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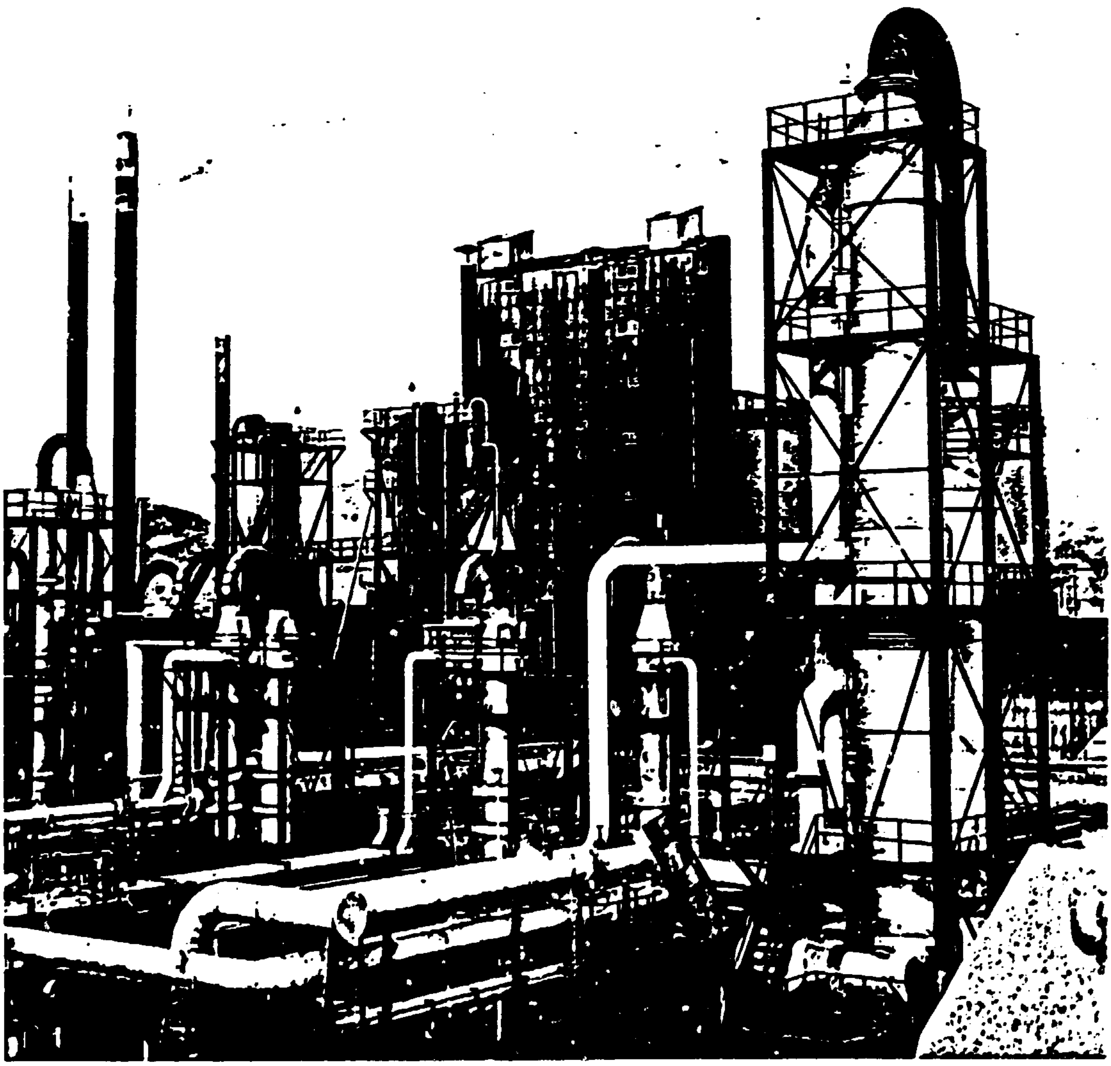
CARBON BLACK PLANT



67/5

Technology Owner: Lucky Engineering CO.,Ltd.
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This is the Lucky Continental Carbon(LCC) Company's Carbon Black Plant technology, originally supplied by the Licensor, Contineutal Carbon(Concart), U.S.A.

LCC, as a 50/50 joint venture between Lucky Ltd., of Korea and Concart, was established in 1968. Plant production capacity has increased four-fold during the decade from 1969, when Plant No.1 was put into operation, to 1979.

With accumulated experience and up-to-date technologies in reactor design, energy-conservation equipment, waste gas utilization, etc., Plant No.2 was constructed in 1980. Today, LCC is the 4th largest producer of carbon black outside the U.S.A.

Technolagy Process Description:

Several processes have been developed for obtaining the various grades of carbon black. They are the channel and oil impingement processes, the thermal black process, and the gas-furnace and oil-furnace processes.

The plant introduced here utilizes the oil furnace process, which is currently used for over 90% of carbon black production.

This plant consists of sections for reaction, collection, pelletization, drying and storage, and shippment.

Reaction

Air, auxiliary fuel and feedstock oil are supplied to the reactor to form carbon black which is suspended in the reaction gases.

Process air preheated is supplied to the reactor head and burns auxiliary fuel in the combustion chamber of the reactor to make an appropriate condition for carbon black formation.

Feedstock oil, which has been heated by oil preheater, is pumped through a spray nozzle shrouded by a small axial stream of unheated air.

Both nozzle spray pattern and longitudinal nozzle position affect black properties, and oil to air ratio, which affects particle size, must be closely controlled.

Primary-quench water-sprays, appropriately located, stop the reaction and adjust the smoke temperature to that required for entry to the preheaters.

Collection

Smoke leaving the preheaters enters a collection system which uses bagfilters made of siliconecoated glass fiber or teflon. Carbon black from the filter product outlet is usually pneumatically conveyed through a pulverizer to the accumulator tank feeding the pelletizer.

The pulverizer serves only to protect the product from the possible inclusion of coarse residue particles (coke, refractory) which may infrequently be carried from the reactor.

Pelletization

To facilitate shipping and handling, the carbon black is pelleted, giving a free-flowing product. Carbon black is fed from the accumulator tank through the rotary valve and screw conveyor to the pelletizer. Water enters the pelletizer through sprays and is mixed with black.

The mixing and cutting action of the pins converts this damp mass into pellets, rounded to roughly spherical shape. To attain desired pellet properties, pelletizing additives are frequently introduced with the pelletizing water.

Drying

Wet pellets from the pelletizer are fed to the dryer where the moisture content is reduced.

Dryer product temperature must be high enough to produce suitably dry product, but temperatures too high may promote undesirable oxidation of black or even create a fire hazard. Therefore, close control, though difficult, is essential.

Storage and shipment

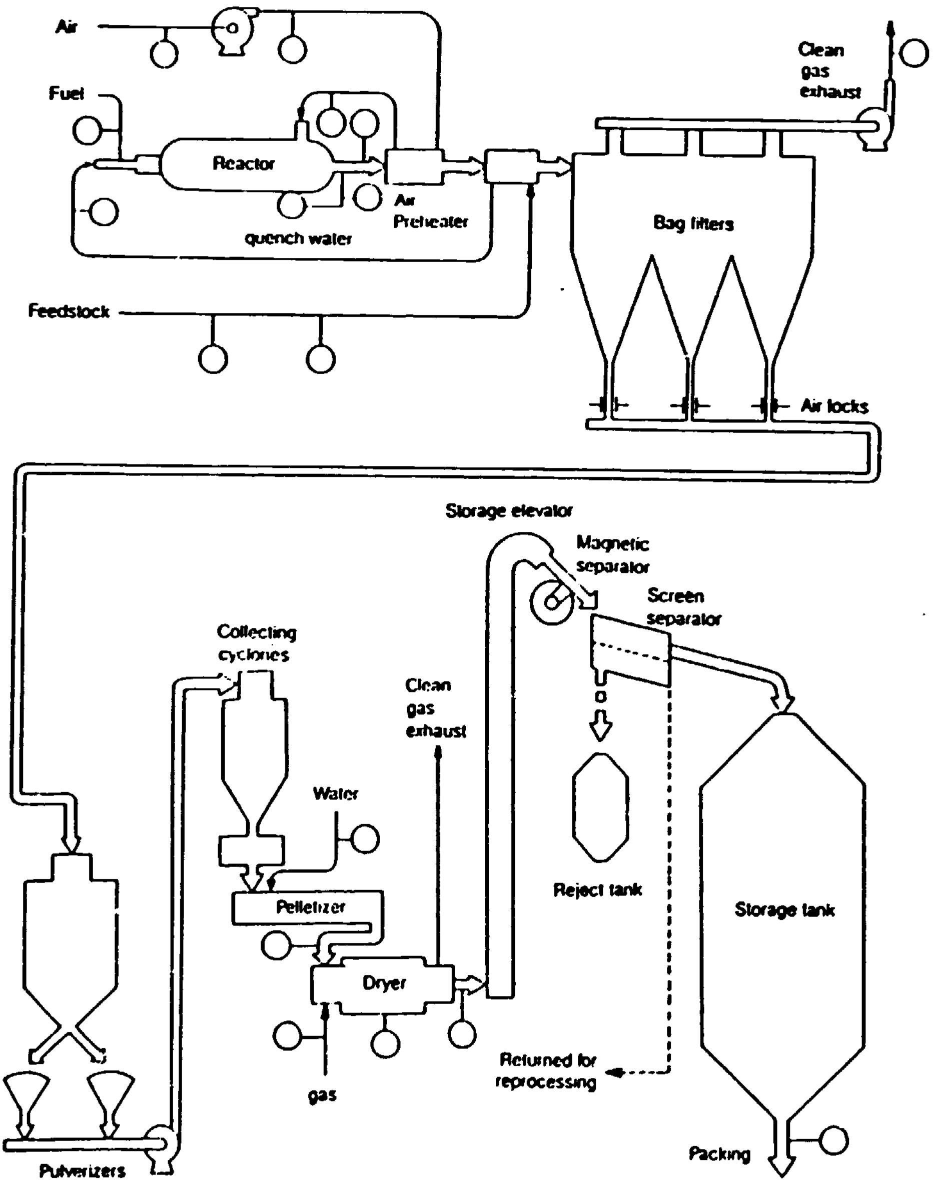
Storage tanks are elevated so that gravity flow will facilitate the loading of bulk shipments and delivery to packaging equipment.

Product leaving the dryer is lifted by a bucket elevator, passes over a magnetic separator and screen separator, and is delivered to the proper storage compartment by a screw conveyor system.

The magnetic separator guards against inclusion of magnetic material infrequently found in the product. Since such material probably results from steel corrosion, its appearance calls for corrective action.

The screen separator removes oversized pellets and is particularly needed for some types of black for which pelletizing control is difficult. Pelleted carbon black is shipped in bulk or packaged in bags or other containers.

Process Flow Diagram:



List of Equipment and Machinery:

- Reactor
- Air Preheater
- Oil Preheater
- After Cooler
- Bag Filter
- Cyclone Separator
- Pulverizer
- Pelletizer
- Fire Box and combustor for dryer
- Rotary dryer
- Load cell measuring tank
- Load cell
- Bucket elevator
- Feedstock storage tank
- Product storage tank
- Additive storage and dissolving tank
- Blower and Fans
- Utility Pumps
- Air Compressor
- Waste Gas Boiler

Raw Materials and Energy Consumption Rate:

Oil used as feedstock for carbon black process has been selected on the basis of high aromaticity, low content of refractory-damaging materials and low content of alkali metals.

Typical feedstock for oil furnace process of carbon black is:

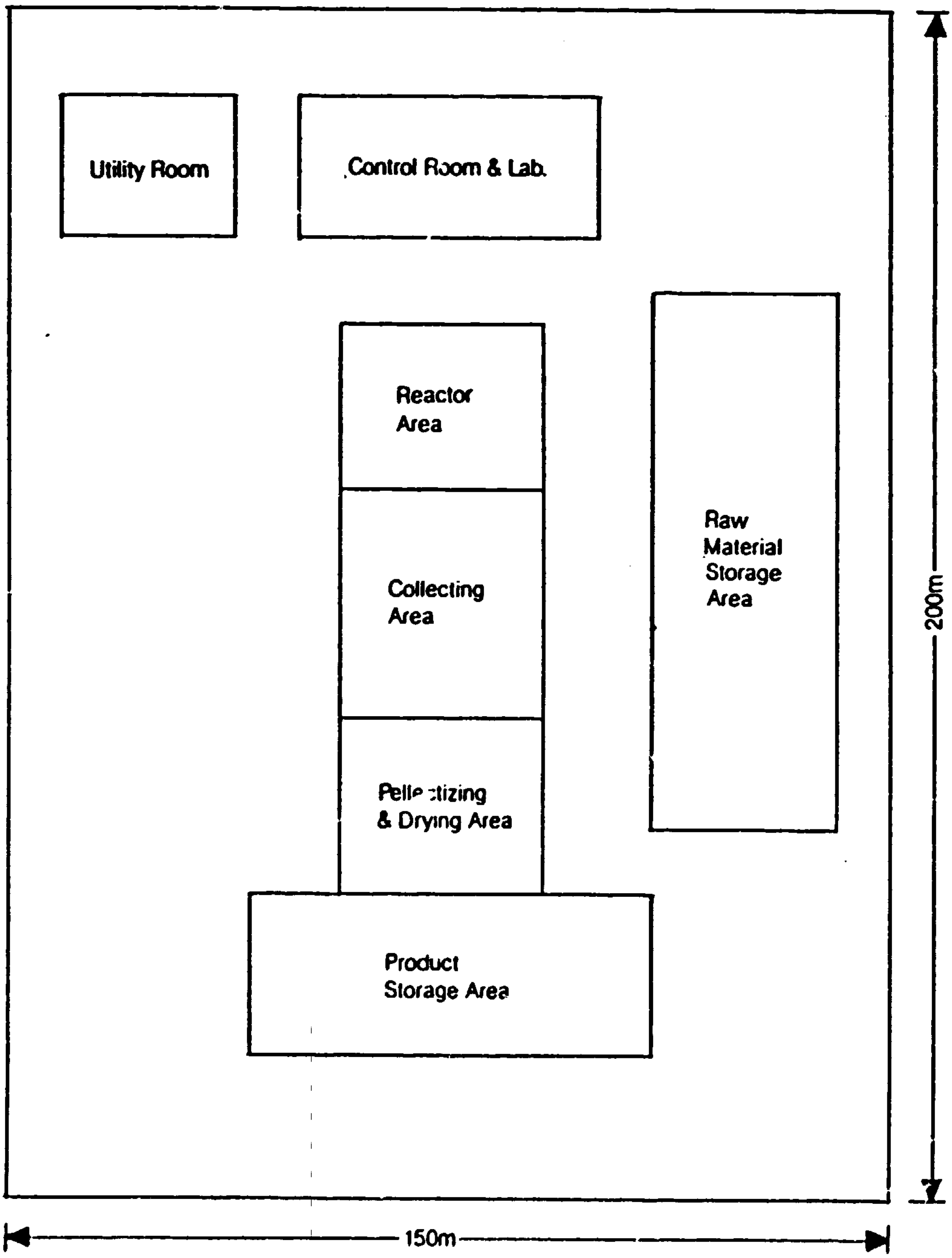
- Catalytic cracker decant oil.
- Ethylene plant residum from naphtha and gas oil cracking
- Extract from solvent refining of catalytic cracker cyclic oils.
- Coal tar distillate, such as creosote, antracene oil, etc.

Unit Consumption

Raw Material and Utilities	Requirement (Per ton of Carbon Black)
Feedstock oil (creosote)	2.0 ton
Auxiliary fuel (catalytic cracker oil)	0.3 ton
Electric power	380 Kwh
Process water	3.0 ton

Plant Capacity: 40,000 MT/Year

Space Requirement:



Personnel Requirement:

Classification	No. of Persons
Plant manager	1
Engineers	6
Skilled operators	45
Operators	8
Assistant Workers	5
Total	65

Estimated Total Investment: US$15,000,000

Construction Period: 18 month

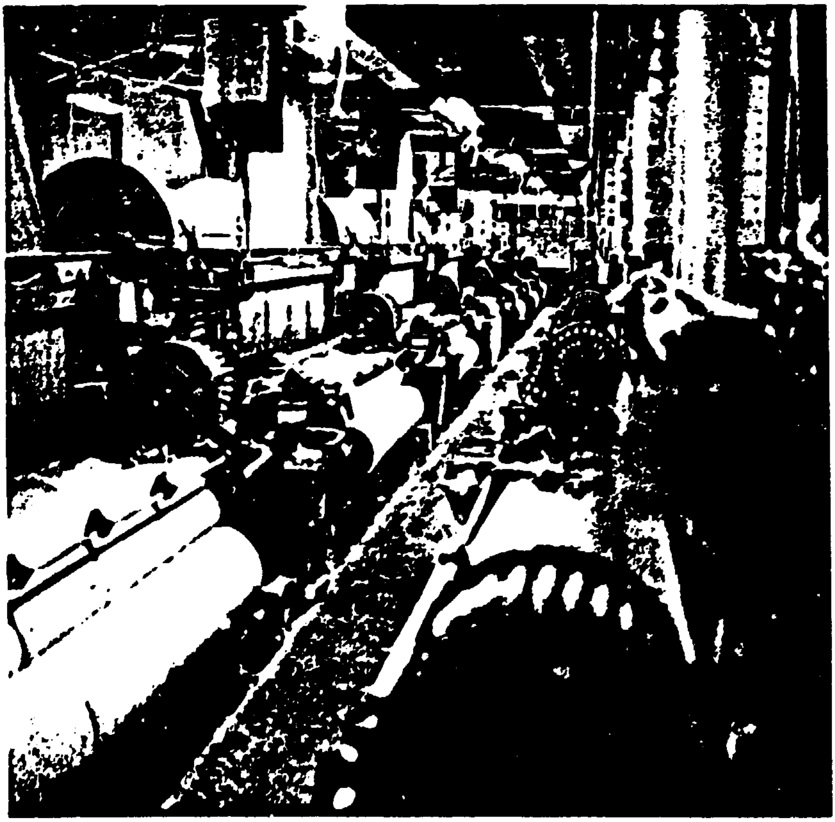
Products and Specifications:

Carbon blacks being produced in the plant introduced here can be made to conform to pertinent specifications depending upon the type of product for which the carbon blacks are used. Current products include 5 major kinds: ISAF (intermediate super abrasion furnace), HAF (high abrasion furnace), FPE(general purpose furnace) and SRF (semi-reinforcing furnace). In addition, different structure levels for each of the 5 major grades can be utilized to distinguish the following detailed grades.

SPECIFICATIONS

Grade	ASTM Stress/Strain Properties (from IRB#5)			Typical physico-chemical properties							
	Cured @145°C (min.)	Tensile Strength kg/cm² (min.)	300% modulus (kg/cm²)	ASTM Iodine No. (mg/g)	DBP Absorp. (cc/100g)	Ash Content (% max.)	Heat Loss (% max.)	Sieve residue (% max.) #35	Sieve residue (% max.) #325	Bulk Density (g/cm³)	Fines (% max.)
Reference Black IRB #5	15 30	273 282	125 157	82	102						
ISAF	15 30	−26 −10	−10 −10	122	115	0.75	2.5	0.0010	0.10	0.35	15.0
ISAF-LS	15 30	−14 −7	−53 −56	118	78	0.75	2.5	0.0010	0.10	0.42	15.0
HAF	15 30	−30 −14	0 −9	82	102	0.75	2.5	0.0010	0.10	0.37	15.0
HAF-HS (N-339)	15 30	−16 −14	+12 +12	90	120	0.75	2.5	0.0010	0.10	0.34	15.0
HAF-HS (N-375)	15 30	−23 −14	+5 +5	90	114	0.75	2.5	0.0010	0.10	0.35	15.0
HAF-LS	15 30	−2 +14	−42 −40	82	72	0.75	2.5	0.0010	0.10	0.46	15.0
T-HS (N 351)	15 30	−28 −14	+11 +13	68	120	0.75	2.5	0.0010	0.10	0.35	15.0
FEF	15 30	−51 −42	−2 −5	42	122	0.75	2.0	0.0010	0.10	0.36	15.0
GPF	15 30	−50 −42	−23 −32	36	91	0.75	1.0	0.0010	0.10	0.42	15.0
SRF	15 30	−44 −42	−39 −48	29	70	0.75	1.5	0.0010	0.10	0.49	15.0

ACETATE FILAMENT YARN MFG PLANT



Technology Owner: Sunkyong Engineering & Construction Limited

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.K.P.O.Box 222, Seoul, Korea
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Technology Process Description:

One full package of Acetate Filament Yarn Mfg Plant, which consists of one set of raw material feeding system, mixing system, filteration system, spinning system, hot air & water system and its auxiliary machinery & materials.

- We, Sunkyong Engineering & Construction Ltd., have pleasure to provide all phases of the project from feasibility study and engineering/design to final commissioning; start up operation and maintenance for this plant with highly accumulated technology and can provide clients with most reliable and economical ACETATE FILAMENT YARN MFG PLANT.

Process Flow Diagram:

- Mixing
- Filtration
- Spinning
- Interlacing
- Take Up
- Hot Air

- Recovery of Acetone
- Preparation
- Heating System
- Air Conditioning
- Waste Yarn Recovery
- Inspection

<u>List Of Equipments And Machinery:</u>

- Hot Water Equipment
- Hot Air Equipment
- Acetate Filament Yarn Spinning
- Take - Up Equipment
- Inverter & Panel
- Spinning Nozzle & Mesh
- Packing Equipment

<u>Raw Materials And Utilities Consumption:</u>

. Flakes	99 - 99 KG
. Acetone	7 - 10 KG
. Oil	3 - 4 KG
. Steam (3 KG/CM2)	1.7 - 2 Ton
. Electricity	140 -180 KWH
. Industrial Water	5 - , 43
. Compressed Air	100 -120 NM3

Basic : 100 KG of Product

Plant Capacity:

Acetate Filament Yarn : 1,500 Ton/Year

Space Requirement:

16,350 M2 (Building)

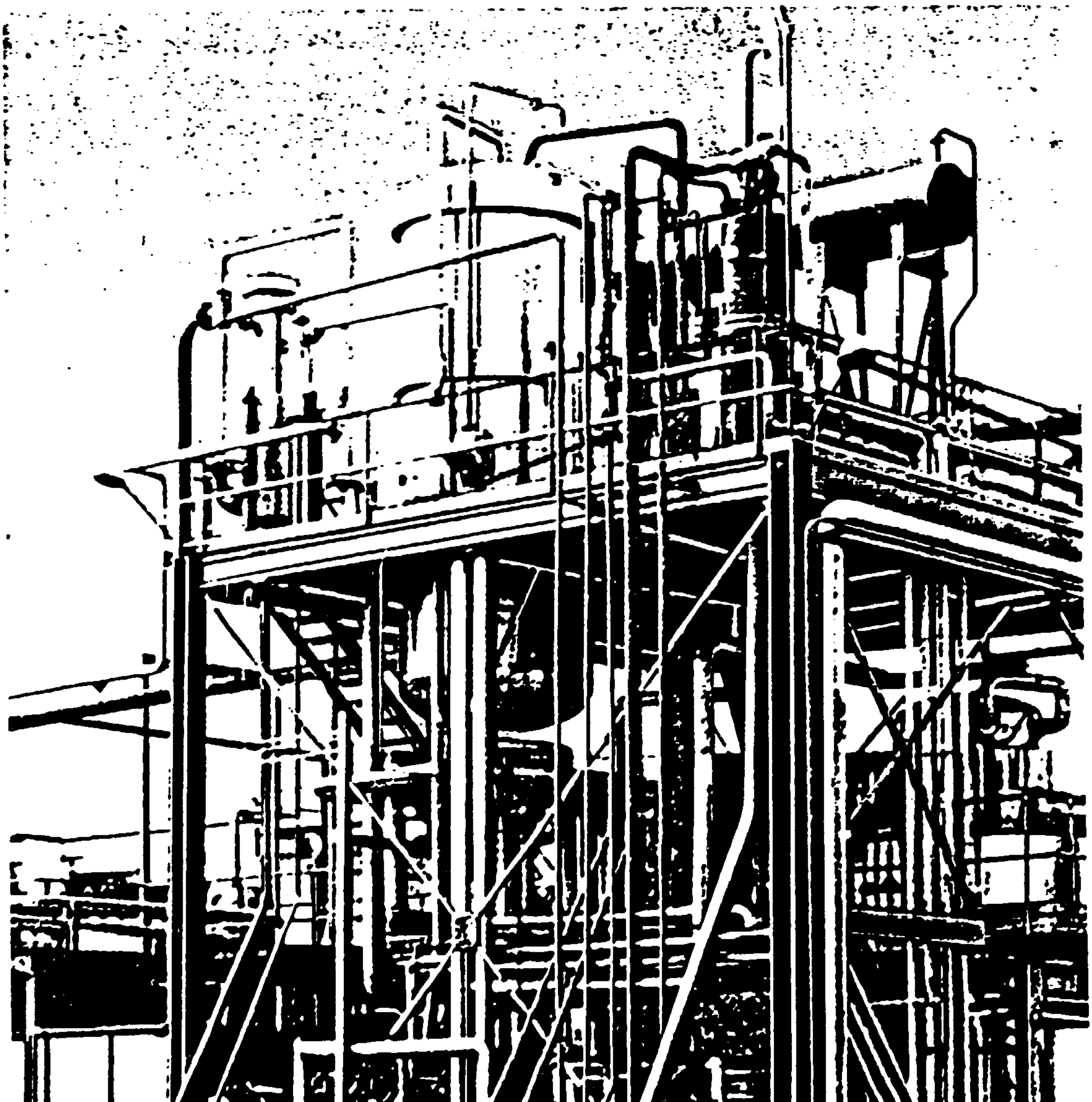
Personnel Requirement:

260 Persons

Estimated Total Investment:

Abt. US.D 15,500,000

EDIBLE OILS PLANT



Technology Owner: Lucky Engineering Co., Ltd.
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Edible oils are largely classified into animal and vegetable oils. Of these two, vegetable oil has long been used in human nutrition. It is mainly used in mayonnaise, salad oils, for cooking and frying, etc. Since the development of modern industrial process for producing edible oils from vegetable source in late 1930's, demand as well as production have greatly increased accordingly with rising world population and living standards. The separation of oils from vegetable materials constitutes a distinct and specialized branch of fat technology.

Lucky Engineering Co., has been concentrating on the project of chemical processing plants since its establishment. With the technical collaboration of world renowned licensors of edible oil processing and applying the sophisticated engineering practice, Lucky Engineering Co., can provide the efficient and cost effective engineering services for the successful constuction of edible oil producing plants to clients all over the world.

Technology Process Description:

Vegetable oils are derived from tree crops or seeds of plants. They consist mostly of the fatty acid esters of glycerol, commonly called triglycerides.

The edible oil producing processes can largely be divided into two categories;-extraction and refining. Depending upon the raw materials, some or all of preparation steps such as cleaning, grinding, dehulling, sterilizing, and flaking may be required. The preparation steps cannot be overlooked because it eventually effects on product yield and/or quality. For oilseeds with high oil content prepressing step can be combined in the extraction. A number of methods are available for oilseed extraction. Most of them are based on percolation rather than on total immersion of the material to be extracted. A combination of percolation and immersion process, with intermediate flaking and desolventizing, is sometimes employed for material containing more than 40% oil. Industrial hexane is used throughout the edible oil process as extraction solvent largely because of its toxicological acceptability, relative selectivity for glycerides and ease of recovery.

Purpose of the refining process is primarily to improve product quality. Economics of refining, which is strongly effected by neutral oil yield and increasingly by effluent treatment and energy cost is also a principal factor in selecting the processes.

EXTRACTION PLANT

Typical flow diagram of prepress extraction plant is shown in Figure 1.

Preparation

This step entirely depends on the characteristics of oilseeds as mentioned earlier. Seeds with high oil content are prepressed and flaked to ensure satisfactory extraction after cleaning.

Extraction & Desolventizing

The decorticated kernels are cooked (conditioned) with steam and prepressed in expellers where the oil content is reduced to 10-15%. The pressed cake is flaked through large rollers and is fed into the solvent extractor. Many varieties of extractors exist but continuous countercurrent types are mostly adopted in the design. Flakes are countercurrently contacted with solvent. After extraction flakes go to the desolventizer where most of solvent is removed. The desolventized meal is processed further as required.

Evaporation

The oil-solvent ,mixture(miscella) is filtered to remove fines and is fed into a series of evaporators and stripper. In order to reduce energy consumption required for evaporator operation the hot streams evolved from the desolventizer and oil stripper are utilized as heating medium for the evaporators.

The solvent vapor coming out of the evaporators is directed to the vapor condenser and collected in a separator. The oil rich stream which still contains small amount of solvent is fed into the oil stripper.

Stripping

The evaporator effluent stream is further treated in the stripper. Stripping steam is injected into the bottom of the stripping column and trace of solvent remained in the oil is completely stripper bottom is fed into the evaporator to be used as heating medium of the last evaporator. The evaporated and condensed solvent is collected in a separator and bottom layer of the condensate is introduced into another stripper to recover solvent. The bottom stream of the stripper is sent to the waste water treatment system.

Degumming

Removel of phosphatides from oils is essential because they affect oil processing efficiency and product quality. Degumming step and processes are more or less different depending on the sources of oil. However, if degumming is done at all, it is almost always accomplished by hydrating the phosphatides and similar materials to make them insoluble in the oil. In all cases separation of the hydrated gums from the oil is done with continuous centrifuges.

The solvent-freed oil effusing from the last evaporator is sent to the mixer where the process water is added and mixed with oil by agitation.

The lecithin/oil mixture is fed into the centrifuge. The degummed crude oil is sent to storage or refining plant. The separated lecithin is either mixed with the desolventized meal or sent to refining section.

REFINING PLANT

The schematical flow sequence of refining processes is shown in Figure 2. As indicated in the diagram eigher alkali or steam refining process can be employed but following description is concerned with the latter process. Winterization or hydrogenation is optional treatment step of which adoption is to be decided by the characteristics of crude oil quality and end product utilization.

Steam Refining

Steam refining, or deacidification by steam stripping, constitutes the principal alternative to alkali refining and is always carried out in a semi-continuous or continuous manner. This process normally operates at vacuum. Neutral oil losses in stripping are significantly lower than those quoted for alkaline deacidification. Effluent formation is also lower in steam refining. To be successful, steam refining must be practiced on oils naturally very low in phosphatides or from which phosphatides have been removed.

Bleaching

The most important adsorbent used in bleaching edible oils is bleaching clay. Bleaching of oils by adsorption involves the removal of pigments that are either dissolved in the oil or present in the form of colloidally dispersed particles. The amount of bleaching clay required depends on the history and prior processing of the oil. The reduction of bleaching clay consumption levels is an important objective for the refining plant operation, since higher levels mean higher clay costs, greater losses of oil in spent clay, and lower filter press capacity. The bleaching operation is carried out under vacuum and heated condition to flash off dissolved air and moisture.

Deodorization

Deodorization is a process of steam distillation at relatively high temperatures conducted under vacuum. The triglycerides with very low vapor pressures are relatively unaffected and the odoriferous impurities, such as lower molecular weight hydrocarbons, aldehydes, ketones, and fatty acids formed by oxidative deterioration, are removed by steam distillation.

Deodorization is the most energy intensive process in energy requirement is very important. Energy is used to heat the oil to the operating temperature, to provide the live steam used for stripping, and to provide the motive steam generally used to operate the vacuum system. In order to reduce energy consumption the oil-to-oil heat recovery system which provides for heating of incoming feedstock is installed in the deodorization section.

Process Flow Diagram:

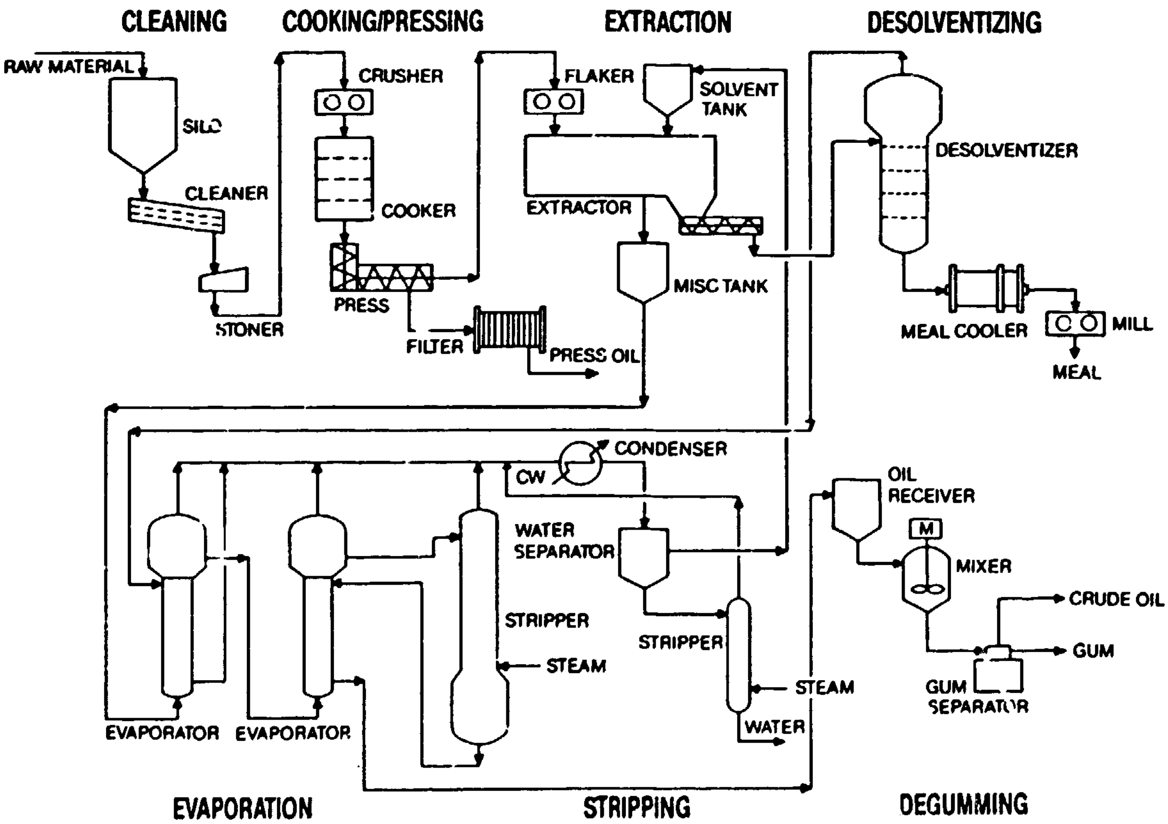


Figure 1

SEQUENCE OF OIL REFINING PROCESSES

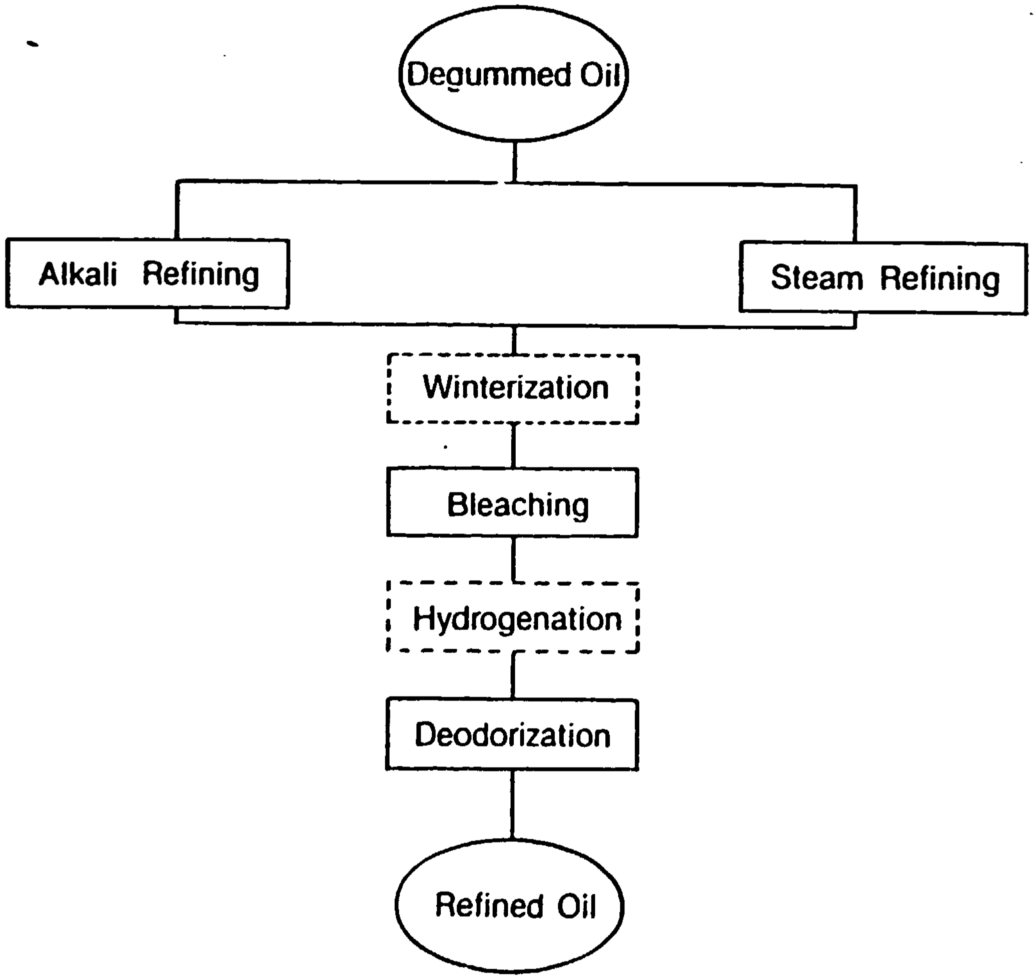


Figure 2

List of Equipment and Machinery:

- Silo
- Cleaner
- Stoner
- Crusher
- Cooker
- Press
- Filter

- Flaker
- Extractor
- Solvent Tank
- Miscella Tank
- Desolventizer
- Meal Cooler
- Mill
- Evaporator
- Stripper
- Condenser
- Water Separator
- Oil Receiver
- Mixer
- Gum Separator

<u>Estimated Total Investment:</u> US$1,000,000

Product Specifications:

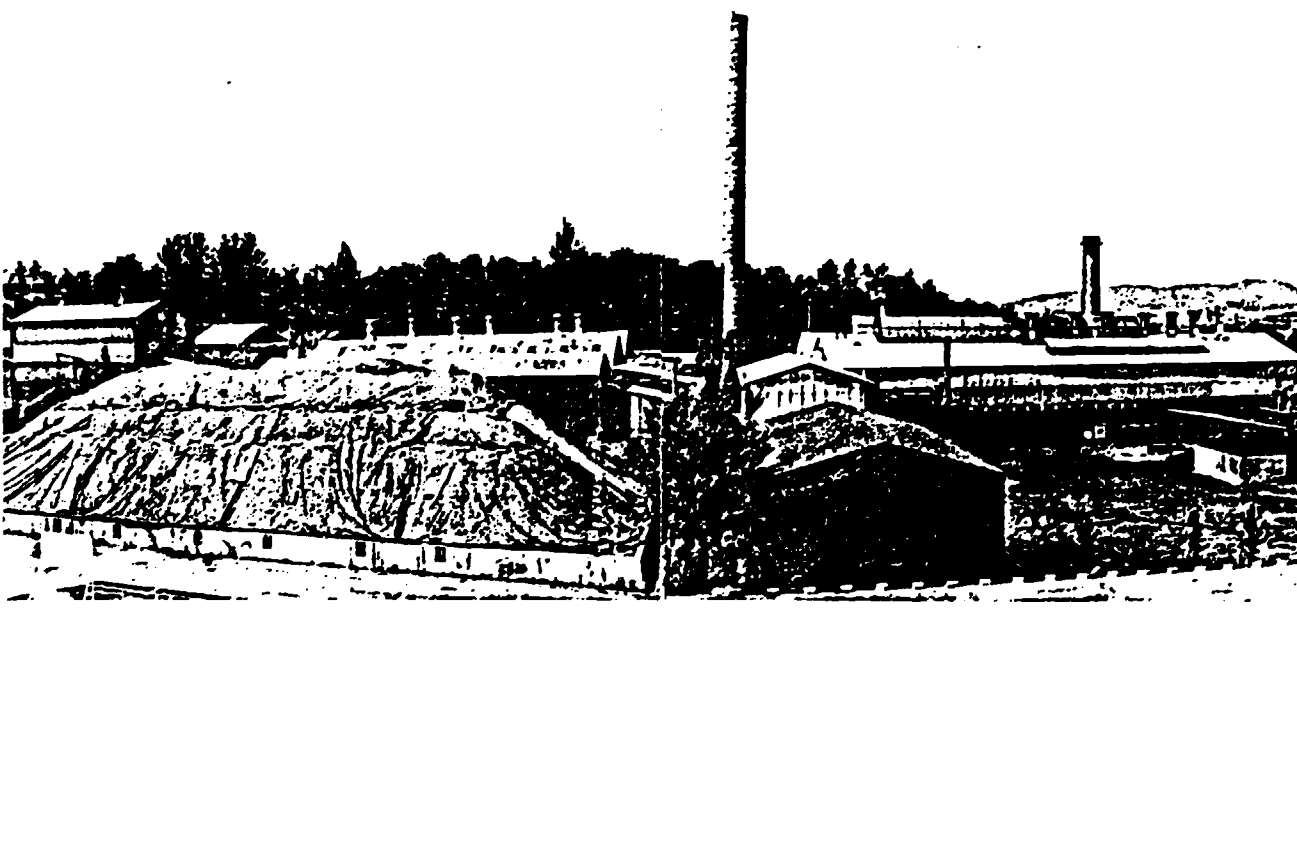
CRUDE OIL

Moisture & impurities	%	1.0 Max.
Acid value	KOH mg/g	40 Max.
Saponification value	KOH mg/g	183-192
Iodine value	I_2 g/100g	99-109
Unsaponifiables & waxes	%	5.0 Max.

REFINED OIL

Moisture & impurities	%	1.0 Max.
FFA	%	1.0 Max.
Smoke point	C	210 Min.
Cold test	5.5hrs@0 C	pass
Color	LOV 5¼" cell	Y-35,R-50 Max.
Unsaponifiables	%	3.5 Max.

Formed Coke Plant



Technology Owner

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TEL : 783 - 1041/8
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Technology Process Description:

The process flow diagram enclosed shows the sequence of the following operations that are briefly described below.

(1) Storing of Raw materials

Raw materials required are anthracite, coke breeze, petroleum coke, coking coal and coal tar pitch. These materials are stored without weathering, spontaneous combustion, increasing of moisture at the storage yard.

(2) Grinding and Fractionation

Clean coal is produced through the floatation process after anthracite is crushed in the Ball Mill. The proper sizes of the remaining materials are made during the crushing process.

(3) Floatation

After anthracite is crushed at the Ball Mill, the reagents are added. During the Floatation process,

clean coal and tail are separated by specipic gravity of material.
Moisture is decreased at the disk filter to the required level of 16 - 20%.

(4) Drying

Dehydrated Clean coal and Coke breeze are dried in the rotary dryer.
The moisture content is less than 10%, and the heat source is waste heat gas of the coke oven.

(5) Forming

Blending coal mixed correctly was kneading for about 7 minutes with superheated steam of 300 - 350℃ and pressed into briquettes.

(6) Coking

The green briquettes are put in the charging box, then transfered to the charging car by hoist.
Next, the green briquettes enter the inclined furnace of rapid high temperature for carbonization and are carbonized at 1100℃ (max, temperature), for about 40 minutes.

(7) Quenching

The carbonized coke is then poured into the quenching pond by using chute car and is quenched for 3-4 minutes.

Then it is transfered by conveyor belt to the coke storage bin.

(8) Storing and packing

The stored coke is screened to separate sizes and is restored by size, then it is loaded onto trucks for delivery.

(9) Quality Inspection

The basic properties of raw materials and final products are subjected to through korean standardization tests.
Every manufactureing process is inspected periodically to ensure factory working standards.
The essential tests of the final product consistes of proximate analysis, strength test (Drum, Shatter index), dimension and porosity.

(10) Product : Formed Coke for foundry.

(11) Usage

- High grade foundry for machine or automobile industry.
- Ductil cast Iron.
- Other foundries.

(12) The effect of the formed coke in the cupola.

- Heat source.
- Carbon additive
- Reducing agent.
- Space support.

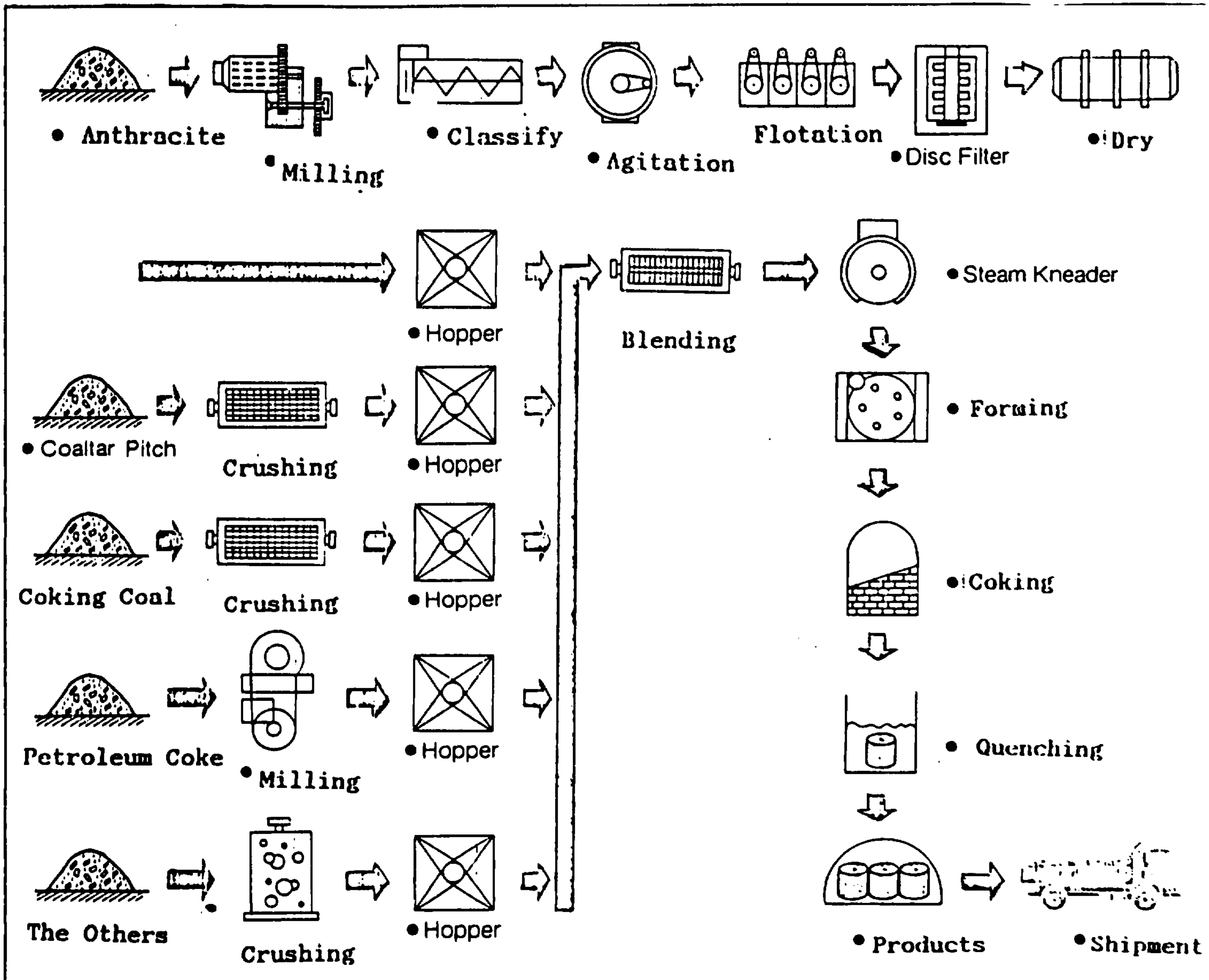
(14) The dimensions of coke. : This coke has o pinhole in center.

No	Dia (mm)	Height (mm)	Hole dia (mm)	Net weight (mm)
1	90	90	12	0.65
2	115	115	19	1.20
3	135	130	25	1.80

(15) Properties of coke

No	Property	(%)
1	Ash content	8.2 to 8.5
2	Volatile matter	Max 1.5%
3	Shatter Index	98.0% min
4	Porosity	33 to 35

Process Flow Diagram:



List of Equipment & Machinary:

No	Equipment	Quantity	Dimension	Application
1	Boiler	1	Cap. : 5 ton/hr Package Tub Type	Waste heat Boiler
2	Suction Blower	1	cap.: 850m^3/min 200mmAq	Air, water cooling turbo Blower
3	Stack(1)	1	H : 53m Dia : 1580/2240	
4	Stack(2)	1	H : 25m Dia : 1580/2240	
5	Duct	1	L : 110m , Dia:1900	
6	Waste gas Blower	1	Cap.: 572m^3 / min 200mmAq	Turbo Type Waste gas
7	Dryer	1	cap.: 6 Ton/hr cylinderical counter	Dry for Breeze , Anthracite
8	Cyclone	1	Cap : 270m^3/ min cyclone seperator	Waste gas
9	Roll Crusher	1	Cap. : 8~10 Ton/hr	Breeze
10	Hammer Cru-sher	1	Cap. : 4~6 Ton/h.	Pitch
11	Pitch Hopper	1	Cap. : 2m^3 Water cooling Type	Pitch
12	Coking Coal Hopper	1	Cap. : 11m^3 Pyramid Bottom type	Coking coal
13	Petro coke Hopper	1	Cap. : 16.2m^3 Pyramid Bottom type	Petro coke
14	Anthracite Hopper	1	Cap. : 19.5m^3 Pyramid Bottom type	Anthracite
15	Breeze Hopper	1	Cap. : 30m^3 Pyramid Bottom type	Breeze

No	Equipment	Quantity	Dimension	Application
16	Mixer	1	Paddle Type	Blending Coal
17	Feed in	7	Cap. : 15 m^3 Pyramid Bottom type	Briquetter
18	Kneader	7	Cap. : 4 Ton/hr Vertical Type	Briquetter
19	Rotaty press	7	Cap. : 60 EA /min Central Press Type	Briquetter
20	Exhaust Fan	2	Cap. : 250 M^3/min 200mm Aq	Petro coke
21	Rotary Feeder	1	Cap. : ϕ150 X 0.4 Kw	Petro coke
22	Bag Filter	1	Cap. : 400 M^3/min	Petro coke
23	Product Silo	1	Cap.: ϕ3000 X 2350 H	Petro coke
24	Raymond Mill	1	Cap. : 50 inch	Petro coke
25	Cyclone	2	Cap. : 4 M^3/min	Petro coke
26	Dust Blower	1	Cap. : 400 m^3/min	Petro coke
27	Ball Mill	4	Cap. : 4 Ton/hr	Floatation
28	Agitator	4	Cap. : 4.8 m^3	Floatation
29	Floatator	8 row 80 cell	Cap. : 0.7 Ton/hr	Floatation
30	Disk Filter	2	Cap. : 42~60 Ton/hr	Floatation
31	Tail Pond	2	Cap. : 330 M^3	Tail

Raw Materials and Energy consumption:

(1) The Principle Raw Matrials.

1) Cleaned Anthracite.

2) Coke Breeze.

3) Petroleum coke.

4) Coking coal.

5) Coal tar pitch

The blending ratio is changeable based on ash content of coke. Petroleum coke is not used for high ash content of coke.

. Energy consumption rate per 1 ton of final coke products.

No	Energy	Unit	REMARK
1	Electric Bnergy (kwy)	33.5 Kwh/T-coke	
2	Bunker C - Oil	21.3 liter/T-coke	
3	Steam (Kg)	138.0 Kg/T-coke	
4	Kerosene (liter)	0.57 liter/T-coke	
5	Cooling water (Ton)	2.07 T/T-coke	Changeable
6	Light Oil (liter)	4.82 liter/T-coke	Changeable

Plant Capacity:

Total time of charge, discharge and coking is 40 to 1 hr, for a dialy production of 33 batches.
There is a total of 350 working days per year, and 15 days per year for annual maintenance.
The daily production of 1 furnace is 23 ton, allowing for 8,050 ton per furnace annually.
By utilizing all 13 furnaces, this provides an annual production of 105,000 tons.

Space Requirement:

S P A C E		A R E A (m^2)	REMARK
Building	Floatation Plant	1,200	
	Carbonization Plant	2,300	
	Crushing Facilities	650	
	Production storage	530	
	Shower & Dressing Room	200	
	Office & Conferance Room	1,060	5,940

Storage Yard	Raw Materials	23,000	
	Production	5,000	
T O T A L		33,940	

Personnel Requirements:

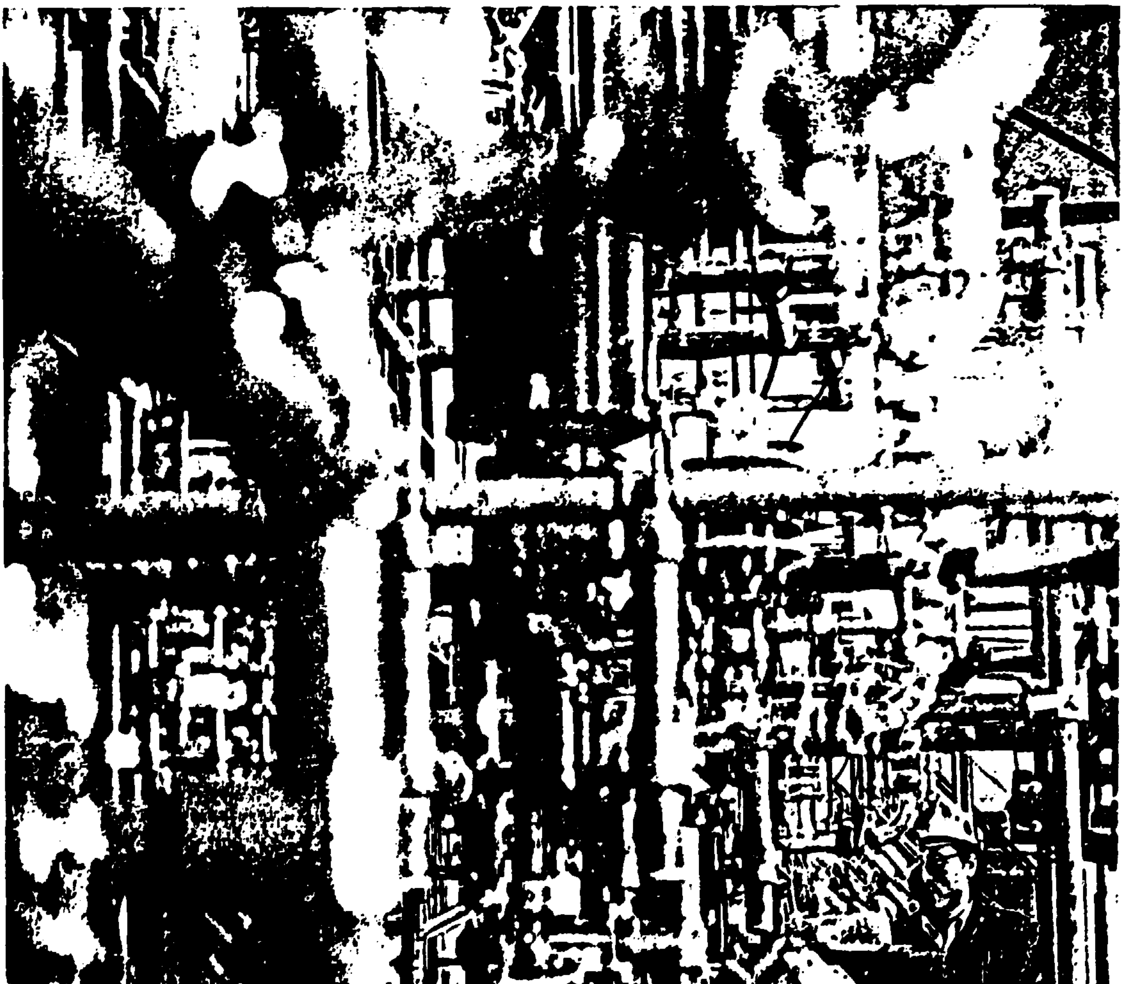
(1)	Production Department	34 (3 shift)
(2)	Maintenance Department	13
(3)	Quality Control Department	10
(4)	General Management & Accounting Department	30
	TOTAL	137 (Persons)

Estimated Total Investment:

• Production Scale : 105,000 Ton / Year , Coking Time 43 Min /cycle				
Item Class	Equipment	Quantity	Capacity	Price (US $) 1$: 670 won
Machinary	Ball Mill etc.	3	4 Ton/hr	298,507.
	Briquetter etc.	7	5 Ton/hr	4,477,612.
	Double H / C	2	7 Ton/hr	44,776.
	Hammer Crusher	1	4 Ton/hr	29,851.
	Raymond Mill	1	50 Inch	223,881.
	Roll Crusher	1	8 Ton/hr	74,627.
	Electric	1	800KvA,420Kw	492,537.
	Water Supply	1	300 Ton/day	74,627.
Building	Floatation plant	1	1,200 m²	388,800.
	CarbonizationPlant	1	2,300 m²	783,582.
	CrushingFacilities			1,044,776.
	Coal Storage		23,000 m²	626,866.
	Water Tank			298,507.
Equipment	Heavy Equipment			522,388.
	Machine Tool			447,761.
Others				797,015.
TOTAL				10,626,113.

* Note : Land is a special outlay.

HIGH FRUCTOSE SYRUP PLANT



Technology Owner: Lucky Engineering Co., Ltd.
C.P.O. Box 6762, Seoul, Korea
Telex: LUCKENG K24955
Telephone: 783-0091, 2685
Fascimile: 784-6887

High fructose syrup (HFS) is a carbohydrate type sweetener which contains approximately 45% fructose and 55% glucose and its sweetness is as high as sugar and twice as sweet as glucose. HFS is an isomer of glucose and manufactured from starch which is a cheap raw material obtained from corn, sweet potatoes, wheat and cassava roots, etc. As a sugar substitute, it is an economical sweetener used in food and pharmaceutical industries. In the pharmaceutical field, it is used as a sweetener and nutrient for diabetics.

Recent technological innovation in HFS production was achieved by the successful application of enzyme catalysis. In addition, the enzymatic process for the production of HFS in large scale has been more favoured by the development of a cheap enzyme source from microorganisms and its immobilization processes.

Lucky Engineering Co. offers the most advanced technology of HFS production based on know-how and expertise accumulated from its various experiences in the same field.

Technology Process Description:

The raw material of high fructose syrup (HFS) to be manufactured by LEC process is starch which can be derived from maize, cassava roots, sweet potatoes and wheat. The starch slurry is liquefied by the action of enzyme (amylase) and the liquefied starch is saccharified by adding glucoamylase. Finally the glucose produced by saccharification is converted to HFS by the isomerization reaction.

Details of each processing step can be described as follows.

Liquefaction(Hydrolyzation)

Starch slurry (35% DS) is pumped out of storage tank and sent to a tubular type reactor. Enzyme is added into the slurry transfer line and alkali solution is injected to adjust the pH of the slurry. The slurry is heated to the optimum temperature before entering the reactor.

The holdup time in the reactor is usually less than an hour. PH of the reactor effluent is louered by adding oxalic acid and transferred to the saccharification reactors.

Saccharification

Saccharification is operated on a batch mode. Saccharification temperature is slightly lower than the liquefaction temperature, therefore the liquefied starch coming out of tubular reactor is cooled by transfering heat to the incoming starch slurry in a heat exchanger and directly fed into the saccharification reactors.

Generally, the saccharification section is comprised of 15 to 18 vertical vessel type reactors.

Saccharification enzyme is added into the reactor and the agitator is started. Heating medium is supplied to the reactor jacket to maintain the reaction temperature. Reaction takes about a few days.

Upon completion of the reaction, filtration aid is added to the reactors and then the mixture is pumped to the filter. Before filtration, the reactant mixture is heated to inactivate the enzyme.

1st Concentration

The glucose syrup produced in the saccharification section is sent to an evaporator after filtration to reduce the treating volume in the purification section. Usually the syrup is concentrated to 45% DS. The vapor from the first evaporators is utilized as a heating medium in the 2nd evaporators.

Refining

The concentrated glucose syrup is continuously withdrawn from the evaporator and sent to the active carbon mixing tank. The syrup is decolorized and deodorized in a mixing tank and the mixture is filtered in the filter press. The filter cake(used active carbon) may be reused by recycling to the saccharification section. The filtrate is fed into the ion exchangers of cation, anion and mixed bed. In this refining section, all of the impurities both organic and inorganic are removed.

Isomerization

The refined glucose syrup is neutralized with alkali solution and cooled to the optimum reaction temperature before isomerizing. The cooled syrup is fed into a series of isomerizing columns filled with immobilized enzyme. The conversion rate is approximately 45%.

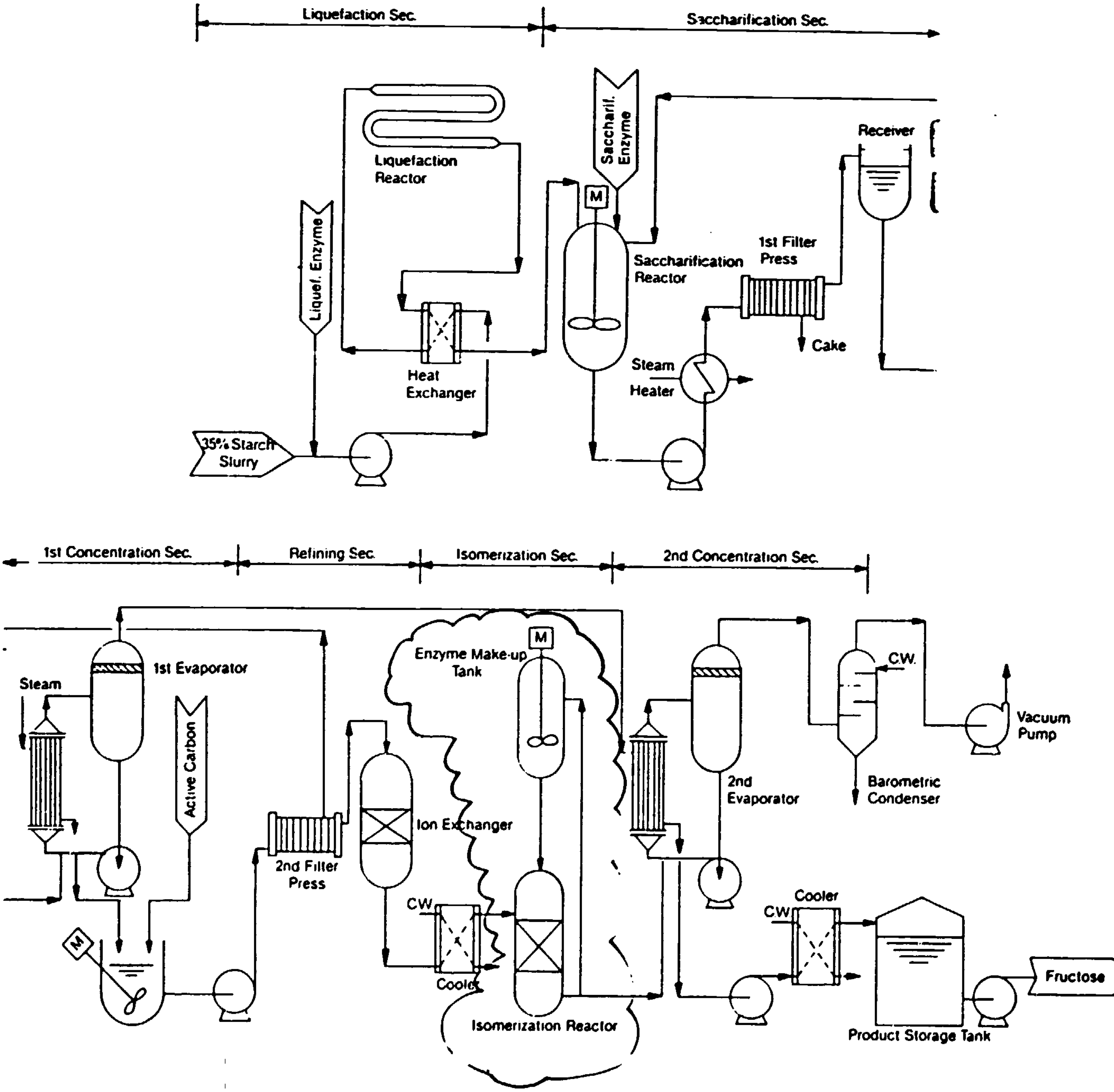
2nd Concentration

The reactor effluent is sent to the 2nd evaporator for the final product conditioning and is concentrated up to 75% DS. The evaporator is operated by supplying vapor generated from the 1st evaporator and live steam.

Hence, two steam heaters are required for the evaporator. The product is cooled and acidified to PH 4.0 - 4.5. The PH adjusted product is sent to a storage tank.

It is desirable to minimize the holding time in the storage tank to prevent discoloring of the product. The syrup is supplied to consumers either as bulk by tank truck or as a canned product.

Process Flow Diagram:



TO BE OMITTED

List of Equipment and Machinery:

- Liquefaction Reactor
- Saccharification Reactor
- Isomerization Reactor
- Filter Press
- Evaporator
- Slurry Exchanger
- Steam Heater
- Water Cooler
- Ion Exchanger
- Barometric Condenser
- Storage Tank
- Vacuum Pump
- Pumps

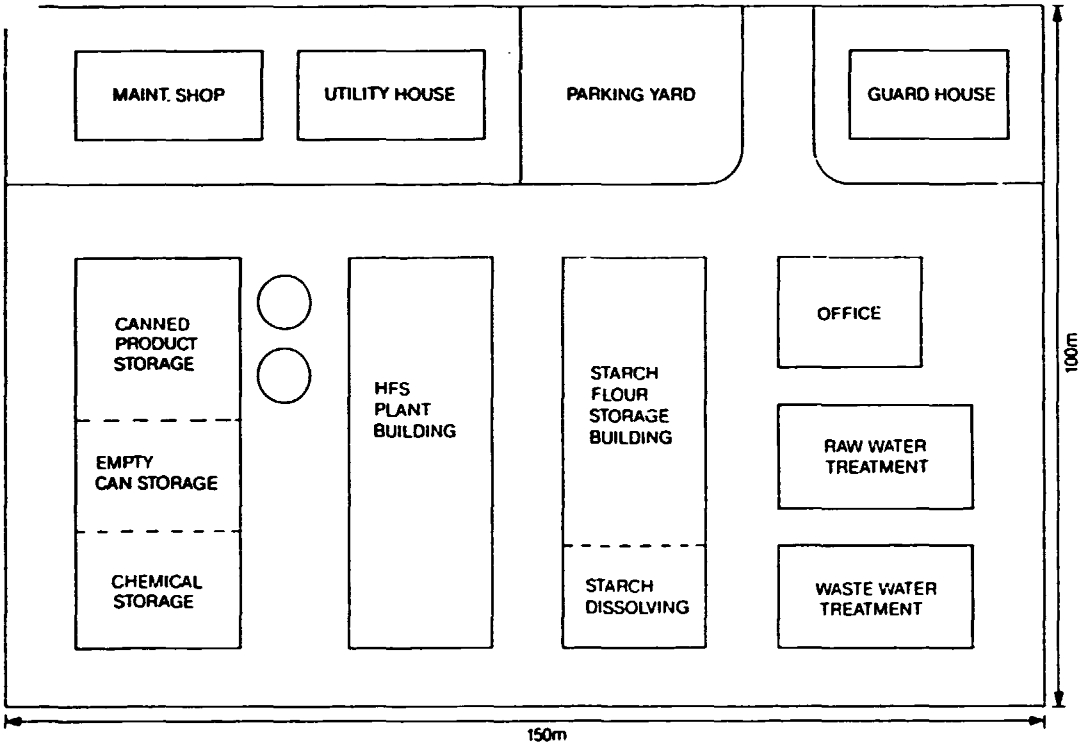
Raw Materials and Energy Consumption Rate:

Raw Material & Utilities		Requirement (Per ton of 75% DS HFS)
Starch	Tapioca Flour	950 Kg
	or 35% DS Starch Sluny	2.32 m^3

Enzyme	Liquefaction (powder)	4.5 Kg
	Saccharification (liquid)	1.5 Kg
	Isomerization (pellet)	1.0 Kg
Chemical	Soda ash (commercial grade)	1.5 Kg
	Oxalic Acid (commercial grade)	1.8 Kg
	Activated Carbon	13 Kg
	Hydrochloric Acid (35%)	35 Kg
	Magnesium Sulfate	0.6 Kg
	Caustic Soda (45%)	6.5 Kg
	Filtration Aid	4 Kg
Utilities	Steam	1,200 Kg
	Treated Water	70 m^3
	Electric Power	50 KWH

Plant Capacity: 20,000 MT/Y

Space Requirement:



Personnel Requirement:

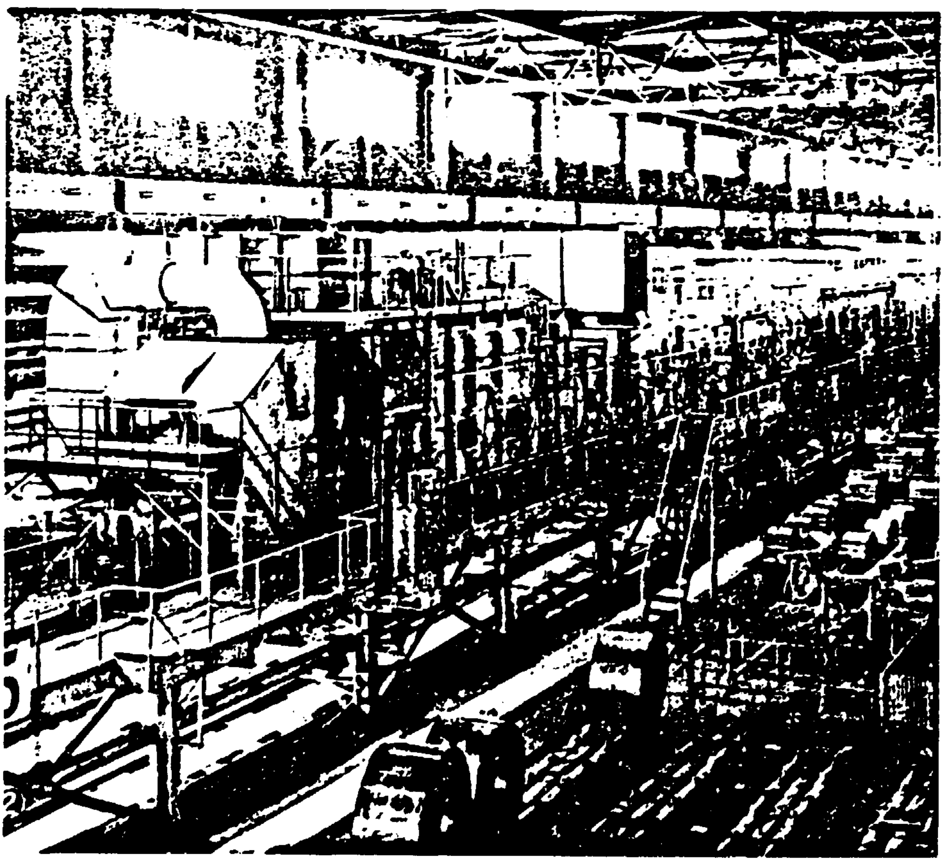
Classification	No. of Person
Section Chief	1
Engineer	1
Chemist	1
Operator (3 shifts)	12
Analyst (3 shifts)	6
Worker (3 shifts)	30
Total	51

Estimated Total Investment: US$2,000,000

Product Specifications (Typical):

Dry Substance	%(wt)	75
Moisture	%(wt)	25
Ash	%(wt)	0.01
PH		4.0 - 4.5
Monosaccharide	%(wt) on DS	96
Dextrose	%(wt) on DS	52
Fructose	%(wt) on DS	44
Oligosaccharides	%(wt) on DS	4

IGNITION COIL MFG PLANT



Technology Owner: Sunkyong Engineering & Construction Limited

.Head Office: Sungwha Bldg. 192-18
Kwanhun-Dong, Jongro-Gu,
Seoul, Korea

.K.P.O.Box222, Seoul, Korea

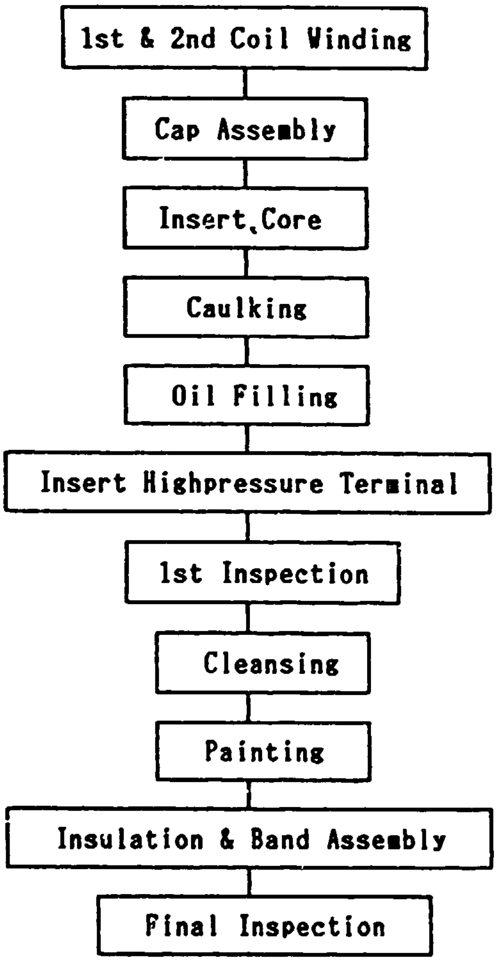
.Telephone: 738-2222 .Telex: SKYGECO K26292

.Telefax: 736-7040 .Cable: "SKYGECO" SEOUL

Technology Process Description:

- Coil Winding Section
- Assenbly Section
- Injection Molding Section
- Press Section
- Inspection
- We, Sunkyong Engineering & Contruction Ltd., have pleasure to provide all phases of the project from feasibility study and engineering/design to final commissioning, start up operation and maintenance for this plant with highly accumulated technology and can provide clients with most reliable and economical IGNITION COIL MFG PLANT.

Process Flow Diagram:



List Of Equipments And Machinery:

- 1st & 2nd Coil Winding M/C
- Hot Air Dryer
- High Speed Precision Press M/C
- Caulking M/C
- Dry - Off Oven
- Baking Oven
- Oil Filling M/C
- Ultrasonic Cleansing M/C
- Paint Booth
- Conveyor
- Air Compressor
- Feed Roller
- Power/Hydraulic Press M/C
- Lathe
- Hydraulic Projector
- Injection Molding M/C
- Band Assembler
- Test/Inspection Equipments

Raw Materials And Utilities Consumption:

1. Motorcycle Ignition Coil

    - Silicon Steel
    - Rolled Steel
    - Al - Alloyed Steel
    - Copper Coil

- Insulated Paper (15 - 25 µ mm Thk)
- Resin (Epoxy, Poly Propylene)
- Bobbin
- Terminal

2. Automobil Ignition Coil

- Silicon Steel
- Rolled Steel
- Resin (Alkylate, Phenol, Epoxy)
- Insulated Paper (15 - 25 u mm Thk)
- Mineral Insulating Oil
- Insulator
- Spring
- Terminal
- Bobbin

3. Utilities

- Electric Power : 300 KW
- Water : 200 Ton/Month
- Compressed Air : 30 M3/Day

Plant Capacity:

- Motorcycle Ignition Coil (6,12 Volt): 150,000 EA/Yr
- Automobil Ignition Coil (12 Volt) : 120,000 EA/Yr
- Basis ; 300 Working Days/Year, 8 Hrs/Day

Space Requipment:

- Factory Area : 3,000 M2
- Site Area : 4,500 M2

Personnel Requirement:

- Operator : 41 Persons
- Supervisor : 6 Persons

Estimated Total Investment:

A bt. US.D 1,710,000

Construction Schedule:

12 Months

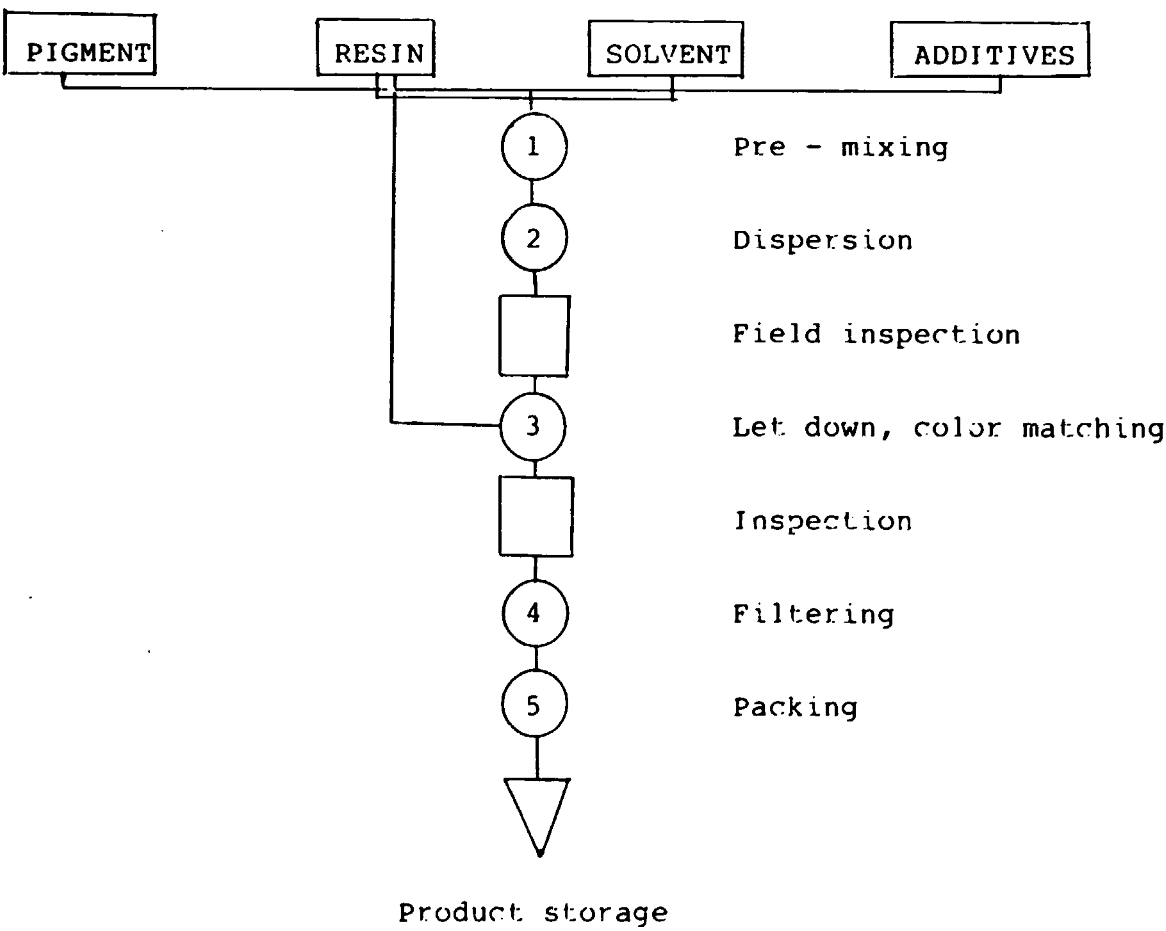
PAINT PLANT

노루표

Technology Owner: Daihan Paint & Ink CO. LTD.
615 Paktal-Dong, Anyang City, Kyonggi-Do, Korea
Yeouido P.O.Box 798 Seoul, Korea
Telex: K23580 DPINK
Telephone: 02-869-0441
Fax: 784 - 1061

Technology Process Description:

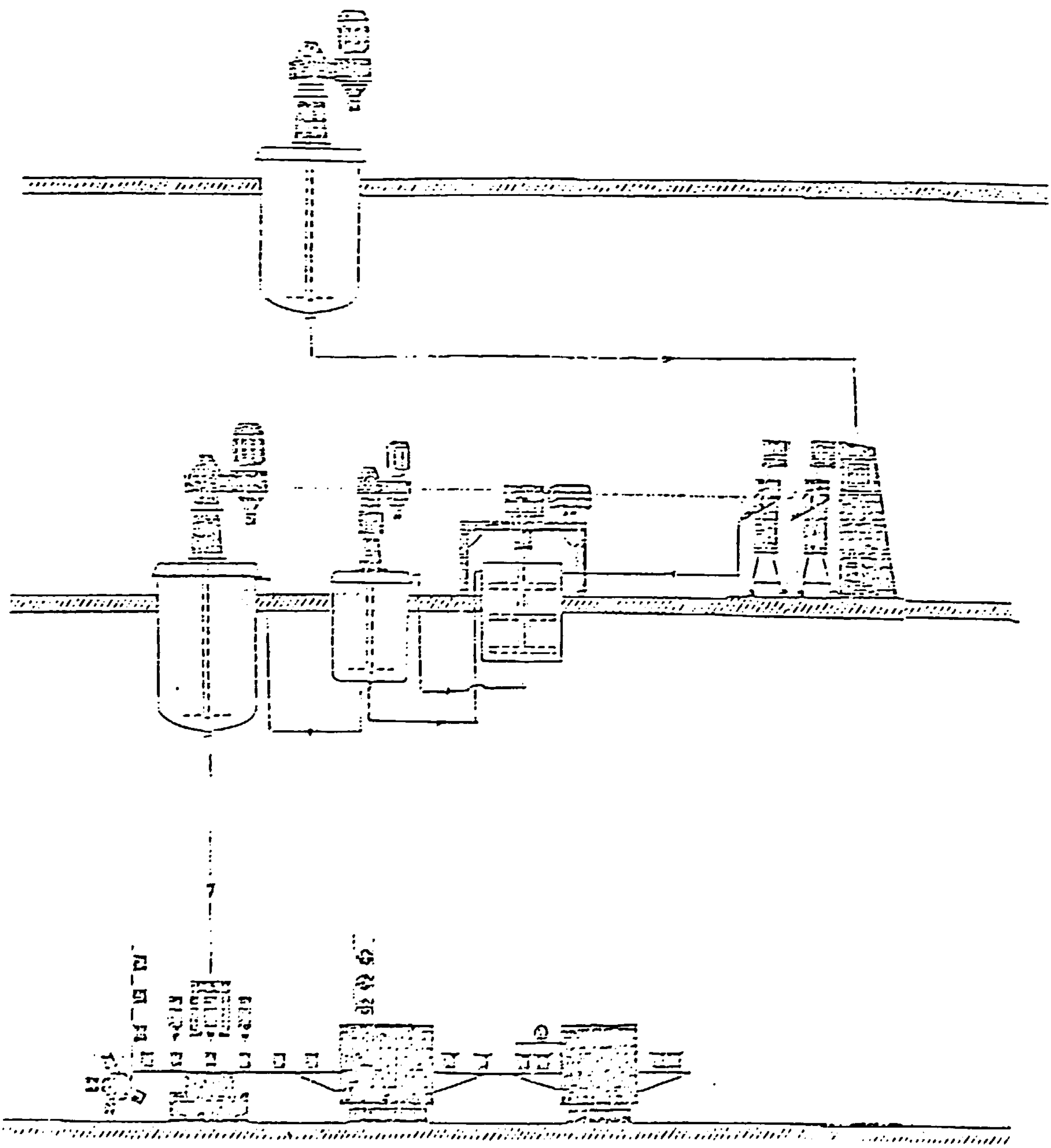
The Process of paint manufacture



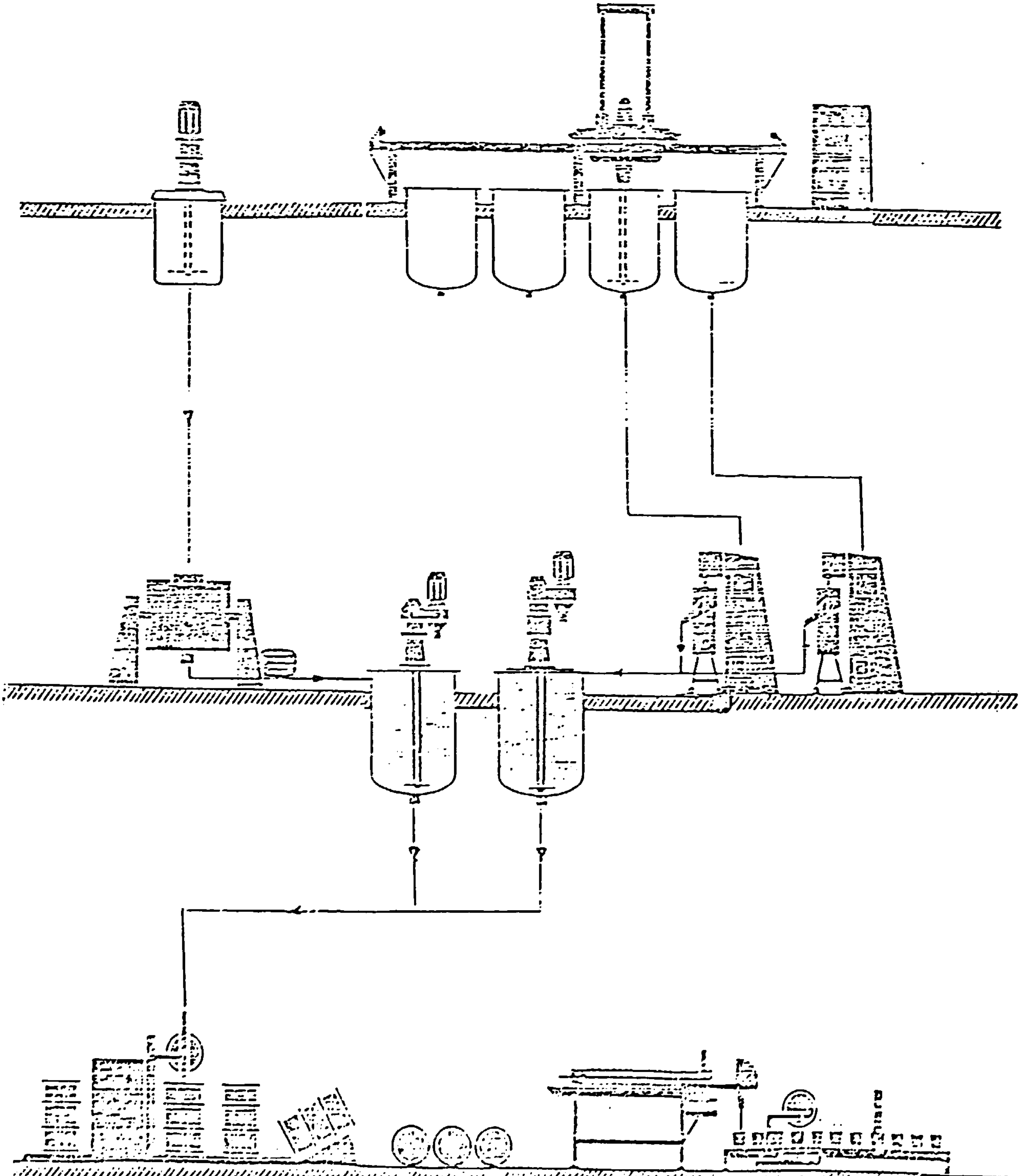
Process Flow Diagram:

Flow diagram for the production of Paint

Flow diagram (I)



Flow diagarm (II)



List Of Equipments And Machinery:

Equipments and machinery

The stage of Process	The name of machinery	Number	Capacity
Pre - mixing	Disperser	1	30HP
Dispersion	Three roll mill	1	900MM
	Sand grind mill	1	18L, 20HP
	Sand grind mill	1	50L, 50HP
Let - down	Tank with mixer	2	1.8M^3, 20HP
	Tank with mixer	1	5.4M^3, 50HP
Color - matching	Disperser	2	15HP
	Disperser	1	10HP
Filtering & filling	Filling machine	3	18L, 4L
Other equipments	Hoist	1	1,000Kg
	Emulsion storage tank	1	5M^3
	Table lifter	1	1,000Kg
	Digital scale	1	1,000Kg
	Winch	1	500Kg

Inspection Tools

Order	Name	Number	Use
1	Grind guage	1	Check grind fineness
2	Spray booth	1	Check Color
3	Spray gun	1	Check Color
4	Compressor	1	Supply air
5	Thickness guage	1	Check film thickness
6	Oven	1	Baking
7	Weight Per gallon cup	1	Check s.g
8	Ford cup#4	1	Check viscosity
9	Digital scale	1	Weighing
10	Laboratory disperser	1	Dispersing
11	Ku viscometer	1	Check viscosity
12	Space temp. measurement guage	1	Check space temp
13	Applicator	1	Application
14	Stop - watch	2	Check time
15	Impact guage	1	Check impact
16	Cross - cutter	1	Check cross - cut
17	Erichsen	1	Check bend
18	Temp. control water - bath	1	Control temp
19	Sample talbe	1	Store samples
20	Laboratory talbe	1	For experiments

Raw Material & Energy Consumption Rate:

Raw material

Kinds	Raw material	Rate (%)
Pigment	.Organic & inorganic .Extender	33.2
Resin	.Synthetic resin, Emulsion (for example oil modified alkyd)	51.0
Solvent	.Aromatic hydrocarbon .Aliphatic hydrocarbon, alcohole,etc	13.8
Additives	.Apply for paint	2.0
Total		100

Electric power : 250KVA

Plant Capacity:

Capacity of the plant as operated according to the offered process is assumed to amount to 1000 M/T per year of paint.

Space Requirement:

See to the description.

Personnel Requirement (for direct operation of the plant):

Manual

. Raw material warehouse	2
. Pre - mixing	2
. Dispersion	2
. Let - down	1
. Color - matching	3
. Filling station	2
. Inspection	2
. Product warehouse	2
. Equipment maintenance	1
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Semi - automatic

. Raw material warehouse	1
. Pre - mixing	2
. Dispersion	1
. Let - down	1
. Color - matching	2
. Filling - packing	1
. Inspection	1
. Product warehouse	1
. Equipment maintenance	1
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