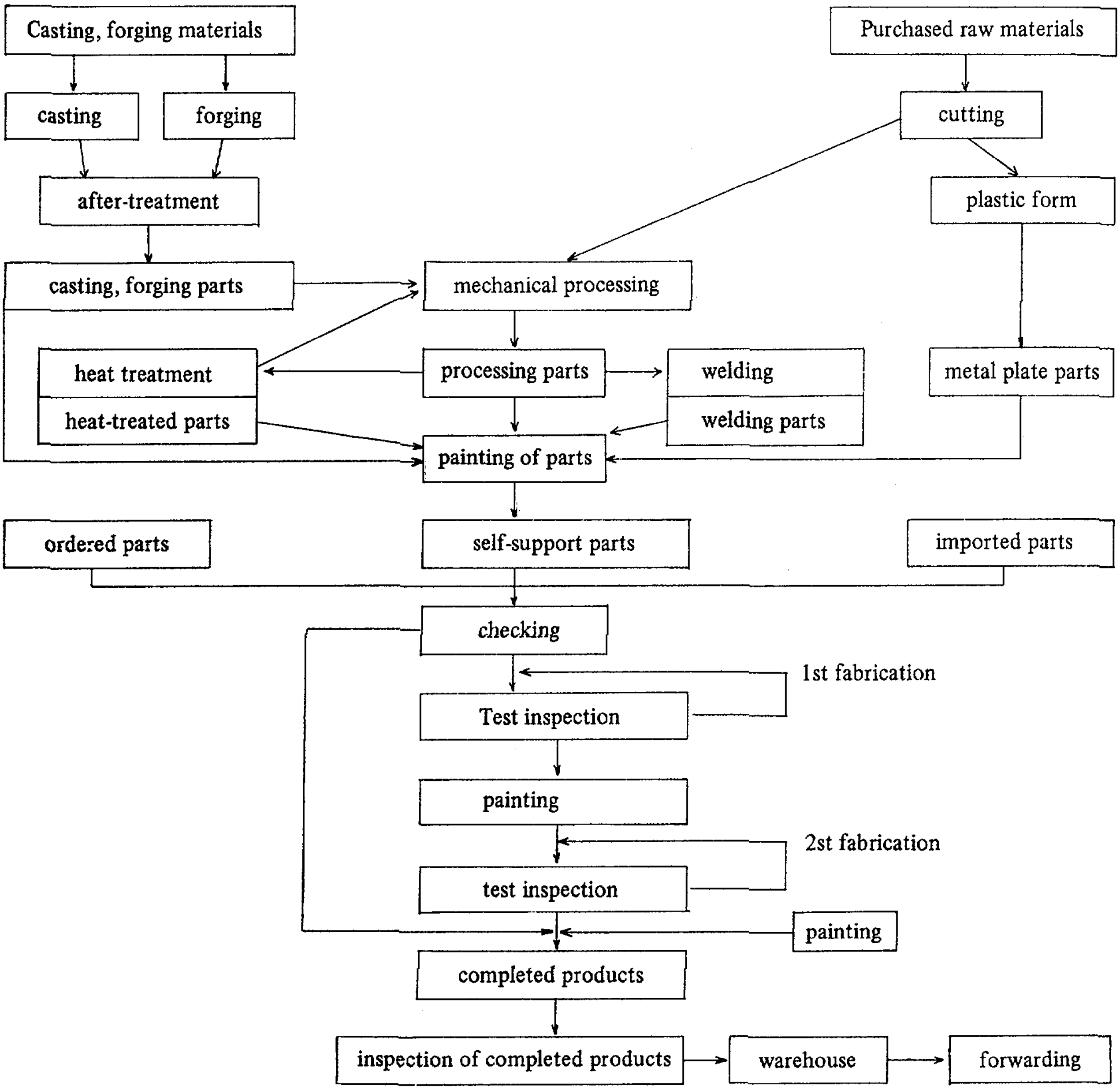
(g) Classification according to drive type
- Traction Type
- Traction and driving type
- Driving type

Specifications

Division	8 H.P	10 H.P	6 H.P	8 H.P	10 H.P
○ Engine					
Type	*water cooling* kerosene	*water cooling* kerosene	*water cooling* Diesel	*water cooling* Diesel	*water cooling* Diesel
Normal capacity (ps/rpm)	8/2,000	10/2,000	6/2,200	8/2,200	10/2,200
Max. capacity (ps/rpm)	9.3/2,000	13/2,200	8.5/2,200	10.6/2,200	13.5/2,200
Feul consumption rate (g/hr)	300	296	214	218.3	228
Weight (Kg)	118	124	102	124.5	156
○ *Main body*					
Type	Traction-driving Type	Traction-driving Type	Traction-driving Type	Traction-driving Type	Traction-driving Type
Length x width x height (mm)	2,450 x 1,000 x 1,360	2,450 x 920 1,350	2,230 x 875 1,215	2,340 x 985 1,300	2,360 x 960 1,340
Weight (Kg)	403	408	352	410	465
Max. Speed (Km/hr)	11.1	11	11	11.9	12.2
Transmission stage	Forward 6 Backward 2	Forward 6 Backward 1	Forward 6 Backward 1	Forward 6 Backward 2	Forward 6 Backward 2
○ Plough					
Weight (Kg)	34	41	40	42	42
Plough width (mm)	280	275	240	280	280
Tilling width (Cm)	25	25	24.7	24.2	25
Tilling depth (Cm)	14	14	14	14	14
○ Rotary					
Weight (Kg)	81	80	66	83	82
Number of blades	18	18	14	18	18

Manufacturing Process



Process Description

To produce power tiller, its component parts are divided into self-support parts, ordered parts and imported parts. According to the component parts, processing method and raw material should be considered and decided. After self-support parts are made through various manufacture progressions using various raw matherials such as round bar, steel pipe, steel plate, forging and casting materials, first assembly parts are checked, second assembly and semi-products are completed and painting is carried out-finally. Completed products must pass idling operation test and loading operation test.

Besides, above mentioned casting and forging materials are divided into casting part and forging part respectively. As for casting products, after making wooden mould required and making space in casting sand, melted iron is poured into the space, and then remove casting sand after the melted iron to be hardened, and finally casting product is produced by removing various slags attached on the surface. Forging products are made by pressing heated materials in metal mould to be the same shape or by hammering heated materials to be the shape required.

Once casting products and forging products are produced, some parts are painted after heat treatment, and others are painted after mechanical working in machine industrial plant. Besides, purchased raw materials are cut to transfer to mechanical processing directly, or worked to be metal plate form which is a component part itself, or matal plate are welded to be a complete component part.

Production and Export of Korean Power tiller (1981)

Year	Production (HP)	Export ($US1,000)
1979	506,808	71
1980	550,535	45
1981	653,832	458

Required plant site

Factory Area	4 ha (10 Acre)
Building Area	1 ha (2.5 Acre)

Required Manpower (Person)

Technician	300
Officer & Engineer	100

Export of Korean power tiller for every continent (1981)

Asia.	Europe.	N. America.	S. America.	Africa.	Oceania.	Total
73	1	78	14	130	10	306

Required Facilities (No. of Machine)

Machine Tool	100
Metal working machine	100
Inspection & Testing Equipments	40
Painting Line	1
Heat-treatment facility	2

Example of Plant Capacity and Construction Cost

1) Plant capacity : 1,000 sets/month
   * Basis : 8 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$1,500,000
o Utility facility	:	US$ 300,000
o Installation cost	:	US$ 200,000
Total	:	US$1,500,000

3) Required Space

o Site area	:	16,200 m^2
o Building area	:	4,050 m^2
Total	:	20,250 m^2

4) Personnel Requirement

o Manager	:	15 persons
o Engineer	:	85 persons
o Operator	:	300 persons
Total	:	400 persons

Any inquiry about the information contained should be sent to:

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Water Pump Making Plant

The pump is usually classified into rotary motion pump, reciprocal pump, and special method pump.

The pump is a general term to indicate machines which lift water or liquid from lower place to higher place and which carry much water or liquid through a narrow passage.

Because pump has various kinds according to its use, here, we will explain about agricultural pump.

Component parts of the pump are casing rotation shaft, impeller rotating with the shaft to lift water, hood valve, sucking tube, exhustion tube, grand packing and mechanical seal.

Reciprocal pump is divided into casing, air chamber, exhaustion and sucking valve, packing, piston, regulator, crank shaft and pulley.

To manufacture pump, casting facility, cutting processing facility, fabrication facility and painting facility are required, and design room and designers are also required to design pump according to its specific use.

A. Rotary motion pump

This indicates a pump whose moving part takes rotary motion.

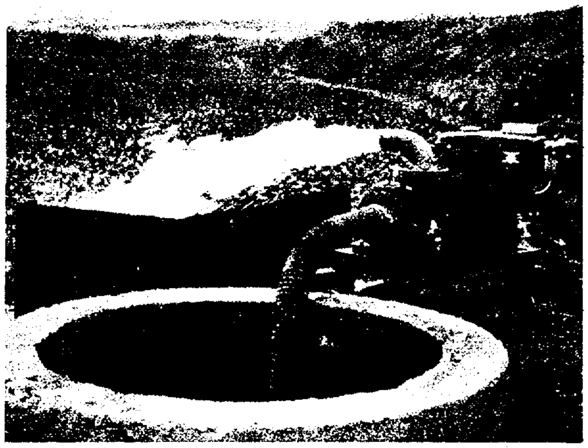
1. Centrifugal pump: It is made that water can jump out by centrifugal power. Sucking tube and exhaustion tube are made respectively, and so, much water can be carried. This is produced mainly for agricultural use.
   - Volute pump ; This is such pump that after water scattering without guide blades and water can flow directly to the outlet.
     It's structure is simple and it's price is low and so, it is used mainly for agricultural use.
   - Turbine pump; This has guide blades with more than two impellers.
     It is used mainly for housing, mining or industrial use.
   - Single suction pump & double suction pump ; Single suction pump is used mainly in small size, and double suction pump is used mainly in large size fixed facility.
   - Multi-stage pump ; In case of failure to pump
4 much water with one impeller, multi-stage pump is used.
     Multi-stage pump, which has a mechanical structure to pump water through guide blades with several impeller on the same shaft, is used to increase head.
   - Horizontal shaft pump and vertical shaft pump ; Those pumps above mentioned are horizontal shaft pumps, and vertical shaft pump is useful to pump much water at lower head of 4-5 m.
2. Axial pump ; This is also called propeller pump. It has such a structure that propeller typed guide blade pushes water up by its rotation.
   In case of large volume under 4 m head, its efficiency is better than that of centrifugal pump.
3. Rotation pump ; This has such structure that water can be sucked by vacuum produced by change of volume which is made by rotating one or more than one moving bodies in a tight closed container having sucking tube and exhaustion tube.
   This pump has a small structure, has no valve and can be easily controlled in speed.
   It is classified into gear pump, roller pump and wesco pump.

B. Special pump

1. Hydraulic Ram ; It is also called automatic pump or water-falling pump. It uses the principle of falling power of water directly.
2. Air lift pump ; If one part of pump tube is sunken into water and pressure air is inserted from down, mixture of water and air bubble can be produced, and so, for this mixture is lighter than water, water can be pumped up to high place.
3. Jet pump ; If vapour or water of high pressure is introduced into nozzle, it can be spouted in high speed.
   Jet uses such principle that air of water around area can be accompanied at this time.
4. Sprinkler ; This is a system to spray water, fertilizer, or agricultural chemicals on soil ground.

C. **Reciprocating Pump**

1. Classification by pumping function
   - Suction pump
   - Force pump
   - Suction and force pump
2. Classification by structure of moving body
   - Piston pump
   - Plunger pump
   - Bucket pump
3. Classification by pumping operation
   - Simplex pump
   - Duplex pump
   - Differential pump



Kinds of Products and Specifications

size (in)	3.0	3.0	4.0
Type	centrifugal	self-priming	centrifugal
Dimension L x W x H (mm)	457 x 400 x 465	525 x 335 x 503	485 x 340 x 510
Weight (Kg)	34	42	38
Max. Capacity (M^3/Min)	1.3	1.2	2.0
Max. Total Head (M)	14.2	16.4	14.4
Power Required (PS)	3.0 - 4.7	3.9 - 5.9	3.5 - 6.5
R.P.M	1,800	1,800	1,750

Process Description

Pump plant has different facility size according to what is the material of casing.

There are three kinds of casing materials which are iron casting, aluminium and plastic respectively. Until now, casting material has been mostly used but because of its heavy weight there are some cases that Die-casting or plastic is used. Here, we will explain the manufacture progression of pumps which are used casting iron for agricultural use.

Because casing ejector parts, sucking flange, pulley, impeller, hood valve and strainer of pump are worked by casting, after making wooden mould required and then making. space in casting sand, melted iron is poured into the space,. and then the casting sand is removed after the melted iron to be hardened, and finally completed components can be made after inspection, metal working and painting.

And also, shaft is cutted, worked mechanically, and then completed. Machine table is made completely after cutting, welding, inspection, grinding and painting. Bolt, nut, bearing, plate, hose, belt, waterinlet, drainage, cock, are inserted by ordered items, mechanical seal is imported. After inspection of component parts, they are fabricated, inspected, painted, and finally stored in ware house.

Required Facilities

Lathe
Milling machine
Shaping machine
Drilling machine
Hobbing machine
Press
Welding machine
Hand grinder
Painting Facility
Foundry facility (2 Ton/Day)
Inspection Facility

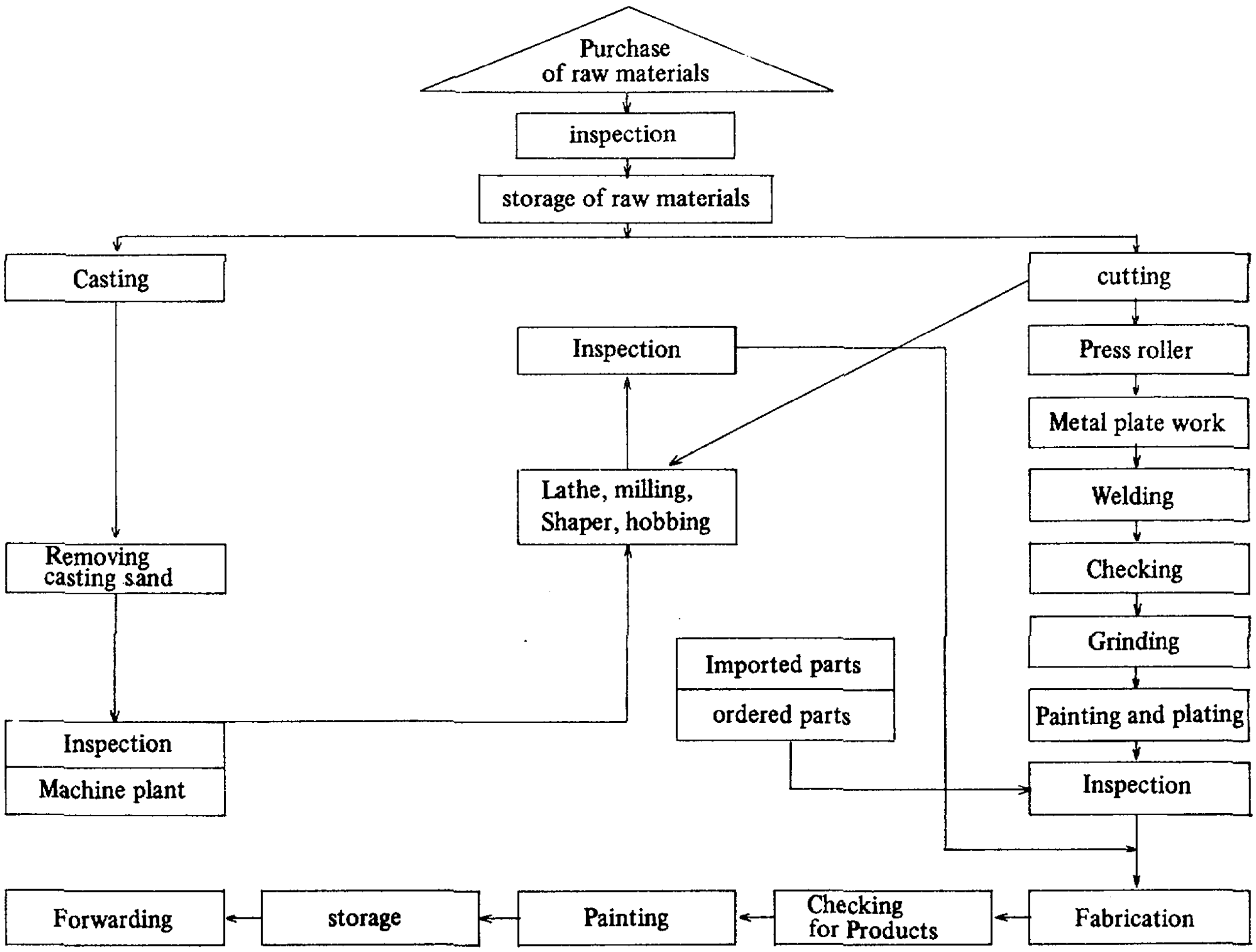
Required plant site Area

Factory Area	0.4 ha (1 Acre)
Building Area	0.15 ha (0.4 Acre)

Required Raw Material

Cast iron (Body)	25-40 Kg
Steel plate	20-40 Kg
Bronze	4-8 Kg
Angle	
Rubber packing	
V-Belt	
Mechanical seal	
Gland packing	
Bearing	
Valve ball	
Hose	

Manufacturing Process



Example of Plant Capacity and Construction Cost

1) Plant capacity : 1,000 sets/month
   * Basis : 8 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US\$300,000
o Utility facility	:	US\$ 50,000
o Installation cost	:	US\$ 50,000
Total	:	US\$400,000

3) Required Space

o Site area	:	1,620 m^2
o Building area	:	600 m^2
Total	:	2,220 m^2

4) Personnel Requirement

o Manager	:	3 persons
o Engineer	:	17 persons
o Operator	:	50 persons
Total	:	70 persons

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Engine Lathe Making Plant

When we say about a nation's machine industry, we necessarily have to discuss its machine tool industry.

It's becase the development of the machine industry as a backbone of modern industry depends unavoidably upon stable establishment of machine tool industry, the basis of machine industry.

It also follows that the machine tool provides every field of machine industry with its technical basis.

Therefore, the machine tool industry plays an important role in a nation's industry as the motive power in the development of modern industry.

In Korea, a few machine tool manufacturers grew spontaneously since 1950's in the prosperity period of 1970's machine tool industry was driven forward as an important field of an industrial policy.

As a result of this long-term efforts, Korea took the 14th place in terms of consumption of machine tools and the 20th place in terms of production of them.

In view of the market structure of machine tools, over 70% of them are used for machine industry.

Especially they occupy 50 to 60% of the general machine and automobile industry.

Machine tools have a character of capital goods and there are various kinds of machine tools.

Among them, lathes have the greatest demand, which 84% of all metalworking industry firms in the world use of all the various kinds of machine tools now on application 16.1% are lathes, which take the 1st place of machine tools.

So lathes have the wide-range market the world over.

Lathes are used where it is necessary to rotate things and to provide them with needed depth and shift.

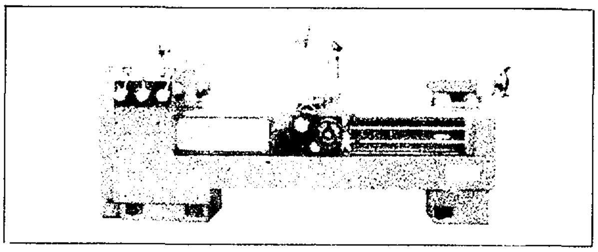
This equipment is primarily applied on the cylindrical materials. Along with the development of machine industry the types of lathes have modernized and developed, and have been diversified.

Now there are over ten kins of lathes containing engine lathe, bench lathe and turret lathe.

Engine lathes are the most frequently used ones, which is referred to as a typical "lathe".

In this brochure, the meaning of "lathe" is limited to and suggest the "engine" lathe with the greatest demand.

Engine lathe is used so widely that it is much more



suitable for the production with various kinds and small quantity.

Turning is the basis of all machine works as well as the standard method of cutting works, so that nowadays it counts for much in the machine manufacturing factory.

Works available with lathe are turning, boring, facing, parting and tapering, threading and so forth, but the scope of works with engine lathe can be extended if used with the various kinds of speical parts.

The method of determining the size of engine lathe is the one by means of indicating swing over bed, swing over carriage and maximum distance between centers.

The size is classified in small, middle and large type.

And according to the size of the swing over bed, there are small type, middle type and large type, of which the sizes of the swing over beds are respectively below 400mm, below 550mm and above 550mm.

On top of these, there are so many other ways to determine the size of engine lathe according to the fatotrs such as center distance from 600 to 6,000mm, spindle r,p,m with the range of 1,000 to 1,500 and main spindle motor from 2.2 to 15Kw, and the weight of to 7.5 ton.

Specifications

Center distance	mm (in)	1,500 (60)	2,000 (78)
Swing over bed	mm (in)	520 (20)	
Swing over carriage	mm (in)	330 (13)	
Main spindle speed	r,p,m	25 – 1,500	33 – 2,000
Main motor	HP	AC 10	
Net weight	Kg	2,500 (5,500)	2,600 (5,700)

Demand and supply of Korean engine lathe

($US: 1,000)

year	production	import	export	domestic demand
1979	74,436	45,611	9,440	110,607
1980	61,292	16,532	16,500	61,324

Process Description

1. Sourcing

Referring to chart and list of parts, purchase items are broken down into two kinds, which are respectively ones self-procurable and the others acquired by an outside order. It is necessary to process within the firm parts and materials containing the middle and large-size things and the principal axis when they are difficult to acquire by placing an outside order. Basically all the small-size parts must be processed by the method of place-an-outside order, and the specialized sub-factories should be rendered manufacturing the parts such as gears, lead screws, and those to be through heat-treatment. In case of control box, the whole unit will be supplied from the facotry specializing in
will be supplied from the facotry specializing in electricity and after then it will be subject to intërfacing within the firm. Raw materials such as casting irons will be provided form other specialized factories.

2. Pretreatment

Raw materials such as casting irons will be supplied from the makers after those materials have under gone the stages of stress relieving, sandblasting and painting for anti-corrosion.

3. Machine Work

In manufacturing the engine lathe, the basic processing-machines used are as follows shown in the table "Processing facilities". Machine processes are devided into rough cutting and finishing. For example, beds after machine-processed are supposed to be through flame hardening by guideway to the final stage of finishing and also spindles after machine-processed will be hardened on its nose part to reach the stage finishing. If applicable, some important local parts will undergo mid-test.

4. Inspection

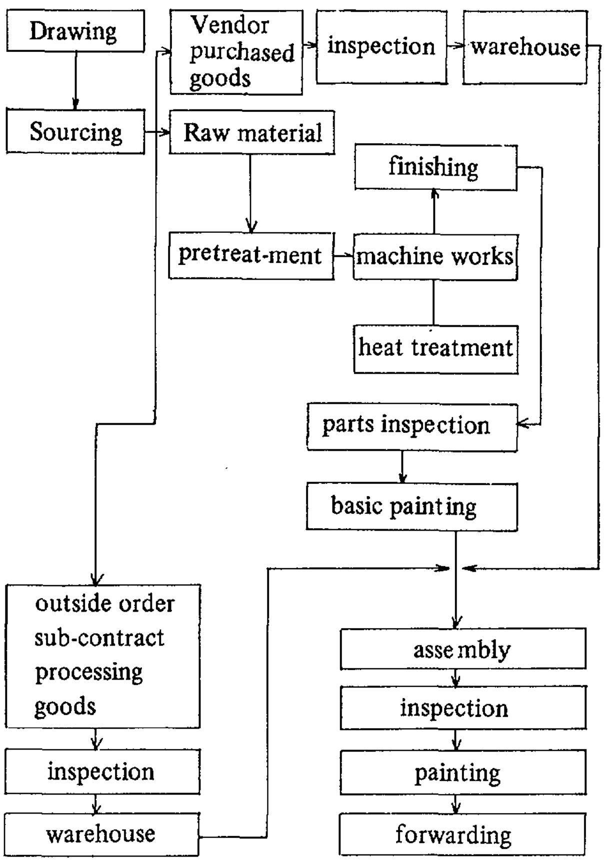
Completed parts, after processed within the firm, will be subject to the final test to ensure the proper measures. And goods purchased before they are put by an outside order will be subject to acceptance test into the warehouses. In this course, sections of all iron castings, which has not been processed, will be completed with primer painting. Of course the large-size materials will be carried to and put into the warehouse.

5. Assembly

Assembly consists of 3 stepts; assembly of sub-units, assembly of units and general assembly. After subunits and units have been assembled, it is necessary to wash them. So the washer must be installed. Then grease or lubricant oil specified will be applied on the rotating parts such as bearings. Assembly of units is completed by setting up headstock, tailstock, bed and carriage and feed mechanism in order. When assembling headstock, it is necessary to prepare dynamic balancing tester in order to make a throughgoing investigation into dynamic unbalance.

After the whole parts are set up in its place, tolerance of accuracy and functional/performance test are made. If the product has been found acceptable after it was tested according to the above procedures, it will be forwarded after going through the final painting process.

Manufacturing Process



Required Facilities (Unit)

Planer	3
Guidway Grinding machine	2
Flame Hardening machine	1
Machining center	4
Radial drilling machine	3
Boring and milling machine	4
Honing machine	1
Universal grinding machine	4
Surface grinding machine	4
N.C. Lathe	5
Engine Lathe	3
Milling machine	4
Tool grinding machine	3

Required Raw Materials

Grey cast iron	: 1,500 Kg	Grey cast iron
Grey cast iron	: 1,500 Kg	Grey cast iron meechanite, spheroidal graphite cast iron
Alloy steel	: 300 Kg	Carbon steel, Cr-Mo Ni-Cr, Ni-Cr-Mo
Non-ferrous	: 100 Kg	Bronge castings, Al-Alloy Al-Alloy castings.

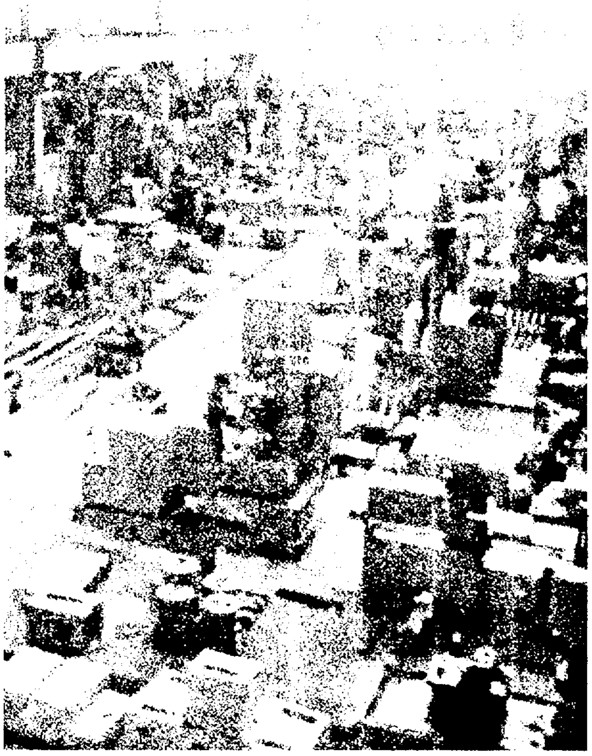
This business is planned to produce and sell 1,200 units of engine lathes per year, but this figure can be readjusted to the changing market conditions.

Production Scale

classification	size (mm)	units/month	units/year
small type	400 x 750 400 x 900	50	600
medium type	520 x 1,000 520 x 1,500	40	480
large type	620 x 3,000- 8,000	10	120
Total		100	1,200

We put emphasis on the production of the small and midsize lathes with the greater demand, while selecting the large size lathes with the intention of diversification of items. Process machine facilities needed for this purpose are as follows shown in the next table "Required facilities"

If we are planning to establish a facotry having annual production capacity of 1,200 units, for example, man power and factory site needed are as follows.



View of Engine Lathe manufacturing plant

Required Man Power	
Engineers	36
Craftsmen	40
Technician	240
Apprenties	16
Office workers	68
Total	400

Required Factory Site	
Factory building	12,000m^2
Building Attached	900m^2
Facilities Attached	900m^2
A lot	40,000m^2

Example of Plant Capacity and Construction Cost

1) Plant capacity : 1,200 sets/year
   * Basis : 8 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$750,000
o Utility facility	:	US$100,000
o Installation cost	:	US$ 50,000
Total	:	US$900,000

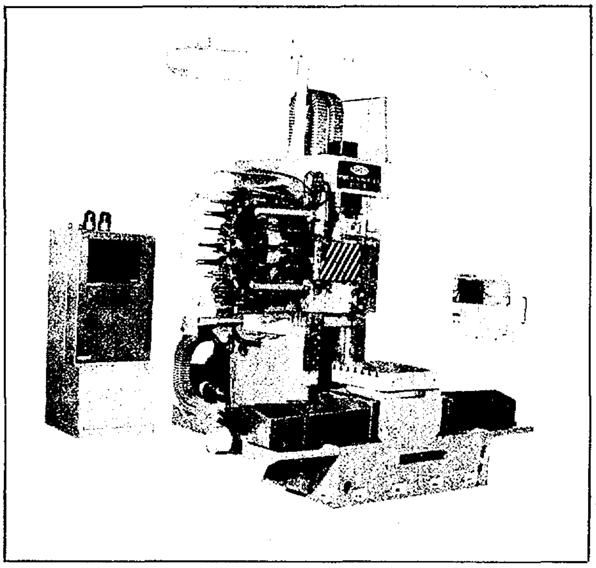
3) Required Space

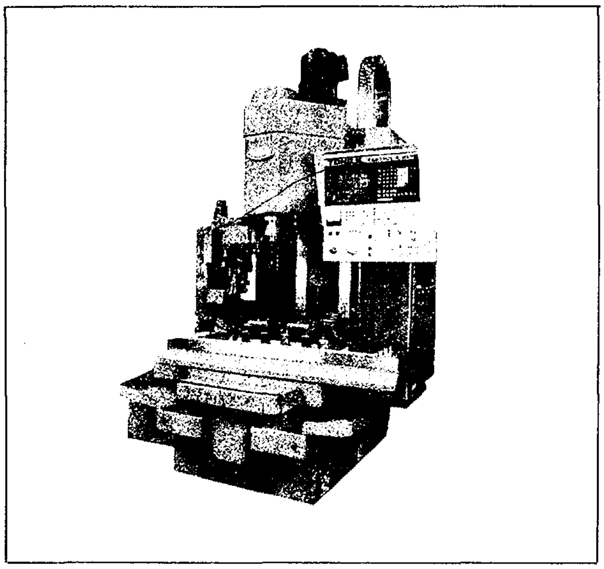
o Site area	:	40,000 m^2
o Building area	:	12,000 m^2
Total	:	52,000 m^2

4) Personnel Requirement

o Manager	:	10 persons
o Engineer	:	70 persons
o Operator	:	250 persons
Total	:	330 persons

CNC Milling Machine Making Plant





The price of the foundational Milling Machine is about 3,000 U.S. Dollar. But KOREAN Industrial firms does not only make this simple kind of Milling Machines but are capable of producing high sophisticated Machinery like the new Type of Machining centers for FMS systems which price is of course higher than a normal Milling Machine. The price is about 200,000 U.S. Dollar.

Now we would like to introduce the CNC Machining centers which are selling at this present time on the international Market. In the following explanation we will describe the features of Korean Machining centers and the process of Manufacture which they went through in order to reach this high quality.

Already the TNV-50 vertical Machine center is known as a Machine which is high reliable, easy to operate and does no harm to the environment because it does not have an Hydraulic system.

Features of the TNV-50 Machining center:

1. compact space-saving Design all auxiliary equipment is mounted on the main body.
2. No Hydraulics.
   There are no hydraulike so reliability is increased, maintanence, cost are lowered and the enviroment does not suffer from lost of oil.
3. High spindle power.
   The spindle power is 10/15Kw for heavier cutting and higher production rates.
4. No Gears on the spindle.
   The spindle is belt driven by an AC Motor, therefore there is no vibration like that found in gear driven spindles.
5. Well supported spindle.
   The spindle is supported by high precision bearings for precision machining with minimum heat build-up at high spindle speeds.
6. Large work Envelope.
   The size of the work envelope is large relative to the machine size the X, Y and Z axis dimensions are: 500/750x400x500mm.
7. High traverse speed.
   The maximum traverse speed in all 3 axis are 12m/min to save time and increase productivity.
8. Automatic central lubrication system.
   It performs all frequently reqired lubrication.

Manufacturing Process Description

The machining center has like all other numerically controlled machining centers three moving axis, a longitudinal axis (X) located in the table unit, a transversal axis (Y) which is located in the column-bed and moving the column forward and backward and a vertical axis (Z) that is moving the spindle head up and down and is located in the column unit. All movements are controlled and the tools are automatically changed from the magazine which is mounted to the column to the spindle by the CNC-control and the programm entered in to it this way the entire machining process for workpieces of various complexity like milling, drilling, boring, tapping, slotting and so on are carried out automatically.

To garranty such automatic operation over a period of 5 to 10 years, as well as to guarranty the precision needed extreem are must be taken during assembly and each part must be checked individually, the precision after assembly is in most cases within 0.005mm per 1 meter and should never be above 0.01mm per 1 meter for perpenticularity and parallelity of all slideways and axis movements to each other. The main spindle has a run out of 0.003mm or less by using high precision angular contact ball bearings. Any shock load on them then not rotating will destroy their precision and make them unusuable.

From the design point of view the MACHINE can be devided into seven different units;

1. Table unit
2. Column-bed unit
3. Column unit
4. Spindle head
5. Automatic tool changer (ATC)
6. CNC Control
7. Hydraulic unit

All three axis have the same feed (moving) system, consisting of a DC servo motor which is driving the ballscrew through a special elastic but torsion stiff coupling. The nut of the ballscrew is mounted on the table, the column or the spindle head respectively and the ballscrew itself is mounted in the bed castings or the column by using a combination bearing on each side of the ballscrew.

In order to position the table, column or spindle head precisely the ballscrew is precision ground and the ball nut is preloaded to avoid any backlash and enable the axis to position form either direction. The required positioning accuracy is within 0.01mm for all axis. To measure the position of the table, column or spindle head fine grated linear glass scales are used which are directly connected to the CNC-control. The table is moving on the hardened cast iron slide ways of the table-bed. To achieve good sliding characteristics the table slideways are lined with a special plastic that is giving an especially good gliding ratio. The table is moved by the feed system described above.

The column-bed unit with its slideways system has been designed very carefully since it has to carry the weight of the entire column, spindle head and ATC which amounts to about 7 tons. The slideways are suing 12 linear roller shoes, four on top, four on the bottom and four on the side. They are preloaded with about 1000Kg to assure absolute backlash free movement of the spindle head-column system. The ways itself are of high quality tool steel carefully hardened and precision ground, Further the slideways are equipped with two adjustable tapered plates (gibs) which are lined with plastic as in the case of the table slideways. This is needed to reduce vibration on the entire machine. The feed system is again the same as above.

The column unit contains a balance weight of 900Kg which is connected with wire ropes and four roller blocks on top of the column to the spindle head

Kinds of Products and Specifications

MODEL			MCH-20	MCH-30	MCV-20
Table Working Area		mm	630x630 (24.8x24.8)	800x800 (31.4x31.4)	1500x600 (59x23.6)
Table Indexing			1°x360	1°x360	–
Table Load Capacity		Kg	1600 (3.527 lb)	2000 (4.410 lb)	2000 (4.410 lb)
Spindle Center to Table Top		mm	0~730 (0~27.5)	–100~800 (–4~31.5)	100~800 (4~31.5)
Spindle Nose To Table Center		mm	100~730 (3.9~28.7)	100~900 (4~35.4)	610 (24)
Travel	X axis	mm	800 (31.4)	1200 (47.2)	1300 (51.2)
	Y axis	mm	700 (27.5)	900 (35.4)	630 (24.8)
	Z axis	mm	630 (24.8)	800 (31.5)	700 (27.5)
Feed Rate (XYZ axis)		mm/mm	0~7000 (0~275)	0~700 (0~275)	0~7000 (0~27.5)
Rapaid Traverse		mm/mm	10000 (390)	10000 (390)	10000 (390)
Spindle Nose		ISO	R297/No. 50	R297/No. 50	R297/No. 50
Spindle Speeds		r.p.m.	25~3550	14~3550	25~3550
Spindle Speed Range			inf. var.	inf. var.	inf. var.
Spindle Motor		Kw	15AC	22AC	15AC
Magazine Capacity		EA	20 (40)	40	20 (40)
Tool Selection			random	random	random
Max. Tool (Dia/Length/Weight)			140/300/20 (5.5/11.8/44 lb)	140/300/20 (5.5/11.8/44 lb)	140/300/20 (5.5/11.8/44 lb)
Standard Control			FANUC 6MB	FANUC 6MB	FANUC 6MB
Floor Space		mm	3900x3800 (153x149)	3400x4200 (133x165)	4000x3800 (157.5x149.6)
Weight (approx.)		Kg	13,000 (28,652 lb)	16,000 (35,264 lb)	13,000 (28,652 lb)

in front in order to balance the weight of the spindle head and release tension on the ballscrew and the bearings of the feed system. The feed system itself is designed the same way as mentioned above. On the side of the column an oil cooling system is mounted to cool the oil in the spindle head during operation.

The spindle head carrying the 15 Kilowatt spindle motor contains a gear train to reduce the motor speed of 4200 rpm to 3550 rpm or 890 rpm on the spindle. All other needed spindle speeds are obtained by varying the motor speed down to 150 rpm. To allow a vibration free operation at these high rotational speeds high precision ground gears and bearings are used for the entire spindle head gear train. The shifting of the gears from high to low range is done automatically by the hydraulic rotary cylinder and a set of solenoid valves which is in turn controlled by the electronic system.

The CNC-control is consisting of the overarm control panel, the CNC-control and the electric cabinet. The electric cabinet is containing the velocity and position-control units for the three feed motors and the spindle motor as well as other control gear needed for the interface between the CNC-control and the machine. The hydraulic unit is divided into two parts, the pump unit which is mounted separately behind the machine and the solenoid valve units mounted of the column. The solenoid unit is controlling the flow of hydraulic oil to the different cylinders and hydraulic motors in the ATC and in the spindle head, while the pump unit is consisting of tank, hydraulic pump and motor.

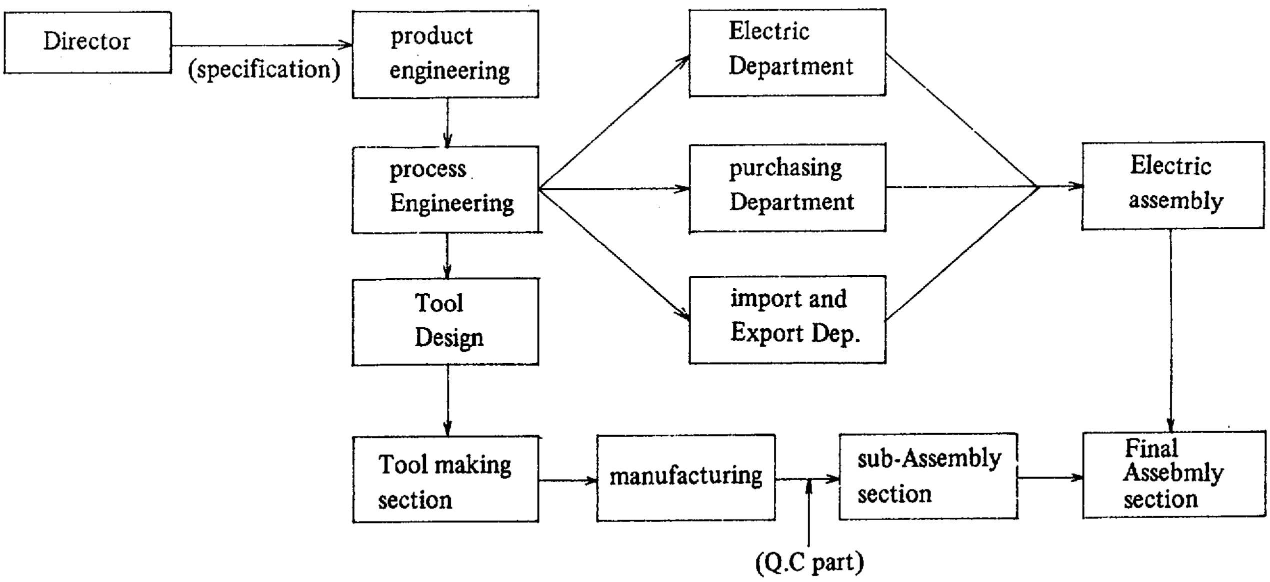
Automatic Tool Changer

The tool changer is designed as 20 place disc type magazine allowing tools with a standard Taper NT No. 50 (ISO R 297) with sizes up to 140mm in diameter and 300mm in length. The maximum weight is 20Kg. Tools with a diameter up to 250mm can be used, when the neighbouring places are kept free.

A powerful hydraulic motor combined with a planetary gear drive is used to rotate and position the magazine.

All movements are exactly controlled in their endpositions and electrical interlocks are asuring proper operation. In order to manufacture high reliable and accurate heavy-duty machining centers a company has to be well organized. From the Design of the product till the ready machining center many steps have to be taken.

Manufacturing Process



Required Machinery and Equipments

- o Engine Lathe
- o High speed precision Lathe
- o Turret Lathe
- o Milling machine
- o NC Lathe
- o Engraving machine
- o Planner
- o Shaping machine
- o Slotter
- o Boring machine
- o Broaching machine
- o Tapping machine
- o Rivetting machine
- o Drilling machine
- o Radial drilling machine
- o Tool Grinding machine
- o Hobbing machine
- o Lapping machine
- o NC wire cutting machine
- o Electric Discharging machine
- o Balancing machine
- o Hydraulic press
- o Hack saw
- o Gear Tester
- o Electric Furnace
- o High frequency Heat treatment Facility
- o Shearing machine
- o Projection welder
- o Spot welder
- o Seam welder
- o Butt welder

Required Raw material and parts

- o Table unit
- o Saddle unit
- o Steel plate
- o Steel pipe
- o Spindle Head unit
- o Feed unit
- o Ball screw
- o Duct unit
- o Bed unit
- o Column unit
- o Air unit Base
- o Cover unit
- o Splash guide unit
- o Magazine unit
- o NC & motor

Example of Plant Capacity and Construction Cost

1) Plant capacity : 400 sets/year
   * Basis : 8 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$1,100,000
o Utility facility	:	US$ 300,000
o Installation cost	:	US$ 200,000
Total	:	US$1,600,000

3) Required Space

o Site area	:	40,000 m^2
o Building area	:	12,000 m^2
Total	:	52,000 m^2

4) Personnel Requirement

o Manager	:	10 persons
o Engineer	:	150 persons
o Operator	:	200 persons
Total	:	360 persons

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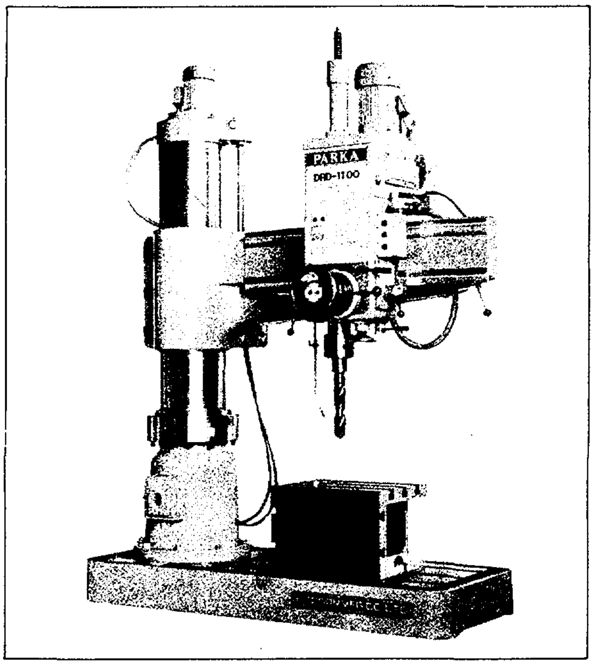
FILE: P-22
ISIC: 3823

Drilling Machine Making Plant



The drilling machine is a tool which is equiped with instruments that can give rotation and feed movement to the twist drill.

It's main functions are single purpose operation to bore, reaming, boring, counter boring, counter sinking, spot facing, and tapping with the help of other proper instruments.

The general structure of the drilling machine consists of main driving system which gives rotary motion to the shaft fixing other working instruments and changes rotation speed, feed system of the main shaft which gives feed movement to the shaft, and column which secures the base spindle box to the base.

It is also called bench drilling machine because it is used usually being secured to the bench.

High speed rotation is required because it is used mainly to bore small holes, driving of the main shaft is made mainly by V-Belt, and transference of the main shaft is made by hand.

It has the same structure as that of the bench drill press but the two of them are different each other in that the upright drilling machine can transfer and control the distance of transference automatically.

In driving, small size upright drilling machine uses belt, but medium or large size upright drilling machine uses gear.

There are two kinds of tables which are square and round respectively.

They are almost such tables as rotate around the column.

Large and heavy iron and steel materials to work difficult to move when you want to bore many holes on them.

This radial drilling machine has, as a suitable machine to bore holes on such a large and heavy iron and steel materials, an arm to transfer drilling head levelly.

And, it can work without moving the large and heavy iron and steel material because the arm can rotate with the column being the center and can move up and down from the column.

Kinds of Products and Specifications

(1) Upright drilling machine

Machining Capa		
Drilling (steel, cast iron)	mm	40/50
Tapping (steel, cast iron)	mm	M22/M26
Dimensions		
Swing	mm	560
Diameter of table	mm	520
Vertical traverse of table	mm	510
Max. Distance spindle to tale	mm	745
Max. Distance spindle to base	mm	1130
Diameter of column	mm	175
Spindle		
Diameter of spindle/Quill	mm	62/70
Spindle stroke	mm	180
Taper of spindle	mm	MT #4
Number of spindle speed	step	12
Range of spindle speed	r.p.m	75-1525
Number of feed speed	step	3
Range of feed speed	mm/rw	0.1-0.3
Spindle drive motor	Kw	1.5

(2) Radial drilling machine

Model	DRD – 2000	DRD – 1500	DRD – 1100	DRD – 915
Drilling(steel/cast iron)	75/90	50/60		35/45
Boring (steel/cast iron)	220/280	100/150		
Tapping (steel/cast iron)	M60/M80	M25/M40		M25/M40
Dimensions				
Diameter of column	500	350	320	230
Distance, center of spindle to face of column	400-2015	345-1525	325-1130	300-915
Ditance Base to spindle nose	400-1690	365-1430	350-1260	290-1100
Traverse of Arm on column	890	765	610	590
Max. Height	3280	3160	3000	2370
Base size	3100x1250	2300x880	1900x780	1550x700
Working surface of base	2080x1240	1630x860	1270x760	915x560
Net weight (Kg)	7500	4500	3000	1500
Spindle				
Diameter spindle/quill	85/105	70/105	70/105	65/80
Vetical traverse of spindle	400	300	300	220
Taper of spindle	MT #5	MT #5	MT #5	MT #4
Number of spindle speed	16	12	12	9
Range of spindle speed	22-2080	40-1850	40-1850	49-1524
Number of feed speed	12	6	6	3
Range of feed speed	0.04-1.33	0.06-1.0	0.06-1.0	0.1-0.35
Motors				
Spindle drive motor	7.5 Kw	3.7 Kw	3.7 Kw	2.2 Kw
Arm elevation motor	3.7	0.75	0.75	0.75
Clamping motor	1.5	0.75	0.75	
Coolant pump motor	0.1	0.1	0.1	0.1

Process Description

Drilling machine consists of casting products which forms the outer appearance of the machine and maintains its strength, and steel products which drive and transfer the main shaft being fabricated in the spindle box.

The casting products, as main frame of the machine, are treated by annealing treatment after casting with high quality iron, and casting stress can be removed because the casting products are left free in atmosphere and treated with artificial seasoning.

Besides, processing stress can also be removed, there is no secular change and accuracy of the machine can be maintained for a long time because this casting part is worked carefully by planer, remains for a specified period in atmosphere after rough cutting.

Among these parts, progression of spindle box passes through 13 progression stages on mechanical processing including marking, planner processing, machining center, boring, drilling, milling, and passes through 13 progression stages in fabrication including painting, scraping honing, and attachment of assembly components.

After that it can be fabricated in the arm of the radial drilling machine.

Important parts of steel processing are treated with proper heattreatment such as annealing and quenching, and with mechanical processing according and quenching, and with mechanical processing according to their material qualities after rough cutting.

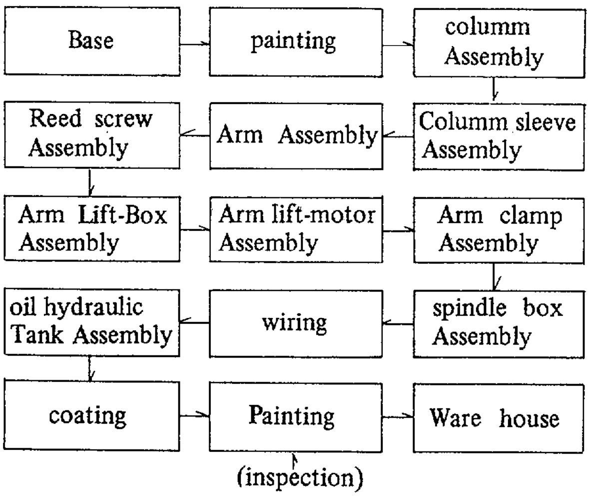
And after proper heattreatment according to their material qualities and functions, precise processings including inner bore, outer bore, and gear grinding begin.

Let's take the manufacture progression of DRD-1500 spindle for example.

After passing through 3 progression stages in mechanical processing prior to Heat-treatment, and then, after passing through 5 progression stages including drilling, milling, and spline, it comes to be treated with heat treatment.

And after heattreatment, it is fabricated after passing through 4 progression stages of precise grinding.

Manufacturing Process



Export of Korean drilling machine

year	No. of machine	value($US1,000)
1979	4,703	977
1980	2,026	977
1981	804	869

Export of Korean Korean drilling machine for every continent (1981)

Asia	Europe	N.America	S.America	Oceania	Africa	Total
170	602	15	1	9	5	802

Required Facilities

Foundry facility
Heat Treatment facility
Lathe
Milling machine
Drilling machine
Boring machine
Planer
Gear Hobbing machine
Shaping machine
Grinding machine
Engraving machine
Painting facility

Required Raw Materials

(unit: Kg)

Material \ Type	DUD-560	DRD-2000	DRD-1500	DRD-1100	DRD-915
Grey cast iron	728	7980	4453	2962	1545
Bronze cast	12	62	20	20	22
Al cast	–	100	22	18	14
High carbon steel	195	375	325	270	138
Speical steel	28	284	200	200	75
General steel	24	42	38	33	28

Example of Plant Capacity and Construction Cost

1) Plant capacity : 100 sets/month
   * Basis : 8 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$600,000
o Utility facility	:	US$100,000
o Installation cost	:	US$100,000
Total	:	US$800,000

3) Required Space

o Site area	:	8,000 m^2
o Building area	:	2,000 m^2
Total	:	10,000 m^2

4) Personnel Requirement

o Manager	:	5 persons
o Engineer	:	25 persons
o Operator	:	30 persons
Total	:	55 persons

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Hydraulic Press Making Plant

View of Deep Drawing Press

The hydraulic press has a wide range of application scope and used in all the spheres of various industries: from the routine necessities of our daily life such as home utensils including tablewares, spoons, pot and other kitchen wares as wall as home-electric goods containing TV sets, radios and electric fans, electric jars to the electric wires and tools such as electric wall cutlets, plugs.

This unit is also employed in the auto-industry and applied in the process of manufacturing the frames of automobile and the aluminum sashes. This unit is of high efficiency in manufacturing at high speed and it is constituted of high precision on safe, hard basis.

It is completely automatic, so that this unit is easy to operate. At whatever position of strokes this equipment can give full pressure and performance ability without bringing on an excessive loading, also it is easy and simple to control and maintain the pressure applied. In forming and moulding the synthetic resins and rubber goods, it is necessary to use the hydraulic moulding press, producing the materials with 50 to 1,000 Ton's capacity.

The hydraulic deep drawing press 100 to 5000 ton's capacity are employed to form and mould the various steel plates such as steel plates and stainless steel plates as well as the body and parts of an automoble, electric-communication equipments and kitchen wares.

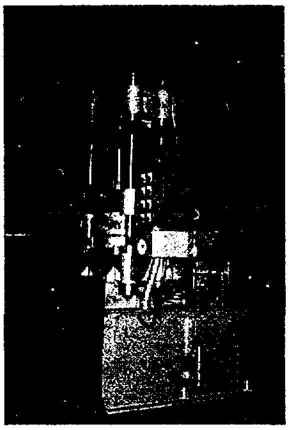
To mould compound plates, hard boards, resin plates and other materials for construction we need hydraulic hot press which can make out things with 50 to 5,000 ton's capacity. For the purpose of packing the various kinds of textiles and fishing nets, hydraulic packing press with the production-ability of 100 to 500 ton's capacity should be used.

Hydraulic forging press can be employed in moulding the parts of automobiles and the welding parts of machinery for mining work. In order to manufacture the non-ferrous materials (including copper, bronze, aluminum and aluminum-alloy of which the tube or bars are generally made up), we should employ Non-Ferrous horizontal Extrusion press with 300 to 3,000 ton's capacity and also need to manufacutre continuous casting and form the materials of Al, Zn & Mg, Horizontal cold chanber type die-casting machine with the 100 to 500 ton's capacity.

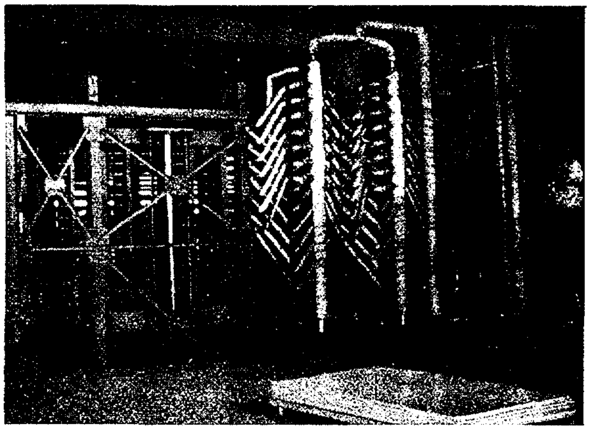
Kinds of Products and Specifications

○ Hydraulic Molding Press

Model / Item	Unit	SCMP 37	SCMP 50	SCMP 70	SCMP 100	SCMP 150
Pressing Capacity	tons	37	50	70	100	150
Ram stroke	mm	250	280	380	380	450
Heating plate size	mm	405x405	405x405	460x460	500x500	510x510
Daylight	mm	400	450	600	600	670
Down Ward speed	mm/sec	50	50	75[	60	80
Upward speed	mm/sec	35	35	50	50	80
Pressing speed	mm/sec	2	2	2	1.5	1.2
Motor	HP	3	3	5	5	7.5
Pressure	Kg/cm^2	210	210	210	210	210
Net Weight	Kgs	1,300	500	2,000	2,500	3,000



View of molding press

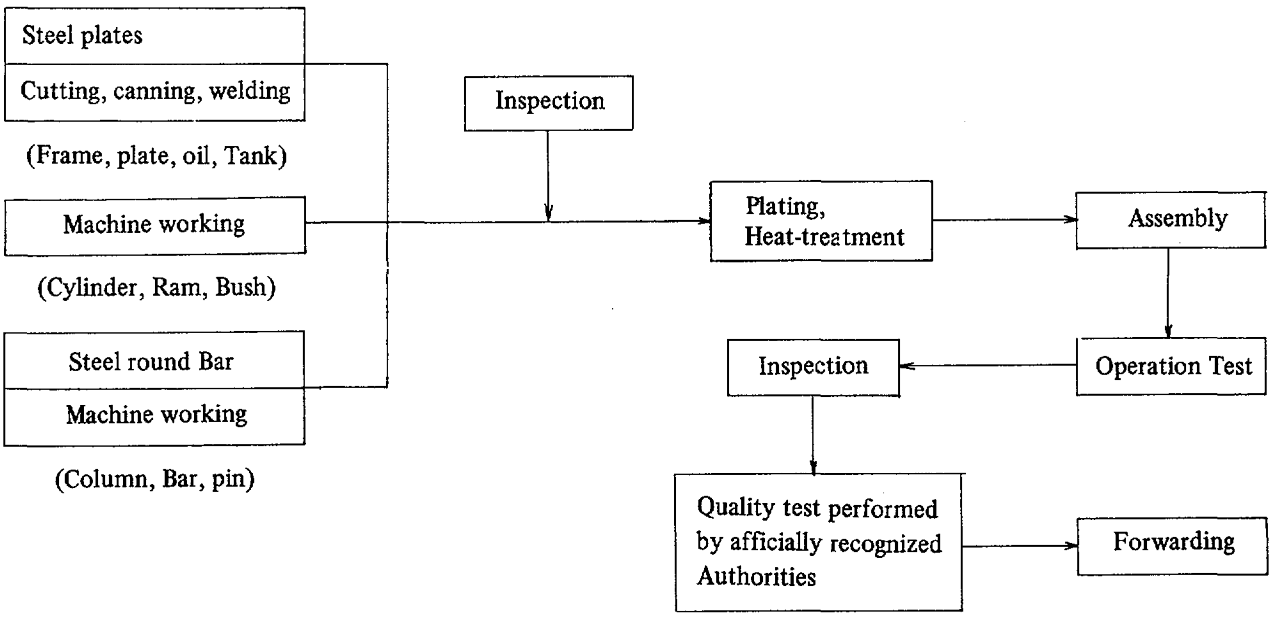


View of Hydraulic Hot Press

2. Hydraulic Deep Drawing Press

Model	SDP 150-50	SDP 200-70	SDP 300-100	SDP 500-150	SDP 750-250	SDP 1,000-300	SDP 1,500-500
Pressing Capacity (ton)	150	200	300	500	750	1,000	1,500
Bolster Size (m/m)	1,000 1,200	1,000 1,200	1,500 2,000	1,500 2,000	2,000 2,500	2,000 3,000	2,000 3,500
Daylight (m/m)	800	900	1,200	1,200	1,700	2,000	2,500
Ram Stroke (m/m)	500	600	800	800	1,050	1,500	1,500
Die Cushion (ton)	5-50	5-70	10-100	10-100	25-250	30-300	150-500
Die Cushion Stroke (m/m)	200	250	300	300	500	600	700
Motor (HP)	25	40	75	75	200	300	300
Downward Speed (mm/sec)	200-300	200-300	100-250	100-250	150-200	150-200	150-200
Upward Speed (mm/sec)	200-300	200-300	200-350	200-350	150-200	150-200	150-200
Pressing Speed (mm/sec)	11-22	10-20	10-20	10-20	10-20	15-30	10-20
Pressure (Kg/cm)	210	210	210	210	210	210	210
Net Weight (ton)	16.5				68	92	

Manufacturing Process



Production and Export of Korean hydraulic press

year	Production (No. of machine)	Export ($ US1,000)
1979	2,084	189
1980	1,401	542
1981	2,155	197

Required Facilities

- o Lathe
- o Milling machine
- o Shaping machine
- o Plano miller
- o Welding machine
- o Radial drilling machine
- o Grinding machine
- o Hobbing machine
- o Boring machine
- o Crane

Required Raw Material

- o Steel plate (Frame, oil Tank)
- o Steel round Bar (Column, Bar, pin)
- o Steel casting (cylinder, Ram)
- o Bronze (Bush, Adapter, piston)
- o Hydraulic Equipment (Pump, valve, motor)
- o Electric Equipment (Magnet switch, N.F.B.)
- o Steel pipe

Example of Plant Capacity and Construction Cost

1) Plant capacity : 100 sets/month
   * Basis : 8 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$500,000
o Utility facility	:	US$100,000
o Installation cost	:	US$100,000
Total	:	US$700,000

3) Required Space

o Site area	:	3,000 m^2
o Building area	:	1,000 m^2
Total	:	4,000 m^2

) Personnel Requirement

o Manager	:	5 persons
o Engineer	:	25 persons
o Operator	:	50 persons
Total	:	80 persons

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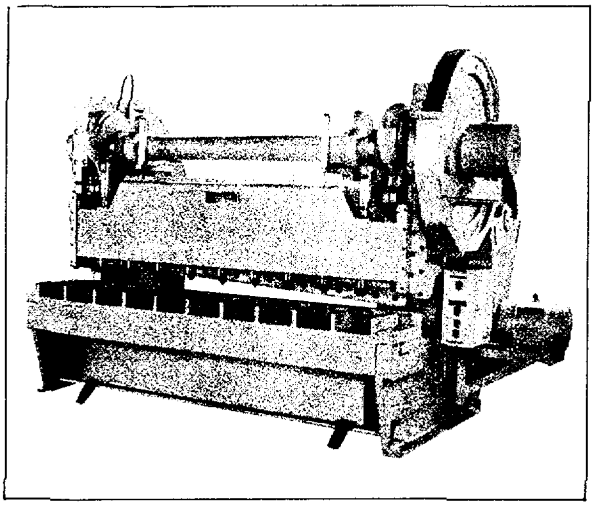
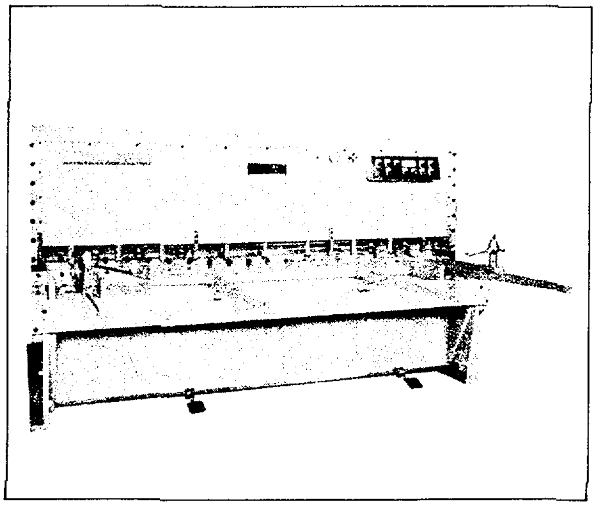
FILE: P-24
ISIC: 3823

Shearing Machine Making Plant





Shearing machines are used when manufacturing various kinds of containers, control panels, kitchen tools and agricultural machines by cutting the plates such as steel plates, stainless steel plates and non-ferrous plates.

Steel plating works cannot be done without this equipment, of which the cutting-work with precision has great influence upon steel-plating work.

This unit is applied in almost all the areas of manufacturing industry including the automobile, bicycle, electricity, electronic products and vessel as well as the rolling mill, pressing-factory.

Characteristics of this unit are as follows.

- Hard and strong welding structure made up of thick steel plate.
- Used as its materials, the special Alloys with exact precision and endurance.
- Ensures the perfect, stability because this unit employs the preventive ways from breakdown and excessive-load.
- Stable combination of steel plates.

Kinds of products and Specifications

(How to determine pressure)

Punching pressure on a flat work can be obtained from the following fomula.

P = T x L x S (Kg)

T = Plate thickness of material to be punched

L = Length of periphery of punching shape

S = Shearing-resistance of the material

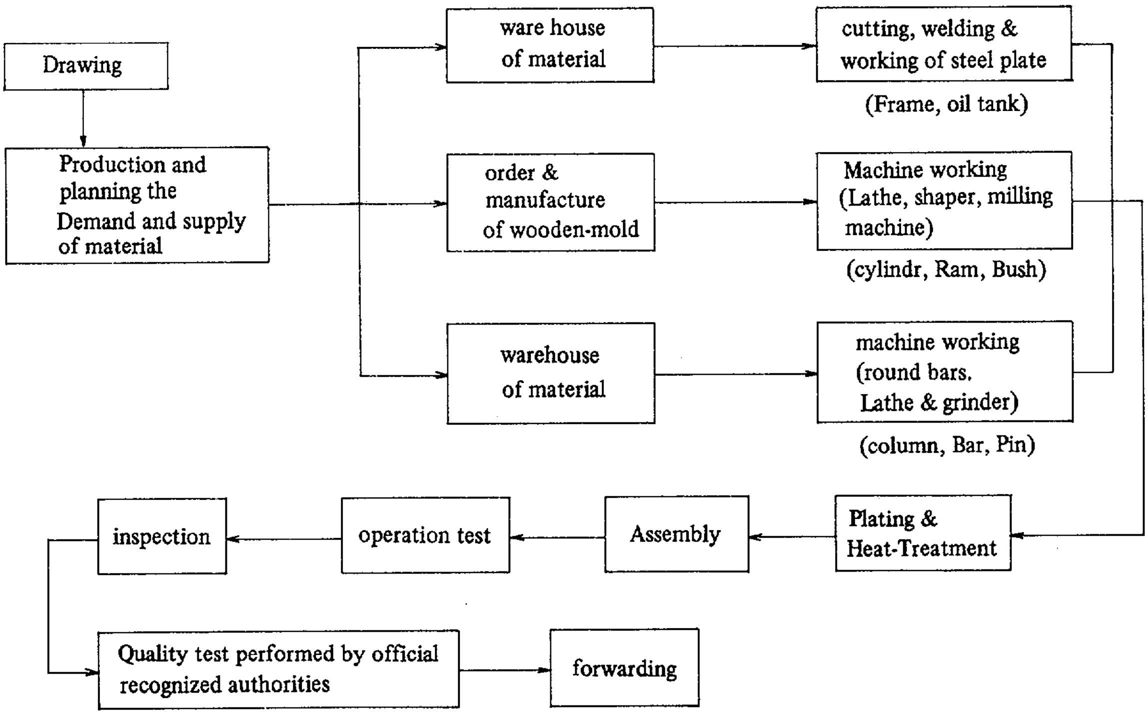
Data for Calculating punching capacity

materials	Shearing Resistance (Kg/mm^2) Mild	Shearing Resistance (Kg/mm^2) Rigid	tensile strength (Kg/mm^2)
iron plate	32	40	34 - 50
steel plate	45 - 50	35 - 60	
stainless steel	52	56	60 - 75
duralumin	22	38	
copper	18 - 22	25 - 30	21 - 24
Brass	22 - 30	30 - 40	34 - 42
Aluminum	7 - 9	13 - 16	8 - 15

Specifications

Form Number	Cutting Ca. Pacities T x L	Number of Storkes per min.	Gap of Flame (m/m)	Angle of Blade	Length of Blade(m/m)	Motor HP Required (kw)
GS 3 – 6	10 x 2000	25	350	$2^\circ 30'$	2270	15 (11)
GS 3 – 8	10 x 2500	25	350	$2^\circ 30'$	2830	15 (11)
GS 3 – 10	10 x 3050	25	350	$2^\circ 30'$	3330	20 (15)
GS 4 – 6	13 x 2000	25	350	$2^\circ 30'$	2350	15 (11)
GS 4 – 8	13 x 2500	25	350	$2^\circ 30'$	2830	20 (15)
GS 4 – 10	13 x 3050	25	350	$2^\circ 30'$	3490	25 (19)
GS 5 – 6	16 x 2000	25	350	3°	2385	25 (19)
GS 5 – 8	16 x 2500	25	350	3°	2900	25 (19)
GS 5 – 10	16 x 3050	18	350	3°	3450	25 (19)
GS 6 – 8	20 x 2500	20	350	3°	2900	30 (22)
GS 6 – 10	20 x 3050	18	350	3°	3410	30 (22)
GS 8 – 6	25 x 2000	18	350	$3^\circ 30'$	2490	30 (22)
GS 8 – 8	25 x 2500	18	350	$3^\circ 30'$	2990	40 (30)
GS 8 – 10	25 x 3050	18	350	$3^\circ 30'$	3380	50 (37)
GS 10 – 6	32 x 2000	18	350	4°	2540	40 (30)
GS 10 – 8	32 x 2500	18	350	4°	3040	40 (30)
GS 10 – 10	32 x 3050	18	350	4°	3350	50 (37)
GS 13 – 6	40 x 2000	17	350	5°	2530	50 (37)
GS 13 – 8	40 x 2500	17	350	5°	3030	60 (45)
GS 13 – 10	40 x 3050	17	350	5°	3580	75 (55)
GS 16 – 5	50 x 1550	17	350	$5^\circ 20'$	2035	75 (55)

Manufacturing Process



Export of Korean shearing machine (1981)

No. of machine	Value ($)
31	408,660

Export of Korean shearing machine for every continent (1981)

Asia	N. America	Africa	Total
28	2	1	31

Required Facilities

Lathe
Radial drilling machine
Shaping machine
Milling machine
·Face Lathe
Boring machine
Grinding machine
Slotter
Bending Roller
Fork Life Truck
Auto welder
Ar gas welder
Auto gas cutter

Required Raw Material

Steel plate (Frame, oil Tank)
Steel round Bar (Bar, pin)
Steel casting (cylinder, Ram)
Bronze (Bush, Adapter, piston)
Steel pipe
Forged steel (Knife, holder)
Hydraulic equipment (Pump, value, motor)
Electric equipment (N.F.B. magnet switch)

Example of Plant Capacity and Construction Cost

1) Plant capacity : 100 sets/month
   * Basis : 8 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$500,000
o Utility facility	:	US$100,000
o Installation cost	:	US$100,000
Total	:	US$700,000

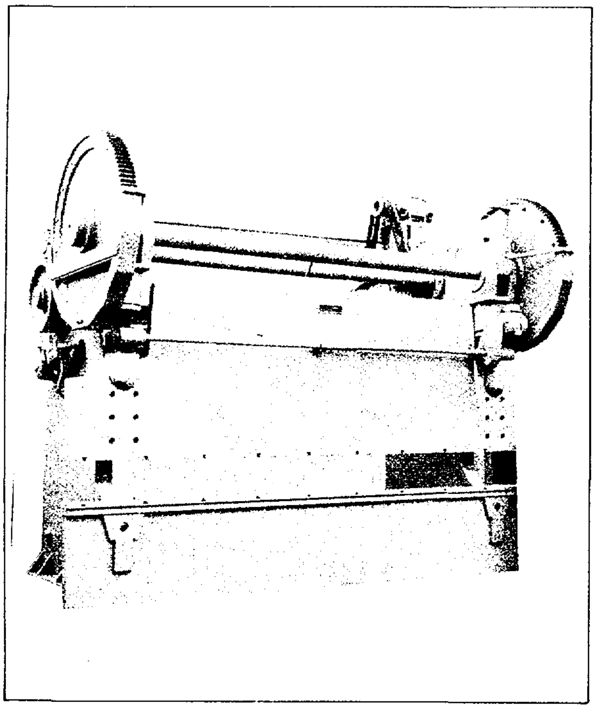
3) Required Space

o Site area	:	3,000 m^2
o Building area	:	1,000 m^2
Total	:	4,000 m^2

4) Personnel Requirement

o Manager	:	5 persons
o Engineer	:	25 persons
o Operator	:	30 persons
Total	:	55 persons

Press Brake Making Plant



Press Brakes are used to manufacture Containers, Kitchen wares and agricultural tools Consisting of bended steel plate materials such as steel plates and stainless steel plates.

The Typical type of this unit prevalently employed in Korea has the productive Capacity of manufacturing and processing the materials of 50 to 1,000 ton's capacity.

Constituting parts of this equipment such as frames, Rams and Beds are made up by fully making use of the welded structure of thick steel plates.

This unit is designed to revolve and adjust worm gear precisely by Separate power in order to keep the balance state of the right and left-side and also designed to be controlled by an opening lever.

In order to avoid wearing-down and to maintain for a long time the state of precision with which the unit operates, bronze is used as a material consituting the bushing of the axis of gyration.

And this equipment is made up so that the elasticity of ram and die should be maintained in terms of dynamics when pressurized.

The general type of press brakes which are Produced in Korea is the one which needs the pressure of 80 to 150 tons to be applied when blending the inner angle of steel plates with the thickness of 3.2 to 7.0mm.

According to the thickness of the steel plate, the Weight by Ton to be applied various as shown in the following chart.

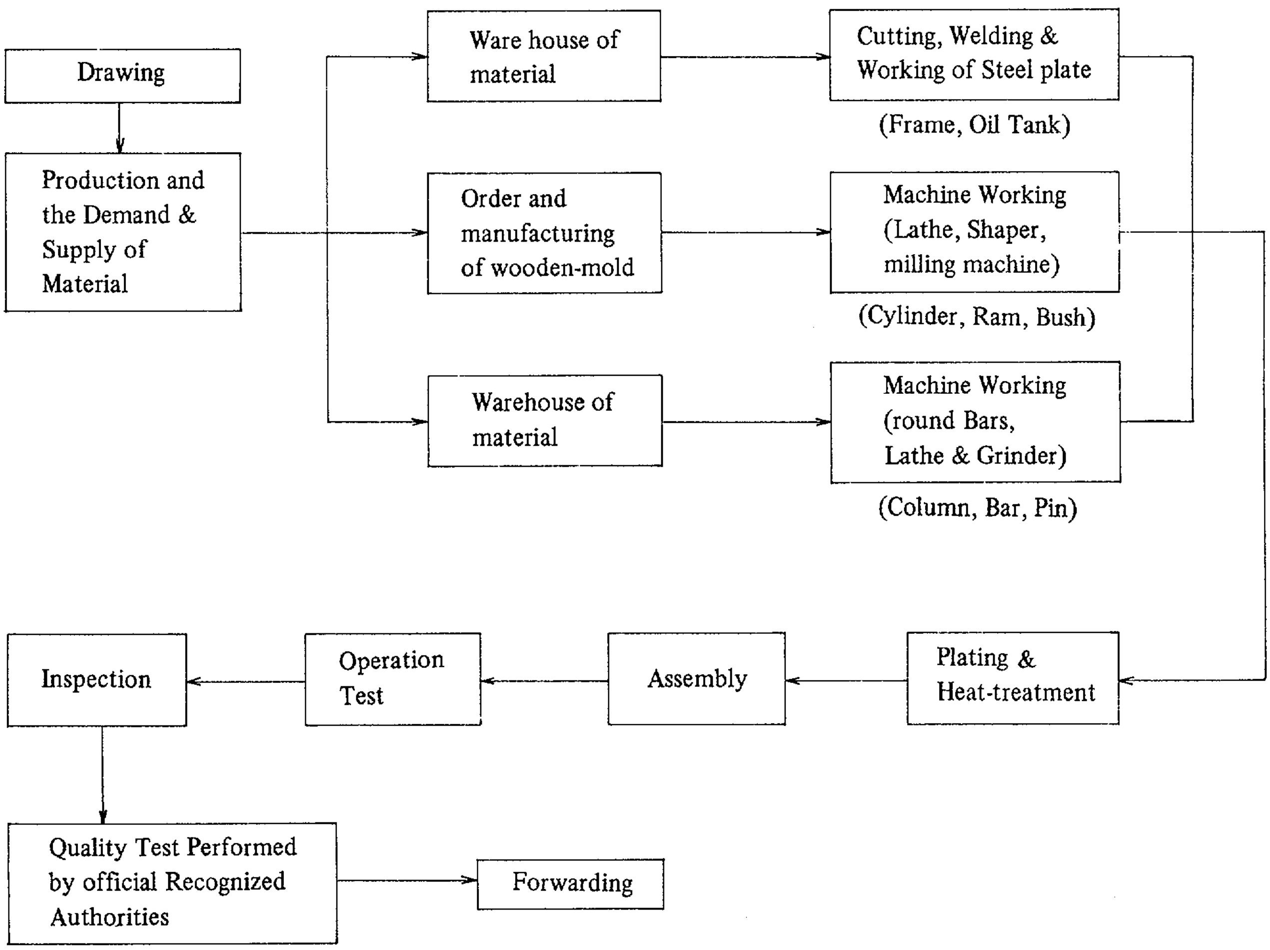
PRESS TONNAGE REQUIRED PER LINEAR FOOT TO BEND MILD STEEL

Plate Thickness		Width of Vee Die Opening																						
Inches	mm	¼"		3/8"		½"		¾"		1"	¾"	1"	1½"	2"	2½"	3"	3½"	4"	5"	6"	7"	8"	10"	12"
.036	0.66	3.1	2.3	1.7	1.4	1.1																		
.448	1.22	5.3	4.0	3.0	2.5	2.2	1.7	1.3																
.060	1.52	9.6	7.1	5.6	4.5	3.8	2.8	2.2	1.8	1.5														
.075	1.9		11.9	9.2	16.7	6.3	4.7	3.5	3.0	2.5	2.1	1.8												
.105	2.66					13.1	9.7	8.0	6.5	5.6	4.6	4.1	3.2											
.120	3.05					19.2	14.2	11.1	9.0	7.5	6.3	5.5	4.4	2.9										
.130	3.43						18.6	14.5	11.9	9.9	8.5	7.3	5.8	4.0										
3/16	4.76							27.4	23.1	19.3	16.4	14.3	11.2	7.5	5.7	4.4								
1/4	6.35									39.4	33.3	29.5	22.7	15.4	11.4	9.0	7.4	6.1						
5/16	7.94											50.4	39.8	27.0	19.7	15.3	12.7	10.5	7.7					
3/8	9.53												61.6	42.3	30.9	24.0	19.6	16.3	12.3	9.5	11.2			
7/16	11.11													61.7	45.8	35.4	28.6	24.4	17.3	14.8	15.9			
1/2	12.70													85.2	63.6	48.8	39.7	33.3	24.6	19.4	15.9	13.1		
5/8	15.88														110.0	86.2	70.0	58.3	43.1	33.3	27.4	23.3	16.9	
3/4	19.05															138.0	110.0	93.0	68.7	53.[illegible]	43.6	36.5	27.1	21.0
7/8	22.22																165.0	137.0	104.0	80.7	64.6	52.9	39.7	31.6
1	25.40																	197.0	143.0	113.0	91.2	76.2	56.3	44.2

Types of products and specifications

Model	Bending capacity	Tonnage	Length of table	Inside length of table	Width of table	Open Height	Overall Height	Depth	Gap	Stroke	Motor
	m/m		m/m	m/m	m/m	m/m	m/m	m/m	m/m	m/m	
SCF–1	3.2x1000	30	1000	800	162	300	1500	700	200	180	2HP
SCF–2	3.2x1300	45	1300	1100	162	300	1575	800	200	180	2HP
SCF–3	3.2x1500	54	1500	1300	162	300	1575	835	200	200	2HP
SCF–4	3.2x1700	75	1700	1500	200	350	1750	1000	200	200	2HP
SCF–5	4.5x2000	100	2000	1670	200	350	2000	1050	200	220	3HP
SCF–6	4.5x2300	100	2300	1970	200	350	2200	1250	200	220	3HP
SCF–7	4.5x2500	150	2500	2270	200	350	2400	1400	200	220	5HP
SCF–8	4.5x2800	150	2800	2470	200	350	2550	1500	200	220	5HP
SCF–9	4.5x3000	200	3000	2670	250	350	2600	1600	200	220	7.5HP
SCF–10	4.5x3300	200	3300	2970	250	350	2700	1650	200	220	7.5HP
SCF–11	4.5x4000	250	4000	3670	250	350	3600	1800	200	220	15HP
SCF–12	4.5x5000	300	5000	4670	250	350	4400	2000	200	220	15HP
SCF–13	6.0x1300	70	1300	1100	162	300	1575	800	200	180	2HP
SCF–14	6.0x1500	100	1500	1300	162	300	1650	835	200	220	3HP
SCF–15	6.0x2000	150	2000	1670	200	350	2150	1250	200	220	5HP
SCF–16	7.0x2500	200	2500	2270	200	350	2450	1400	200	220	7.5HP
SCF–17	7.0x3000	250	3000	2670	250	350	3050	1600	200	220	15HP
SCF–18	7.0x4000	300	4000	3670	250	350	3600	1800	200	220	15HP
SCF–19	7.0x5000	350	5000	4670	250	350	4400	2000	200	220	15HP

Manufacturing Process



Required Facilities

- Lathe
- Radial Drilling machine
- Shaping Machine
- Milling machine
- Face Lathe
- Boring machine
- Grincling machine
- Slotter
- Bending machine
- Fork Lift Truck
- Auto Welder
- Ar Gas Welder
- Auto Gas Cutter

Required Raw Material

- Steel plate (Frame, Oil Tank)
- Steel Round Bar (Bar, Pin)
- Steel Casting (Cylinder, Ram)
- Bronze (Bush, Adapter, Piston)
- Steel Pipe
- Forged Steel (Knife, Holder)
- Hydraulic Equipment (Pump, Valve, Motor)
- Electric Equipment (N.F.B. Magnet Switch)

Example of Plant Capacity and Construction Cost

1) Plant capacity : 100 sets/month
   * Basis : 8 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$500,000
o Utility facility	:	US$100,000
o Installation cost	:	US$100,000
Total	:	US$700,000

3) Required Space

o Site area	:	3,000 m^2
o Building area	:	1,000 m^2
o Other	:	m^2
Total	:	4,000 m^2

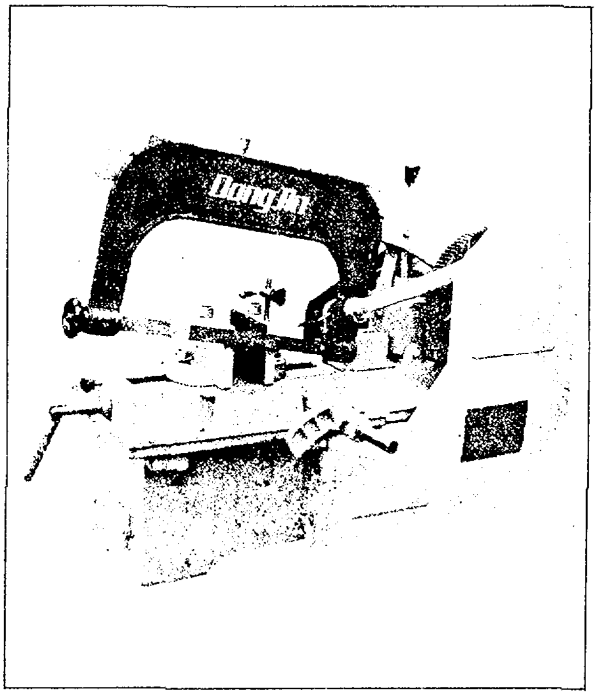
4) Personnel Requirement

o Manager	:	5 persons
o Engineer	:	15 persons
o Operator	:	30 persons
Total	:	50 persons

Hack Sawing Machine Making Plant

This equipment as a kind of steel processing achines is used for cutting-processing of iron & steels (round-material; angular-material, plate goods) and non-ferrous metal. Describing briefly the structure of this unit, there are various parts constituting this machine ; the bed part contains operating motor, cold-water supply system as well as the electric control system. The guide part maintains the system giving the alternate-movement to the Blade of the saw.

And the saw-blade for cutting is mounted on the frame part. The main medal part connects the shift-movement with the frame part. Other part is Gear-Box assembly varying the cutting speed of the saw-blade. It is possible to vary the speed at 2-stage the angles. The cutting-oil supply system is provided to prolong the longevity of the saw-edge and to improve the operation-efficiency of cutting-works. Also the electric and oil-hydraulic pressure safety equipment is mounted for the purpose of safe-operation of this machine.



View of Hack Sawing Machine.

Specifications

Model	SM-170	SM-180	SM-250
cutting capacity (mm)	150 x 152	180	225 (round 250)
Size of saw Blade (mm)	350 x 25 x 1.25	350 x 25 x 1.25	450 x 30 x 1.65
Stroke (mm)	80–152	130 – 190	90 – 130
Cord thickness (mm)	1.25	1.25	1.65
Motor	200W, 100/200V	400W, 100/200V	1.5Kw, 200V
Floor space (mm)	340 x 900 x 640	1,000 x 350 x 650	1,250 x 430 x 880
Net weight (Kg)	130	150	410

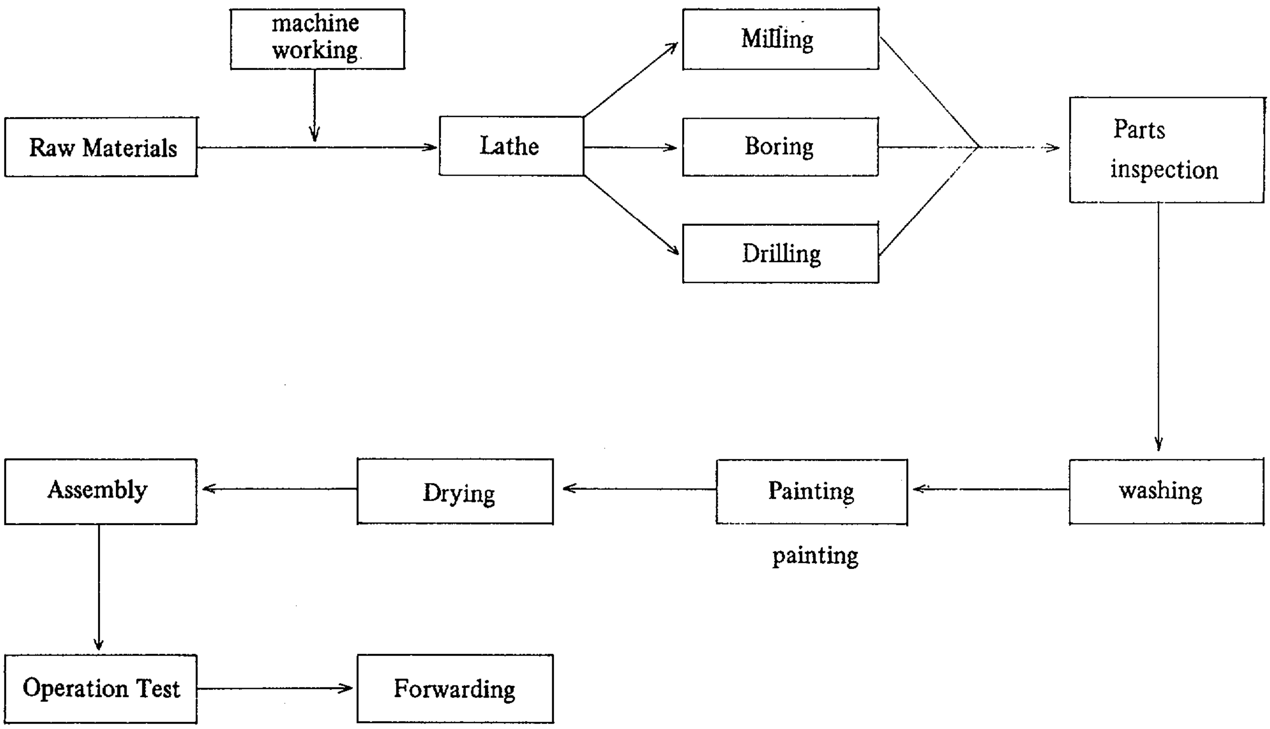
Export of Korean Sawing machine

year	No. of machine	Value ($US1,000)
1979	508	102
1980	162	100
1981	2,315	267

Export of Korean Sawing machine for Every continent (1981)

Asia	Europe	N. America	S. America	Africa	Total
477	32	20	1,777	7	2,313

Manufacturing process



Utilities

Electric power	: 50 Kw

Required plant site

Land	:	660 M^2
Building	:	330 M^2

Required Facilities

Lathe	4 Units
Milling machine	2 Units
Tapping & Drilling machine	2 Units
Bench drilling machine	2 Units
Shaping machine	1 Units
Roller Conveyor	1 Line
Air Compressor	1 Unit
Spray Booth	1 set
Shore hardness tester	1 set
Height gauge	1 set
Block gauge	1 set
Micrometer	4 sets
Tachometer	1 set
Vernier calipers	11 sets
Stop watch	1 set
Cylinder gauge	1 set
Electrical Level	1 set
Limit Gauge	1 set

Required Raw Material

Model	SM-170	SM-180	SM-250
Graphite cast iron	98.5 Kg	114.8 Kg	226.5 Kg
SS41 & S45C	83.9 Kg	89.3 Kg	138.4 Kg

Example of Plant Capacity and Construction Cost

1) Plant capacity : 100 sets/month
   * Basis : 8 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$400,000
o Utility facility	:	US$ 50,000
o Installation cost	:	US$ 50,000
Total	:	US$500,000

3) Required Space

o Site area	:	660 m^2
o Building area	:	330 m^2
Total	:	990 m^2

4) Personnel Requirement

o Manager	:	5 persons
o Engineer	:	25 persons
o Operator	:	50 persons
Total	:	80 persons

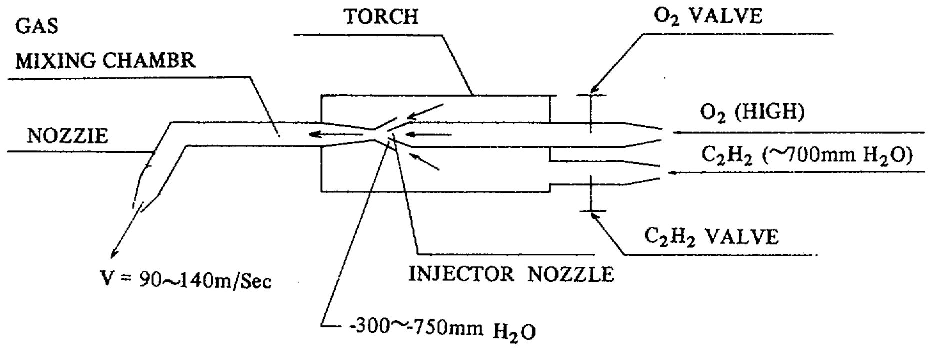
FILE: P-27
ISIC: 3823

Gas Welding Machine Making Plant

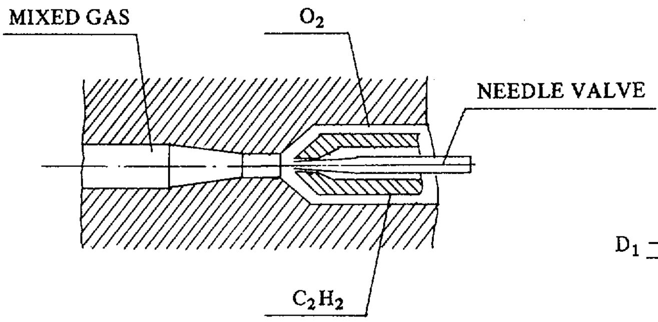
Low Pressure Gas Welding Machine which is widely distributed and used in South-eastern Asia including Japan and Korea, is called variable pressure type welding machine or French Type Welding Machine.

In the low pressure welding machine, low pressure acetylene gas (700mmHg) cannot push itself to the mixing chamber of torch to mix well with oxygen. Therefore, oxygen with higher pressure than acetylene is emitted through injector nozzle and by its absorption force sucks in acetylene into the mixing chamber.

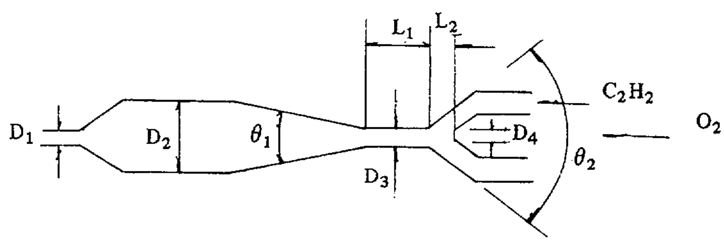
This Gas Welding machine is Convenient to handle and widely used because Small-sized nozzle weighs light and manipulation of the machine does not require much skill even for the beginners to master.



(The Structure of Low Pressure Type Welding Machine)



(The Structure of Variable Pressure Type Welding Machine)



The Structure of Injector-type Mixer

The efficiency of Low-pressure welding machine depends for the most part on the performance of injector.

The Injector should be capable of absorbing acetylene at least as much as oxygen with pressure 1-5 Kg/cm^2.

The specifications and appearances of injector type mixer are Varied in close relations with the diameter of the nozzle.

The following Figure illustrates a model of injector type mixer.

Symbol	Calculation
D_1	Nozzle Diameter
D_2	$D_2 = 3\ D_1 = 3\ D_3$
D_3	$D_3 = D_1$
D_4	$D_4 = D_1/3 = D_3/3$
θ_1	$10°$
θ_2	$60°$
L_1	$L_1 = 7\ D_1 = 7\ D_3$
L_2	$L_2 = 1.2\ D_1 = 1.2\ D_3$

Kinds of Products and Specifications

No. 00 Welding Machine

Length : 325mm
Weight : 300g

Nozzle No.	Welding Capacity (mm)	Gas Pressure (Kg/cm^2)	
		Oxygen	Acetylene
10	Thin plate	0.5–0.8	over 0.01
15	Thin plate	0.5–0.8	over 0.01
25	Thin plate	0.5–0.8	over 0.01
50	0.5 – 1.0	0.8–1.2	over 0.01
75	1.0 – 1.5	0.8–1.2	over 0.01
100	1.5 – 2.0	1.0–1.5	over 0.01
150	2.0 – 2.5	1.0–1.5	over 0.01

Small Size Welding Machine

Lenght : 395mm
Weight : 580g

Nozzle No.	Welding Capacity (mm)	Gas Pressure (Kg/cm^2)	
		Oxygen	Acetylene
25	– 0.5	0.8 – 1.0	over 0.2
50	0.5 – 1.0	1.0 – 1.5	over 0.2
75	1.0 – 1.5	1.5 – 2.0	over 0.2
100	1.5 – 2.0	2.0 – 2.5	over 0.2
150	2.0 – 2.5	2.5 – 3.0	over 0.2

Medium Size Welding Machine

Lenght : 435mm
Weight : 725g

Nozzle No.	Welding Capacity (mm)	Gas Pressure (Kg/cm^2)	
		Oxygen	Acetylene
50	1 – 2	1.5 – 2.0	0.2 – 0.3
75	2 – 3	1.5 – 2.0	0.2 – 0.3
100	3 – 4	1.5 – 2.0	0.2 – 0.3
150	3.5 – 5	1.5 – 2.0	0.2 – 0.3
225	5 – 7	2.0 – 3.0	0.2 – 0.3
350	7 – 9	2.0 – 3.0	0.2 – 0.3
500	9 – 13	2.0 – 3.0	0.2 – 0.3

Large Size Welding Machine

Length : 505mm
Weight : 1,175g

Nozzle No.	Welding Capacity (mm)	Gas Pressure (Kg/cm^2)	
		Oxygen	Acetylene
100	5 – 7	2.0 – 3.0	0.2 – 0.3
150	7 – 9	2.0 – 3.0	0.2 – 0.3
225	9 – 12	2.0 – 3.0	0.2 – 0.3
350	12 – 14	3.0 – 4.0	0.2 – 0.3
500	14 – 17	3.0 – 4.0	0.2 – 0.3
750	17 – 20	3.0 – 4.0	0.2 – 0.3
1000	20 – 25	3.0 – 4.0	0.2 – 0.3

Medium Size Gas Cutting Machine

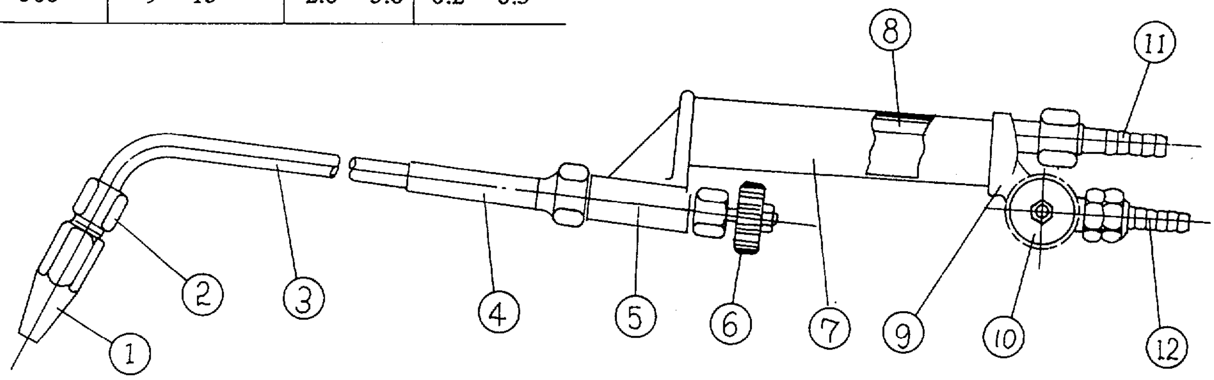
Lenght : 435mm
Weight : 825g

Nozzle No.	Cutting Capacity (mm)	Gas Pressure (Kg/cm^2)	
		Oxygen	Acetylene
1	3 – 10	2.5	0.2 – 0.3
2	10 – 20	2.5	0.2 – 0.3
3	20 – 30	3.0	0.2 – 0.3

Large Size Gas Cutting Machine

Length : 505mm
Weight : 1,200g

Nozzle No.	Cutting Capacity (mm)	Gas Pressure (Kg/cm^2)	
		Oxygen	Acetylene
1	3 – 20	2.5	0.2 – 0.3
2	20 – 50	3.0	0.2 – 0.3
3	50 – 100	3.0	0.2 – 0.3



No.	Description	No.	Description	No.	Description
1	Nozzle	5	Body	9	Distributor
2	Header	6	Needle valve	10	Gas valve
3	Composing pipe	7	Handle pipe	11	Oxygen Hose Nipple
4	Mixing tube	8	Inner pipe	12	Acetylene Hose Nipple

Export of Korean Gas-Welding Machine for every Continent (1981)

(No. of m/c)

Asia	N. America	Africa	Total
4,149	24	4,210	8,383

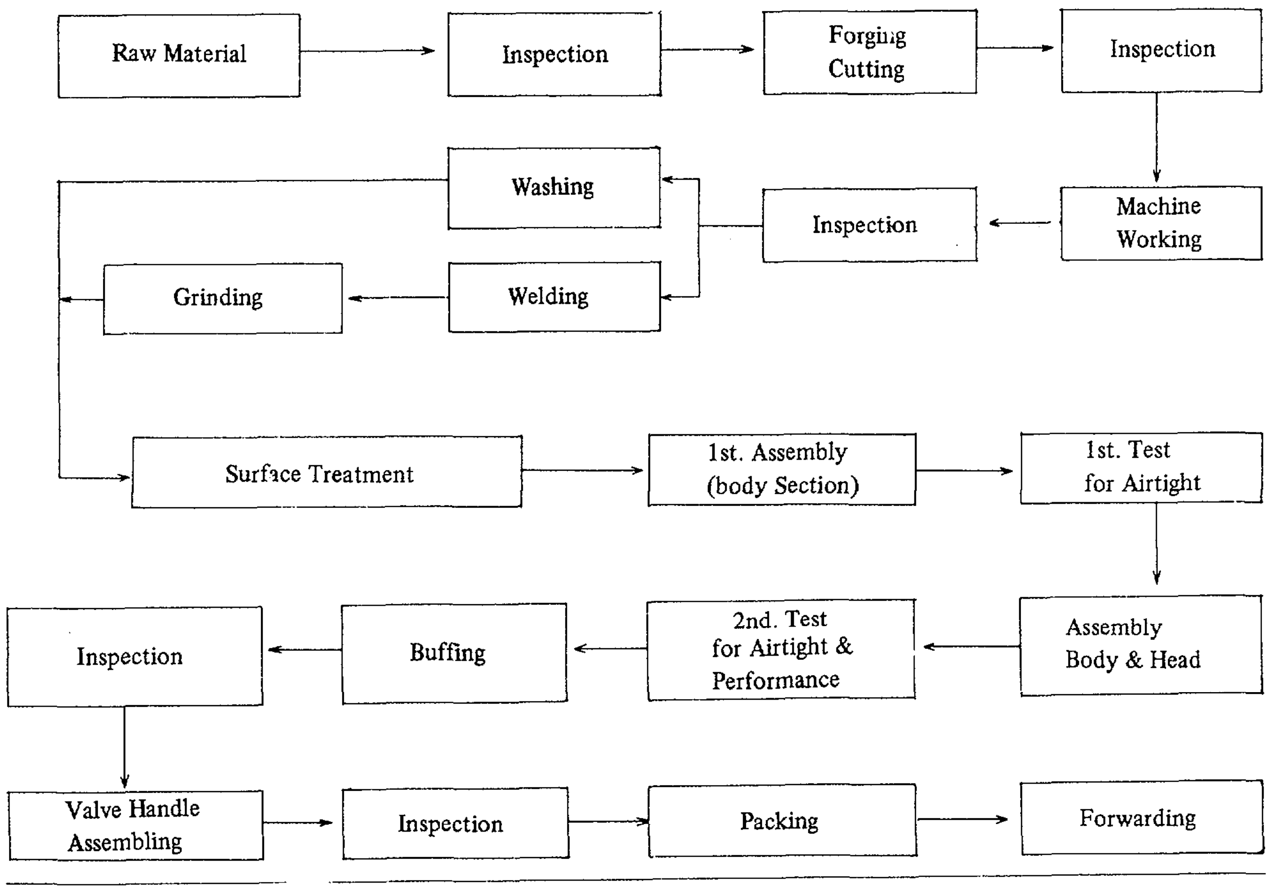
Required Raw Material

Nozzle (Bronze Bar)
Header (Bronzer Bar)
Composing Pipe (Seamless Copper tube)
Body (Forged Bronze Bar)
Needle Valve (Bronze Bar)
Handle Pipe (Seamless Copper Tube)
Distributor (Forged Bronze Bar)
Gas Hose Nipple (Bronze Bar)

Required Facilities & Machinery

Lathe
Automatic Lathe
Turret Lathe
Special Machine
Milling Machine
Drilling Maching
Tool Grinding Machine
Sawing Machine
Power Press
Friction Press
Welding Machine
Grinding Machine
Buffing Machine
Air Compressor
Air-tight Tester
Performance Tester

Manufacturing Process



Example of Plant Capacity and Construction Cost

1) Plant capacity : 100 sets/month
   * Basis : 8 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$500,000
Total	:	US$500,000

3) Required Space

o Site area	:	3,000 m^2
o Building area	:	1,000 m^2
Total	:	4,000 m^2

4) Personnel Requirement

o Manager	:	5 persons
o Engineer	:	25 persons
o Operator	:	50 persons
Total	:	80 persons

Concrete Mixer Making Plant

Mixer is a machine which blends and discharges material. Several kinds of mixer are now available, but if divided into two large categories, there are forced-mixing and gravitational type mixers. Forced mixing type mixer can produce various kinds of concrete, ranging from low slump for pavement use to high slump and concrete used for building construction.

Also it can be used for mixing of glass, paint, fertilizer, and feed stuff. Forced-mixing type mixer has a rotating paddle installed inside the stationary vessel, blends the material by the rotary motion of paddle, and discharges the mixed material through semi-circular exhaust gate placed at the bottom.

Rotary power of motor is conveyed through V-belt and middle axis to the input of speed reducer.

More than two paddles and scrapers connected to the output of speed reducer are designed with angles in-between that their rotation brings above blending of different materials.

The recently developed pressurized cleaning device to wash the concrete away from the wall inside the mixer has made it possible to improve the blending efficiency.

The initial cost of forced-type mixer is less than that of gravity-type mixer because of less time spent in mixing and higher mixing efficiency. On the contrary the forced-type mixer requires more running cost than gravity-type mixer because of the greater power loss in friction. Models and specifications of forced-typed mixer are shown as follows (Pan Mixer)

Specifications (Pan Mixer)

Model	Capacity (M^3/Batch)	Motor output (Kw)	Weight (Ton)
AE-500	0.5	22	2.2
AE-1,000	1	37	3.7
AE-1,500	1.5	45	5
AE-2,250	2.25	30 x 2	8.7
AE-3,000	3	45 x 2	15

Gravity-type mixer is also used like forced-type mixer to mix various kinds of materials.

And especially in producing concrete, gravity mixer can blend aggregate with larger diameter (even 150 mm) and even produce concrete used for dam construction.

Gravity mixer is composed of main frame and rotary mixing drum with built in blade which mixes the received material by rotary motion. Mixing drum. is smoothly rotated by gear coupling and cycle speed reducer connected with motor.

Mixed material is discharged by the tilting of drum which is functioned by the oil (or air) pressure cylinder attached to the frame. The impact caused by the tilting of drum is absorbed by the attached air (or oil) pressure cushion buffer.

The running and maintenance cost of gravity mixer is not much counted because for one thing comparatively small horsepower is required to operate the mixer and for another drum and blade are specially welded to resist friction, and rewelded if worn out.

However, the weak point to the gravity mixer is high initial cost to operate more than two units of mixer simultaneously to meet the working product capacity per hour because gravity mixer spends more time to mix materials than forced-type mixer.

The models and specifications of typical gravity mixer manufactured in Korea are shown as follows. (Tilting Mixer)

Specifications (Tilting Mixer)

Model	Capacity (M^3/Batch)	Motor output (Kw)	Weight (Ton)
36 S	1	11	3.7
56 S	1.5	15	5
72 S	2	22	5.8
90 S	2.5	30	7.0
112 S	3	37	8.6

"Double-Axis Mixer", improved type of forced-type mixer with good points adopted from gravity mixer, has been recently developed to economize both the initial and running cost.

The structural function of double-axis mixer is as follows; two distinct parts move together inside the mixer, and power from the motor is conveyed through V-Belt to the speed reducer. Power from output of speed reducer, then, is conveyor to the shaft.

The paddle is attached to the shaft, and paddle mixers the material by its rotary motion.

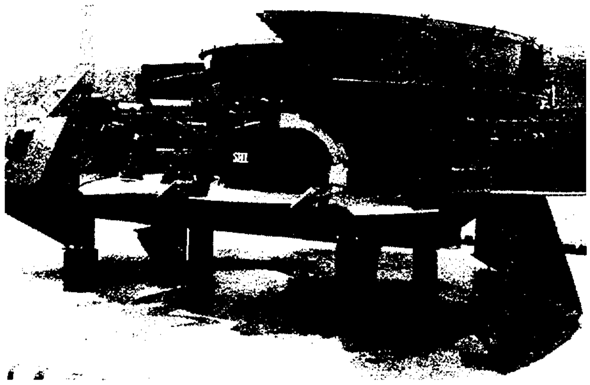
Two shafts are rotating, each shaft the other way, so as to turn the material around the shaft.

Double-axis mixer, featuring the following several Characteristics, enjoys the ever-growing demand.

1) The bottom-turned-gates are used to discharge mixed materials fallen by gravitational weight, ensuring fast produce and higher efficiency.
2) As the materials are mixed by the double blades attached to two shafts turning the other way, they are moving in both ways the other way round. That is, mixed materials which are turned one way by one blade are then pushed to the other blade, which by its turn mixes the material the other way round.
   The double mixing by the rotation of two shafts ensures the superior mixing performance.
3) As one third of paddle is exposed to the outside, it has very low friction rate.
   The rare sticking of concrete to the paddle makes the maintenance and cleaning work.
4) Aggregate with diameter from 80 to 150 mm can be mixed, too. The models and specifications of double-axis mixer are shown as follows.

Specifications (Double-Axis Mixer)

Model	Capacity (M^3/Batch)	Motor output (Kw)	Weight (Ton)
DAM-1,000	1	15 x 2	4.9
DAM-1,500	1.5	22 x 2	6.7
DAM-2,000	2	30 x 2	8.2
DAM-2,500	2.5	37 x 2	10.0
DAM-3,000	3	45 x 2	11.2
DAM-6,000	6	45 x 2	22



Concrete Mixer (Pan Type)

Manufacturing Process

Drawing → Purchase of Raw-Materials → Acceptance Inspection → Manufacturing (speed-reducer, vessel) → Inspection → Assembling → Operation Test → Inspection → Painting → For warding

Drawing → Purchase of parts (Motor and other parts) → Acceptance Inspection → Assembling

This information has been prepared by the Technology Transfer Center (TTC) of KAIST in Korea. Further information is available and could be sent if required. Any liaison between the technology owner and the customer could also be made by this center.

Please write to:

Technology Transfer Center
Korea Advanced Institute of Science and Technology
P.O. Box 131, Dong Dae Mun, Seoul, Korea
Telex: KISTROK K27380

Construction of the plant

– On the basis of producing 300 Tons per a year –

Plant Description

Site Area : 500 M^2
Plant Area : 300 M^2
Office & Annex Area : 100 M^2

Required Man power (Unit : Men)

Designer : 2
Engineer : 3
Technician : 15
Office worker : 4
Office worker : 4

Major required utility

Electric power : 400 Kw
Air compressor : 100 Kw x 1

Gas station : Oxygen storing utility : 1 Unit

Required Machinery

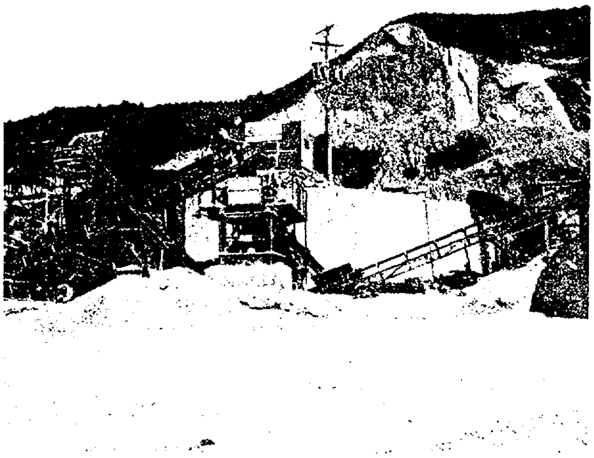
Welding Machine
Cutting Machine

Lathe,

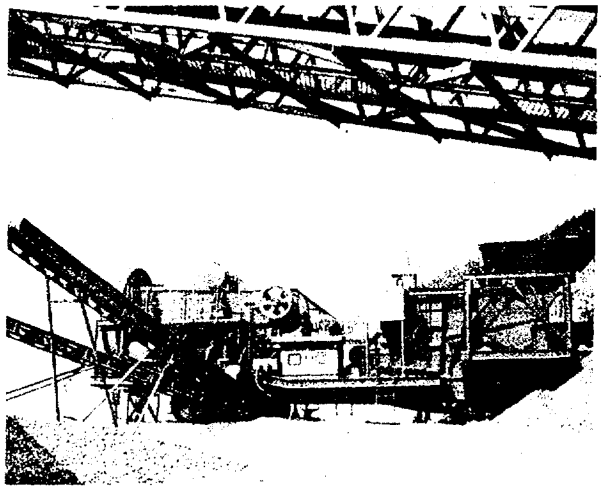
Slotting Machine
Drilling Machine

Boring Machine

Crusher Making Plant



Crushing Plant
Type : JCSG-4
Capacity : 130 Ton/H



Crushing Plant
Type: JJSG-4
Capacity : 50 Ton/H

Crushing plant, as a plant which produces the various aggregates used in every construction and civil engineering work, produces mostly stones under 40 mm and 25 mm.

This aggregate is used for Remicon.

Gravels under 40 mm and 19 mm used in foundation and surface layer of road construction meet demand by chaging production progression.

Recently, natural aggregate is used after being selected by screen according to the size.

However, because of exhaustion of natural aggregates, aggreagte is being supplied by developing and crushing stony mountains. Usually, Remicon aggregate uses 3-6 degree hardness stones because excessive soft or excessive hard stones can influence concrete strength and life of machine.

Kinds of aggregate are 0-5 mm, 5 mm-25 mm, 25 mm-40 mm and over 40 mm. Crushing plant can be classified into stationary crushing plant and portable crushing plant according to use of porducts, plant situation and stone quality.

The most common arrangements are primary Jaw crusher, secondary cone crusher, and primary Jaw crusher, secondary Jaw crusher. Portable plant has product capacity of 50 T/H, 80 T/H, 100 T/H, 130 T/H, 150 T/H, or 200 T/H.

However, in case of need, 250 T/H, 300 T/H can be possible stationary plant has product capacity of 100 T/H, 150 T/H, 200 T/H, 250 T/H or 300 T/H.

And there are also big plants with product caopcity of over 300 T/H according to the size of stony mountain by demand.

Manufacturing Process Description

Natural stones are put into bin by dozer and loader. Natural stones in bin are drawn into Jaw crusher by feeder. Among natural stones, small size stones put directly into screen by conveyor without passing through crusher. All of the natural stones crushed in Jaw crusher go to screen, and in screen, aggregate are selected according to the size, and finally selected aggregates are conveyed to stock yard by belt conveyor. At this time, over size stones go to cone crusher and are crushed secondarily. Crushed stones in cpne crusher go back to the screen and in the screen they are selected according to the size. When you want to produce stones of over 40 mm or under 25 mm, it can be possible by controlling the openning of Jaw crusher and cone crusher.

Construction of Crushing Plant

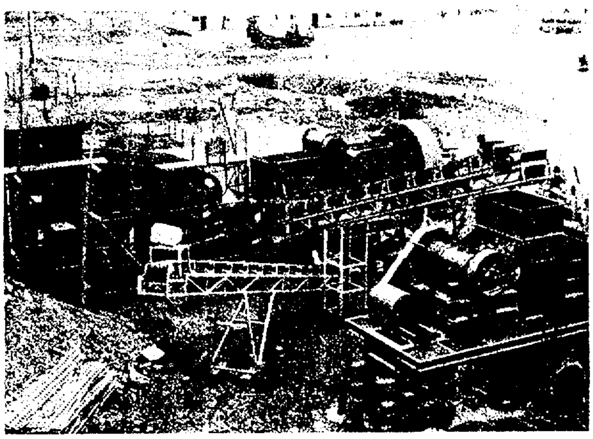
To Construct aggregate plant, 600 M^2 of lot, power facility, loader, crushing plant type truck and dozer are required. In case of 200 T/H stationary plant, about 9 employees are required. Utility facility is not required except for power facility. However, as the case may be, water washing facility is required to remove soil and stone power of aggregates. There are two methods of removing soil and stone powder of aggregates. One of them is to attach water spray system to screem and the other of them is to attach water washing attachment independently. In aggregate production system, usually main suppliers are Remicon production makers, and so, aggregate production system is influenced directly by demand of Remicon. Stone powder as by-product is supplied into As-con plants. Crushing plant construction is necessary in every country because exhaustion of natural aggregate causes rapid inerease of demand of aggregate.

Utility

o Electric Power	: 400Kw
o Air Compressor	: 100Kwx1
o Gas Station	: Oxygen Storage Equipment x 1

Required Machinery

- o Lathe
- o Shearing Machine
- o Welding Machine
- o Slotting Machine
- o Drilling Machine
- o Boring Machine



Crushing Plant
Type : JJSG-6
Capacity : 150 Ton/H

Example of Plant Capacity and Construction Cost

1) Plant capacity : 300 ton/year
   * Basis : 8 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$500,000
o Utility facility	:	US$ 50,000
o Installation cost	:	US$ 50,000
Total	:	US$600,000

3) Required Space

o Site area	:	6,000 m^2
o Building area	:	2,300 m^2
Total	:	8,300 m^2

4) Personnel Requirement

o Manager	:	2 persons
o Engineer	:	14 persons
o Operator	:	25 persons
Total	:	41 persons

Any inquiry about the information contained should be sent to:
IPCT/II/PROM, Registry file No. ID/562/12, UNIDO, P.O. Box 300, A-1400 Vienna, Austria

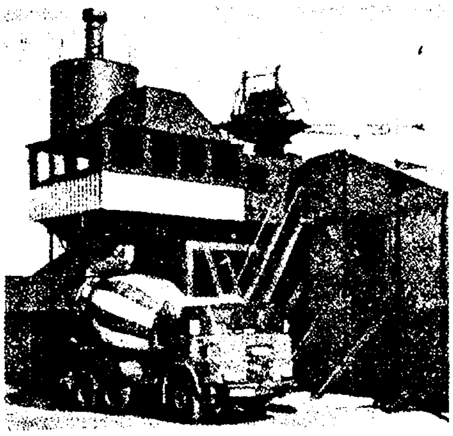
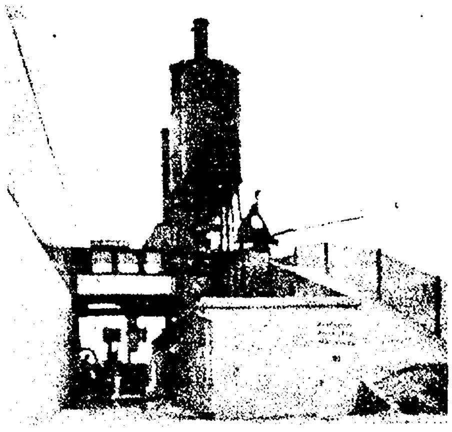
Concrete Batcher Making Plant

Concrete Batcher Plant can be defined as an equipment which is designed to contain within this unit all the resources such as concrete consisting of cements and aggregates, and to measure the fixed amount of mixed materials, then inputting this into the concrete mixer. In other word this unit is an equipment necessary to make the most of concrete economically with high efficiency. This equipment is simple to operate and it works precisely. Besides, this unit as a movable type plant is easy to assemble, dis-assemble and easy to carry. There are two types of aggregates-keeping reservoirs; star pattern silo type, clover-leaf silo type. The star pattern silo types are laid out to input the aggregates into the reservoir, while the clover-leaf types are designed to put the aggregates into the tank through conveyor and buket elevator. Accumulating-measurement method is employed in this facilities, so that the aggregates after being measured will be carried and input into the concrete mixer.

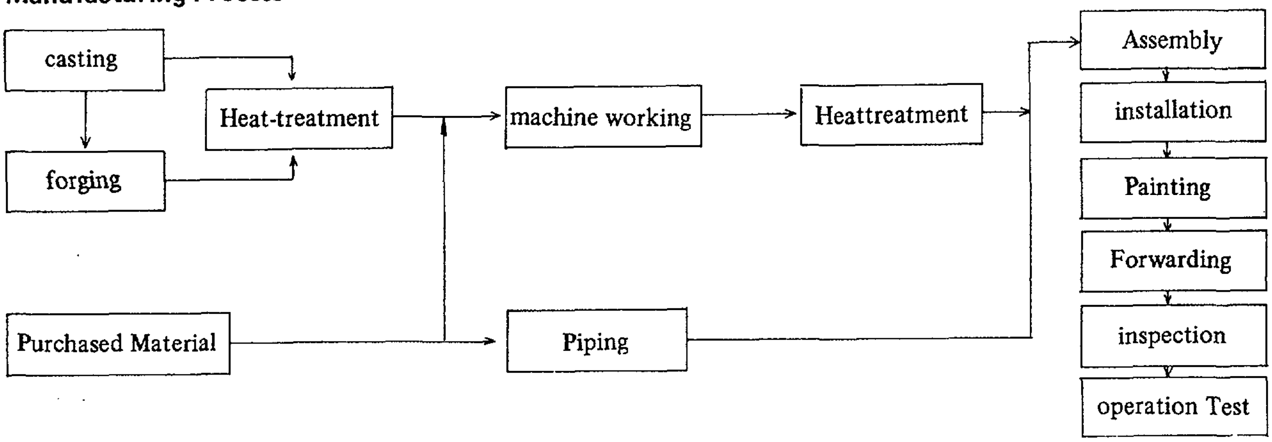
According to the mixing methods, concrete mixers can be break down into two types, gravity-blending-mixers and compulsive-blending-mixers. Gravity-blending-mixers are designed to blend the materials by rotating the body containing the materials and making it falling down according to the law of gravity, so this gravity blending mixers are generally suitable for use where it is necessary to gain the thin concrete. Compulsive-blending mixers are designed to revolve the wings with the body fixed and as a result to mix the materials compulsively, so that this type is appropriate when it is necessary to get thickened concrete. In Korea, recently the one-card method of controlling and blending the aggregates, cements and water is being prevalently in use. This one card method, as it were, is one operated by the control system of an entirely self-acting punch card system, so it works by the force of air pressure and Hydraulic pressure.

Kinds of Products and Specifications

Model	Betomix 30	Betomix 50	B2000
Mixing output:	30 m^3/h set volume of concrete assuming 30-second mixing cycles	50 m^3/h set volume of concrete assuming 30-second mixing cycles	90 m^3/h of set concrete at 30 set mixing time/batch
Built-in power mixer	ZE 500/750	ZE 1000/1500	ZE 2000/3000
Concrete discharge height:	3.8 m	3.8 m	3.8 m
Aggregate storage volume, depending on dragline loader:	1300 - 1800 m^3	1300 - 1800 m^3	1800 - 2500 m^3
Active storage volume (assuming 50° flow angle):	60 m^3	60 m^3	160 - 360 m^3
Number of aggregates which can be stored:	4 - 6	4 - 6	4 - 6
Batching rate of aggregate sector gates:	200 metric tons/h each	200 metric tons/h each	300 - 360 metric tons/h
Number of cement screws to be connected:	2	4	2
Cement screw delivery rate:	25 metric tons/h each	35 metric tons/h each	60 metric tons/h each
Weighing capacity of aggregate weigher:	0 - 1500 kg	0 - 2500 kg	0 - 5000 kg
Weighing capacity of cement weigher:	0 - 250 kg	0 - 500 kg	0 - 1000 kg
Scale calibrations on water meter:	0 - 100 litres	0 - 250 litres	0 - 500 litres
Working pressure of hydraulic system for mixer gate:	100 bars	100 bars	100 bars
Working pressure of pneumatic system:	6 - 8 bars	6 - 8 bars	6 - 8 bars
Water pressure required 1 metre above datum level:	4 - 6 bars	4 - 6 bars	4 - 6 bars
Water main diameter:	1 1/2" intl. dia.	65 mm nom dia	nom. 80 mm
Total installed electrical rating with 1 cement screw and dragline loader:	34 + 8 + 12 = 54 Kw	54 + 11 + 20 = 85 Kw	app. 150 Kw
Operating voltage/frequency:	440 V/60Hz	440V/50Hz	440V/60Hz

Manufacturing Process



Required Raw Material

SS 41	28,000 Kg
Steel Bar	400 Kg
S45 C	500 Kg
SGP	7,000 Kg
STPG	1,600 Kg
STB 35	7 Kg
BC	14 Kg
Channel	2,000 Kg
Angle	1,500 Kg
I-Beam	550 Kg
H-Beam	15,000 Kg
Check plate	2,900 Kg
Ni-Hard steel	1,500 Kg

Required Facilities

- o Lathe
- o Drilling machine
- o Bending Roller
- o Hack sawing machine
- o Hydraulic press
- o Hydraulic press Brake
- o Shearing machine
- o Automatic Gas Cutter
- o Arc welder
- o Over Head Crane

Example of Plant Capacity and Construction Cost

1) Plant capacity : 300 ton/year
   * Basis : 8 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$500,000
o Utility facility	:	US$ 50,000
o Installation cost	:	US$ 50,000
Total	:	US$600, 00

3) Required Space

o Site area	:	12,000 m^2
o Building area	:	3,000 m^2
Total	:	15,000 m^2

4) Personnel Requirement

o Manager	:	2 persons
o Engineer	:	14 persons
o Operator	:	25 persons
Total	:	41 persons

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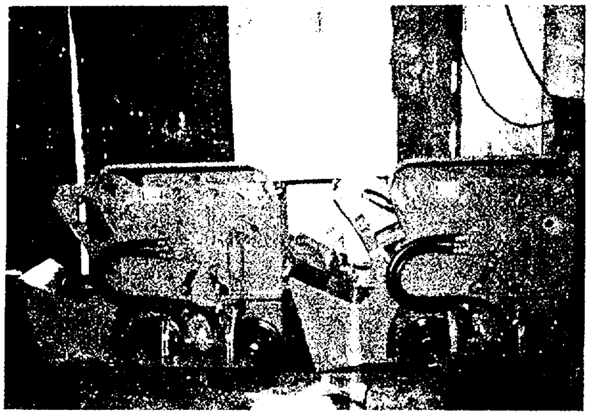
FILE: P-31
ISIC: 3824

Rocker Shovel Loader Making Plant



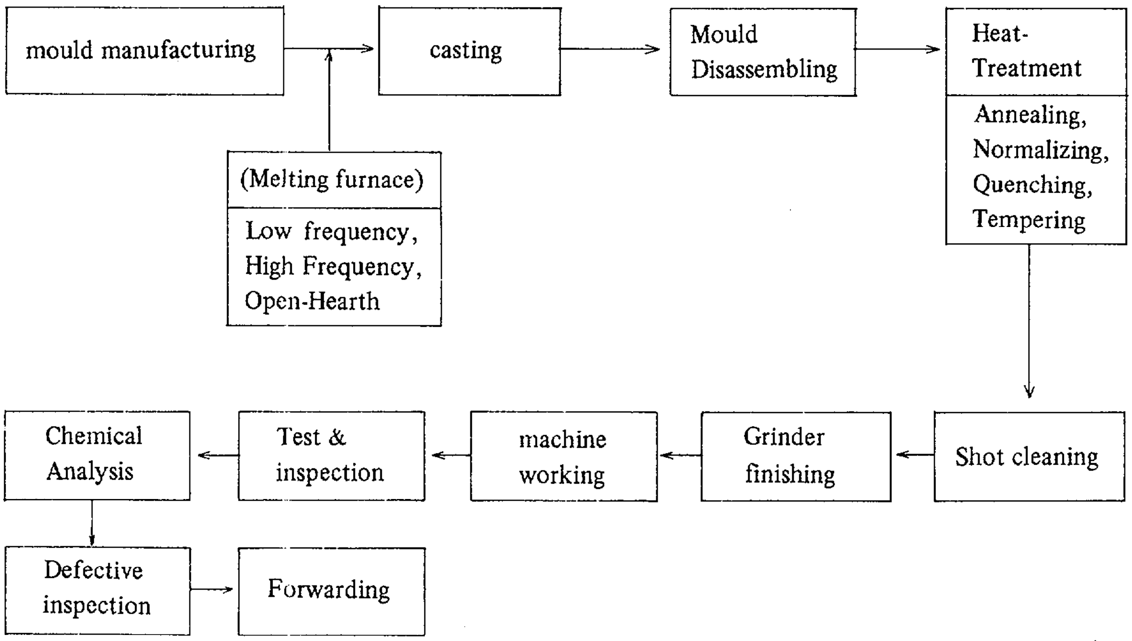
Rocker shovel loader is a mining machine designed to effectively load dug-up and pumice onto the mine car by use of air-pressure, especially effective in tunnel work. It has loading capacity of 10-40M^3 per hour and has characteristics suitable for high-speed digging work in all kinds of mine. With the simple structure structure easy to disassemble and assemble and also easy for maintenance work, it is equipped with guide step plate for operator for the safety purposes under every work condition. Valve lever is also designed and built in to come to stop position automatically.

Process Description

Lower deck, upper deck, and rocker which are designed and manufactured suitable for mining work, most be processed through precision casting of high quality steel. Important parts such as gear must be manufactured by using high-quality steel and adopting excellent heat treatment to ensure the long time-efficiency.

Besides, air motor must be ensured to operate in a safe and powerful way in the dusty and gassy air.

Manufacturing Process



Specifications

Item	MODEL SR77	MODEL SR88
Total Weight	2000kg	3700kg
Bucket Capacity	$0.1 \sim 0.17M^3$	$0.18 \sim 0.3M^3$
Loading Capacity (Theorical)	$0.5 \sim 1.0M^3$/MIN.	$1 \sim 2M^3$/MIN
Loading Capacity (Practical)	$10 \sim 20M^3$/HR.	$20 \sim 40M^3$/HR
Bucket Down Length	1680mm	2070mm
Bucket Down Height	1280mm	1450mm
Case Length	1066mm	1320mm
Bucket up Height	1960mm	2320mm
Discharge Distance Behing Loader	360mm	450mm
Discharge Height of Bucket	1330mm	1390mm
Range of side Digging	1000mm	1500mm
Wheel Base	688mm	826mm
Floor Length	700mm	750mm
Range of Rail Gauge	$460 \sim 900$mm	$550 \sim 1100$mm
Air Motor for Bucket Operating	10Ps	20Ps
Air Motor for Traveling	10Ps	20Ps
Air Pressure	$4 \sim 8kg/cm^2$	$5 \sim 8kg/cm^2$
Air Consumption	$7M^3$/MIN	$16M^3$/MIN
Air Hose Size	ϕ 1″	ϕ 1¼″

Required Facilities

- Cupola, Arc Furnace
- Wooden mould equipment
- Lathe
- Planner
- Hobbing machine
- Bending roller
- Heat treatment equipment

Required raw Material

- Roll mill steel (SS)
- Cast iron (FC)
- Cast steel (SC)
- Forging steel (SF)
- Carbon steel (S30C)
- Molybdenum steel (SCM)
- Bronze (BC)
- Bolt (S20C)
- Air hose (rubber)
- Bearing
- Air motor

Example of Plant Capacity and Construction Cost

1) Plant capacity : 900 sets/year
   * Basis : 8 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$800,000
o Utility facility	:	US$ 50,000
o Installation cost	:	US$ 50,000
Total	:	US$900,000

3) Required Space

o Site area	:	25,000 m^2
o Building area	:	6,000 m^2
Total	:	31,000 m^2

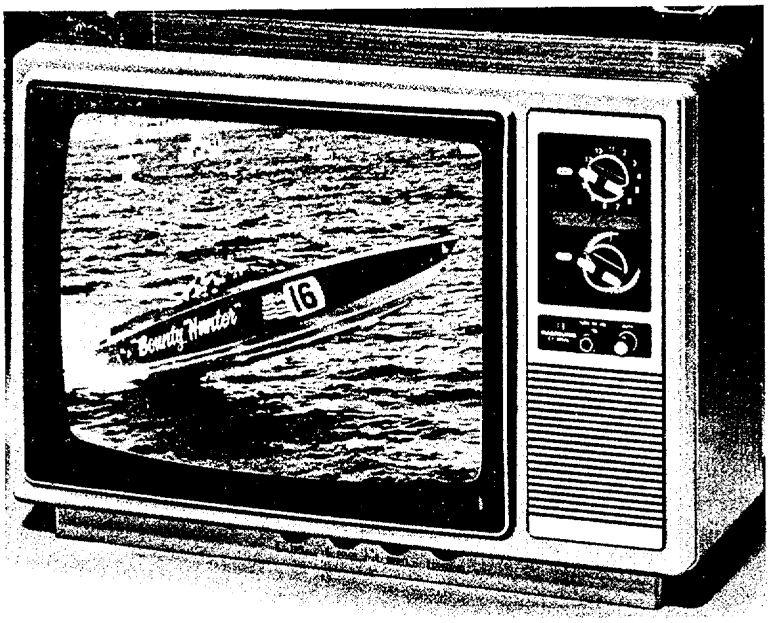
4) Personnel Requirement

o Manager	:	2 persons
o Engineer	:	14 persons
o Operator	:	25 persons
Total	:	41 persons

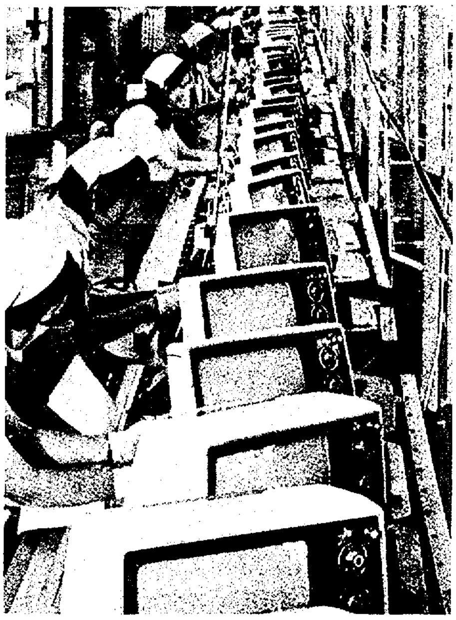
Q

FILE: Q-31
ISIC: 3832

TV Assembling Plant



View of Product



View of Television Assembling Plant

The television manufacturing is more technology-intensive and rapid in its technical renovation than any other industries, with diverse performances and functions in its products. Economically, compared with heavy and chemical industries, it is an industry requiring relatively lower capital investments. It is characterized by low resources and energy consumptions and also is virtually pollution-free.

The television industry is relatively easy in its international division of labor, and it can usually be multinational with ease and highly value-additive. It occupies an important position in the electronics industry, because electronics products worldwide tend to be closely related in their order to the B/W TV, color TV, audio articles, VTR and then to computers starting from radio.

The television requires 300 component parts in case of a B/W set and 800 in case of a color set, while the VTR needs 3,000 parts. Such requirements for many component parts increase in turn the demand for related parts. In particular, the brown tube offers a kind of technical spillover effect. The technology learned in processing and forming special tubes constitutes a new basis for the development of glass and optical instrument industries, while the shadow neck manufacturing technology is an example of well-established technology.

The plant introduced here can use any one among the methods of NTSC, PAL and SECAM through its own accumulated technical know-how, producing a variety of screen sizes ranging from 5 to 20 inches characteristic of lower power consumptions.

With the successful solution of such problems of great importance as the narrow neck, improvement of fluorescent materials and coating method and development of indicators based on plasma display, LED, LCD and the like, further efforts are being made to develop new technologies.

Products and Specifications

The B/W television has the following characteristics

- 100% solid state chassis using integrated circuits, transistors and other ultra-reliable solid state devices. It makes for greater reliability, stability and durability.
- Lower power consumption. No more than the half of the average light bulb.

- Quick-start picture tube with a new quick-heat filament uses no power when the set is turned off.
- Keyed automatic gain control (AGC) to lock out RF interference from aircraft, auto ignitions, etc. which cause fluttering pictures, snowy reception.
- VHF and UHF detent tuners to precisely click into channels.
- Elegant plastic cabinet.
- Telescopic VHF and loop UHF antennas for better picture reception.
- Regulated power supply which gives you perfect pictures even under low AC voltage conditions.

Specifications of general model (BT-312K/Y) are shown in the table-1.

Characteristics of the color television are as follows

- Advanced 100% solid state chassis using ICs and closetolerance transistors to give you greater reliability and low power consumption.
- Quick-start picture tube with a new quick-heat filament which uses no power when the set is turned off.
- In-line gun, slotted mask and black matrix for sharper contrast and brighter color.
- VHF and UHF click-stop tuners for precise, accurate channel selection.
- Auto-Color/AFT (Automatic fine tuning) button adjusts automatically the picture for color, tint and picture.
- Automatic gain control (AGC) to look out RF interference from aircraft, auto ignitions, etc.
- Automatic degaussing to prevent magnetically caused color distortion.
- Dipole antenna for better picture reception.
- CATV/MATV easy hook-up for cable TV or master antenna system.
- Regulated power supply for perfect picture under low AC voltage line conditions.
- Attractive walnut grained high impact plastic cabinet.

Specifications of model (CT-385AL) are shown in the table-2

Contents of Technology

1) Process Description

Both B/W and color TV sets depend on a conveyor system in assembling. Following the forming and banding of component parts, insertion of asbestos tubes, assembly of radiator plates and the like in preliminary processing, various resistors, condensers, coils and transformers are inserted in the PCB, with inspections closely following. The insertion of these component parts requires more manpower than other processes. The soldering is carried out by an auto-soldering machine. The component parts are also attached to the back of PCB. The assembled PCB is adjusted for PIF (picture intermediate frequency) trap and SIF (sound intermediate frequency) to complete the sound and picture adjustment. When the PCB process is thus completed, the wiring comes next. A tuner and VR wiring are connected to the PCB assem-

Table 1. Specifications of B/W Television

Screen size	12" diagonal measure
Picture tube	Quick-start, 90-degree deflection
Antenna	VHF telescopic rod or 300 ohms ext. UHF loop or 300 ohms ext.
Speaker	3" round, front-mounted

	US standard		CCIR "B/G" system	CCIR "I" system
	AC only	AC/DC		
Power source	120V 60Hz	120V 60Hz DC 12V	110/220V 50Hz DC 12V	240V 50Hz DC 12V
Power consumption	AC 28W	AC 30W DC 14W	AC 30W DC 14W	AC 30W DC 14W
Audio output (max.)	1W	1W	1.2W	1W
Tuning range				
VHF channels	2-13	2-13	2-13 (B)	
UHF channels	14-83	14-83	21-69(G)	21-68
Net weight	13.9 lbs (6.3 kg)	16.1 lbs (7.3 kg)	16.1 lbs (7.3 kg)	15.4 lbs (7 kg)

Unit dimensions	15.7"(W) x 11.2" (H) x 12.5" (D) 399(W) x 284(H) x 318(D) mm
Accessories	UHF loop antenna DC car adaptor cord (AC/DC model)

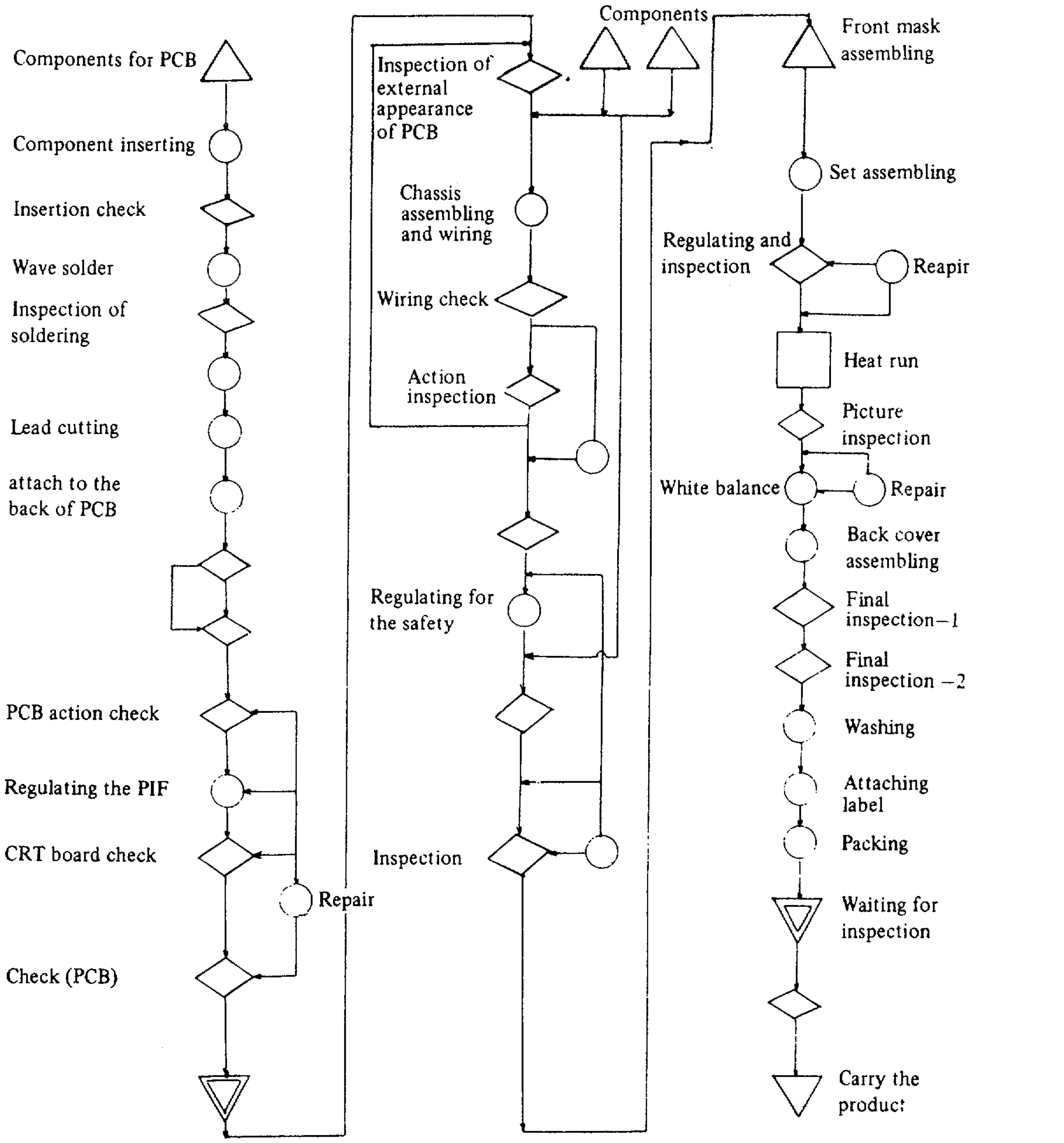
- VHF only and/or AC 110/120/220/240V 50/60Hz model is available.
- Unit dimensions do not include controls and antenna protrusions.

Table 2. Specifications of Color Television

Screen size	15" diagonal measure (in USA) 16" diagonal measure (in other countries)
Picture tube	Quick-start, in-line gun, slotted mask Black matrix, 90-degree deflection
TV system	US standard system
Color system	NTSC system
Tuning range	VHF channels 2-13 UHF channels 14-83
Antenna	VHF detachable dipole, 300 ohms ext. or 75 ohms CATV connector UHF loop or 300 ohms ext.
Picture tube voltage	24.5 kv (max.)
Semiconductors	4 ICs, 10 transistors, 20 diodes, SCR, PUT, Thermistor, Posister 1 ea.
Video IF stage	Integrated circuit
Focus	Electrostatic
Sweep deflection	Magnetic
Speaker	3.5" round, front-mounted
Audio output	1.5 watts (max.)
Power source	ac 120v 60hz
Power consumption	74 watts (max.)
Net weight	38 lbs (17.2 kg)
Unit dimensions	21" (W) x 14.6" (H) x 16" (D) 533 (W) x 371 (H) x 406 mm (D)

bly and iinspected to be followed by the second PIF adjustment. It is then moved to the finishing section for the final assembly with chassis and cabinet in which are already fixed a speaker, mask element and CRT (cathode ray tube). On completion of assembling the cabinet and chassis, the assembly undergoes an adjustment of deflection yoke and the final inspection of its frequency and insulation with the back cover also fixed. In the back cover, an antenna terminal and terminal wires are adjusted to complete the finishing process. Such equipment as spectrum analyzer, vectorscope, frequency counter and sweep generator in the final inspection to check the high voltage generating fly back transformer and picture tube explosion hazards in accordance with standards of the IEC (International Electrotechnical Commission) and the UL (Underwriters' Laboratory) of the United States. The next is the packing process in which finishing touches are added to eliminate possible damages on the surface of TV sets, such items as CRT, back cover and mask are washed, an envelope with proper instructions is inserted and the TV set is packed in a box with

Television Assembling Process Diagram



nameplate and other labels, thus completing the final work in the packing section and also the entire work in the production line for subsequent delivery.

2) Equipment and Machinery

Conveyor
Soldering machine
P.C.B.
Automatic inserting machine
Injection molding machine
Hot stamping machine
TV pattern generator
Signal generator
Oscilloscope
Modulator
Power supplier
Temperature controller
Chamber
Painting equipment
Spot welder
Trolly conveyor
Slot conveyor
Belt conveyor
Tapping machine
Power press
Urethane foaming equipment
Helium leak tester
Die casting machine
Enjection machine
Grinding machine
Projection welder
Shearing machine
Cold rolled forming machine
Compressor manufacture equipment
Crank press
Oil press

Example of Plant Capacity and Construction Cost

1) Plant capacity : 60,000sets/year
 * Basis : 8 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$2,181,400
Total	:	US$2,181,400

3) Required Space

o Site area	:	9,000 m^2
o Building area	:	9,000 m^2
Total	:	18,000 m^2

4) Personnel Requirement

o Manager	:	12 persons
o Engineer	:	35 persons
Total	:	47 persons

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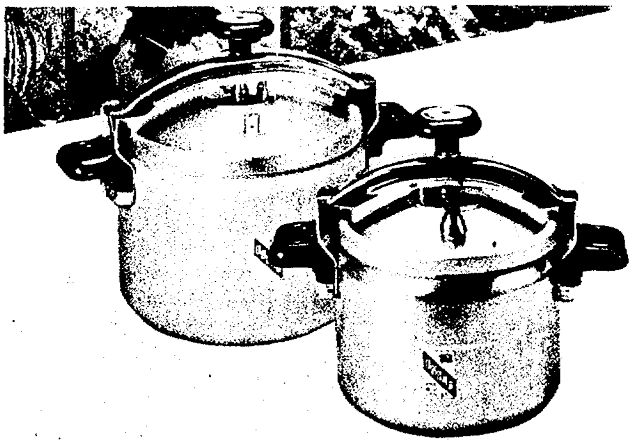
Rice Cooker Assembling Plant



View of Products

One of the necessisities in our daily life, the electric rice cooker is an appliance for cooking rice, not using such conventional energy sources as anthracite, wood, gas and the like but preparing rice and other meals in a simple, clean and convenient way by making use of electric energy.

First manufactured to improve the living standard, shorten housewive's cooking time and provide conveniences, rice cookers are rapidly increasing in frequency of uses and widening in stratum of their users.

The principle of a rice cooker lies in that the temperature does not rise above the water boiling point of 100°C in the beginning when heated, but when rice is well cooked and water has been absorbed, the temperature at the bottom of the rice cooker starts suddenly to rise. Taking advantage of such a sudden rise in temperature, the electric rice cooker actuates a bimetal to cut the electric current, making the rice cooking automatic.

After the electric current is cut off, the rice is steamed to a proper degree by the remaining heat in the cooker. No doubt this product offers a good reasibility to be a most promising industry of small and medium business type in developing countries.

Products and Specifications

More than 10 different types of varied electric rice cookers as well as electric pressure cookers are produced in this plant. These products are characterized by accurately acting automatic switches so that anybody can cook rice with not mistake, and the cooked rice is of good taste because it is automatically kept warm even after complete cooking with no spillover of rice water. The thermal efficiency is enhanced by the full heat effect of direct heating system.

The pressure cooker is equipped with four-step safety devices, the steam nozzle and single valve keeping the internal temperature constant at 115°C, and also the safety valve, packing and clamp hanger enabling its cover to be opened without discharging steam during and after the cooking.

In particular, rice cookers produced in this plant range from 1,000ml to 4,000ml in volume, while pressure cookers are up to 10,000ml. Detail specifications of rice cookers are shown in table 1;

Table 1. Specifications of Electric Rice Cooker

Model	Electric power	Capacity	Weight
DW-151	600 W	2,600mℓ	3.1 kg
DW-152	800 W	3,000mℓ	3.9 kg
DW-90	450 W	1,000mℓ	2.4 kg
DW-150	600 W	2,000mℓ	2.8 kg
DW-560	950 W	4,000mℓ	4.2 kg

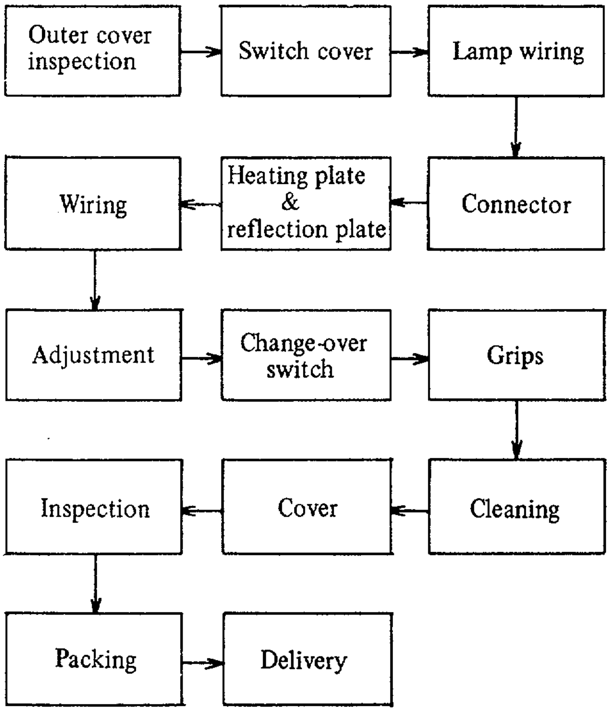
Contents of Technology

1) Process Description

The outer cover is first thoroughly inspected for scratches, damages and coating, and then spring washers are fixed to bolts only on complete outer covers. Switch covers are attached and fixed not to move. The lam wiring is also checked to be sure it is well connected, and bolts are tightened up. The contact bar is confirmed whether it is straight and the outer cover is fixed to the contact bar so that it may not move.

The heating plate and reflecting mirror assembly component is fixed to the foot of the outer cover. The state of wiring is confirmed to see whether it is correct and the bolt-tightened wiring is not movable. The action of the automatic switch for the rice cooker

Electric Rice Cooker Assembling Process Block Diagram



should be smooth and the shifting switch beneath the outer cover should also be well tightened in the shifting switch fixing groove. Then the bottom plate is attached so that it is well incorporated into foot holes and the interior components cannot be seen.

Grips on the outer cover are fixed by tightening up so that they may not move. Dirtied spots are polished clean by thinner-soaked rags and the knob on cooker cover is tightened so that it may not move prior to transferring to the next process. Respective component parts are conveyed to the assembly line and the cover is provided with silicon packing to protect from possible scratches.

The first and second safety devices are then so assembled as not to allow any gap between the outer cover and disc holder. Following the outer inspection and cleansing, various quality markings and certificate are fixed on the designated parts and packed in a box for delivery.

2) Equipment and Machinery

Press machine
Coating equipment
Painting equipment
Die casting machine
Heater manufacturing equipment
Phenolic resin injection machine
Plastic injection machine
Conveyor system
Buffing equipment
Watt/volt meter
Insulation resistance tester
Rolling machine

3) Raw Materials

o Electric rice cooker (2.5ℓ)

Raw materials	Requirement (per unit of product)
Cold-rolled steel plate	1kg–3kg
Aluminum	0.7kg–2.0kg
Bimetal	2g

o Pressure cooker (10.0 ℓ)

Raw materials	Requirement (Per set of product)
Aluminum	2–3.2kg
Phenolic resin	0.2kg
Stainless	1–1.5kg

Example of Plant Capacity and Construction Cost

1) Plant capacity : 600,000 sets/year
 * Basis : 12 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$200,000
o Utility facility	:	US$ 50,000
o Installation cost	:	US$ 50,000
Total	:	US$300,000

3) Required Space

o Site area	:	700 m^2
o Building area	:	450 m^2
Total	:	1,150 m^2

4) Personnel Requirement

o Manager	:	1 persons
o Engineer	:	20 persons
o Operator	:	129 persons
Total	:	150 persons

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Dry Cell Making Plant

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.

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 demana for dry cells differs 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 of transistor radios, tape recorders and other electric equipment as the living standard improves, not to mention the demand for dry cells for use in flashlights. In Korea, the dry cell industry is already regarded as an industry with maximum returns as directly proportional to its scale, and therefore it is oriented toward large-scale production.

Manufacturing systems are being automated to provide the industry with a high potential for further development. Climatic and seasonal influences bear heavily on the manufacture of dry cells. Accordingly, a plant site in some temperature region of about 20°C is 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 is necessary if required manufacturing conditions are to be wet.

View of Products

Products and Specifications

R20 (UM-I), R14 (UM-2) and R6 (UM-3) with the capacity of respectively 1.5 volts are produced in this plant in addition to 9-volt.006P (FC-1) and 6-volt 941 (4 FM). Detail specifications for UM-1 (R-20) and UM-2 (R-14) are as the table 1 and table 2.

Table 1. UM-1 (R20) Dry Battery Specification

Design and construction			
Nominal voltage			1.5 volts
Usual number and type of cells			"D" cell
Terminals			Flat surface
Maximum weight			90gs
Jacket			Metal
Electrical and Mechanical tests			
Test			Storage time
Delayed capacity			12 months
Electrolyte leakage			None
Electrolyte leakage above 45°C, storage			30 days
Electrical characteristics			
	O.C.V.	C.C.V.	S.C.
Initial	1.580 – 1.700	1.450 - 1.530	5.5 – 7.0
12 months storage	1.550 – 1.700	1 380 - 1.450	4.5 – 6.0
Minimum capacity test equipment			
Load resistance	4 ohms	4 ohms	20 ohms
Discharge through	Test 1	Test 2	Test 3
Test-end voltage	0.9	0.85	0.9
Service life (initial)	5.5 hrs	550 min	60 hrs
Service (12 months storage)	5.0 hrs	550 min	50 hrs

- Test 1 : Discharge through 4 ohms continuously
- Test 2 : Discharge through 4 ohms for 30 minutes per day, then on open circuit for 23 hours. Repeat this cycle continuously.
- Test 3 : Discharge through 20 ohms for 4 hours per day, then on open circuit for 20 hours. Repeat this cycle continuously.

Table 2. UM-2 (R14) Dry Battery Specification

Design and construction			
Nominal voltage			1.5 volts
Usual number and type of cells			"C" cell
Terminals			Flat surface
Maximum weight			46gs
Jacket			Metal
Electrical and mechanical tests			
Test			Storage time
Delayed capacity			12 months
Electrolyte leakage			None
Electrolyte leakage above 45°C in storage			30 days
Electrical characteristics			
	O.C.V.	C.C.V.	S.C.
Initial	1.580 – 1.700	1.400 - 1.500	3.5 4.5
12 months storage	1.550 · 1.700	1.380 – 1.450	3.3 · 4.0
Minimum capacity test equipment			
Load resistance	4 ohms	4 ohms	40 ohms
Discharge through	Test 1	Test 2	Test 3
Test-end voltage	0.9	0.85	0.9
Service life (initial)	2.0 hrs	200 min	70 hrs
Service (12 months storage)	1.5 hrs	150 min	60 hrs

- Test 1 : Discharge through 4 ohms continuously.
- Test 2 . Discharge through 4 ohms for 30 minutes per day then on open circuit for 23 hours. Repeat this cycle continuously.
- Test 3 . Discharge through 40 ohms for 4 hours per day, then on open circuit for 20 hours. Repeat this cycle continuously.

Contents of Technology

1) Process Description

Zinc ingot with the purity of 99.97 percent is first smelted and rolled. It is then made into tablets with constant specifications and subsequently extruded by applying 250-ton pressure to make zinc plates.

Manganese dioxide, electrolytic manganese dioxide and graphite are mixed uniformly in a kneader for about 30 minutes by rotating. The mixture is adsorbed in zinc chloride in accordance with specifications and also blended in a high-speed revolution.

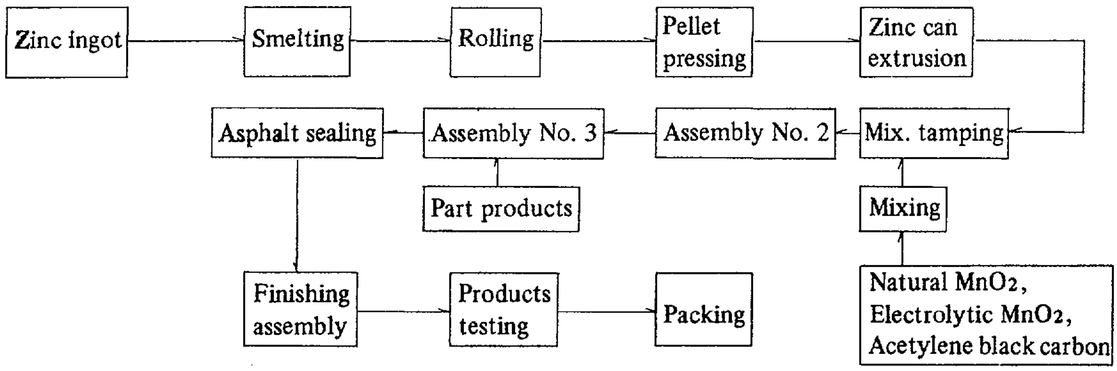
The mixutre thus prepared is molded in a molding machine by applying 5-pound pressure. Such parts as metal jacket, bottom and top cap cover are adjusted to 0.03mm in thickness by means of high performance press and supplied to the assembly line.

It is asphalt-sealed and finished as product in the finishing assembly line, with an inspection carried out under actual but simulated load to reject defective products. It is then packed in a small unit and carton boxes in the automatic line for delivery.

2) Equipment and Machinery

Zinc can making equipment
Assembling equipment No. 1, No. 2, No. 3
Compound agent making equipment
Component parts making equipment
Asphalt dissolving and purifying equipment
Finishing equipment
Inspection equipment
Packing equipment

Dry Cell Manufacturing Process Block Diagram



Example of Plant Capacity and Construction Cost

1) Plant capacity : 23,000,000pcs/year
   * Basis : 8 hours/day, 300 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$4,500,000
o Utility facility	:	US$ 800,000
Total	:	US$5,300,000

3) Required Space

o Site area	:	2,500 m^2
o Building area	:	10,000 m^2
Total	:	35,000 m^2

4) Personnel Requirement

o Manager	:	3 persons
o Engineer	:	9 persons
o Operator	:	126 persons
Total	:	138 persons

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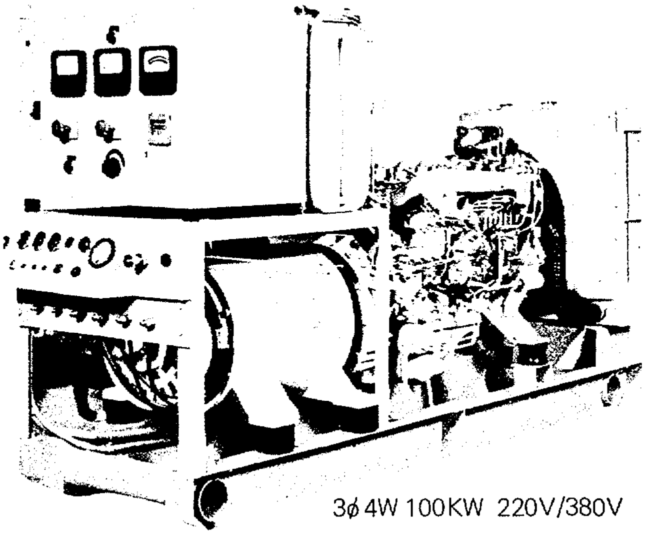
FILE: Q-34
ISIC: 3831

A.C. Generator Assembling Plant



3ϕ 4W 100KW 220V/380V

The generator is a machine generating the electirc energy which is a basis for the modern industry. In other words, all industrial machinery in use in modern times are so manufactured as to properly function only when depending upon the electricity as their energy source.

Starting from a small article used in the house to large facilities in the plant, they are simply impossible without the electricity. It is the very generator that produces the electricity which is the source of such a power.

Siemens of Germany greatly contributed in 1866 to opening up the way to the utilization of electric energy by developing the principle of electromagnetic induction into the practical technology. Thereafter, the alternating current transmission method was realized by Westinghouse of the United States.

The principle of such a generator is applied in rotating a coil between magnetic poles or in rotating a magnetic pole between coils, thus obtaining the electric current at both terminals of the coil.

The generator largely breaks down into the DC generator and AC generator. However, due to the spark generated by the contact between a slip ring and brushes, the use of a high voltage and high capacity DC generator is impossible.

On the contrary, the AC generator is used for almost all machines, while the DC generator is mainly used in the field of special uses, that is to say, where an accurate speed control is required.

Products and Specifications

In this plant, explanations are given chiefly on the

Table 1. **Specifications of Standard Diesel Engine A.C. Generators**

Generator capacity (KW)	(KVA)	Voltage (V)	Phase (ϕ)	Fre-quency (Hz)	Power factor (%)	No. of poles	Exciter capacity (KW)	Engine (b.h.p.)
100	125	220-380	3(3 or 4 wire)	50	80	4,6	3	150
100	125	220-380	3(3 or 4 wire)	60	80	4,6	3	150
200	250	220-380	3(3 or 4 wire)	50	80	4,6	5	300
200	250	220-380	3(3 or 4 wire)	60	80	4,6	5	300
300	375	220-380	3(3 or 4 wire)	50	80	4,6	7.5	450
300	375	220-380	3(3 or 4 wire)	60	80	4,6	7.5	450
400	500	3,000-3,300	3(3 or 4 wire)	50	80	4,6	10	600
400	500	3,000-3,300	3(3 or 4 wire)	60	80	4,6	10	600
500	625	3,000-3,300	3(3 or 4 wire)	50	80	4,6	10	750
500	625	3,000-3,300	3(3 or 4 wire)	60	80	4,6	10	750

self-exciting AC generator and brushless AC generator.

The disel engine-driven AC generator is simple and economic in operation and maintenance. Moreover its fuel is economical and easily available. This product is a portable type diesel engine-driven AC set coupled to a disel engine and mounted on a common base.

The control panel and other necessary apparatus are also assembled on this base to form one integral unit. Therefore, the machine can be installed directly on the ground without particular foundation. Owing to these advantages, it is used widely as follows:

- Power source for civil engineering and construction work.
- Emergency supply equipment for hospital, bank, theater, building, pumping station, hotel etc.
- Power source for communications equipment.
- Portable power supply for traveling service and work.
- ○ Power supply in busy season for agricultural and forestry areas.
- ○ Lighting source for a remote place.

The brushless AC generator is a type of generator developed to replace the conventional brush-type generator which requires slip-rings and brushes for the field excitation, reducing the radio interference and maintenance cost to a satisfying extent. It has revolving-amature type AC exciter with rotating rectifiers directly connected to the generator field and, the generator output excites the excites through AVR and the exciter generates and excites the generator.

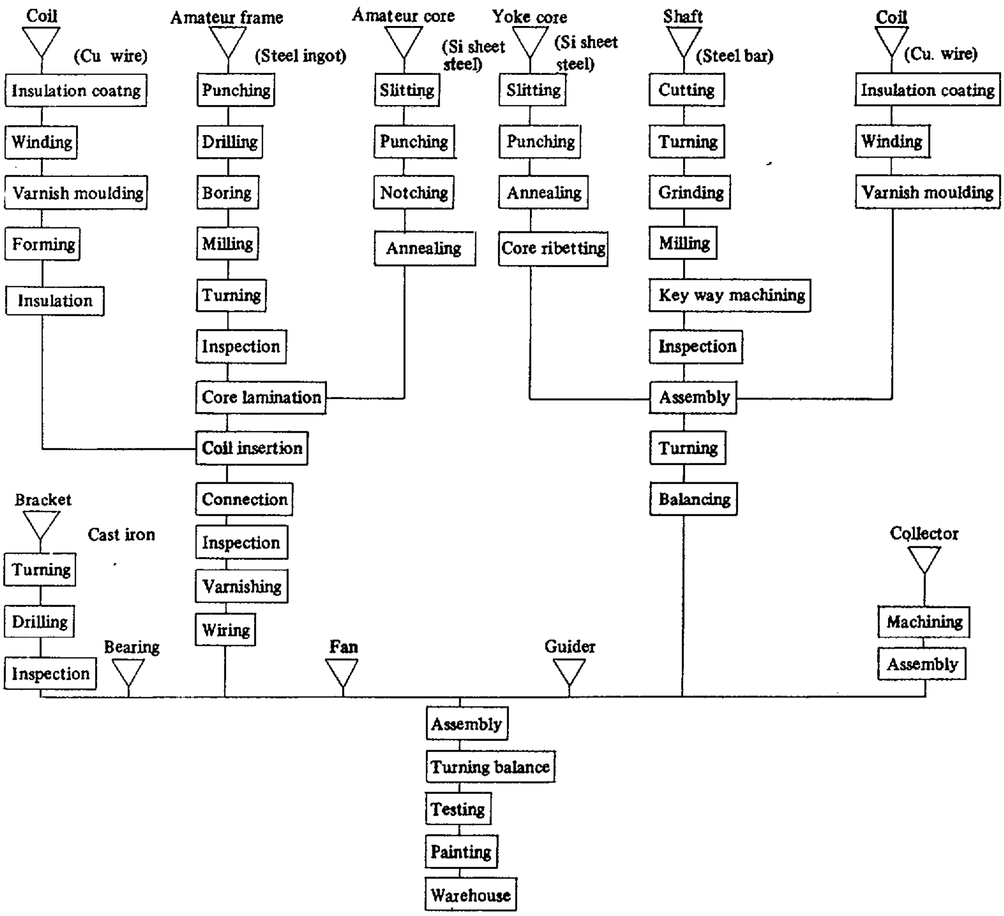
Contents of Technology

1) Process Description

Amature frame

Amature frames are made of welded steel plate for a sufficient mechanical strength and good features. Rolled steel sheets are processed by punching, roll forming, drilling, boring, milling and turning to welded structures.

Alternating Current Generator Assembling Process Block Diagram



Yoke core

Yoke cores are constructed with laminated silicate steel sheet of good quality to decrease core losses. Sheet cores are slitted and punched to desired shape, and each slot is punched out (notching) for inserting in stator windings. After cores are annealed to remove the mechanical stress and give uniform electro-magnetic characteristics, and then it is fabricated in the stator frame.

Amature winding

Amature windings are made of insulated annealed copper wires, double glass covered wires, or enameled wires. Insulated wires are wound, varnished and formed (there are no forming process for the random wound coils) to desired turns, size and hexagonal shape, then inserted into stator core slots, with each wire cemented and vacuum impregnated.

Rotor core

Rotor cores are constructed with laminated silicate steel sheet or hot rolled steel. In the same way as for stator cores, slitting, punching and anealing process are applied, and then laminated by rivetting or welding.

Rotor winding

Rotor winding are made of insulated wires like stator windings. Insulated wires are wound to desired turns, size and shape, and then varnished and formed.

Shaft

Shafts are made of forged steel for a sufficient mechanical strength for carrying centrifugal force and power transmission. Forged steel bars are processed by cutting, turning, grinding and milling into a desired dimensions and shape. And the, rotor cores and rotor windings are assembled and dynamically balanced.

Miscellaneous

Also other parts of generators are made of proper materials and suitably treated for desired purposes and performances.

Assembly

The stator, rotor, brackets and all other parts are assembled into a complete set of generator.

Inspection and test

After assembly, generators are inspected and tested for dimensions, materials, workmanship, painting and performances.

2) Equipment and Machinery

NC lathe
Rotary milling machine
Cyclinderical grinding machine
Auto punch press
Coil inserting equipment
Grinding machine
Slitting machine
Conveyer
Bending roller
Inspection equipment

FILE: Q-35
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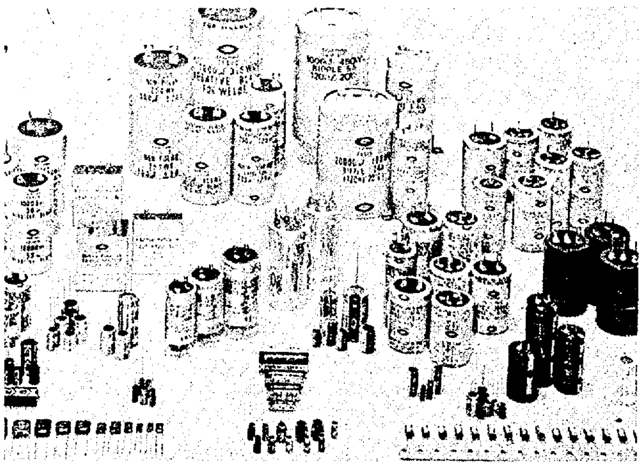
Condenser Manufacturing Plant



View of Products

The condenser provides an electric capacity by arranging in parallel two sheets of electrodes, respectively anode (positive) and cathode (negative). It is manufactured by inserting diversified inductive substances between electrodes to increase the capacity per unit area.

Along with the resistor and inductor, such a condenser plays an important role as an element in the electric circuit. Concrete roles are; Firstly, it impedes direct current to allow the passage of only alternating current, secondly, it combines with a coil to form oscillating circuit and thirdly, it determines characteristics of time-constant circuit.

Depending upon the structure and material, such condensers break down into many types, notably into the fixed condenser and variable condenser. In this plant, explanations are restricted respectively to the ceramic condenser and electrolytic condenser falling under the fixed condenser.

The ceramic condenser employs titanium dioxide (TiO_2) as its inductive substance and is used as a low-capacity condenser in high frequency circuit or oscillating circuit. The electrolytic condenser uses as its inductive substance the metallic oxide formed by electrolytically oxidizing the surface of such anode oxidizable substances as aluminum, titanium and the like, with protection provided by charging electrolytic solution.

Such an electrolytic condenser, extremely thin in oxidized film and large in voltage resistance, has the advantage of forming a small-sized condenser of large static electricity capacity.

This condenser belongs to an industry to be essentially developed in the electric and electronics industry of a modern industrial nation. It is of small and medium business and labor-intensive with characteristics of requiring much know-how.

Products and Specifications

The ceramic condenser is further divided into two types. One is the temperature compensating ceramic capacitor and the other is the high dielectric constant ceramic capacitor with the following specifications and features:

- Changes in capacitance due to temperature changes are linear and reversible. Moreover, any optional temperature coefficient is obtainable.
- Compared with conventional types of capacitors, construction of these is much simpler and inductance is negligible, enabling them to function as capacitors up to high-frequencies.
- Conveniently small-sized.
- The Q-value is superior from low to high frequency ranges.
- Excellent heat resistance; insulation deterioration due to temperature rise is limited.
- Capacitors with small capacitance tolerance are easily obtained. No secular change is observed in capacity value.

Among them, specifications of the condenser with working voltage of 500V DC and 1-2KV DC are as shown in table 1 and table 2. Characteristics of the high dielectric constant ceramic capacitor are as follows:

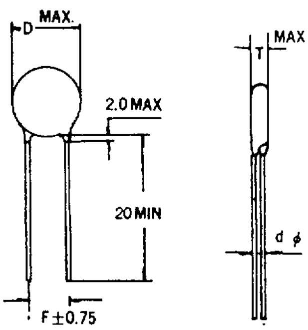
- Extremely high dielectric constants compared with other dielectrics, resulting in producting small-sized capacitors with large capacitance.
- Quite simple construction as capacitors, permitting their use over a wide frequency range.
- Excellent heat resistance; decrease in insulation resistance caused by temperature rise negligible.
- Good moisture resistance for permanent use under normal atmospheric conditions.

Among them, specifications of the condenser with working voltage of 50V DC and 1-2KV DC are as shown in table 3 and table 4.

With respect to the electrolytic condenser, miniature and large aluminum electrolytic capacitors and PET film and metalized film capacitors are produced in this plant. Specifications of the miniature electrolytic capacitor used for general electronics equipment are as shown in table 5, while those of RB series in use over wide temperature range in industrial switching regulator and telecommunications are as shown in table 6.

Table 1. Specification of Temperature Compensating Ceramic Capacitor with working Voltage of 50V DC

W.V	Type	Capacitance (pF)										Dimensions mm			
	JIS	A	C	L	P	R	S	T	U	SL	W				
	TC	P 100	NP 0	N 80	N 150	N 220	N 330	N 470	N 750	P 350 N 1000	N 1500	D	T	F	d
50V DC	DT-200	1~9	1~15	1~16	1.5~22	1.5~24	2~27	2~33	2~51	0.5~131		5.0	4.0	2.5	0.5
	DT-201	10~15	16~33	18~36	24~43	27~47	30~56	36~56	56~82	141~241	68~100	6.3	3.0	5.0	0.6
	DT-203	16~30	36~56	44~62	47~68	51~82	62~100	62~110	91~120	271~431	110~200	8.0			
	DT-205	33~47	62~100	68~110	75~130	91~170	110~180	120~160	130~240	471~621	220~470	10.0			
	DT-207	51~82	110~150	120~180	150~200	180~220	200~270	180~300	270~470			12.5			

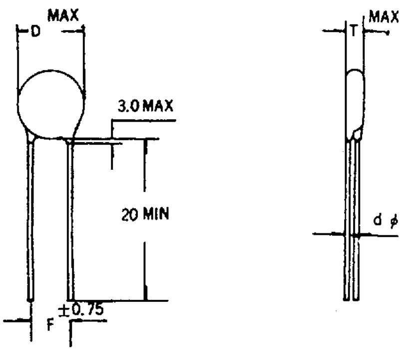


Basis :

1. Temp. Range −25~+85℃
2. Working Voltage 50V. DC
3. Testing Voltage 150V. DC. 1~5 Sec (50 mA MAX)
4. Insulation Resistance 10,000 MΩ MIN. (50V. DC.)
5. Q More than 30 pF: 1000 MIN.
   Less than 30 pF: 400+20C (c: cap)
6. Testing Condition 1 MHz (0.5~5V. RMS) at 20℃

Table 2. Specification of Temperature Compensating Ceramic Capacitor with Working Voltage of 1-2 KV DC

Type		Capacitance (pF)		Dimensions (mm)				Capacitance (pF)		Dimensions (mm)			
	W.V	1 KV DC						2 KV DC					
	JIS	U	SL					U	SL				
	T.C	N 750	P 350~N 1000	D	T	F	d	N 750	P 350~N 1000	D	T	F	d
DT-800		6~22	3~47	8.0	4.0	6.35	0.8	–	–		4.0	9.52	0.8
DT-810		24~36	51~91	11.0				10~15	10~36	11.0			
DT-820		39~75	100~180	13.5		9.52		16~30	39~68	13.5			
DT-821		82~120	200~270	16.0				33~47	75~130	16.0			
DT-830		130~240	300~390	20.0				51~100	150~240	20			
DT-831		270~330	430~510	22.0				110~180	270~330	22			

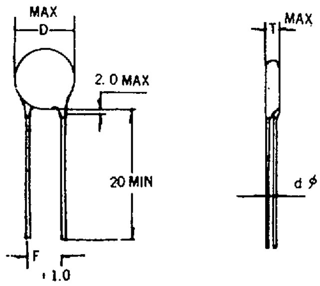


Basis

1. Temp Range −25~+85℃
2. Working Voltage 1~2 KV. DC
3. Testing Voltage 1 KV, DC: 2KV. DC. 1~5 Sec (50 mA MAX.)
   2 KV, DC: 4KV. DC.
4. Insulation Resistance 10,000 MΩ MIN. (500V. DC.)
5. Q More than 30pF: 1000 MIN.
   Less than 30pF: 400+20C (C: Cap)
6. Testing Condition 1 MHz (0.5~5V, RMS) at 20℃

Table 3. Specification of High Dielectric Constant Ceramic Capacitor with Working Voltage of 50V DC

W. V	Temp. Characteristics T. C	Temp. Characteristics Cap. change	Type	Capacitance (pF)	Capacitance Tolerance	tanδ MAX	Dimensions (mm) D	T	F	d
50V DC	B	±10%	DB-200	100. 120. 150. 180. 220. 290. 330. 470. 560. 680. 1000. 1200	±10% (K) ±20% (M)	2.5%	4.5	4.0	2.5	0.5
			DB-201	1500. 1800. 2000. 2200. 2700. 3300			6.3	3.0	5.0	0.6
			DB-203	3900. 4700. 5600			8.0			
			DB-205	6800. 8200			10.0			
			DB-207	10000. 15000			12.5			
	D	+20% −30%	DB-200	150. 220. 330. 470. 680. 1000. 1200	±20% (M)		4.5	4.0	2.5	0.5
			DB-201	2200. 3300			6.3	3.0	5.0	0.6
			DB-203	4700. 5600			8.0			
			DB-205	6800. 8200			10.0			
			DB-207	10000. 15000			12.5			
	F	+30% −80%	DB-200	1000. 2200. 4700	+80% −20% (Z)	5.0%	4.5			
			DB-201	10000			6.3			
			DB-203	22000			8.3			
			DB-205	40000			10.0			
			DB-207	47000			12.5			
			DB-209	100000			16.0			

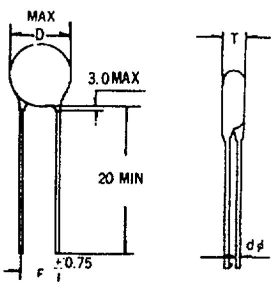


Basis :

1. Temp Range — −25~+85℃
2. Working Voltage — 50 V. DC
3. Testing Voltage — 150V. DC. 1~5Sec. (50 mA MAX)
4. Insulation Resitance — 7.500MΩ MIN (50V. DC.)
5. Testing Condition — 1KHz (0.5 ~ 3V. RMS) at 20 ℃

Table 4. Specification of High Dielectric Constant Ceramic Capacitor with Working Voltage of 1-2KV DC

W. V	Tamp. Characteristics T. C	Tamp. Characteristics Cap. change	Type	Capacitance (pF)	Capacitance Tolerance	tanδ MAX	Dimensions (mm) D	T	F	d
1KV DC	B	±10%	DB-800	120. 150. 180. 220. 270. 330. 390. 470. 560	±10% (K) ±20% (M)	2.5%	8.0	4.0	6.3	0.8
			DB-820	680. 820. 1000. 1200. 1500. 1800. 2200			13.5		9.52	
			DB-821	2700. 3300			16.0			
			DB-830	3900. 4700. 5600			22.0			
			DB-831	6800. 8200. 10000			24.0			
	D	+20% −30%	DB-800	150. 220. 330. 470	±20% (M)		8.0		6.3	
			DB-820	680. 1000. 1500. 2200			13.5		9.52	
			DB-821	3300			16.0			
			DB-830	4700			22.0			
			DB-831	6800. 10000			24.0			
	E	+20% −55%	DB-800	470	+100% −0% (P)		8.0		6.3	
			DB-810	1000			11.0		9.52	
			DB-820	2200			13.5			
			DB-821	4700			16.0			
			DB-830	10000			20.0			



Basis :

1. Temp Range — −25~+85℃
2. Working Voltage — 1KV. DC
3. Testing Voltage — 2KV. DC. 1~5Sec (50mA MAX)
4. Insulation Resistance — 10,000MΩ MIN (500V. DC.)
5. Testing Condition — 1KHz (0.5~5V. RMS) at 20℃

Table 5. Specification of Miniature Electrolytic Capacitor

Item	Characteristics
Operating temperature range	−40°C ~ +85°C
Leakage current max.	I = 0.03CV or 4μA whichever greater (after 1 minutes)
Capacitance tolerance	±20% at 120Hz 20°C
Dissipation Factor at (120Hz 20°C)	For CN > 1000μF : tan δ increases by 0.02 for each 1000μF from below value
Low temperature characteristics (Impedance ratio at 120Hz)	
Load life (at 85°C)	After application of the rated voltage for 1000hrs
Self life (at 85°C)	After 1000hrs with no load, leakage current, capacitance, tan δ not exceeding specified value in load life

Dissipation Factor:

WV	6.3	10	16	25	35	40	50	63	80	100
Tan δ	0.22	0.19	0.16	0.14	0.12	0.12	0.1	0.09	0.09	0.08

Low temperature characteristics:

WV	6.3	10	16	25~100
Z-25°C/Z+20°C	4	3	2	2
Z-40°C/Z+20°C	8	6	4	3

Load life:

Leakage current	not exceeding the specified value		
Capacitance change	not exceeding the initial value from below table		
	rated voltage	WV<16	WV>16
	Dφ≤6	±20%	±20%
	Dφ>6	±20%	±15%
Tan δ	not exceeding 150% of initial value		

RADIAL — Dφ x L (mm)

W.V	6.3	10	16	25	35	40	50	63	80	100
S.V / CAP. (μF)	8	13	20	32	44	50	63	79	100	125
0.47	→	→	→	→	→	→	5x11	→	→	5x11
0.68	→	→	→	→	→	→	5x11	→	→	5x11
1.0	→	→	→	→	→	→	5x11	→	→	5x11
1.5	→	→	→	→	→	→	5x11	→	→	5x11
2.2	→	→	→	→	→	→	5x11	→	→	5x11
3.3	→	→	→	→	→	→	5x11	→	→	5x11
4.7	→	→	→	→	→	→	5x11	5x11	5x11	6x11
6.8	→	→	→	→	→	→	5x11	5x11	5x11	6x11
10	→	→	→	→	→	→	5x11	6x11	6x11	8x11.5
15	→	→	→	→	5x11	5x11	6x11	6x11	8x11.5	8x11.5
22	→	→	→	5x11	6x11	6x11	6x11	8x11.5	8x11.5	10x12.5
33	→	→	5x11	6x11	6x11	8x11.5	8x11.5	8x11.5	10x12.5	10x16
47	→	5x11	6x11	6x11.5	8x11.5	8x12.5	8x12.5	10x12.5	10x16	10x20
68	5x11	6x11	6x11	8x11.5	8x11.5	10x12.5	10x12.5	10x16	10x16	10x20
100	6x11	6x11	8x11.5	8x11.5	10x12.5	10x16	10x16	10x20	13x20	13x20
150	8x11.5	8x11.5	8x11.5	10x12.5	10x16	10x20	10x20	13x20	13x20	13x25
220	8x11.5	8x11.5	10x12.5	10x16	10x20	10x20	13x20	13x20	13x25	16x25
330	10x12.5	10x12.5	10x16	10x20	13x20	13x20	13x20	13x25	16x30.5	16x30.5
470	10x12.5	10x16	10x20	13x20	13x25	13x25	16x25	16x25	16x34.5	18x30.5
680	10x16	10x20	13x20	13x25	16x25	16x25	16x25	16x30.5	18x36.5	
1000	10x20	13x20	13x25	16x25	16x25	16x25	16x30.5	18x36.5		
1500	13x20	13x25	16x25	16x30.5	16x34.5	16x34.5	18x40			
2200	13x25	16x25	16x25	16x34.5	18x36.5	18x40				
3300	16x25	16x30.5	16x34.5	18x40						
4700	16x30.5	16x34.5	18x36.5							
6800	16x34.5	18x40								
10000	18x40									

AXIAL — Dφ x L (mm)

W.V	6.3	10	16	25	35	40	50	63	80	100
S.V / CAP. (μF)	8	13	20	32	44	50	63	79	100	125
0.47	→	→	→	→	→	→	6x12	→	→	6x12
0.68	→	→	→	→	→	→	6x12	→	→	6x12
1.0	→	→	→	→	→	→	6x12	→	→	6x12
1.5	→	→	→	→	→	→	6x12	→	→	6x12
2.2	→	→	→	→	→	→	6x12	→	→	6x12
3.3	→	→	→	→	→	→	6x12	→	→	6x12
4.7	→	→	→	→	→	→	6x12	6x12	6x12	6x12
6.8	→	→	→	→	→	→	6x12	6x12	6x12	6x16
10	→	→	→	→	→	→	6x12	6x12	6x16	8x16
15	→	→	→	→	6x12	6x12	6x12	6x16	8x16	8x16
22	→	→	→	6x12	6x12	6x16	6x16	8x16	8x16	8x16
33	→	→	6x12	6x12	6x16	8x16	8x16	8x16	8x16	8x20
47	→	6x12	6x12	6x16	8x16	8x16	8x16	8x16	8x20	10x21
68	6x12	6x12	6x16	8x16	8x16	8x20	8x20	8x20	10x21	10x26
100	6x12	6x16	8x16	8x16	8x20	8x20	8x20	10x21	10x26	13x26
150	6x16	6x16	8x16	8x16	8x20	10x21	10x21	10x26	13x26	13x26
220	8x16	8x16	8x16	8x20	10x20	10x26	10x26	13x26	13x26	13x31.5
330	8x16	8x16	8x20	10x21	10x26	13x26	13x26	13x26	13x31.5	16x31.5
470	8x20	8x20	10x21	10x26	13x26	13x26	13x26	13x31.5	16x31.5	16x41.5
680	8x20	10x21	10x26	13x26	13x31.5	13x31.5	16x31.5	16x31.5	16x41.5	18x40
1000	10x21	10x26	13x26	13x26	13x31.5	16x31.5	16x31.5	16x41.5	18x40	
1500	13x26	13x26	13x31.5	16x31.5	16x41.5	16x41.5	18x40			
2200	13x26	13x31.5	16x31.5	16x41.5	18x40					
3300	16x31.5	16x31.5	16x41.5	18x40						
4700	16x31.5	16x41.5	18x40							
6800	16x41.5	18x40								
10000	18x40									

Table 6. Specification of RB Series Capacitor

Item	Characteristics
Operating temperature range	−40°C ~ +125°C
Capacitance tolerance	±20% at 120Hz
Leakage current max.	I = 0.006CV or 2μA whichever greater (after 5 minutes)
Dissipation Factor Low temperature characteristics (impedance ratio)	
Load life (at 125°C)	After application of the rated voltage for 1000hrs
Self life (at 125°C)	After 1000hrs with no load, leakage current, Capacitance, tan δ not exceeding specified value in load life.
Storage temperature	−55°C ~ +40°C

Dissipation Factor / Low temperature characteristics:

WV \ Item	Tan δ (at 120Hz 20°C)	impedance ratio Z-25°C/Z+20°C	impedance ratio Z-40°C/Z+20°C
10	0.2	3	6
16	0.15	2	4
25	0.15	2	4
35	0.12	2	4
50	0.10	2	4

Load life:

Leakage current	not exceeding specified value
Capacitance	not exceeding ±20% of initial value
Tan δ	not exceeding 200% of specified value

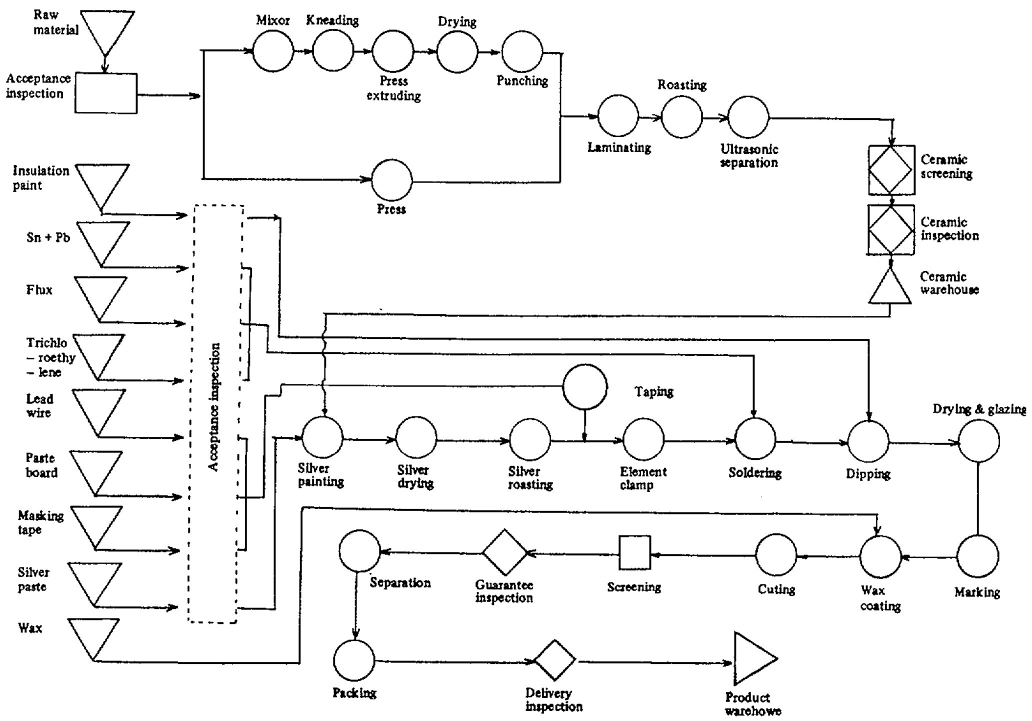
RADIAL — Dφ x L (mm)

WV	10	16	25	35	50
SV / μF	13	20	32	44	63
0.47	→	→	→	→	8x11.5
1.0	→	→	→	→	8x11.5
2.2	→	→	→	→	8x11.5
3.3	→	→	→	→	8x11.5
4.7	→	→	→	→	8x11.5
10	→	→	→	8x11.5	10x12.5
22	→	→	8x11.5	10x12.5	10x20
33	→	8x11.5	10x12.5	10x16	10x20
47	8x11.5	10x12.5	10x16	10x20	13x20
100	10x16	10x20	13x20	13x20	16x25
220	13x20	13x20	13x25	16x25	16x30.5
330	13x20	13x25	16x25	16x34.5	
470	13x25	16x25	16x30.5		
1000	16x30.5				

AXIAL — Dφ x L (mm)

WV	10	16	25	35	50
SV / μF	13	20	32	44	63
0.47	→	→	→	→	6x16
1.0	→	→	→	→	6x16
2.2	→	→	→	→	6x16
3.3	→	→	→	6x16	8x16
4.7	→	→	6x16	6x16	8x16
10	→	6x16	6x16	6x16	10x21
22	6x16	8x16	8x16	8x16	10x26
33	8x16	8x16	8x16	8x20	13x26
47	8x16	8x20	8x20	10x21	13x32.5
100	8x20	10x21	10x26	13x26	16x41.5
220	10x26	13x26	13x26	13x32.5	
330	13x26	13x26	13x32.5	16x32.5	
470	13x26	16x32.5	16x32.5	16x41.5	
1000	16x32.5				

Condenser Manufacturing Process Flow Sheet



Contents of Tecnnology

1) Process Description

The description is restricted to the case of ceramic capacitor here. First, the prepared raw material (TiO_2, $BaTiO_3$) is mixed with methylcellulose, glycerine and water for kneading, press extruding and drying at 160°C. In the other process, it can also be completed by means of dry press process.

The raw material thus prepared undergoes the roasting process at 1,200-1,400°C for 18-26 hours and then ultrasonic separation process. The ceramic thus completed is applied with paste for printing and then dried at 100-200°C to be silver-roasted again at 800°C and inserted with elements.

On the other hand, prepared lead wire, masking tape, flux, Sn+Pb and insulating paint are used in soldering the terminal and element in one second at 215°C plus-minus 5°C, dipping to apply insulation paint coating to the element and coating crystal wax and micro crystal wax. The finished material is cut in accordance with the ordered capacity. Products thus finished are inspected to see whether meeting specifications and then packed and delivered.

2) Equipment and Machinery

Press machine	Kneading machine
Mix machine	Punching machine
Press extruding machine	Roast furnace
Silver drying furnace	Dipping machine
Taping machine	Marking machine
Soldering machine	Wax coating machine

3) Raw Materials

Raw materials	Requirement (per 10,000 pcs of products)
TiO_2, $BaTiO_3$	1,310 g
Silver paste	52 g
Sn + Pb (60:40)	296 g
Insulation paint	1,112 g
Lead wire	2,494 g
Wax	53 g

Example of Plant Capacity and Construction Cost

1) Plant capacity : 1,000,000ea/month
  * Basis : 8 hours/day, 240 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$1,953,000
o Utility facility	:	US$ 342,000
Total	:	US$2,448,000

3) Required Space

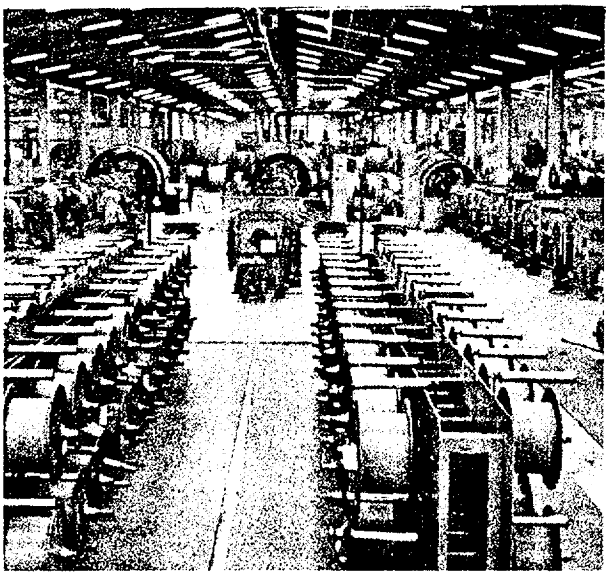
o Site area	:	500 m^2
o Building area	:	100 m^2
o Other	:	330 m^2
Total	:	930 m^2

4) Personnel Requirement

o Manager	:	4 persons
o Engineer	:	4 persons
o Operator	:	21 persons
Total	:	29 persons

FILE: Q-36
ISIC: 3839

Communication Cable Making Plant



View of Cable Making Plant

With the social development, man has come to require more comfortable and convenient life. As one of the modern conveniences, the telephone was born to enable man to communicate with other persons in faraway places, that is to say, to transmit one's natural voice instead of talking to their faces. Nowadays, even a day's life is unthinkable without telephone, therefore, the manufacturing technology of communications line has much developed. The communications line is a product widely used not only in telephone talks but also in the industrial field requiring information transmission. Such a communications line is the very recent communications cable.

It should first be strong enough to resist the external noise, be able to preclude any interference between lines. In response to the requirement that the cable should be light and thin but be able to transmit much information at one time, diverse high-quality products have been developed along with the improvement in technology. In recent years, optical fibers substituting for conventional copper wire have been developed for practical use in developed countries. In Korea such optical fibers have been successfully developed by its own research team to be put to practical use very soon. The communications cable is expected to greatly increase in demand with the advancement of an industrial society and development of manufacturing technology.

In developing nations, the communications cable manufacturing plant as a key social industry should be essentially established on a strong production footing accompanied by the accumulation of technology.

Products and Specifications

In this communications cable plant are produced the standard coaxial cable (2.6-19.5mm), small diameter coaxial cable (1.2-4.4mm), polyethylene insulated city cable, paper insulated city cable and paper insulated carrier cable.

o Standard coaxial cable

Standard coaxial cable consists of 2.64mm mild copper wire conductor with PE discs inserted at the interval of 30mm for insulation and enclosed by double steel tapes. It is characterized by the following:

- The conductor resistance (20°C) is 3.3 ohms/km for inner conductor and 2.4 ohms/km for outer conductor.
- The insulation resistance (DC, 500V after 1-minute charging) is 8,000 megaohms/km between inner conductor and outer conductor, and 1,000 megaohms/km between outer conductors.
- The characteristic impedance (20°C) is 7.5 plus-minus 1 ohm at 2.5 MHz.

o Small diameter cable

1.2--4.4mm small diameter cable uses 1.18mm mild copper wire as its conductor with PE tape inserted at equal interval for insulation. Another conductor is of mild copper tape. The small diameter cable is characterized by the following:

- Coaxial conductor resistance is 16.3 ohms/km for inner conductor and 6.2 ohms/km for outer conductor.
- Insulation resistance is 5,000 megaohms/km between inner conductor and outer conductor, and 500 megaohms/km between outer conductors.

o Polyethylene insulated city cable

Polyethylene insulated city cable uses 0.5, 0.65, 0.9, 1.2mm mild copper wires as its conductor, Polyethylene insulation material is also used. This polyethylene insulated city cable is characterized by the following:

- 94 ohms/km for 0.5mm, 56.8 ohms/km for

0.65mm, 29.2 ohms/km for 0.9mm and 16.5 ohms/km for 1.2mm.

- Insulation resistance is above 10,000 megaohms/km.
- Insulation is not hygroscopic and therefore not liable to be damaged by moisture.
- Not damaged by decay.
- Light in weight and easy to handle because of plastic material.

o Paper insulated city cable

Paper insulated city cable uses 0.4, 0.5, 0.65, 0.95mm mild copper wires as its conductor. This paper insulated city cable is used for wiring between the telephone station and subscribers or between telephone stations for transmission.

- Conductor resistance is 295 ohms/loop. km for 0.4mm, 187 ohms/loop. km for 0.5mm and 58 ohms/loop. km for 0.9mm.
- Insulation resistance is above 2,000 megaohms/km.

Contents of Technology

1) Process Description

i) Copper wire as electric conductor for communications cable is drawn by a drawing machine to be 0.4-1.2mm in diameter.

ii) The drawn wiring material is uniformly insulated by paper, polyethylene or PVC to provide electric insulation.

iii) Two insulated wires are twisted in pairs or in star form.

iv) Pair (star) twisted wire is formed into cable core in 10 paris, 15p, 20p, 25p, 50p and 100p.

v) When exceeding 200 pairs, cable cores are formed in unit sheaf of 25p, 50p or 100p.

vi) In the case of paper insulated cable, the formed cable core is dried in a drying tube.

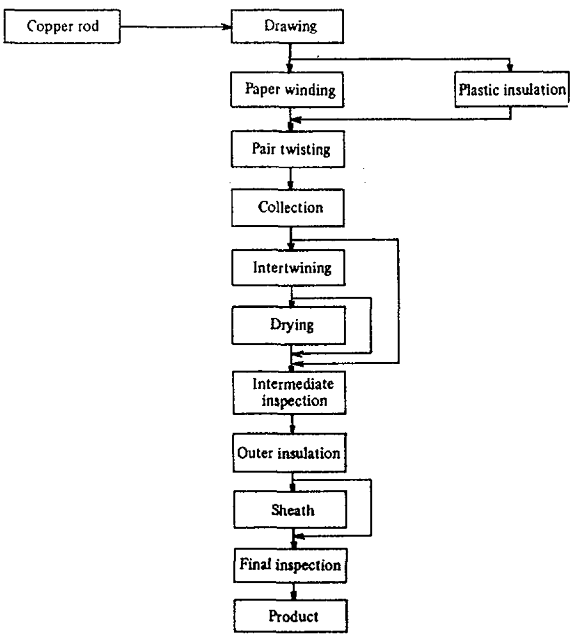
vii) The formed cable core as above undergoes intermediate inspection prior to applying outer coating for insulation.

viii) The cable core pssed the intermediate inspection is coated in outer insulation.

ix) Depending upon uses of cable requiring special protection, the outer part is further protected by steel wire and steel tape.

x) The cable thus finished undergoes final product inspection for packing and delivery.

Communication Cable Manufacturing Process Block Diagram



2) Equipment and Machinery

Drawing machine, thick
Drawing machine, middle
Drawing machine, thin
Paper covering machine
Insulating extruder
Pair twisting machine
Standing machine
Dry tank
Metal sheathing machine
Sheathing extruder
Inspection equipment and other utilities.

Example of Plant Capacity and Construction Cost

1) Plant capacity : 1,500 tons/year
 * Basis : 8 hours/day, 330 days/year

2) Estimated Equipment Cost

o Manufacturing machinery	:	US$3,250,000
Total	:	US$3,250,000

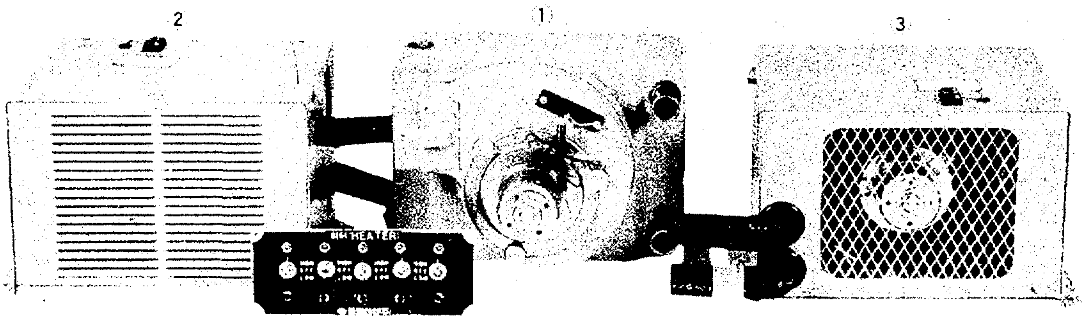
3) Required Space

o Site area	:	15,000 m^2
o Building area	:	4,000 m^2
Total	:	19,000 m^2

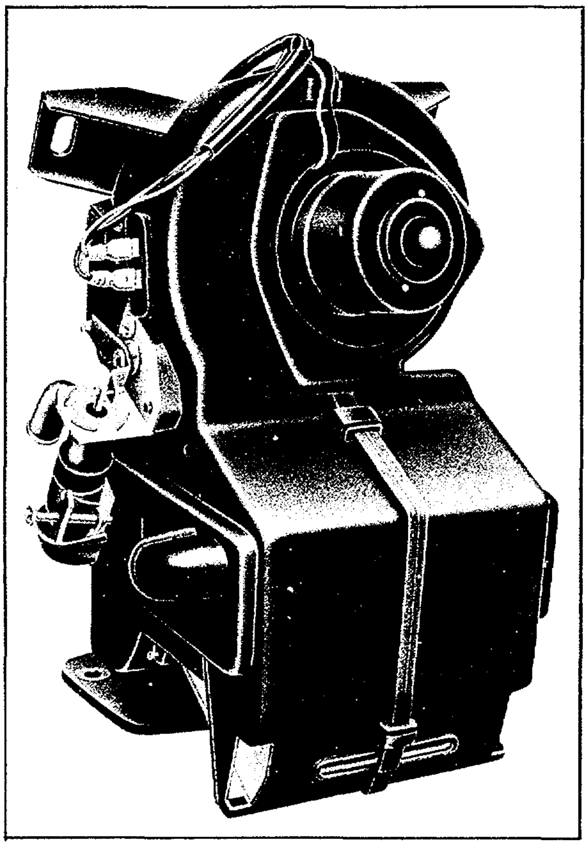
4) Personnel Requirement

o Manager	:	2 persons
o Engineer	:	6 persons
o Operator	:	45 persons
Total	:	53 persons

Car Heater Making Plant



View of Bus Heater



View of Mini-bus Heater

This description is related to the car heater manufacturing plant and its technology for the heat exchanger adopting the tube and corrugated fin type system characterized by the small size, light weight and high heat exchange capacity.

Being the hot-water type car heater, it is also featured by no accompanying hazards of explosion and ignition, being highly energy-saving for its use of engine waste heat and handy operation.

The licensable technology includes the technology of engineering and manufacturing the optimum heating system by calculating the heating capacity for applicable cars. The car heater manufacturing plant itself can also be exported.

Products and Specifications

Car heaters of the following types and specifications are manufactured currently in this plant.

Table 1. Specifications of Car Heater

Product	Type	Specification
Heaters for bus, truck car and others	Tube and corrugated fin type	1,800-22,500 Kcal/hour

Contents of Technology

1) Process Description

The copper foil is rolled and slitted to have the thickness of 0.06mm and required width for subsequent fabrication of corrugate and louver.

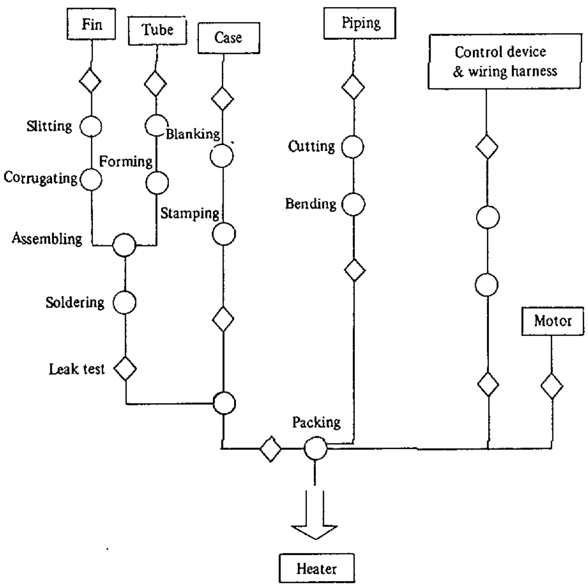
After rolling and slitting to the thickness of 0.14mm and required width, the brass foil is formed into the rectangle and soldered.

The core assembly is made by putting the finished fins and tube together and then soldering them in the soldering furnace.

The upper and lower tanks as well as inlet and outlet tubes drawn from or formed on the core assembly are soldered and put to leak test.

The radiator is placed in a case with blanking and stamping and then the motor and fan are assembled. The control devices (switch, valve and resistor) are made and assembled along with piping and pipe cover.

Car Heater Manufacturing Process Block Diagram



2) Equipment and Machinery

- Slitting machine
- Rolling machine
- Corrugating machine
- Tube miller (including solder coater)
- Soldering furnace
- Acid treatment system
- Press
- Pipe cutter and bender
- Leak tester
- Packing machine
- Conveyor
- Drier
- Painting booth

3) Raw materials and utilities

o Bus heater unit

Raw materials and utilities	Requirement (per ea of product)
Cu foil	2.1 kg
Brass foil	1.4 kg
Steel plate	9 kg
Solder	0.5 kg
Motor	1 ea
Blower case (p.c)	1 ea
Resistor	1 ea
Electric power	1.1 kwh
Fuel	0.5 ℓ
Water	0.2 m^3

Example of Plant Capacity and Construction Cost

1) Plant capacity: 30,000 ea/year
   * Basis: Bus heater

2) Example of estimated construction cost (as of 1982)

o Equipment and machinery	:	US$ 1,530,000
o Utilities	:	US$ 408,000
o Installation cost	:	US$ 586,000
Total	:	US$ 2,524,000

3) Required space

o Site area	:	23,140m^2
o Building area	:	6,940m^2

4) *Personnel requirement*

o Plant manager	:	30 persons
o Engineer	:	18 persons
o Operator	:	186 persons
o Others	:	20 persons
Total	:	254 persons

FILE: Q-38
ISIC: 3833

HOW TO START MANUFACTURING INDUSTRIES

ELECTRIC CABLES AND WIRES

Electric wires and cables, permanently and widely used, belong to a group of industrial products which are indispensable for industrial development and improvement of the quality of everyday life. Factories for production of electric wires and cables built in developing countries can significantly improve the supply and reduce the import of these products.

Industrial production of electric wires and cables begins with investment into production of simpler products, but those which can be used in housing construction, for installation in smaller industrial plants, for public illumination, for smaller industrial and household appliances etc. The here presented technology refers to the production of thermoplastic-insulated wires and cables for voltages up to 1000 V, because developing countries can afford to finance and develop production of exactly this type of products. In connection with this, we suggest the technology for cables and wire production to be carried out in two steps:

The first step includes purchasing of six machines and the equipment for testing field and for the polishing of the wire drawing stone. The producer must purchase already drawn wire Ø 1,20 mm, which must be further drawn and insulated into Ø 12 mm cables. There is also a possibility of wire and cable production for hosehold installations and flexible attachment cables.

A supply of four additional machines and laboratory equipment is foreseen for the second step of production. The producer can purchase and remodel copper wire Ø 8 mm, produce and finalize power supply cables for voltages up to 1000 V, with diametar up to 4 x 50 mm^2, including cabels with mechanical protection. The residual part of the investment is ment for equipment necessary for repairs and maintenance of machines, and for purchase of transportation means for materials handling in the plant and the construction of a transformer for the needs of the plant.

PROCESS DESCRIPTION

Drawn copper or aluminium wire for production of

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insulated wires or cables widely used for electrical purposes is invariably wet drawn on drawing machines from wire rods Ø 8 to 10 mm down to Ø 0,03 mm. The conducting portion of the cable is called conductor. It is made of a set of bare copper or aluminium wires, standed or bunched. A thermoplastic insulation coating is extruded on conductors. Round or sector shaped insulated cores are laid-up or twisted together in helical form in order to get a multi-core cable. Wire or metal tape is often applied over laid-up cores to protect cables against mechanical damage. Provision of an outer protective covering for cables is assured by sheathing; it is usually effected by extruding protective covering over the insulation in single-core cables or over the assembly of cores, resp. over armour in multi-core cables.

Quality control of raw materials is made before starting the production (raw material test) so that the finished insulated wire or cable will satisfy the required quality level. Each production phase is checked (production test) in order to avoid the defective semi-finished product being processed in the next operation phase. Finally, the finished products are submitted to the acceptance test.

In the production of insulated electric wires and cables the continuous production process is used.

PRODUCTION CAPACITY

The quantity of copper wire entering the plant is 2,500 tons per year; from this quantity 3,400 tons of finished products are obtained.

This calculation is based on 16 working hours per day and 300 days per year.

REQUIRED MACHINERY AND EQUIPMENT

I t e m	No.
Rod drawing machine	1
Intermediate wire drawing machine	1
Fine wire drawing machine	1
Bunching machine	1
Thermoplastics insulation machine	1
Thermoplastics cores sheathing machine	1
Cores laying-up (twisting) machine	1
Core rewinding machine	1
Coil packaging machine	1
Armouring machine	1

Others:

Polishing shop
Equipment for testing field
Laboratory equipment

Equipment for the maintenance of machines
Transformer
Fork-lift truck and other transportation vehicles

Price of machinery:	phase I	US dollars	962,418 (1985.)
	phase II	US dollars	1,010,606
Price of equipment:		US dollars	167,668

REQUIRED RAW MATERIALS

Item	Quantity
Copper wire Ø 8 mm	2,500 t/year
PVC granules	700 t/year
Cold rolled steel bands	200 t/year

REQUIRED MANPOWER

Qualification	No. of persons
Engineers	4
Technicians	5
Skilled workers	31
Unskilled workers	4
	TOTAL: 44

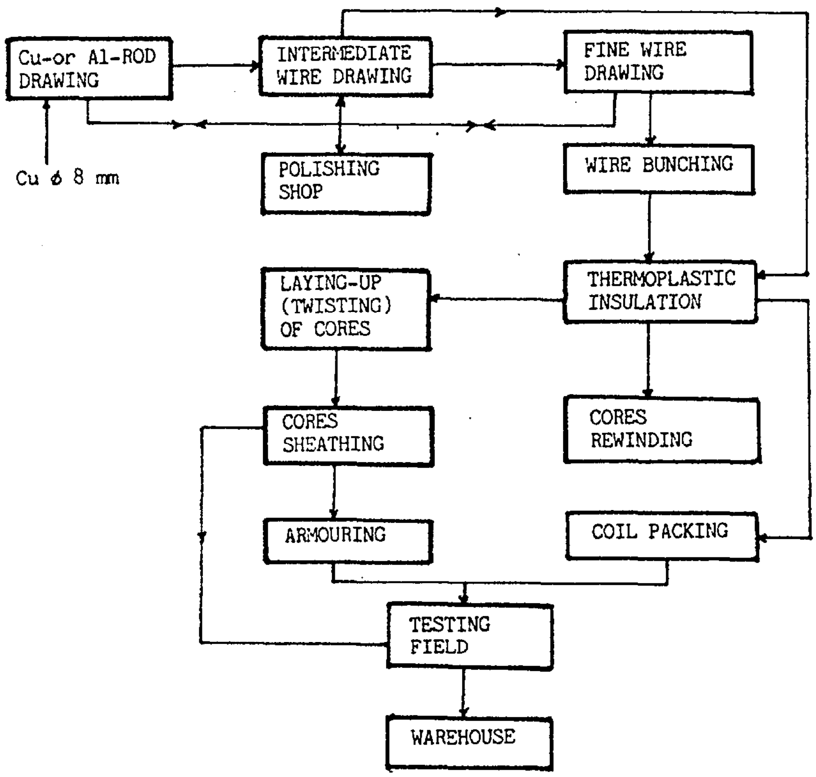
REQUIRED UTILITIES

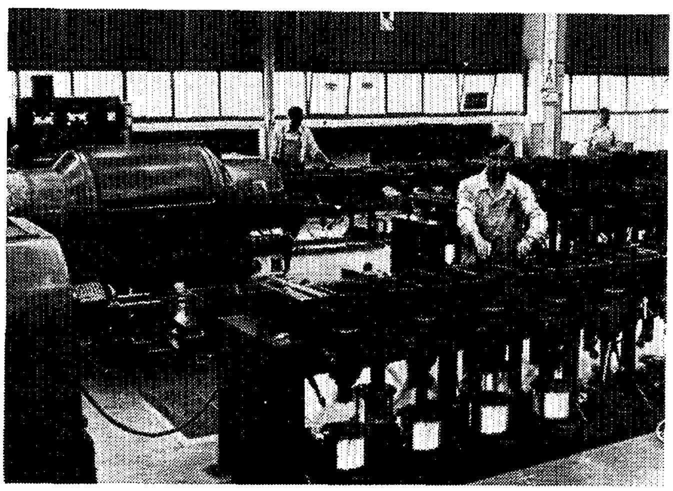
Electric power	1,360 kWh/t of product
Technological water	36 t/t of product

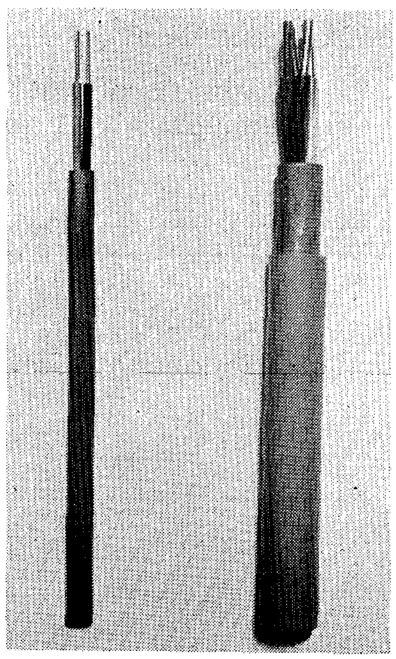
REQUIRED AREA FOR PLANT SITE

The total area occupied by the plant is 3,460 sq.m. which includes 2,500 sq.m. for the production hall and 900 sq.m. for warehouse, laboratory and equipment maintenance shop.

ELECTRIC WIRES AND CABLES PRODUCTION BLOCK DIAGRAM







HOW TO START MANUFACTURING INDUSTRIES

MANUFACTURE OF PRESSING IRONS

The electric iron described here (of 220 V, 1200 W, 50 Hz) is lightweight and of a design that guarantees good functioning. It is controlled by a thermostat and inside rating enables appropriate temperature setting selection. Electric heater is sealed to the aluminium support. This ensures direct contact, efficient transfer of heat and fast achievement of wanted temperature as well as saving of energy. The pilot light goes out when the set temperature is reached. The temperature control maintains the soleplate temperature within the required limits. The soleplate is made of special aluminium alloy with good heat conductivity. The uniform heat distribution permits confortable ironing of all fabrics both natural and synthetic. The iron handle is made of high quality polymer of various colours and in two designs: with open handle and with closed handle. The handgrip is easy to hold and the smoothly polished soleplate slides easily over the fabric. The design permits ironing of narrow sleeves and small pockets.

The iron is fitted with a flexible chord and an earthed plug. The steel chrome plated cap is of a high mirror polish giving the iron an attractive appearance.

Upon completion of assembly each electric iron is tested. Respective design ensures that no disturbances occur in radio/TV broadcasting.

PROCESS DESCRIPTION

The production process consists of four production phases:

1. Machining
2. Grinding and surface protection
3. Polymer processing
4. Assembling and testing

1. Machining

Parts of sheet metal are obtained by cutting, hammering, boring and molding on corresponding equipment. Holes are drilled and grooves are cut by means of special automatic equipment. The

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base of the electric iron made of aluminium alloy is casted on equipment for pressure casting. Electric heater is manufactured in a special shop or delivered by other manufacturer.

2. Grinding and surface protection

Upon completion of pressure casting the support of the electric iron is grinded and polished on special semiautomatic machine. The exposed surfaces are protected by galvanizing (zinc coating) in automatic galvanizing plant. Automatic transportation equipment serves for transportation of parts through the plant; it starts from the preparation of surface in the acid dip, it continues to the washing in running water, galvanized coating, copper, chrome, and nickel-coating and it ends with drying and storing in the warehouse.

3. Polymer processing

Parts made of polymer are manufactured by pressure injection or by injection on particular equipment for polymer processing. This equipment is furnished with adequate auxiliary tools:

- for preparation of granules
- for transportation of granules to the equipment funnel
- for warming (heating) of the mould and surfaces that receive plastic coating
- for mounting and dismounting of moulds from the machine
- for grinding of rough surfaces and excessive polymer outpours.

4. Assembling and testing

Electric irons are assembled on the assembly line by special equipment and screwdrivers. Finished electric irons are tested on a testing bench. Finished products are packed in cardboard boxes and transported to the finished goods storage.

In the manufacture of electric irons a continuous system of production is used.

PRODUCTION CAPACITY

The capacity of production is 250,000 irons per year. Based on a 16 hours working day (two shifts) 250 days per year, at 80% of total capacity.

REQUIRED MACHINERY AND EQUIPMENT

I t e m	No.
Machine plate shears	1
Hydraulic press 630-1600 kN	2
Trimming machine	1

Excentric presses 250-500 kN	4
Winding machine	1
"Siluminium" pressure casting machine	1
Grinding machines	5
Polymer injection moulding machines	2
Galvanization plant	1
Spot welding device	1
Assembly line with equipment	1
Testing table	1
Other: environment protection equipment, drawing, injection moulding and pressure casting tools	

FOB price of machinery and equipment: about 1 million US dollars.

REQUIRED RAW MATERIALS

I t e m	Quantity
Steel plate 0.8 - 2 mm	0.5 t/t of product
Insulating compound	0.12 t/t of product
Polymer granulation	0.35 t/t of product
"Siluminium" alloy	0.32 t/t of product
Standard parts, auxilliary materials, packiging materials.	

REQUIRED MANPOWER (for two shifts)

Q u a l i f i c a t i o n s	No.
University qualifications (engineers and economists)	12
Technicians	6
Highly skilled workers	8
Skilled workers	24
Semi-skilled workers	45
Unskilled workers	45
TOTAL:	140

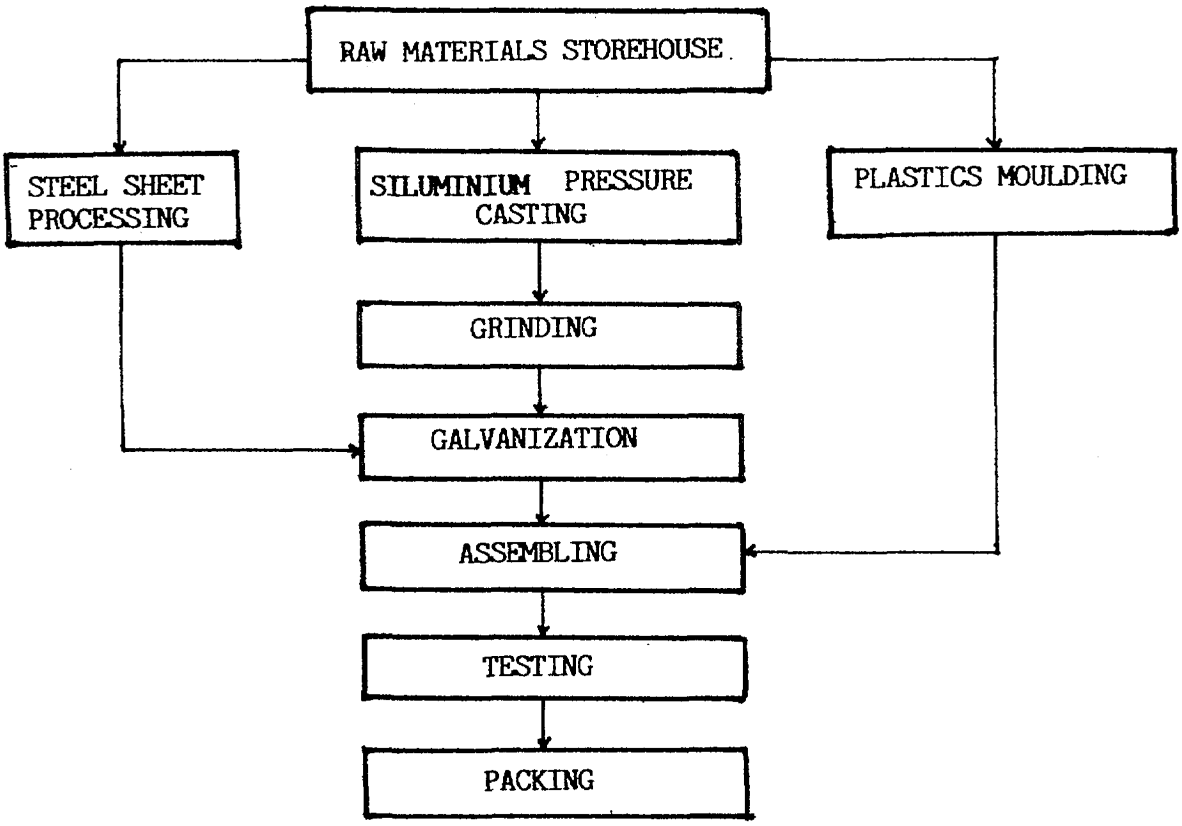
REQUIRED UTILITIES

Electric power	55,000 kWh per year per shift
Gas	7,000 m^3 per year per shift
Compressed air (6 bar.)	500,000 m^3 per year per shift
Water	9,000 t per year per shift

REQUIRED AREA FOR PLANT SITE

A total area of 1800 m^2 is needed, including plants, storage and offices.

PROCESS BLOCK DIAGRAM FOR MANUFACTURE
OF ELECTRIC IRONS



FILE: Q-40
ISIC:3833

WATER HEATER MANUFACTURING PLANT

Electric water heaters are ideal for water heating in buildings with no central heating or for buildings provided with central heating but where water is not heated during the summer months.

In presented electric water heaters an overflow system is used in which the water container is constantly exposed to the outside atmosphere by means of a drain (overflow) pipe. A drain valve is built in on the cold water inlet pipe in the water container. Any type of electric water heater can be connected to this system. The system permits the connection of one overflow point only.

The ten litre electric water heaters are provided with corrosion resistant plastic water containers ensuring many years of service. Their up-to-date design guarantees the optimum electric power consumption, while the thermal insulation lessens undesirable heat losses. The controller ensures continuous control of water temperature in conformance with current standards for preparation of hot water. Considering the listed technical properties and the functioning of electric water heaters the advantages are:

- hot water available at any time
- reduced heat losses
- lower utility costs
- lesser scale sedimentation.

The electric water heaters are made in two versions: for vertical and for horizontal mounting; they can be round or square shaped. Their performance is reliable since they are subject to close testing during the production process.

PROCESS DESCRIPTION

The water heaters described here have the following characteristics:

- Operating volume	10 l
- Electric heater power	1000 W, 220 V, 50 Hz
- Tank material	polypropylene

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- Heater material copper
- Thermal insulation soft polyurethane

The production process consists of the following stages:

1. Machining
2. Polymer processing
3. Pre-assembly and testing
4. Assembly and final testing

1. Machining

Parts of metal sheet are obtained by cutting, drilling and moulding with corresponding equipment. Machinery is equipped with special devices and tools necessary for each technological operation.

Electric tube heaters are manufactured in a special plant or delivered by another manufacturer.

2. Polymer processing

Polypropylene container is produced on a special blowing machine. The external thermoplastic shell is produced by injection moulding. Machines are equipped with necessary auxiliary equipment for preparation of granules, transportation of granules to the funnel, heating of moulds and zones, for plastification, for mounting and dismounting of moulds from the machine and for cleaning of the surface of the product.

3. Pre-assembly and testing

Individual parts (container and electric tube heater) are assembled and thermaly insulated through soft polyurethane on the pre-assembly-benches. They are tested for watertightness individually or in batches by adequate testing equipment in conformance with the current standards on testing of containers under pressure.

4. Assembly and final testing

Electric water heaters are assembled on the assembly line by special equipment and then subjected to final testing. Finished products are packed in cardboard boxes and transported to the storage for finished products.

In the manufacture of electric water heaters a batch method or a continous system of production can be used.

PRODUCTION CAPACITY

Annual production capacity of the plant is 100,000 electric water heaters. The calculation is based on a 250 day year and a 16 hour day (two shifts) at 80% of total capacity.

REQUIRED MACHINERY AND EQUIPMENT

I t e m	No.
Machine shears for steel sheet	1
Eccentric press 250 - 500 kN	2
Blow moulding machine	1
Injection moulding machine 100 g	1
Injection moulding machine 200 g	1
Injection moulding machine 1500 g	1
Stamping machine	1
OTHERS:	
Assembly line and equipment	
Testing equipment	
Transport and storage equipment	
Tools	

FOB price of equipment: approximately US dollars 1 million.

REQUIRED RAW MATERIAL

I t e m	Quantity
Zinc-plated sheet steel	0.4 t/t of product
Polypropylene polymers	1.1 t/t of product
Other polymers	1.4 t/t of product
Electric tubular heater	supplied from another producer
Soft polyurethans	supplied from another producer
Standard parts, auxiliary material, packaging material	

REQUIRED MANPOWER (for two shifts)

Qualification	No.
University graduate	10
Technicians	4
Highly skilled workers	7
Skilled workers	18
Semi-skilled workers	28
Unskilled workers	35
TOTAL:	102

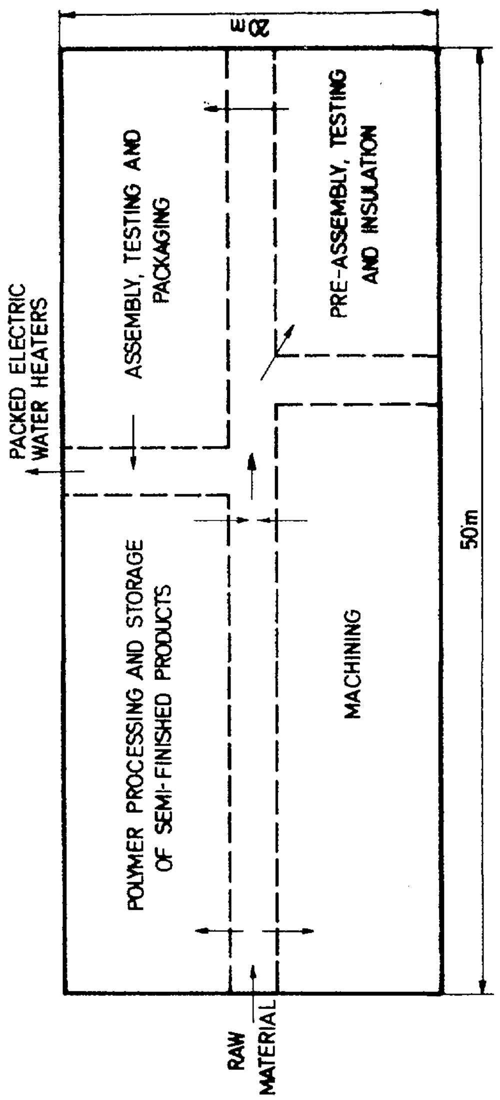
REQUIRED UTILITIES

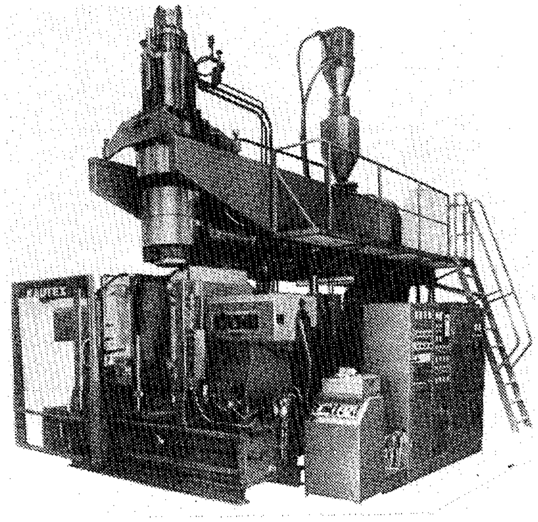
I t e m	Quantity
Electric power	50,000 kWh/year per shift
Gas	8,000 Nm^3/year per shift
Compressed air (6 bar)	450,000 Nm^3/year per shift
Water	15,000 t/year per shift

SERVICES OFFERED

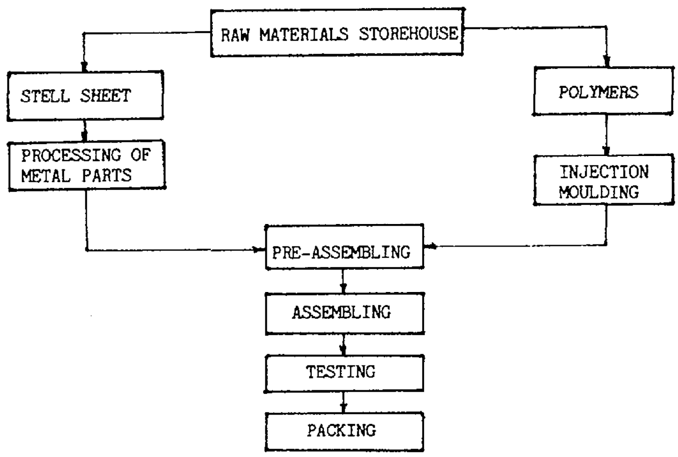
Know-how, joint venture, licence, turn-key, tender documentation, project documentation, organization of construction, engineering, carrying out the investment operations, personnel training.

ELECTRIC WATER HEATERS MANUFACTURING PLANT: OUTLINE OF TECHNOLOGICAL ZONES





ELECTRIC WATER HEATERS MANUFACTURING BLOCK DIAGRAM



FILE: Q-41
ISIC: 3831

HOW TO START MANUFACTURING INDUSTRIES

MANUFACTURE OF DISTRIBUTION TRANSFORMERS

The manufacture of distribution transformers designed and constructed in accordance with contemporary scientific experience is considered. The distribution transformers are manufactured as the three-phase oil transformers suitable for installation in locations within the plant or in the open site. The design ensures their utilization practically in any climatic conditions. They are manufactured for standard powers of 50, 100, 160, 250, 400, 630, 1000 and 1600 kVA and standard transformation ratios of 10/0.4 kV and 20/0.4 kV and in a version of 10-20/0.4 kV.

They are designed, constructed and manufactured for frequency of 50 Hz, for permanent operation at hight up to 1000 m above sea level. At hights over 1000 meters the rated power decreases by 2% for each successive 500 m. They are natural air cooled and the desigms with or without the oil tank are manufactured.

The oil tank is made of rolled sheet and grants the highest quality in regard to leak-proof. Carefully selected, tested and technologically elaborated methods of anticorrosive tank protection fulfil practically all requirements that may be claimed in different climatic conditions. All transformers are filled with high quality degasified and dehydrated oil.

The transformer core is made of high quality cold rolled sheet. Particular construction of coils ensures that all transformers of this sort satisfy all test and impuls voltages, as well as dynamic tests.

The active part of tranformer is fixed to the tank to ensure absolute stability in practically all conditions of transportation to the installation site.

Transformers are designed with porcelain insulators of such type which makes possible replacement without the opening of the transformer.

The technical specifications of considered transformers comply with the requirements prescribed by DIN 42500 (for powers up to 630 kVA) and DIN 42511 (for powers up to 1600 kVA).

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PROCESS DESCRIPTION

The production process for considered transformers begins simultaneously with manufacturing of tank, core, coils and insulation parts as well as with machined components or locksmith shop items.

Upon completion of the core, the coils are instaled on it. When the active part of the transformer is completed the transformer is transported to the vacuum dryer. Dry active part is then transported to the location at which it has to be installed into the tank. The cover is set and accessory equipment (fan, plates, etc.) installed before the transformer is filled with insulation oil. Filling is made while the active transformer part is kept under vacuum.

The transformer is tested, and then painted and packed.

At all stages of the production a strict intermediate quality control of all parts, sub-assemblies and assemblies is provided. It includes the quality control of the core (sheet grooves, sheet dimensions, dimensions of completed core), coils (dimensions, number of windings), tank, dimensions, preparation for paint coating, coating quality, thickness of anticorrosive protection coating etc.

Manufacturing of transformers is organized as a continuous assembly line production with only drying as a batche process.

PRODUCTION CAPACITY

All data listed here (equipment, materials, manpower, power, assembly table) are based upon the projection of annual production of approximately 2000 transformers of 250 kVA (that makes the production of approximately 3000-4000 items yearly in case the entire assortment of 50 kVA and above is manufactured), in a 2 x 8 hours work day, in 250 work days yearly and 70%-80% average utilization of the capacities.

REQUIRED MACHINERY AND EQUIPMENT

I t e m	No.
Plate shears for up to 5 mm thickness	1
Transformer strip shears for up to 0.5 mm thickness	6
Welding equipment	4 sets
Bending press for up to 5 mm thickness	1
Lathe	2
Milling machine	1
Standard tools for manual treatment	1 set
Grinding machine	3
Rod bending machine	1
Winding machine	4

Electric drill	3
Crane of carrying capacity 50 kN	1
Assembly line	1 set
Testing equipment	1 set
Oil drying plant	1
Painting cabin	1 set
Vacuum drying equipment	1 set
Core assembly table	6
Standard office equipment	

FOB price of machinery and equipment + know-how approx. US dollars 1,019,000.

REQUIRED RAW MATERIALS

I t e m	Quantity
Transformer strip, 0.3 mm	1,120 t/year
Winding copper	400 t/year
Insulation paper	40 t/year
Transformer oil	700 t/year
Black plate, profiles etc.	640 t/year
Other material	130 t/year

REQUIRED MANPOWER (for two shifts)

Qualification	No.
University qualifications	2
Technicians	7
Lower educational background	6
Highly skilled workers	4
Skilled workers	18
Semi-skilled workers	39
TOTAL:	76

REQUIRED UTILITIES

Electric power	150 kWh/t of finished product
Water	0,36 t/t of finished product

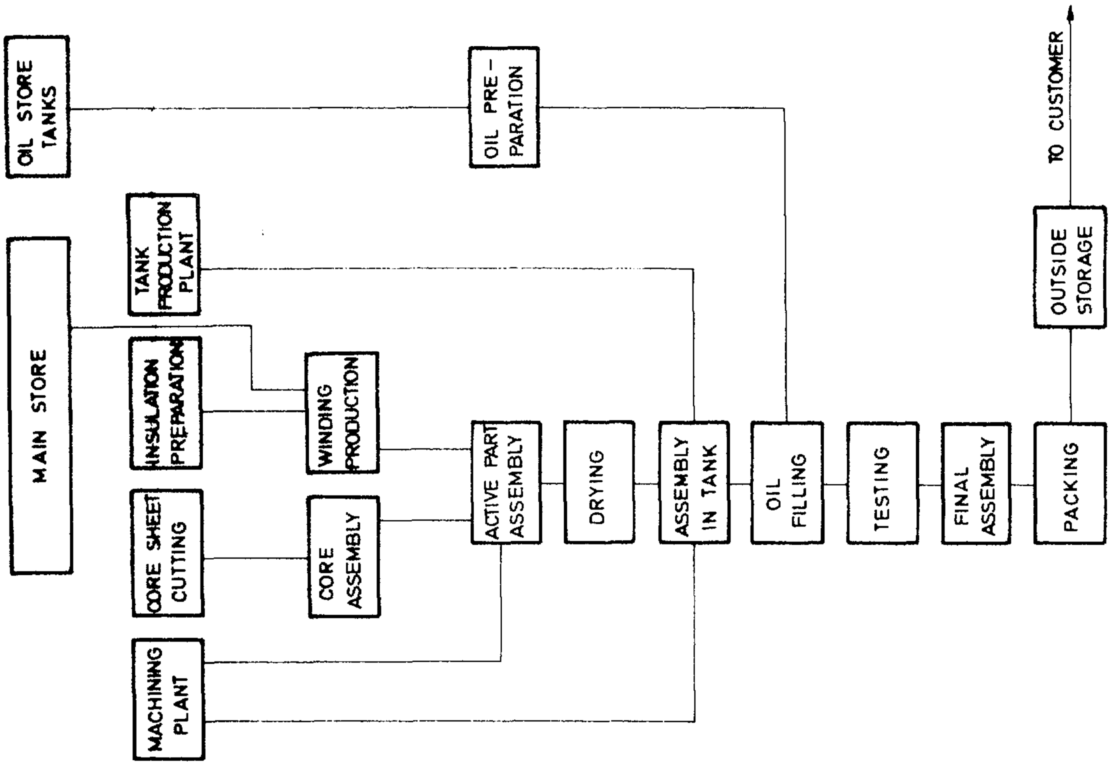
REQUIRED AREA FOR PLANT SITE

For a normal process of production a total area of 1500 m^2 is needed, including production plants, storage, laboratories, offices and auxiliary premises.

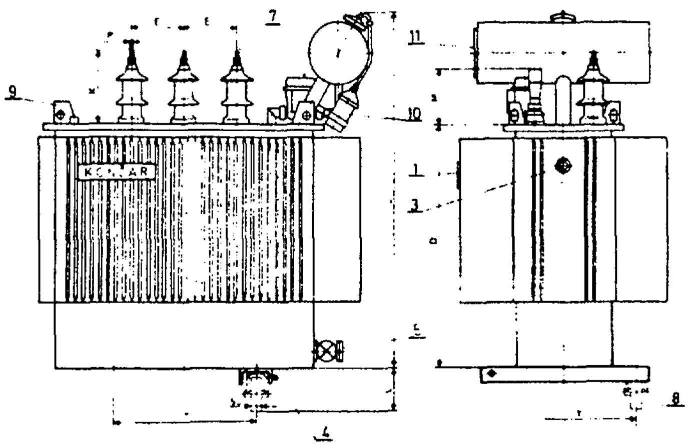
SAFETY MEASURES

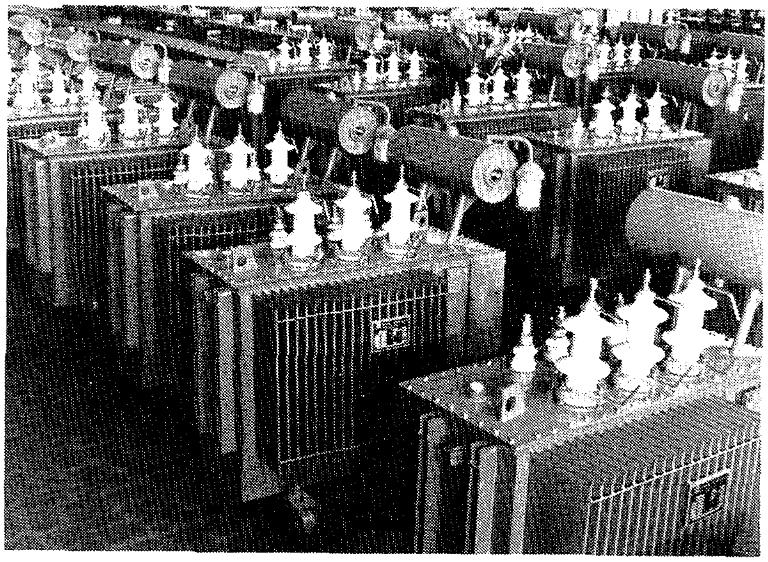
No special safety and protection measures are required for the process of production, only the standard measures customary in this type of manufacture, unless local regulations of the customer country pose special requirements concerning transformer oil handling.

Since the concept of production does not allow any spilled transformer oil to enter the public sewage system or water supply, no special environmental measures are necessary.

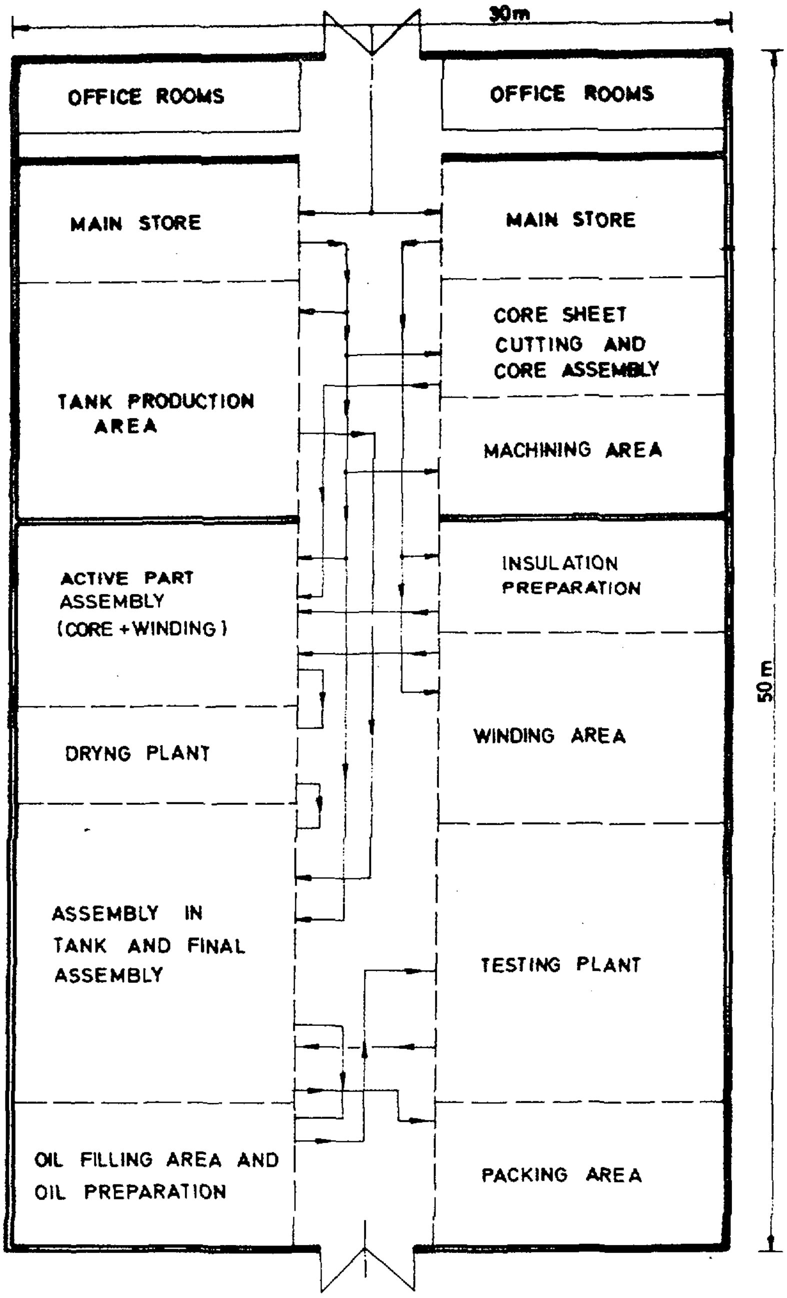


MANUFACTURE OF DISTRIBUTION TRANSFORMES 50 kVA to 1600 kVA: OUTLINE OF TECHNOLOGICAL ZONES





DISTRIBUTION TRANSFORMER PRODUCTION PLANT
(SHEMATICAL LAY-OUT)



FILE: Q-42
ISIC: 3831

HOW TO START MANUFACTURING INDUSTRIES

MANUFACTURE OF SWITCHES

The programme of production contains the manufacture of a range of products from middle and low voltage switchgear to complete transformer stations of 12 kV and 24 kV, and up to 100 kVA:

- middle voltage switchgear fixed assembly L 38 kV
- middle voltage withdrawable switchgear assembly OR 1pi12 and OR 1pi24
- low voltage fixed switchgear assembly VMK 3
- low voltage withdrawable switchgear assembly VMK 6
- control switchgear assembly
- metal-enclosed transformer station 12/24 kV - 1000 kVA
- metal-enclosed compact transformer stations 12/24 kV - 1000 kVA

Transformer stations are completely finished manufacturing products, transferred to the construction site complete with the transformer; they are minimally dimensioned and require very little space. The stations are made as end, or intermediary or junction stations, which is achieved by supplying them with the appropriate number of disconnectors on the high voltage side.

Switchgears are composed of switching devices with accessory control, measuring, signal, protective and regulation instruments, assembled into a functional unit and protected by an outer metal armature. The switchgear for internal mounting, with withdrawable equipment and secondary electronic protection, measuring, control and signalling, is a new solution resulting from the synthesis of a 20-year old experience in manufacturing and exploitation, and the development of the component parts specially adapted to the functions of the switchgear. Each switchgear is separately tested for its main and secondary circuit.

The total annual production capacity is 500 metal-enclosed transformer stations, 400 middle voltage switchgears and 700 low voltage switchgears.

PROCESS DESCRIPTION

The process of production consists of the manufacture of metal armatures into which parts of the electrical equipment are

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set:
- Manufacture of metal armatures from thin pickled sheets and profiles. This is accompanied by the following treatment of the material:
  - cutting of steel plates with cutting tool and according to the given patterns
  - cutting of corners and punching of holes with the press
  - cutting of steel profiles and non-ferrous metal profiles (copper, aluminium etc.) with special circular saws
  - pressing and bending of sheets and profiles and shaping of various elements
  - turning of various non-standard parts required in maintenance and in replacement of worn-out parts, on the universal lathe
  - vertical drilling of holes on the column drill, by means of adequate patterns
  - assembly and welding of armature sheets
  - mechanical processing (abrasion) of welded parts prior to protective coating
  - preparation of respective surfaces and subsequent protection from corrosion and mechanical damage (paint coating, in separate workshop)
  - mounting and wiring of electrical equipment
  - setting of horizontal collectors
  - final testing of products
  - transportation of products to the warehouse for final goods.

On customer's request packaging and special protection for transport purposes are considered.

In the manufacture of switching devices the batch system of production is used.

PRODUCTION CAPACITY

Metal-enclosed transformer stations	500 per year
Middle voltage switchgear	400 per year
Low voltage switchgear	700 per year

Based on a 2 x 8 hours working day, 250 hours per year, at 80% of total capacity (utilization).

REQUIRED MACHINERY AND EQUIPMENT

I t e m	No.
Plate shears, for up to 4 mm	2
Punching and nibbling machine	1
Circular steel saw	1
Circular copper saw	1
Excentric press 250 - 600 kN	4
Hydraulic press brake	2
Lathe	2

Milling machine	1
Column drill Ø 12 to 23 mm	4
Thread treatment machine	1
Arc welding machines	4
Equipment for abrasion treatment of metal	3
Surface protection equipment	1 set
Product testing equipment	1 set
Internal transporting equipment	1 set

The above equipment should be completed with the usual set of work tables and tools for manual treatment.

FOB price of machinery and equipment + know-how approx. US dollars 1,1oo,ooo.

REQUIRED RAW MATERIALS

I t e m	Quantity
Pickled sheets	1800 t/year
Black sheets	30 t/year
Steel profiles	80 t/year
Copper profiles	120 t/year
Insulation material	7 t/year
Degreasants, pigments etc.	12 t/year
Various electrical assembly accessories	450 t/year

REQUIRED MANPOWER (for two shifts)

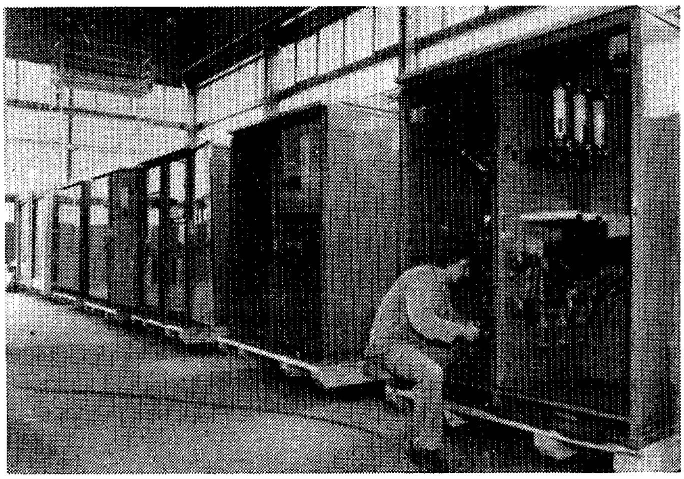
Qualifications	No.
University qualifications	10
Technicians	25
Lower educational background	10
Highly skilled workers	25
Skilled workers	60
Semi-skilled workers	15
Unskilled workers	10
TOTAL:	155

REQUIRED UTILITIES

Electric power 650,000 kWh per year

REQUIRED AREA FOR PLANT SITE

The total work space required is 3500 m^2, including plant storage, laboratory, auxiliary facilities.



TRANSFORMERS

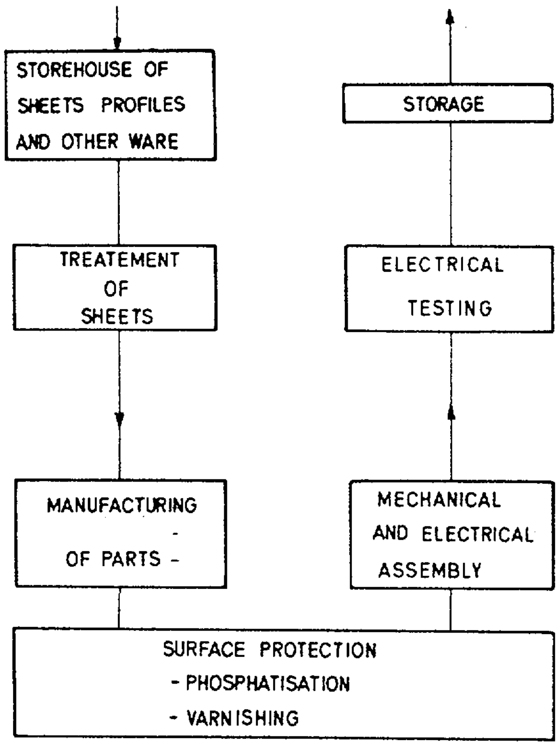
OTHER RELEVANT INFORMATION

Electrical equipment for transformer stations, switchgear and control switchgear assemblies should be imported from the licence provider or other supplier in agreement and cooperation with the licence provider.

SAFETY MEASURES

Waste water treatment is needed.

MANUFACTURING OF TRANSFORMER KIOSKS AND SWITCHGEAR ASSEMBLIES: OUTLINE OF TECHNOLOGICAL ZONES



FILE: Q-43
ISIC: 3839

HOW TO START MANUFACTURING INDUSTRIES

MANUFACTURE OF 2 NVO FUSES

Fuses with a great switching potential are used in the distribution of electric power in industry, on switching panels, in shipbuilding etc. They are manufactured in accord with IEC 269-1 and VDE 0636 regulations. The fuselink cartridge can be made with pin contacts, cylindric caps and a screw, depending whether it is meant for general or back-up application. General purpose fuses protect cables and electric wires from short--circuiting. Back-up fuses protect only from the electric current in a short-circuit, while a different device has to be used as the overload protection. The programme of production containes the following fuse types:

Size	Fuselink cartridge current			Socket
00	6	to	125 A	up to 125 A
0	25	to	160 A	up to 160 A
1	25	to	160 A	up to 250 A
2	315	to	400 A	up to 400 A
3	500	and	630 A	up to 630 A

For all sizes and types of fuses the breaking power is above 100 kA. (effective value of symmetric component of the short circuit current) at voltage of $\sim$ 550 v and cos$\varphi \leq$ 0.2. At the voltage of 440 V and at interval constant of $\leq$ 15 ms the breaking capacity is 80 kA.

The main advantage of low voltage fuses (circuit breakers) compared to other low voltage safety devices is a relatively low cost and high breaking power. They represent a particular type of safety devices that break the circuit when still in the process of exceeding the safe level. Total annual production capacity is 2,000,000 fuses.

PROCESS DESCRIPTION

The technological process consists of the following basis phases:

- Manufacture of steatite parts

Steatite is a raw material obtained entirely from imports, and the manufacture of steatite parts is subcontracted.

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- Manufacture of metal parts

The assortment of products requires the manufacture of a certain number of Al, Cu and brass plate and profile positions with the application of such processes as cutting, stamping, forging, hard soldering and manual treatment.

Eccentric or friction presses and mechanical cutting tools are used for fabrication of metal parts. Eccentric press consists mostly of pneumatic manipulators that ensure expeditious procedure and the required quality of fabricated parts.

Sealing is completed with semi-automatic equipment. The metal strip is welded to the contact plate by means of oxy-acetylene flame.

- Deburring

After cutting and stamping the metal parts are deburred by being rotated in a drum.

- Protection of surface

Surface protection of small metal parts is achieved through galvanization (with silver and nickel).

- Assembly

The assembly procedure has been elaborated for a large scale line production. The required material is conveyed to the work posts in cars while the singular parts are transported among work posts by means of conveyer belt. Beside the basic assembly operations completed on the line, the metal strips are attached to the contact by point welding, casings are filled with sand, tested and packed.

Point welding is carried out by point welding equipment while the operation of sand filling is completed by means of special equipment that permits the filling of several casings at the same time through vibration to ensure efficient compacting of sand within the casing.

The assortment of products requires batch production.

PRODUCTION CAPACITY

2,000,000 items per year.
Based on: 2 x 8 houry/day, at 80% utilization of total capacity.

REQUIRED MACHINERY AND EQUIPMENT

I t e m	No.
Metal cutting shears	1
Excentric press 200 to 400 kN for stamping sheet metal	4
Forging friction press	1
Hard soldering unit	1
Deburring drum	1
Surface protection line (in galvanizing drum)	1 set
Equipment for assembly line with testing equipment	1 set
Equipment for sand filling	2
Maintenance tools and equipment	1 set
Equipment for waste water treatment	1 set

FOB price of equipment and know-how approx. 900,000 US dollars.

REQUIRED RAW MATERIALS

I t e m	Quantity
Steatite	100 t/year
Semi-finished non-ferrous metal goods (Al, brass, Cu plate, profiles)	20 t/year
Component parts and other (screws, gaskets, connective material etc.)	2 t/year
Quartz sand	80 t/year

REQUIRED MANPOWER (for two shifts)

Qualifications	No.
University qualifications	4
Technicians	10
Lower educational background	6
Highly skilled workers	7
Skilled workers	18
Unskilled workers	48
TOTAL:	93

REQUIRED UTILITIES

Electric power	180,00 kWh/year
Water	5 m^3/h

REQUIRED AREA FOR PLANT SITE

The total work space required is 1000 m^2, including workshops, storage, laboratory, offices and subsidiary facilities.

SAFETY MEASURES

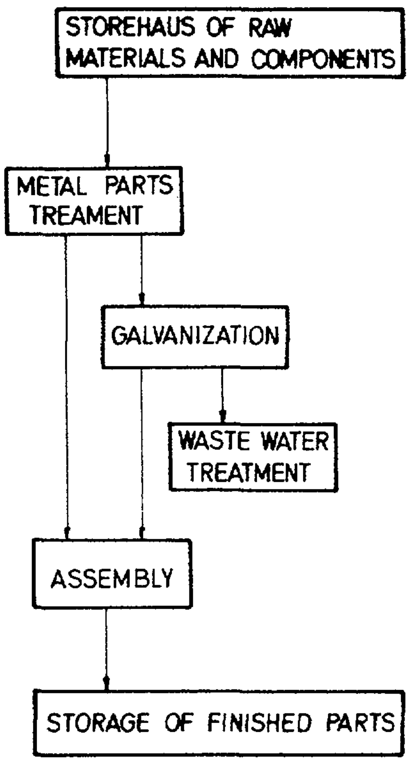
The process of production requires a waste-water treatment.

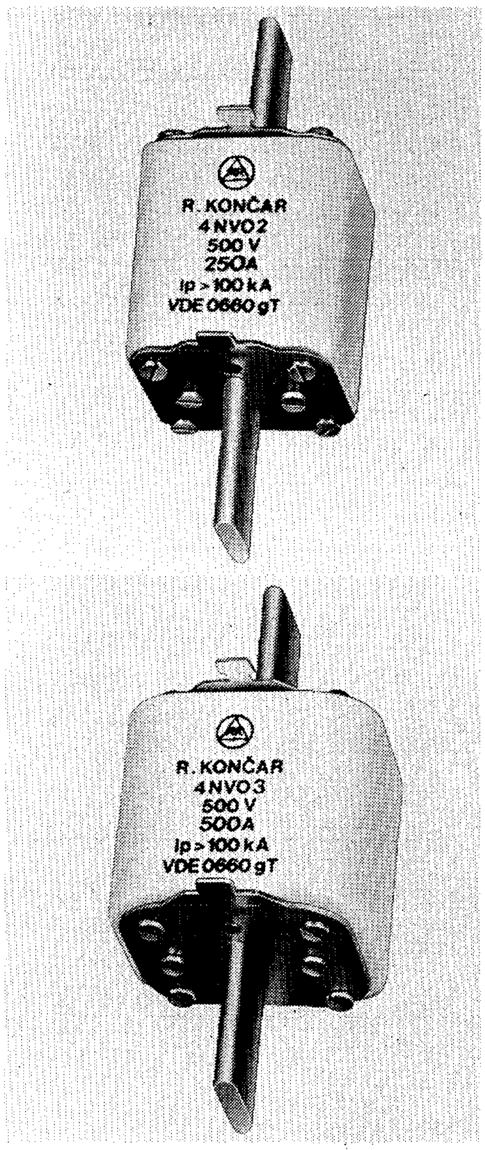
OTHER RELEVANT INFORMATION

It is not economical to organize the manufacture of steatite parts within the manufacturing process, but it should be done in cooperation.

Nuts, bolts and screws are bought as finished products.

FLOW SHEET DIAGRAM OF TECHNOLOGICAL ZONES FOR 2NVO FUSES MANUFACTURING





MANUFACTURE OF ELECTRICAL FITTINGS

The manufacturing of electrical fittings for damp and dusty working spaces such as decks, engine rooms, laundries, tunnels, warehouses, workshops etc. is presented.

The assortment consists of the following products:
- lighting fixtures
- junction boxes
- sockets
- switches
- plugs
- special devices (e.g. the Morse-key, alarm bells etc.).

All products are manufactured in several basic types with a practically unlimited number of combinations and designs.

The production is conceived in such a manner that a rather large assortment of products can be manufactured with relatively little equipment and in relatively small area and it does not require any major additional improvement of the adopted process.

Flexible enlargement of the capacity (change in the capacity of a series of products in favour of another), is also possible. The assortment of products is sufficient for all kind of electrical installations in humid or dusty environment.

PROCESS DESCRIPTION

The technological process comprises the following operations:cast making, shavings removal, metalworking, surface protection, assembly and testing.

Cast making

Aluminium alloy (AlMG5, AlMG8) casts are basic to the entire production programme. The bulk consists of large series of pressure moulded small casts. The other casts are made by means of gravity permanent mould casting. Cast cleaning is done mostly by stamping, vibration and sanding.

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Shavings removal

This is the phase of cast finishing and the manufacture of a larger quantity of mouldings made of barred material. Technologies that are used are turnery, drilling, cutting, milling, and occasionally manual finishing and polishing.

Metalworking

The assortment of products requires the manufacture of a certain number of parts made of steel sheets or profiles by applying such operations as cutting, stamping, welding and manual finishing.

Surface protection

The surface of the product is protected by point. The preparatory treatment of the surface, point spreading and drying of the pointed parts occurs in a closed flow system.

For a smaller part of components galvanization is required. This operation should be done by subcontracting.

Assembly

The products are assembled, and inspected on a assembly line, packed and transported to the warehouse for finished products.

In the manufacture of waterproof materials for electrical fittings a batch system of production is used.

PRODUCTION CAPACITY

The capacity of production is 120,000 items per year or 80 tons of product per year.

Production is based on: 16 working hours per day (two shifts) 250 working days per year at 80% of total capacity.

REQUIRED MACHINERY AND EQUIPMENT

I t e m	No.
Melting and moulding furnaces	3
Pressure moulding machine	1
Gravity permanent mould casting machine	1
Cast finishing equipment	1 set
Automatic turning lathe	1
Automatic turret lathe	3
Specialized turning lathe	1
Specialized drilling machine	4
Milling machine	1

Metalworking equipment	1 set
Surface protection line	1 set
Assembly line equipment	1 set
Maintenance tools and equipment	1 set

FOB price of machines and equipment: about 1 mil. US dollars.

REQUIRED RAW MATERIALS

I t e m	Quantity
Aluminium alloy	50 t/year
Iron and steel semi-finished goods (profiles and sheets)	15 t/year
Semi-finished brass products (profiles, sheets)	20 t/year
Component parts etc. (glass, gaskets, insulating elements, connectors, colour etc.)	15 t/year

REQUIRED MANPOWER (for two shifts)

Qualification	No.
a) Direct manufacturers	
Highly skilled workers	7
Skilled workers	20
Unskilled workers	28
b) Indirect manufacturers	
University qualifications	4
Technicians	6
Lower educational background	4
TOTAL:	69

REQUIRED UTILITIES

Electric power suply	13,000 kWh/t of product
Water	100 t/t of product

REQUIRED AREA FOR PLANT SITE

A total of $900m^2$ of work space is required, including manufacturing facilities and storage.

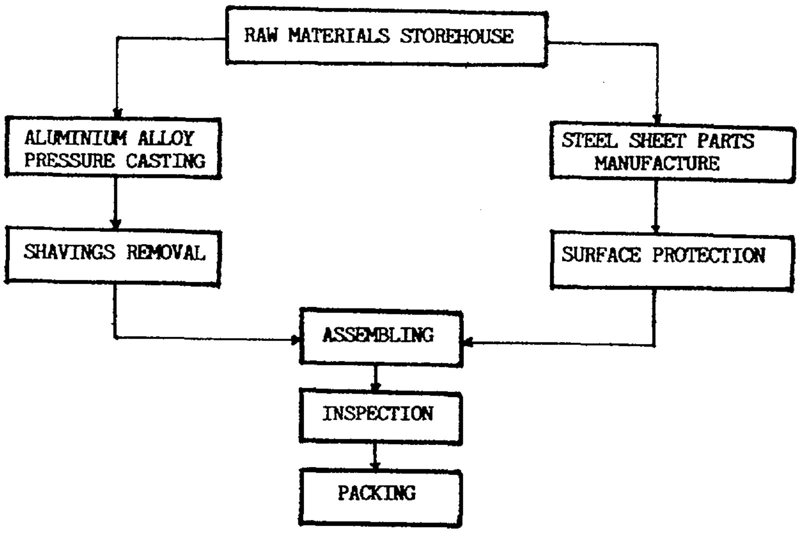
OTHER RELEVANT DATA

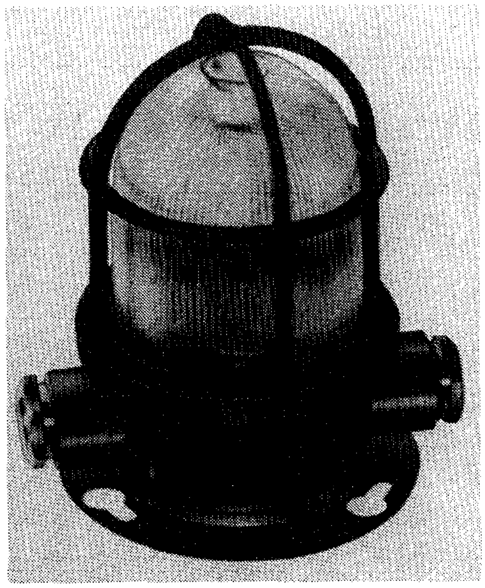
It is not economical to organize the manufacture of certain parts or some operations (e.g. galvanization, manufacture of glass components, insulating masses, rubber etc.) within the basic production process, so it should be done in cooperation.

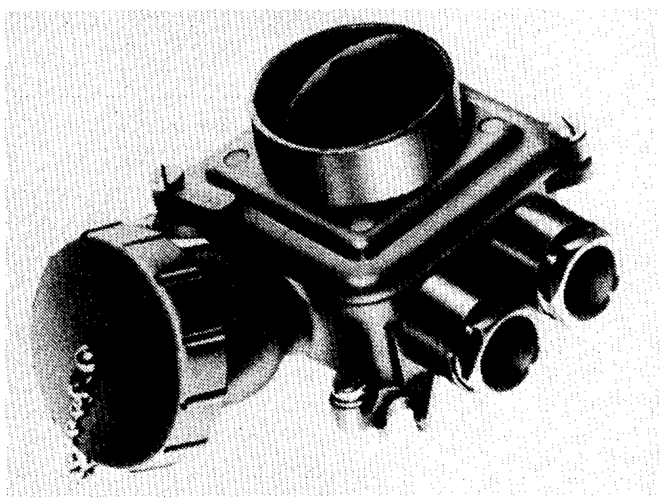
With an additional investment in the moulding process the programme of production can be extended to cover manufacture of the same products in brass.

About 50% of the electric power consumption can be substitued by liquid or gas fuel (alloy melting, colour drying).

PROCESS FLOW SHEET FOR ELECTRICAL FITTINGS







FILE: Q-45

ISIC: 3839

HOW TO START MANUFACTURING INDUSTRIES

MANUFACTURE OF PLUGS

Plug devices are used for the connection of mobile and portable electric power users. Accordingly, they connect and disconnect fixed and movable lines, without the use of tools or aids. The use of plug devices is illustrated in Fig. 1. The accessories are designed so that parts of socket-outlets and connectors (when they are wired as in normal use) and live parts of plugs and appliance inlets (when in partial or complete engagement with complementary accessories), are not accessible. Accessories with earthing contact are designed in such a way that:

- when inserting the plug or connector, the earth connection is made before the neutral connection and the phase connection;

- when withdrawing the plug or connector, the phase connections are broken before the neutral connection and the earth connection.

The production process is continuous. Raw material is conveyed from the storage to the working place in standard pallets or in boxes. In the first phase of production the parts are transfered for further processing in standard containers by means of cards.

Completed semi-finished products are transported either to the storage of semi-finished products or directly to the assembly line. Special equipment and pneumatic or electrical screwdrivers are used in assembling. The appropriately designated, packed in suitable boxes and transported to the storage for finished products.

PROCESS DESCRIPTION

All the plastic parts (thermoplastics) are made by means of special injection moulding machine.

Parts made of non-ferrous metal (brass) are manufactured by means of various types of special machines. They are washed in a special detergent too, and dried. Other parts such as standard screws, nuts and washers are bought ready-made on the market.

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All parts are transported to the warehouse of semi-final products, where they are assembled and packed. The assembly line is equipped with tools and ancillary devices. The product are stored in the warehouse for finished goods.

Plug devices are used for currents of 16, 32, 63 and 125 A as well as voltages of 25, 50, 110, 220, 380, 440, 500 and 750 V. For currents above 32 A the mechanical or electrical interlocking are utilized to ensure the connecting and disconnecting of the device only when there is no power on it. For purpose of better classification the connecting parts are marked with colors: pink for 25 V, white for 50 V, yellow for 110 V, blue for 220 V, red for 380 V and black for 500 V. The green color is used for frequency. Plug devices for small voltages have 2 or 3 poles and for voltages above 50 V 3,4 or 5 poles.

In the manufacture and assembly of plastic plug devices a continuous system of production is used.

PRODUCTION CAPACITY

10,000 sets of plug devices 16 A
10,000 sets of plug devices 32 A
Based on 16 hours of work per day, 264 days per year.

REQUIRED MACHINERY AND EQUIPMENT

	I t e m	No.
1	Single spindle automatic lathe	1
2	Injection moulding machine	2
3	SEMI-AUTOMATIC machine for finishing el. contacts (by drilling and threading)	1
4	SEMI-AUTOMATIC machine for finishing (by slitting)	1
5	Degreasing tub	2
6	Centrifugal drier	1
	Crane	1
	Device for purification of waste water	1
	Device for air distribution	
	Assembly line with assembly equipment	
	Standard tools and necessary equipment	

FOB price machinery and equipment: about US dollars 800,000

REQUIRED RAW MATERIALS

I t e m	Quantity
Polyamide (thermoplastics)	27 t/year
Brass bars	9 t/year
Screws, springs and washers	5 t/year

REQUIRED MANPOWER (for two shifts)

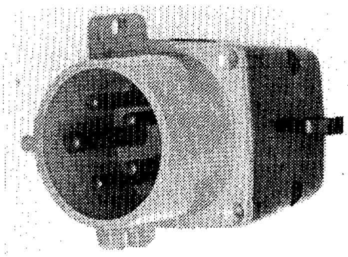
Qualification	No.
University graduate	1
Two-year post secondary education	1
Secondary education (technicians)	7
Skilled worker	5
Semi-skilled worker	20
TOTAL:	34

REQUIRED UTILITIES

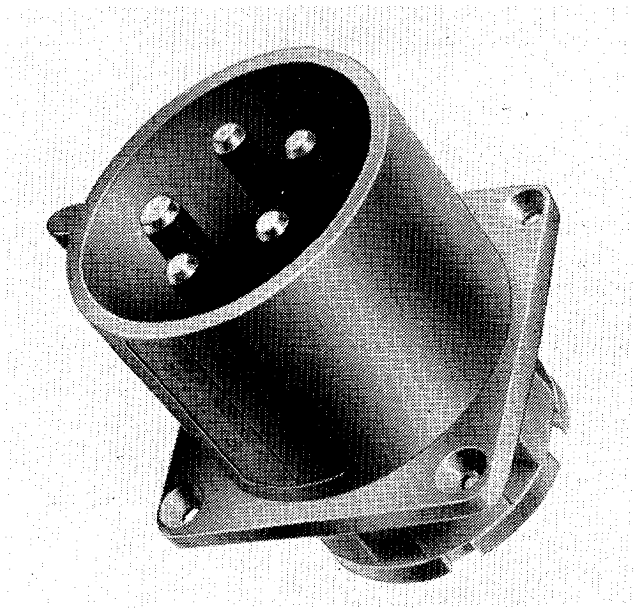
Electric energy	700 kWh/t of product
Water	100 l/t of product

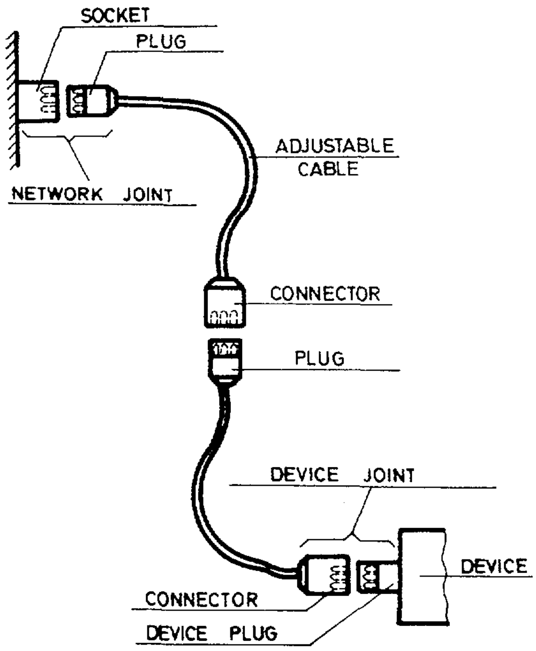
REQUIRED AREA FOR PLANT SITE

A total area of 370 sq metres is required, including: large technological workshop (200 m^2), office premises (40 m^2), werehouses (90 m^2), canteen (20 m^2) and sanitary facilities (20 m^2).

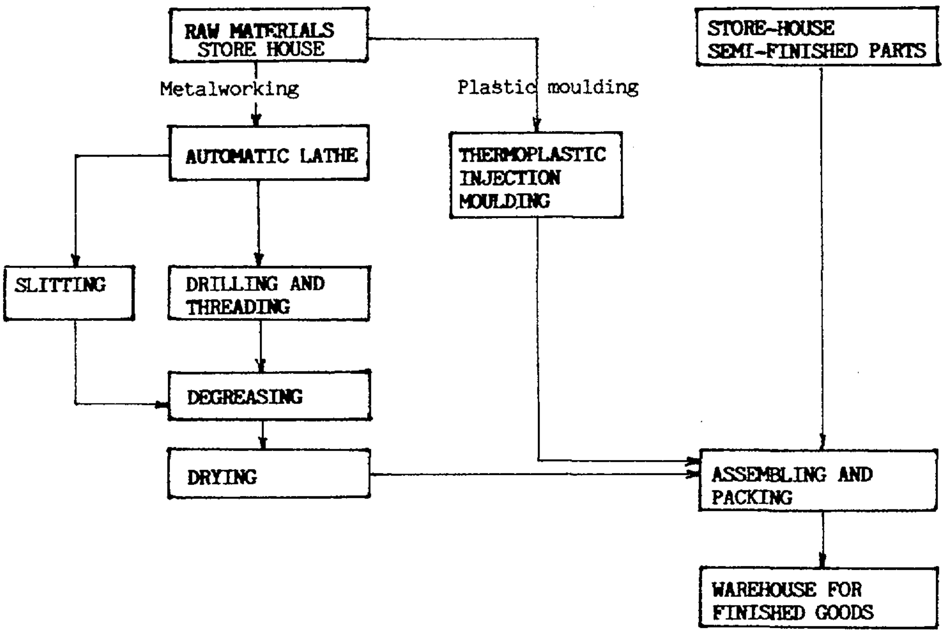


THE USE OF PLUG DEVICES





FLOW SHEET FOR MANUFACTURE AND ASSEMBLY OF PLASTIC PLUG DEVICES



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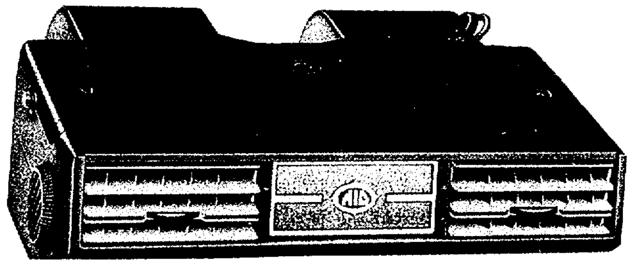
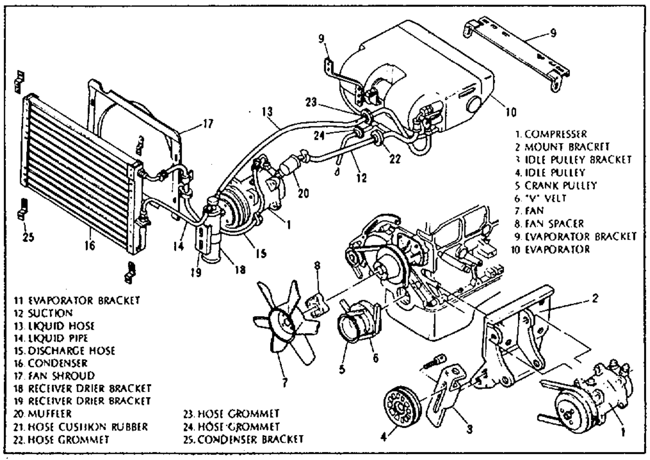
Car Cooler Making Plant



View of Product



View of Universal System

The car cooler, with easily evaporating refrigerant R-12 flowing inside, vaporizes the refrigerant and cools the air, making the environment comfortable by removing thereby the moisture in the air in droplets.

The air cooling portion is called the cooling unit, and the refrigerant taking the heat away from the air by means of the cooling unit is transported to the condenser in front part of the radiator by the engine-driven compressor. In this condenser, the heat taken away from the air by the cooling unit is reversely released to the air.

The refrigerant proceeds again with the capacity to take away the heat to the cooling unit. It is the car cooler that cools the interior of car by repeating this process.

This plant and technology are for engineering and manufacturing the air conditioning system regulating the temperature and moisture conditions in the car to the extent most pleasant to the human body by equipping the car, truck and bus with such coolers.

The highly efficient, compact heat exchangers manufactured by expanding, soldering and brazing method are used now. What are to be licensed are:

1. The design technology related to the cooling system most effective for the heat load of applicable vehicles.

2. The design technology related to respective component parts of the system including the evaporator, condenser and other parts.

3. Production and inspection technology related to the products suiting the design capacity.

The plant layout as well as the plant complete with facilities for manufacturing the products can also be exported.

Products and Specifications

Types and specifications of the car coolers manufactured in this plant are as follows

Table 1. Specifications of Car Cooler

Product	Type	Specification
Bus cooler	Main engine-driven	19,000Kcal/hr 22,000Kcal/hr 24,000Kcal/hr
Truck and car cooler	Dash hang-on type Built-in type	3,000Kcal/hr 3,500Kcal/hr
Mini-bus cooler	Main engine-driven	7,000-15,000 Kcal/hr

Contents of Technology

Condenser

Small-size, high-performance latest type for radiation, the tube and corrugated fin type condenser is manufactured by the aluminum brazing process.

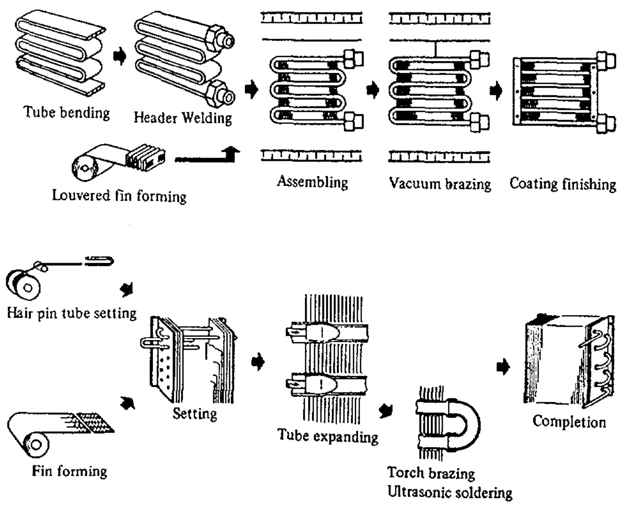
Evaporator

The tube and plate fin type evaporator is manufactured by the expanding process providing the excellent air conditoning effect at all times in terms of running, economy and space of vehicles and fixed to the cooling unit.

Assembling

The delivered compressor, expansion valve, receiver drier and cooling unit are assembled for inspection and subsequent delivery.

Car Cooler Manufacturing Process Flow Sheet



2) Equipment and Machinery

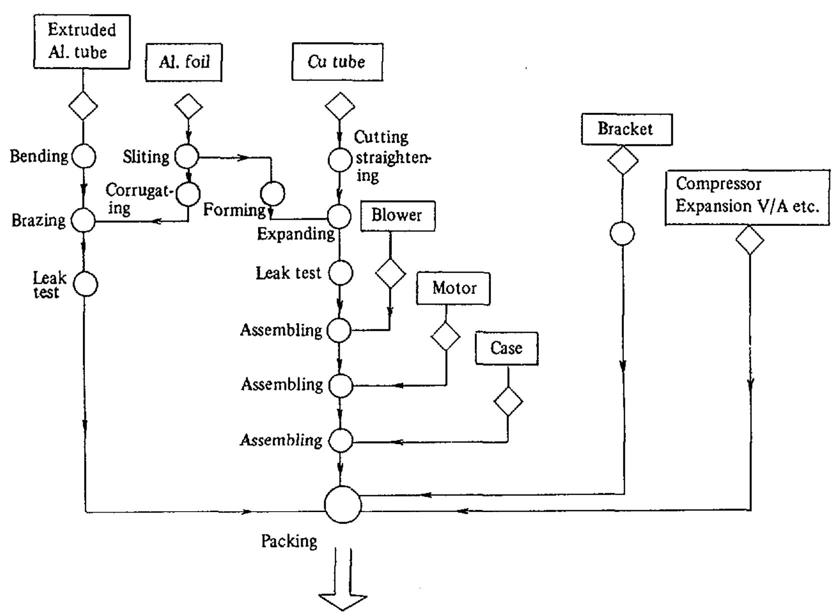
Fin line-Uncoiler, Leak tester
Fin press, Corrugating machine
Collector, Painting booth
Fin dies
Tube straightner and cut-to-length machine
Pipe bender
Tube cutter
Tube expander
Vacuum brazing furnace or soldering furnace
Slitting M/C
Tube end sizing machine
Ultrasonic degreaser

3) Raw materials

○ Car cooler

Raw materials and utilities	Requirement (per set of product)
Al foil (0.15m/m)	2 kg
Extruded Al tube	1.2 kg
Copper tube	1 kg
Motor (DC 12V x 85W)	1 ea
Blower and unit case (plastic)	470 g
Compressor (105cc/rev)	1 ea
Receiver drier	1 ea
Expansion valve	1 ea
Freon hose	3 ea
Electric power	1.2 kwh

Car Cooler Manufacturing Process Diagram



Example of Plant Capacity and Construction Cost

1) Plant capacity: 12,000set/year
(On the basis of car and truck coolers)

2) Example of estimated construction cost (as of 1982)

o Equipment and machinery	:	US$ 2,666,000
o Utilities:	:	US$ 466,000
o Installation cost	:	US$ 714,000
Total	:	US$ 3,846,000

3) Required space

o Site area	:	23,140m^2
o Building area	:	6,940m^2

4) Personel requirement

o Plant manager	:	32 persons
o Engineer	:	20 persons
o Operator	:	180 persons
Total	:	232 persons

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HOW TO START MANUFACTURING INDUSTRIES

MANUFACTURE OF PLASTIC ZIPPERS

The product is a plastic coil slide fastener set into all kinds of clothing, footwear, leatherware, upholstery, camping accessories, protective clothing, sports articles, items used in industry etc. It consists of two elements: the chain and the slider. The chain is a cotton or polyamid tape with a coil made of polyamid monofilament and sewn to the tape. The slider body and pulls are made of zinc alloy. The slide fastener comes either in an open-end or in a closed-end version. It is manufactured in three sizes: 4 mm (closed-end only), 5 mm and 7 mm coil width in open and closed-end versions, in customer ordered lenghts, and in different colours according to the colour chart. The lateral strength of the slide fastener is 30, 40 or 50 daN/1", depending on the size of the fastener.

PROCESS DESCRIPTION

After the coil forming operation the coil, previously woven by automatic looms, is sewn to the cloth tape. The tape is not included in the present offer. Such an unfinished slide fastener chain is wound on stainless steel dyeing coils by means of a special winding unit. The process of dyeing is carried out in pressure dyeing machines by means of textile dyes. The dyed chain is then dried and finished, after which the coils are completed, i.e. they are cut through, coil rests are removed, coils are marked for length, and the metal stop is riveted (only in closed-end slide fasteners). All the above operations are performed by one automatic machine, but if necessary all can be done by separate simple machines or devices, which can also be made available.

The open-end stop is made by a special machine for plastic open-end stop casting, where several tools are applied in the processing cycle. The slider is attached to the fastener chain, either automatically or manually, the tape is cut to the desired length, the slider-stops added; the product is checked and packed into plastic bags.

The sliders are cast in zinc alloy by pressure moulding machines, then treated in rotating drums, parts are polished,

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This information has been prepared for UNIDO by the Institute for Developing Countries, Yugoslavia. Inquiries should be addressed to: IPCT/II/PROM, Registry file No. ID/562/12, UNIDO, P.O. Box 300, A-1400 Vienna, Austria.

the body of the slider deburred, and the product is finally assembled either automatically, semi-automatically or manually. Parts of the slider are also stamped, polished and assembled in a similar manner. In the end the sliders are enamelled in special drums.

PRODUCTION CAPACITY

The total annual capacity of production is 3,000,000 m or 11,000,000 single slide fasteners of various sizes, i.e.

- Size 4 mm 1,000,000 m or 5,000,000 items/y
- Size 5 mm 1,000,000 m or 3,500,000 items/y
- Size 7 mm 1,000,000 m or 2,500,000 items/y

The calculation is based on: 8 hour working day, 273 days/year.

REQUIRED MACHINERY AND EQUIPMENT

I t e m	No.
Coilling machine	8
Coil to tape sewing machine	3
Winding machine	1
Chain dyeing vat	1
Chain drying and finishing machine	1
Thermofixing machine	1
Finishing machine	3
Open-end bottom stop casting machine	2
Slider pressure casting machine	3
Slider body and pull stamping machine	2
Sprue cutter	1
Slider polishing machine	1
Calibrating machine	3
Automatic slider assembly machine	4
Slider enamelling vat T-50	1
Slider enamelling vat T-20	1
Bottom stop attaching machine	3
Automatic slidering machine	1
Magnetic cutting device	3
Top stops attaching machine	5
Packing device	2

Price of machines and equipment: approx. 750,000 US dollars.

REQUIRED RAW MATERIALS

I t e m	Quantity
Cotton and polyamid tape	7,000,000 m
Pollyamid monofilament	16.0 t/year
Polyamid sewing thread	2.8 t/year

Zn-alloy GDZn Al4-Cul	26.0 t/year
Brass tape	3.5 t/year
Newsilver tape	1.5 t/year
Al-tape	1.2 t/year
Polyamid granulated for open and plastic stop	0.9 t/year
Dyes, enamels, adjuvants	1.6 t/year

REQUIRED MANPOWER (for two shifts)

Qualification	No.
Economists	2
Technicians (chemical, textile, mechanical)	4
Skilled workers	14
Unskilled or semiskilled workers	70
TOTAL:	90

Note: The number of workers may vary depending on the desired level of automation. The above number is a rough approximation.

REQUIRED UTILITIES

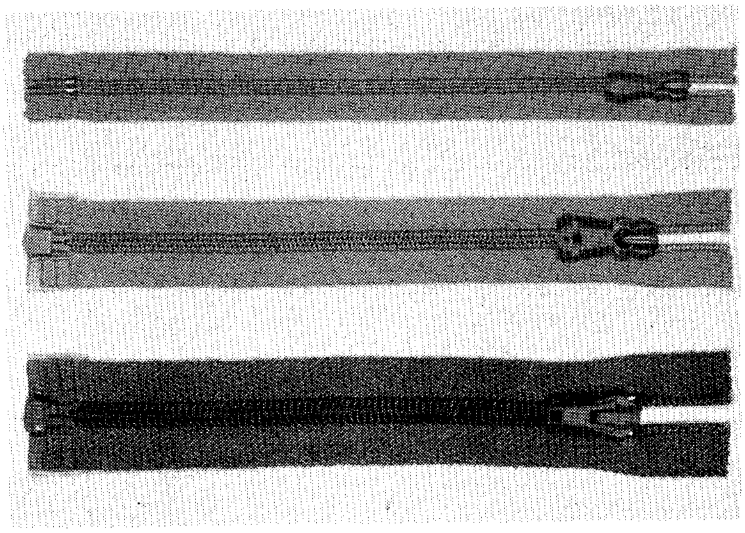
I t e m	Quantity
Electric power	about 133,000 kWh/1,000,000 m of product
Petrol	about 46.8 t/1,000,000 m of product
or	
Steam	582 t (p=600 kPs) for 1,000,000 m of product
Gas (propane-butane)	1,500 m^3/1,000,000 m of product
Water	9,500 t/1,000,000 m of product

REQUIRED AREA FOR PLANT SITE

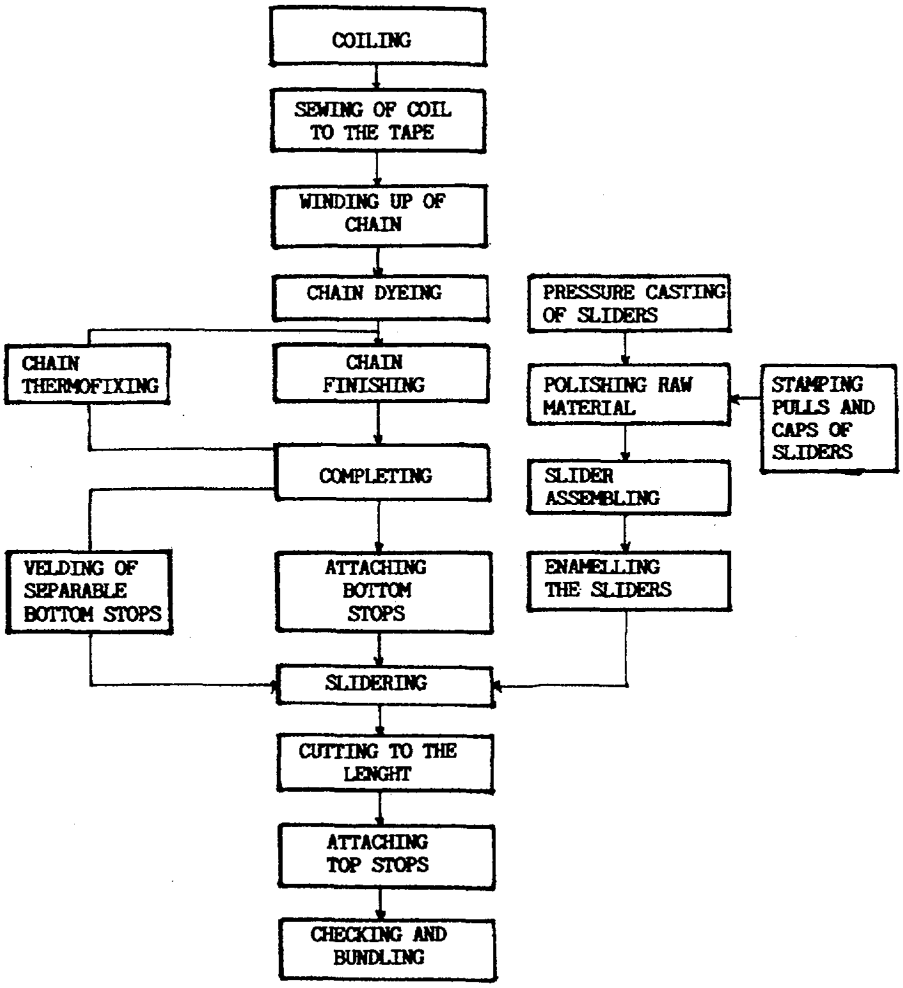
An area of 650 m^2 is required for the plant which includes: the production area, warehouses, laboratory, offices, secondary premises.

SAFETY MEASURES

Fire prevention, particularly of the enamelling and of the pressure casting premises is necessary.



PROCESS FLOW SHEET FOR PLASTIC ZIPPERS



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