ADANA UNIVERSTY – INDUSTRY JOINT RESEARCH CENTER

Scattering Papers

In

Chemical Industry

By

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Scattering Papers In Chemical Industry

1 - Linear Alkyl Benzene 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 alkyl benzene sulfonate , and the production of alkyl benzene sulfonate detergent now accounts for about 60 percent of the total detergent production in the world . This is because alkyl benzene sulfonate has excellent performance as a cleansing agent and because it is easily available at a low cost from the petrochemical industry .

In general, alkyl benzene 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 un degraded 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 alkyl benzene is a major raw material of LAS and as demand for soft type detergent is increasing so is demand for linear alkyl benzene . 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 alkyl benzene 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 alkyl benzene produced by this plant has a high biodegradability, and its alkyl benzene content is 97.4 % and normal alkyl benzene content is 93 % Other properties of the product are shown in table 1.

Table 1. Typical Property Of Linear Alkyl benzene

Bromine number	0.01
Saybolt color	+30
Alkyl benzene content , wt - %	97.4
Doctor test	Negative
Un sulforatable cont , wt - %	1.0
Water, wt - %	0.1
Specific gravity at 60 F	0.8612
Refractive index , $n_{20\ D}$	1.4837
Flash point (ASTM D - 93) , F^0	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 alkyl benzene sulfonate solution	+ 26
Normal alkyl benzene , wt - %	93
2-Phenyl isomer, wt - %	20.0
Paraffin, wt - %	0.1
Biodegradability (ASTM D - 2667) , %	95.0

Contents of Technology

1) Process Description

The alkyl benzene 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 HCI 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 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 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 conversation takes place. Reactor effluent exchanges heat with the feed, further cooled and goes to the product separator. The separator gas is used for recycled 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 processes 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 in 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.

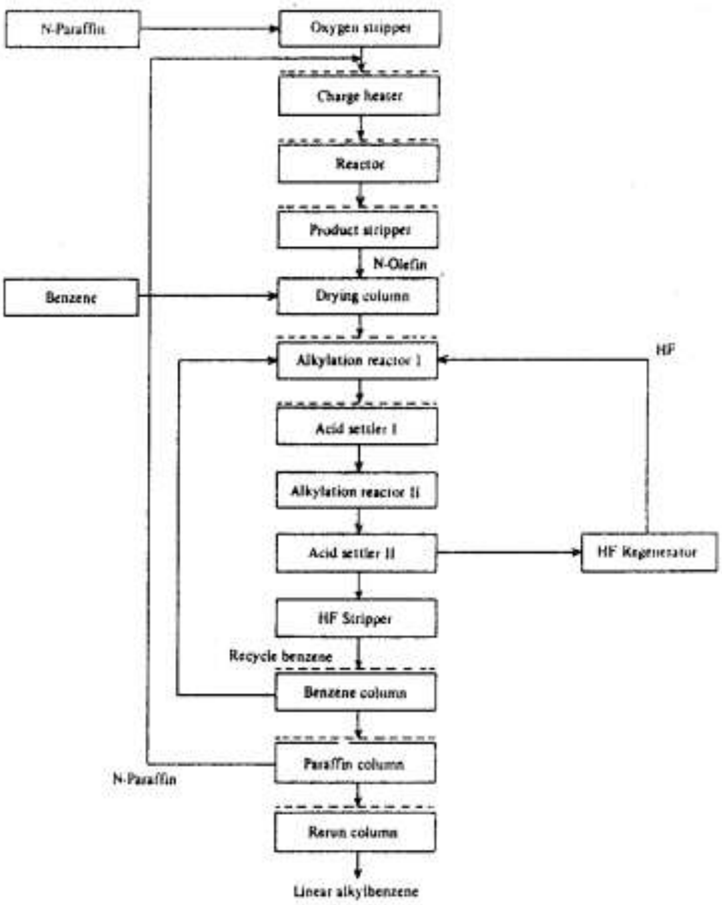
HF stripper bottoms are charged to the benzene column where recycle benzene is taken as an over head product and returned to the reactor. A small portion of this benzene (the drag stream) is drawn off to prevent build-up of any impurities which may be introduced with the feed streams. The quantity of 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 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) 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 kw h
Cooling water	8 m3
Fuel	5.5 kcal
Steam	



2 - Soy Milk Processing Plant

Over the last years, the production of soybean has been increasing worldwide . At present , 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 liters 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 soybeans was being used as a principal source of nutrients and was considered to be a holy food by priests .

Up to 50 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 flavor . In the Orient , people are used to this flavor , caused by the oxidation of the oil during the disintegration process at room temperature . It was discovered later that by disintegrating soybeans at higher temperature (over 83 C) , the beamy flavor disappeared and the taste of the milk became acceptable to Western consumers .

Process Description

Cleaning and selection : Soybeans must be cleaned and soared 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 spilt 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 beams absorb water, There by increasing their weight 2 - 3 times .

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) separates the slurry into two phrases : milk and insoluble bean particles . The better grinding is , the higher the yield of protein extracted from the soybean will be . Each 10 kg of slurry produces 8 liters of milk and 2 kg of insoluble with a moisture content of 80 % .

Formulation : The milk is then heated to 80 C and sugar , salt , flavor and stabilizing agents are added in a formulation tank with an agitator . Different flavors can be used , for example : banana , guava , chocolate , strawberry , caramel , butter , coconut or coffee . The amount of sugar added is between 4 % and 15 % , according to taste . Stabilizing agents , such as locust bean gum and aragonite , 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 on the grinding process to 98 C .

Packaging : The sterilized and cooled milk is filled into one - liter poly ethylene 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.

production scheme for a soy mild processing plant

Tables 1 - 5 are based on a plant with a production capacity of 300 to 400 thousand liters of soy milk per month , operating 12 hour 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
Plate - type heat exchanger	1
Filling machine for pouches	1
Cold room	1
Isothermal truck	1
Drier	1
Boiler	1

Table 2 . requirement of raw and subsidiary materials (per month)

Item	Quantity (tones)
Soy beans	28
Sugar	25
Salt	0.25
Flavor	0.80
Stabilizer	0.80
Packaging (one - liter packages)	300 000

Table 3 . area required for plant site

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

Figure 1 . Simplified of equipment for Soy milk processing plant

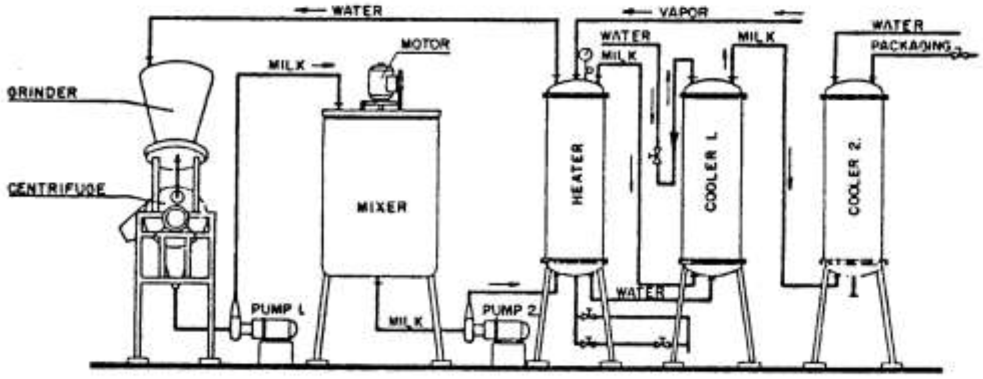


Figure II Process – flow – Sheet for Soy milk Processing Plant

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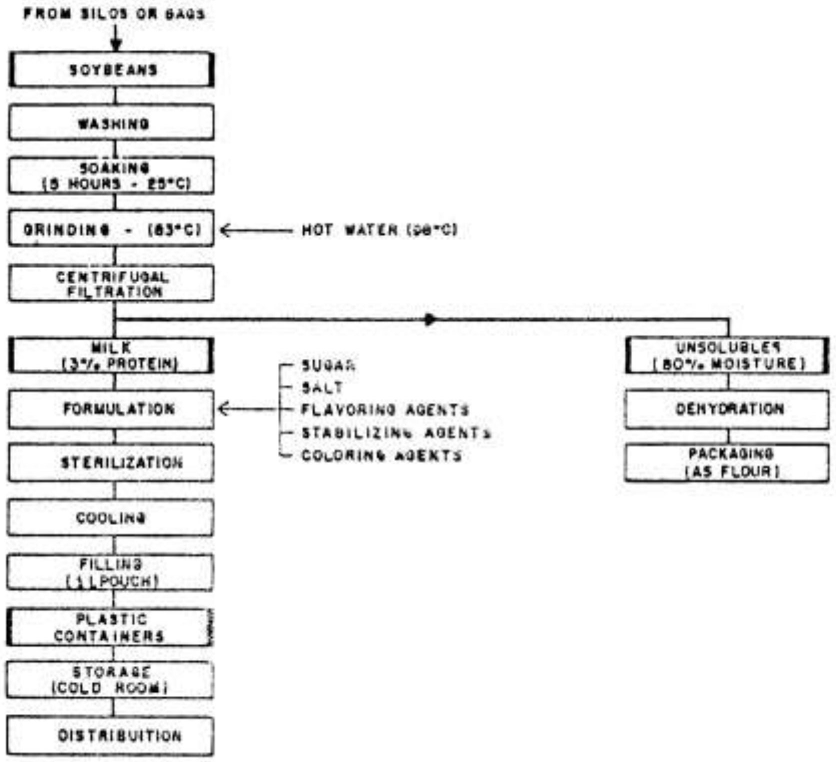
Figure II. Process flow-sheet for soymilk processing plant



3 - 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 micro nutrients intact , essential compounds that are rarely found in regular daily diets . By refining soybean oil , essential micro nutrients are eliminated : extracted soybeans 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 micro nutrients 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 balancer 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 flavor that was possible some years ago . Through extrusion , enzymes and anti - nutritional factors found in the soybean are inactivated , the beany flavor 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 . Some times , by combining ventilation and aspiration , a better separation of the hulls is possible . The separation is made by 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 . Flavor 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 cell . 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 out side 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 :

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

production scheme for a whole soy flour processing plant

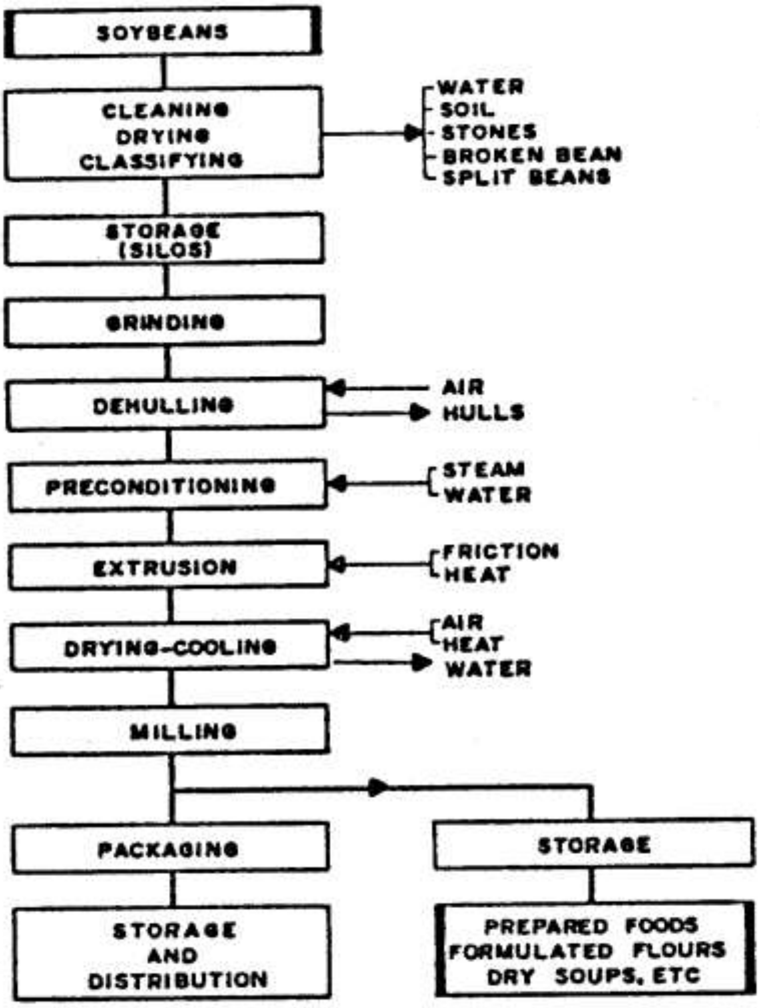
Tables 1- 3 are based on a plant with a production capacity of 75 tones per month , operating 12 hours per day , 25 days per month and 300 days per year . A process flow - sheet is also given below .

Table 1. machinery and equipment required

Item	Quantity
Boiler	1
Drier	1
De huller	1
Grinder	1
Extruder	1
Drier - cooler	1
Pin mill	1
Packaging machine	1

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

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


SOYBEANS
CLEANING DRYING CLASSIFYING
WATER
SOIL
STONES
BROKEN BEAN
SPLIT BEANS
STORAGE (SILOS)
GRINDING
DEHULLING
AIR
HULLS
PRECONDITIONING
STEAM
WATER
EXTRUSION
FRICTION
HEAT
DRYING-COOLING
AIR
HEAT
WATER
MILLING
PACKAGING
STORAGE
STORAGE AND DISTRIBUTION
PREPARED FOODS FORMULATED FLOURS DRY SOUPS, ETC

4 - Malt production

Introduction :

Malt is to substantial degree used as a raw material in the brewing process , necessitating as much as 10 - 17 kg malt to produce 1 hl beer based on 100 % malt utilization and approx 10 - 12 kg / hl beer with the addition of raw grain . It is also used as a component for patent food , baking auxiliary agents , and for other prepared foodstuffs .

The most common natural product as base material for industrial malting is barley , which is growing in many places of the world . Wheat, rye and sorghum are also used for malting . Barley, however , and especially the two - row spring barley (known as brewer's barley) proved to be most suitable for the production of brewing malt in industrial scale .

The aim of malting is to produce enzymes , breaking down the protein of high molecular weight during malting operation to low – molecular - weight protein for modification of cell walls between the starch cells in order to produce essential enzymes requisite for the brewing process .

Malting is a natural process performed to an optimum and within the shortest possible time when realized in industrial malting either latest technology and parameter-related in view of :

- Oxygen
- Addition of water and
- Temperature

Process Description :

The parameter for brewer's barley are dictated by :

Moisture content :	12 – 13 %
1000-grain weight :	35 - 48 g
germinative power :	not below 96 %
protein content :	9 - 11.5 % (dry matter)
full-barley contents :	exceeding 85 % (screen size 2.5 mm)

Barley Conditioning :

The combine - harvested raw barley is relieved of coarse and fine impurities , carried to the weighers for weighing and subsequently stored in silo bins .

Conscientious care must be taken when storing barley with negative storage properties to retain the germinating power of the brewer's barley . Consequently, lots with a moisture content above 13 % necessitate additional cooling and / or preservation by cooling . The barley is fed onto grading machines for grading in 2 or 3 grades to obtain uniform malting parameters . To counter the danger of infestation the stored barley is frequently fumigated with tablets which render the vermin innocuous and dissolve during storage .

Malting :

The malt processing mainly comprises three steps :

Steping .
Germinating .
Kilning .

As a basis for subsequent germination the barley achieves a moisture pick - up to 48 % during steeping . More over , the barley steeps provide for an intensive " wet washing " by simultaneously adding compressed – air . Carbon dioxide that builds up is removed during the so called " dry steeping phase ", adding spray water at the same time .

The steeping period normally lasts approximately two days.

Germination is carried put in so - called " germinating boxes " , the greater part of which are designed these days to the Saladin system . This enables the germinating stock to be individually loosed and turned when using screw turners (shown in the process flow diagram) . faultless aeration of the germinating stock (green malt) is ensured during the entire germination period , adding water from time to time to keep the product moisture constant .

The germinating process normally lasts five to six days .

Green malt is taken onto the kiln with a moisture content of approx 45 % and takes about 20 hours to reach a final moisture content of approx 4 %.

The kilning process is run in two steps . the so - called " withering period " is followed by the kiln - drying phase . Specific temperatures apply to either processing step to achieve the desired malt parameters . the so - called light " Pilsner Malt " is mainly produced on recently developed kilns , which have also proved suitable for the production of dark malts and other special malts .

Energy saving heat-recovery plants have been introduced successfully during the past few years, e.g. by glass tube heat exchangers and by two-floor kilns.

Malt Treatment :

After completion of the kilning process the rootlets (approx 3 %) sticking to the malt are carefully separated by means of " whirling ". They are utilized for producing animal feed . Subsequently , the malt is stored in silos . Mostly, prior to reaching the consumers , it is guided to pass through an " air washing " step within the malt dispatch section .

The yield obtained by malting cleaned and graded brewer's barley rates at approx 80 % .

The process " steeping - germination - kilning " shall be one course without interruption . The plants are designed to suit one barley lot being processed as one batch .

Example of the Plant :

Capacity : annual output of 10,000 tons of malt .

Required Machinery and Equipment :

1	Barley intake and pre cleaning	20 t / h
2	Barley main cleaning and grading	10 t / h
3	Fittings for barley silo plant (concrete silos by customer)	6*500 t
4	Conveyors to steeping plant	20 t / h
5	Steeping plant with 2 conical steeps	2*40 t
6	Hydraulic conveyors for steeped product	100 m3/h
7	Germinating box plant with 6 germinating units	6*40 t
8	Mechanical green malt conveyors	40 t / h
9	One-floor circular kiln	40 t
10	Kiln-dried malt conveyors	60 t / h
11	Malt degermination	10 t / h
12	Fittings for malt silo plant (concrete silos by customer)	8*250 t
13	Malt dispatch	10 t / h
14	Germinating box cooling plant	

Required Raw Materials and Utilities :

The average daily requirement of raw materials amounts to approx . 38 to 40 tons (based on 330 operation days per year) .

The utility consumption values per 1,000 kg processed malt amount to :

Total water consumption :	Approx. 8 m^3
Waste water obtained :	Approx. 2 m^3
Total power consumption :	Approx. 150 kWh
Heat demand (without heat – recovery , one-floor kiln)	1,000,000 kcal

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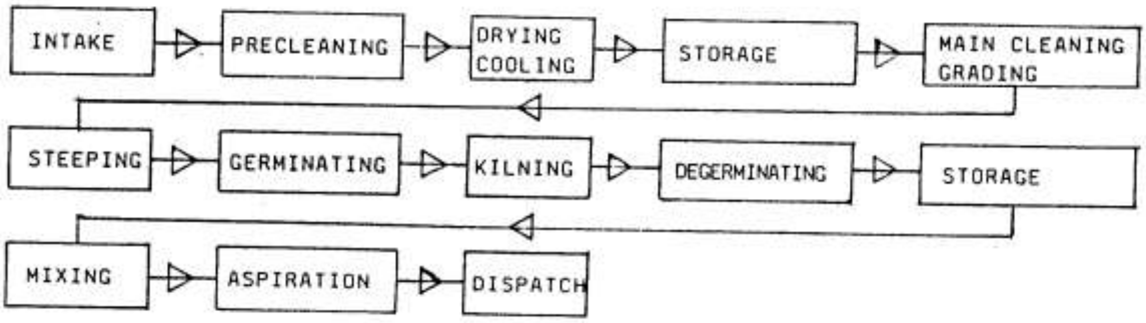
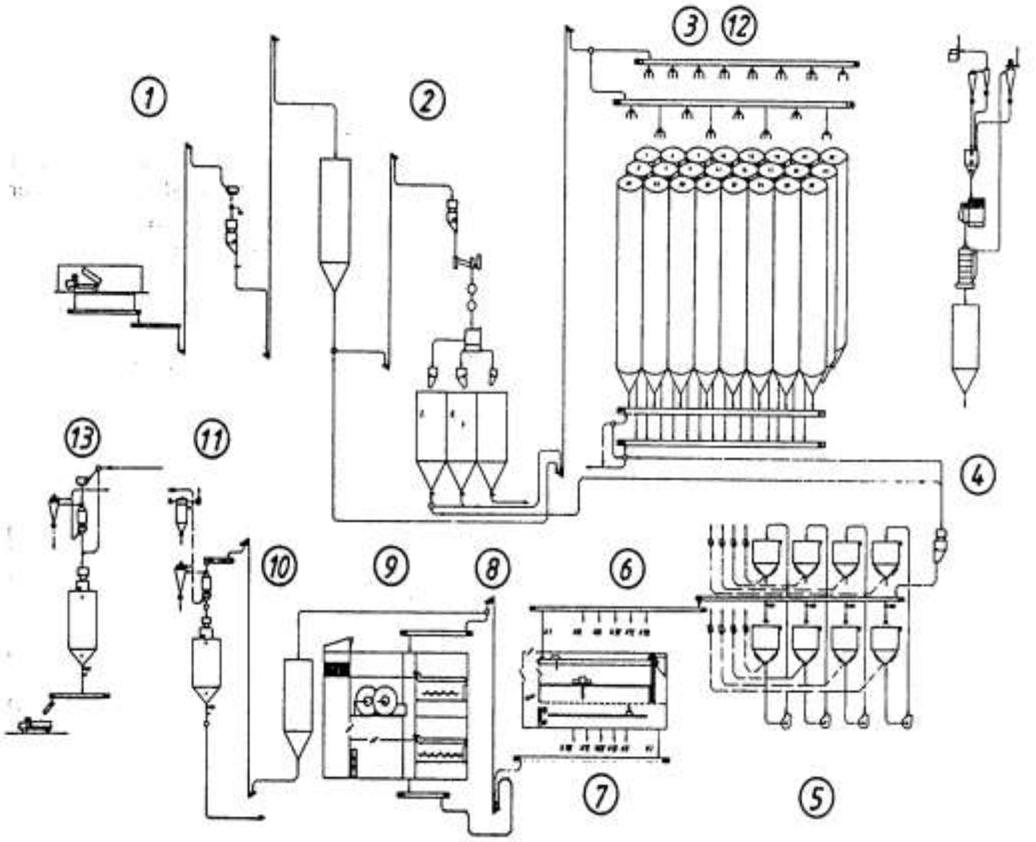
Process Flow Sheet



Process Flow Diagram



5 - Urea Resin Adhesive Plan

This is the industry for making the non - concentrated adhesive mainly used by the plywood industry , and the concentrated adhesive for wood working . The flue is made from such raw materials as urea , melamine and formaldehyde .

A long tine ago , plywood was made by using adhesives of starch and protein groups . But , thanks to the development of adhesives of the synthetic resin group , all kinds of plywood are manufactured with this type of resin at present .

The adhesive requires some modification in its characteristics so as to conform with the conditions for use at plywood manufacturing plants . But the basic manufacturing process will be mentioned below :

The adhesives to be manufactured at the plant are for making plywood. There are two kinds of plywood , namely **Type II** , which is to be used for interior decoration of buildings , and **Type I ,** for the facing of buildings on the outside , which is water proof .

The adhesive of urea - formaldehyde resin (Type II) is to be used for the Type II plywood .

The adhesive of urea – melamine - formaldehyde resin (Type I)is to be used for Type I plywood . the concentrated adhesive is mainly used for wood working

Thus , adhesives are supplied in Type I and II as well as the concentrated type , all of which are supplied . In a liquid shape . They are shipped either in drums or , in case of delivery to big consumers , on tank lorries .

The adhesives also include that of the phenol – formaldehyde , which is mainly used for making plywood for the facing on the outside of buildings . However , its used is a bit difficult as compared with the adhesive of the urea – melamine - formaldehyde resin group .

In such tropical zones like the South Seas , the life of products is shortened , and so it is suggested that they be not stored for a long time . In such a case , Adhesives are used in the form of powder .

The principal raw materials are urea , melamine and formaldehyde . In addition, catalysts, modifier, stabilizing agents , etc. are used. Such agents may be available in a stabilized manner .

Furthermore, the plant will need electric power for operation , steam for heating , cooling water and pure water .

All the processes are of the batch system , in which transformation into methylol and reaction for transformation into methylene take place in the same reactor , and the progress of reaction is regulated by analytical checking.

Whether the reaction has arrived at the final stage or not is judged by analysis . This judgment requires technical skill .

As for the locational condition of the plant , it is desirable that it is constructed in the neighborhood of a plywood plant because of the convenience in sales of products .

Since the consumption of electric power, steam , cooling water, etc. is not large , it would be advantageous if such utilities could be made available from a nearby plant .

The plant will offer no environmental problem to speak of .

Outline of Plant :

A urea resin adhesive plant may be considered economical if its monthly capacity is over 500 tons in normal operation during the day time . Extension of the plant will be easily made available through extension of the reactor .

In addition to the above stated raw materials , the plant will require such subsidiary materials as ammonia , caustic soda or sodium carbonate . Formic acid are also used as a pH controller .

The plant may be built at considerably cheap cost , and its operation and maintenance are not so complicated .

The number of workers may be small . However, the plant should be operated by trained workers .

Products of both Types I and II are most suitable for the manufacture of plywood for general purposes , and they are effective for promotion of the operation efficiency because of easy manufacture .

Process description ;

When manufacturing the adhesives , a fixed amount of formaldehyde is supplied into the reactor and , after control of pH with ammonia or caustic soda , urea and melamine are added , at the fixed ratio , for agitation and melting in order to increase the temperature of the reactor and to proceed the reaction for a fixed length of time .

In the final stage of reaction , it is necessary to take small amounts of sample for inspection of the degree of polymerization .

When the required polymerization has been obtained , the reaction vessel should be cooled immediately , thereby to stop the progress of polymerization, and to send it into the product tank .

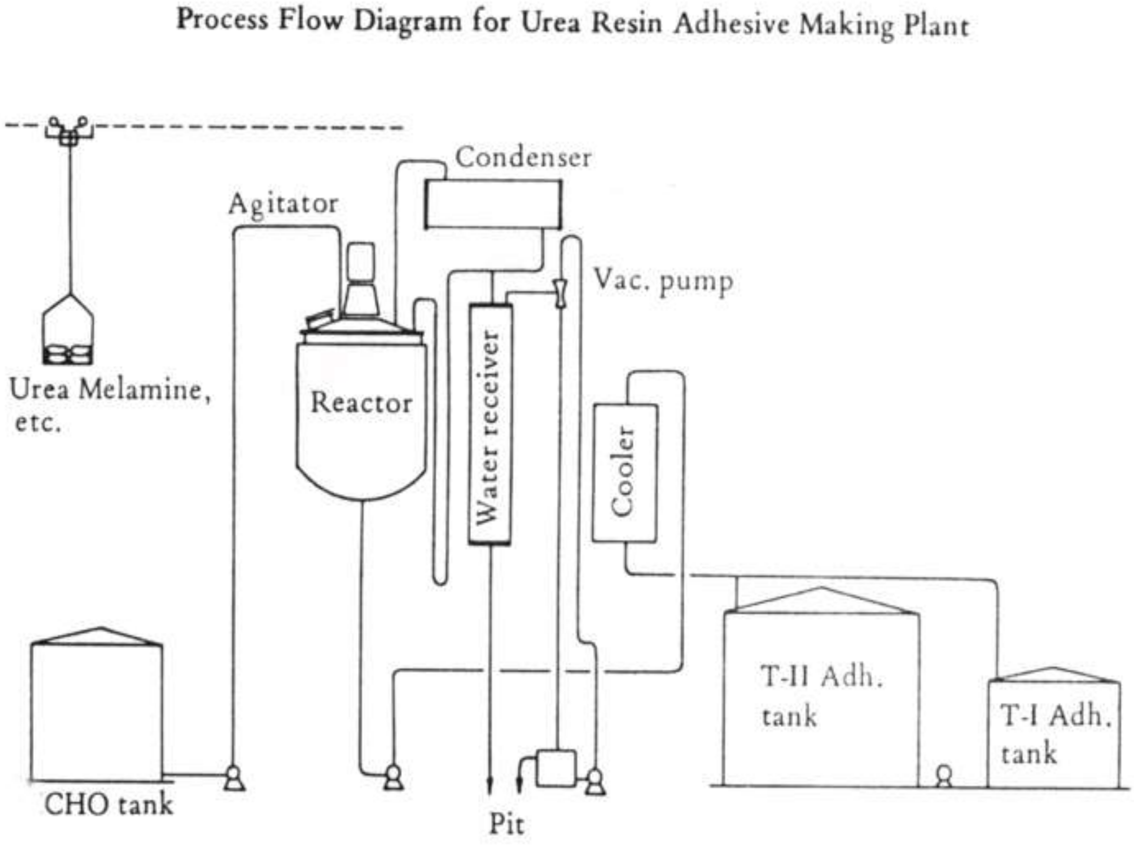
Cooling is arranged by circulating cooling water through the jacket , and reducing the pressure of the reactor by water jet so as to bring about fast cooling by evaporation .

The product has about 50 % of non - volatile matter in T - II , and about 58 % in T - I . the product is packed in drums for shipment on tank lorry . In case of a concentrated adhesive , it is generally shipped in 5 - gallon cans .

Table 1: Required Machinery and Equipment

Item	No.
Reactor	1
Agitator	1
Condenser	1
Vacuum pump	1
Water receiver	1
Cooler and refrigerator	1
Transport equipment	1
Measuring instrument	1
Filling equipment for shipment	1
Tanks	
Formalin storage tank	1
Product storage tank	1
Others	
Analytical instrument	1
Boiler (2 tons / hr)	1

Process Flow Diagram for Urea Resin Adhesive Plant



6 - Ammonium Nitrate Fertilizer & Calcium Ammonium Nitrate Fertilizer

Introduction

Soils subjected to modern agricultural intensive usage require the frequent addition of a number of mineral nutrients.

Nitrogen is the most important among them.

Ammonium Nitrate (AN) is a pure nitrogenous fertilizer having a nitrogen (N) content of about 35 % . 50 % of the N is immediately available to the plants in form of nitrate. The other 50% being ammonium is made available by the soil bacteria. This means that the immediate effect of fertilizing after spreading as well as an expanded effect are achieved.

Nitric acid is an intermediate product in the production of AN.

As early as 1905 Friedrich Uhde, in cooperation with Prof. Oswald, both pioneers in the development of fertilizers, designed and constructed a pilot plant for the production of nitric acid by burning ammonia with air in the presence of a catalyst.

This invention is the basis of the worldwide use of AN in all agriculturally developed areas. The world's consumption in 1985 is estimated to be 70 million metric tons.

Soils, especially grass land, will become acidic after intensive utilization under application of nitrogenous fertilizers. A countermeasure is the addition of limestone meal ($CaCO3$) to the AN thereby producing Calcium Ammonium Nitrate (CAN). Furthermore, the lime itself is alco a nutrient for the plant.

Nitric acid other than ammonia is usually not shipped and stored in big quantities.

Therefore, nitric acid plants are installed together with AN-plants. Both plants are advantageously connected process - wise.

For the production of nitric acid various processes are available. These are mainly:

The mono medium pressure process (4 - 6 bar),

The mono high pressure process (7 - 10 bar) and

The dual pressure process which employs 4-6 bar for the ammonia combustion section and 9-14 bar for the nitric acid absorption section.

The optimum process is selected taking into account the cost of raw materials and catalyst, energy cost, capital investment cost and requirements of the local authorities for emissions. The dual pressure process is presented herein.

The production of AN and CAN is performed in two process steps:

1. Neutralization of nitric acid by ammonia to achieve AN and the concentration of the AN solution,
2. Conversion of the AN melt to solids.

Neutralization, the first process step takes place :

Under atmospheric pressure,
Under vacuum or
Under elevated pressure.

The optimum pressure for Neutralization is selected considering local energy and investment cost.

For the second process step:

The pugmill ,
The fluidized bed granulator,
The pan granulation,
The periling tower

Are alternatively employed. However , the periling tower requires high investment cost for purification of gaseous effluents. It is therefore applied only in special cases.

For the production of CAN lime meal is added to the granulator.

The pressure neutralization in combination with pugmill granulation is presented herein.

Process Description :

Nitric Acid :

Nitric acid is produced from ammonia which is oxidized by combustion with air in the presence of noble metal catalyst.

A platinum-rhodium alloy (9 : 1 composition) has proved to be the most economical catalyst for this purpose .

The production of nitric acid takes place in 3 process steps according to the following equations:

1. Ammonia combustion

$4\ NH3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O + 905\ kJ$

2. Oxidation of the nitric oxide

$2\ NO + O_2 \rightarrow 2\ NO_2 + 113\ kJ$

3. Absorption of the nitrogen dioxide in water

$4\ NO_2 + O_2 + 2\ H_2O \rightarrow 4\ HNO_3 + 343\ kJ$

these three process steps can be carried out under different conditions, resulting in several nitric acid processes as mentioned above.

The dual-pressure process employs the medium pressure of 4-6 bar for nitric acid absorption.

The dual-pressure process was developed with a particular view to the ever more stringent environmental pollution control requirements.

Depending on the plant capacity , the process air is compressed by either a radial or an axial compressor to a final pressure of p abs. = 4 - 6 bar.

The combustion gases are cooled in a waste heat boiler, then passed through heat exchangers for further cooling and finally compressed to p abs. = 9 - 14 bar. The final pressure is selected such that the absorption section is optimized for the specified NO content of the tail gas (100 to 200 ppm) and that the compressor, driven by a condensing steam turbine, can be operated using only the steam generated in the waste heat boiler, while ensuring that some excess steam will always be available in order to guarantee steady operating conditions at all times.

Plant capacities of 1,500 tpd HNO_3 100 % can be achieved in one single train (1 burner and 1 absorption tower) .

The nitrogen yield in a plant of this type is 96.8 % at a NO content in the waste gas of less than 200 ppm.

Acid concentrations of up to 70% can be achieved. Two or more product streams with sifferent concentrations are also possible.

Production and Consumption per metric ton of HNO_3 100 %

Acid concentration	60% HNO_3
Operating pressure	4.5/11 bar
Ammonia	279 kg
Electric power	9.0 kWh
Platinum	0.11 g
Cooling water (t = 10 C).	130 t
Process water	0.3 t
LP heating steam	0.1 t
HP excess steam	
25 bar, 400 C	0,75 t
NO in tail gas	< 200 ppm

Ammonium Nitrate / Calcium Ammonium Nitrate (neutralization under Pressure) :

In the reactor ammonium nitrate is formed from gaseous ammonia and aqueous nitric acid ; the reaction takes place as follows :

$$NH_3 + HNO_3 \rightarrow NH_4NO_3;\ Q\ (kJ)$$

Besides using pure gaseous NH_3 , it is also possible to admit ammonia-bearing gas , for example carbonate gas from an urea plant. Simple design and moderate dimensions of the reactor gave resulted in a reduction of capital and fabrication cost .

Ammonium nitrate solution passes through the reactor by natural or forced circulation. Depending on the concentration of the feed acid, the ammonium nitrate solution reaches a concentration of approx. 93% - 94% .

For more efficient utilization of the process steam , the neutralization takes place under elevated pressure. Ideally, the pressure in the flash evaporator should be between 1.0 and 3.5 bar (abs).

Using 60 % HNO_3 and a system pressure of 1.0 - 3.5 bar for neutralization , the concentration at the outlet of the neutralization section will be in the order of 70 %.

Vapours which are contaminated with AN are used for further concentration of the AN melt to 96,5% - 97.5% . this is applicable for CAN and AN granulation.

Production and Consumption per metric ton of AN (97.5%)

Pressure	3,5 bar abs.
NH_3	213 kg
NHO_3 100% as acid with 60 % HNO_3	789 kg
Cooling water t = 10 C	18.9 m3
Electric power	3.5 kWh
Concentration of AN- solution	97.5 %

Granulation

The concentrated ammonium nitrate solution is fed through a metering station into the pugmill. Recycle material is added from the screening and crushing equipment and from the dust collecting facilities.

For the alternative granulating of calcium nitrate (CAN) the components fed into the granulator are supplemented by powdered lime**.**

From the pugmill, the hot granules are fid to the drying drum for drying by hot combustion gases or hot air.

The dried granules are screened and classified; the temperature of the normal grain size fraction is reduced by cooled air in a fluidized bed cooler to a level which permits storage of the product in bulk. The exhaust air from the cooler is vented through cyclones or filters for dust removal. The fines, the crusher oversize, and the dust from the dust removal facilities are sent back as recycle material to the granulator. The cooled final product is fed to a coating drum for conditioning to prevent caking of the granules and, consequently, to improve the storage properties of the product.

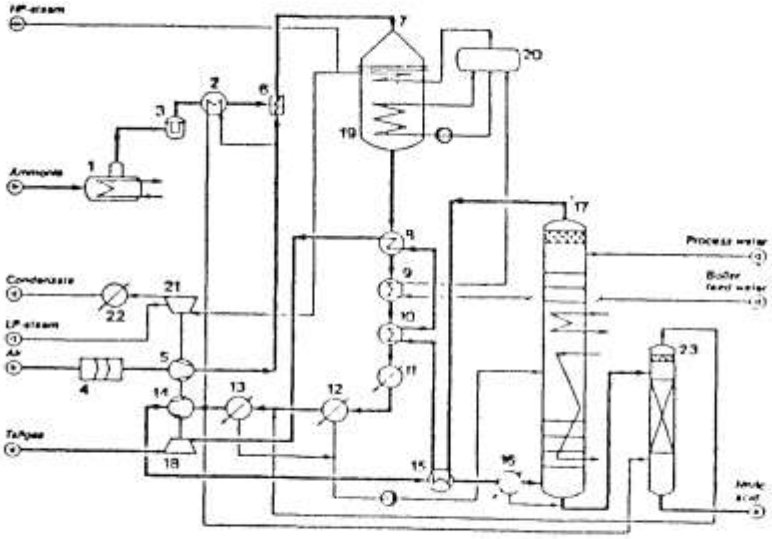
The product can be bagged ex bulk storage or directly after conditioning. Bags at 50 kg weight are normally used.

Plant Feature :

(Example of the Plant for 3 different Capacities)
Raw materials :
Ammonia , Limestone , Nitric Acid
Economical plant capacities : 300 to 2,000 MTPD
Consumption figures per metric ton of product :
AN – 33.5 % N , CAN – 28 % N

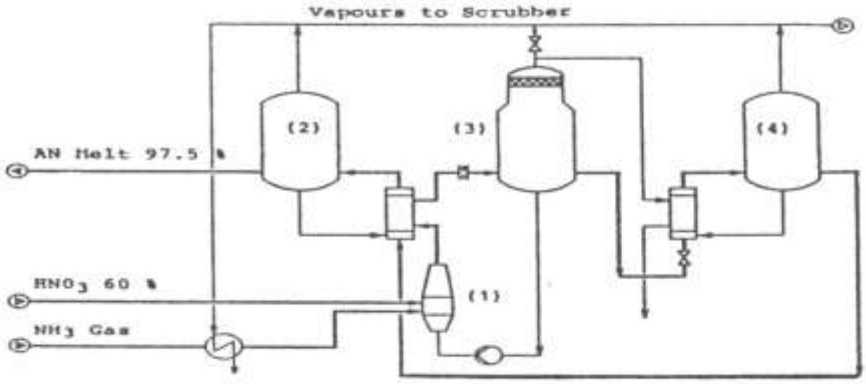
Ammonia	400	kg
Cooling water	110	m3
Electric power	34	kWh

Process Flow Diagram
Dual-Pressure Plant including Heat Recovery



1. NH_3 evaporation
2. NH_3 gas preheater
3. NH_3 gas filter
4. Air filter
5. Air compressor
6. NH_3/air mixer
7. NH_3 burner
8. Tailgas heater III
9. Economizer
10. Tailgas heater II
11. Feed water preheater
12. Cooler condenser I
13. Cooler condenser II
14. NO compressor
15. Tailgas heater I
16. Cooler condenser III
17. Absorption tower
18. Tailgas expans. turbine
19. La Mont waste heat boiler
20. Steam drum
21. Condensing turbine with extract. steam
22. Steam turbine condenser
23. Bleaching tower

for concentration of the AN solution.



1. Reactor
2. 2nd Concentrator
3. Flash Evaporator
4. Ist Concentrator

7 - Complex Fertilizer 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 super phosphate 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 complex 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. Super phosphate , Super phosphate 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 :

1 - 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 (onion, garlic, oil vegetables and barley) since they contribute to raising the soil temperature .

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

2 - Complex fertilizer for beans

Characteristics :

. Three elements of nitrogen, phosphorus and potassium are appropriately contained for the cultivation of beans .

. Magnesia 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 %
	Magnesia	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 forestation.

. Weighing about 15 grams per one, the briquette is the size of a peach seed and saves labor in use.

3 - 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, saving 10 – 20 % of the amount used .
- Fertilizer dissolves slowly with sustained effectiveness.
- Corps increase by 13 - 22 %.

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

4 - complex 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 %
	Magnesium	3 %
	Boron	0.3 %
	Organic material	3.4 %

Contents of Technology

1) Process Description :

first, ammonium sulfate, urea, potassium chloride,. Super phosphate 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	Briquetting section	Blending section
Hammer crusher	Bucket elevators	Crusher
Bucket elevators	Screen	Screw conveyor
Hopper scale	Hopper scale	Dryer
Granulator	Mixer	Fan
Dryer	Briquette	Cyclone
Blower	Vibrating screen	Hoppers
Cooler	Hammer crusher	Belt conveyors
Vibrating screen		Bucket elevators
Cyclones		Raw material storage tank
		Hopper scale
		Hammer crusher
		Screens
		Mixer
		Packing machine
		Heat sealer
		Chain conveyor

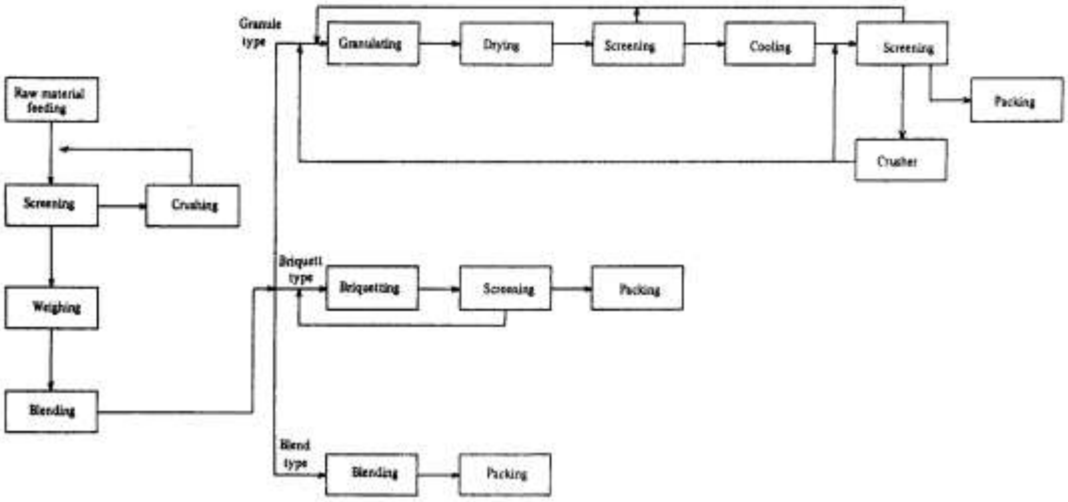
Example of Plant Capacity and Construction Cost

1 - Plant capacity : 225,000 m \ t
basis : 24 hours \ day , 300 days \ year

2 - Required Space

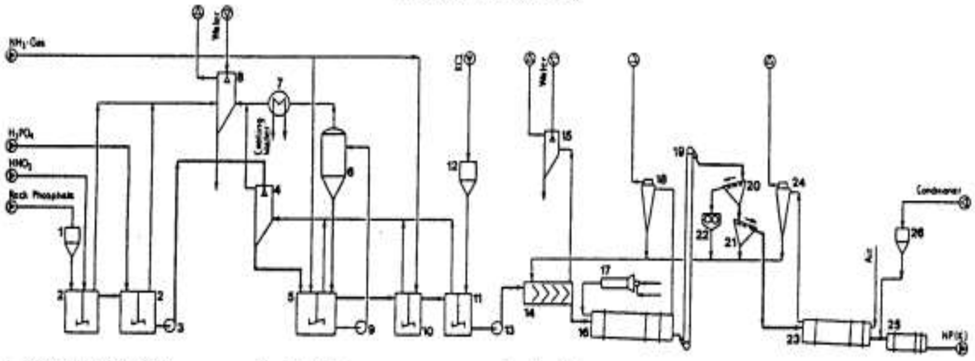
Site area	1.000 m^2
Building area :	8.200 m^2
Other	1.800 m^2
Total	11.000 m^2

Complex Fertilizer Manufacturing Process Block Diagram



Process Flow Diagram

Phosphonitric Process



1. Phosphate rock bin
2. Digester
3. Pump
4. Scrubber
5. Neutralizer
6. Separator
7. Condenser
8. Scrubber
9. NP melt pump
10. Final neutralizer
11. Melt mixing vessel
12. KCl bin
13. Melt pump
14. Granulator
15. Scrubber
16. Drying drum
17. Air heater
18. Dust removal facilities
19. Bucket elevator
20. Coarse screen
21. Fine screen
22. Crusher
23. Cooler
24. Dust removal facilities
25. Coating drum
26. Conditioner bin

8 - Compound Fertilizer DAP (Di Ammonium Phosphate)

Plants - Pipe Reactor Process

introduction :

main nutrients for crops are nitrogen , phosphorous , potassium and calcium. These among others must be made available continuously and in correct proportions by the soil .

The individual effect of each of these nutrients is the following :

Nitrogen promotes :

- plant growth - speeds development both above and below ground , influencing the size , weight and colour of the plant yield , e.g . grain , tuber or fruit .

- the synthesis of amino acids, protein and lipids, thus contributing in large part to the nutritional value of vegetable foodstuffs.

- technical characteristics dependent on the protein content, e.g. the baking properties of wheat.

Phosphorus promotes :

- the synthesis of organic phosphorus com- ponds in the plant organism e.g. phosphoric lipids, nucleic acids, and enzymes necessary for the formation of proteins, carbohydrates and other lipids and enzymes.

- the plants reproductive phase , e.g. the ripeness and quality of seeds and fruit.

- the mineral content of plants used in food- stuffs and animal feed.

Potassium promotes:

- nearly all metabolic processes leading to the synthesis of valuable components such as proteins and carbohydrates .

- the vitamin and mineral content (especially of fruit and vegetables).

- technical properties dependent on the carbohydrate content (e.g .the processing properties of potatoes or the malting properties of barley)

-the development of strong plant tissue .

-resistance to cold , drought , pests and disease

Calcium promotes :

- The intake of nutrients and transpiration and metabolism in the plant .

Soils which are subjected to intensive agricultural usage especially after application of pure nitrogenous fertilizers over long periods such as ammonium nitrate or urea show a deficiency and unbalance in nutrients . This can be leveled by applying compound fertilizers .they offer the following main advantages :

- Compound fertilizers can be produced with different nutrient content .it is thus possible to provide a fertilizer with optimum nutrient properties taking into account the needs of the crop ,the soil conditions and the climate.

- The nutrient components can be dispensed in one operation only.

- Uniform distribution of the nutrients in the soil ,since the main nutrient components are present in the desired ratio in every fertilizer granule .

- Separate calcium fertilizing is unnecessary since many of the available fertilizer types contain calcium

- Improvement of plant growth by using fertilizer types containing trace nutrients like Mg ,Cu ,Mn ,Zn ,B ,Mo ,Co ,as an additional component .

The nutrient content of compound fertilizers is quoted in % by wt. n for the nitrogen content %by wt. p_2O_5 for the potassium content.

Fertilizers with only 2 main nutrients (NP types)- namely nitrogen and phosphate – are mono ammonium phosphate, diammonium phosphate. Fertilizer with elevated nitrogen com- tent are urea phosphates and the nitro phosphate Fertilizers. NPK fertilizers are produced by adding potassium compounds in the form of potassium chloride (KCI) or potassium Sulphate (K_2 SO_4) .

Several Processes are available to Produce NP (K) Fertilizers. The optimum process can be selected taking into account the availability of raw materials, the prevailing soil and climatic conditions and the type of crop whether the im - mediate effect or an expanded effect or a combination of both is desired.

Nitrogen in form of nitrate is of immediate effect as well as phosphorus in a water soluble form as well as phosphorus in a water soluble form (mono – or diammonium phosphate and mono calcium phosphate).

Nitrogen in form of ammonium is of expanded effect as well as phosphate in from of di – calcium phosphate, the latter being citrate soluble. The use of fertilizers with maximum water solubility of the P_2O_5 is recommendable for neutral soils and for plants with a short growth period. The raw material phosphate rock is available and mined in many places of the world, the rock contains phosphorus in from of tri calcium phosphate which is water insoluble. The phosphorous has therefore to be transformed to a water and / or citrate soluble form, by " attack " with mineral acids such as sulfuric acid and / or nitric acid and / or phosphoric acid, In case sulfuric acid is used, a suspension of gypsum crystals in phosphoric acid is achieved. This process can be described by the following formula :

$$Ca\ (PO_4)_2 + 3\ H_2SO_4 + 6\ H_2O \rightarrow 2H_3PO_4 + 3\ CaSO_4 + 2\ H_2O$$

The gypsum is separated by means by means of Filtration to produce phosphoric acid which is an intermediate product for mono - / diammonium – phosphate (MAP / DAP)

MAP /DAP can be produced by different processes. Most common are the " Preneutralizer process " and the " Pipe Reactor process ". the latter is presented here due to its merits in low capital investment and low energy cost .

Process Description :

To obtain MAP phosphoric acid is ammoniated in the pipe reactor with ammonia to a molar NH_3 / H_3PO_4 ratio of approx. 0.6.

The heat of reaction causes most of the water introduced with the phosphoric acid to evaporate at the outlet of the pipe reactor, resulting in a highly concentrated ammonium phosphate melt. This melt is sprayed onto the return material in the drum granulator and granulated.

By introducing ammonia into the granulation bed, further ammunition to a molar NH_3/ H_3PO_4 ratio of about 1.0 takes place. The reaction heat evaporates a further portion of the water introduced with the phosphoric acid .

The granules formed are then dried and cooled in a drum.

Depending on the concentration of the phosphoric acid, the drying will either proceed auto thermally or with the aid of hot air.

The product is then classified. The fines, the crushed oversize and the dust removed from the waste air are returned to the drum granulator.

The on-size material is further cooled in a fluidized bed cooler or in a cooling drum and conveyed to product storage.

The exhaust gases from the drying drum and cooling facilities are passed through dust removal systems. The exhaust gases from the drying drum and drum granulator are then jointly scrubbed with phosphoric acid to recover ammonia. By subsequent water scrubbing fluorine is eliminated.

To obtain DAP, a molar NH_3/ H_3PO_4 ratio of approx. 1.35 is adjusted in the pipe reactor and this will be raised to about 1.8 in the granulator. Due to the larger reaction energy , the drying normally proceeds auto thermally.

To produce a NP fertilizer with a higher nitrogen content, an additional nitrogen component, such as urea, ammonium Sulphate or ammonium nitrate is admixed to the return material and granulated jointly with the ammonium phosphate melt in the drum granulator.

For the production of fertilizer containing potash, potassium chloride or potassium Sulphate is admixed in the granulator.

The product can be bagged ex bulk storage or directly. Bags at 50 kg weigh are normally used.

Plant Features

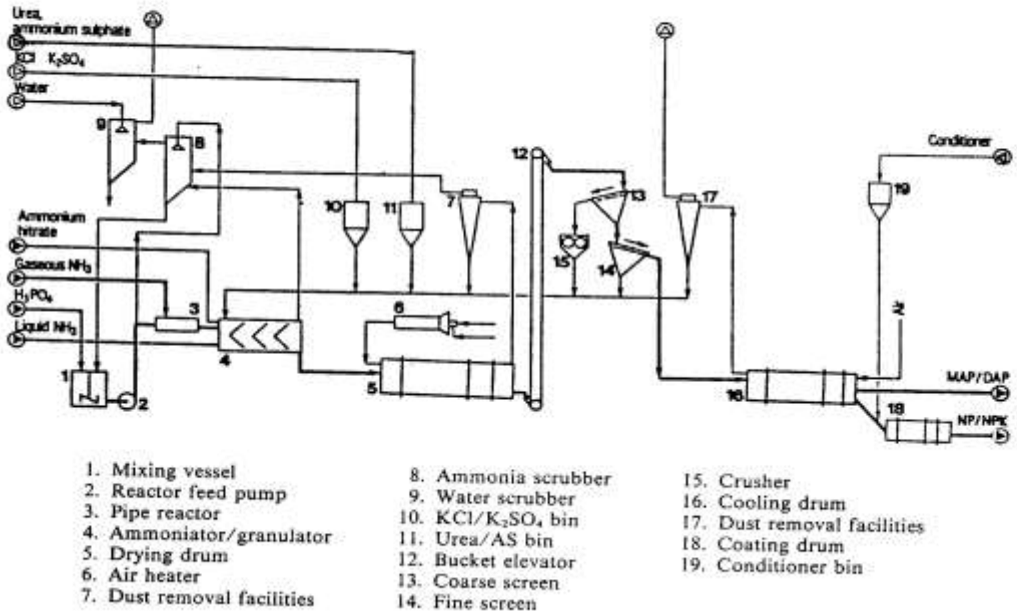
Consumption figures per metric ton of product DAP (N : P_2O_5 = 18 : 46) :

Phosphoric acid (45 % P_2O_5)	1,035.2 kg P_2O_5
Ammonia (100 % NH_3)	221.9 kg (100 % NH_3)
Electric Energy	35 KWh
Cooling Water	_
Oil / Gas	_

Process Water	0.005 m^3
Plant capacity	1,000 MTP.
Required area for plant site	1,800 m^2
Manpower Operating staff	1 foreman + 2 skilled workers / shift
Other technical staff	Engineers : 1
	Chemist : 1
	Maintenance : 2

The necessary production machinery and equipment is itemized in the Process Flow Diagram.

Process Flow Diagram
Pipe Reactor Process



9 - Compound Fertilizer NPK Plant
(Nitrogen, Phosphate and Potash)

Phospho - Nitric Process

Introduction :

Main nutrients for crops are Nitrogen, Phosphorous, Potassium and Calcium . These among others must be made available continuously and in correct proportions by the soil.

The individual effect of each of these nutrients is the following :

Nitrogen promotes :

- Plant growth-speeds development both above and below ground, influencing the size, weight and colour of the plant yield, e.g. grain, tuber or fruit .
- The synthesis of amino acids, protein and lipids, thus contributing in large part to the nutritional value of vegetable foodstuffs
- Technical characteristics dependent on the protein content, e. g. the baking properties of wheat

Phosphorus promotes :

- The synthesis of organic phosphorus compounds in the plant organism e.g. phosphoric lipids, nucleic acids, and enzymes necessary for the formation of proteins, carbohydrates and other lipids and enzymes .
- The plant's reproductive phase, e.g. the ripeness and quality of seeds and fruit
- The mineral content of plants used in foodstuffs and animal feed

Potassium promotes :

- nearly all metabolic processes leading to the synthesis of valuable components such as proteins and carbohydrates .
- The vitamin and mineral content (especially of fruit and vegetables)
- Technical properties dependent on the carbohydrate content (e . g . the processing properties of potatoes or the malting properties of barley)
- The development of strong plant tissue
- Resistance to cold, drought, pests and disease

Calcium promotes :

* The intake of nutrients and transpiration and metabolism in the plant .

Soils which are subjected to intensive agricultural usage especially after application of pure nitrogenous fertilizers over long periods such as ammonium nitrate or urea show a deficiency and unbalance in nutrients. This can be leveled by applying compound fertilizers. They offer the following main advantages :

* Compound fertilizers can be produced with different nutrient contents. It is thus possible to provide a fertilizer with optimum nutrient properties taking into account the needs of the crop, the soil conditions and the climate.

* The nutrient components can be dispensed in one operation only.

* Uniform distribution of the nutrients in the soil, since the main nutrient components are present in the desired ratio in every fertilizer granule.

* Separate calcium fertilizing is unnecessary, since many of the available fertilizer types contain calcium.

* Improvement of plant growth by using fertilizer types containing trace nutrients like Mg, Cu, Mn, Fe, Zn, B, Mo, Co as an additional component.

The nutrient content of compound fertilizers is quoted in :

% by wt. N for the nitrogen content .

% by wt. P_2O_5 for the phosphate content .

% by wt. K_2O for the potassium content..

Fertilizers with only 2 main nutrients (NP types) - namely nitrogen and phosphate - are monoammonium phosphate, diammonium phosphate. Fertilizer with elevated nitrogen content are urea phosphates and the nitro phosphate fertilizers. NPK fertilizers are produced by adding potassium compounds in the form of potassium chloride (KCI) or potassium Sulphate (K_2SO_4).

Several processes are available to produce NP(K) fertilizers. The optimum process can be selected taking into account the availability of raw materials, the prevailing soil and climatic conditions and the type of crop whether the immediate effect or an expanded effect or a combination of both is desired.

Nitrogen in form of nitrate is of immediate effect as well as phosphorus in a water soluble form (mono - or diammonium phosphate and mono calcium phosphate) .

Nitrogen in form of ammonium is of expanded effect as well as phosphate in form of di calcium phosphate, the latter being citrate soluble.

The use of fertilizers with maximum water solubility of the P_2O_5 is recommendable for neutral soils and for plants with a short growth period.

The raw material phosphate rock is available and mined in many places of the world. The rock contains phosphorus in form of tri calcium phosphate which is water insoluble. The phosphorus has therefore to be transformed to a water and /or citrate soluble form, by "attack" with mineral acids such as sulfuric acid and/ or nitric acid and/or phosphoric acid .

The Phospho Nitric Process

This process is an application of nitric acid and phosphoric acid. The fertilizer thus produced always contains a citrate soluble phosphorus portion. Reasonably this process is applied up to a maximum desired water soluble phosphorus portion of 50 % . Capital investment costs are relatively low.

Process Description :

"Attack" takes place in an agitator tank . described as following formula :

$$Ca_3(PO_4)_2 + 6\,HNO_3 \rightarrow 3\,Ca(NO_3)_2 + 2\,H_3PO_4$$

phosphoric acid is then added to the digestion solutio .

$$Ca_3(PO_4)_2 + 2 H_3PO_4 \rightarrow 2 CaHPO_4 + Ca(H_2PO_4)_2 .$$

the quantity depends on the required portion of water-soluble P_2O_5 in the final product. This solution is neutralized with gaseous ammonia in a two-stage neutralization section , thereby producing a mixture of mainly mono - and di ammonium phosphate, di calcium phosphate and ammo nitrate.

The **NP** solution from the first neutralization stage is recirculated through a vacuum separator, in which the vapors are removed and condensed in a downstream surface condenser. The ammonia-bearing exhaust gases from the neutralization section are withdrawn and scrubbed with the digestion solution to recover the ammonia. Thereafter , these gases and the exhaust gases from the digester are scrubbed with water.

For the production of fertilizer containing potash, potassium chloride or potassium Sulphate is admixed in an agitator tank.

In the granulator, the **NPK** slurry is granulated.

The granules are dried by means of hot air and then classified. The fines, the crushed oversize and the dust removed from waste air are returned to the granulator. The on size material is cooled in a fluidized-bed cooler or in a cooling drum, coated with conditioner and conveyed to the product storage.

The exhaust gases from the drying drum, cooling and conditioning equipment are cleaned in the dust removal facilities.

The product can be bagged ex-bulk storage or directly after conditioning. Bags at 50 kg weight are normally used.

Plant Features

raw materials : Rock phosphate.
Nitric acid. 60 % HNO_3
Phosphoric acid , 53 % HNO_3
Sulfuric acid
Ammonia
Potassium Chloride

Consumption figures per metric ton of product :

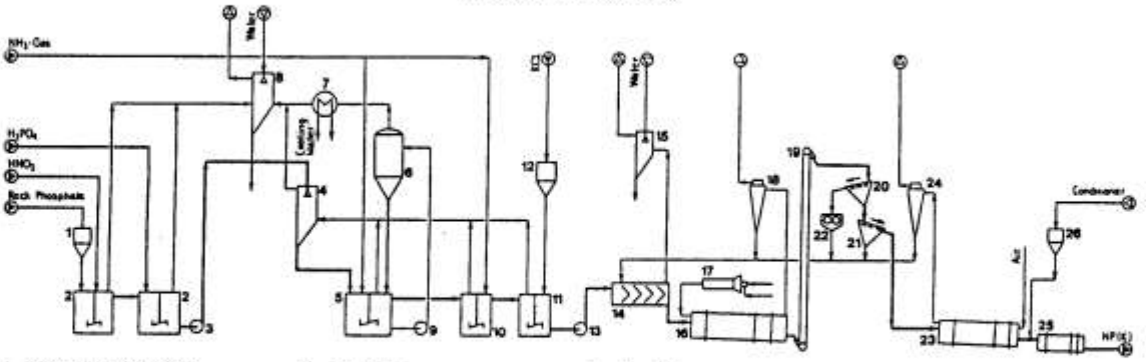
NPK 15 : 15 : 15

Rock phosphate	197.8 kg
Phosphoric acid (53 % P_2O_5)	160.0 kg
Ammonia	67.4 kg (as 100 % HNO_3)
Nitric acid (60 % HNO_3)	369.5 kg (as 100 % HNO_3)
Ammonium nitrate	---
Electric Energy	50.0 KWh
Oil / Gas	10^{+5} kcal
Scrubbing water	0.5 m^3
Plant capacity	1,200 MTPD
Required area for plant size :	2,000 m^2

The necessary production machinery and equipment is itemized in the Process Flow Diagram.

Process Flow Diagram

Phosphonitric Process



1. Phosphate rock bin
2. Digester
3. Pump
4. Scrubber
5. Neutralizer
6. Separator
7. Condenser
8. Scrubber
9. NP melt pump
10. Final neutralizer
11. Melt mixing vessel
12. KCl bin
13. Melt pump
14. Granulator
15. Scrubber
16. Drying drum
17. Air heater
18. Dust removal facilities
19. Bucket elevator
20. Coarse screen
21. Fine screen
22. Crusher
23. Cooler
24. Dust removal facilities
25. Coating drum
26. Conditioner bin

10 - Used Oil Regeneraion

regeneration of used lubricating oil has been increasing in resent years, partly on grounds of environmental protection, partly in order to reduce oil import requirements . the plant described in this profile is based on the acid / clay process, which has been successfully applied in many countries . Input capacity is 1,200 kg per hour of used oil, and resultant output based on a hour day , 250 days per year would be around 1,500,000 kg of blended oils

1. Introduction

The technology of used lubricating oil regeneration has been utilized for many years in industrialized countries and more recently in developing countries. This development has occurred for two main reasons :

(i) to prevent pollution of ground and water by waster oil .

(ii) to reduce the need to import fresh crude oil or lubricating oils and hence diminish the national dependence on foreign sources.

The second reason is especially true for those developing countries which have no oil reserves.

2 . Technology

A . Input materials

The used oil regeneration plant is suitable to treat the following oils : motor can oils (engine and gear) : transformer oils ; industrial oils (excluding steel – hardening oil and mixture of grease / oil) ; aviation lubricants ; railway oils ; and marine oils (bildge oils from ships) .

In order to determine whether the waste oil is suitable for the treatment or not , laboratory tests have to be carried out .

The plant presented in this profile is based on the acid / clay process .

After a coarse filtration, collected oils flow into storage tanks, and then pass through different phases of the following processes.

- dehydration at 160° C under normal pressure ; neutralization by sulphuric acid ; decolorization by activated bleaching clay ; vacuum distillation at 260° C, according to the oil viscosity intended ; filtration through filter press to produce neutral lubricating oil ;blending with additives and finally packaging .

the plant can be started within one hour and reaches after this time its full throughout capacity ;it can be shut - down within 30 minutes, thus allowing a flexible scheme of operation .

C. output products

The acid / clay process is producing a regenerated oil that meets all characteristics required for virgin lubricating oils and form which many types of lubricating oil can be produced : crank case – motor oils , gear – box oils, hydraulic equipment, industrial oils, etc.

Gas oil can be recovered at the end of the dehydration and the distillation phases, and can be in the production process.

Residues from the process are waste water, acid tar, and filer cake.

The waster can be fed into an oil / water separator and afterwards channeled into the sewage system . The filter cake can be dumped in any refuse pit, and the acid tar can be stored in a refuse pit for chemicals, neutralized with lime or burnt in the rotating kiln of a cement plant .

D . References

The acid / clay process in the method of oil regeneration what has been most successfully applied in many countries , with a through put capacities varying from 1.000 to 16.000 kg / hour .

3. Plant Capacity

The plant described below is a small unit , taking into account the size of markets and the transportation problems for collected oils.

A . Treatment capacity

1.200 kg / h of used oil containing less than 2.5 % water , I.e. 2.100Ton / year (7 h / day , 250 d / year) .

B . Output Capacity

(i) 884 kg / h of blended oil, i.e. 1.547 Ton / year ; The blended oil contains 6.3 % additives in average .

(ii) 100 kg / h of gas oil , i.e. 175Ton / year .

C . Waste Materials

(i) waste water	170 kg / h	300 Ton / year
(ii) acid tar	245 kg / h	430 Ton / year
(iii) filter cake	65 kg / h	114 Ton / year

4 . Matrial & Utilities :

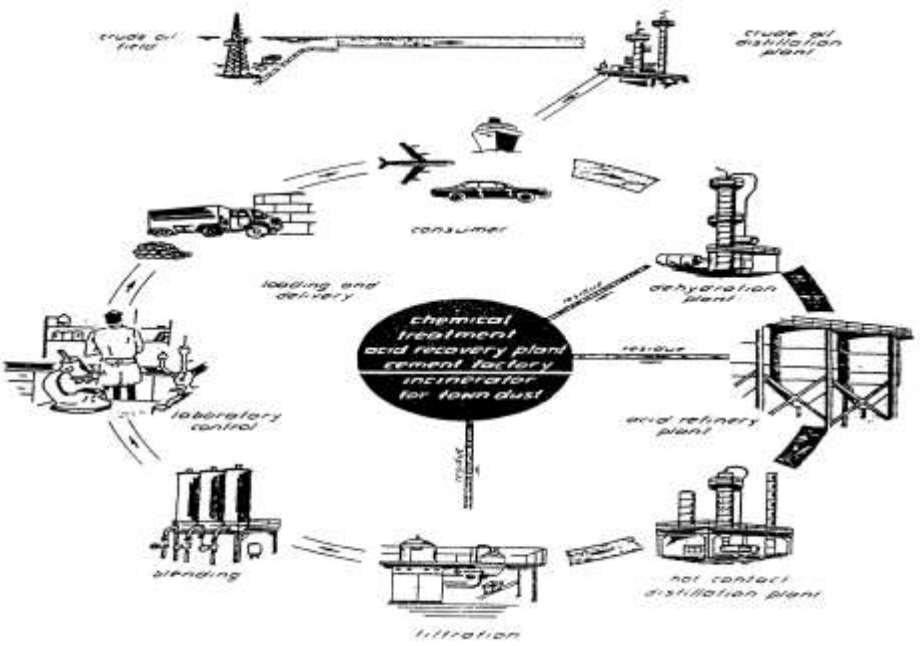
Item	consumption / hour		Annual consumption	
	1200	KG	2100	Ton
Sulphuric Acid 98 %	112	Kg	196	Ton
Bleaching clay	42	Kg	73	Ton
Lime	1	Kg	1750	Kg
Ammonia water 23%	6	Kg	10.5	Ton
Salt	0.5	Kg	875	Kg
Hydrazine	10	Kg	17.5	Kg
Filter paper 70g / m^2	4	m^2	7000	m^2
Gas oil	140	Kg	245	Ton
Electric power 380 V	110	KW	193	KW
City water	3	m^3	5250	m^3
Additives	56	Kg	98	Ton
210 liter drums			4000	

5 . Specific Aspects :

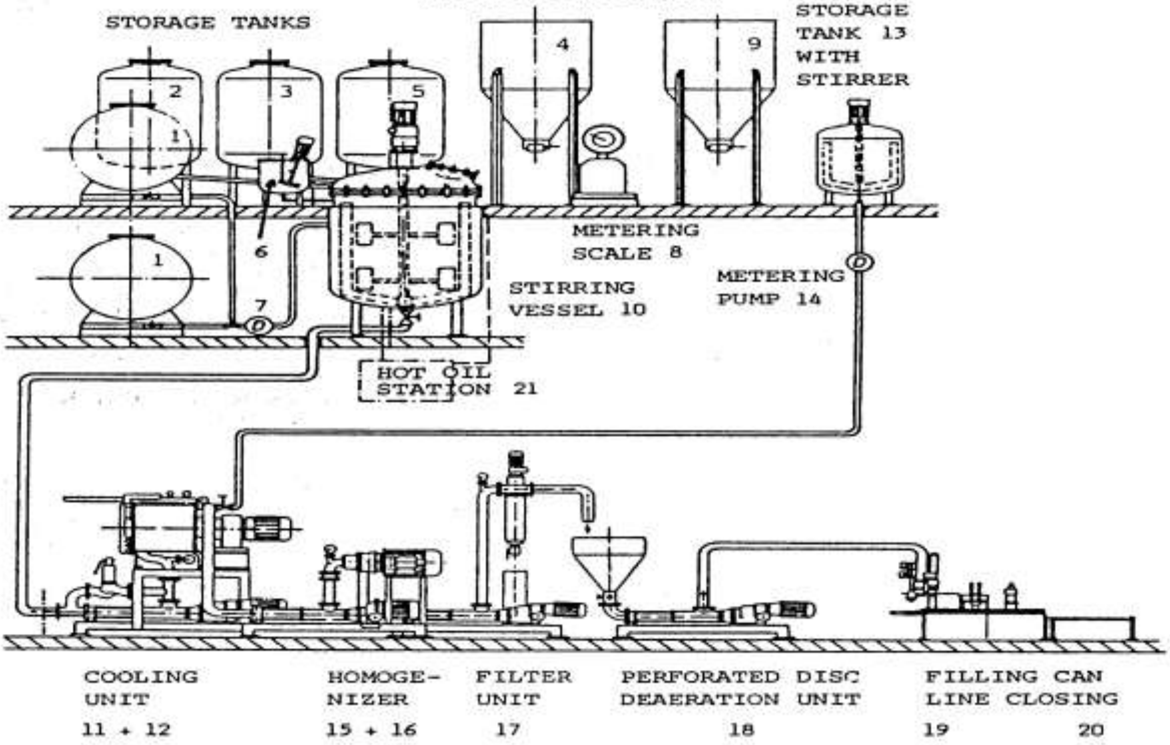
the problem of collection of used oil must be considered with particular attention : infrastructure aspects, quantity available , incentives or assistance to the storage of used oil , all require careful consideration .

The efficiency and the cost of collection will determine the success and the profit – making capacity of the project .

CIRCULATION OF LUBRICATING OIL



Process Flow Diagram



11 - Lubricating Grease

Introduction :

Lubricating grease was Practically Known already in ancient times to the pharaohs and Ro- mans who used tallow and melted fat for lubricating the axles of their vehicles. Only since the middle of the last century mineral oil and soap have been used as basic components of lubricants for industrial purposes. Initially the production was based only on simple saponification of mineral oil with lime soap in open vats. Subsequent treatments like homogenization and deaeration as well as admixing special additives have developed gradually with Both the hot and the cold .set by industrial development increasing standards as production methods are applied in modern plants by using autocaves in which temperatures in the range of 200 to 250° C can be reached for producing various sorts of grease under pressure.

The most important types of lubricating greases manufactured at the present time are metal saponified and non saponified products :

- Approximately 90 % of the greases com- monly used today, are made on metal soap mineral oil basis, out of which the most importent ones are lithium, calcium, sodium and aluminium greases .

To keep production cost of saponified grease as low as possible, fatty acids are added, thus in fluencing the Properties of the grease. The following types of acids are used : fish oil acids, tallow acids, cotton seed fatty acid, wool fat stea – rin, horse fat, resin stick oil, 12 - hydroxide stearic acid etc.

- Non saponified greases are produced on the basis of bentonites, polycarbamide, carbon- black etc. with synthetic oils and with min- eral oils of the paraffinic type as lubricating agents.

Apart from these main components as lubri- cating and thichening agents different additives are used for special purposes :

- to improve the chemical properties for pre- venting oxidation : so- called oxidation inhi- bitiors such as metal naphthenates, alkalisul- phonaphthenates, nitrites, nitrites, benzoates etc. are used as corrosion protection additives ;
- to improve the texture and adhering proper – ties : additives such as polyisobutyls, latex etc. improve such as polyisobutyls, latex etc. improve the adherence of lubricating grease, whereas the texture can be adjusted by adding fatty acid , alkali, glycerin, glycol, acetone ;
- to improve the lubricating properties : sulphuric compounds, molybdenum sulphides, phosphor compounds or other lead soaps are used as additives for emergency running properties ;

- to effect colouring : various trade marks have distinguishing colour that can be ob- tained by adding by adding oil soluble colouring agents ; aliphatic amines (cyclohexylamin, dibutylamin etc.) are used as colour stabilizers .

Example formulae for conventional lubricating greases :

Calcium Complex Grease mineral lubricating oil :

Naphthenb.	83.5 %
Tallow hydrate	6.0 %
100 % acetic acid	8.0 %
filtered castor oil	2.0 %
filtered fish oil fatty acid	2.0 %
vinyl alph anatphthylamin	0.5 %

Lithium Fat

Mineral lubricating oil :

Naphthenb.	82.0 %
LiOH.	1.5 %
12 – hydroxyl stearic acid	10.0 %

Lithium Calcium Lubricating Grease

Mineral lubricating oil :

Naphthenb.	82.0 %
Cotton seed fatty acid	15.5 %
Lithium hydroxyd	1.75 %
Calcium hydrate (71 %)	0.75%

Process Description

The liquid components are drown from the storage tanks by a pump

Batch wise to the plant , together with the dry components preweighed by dosage scales .

A proportion of the mineral lubricant is used to dissolve the 12-hydroxylstearic acid (if e.g. lithium at formula is applied) in the autoclave .

1 - Mineral lubricating oil storage tanks

2 - Special storage tanks for different oil types depending on the applied formula

3 - Storage tanks for liquid additives

4 - Vessel for fatty acids

5 - Storage tank for solvent as used for special grease (I.e. acetone)

6 - Mixing and suspending vessel with builtin mixing turbine

7 - Metering pump for apportioning the mineral lubricating oil into the autoclave vessel.

8 - Metering scales for weighing the dry ingredients, such as stearic acids, calcium hydrates, bentonite etc .

9 - Vessel for dry substances

10 - Autoclave vessel (design pressure 8 bar) double – walled, for thermal oil circulation heating with 1.600 kg working volume and about 2.500 total volume

11 - Special displacement pump vessel. Simultaneously lithum hydroxide is mixed with water to a paste in a small mixing vessel before being added to the dissolved acid in the autoclave. The mixture is heated to about ◌̊ C whilst being constantly and intensively stirred.

12 - Continuously working working scraper cooler with multi- cham – ber scraper system, laid out for cooling the grease from about 220 ◌̊ C to 90 ◌̊ C under continual stirring stirring action

13 - Storage tank fitted with stirrer

14 - Metering device

15 - Displacement pump

16 - In line toothed colloid mill as lubricating grease homo – genizer with metal toothed homogenizing elements

17 - Automatic working plate type filter, with automatic and continuous cleaning device

18 - Perforated disc deaeration unit

19 - Complete filling line for filling containers of various sizes

20 - Can closing device

21 Hot oil station (auxiliary aggregate) for heating the heat conducting oil up to 300 ◌̊ C (usually with the aid of an oil burner).

2 hours later, the hot fat is taken from the auto- clave and pumped into the scraper cooler, where it is cooled to 90 ◌̊ C .

Thereafter the remainder of the mineral lubri- cant and the additives are metered continuously into the product until the has adopted the right consistency. Other components can also be added at this point. The metering pump is operated via a dosaging meter.

The product is then pumped straight into the homogenizer, a toothed colloid mill. After having been homogenized and cooled by admixing more mineral lubricant, it is conveyed to the fil- ter unit and subsequently , via a perforated sheet deaeration unit, to the filling equipment. After intermediate storage it is filled into market size cans of to 2.5 kg . manual cartooning is the final stage of this production process.

Example of the plant

Daily capacity : 3.000 kg / 8 hours

Daily Requirements of production Materials

Approximately in proportions of 3.000 kg according to the applied formula ,

e.g. **for lithium fat based production :**

Mineral lubricating oil :

naphthenb.	Approx. 2.650 kg
LiOH	Approx. 45 kg
12 - Hydroxylstearic acid	300 kg

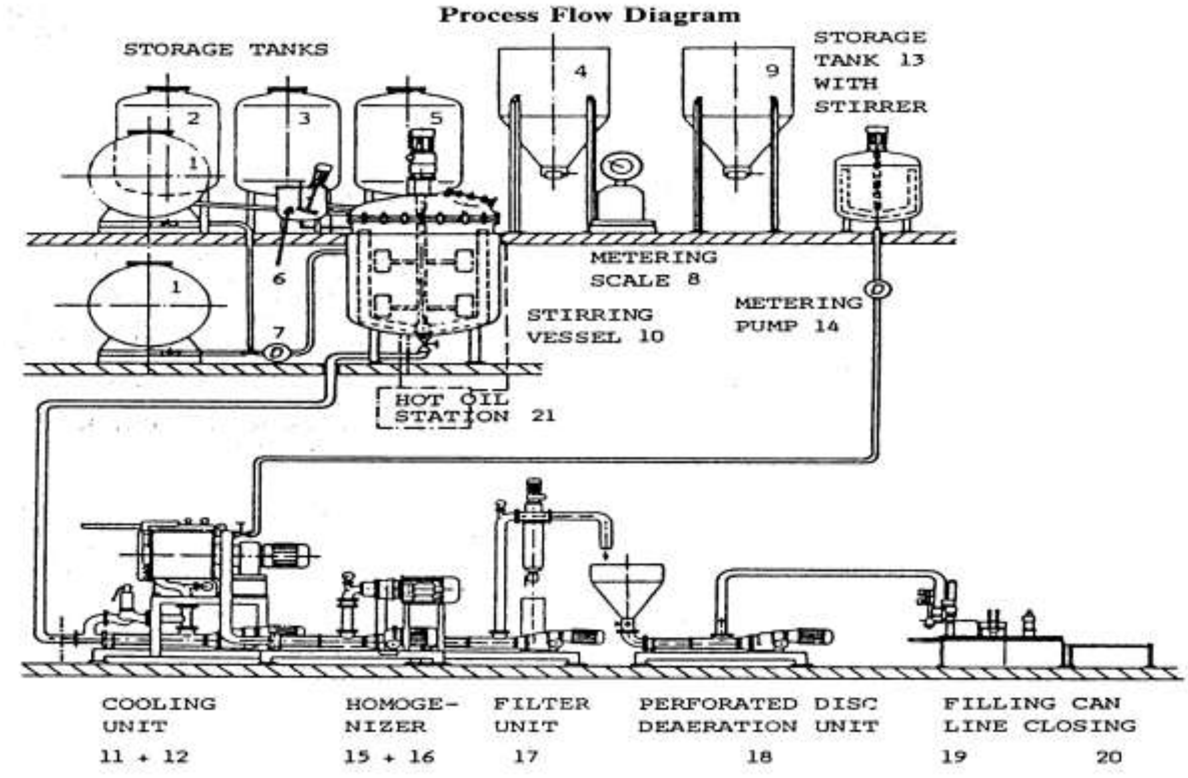
Utility Requirements (per 8 hours)

Electric power	Approx. 300 kwh
Cooling water	Approx. 40 m^3
Fuel oil	80 kg

Plant site Requirement

Floor space for production (height 6 m)	400 m^2
Floor space for raw materials and finished products	400 m^2
offices and laboratory (height 3 m)	60 m^2

Approx. size of total plot 3.000 m^2



12 - Castor Oil & 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 ^{o} C) , greater specific gravity (0.956 – 0.970 at 15 ^{o} 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%), dihydroxy stearic (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 fibers (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 2 Besides these two kinds , a medicinal grade is also specified in pharmacopoeias

Castor Pomace is the residual solid obtained in castor seed milling . Typical pomace obtained in milling contains 35 – 41 % protein, 34 % crude fiber , 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 (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 de - toxicated 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 : Te 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 some times 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 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 tones per 24 hours of seeds , and there are smaller sizes processing 30 and 60 tones per 24 hours .

Solvent extraction : solvent extraction of press cakes with 15 – 18 % oil content can be performed in semi – continuous or continuous (battery) plants . 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 there fore savings in operational costs , which depend on local conditions , must justify the larger capital investment . Usually , for a capacity of up to 100 tones of press cake per day , a semi-continuous plants is a better choice , and for amounts of over 300 tones / 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 volatilization point) in order to achieve good and quick extraction . Heptane if available is a better choice especially 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 there fore 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 .

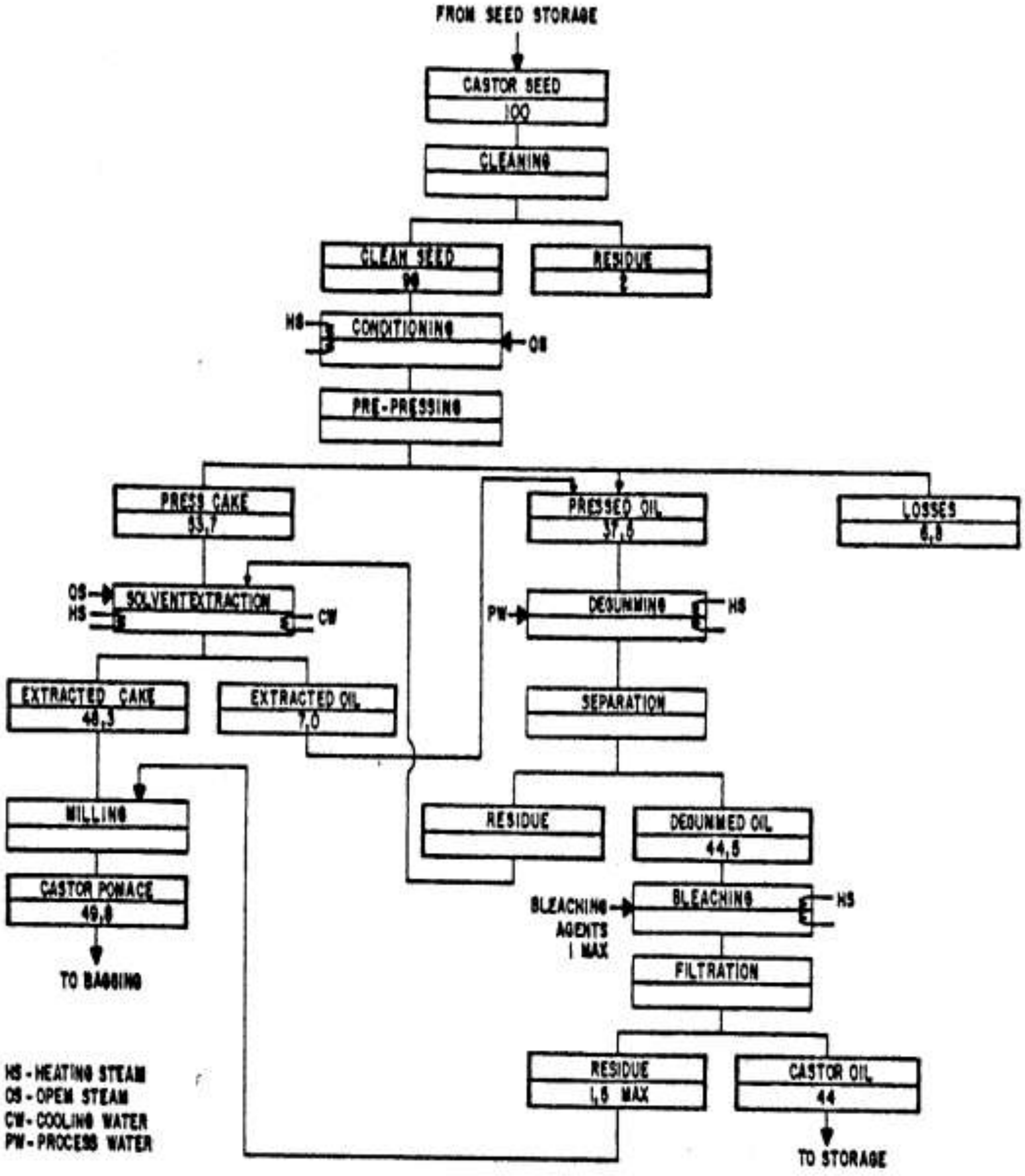
Bleachin : Degummed castor oil some times does not reach the colour standard and a bleaching step is required .

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

Process flow-sheet for castor oil and pomace plant



13 - Toothpaste Production

Introduction :

The industrial manufacture of liquid dental care articles , made on a basis of chalk and soap can be traced back to approx . 1870 . At the turn of the century the first toothpastes in tubes appeared on the market . The expansion of civilization , higher standards of living and also the increase in the consumption of sweets and intensive advertising , brought about a rapid development and increase in the use of toothpaste. Modern toothpaste formulation have gradually replaced other dental care articles , such as toothpowder , mouth rinses , tooth soap etc . Research and development , carried out by the larger companies , produce such modern formulations , which can no longer be compared with the toothpastes made at the beginning of the century . Both the composition and the production methods of the toothpaste have been rationalized and modernized to bring them up to current requirements and technical standards .

Essential Components

Abrasives are the most important ingredients , which influence the cleaning effect of the toothpaste . They shall be free of grit to protect the dental enamel . The hardness of the abrasive material shall not be more than 4 Mohs .Conventional abrasive components are :

Calcium carbonate
Calcium sulphate
Aluminium silicates (Caolines)
Dicalcium phosphatede hydrate

(When using dicalcium phosphatede hydrates and calcium carbonate , the formation of apatite must be avoided which is possible by adding trimagnesiumphosphate). The primary fineness of the abrasive components should be below 15 microns .

Water and moisturizing components such as sorbitol , glyceriol , propylenglycol. Distilled water is used in general . However , pure , filtered well-water is also acceptable . The application of moisturizers improves the resistance to thermal effects and also keeps the toothpaste smooth and prevents if from drying out . They also give the toothpaste a glossy , attractive appearance

Thickening , bonding and stabilizing agents give the toothpaste a certain viscosity and prevent sedimentation . They also add to the glossy appearance . At present the following substances are mainly applied :

Coagulated silicium dioxide
Carboxy Methyl Cellulose (CMC)
Methylcellulose
Special betonites
Alginates and cargheens

Carboxy methyl cellulose or methylcellulose , which are soluble when cold , are usually given preference (unless toothpaste containing enzymes shall be produced).

Foaming agents such as :

Fat alcohol sulphates & Turkey - Red Oil

Are currently applied to improve the cleaning effect . Soap is nowadays used less and as a foaming agent . It has not only an unpleasant after-taste , but also induces the danger of calcium soap forming .

Flavours are achieved by the application of peppermint oil , winter-green oil , methol and different sorts of fruit aroma . Saccharine , sodium cyclamate and other additives are used as sweeteners .

Active ingredients and preservatives are currently applied depending on the wanted effect : alcohol , bromclorophene , chloroform , magnesiumperoxide , sodiumlaurylesarcasinate , calcium chlorate , fluor compound , sodium carbonate , sodium chloride , chamomile extract , vitamin K .

As preservatives the following additives are mainly used :

Methyl and propylesters of the p - hydroxy
Benzoic acid , sodium benzoate etc .

The outline toothpaste formule is composed of :

Calcium carbonate	40 - 50 %
CMC (thickener)	2 %
Water	20 - 30 %
Glycerin	20 %
Perfume oil	2 - 2.5 %
Moisturizing agent	1 - 3 %
Preserving agent approx	0.5 %

Process Description

For the production of toothpaste from various raw materials as described above a processing plant has been developed , which incorporates a combination of various functions . Theequipment is specially designed for the production of toothpaste and is now being used by most of the well-known toothpaste manufacturers . Of course , other products can by made on the processing plant as well , such as cosmetic cream , lotion etc .

The processing plant comprises a highly a highly effective vacuum mixer with mixing and dispersing system, which can be used for each individual toothpaste formulation.

The average time for a batch, made according to the outline given above, is roughly one hour up to the final product ready to be filled into tubes.

The raw materials are drawn into the processing vessel by means of the vacuum . The suction studs are located in such a way as to ensure that the dry , powdery components are immediately moisturized on entering the vessel . The finished toothpaste is pumped out of the central outlet stud of the vessel by means of a feed pump and conveyed into intermediary storage tanks . As an additional safety precaution , a basket screen can be fitted between the pump and the pipeline .

Storing and Filling the Finished Toothpaste

The toothpaste is pumped into two storage tanks below the processing plant ,from where it is later pumped into the feed hopper of the filling machine , which is manually operated and can fill aprox . 800 tubes of 70 – 120 cm^3 / h semi -automatically . The capping machine also operates semi-automatically . It closes tubes of 10-38 mm in diameter , and 60 - 200 mm in length . The packaging and cartooning of the tubes is done by hand .

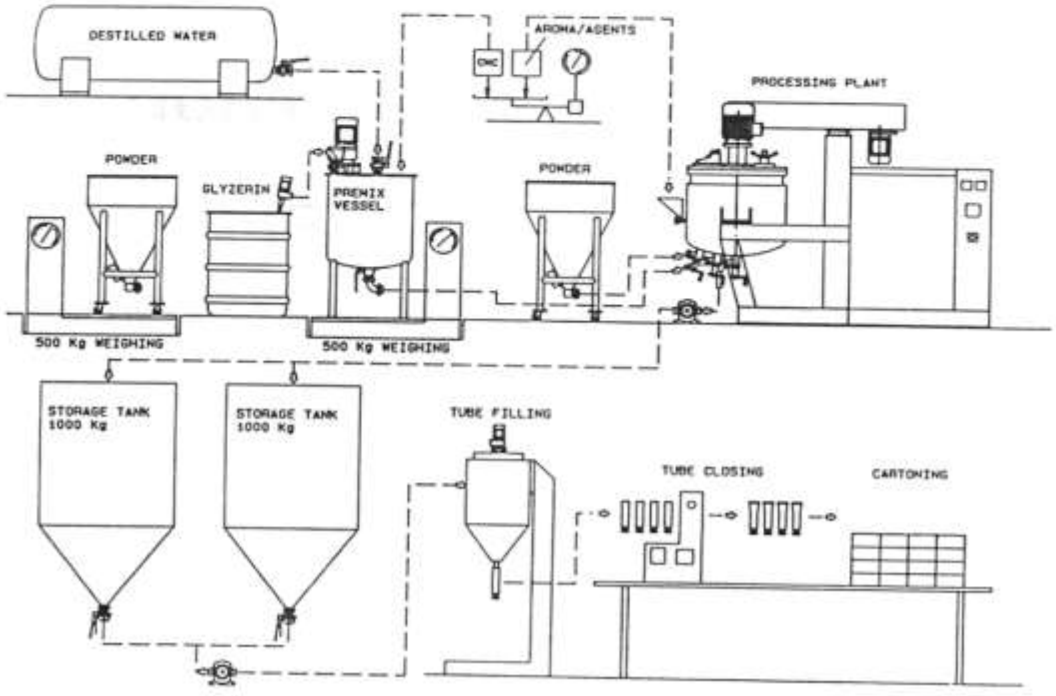
Example of the Manufacturing Plant

The features are shown for two different plant sizes , i.e 1 for 500 kg and 2 for 1000kg per day (8 h operation) .

Requirement of Production Materials per Day .

Plant Size	1	2
Calcium carbonate	200 – 250 kg	400 - 500 kg
CMC (thickener)	10 kg	20 kg
Water	100 - 150 kg	200 – 300 kg
Glycerin	100 kg	200 kg
Perfume oil	10 – 12 kg	20 – 25 kg
Moisturizing agent	5 – 15 kg	10 – 30 kg
Preserving agent approx	2.5 kg	5 kg

Process Flow Diagram



14 - Glass Ware Plant

This technology covers the whole range of manufac- turing 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, kitchen- ware, 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 500 °C . It is molded by bottle forming machine and cooled slowly and uniformly in 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 .

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 color	0.5 Kg
LPC	30 Kg
Bunker - Coil	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

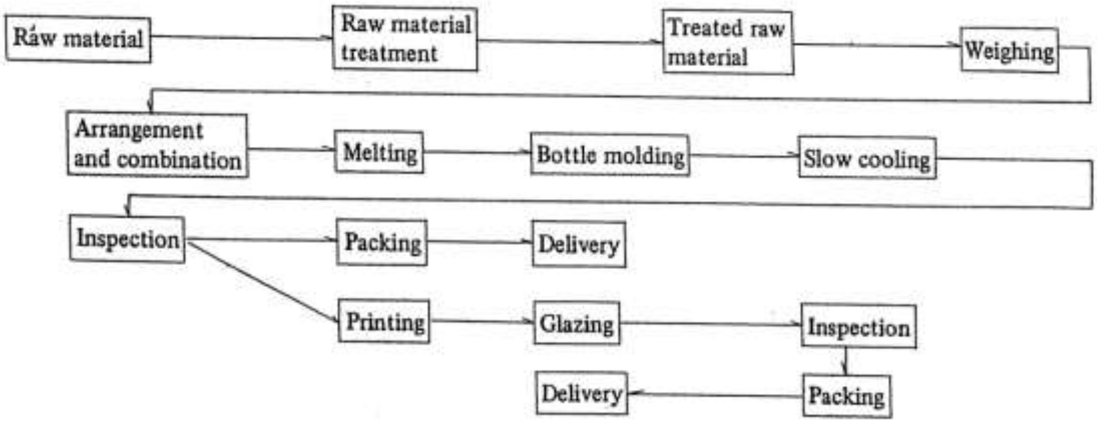
Finished products undergo a strict examination by expert inspectors to check that they conform with a 50 – point list of standards.

Example of Plant Capacity :

(1) Designed capacity of furnace : 80 m / t / day
(2) 2 straight feeder attached 2 six section dounle gob I.S M / C

* Basis : 24 hours / day, 350 days / year.

Bottles and Tableware Manufacturing Process Block Diagram



15 - Glass Sheet 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 undeveloped 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 ssoda – lime glass products are manufactured.

Table 1. Products and its uses

Items	Special features and uses
Clear sheet glass	2 m m to 12 mm, windows, green house 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 Clears 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	

Remarks :

Various cut sizes are available from 6 mm to 12 mm 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 225 g steel ball on 30 cm x 30 cm 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	6 mm	555 °C
Ordinary flat glass	5 mm	60° C	Ordinary flat glass	5mm	150° C

Strength under concentrated load

Item	**Ordinary flat glass**	**Tempered glass**		
Thichness	5	5	6	10
Concentrated	7	28	41	114

Fragment test

Item	**Flat tempered**	**Bending tempered**
Pieces	65	45

Contents of technology

1) Process description :

A - Clear sheet 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 bras " 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 dye to reduced function of refractories and service lift of the draw bars is semi-permanent with high operation rate of the plant.

Stained glass con 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.

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 liad. The glass thus molded is taken out of the furnace and quenched by blowing air to achieve the tempering in the molded form .

C - Press type tempering :

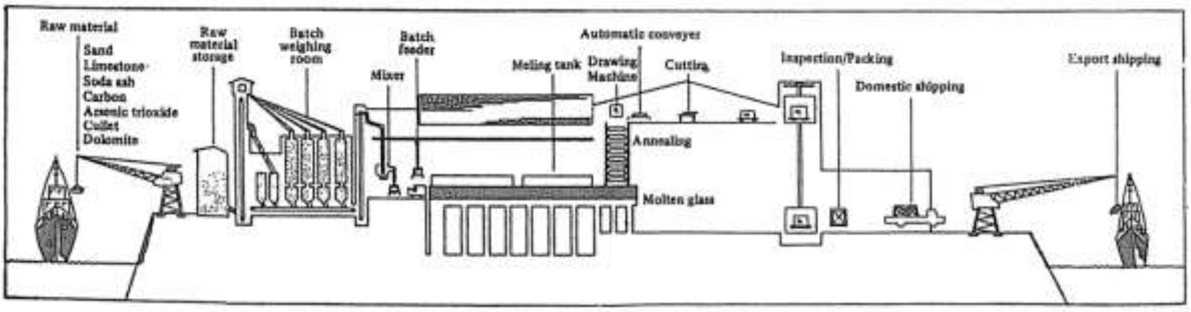
The furnace with an electric heating system consists of three sections. The pretreated glass is heated respectively in these these sections by the first, second and third heatings to its softening point. After pulled out of the furnace, it is pressed by the die with a mold of required curved surface 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 Continuous processes. Plane surface tempering is also possible.

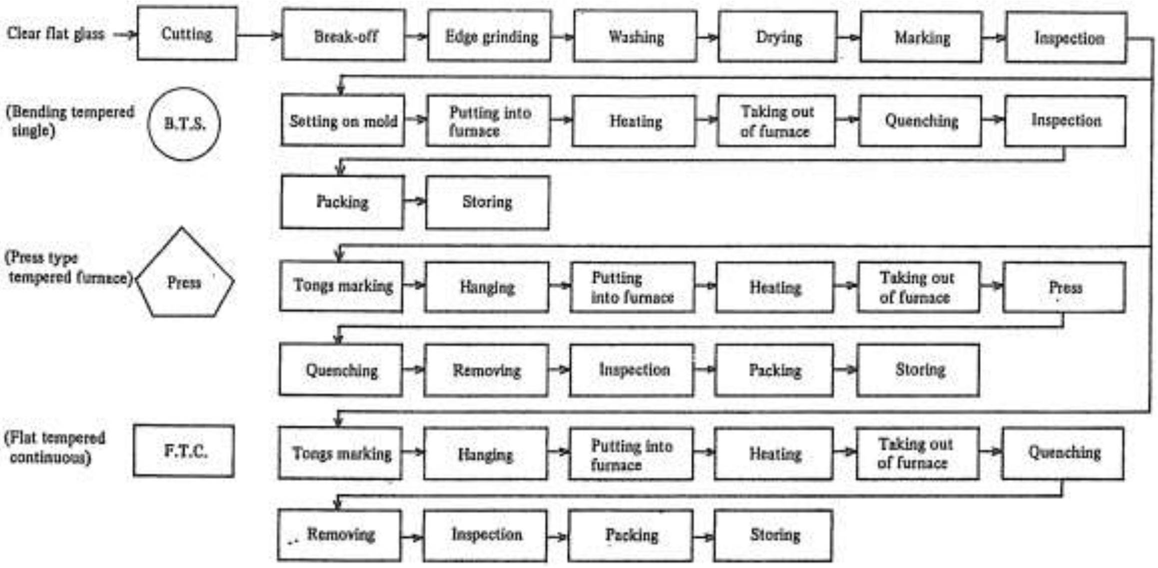
D - F.T.C (flat tempered continuous) :

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 .

Sheet Glass manufac turing process flow sheet



Tempered glass manufacturing process block diagam



2) Raw Materials :

Raw materials	**Requirement (per ton of product)**
Sand	0.9 ton
Limestone	0.1 ton
Soda ash	0.2 ton
Dolomite Others : (salt cake,Arsenic trioxide, etc.)	0.2 ton Small quantity

Example of plant capacity :

1) Plant capacity : 50 ton / day, 17,000 ton / year
   - Basis : 24 hours/ day, 340 days / year

16 - Firebrick plant

1. Preface

The firebrick manufacturing plant is suitable for manufacturing products for furnace – lining.

The basic materials used in the plant are normal clay, rejected bricks and chamotte. Chamotte is produced from the clay in the same plant on a separate production line .

The equipment and the plant can be easily tailored to suit different requirements, ranging from plants using production methods which require a high proportion of manual work to others equipped with automatic machinery lines which require require a relatively small amount of labor.

2 - Potential customers

Potential customers for the products of a firebrick manufacturing plant are :

- Industries which require lining materials (for lining tempering furnaces, power station, storage heaters etc)

3 - Capacity of the plant

The capacity of the plant for the manufacture of firebricks is medium-large.

The production is approximately 2.00 tons per annum of firebricks as well as 500 tons of mortar and smaller quantities of chamotte.

4 - Brief description of the process

Firebricks are made primarily of chamotte, crude clay, bonding clay and rejected bricks.

Chamotte is made of crude clay which is fed to the plug mill and then to the drying section.

The material is then fed through the tunnel kiln. From there, the chamot is either put into storage or fed to the further processing stage to make mortar and firebricks .

In the crusher, binding clay and chamotte are crushed together, after which the material is fed to the screening section . the mortar passes to the weighing stage and then a part is put into storage.

The rest of the mortar is fed to the milling section and then via the weighing section to the mixing stage.

In the mixing stage, the material is prepared for pressing. The bricks are pressed in the pressing stage and are then fed to the drying section.

The dried bricks pass through the tunnel kiln. The firing temperature lies between 1, 250 °C and 1.500 °C.

The finished firebricks are taken to the storage area.

5 - Required basic and auxiliary materials

The quantities of the various materials used depend on the particular product mix and the methods used.

Below are the approximate materials requirements of the plant for one year' s production :

- Raw materials 2,960 tons
- Various additional materials

6 – Area Requirements :

Required site area: 7,680 m^2

Required building area :

Production hangar : 2,160 m^2

Storage hangar : 540 m^2 540 m^2

Office building : 140 m^2

7 - machinery and equipment :

Description :	Quantity :
Crusher unit (complete)	1
Screening unit (complete)	1
Milling unit (complete)	1
Weighing unit (complete)	2
Drying unit (complete)	1
Tunnel kiln (complete)	1
Chamotte - making unit (complete)	1
Filling unit (complete)	2
Transportation equipment	1 set
Laboratory equipment	1 set
Maintenance workshop	1 set

8 - oil consumption :

Fuel oil : 945 tons / year

9 - water requirements :

Water needed : 3,400 m^3/ year

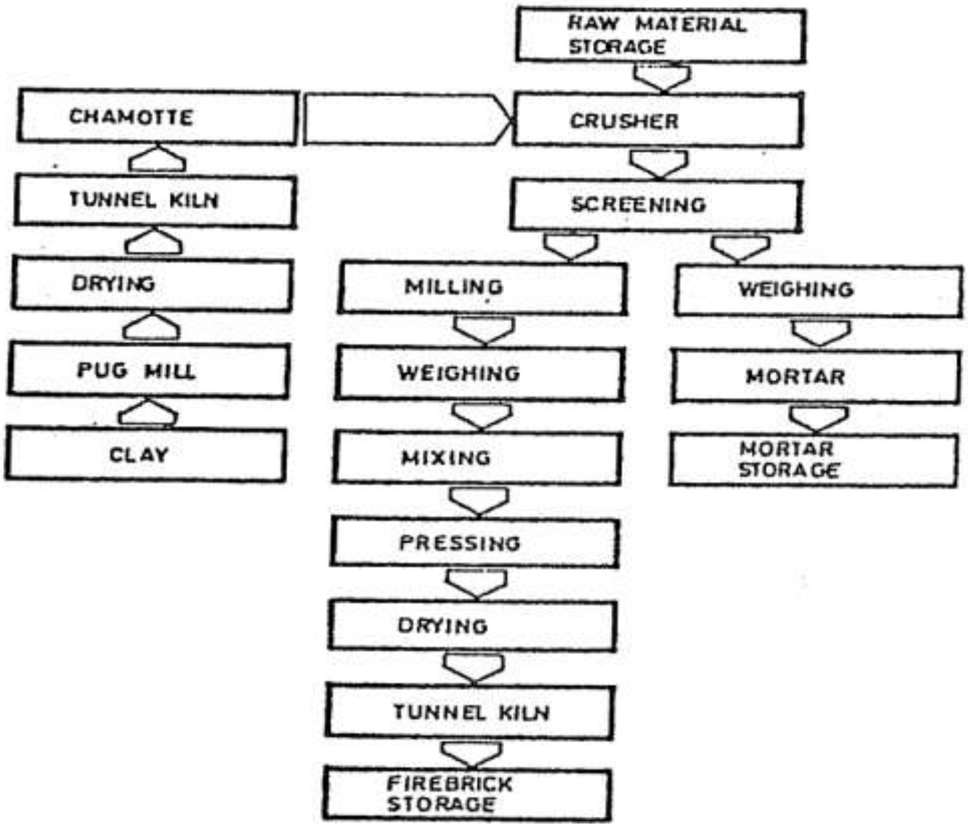
10 - Work – time base :

Number of shifts taken into consideration : 2 shifts per day.

work – time taken into consideration : 8 hour per shift .

number of work – days per year : 310 days . (but 360 days in furnace)

PROCESS FLOW SHEET



17 - Gypsum Board Plant

Gypsum board is made of gypsum , which consists of the core of the board and the both sides of the gypsum core are covered and adhered with paper , and is widely used as a construction material . Gypsum board was originally invented in 1902 , developed in U.S.A. since then , and widely in production in many counties over the world .

The characteristics of gypsum board as building material are briefly summarized as :

Good processing properties and easy application , light as for a heat insulation and fire resistance material , no practical deformation and warp as the lath of the wall .

And because of these excellent properties , gypsum board is regarded as one of the indispensable materials among the interior finishing materials .

Gypsum board is commonly used for the construction of the inside wall , the ceiling , and the partitions . The application technic can be broadly classified into two categories , namely the dry method , in which the gypsum board is finished with wall-papers or is painted , or the printed gypsum board is directly applied , and the wet method in which the surface of the gypsum board is plastered . Hence the choice of the suitable type of gypsum board and the application method thereof are to be considered according to the circumstances .

The paper covering the both sides of gypsum core of the gypsum board is normally consisted of 3 to 8 layers of fibrous tissue . In Japan a paper of 4 layers tissue made of regenerated pulp is commonly used . While it is typical in U.S.A. and U.K. to use a paper of 6 to 8 layers made of the blend of tip pulp and regenerated pulp . The most important properties required for the paper are the adhesion characteristic with gypsum , the strength and the resistance against the undulant tendency caused by the repeated drying and humidification .

The major portion of gypsum consumed for the gypsum board production is dependent to the chemical gypsum in Japan .

Process Description :

The by-product gypsum of wet phosphoric acid production normally contains about 10 to 20% moisture by weight dependent to the pretreatment of the gypsum . The wet gypsum is dried in a dryer , then calcined to form plaster , hemihydrate of calcium sulphate (partly water soluble anhydrite) in a calcinations unit , and stocked in Silos after milling of the calcined product . Heavy oil is usually used for drying and calcinations , and the exhaust gas is released into air passing through a scrubber .

The pulp used as a filler is mixed with required amount of water Pulper .

In a board forming process , plaster , filler , water and additives are fed under fixed ration into a mixer , and the slurry leaving the Mixer is sent to a forming unit . While the paper for the top and the bottom of the gypsum board is supplied to the forming unit continuously through a feeding machine , the slurry is fed in between the top and the bottom papers moving , sandwiched and enveloped by the papers . Setting of the plaster in the slurry takes place on the belt conveyor of the forming unit along the moving of the formed gypsum board , and after certain time allowed for setting the board is cut into uniform size . The setting progresses further on a following conveyor , and at the end of the conveyor the cut gypsum board pieces are placed in a drying unit . In this unit the board travels very slowly through , is dried to 2 to 3% moisture , taken out cooled through a cooling section , and stored in warehouses . The use of steam is common for hating medium of the drying unit .

It was in 1922 when the first production of gypsum board started in Japan , however the commercial production enhanced in large quantity after the World war II . Gypsum board of the following specifications are available in Japan .

Wall board
9 mm , 12 mm , 15 mm thickness
Lath board
7 mm , 9 mm thickness
Acoustic board
7 mm , 9 mm thickness
waterproof board
9 mm , 12 mm , 15 mm thickness
print board
7 mm , 9 mm thickness

example of Gypsum Board Making Plant :

Table 1 : Production Scheme
Raw gypsum…..By - product phosphoric acid gypsum
Plant capacity….3.500.00 m^2 / year
Product board…1.820 mm × 910 mm × 9 mm plain board
Tables 2 , 3 and 4 are based on the above scheme .

Table 2 : Required Machinery and Equipment

Item	No.
Gypsum drying section	
Oil storage tank	1
Furnace	1
Gypsum feeder and Conveyor	1 set
Gypsum dryer	1
Cyclone	2
Exhaust gas blower	1
Scrubber	1
Dry gypsum hopper	1

Gypsum calcining section	
Kettle	2
Furnace	1
Hot pit	2
Pulverizer	2
Silo	3
Plaster hopper	1
Electrical dust collector	1
Bag filter	1
Scrubber	1
Exhaust gas blower	1
Feeder and conveyor	a few
Forming and drying section	
Mixer	1
Additives preparation unit	a few
Paper feed unit	1 set
Cutter	1
Drying unit	1 set
Conveyor	a few
Utility section	
Boiler unit	1 set
Oil storage tank	1

Table 3 : required Area for Plant Site

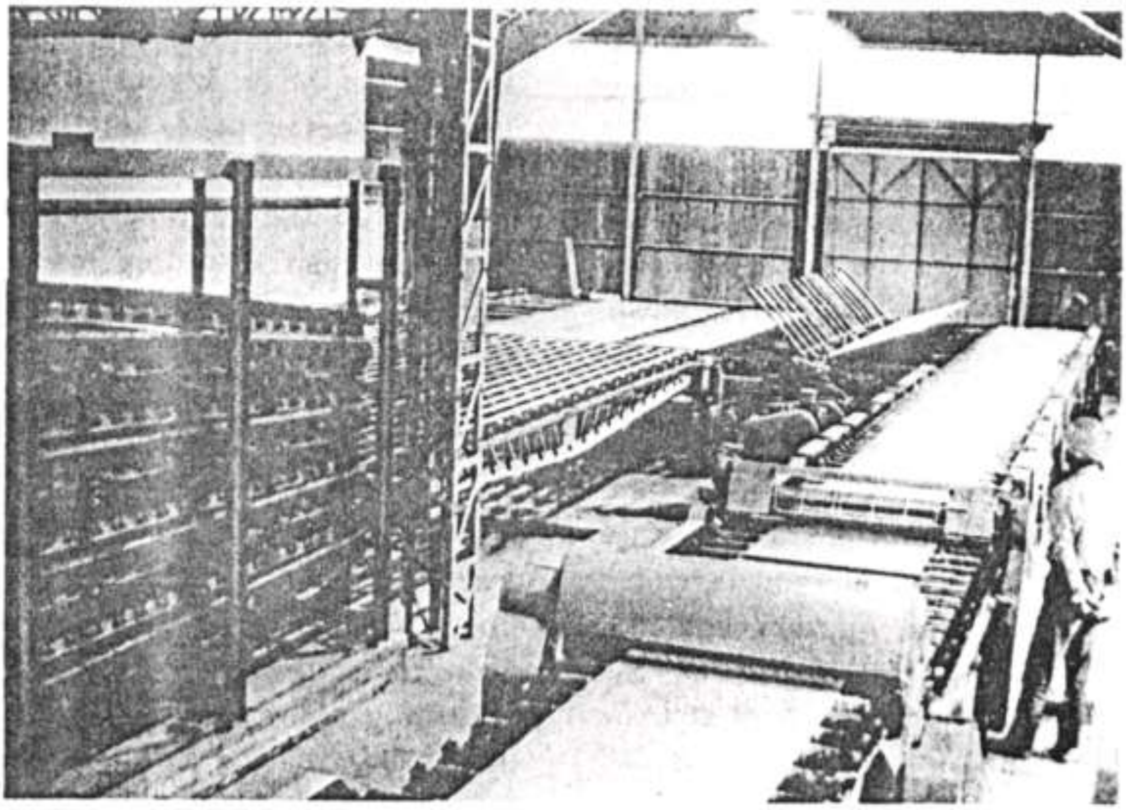
Building . . . . 30 m × 200 m = 6.000 m^2
(for the board forming and drying)
Land . . . . .100 m × 250 m = 2.500 m^2

Table 4 : Required Raw Materials And Utilities

Item	Quantity
Raw materials	
Gypsum	6.4 kg
Paper	0.6 kg
Pulp	0.04 kg
Additives	0.1 kg
Cilities	
Steam	8.0 kg
Fuel (Heavy oil)	0.3 liters
Process water	12 liters
Industrial water	40 liters
Electric power	0.6 kWh

Locational Condition

Gypsum board plant will be desirable to be constructed in a position , where the product board can be sold within an area of several hundreds kilometer radial and also raw gypsum can be easily obtained near the plant . For instance , it is the best condition that the proposed plan is constructed at a neigh bouring of a wet-process phosphoric acid plant in a densely populated locality .



18 - Absorbent Cotton Plant

originally absorbent cotton was developed for the purpose of medical use. at present absorbent cotton is used for sanitary use and in surgical operation as well as for ordinary daily living .

absorbent cotton is a material which comes in direct contact with the human body , so the quality of absorbent cotton is provided for in the pharmacopoeia of advanced countries.

The pharmacopoeia of Japan describes cotton se “the deoiled and bleached tuft of the seed of the cultivated variety of Malvaceae family of plants”. The fibre of absorbent cotton is very elastic ; it consists of 9899.5% α-cellulose which has a diameter of 16- 30μ and a length of 12-40 mm . the colour of absorbent cotton is not pure white ; when piled one upon another ; the overlap has a slightly yellowish white colour .

The following points concerning absorbent cotton are provided by the respective item indicating their figures in the pharmacopoeia of Japan .

1) Remained acid or alkali
2) Amount of water soluble substances
3) Existence of colouring matter
4) Existence of fluorescent whitening agent
5) Sedimentation velocity after impregnating with water
6) Water absorbing capacity
7) Mixing of other fibres
8) Degree of nepping
9) Mixed amount of matters which come from cotton seed
10) Other foreign matter mixed together

The above points are described in the pharmacopoeia of Japan . the U.S. pharmacopoeia and the British pharmaceutical codex are also nearly the same .

The smell of fat and soap is due to insufficient deoiling and water-rinsing . the smell of chemicals and mould is due to unsuitable storage .

Absorbent cotton is sterilized in accordance with the provisions in the pharmacopoeia . Ethylene oxide gas is effective for sterilizing and be included in the plant if desired .

Process Description Based On Before Carding Method

There are two methods of operation : one is automatic and the other is the manual method , in which the facilities are made as simple as possible to keep the production cost low . in view of the simplicity of operation and maintenance , the manual method is taken up in this report .

The cost of the plant becomes much lower by the arrangement of cheaper machines, but this is not a wise policy from the standpoint of smooth operation , quality control of product , maintenance , and life of the machines .

Either virgin cotton or waste cotton can be used as raw material in this plant . Comber waste cotton is desirable in case of waste cotton . in case waste which contains a huge volume of short fibre and impurities is used , these substances should be removed repeatedly . Otherwise , the productivity will be low and the quality of the finished product will be inferior .

1) Opening and cleaning

First , the raw material is cleaned and opened sufficiently in the opening process . In case the raw material contains a lot of short fibre and impurities , this process should be repeated twice .

Next , the raw material packed in a wagon is transported to the filling process . Then , the lumps of cotton raw stuffed evenly in a bucket type loose carrier for bleaching machine ; water is added , and packing is continued by stamping with the feet . this work is done by manual labour .

2) Filling

The 200kg of cotton lumps stuffed in the loose carrier are conveyed to the semi-automatic high temperature and high pressure bleaching machine . Without touching human hands , the cotton lumps are treated with chemicals such as caustic soda , hydrogen peroxide or sodium hypochlorite . the scouring and bleaching processes are completed in approximately four hours . In this case , the quality of the treated cotton in every loose carrier is about equal and uniform . water rinsing , too , must be perfect.

3) Bleaching

There are two methods of manufacturing absorbent cotton : the bleaching before carding method and the bleaching after carding method .In the before carding method, the raw material cotton is bleached and dried first . Then ,carding is carried out the fibre is arranged . This method is employed in Europe

In the after carding method , carding is carried out prior to bleaching and drying . This method is employed widely in Japan .

Each method has respectively its merits and demerits , but the before carding method will be described here .

4) Hydro - extracting

The cylindrical cotton lumps taken out the electrical hoist are conveyed to the hydro-extracting process and is dewatered by the centrifugal hydro-extractor until the water content is approximately to 100% of cotton . the wet cotton is arranged in huge lumps on the stock conveyor for wet cotton of the opening process ; and then , opening and drying are carried out automatically . In order to facilitate the subsequent carding process , the dried cotton is further loosened finely by the opening machine for dried cotton.

5) Opening , drying , opening and reserving

The cotton lumps are then sent automatically and pneumatically to the reserving process by a special fan . the cotton lumps are put in a bin which can reserve 500kg of cotton lumps , and is conditioned thoroughly . By this treatment , the entire cotton lumps are made uniform and retain a suitable amount of moisture .

6) Carding

The cotton lumps which are in almost deoiled state are packed in a wagon and conveyed and supplied to the hoppers of the two carding machines . the 1.800mm width roller card with metallic card clothing wrapped around it cards the cotton fibre , and produces a uniform web . the 1.800mm width web is split in two at the outlet of the carding machine , and the split weds which are 900mm wide of each travels to the same direction on the conveyor , changing its direction by 90 degrees , Accordingly , because there are two carding machines , there will be four webs piled one on top of the other , but the webs are pressed to make one web when they pass through the pressing roller at the outlet of the conveyor , and so they come out as one web .

7) Winding , cutting and packing

When the web is wound as it is in the winding process , a thin but wide lap which is 900mm wide can be marketed . Depending on use , however , there are winding machines with special cutting devices which can freely prepare cotton tapes which are 20-200mm wide and which weigh 180-1.200g/m^2 .

These can be selected by the client .

Outline of plant

A substantial example of an absorbent cotton making plant is given below .

Required Man power

Operation is carried out at two shift operation a day . the total number of labour required is 26 including maintenance , quality control , and testing sections .

Raw Material and Subsidiary

Raw Material

The raw material is to be virgin cotton or waste cotton . There will be a loss of approximately 25 % , depending on the contents of short fibre and foreign matters ; therefore , approximately 13 tons / month of raw material will be required to manufacture 10 tons/month of finished goods .

Various chemicals for bleaching and packing materials are necessary as subsidiary raw materials .

Building

The required floor space for machinery and equipment , excluding the warehouse , the cafeteria , the laboratory , and the dressing room for employees , will be 50 m × 25 m = 1.250 m^2 .the height of the building is to be more than 4m .

Process Flow Sheet for Absorbent Cotton Making Plant ,

"Before Carding Method"
Raw material
↓
Opening & Cleaning
↓
Filling
↓
Bleaching
↓
Hydro-extracting
↓
Opening (for wet cotton)
↓
Drying
↓
Opening (for dried cotton)
↓
Reserving
↓
Carding
↓
Winding &Cutting
↓
Packing

Auxiliary Machinery and Equipment

The auxiliary machinery and equipment are generally different depending on the scope of the plant to be constructed . Ordinarily , the auxiliary facilities required are as follows :

1) Air conditioning equipment
2) Boiler (3tons/hr ., 10 kg/cm^2) , 2 sets .
3) River or well water treatment of facilities for fresh water (50 tons / day).
4) Electric power transforming station (200 kW/hr.)
5) Testing equipment
6) Tools

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19 - Used Oil Filters & Other Oily Waste Materials

Introduction

Wherever oil - changes are made on cars , trucks or other vehicles , that also means the exchange of used filters . Exchanges and maintenance works cause additional oily waste materials , such as oil cans , cleaning rags and saw dust . Nowadays these waste materials are to a large extent either deposited or burnt . their quantity is alarmingly high , and so is their potential danger to the environment . In the Federal Republic of Germany alone this quantity amounts to approx . 160.000 cu.m per year . That leads to a great number of ecological problems .

Uncontrolled depositing : Waste oil belongs to the category of materials that pollute water . Even minute quantities can pollute the ground water and make it useless as drinking water .

Burning : When oily waste materials are burnt ,the air is heavily polluted by acidic and heavymetal compounds in the resulting fumes .

There is a sensible and economic alternative to these two methods : it is the processing and recycling of the occurring waste materials .

The described recycling plant is laid out for the processing of 2.000 tons of oily waste materials per year and yields high-quality material in the form of raw material that can be further processed .

Description of the Production Process

The first stage is the automatic dismantling of the unsorted filter of miscellaneous designs and sizes into the following components :

- Waste oil
- Internal filter
- Sheet metal case of the filter
- Steel bottom and small parts.

Prior to the dismantling the filter are singled out and axially aligned . Their position is determined and automatically controlled .

The dismantling is based on the principle of rotation .

The first step is to separate the filter bottom from the sheet metal case thus also releasing the small parts .

Rotation and gravity effect the centrifuging of a maximum quantity of waste oil and , in the second step , the extrusion of the internal filter . A chopper cuts it down to very small pieces .

In the third step the separation unit releases the sheet metal case of the filter which is also chopped down to small pieces .

A conveying system conveys all individual material to a combined purification – separation and drying unit where the remaining oily particles are removed and metallic and nonmetallic materials separated .

Re - usable parts such as bottom plates , springs and pressure plates are separated , sorted and stored for later use .

The extracted waster oil is collected in a tank and can be used as raw material for a second refining process .

The cleaned filter paper can be used as absorbing material .

A : oil filter

B : Additional oily waste materials

1. Filter paper , metallic materials , small parts , filter bottom
2. oily paper and metallic parts .
3. oily small parts and filter bottom .
4. waste oil .
5. Items 2+3- chopped down
   - I- Waste oil
   - II- Treated non- materials
   - III- Treated metallic materials

Required Machinery and Equipment

Item Description	Pieces
1. Presorting unit	1
2. Dismantling unit	1
3. Fragmentation unit	1
4. Separation unit	1
5. Purification unit	1
6. Drying unit	1
7. Sorting unit	1
8. Conveying system	1

Required Buildings and Areas

Administration	60 sq.m
Production	240 sq.m
Storage	240 sq.m

Required Power and Utilities

Electricity	30 kW
Compressed air	1 cu.m/min
Chemicals:	3.500 1 initial issue
Hydrocarbon fluoride	20 1 per year refill

Design Data

Capacity of the plant :	2.000.000 kg / year One - shift operation 60 % oil filters or Oily waste Materials 40 % additional

20 - Coated Abrasives Plant

Coated abrasives are the products manufactured by coating the paper, cloth or vulcanized fiber sheet with such powder abrasives as aluminium oxide, silicon carbide and garnet for use in various types of grinding work.

Generally used in processing a wide range of products such as metal products, including the stainless steel pipe, steel material and cast iron, and the wood, synthetic resin, leather, stoneware and rubber products, these abrasives are wide-ranging in the market of demand.

With the development of industries, the abrasives show the trend of rapid increases. In particular, since the grinding work exerts important influences not only on the productivity of various machinery works but also on the quality of the products to be machined, the demand for excellent abrasives ever deepens day by day.

Moreover, these coated abrasives are manufactured by relatively simple process and the facility itself is simple and requires small – scale funds for construction.

Above all, it is one of the products to be developed and produced with priority for the development of the existing industries in developing countries which have not enough money to spare .

Products and specifications

The abrasives produced by this plant include the abrasive cloth, abrasive paper and abrasive disc, and also come in sheets, rolls, belts and discs depending on the type of products.

These abrasives generally consist of three basic elements including the backing, abrasive and adhesive bond . Cloth, paper, vulcanized fiber sheet and non-woven farics are in use as backings, while aluminum oxide, silicon carbide and garnet are used as abrasives.

The abrasive bond is composed of two layers.

Namely, one is called a make coat and the other is called a size coat. By changing the combination of these two adhasives in the coating process, various products can be manufactured.

Fig . 1. Structure of Coated Abrasives

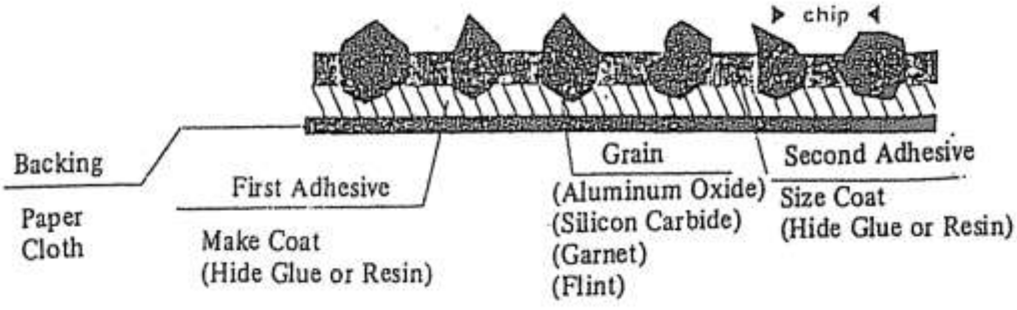
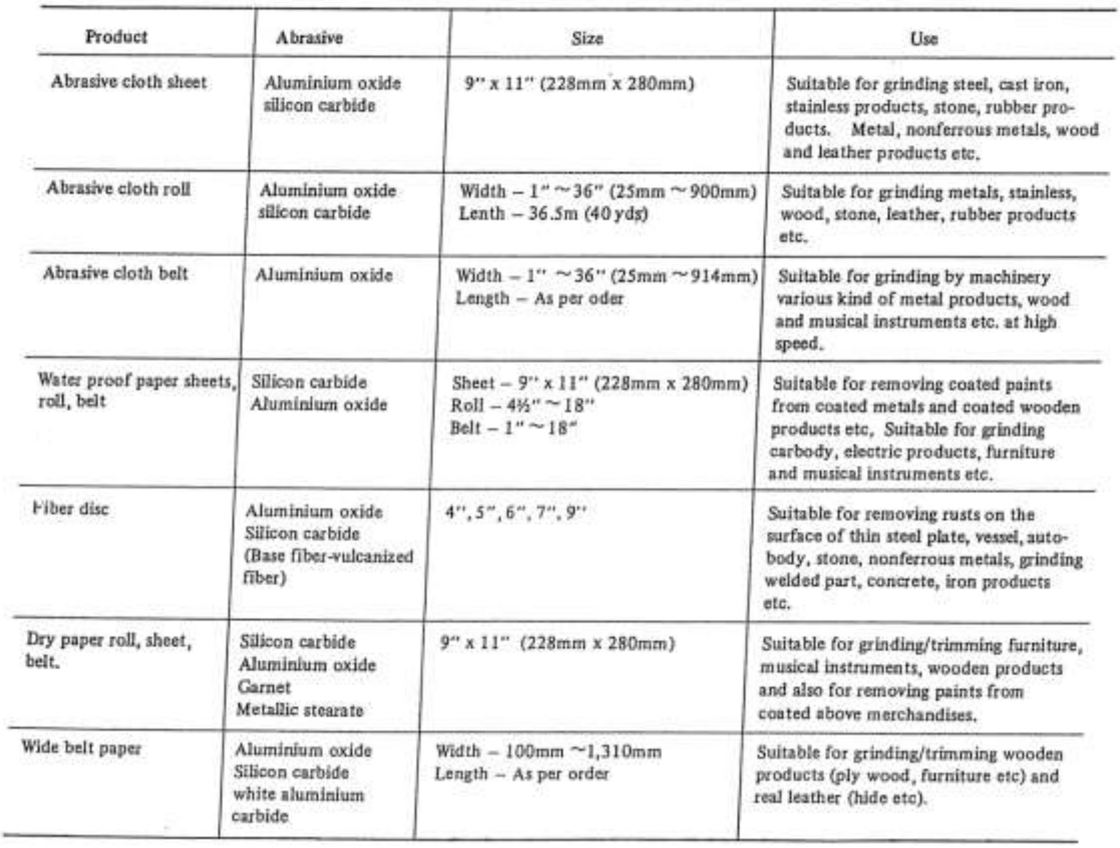


Table 1. size and use of abrasive Material



Product	Abrasive	Size	Use
Abrasive cloth sheet	Aluminium oxide silicon carbide	9" x 11" (228mm x 280mm)	Suitable for grinding steel, cast iron, stainless products, stone, rubber products. Metal, nonferrous metals, wood and leather products etc.
Abrasive cloth roll	Aluminium oxide silicon carbide	Width – 1" ~ 36" (25mm ~ 900mm) Lenth – 36.5m (40 yds)	Suitable for grinding metals, stainless, wood, stone, leather, rubber products etc.
Abrasive cloth belt	Aluminium oxide	Width – 1" ~ 36" (25mm ~ 914mm) Length – As per oder	Suitable for grinding by machinery various kind of metal products, wood and musical instruments etc. at high speed.
Water proof paper sheets, roll, belt	Silicon carbide Aluminium oxide	Sheet – 9" x 11" (228mm x 280mm) Roll – 4½" ~ 18" Belt – 1" ~ 18"	Suitable for removing coated paints from coated metals and coated wooden products etc, Suitable for grinding carbody, electric products, furniture and musical instruments etc.
Fiber disc	Aluminium oxide Silicon carbide (Base fiber-vulcanized fiber)	4", 5", 6", 7", 9"	Suitable for removing rusts on the surface of thin steel plate, vessel, autobody, stone, nonferrous metals, grinding welded part, concrete, iron products etc.
Dry paper roll, sheet, belt.	Silicon carbide Aluminium oxide Garnet Metallic stearate	9" x 11" (228mm x 280mm)	Suitable for grinding/trimming furniture, musical instruments, wooden products and also for removing paints from coated above merchandises.
Wide belt paper	Aluminium oxide Silicon carbide white aluminium carbide	Width – 100mm ~1,310mm Length – As per order	Suitable for grinding/trimming wooden products (ply wood, furniture etc) and real leather (hide etc).

Contents of technology

1) Process description

Though there exist some differences depending upon the type of products, this abrasive material manufacturing process largely breaks down to the cloth processing and treatment process, adhesive coating, grain coating and after treatment, with the following manufacturing process by product :

(A) Adhestive Cloth

Cloth processing

After treating the cloth with chemicals, the surface to be fixed with abrasives is smoothed out with a steam-heated roller. The reverse side of the cloth is also treated with reinforcing materials to supplement its strength. The cotton drill used here is largely divided in two kinds. Relatively light and flexible drills are suitable for abrasive cloths to be used in manufal and mechanical grinding, while stiff and tough cotton drills are suitable for abrasive cloths to be used in heavy mechanical grinding.

First adhesive coating

Prior to coating grains, the first adhesive is applied to the cloth for the grains, whereby such thermoplastic resins as phenolic resin, melamin resin, polyester resin and epoxy resin are used as adhesives in roller coating.

Grain coating

It is a pracess in which grains are adhered on the cloth, usually by electro- coating or gravity coating.

However, the electro-coating method is used here, which is advantageous in that the grains are coated by electric force to provide uniform grain distribution and sharp abrasive surface .

Drying and second adhesive coating

Following the grain coating, the product is dried in a drying the grain, the product is dried in a drying oven and then moved to the second adhesive coating process designed to prevent the adhered grains becoming loosened . on completion of the second adhesive coating, it is dried again in the drying oven, followed by the printing of necessary matters on its back. To be wound by a winding machine. The product is transferred to a hardening oven to be cured for many hours.

Flexing

After cuing, the product goes through the flexing work to be provided with desired level of flexibility .

Among the single flexing, double flexing and triple flexing, the triple flexing is applied here.

After treatment

N After flexing, the product is to desired sizes and packed for delivery or can be prepared in the form of belts or rolls through such after treatment processes as slitting, skiving, bonding and pressing .

(B) Waterproof paper sheets and dry paper sheets printing

Particulars of trademark and specifications are printed on the back of the adhesive papers by the roller-type printing machine.

Water- proofing treatment

Particulars of trademark and specifications are printed on the back of the adhesive papers by the roller-type printing machine.

Water- proofing treatment

The kraft paper is treated with varnish or epoxy resin to improve the waterproofness of the adhesivs papers.

First adhesive coating

The first thermosetting resin is applied in roller coating so that grains can adhere on the water-proof or untreated kraft paper.

Grain coating and drying

As in the case of abrasive cloth, the backing paper coated with the first adhesive is subjected to grain coating by eletro-coating method, followed by drying in an oven .

Second adhesive coating and drying

In order to reinforce the cohesive strength of the coated grains, it is coated with the second adhesive and dried in the oven, followed by curing.

Cutting and inspection

Following the curing, the product is taken up by the winding machine and cut to desired specification for subsequent inspection and delivery packing.

(C) Abrasive disc

Fiber cutting

The vulcanized fiber sheet as the backing material is cut to the product specification by the press, and then trademark and technical data are print o the back of the cut vulcanized fiber sheets.

First adhesive coating

Theremosetting resin is applied by the roller coating machine for adhering the grains .

Grain coating

The grains are dispersed for coating through a hopper in accordance with the gravity coating method.

Discs thus produced are suitable for grinding rough surface.

Second adhesive coating and drying

In order to prevent the grains from becoming loosened, the second adhesive is applied by the curtain coating amchine, followed by drying and curing.

Flexing

The dried product is subjected to double flexing to be provided with desired level of flexibility.

Inspection and packing

Following the flexing, the product undergoes various testing inspections for the confirmation of its abrasive capacity, and then packed for delivery.

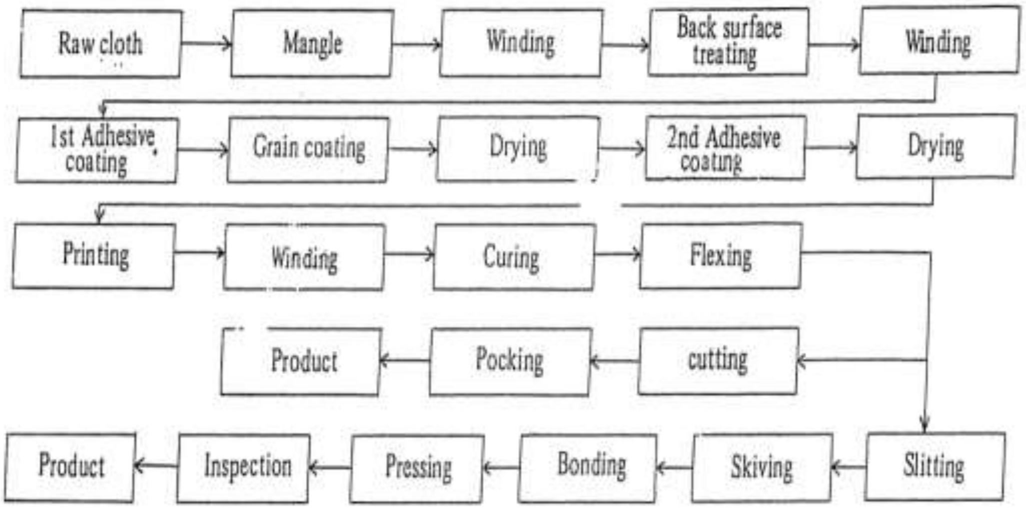
Example of plant Capacity and Construction Cost

Plant Capacity :
Abrasive cloth sheet : 800,000 Sheets / month
Abrasive paper : 300,000 Sheets / month (including water-proof paper)
Abrasive disc : 300,000 Sheets / month
Operating time – 8 hrs / day 25 days / month

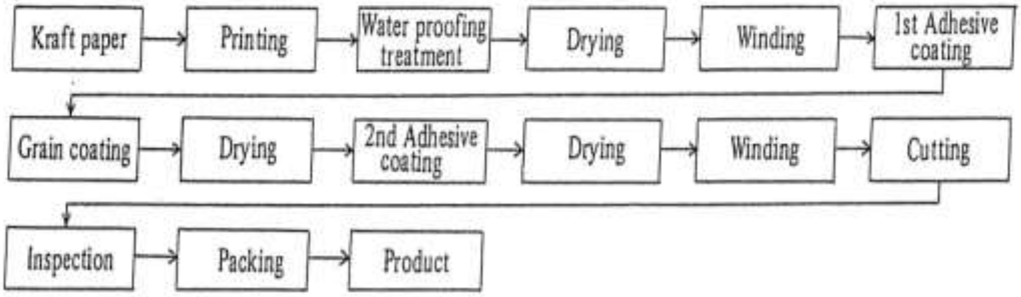
Scattering Papers In Chemical Industry

Abrasive Cloth and Paper Manufacturing Process Block Diagram

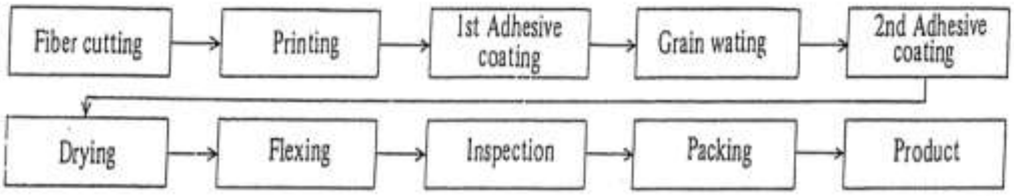
Abrasive Cloth



Water-proof paper sheets and dry paper sheets



Abrasive disc



21 - 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 12 th century, but especially in the 19 th 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 party sintered. Light (porous) bricks are made from common materials with addition of sawdust, coal or tailings . Hollw 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 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 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 plowing-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 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 L day and 300 day / year .

Required machinery and Equipment

Item	
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 –king ; for the kiln	
Transformer station ; control coxes; electric motor supply network	

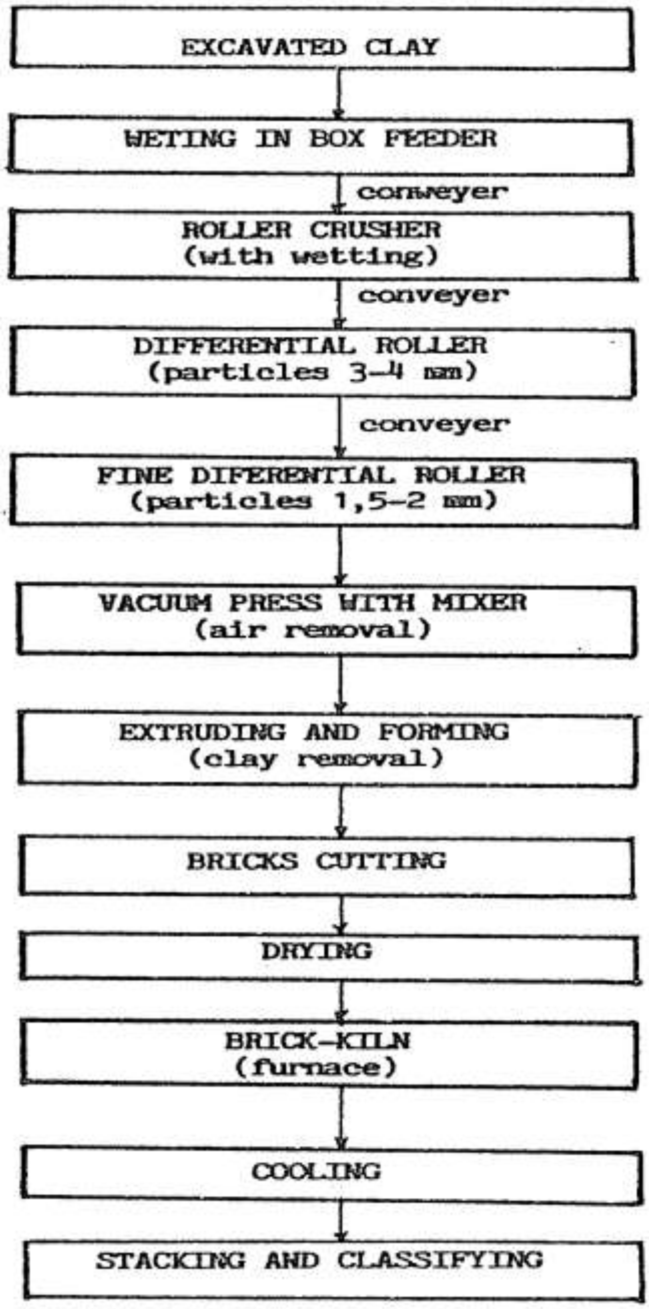
Required raw materials

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 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 .

BRICK PRODUCTION BLOCK DIAGRAM



22 - Burnt Brichs and tiles

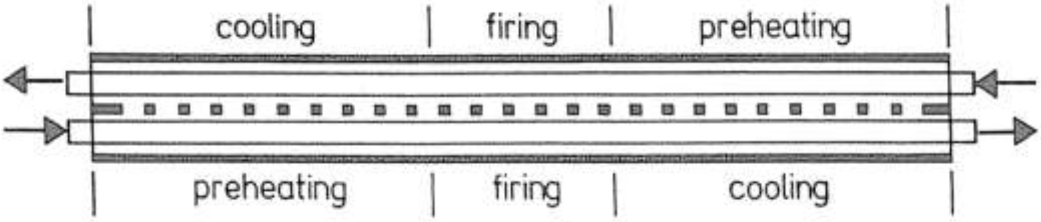
The ceramic industry is one of the oldest industrial exploitation fields of mankind. Pottery, bricks and tiles have always been in demand. Artisan's kilns dug into the ground, were the primitive way of burning the products.

More than 130 years ago, a further step into industrialization was taken by the design of the Hofmann kiln, the first multifuel kiln to be operated in an industrial way . it is the way that up to this day smaller brick factories are operated.fuel consumption is rather high, and great operational skill is required since the firing time exactly determines the burning degree. Still hof-mann kilns operate with a considerable rate of rejects .

A further step into industrialization and continuous operation was the tunnel kiln where the products to be fired are passed through the kiln on cars. Fuel consumption and the rate of rejects were thus reduced and continuous operation secured. The firing period of normal bricks amounts to approx. 60 hours.

The latest technology in kiln operation is the countertravel kiln (Patent Riedel) working as a double kiln where the products to bo fired are countertravelling through the tunnel funnel from either side. Thus the green bricks are heated up by the outcoming burnt burnt bricks cooling down in the tun-nel aside. The tunnels are interconnected by air-holes and the air is steaming sideways from hot to cold (convection) without any longitudinal airstream that is normally used in tunnel kilns.

The countertravel kiln reduces fuel consumption to a bare minimum of 330 kcal / kg of fired product. It is easy to operate, thus reducing the rate of rejects to 2 % or in other words: 98% of the product are first-class. The kiln in multi-fuel, working on oil and gas, but also on solid matter such as coal and bio-mass (saw-dust, coffee – husks).



Description of the production process

According to the nature of the available clay, the incoming raw material must be ground down to a maximum grain size of 1.5 mm, which is done by a roller crusher and a finishing mill.

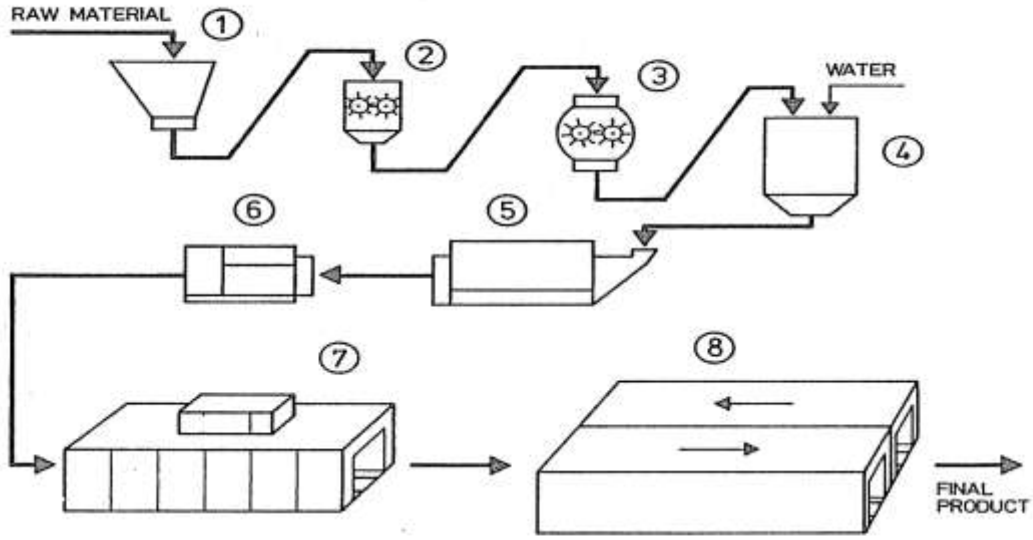
Then water is added to the clay until the material has reached a humidity degree of 20 – 25 % .

After an intermediate storage the treated clay is homogenized under vacuum in a de - airing extrusion thus preventing air - inclusions in the product .

the performed mass is cut to proper size and taking to a drier via a conveying system .The drying takes about 42 hours eventually resulting in a loss of weight of approx 7 % . The dry product is taking from the conveying system and set onto kiln cars by hand . Burning in the kiln is done at 1,000 ° C , which takes approx 60 hours . After the burning process . the final product is manually unloaded from the kiln cars and put on palets or directly on trucks .

Thereject material thatresults from the first steps up to the outletof the drying stage , can be completely re – conveyed to the process vai the mill. Burnt material , too , can be added to the process – flow again , at a portion of 10 % of the quantity of raw material . Finally , reject material may well be used for instance as an additive material for road constructin .

Flow sheet:



1. Box feeder
2. Roller Crusher
3. Finishing mill
4. Preparation vessel
5. Vacuum unit
6. Cutter
7. Drying chamber
8. Counter-travel kiln

Required machinery and Equipment

Item	Description	Pieces
1	Box feeder	1
2	Roller crusher	1
3	Finishing mill	1
4	Double-shaft mixer	1
5	Box feeder for intermediate storage	1
6	Circular feeder	1
7	De-airing extrusion machine	1
8	Cutter for bricks	1
9	conveying and stacking system	1
10	Drier	1
11	Countertravel kiln	1
12	Loading and unloading system	1

Required power and utilities :

Fuel consumption	approx. 675 tons heavy fuel oil / year
Water	8,000 to 10,000 cu.m / year
Electricity	50 kw per ton of burnt goods
Compressed air	20 cu.m / hour, 8 bar

Required Raw Materials

Clay 25.000 t / year

A minimum quantity as is required for the production of 30 years, must be available. The clay pit is to be quantified and investigated by core drilling.

Outline of the plant

Capacity of the plant	20,000 t / year Burnt goods
Mode of operation:	
preparation and forming	2 – shift
stacking and transport	2 - shift
drying section	3 - shift
counter travel kiln	3 - shift
loading and unloading	2 - shift

23 - Spiral Weld Pipe Plant

the spiral weld pipes are manufactured from steel strip or plate by the Driam and Torrance patented process.

The capital expenditure is quite low compared other manufacturing process when and if the projected production capacity does not exceed 100,000 tones per year. Depending on the market situation, it will be necessary to limit the production and therefor a frequent changeover periods without tool changes are advantageous . spiral weld pipe mill save times and expenses occurring from the frequent tool changes.

Pipe in any dimension and lengths can be produced continuously – From hot rolled strip of one dimension, pipes of a whole series of diameter can be manufactured without wasts of materials resulting from cutting.

The pipe will be produced from hot rolled coils.

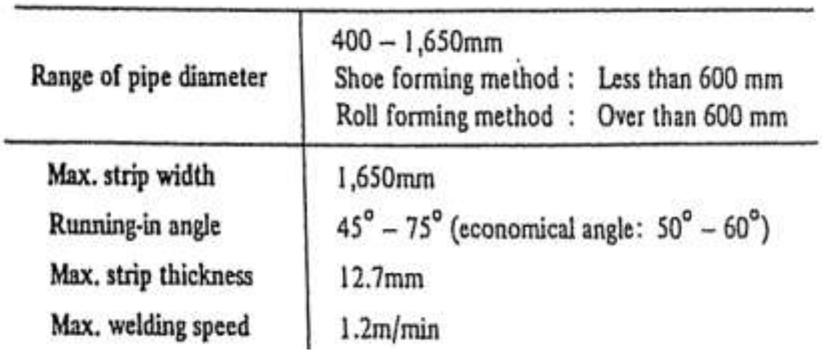
The pipe produced in this facilities are widely used for transmission of water and other liquid as well as piling for construction and mechanical use.

This mill is designed to have a production capacity of 40,000 tonnes of pipe working on a two-shift (16 hours / day) based on the production of 1,000 mm pipe in diameter with 9 mm thickness .

Products and specifications

The facilities are designed for the manufacture and finishing of continuously formed and spiral weld pipe ASTM, JIS, BS standards having a diameter range from 400 mm to 1,650 mm with material thickness from 5mm to 12.7mm.

Table 1. Specifications of Spiral Weld Pipe



Range of pipe diameter	400 – 1,650mm Shoe forming method : Less than 600 mm Roll forming method : Over than 600 mm
Max. strip width	1,650mm
Running-in angle	45° – 75° (economical angle: 50° – 60°)
Max. strip thickness	12.7mm
Max. welding speed	1.2m/min

Contents Technology

(1) Process Description

Spiral pipe making machine

This machine can make all sizes of pipes within the range by varying angle from 45 to 78 degrees. The capacity is dependent on the weld length and the weld length and the welding speed.

So the ratio of the pipe diameter to coil width is very important. The ration between 1. 6 – 2 . 0 is the most reasonable but 2.9 is maximum ratio because of the forming angle limit.

The heavier weight of coil unit is, the better productivity. Most devices of this machine are operated and controlled by the experts.

Non - Destructive Inspection

To obtain high quality of weld, ultrasonic inspection should be done continuously on the welded seam.

When any flaws are checked by the ultrasonic tester, after cutting-off the pipe the accurate position and size have to be seen by the X-ray tester in order to repair. And the repaired welds have to be rechecked by one of both tester.

Hydraustatic tester

All of the water pipes are subjected to be tested to the specificed hydraulic pressure according to the applied hydraulic pressure according to the applied specification or standard.

Plunger pump : 40 HP x 900 R.P.M

Centrifugal pump : 40 HP x 1,800 R.P.M

Blasting machine

Whole surface of pipes to be coated, not only inside but also outside surface, have to be thoroughly cleaned by blasting. The blasting should remove all rust, scale and other impurities from the surface, exposing base metal over all, which presents a grayish appearance.this operation shall be performed by shooting grits onto surfaces by compressed air.

Priming

To promote the adhesion of coating material to steel surface, the suitable primer coating is essential. The priming is done usually by airless sprayer.

Inside coating (Lining)

The application of the lining materials to the inside surface of all pipes other than specials shall be by centrifugal casting by the feed-line method. During the application the pipe should be revolved at speed best suited to produce a smooth, glossy lining of uniform thickness.

Outside wrapping

Outside wrapping shall be performed by pouring melted material on the revolving pipe and spreading it . to the specified thickness. Wrapping materials shall be spirally applied by the felt-application equipment on the coating, while the coated material is held warm .

Melting kettles

The coating material shall be heated in agitated heating kettles equipped with recording thermometers.

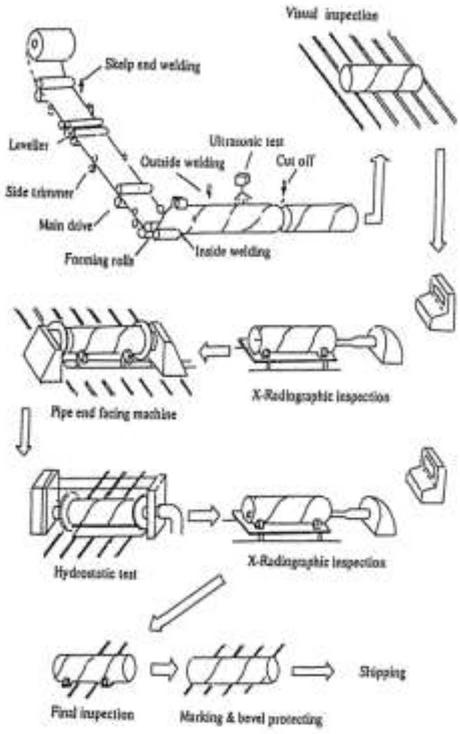
The maximum temperature to which the coating material may be heated and the maximum time that the coating material may be held in the kettle at application temperature are very important

Drying device

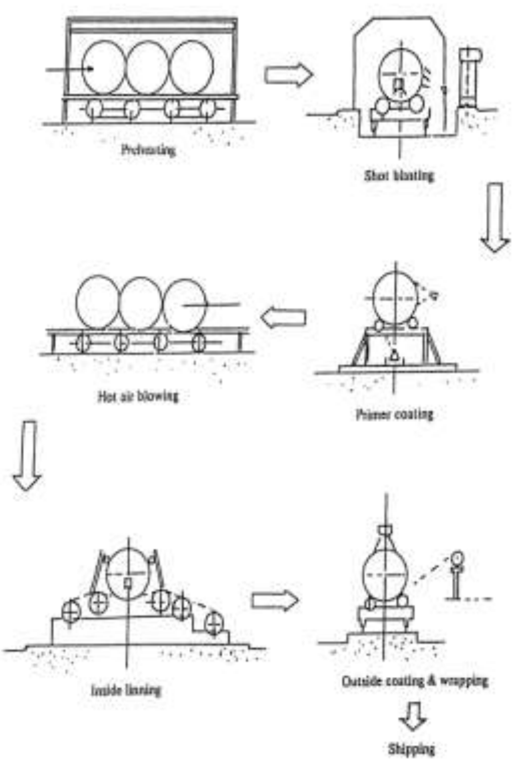
Moisture is harmful in blasting and hazardous in priming and coating. In advance of these process heating pipes are necessary according to the weather .

1) Equipment and Machinery

Spiral pie making machine
Flux sweeping device
Pipe rotating device
Pipe facing and beveling machine
Pipe transportation equipment
Portable ultrasonic tester
Heating facility
Blasting machine
Primer coating machine
Preheating facility
Inside lining machine
Outside coating and wrapping machine
Engine lathe
Shaper
Power station
Laboratory equipment

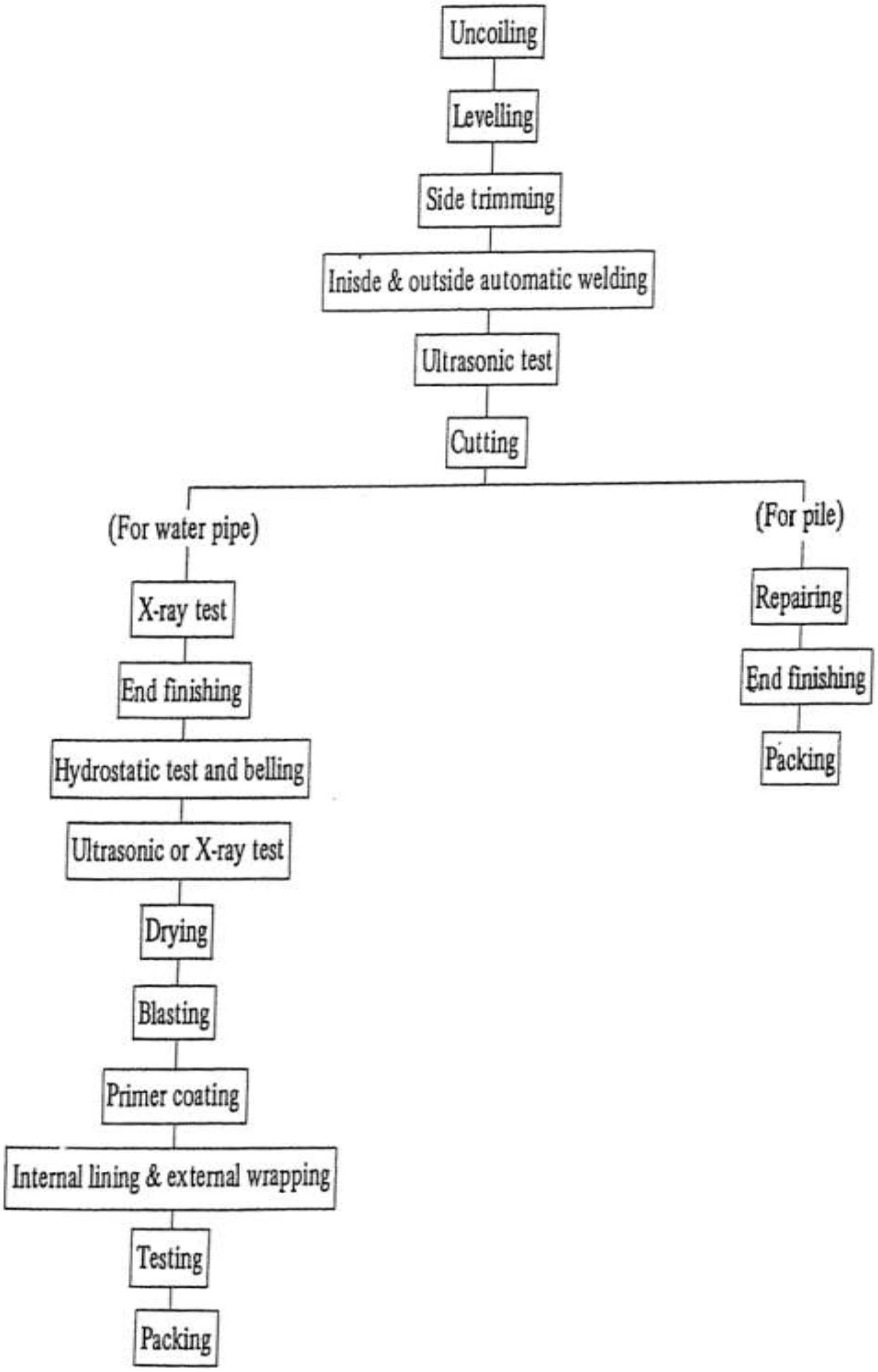


Spiral Weld Pipe Manufacturing Process Flow Sheet



Spiral Weld Pipe Coating Process Flow Sheet

Spiral Weld Pipe Manufacturing Process Block Diagram



24 - Starch Derivatives Prodution

Introduction

For many years starch and starch containing materials have been converted by means of high temperatures in the presence of catalysts into soluble sweet products.

Early in the last century it was discovered that, if potato starch slurry is treated with acid, a sweet tasting syrup was produced, from which dextrose crystallized.

Since that time starch production from amyla-ceous raw materials and starch processing into high-quality starch derivatives has made enormous technological progress, especially over the past thirty years.

In general large amounts of starch are processed into starch sweeteners. Any purified starch extracted, for example, from maize (corn), millet, wheat, rice, potatoes, or from tropical roots such as manioc, tapioca, cassava and yucca, can be used for this purpose. It is hardly often that these raw materials are process directly into starch sweeteners without starch as an intermediate.

Subdivided into glucose syrup (including the “family” of special glucose syrups) and dextrose syrup (as base for subsequent forms of dextrose).

Process description

The process descriptions hereafter refer to the production of :

1. Glucose syrup
2. Special glucose syrups
3. Dextrose syrups
4. Sorbitol (one of the subsequent products out of dextrose syrup)

1 - Glucose syrup

Glucose syrup is used in the food industry not only because of its sweetness and its nutritive value, but in particular for its functional properties (stabilization of moisture, softening ability, build-up of texture, prevention of crystallization of other sugars, formation of film and body). In the first place it is used for sweets and confectionery, ice cream, pastries, preserves and liqueurs.

Glucose syrup is a sweet, colourless, highly concentrated solution of a mixture of easily digestible sugars. Glucose syrup produced by the standard method, I.e. single-stage hydrolysis of starch with acid, has a DE between 32% and 55 % A DE of approx. 42% (which is the most common syryp) goes with a constant sugar spectrum of about 19% glucose, about 14% maltose and about 67 % oligosaccharides. This syrup is concentrated to 43 – 45 % Baume equaling 81 – 85 % dry substance, and at 45 % Baume it is a very viscous product .

To produce glucose by acid hydrolysis, purified starch starch milk is a acidified (commonly in the presence of hydrochloric acid as a catalyst) to an

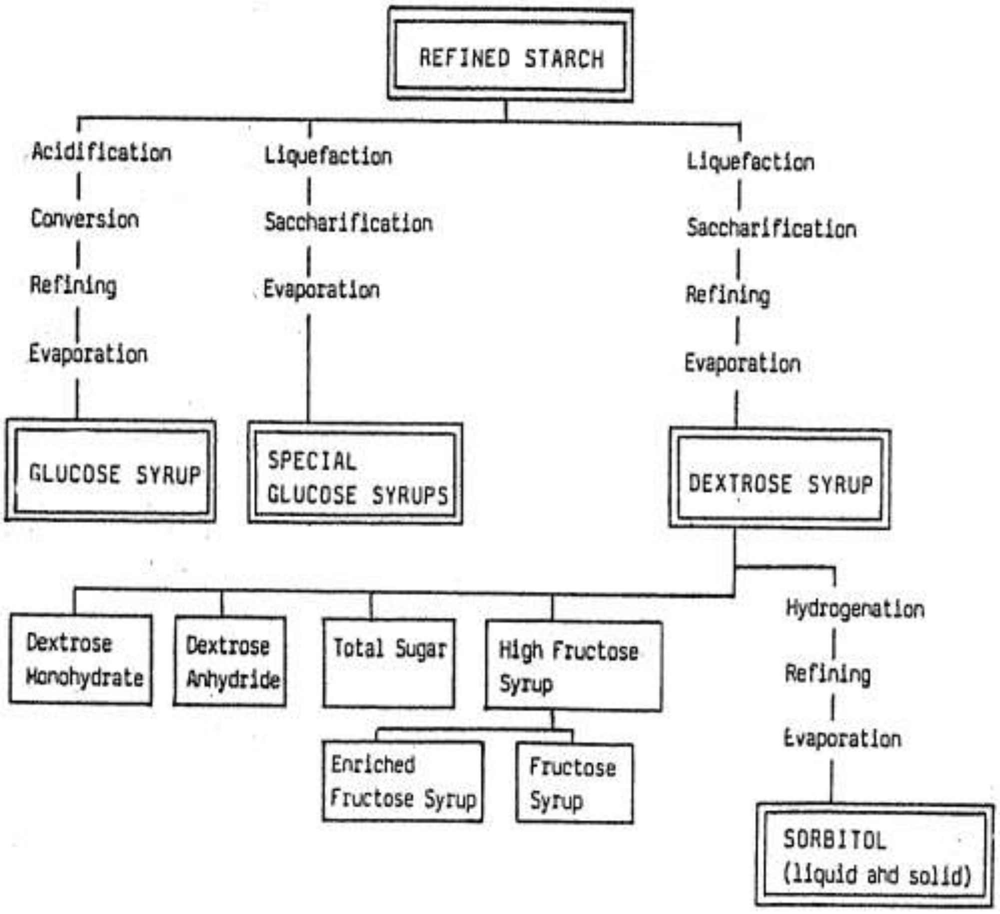
***DE** : Dextrose Equivalent, expressing the degree of hydrolysis (conversion) and, consequently, the breakdown of the glucose chains in the starch.*

Since glucose and maltose-type sugars, unlike the starch molecule, Have reducing aldehyde groups, this reducing property can be utilized to define the DE . The DE is the percentage of reducing sugars (in terms of glucose) in the dry substance of the product concerned. The DE of starch is 0% and that of pure glucose is 100% , the DE is just a measure of the number of reducing groups present, but does not disclose any details about the sugar spectrum, i.e the percentages of glucose, maltose and higher saccharides.

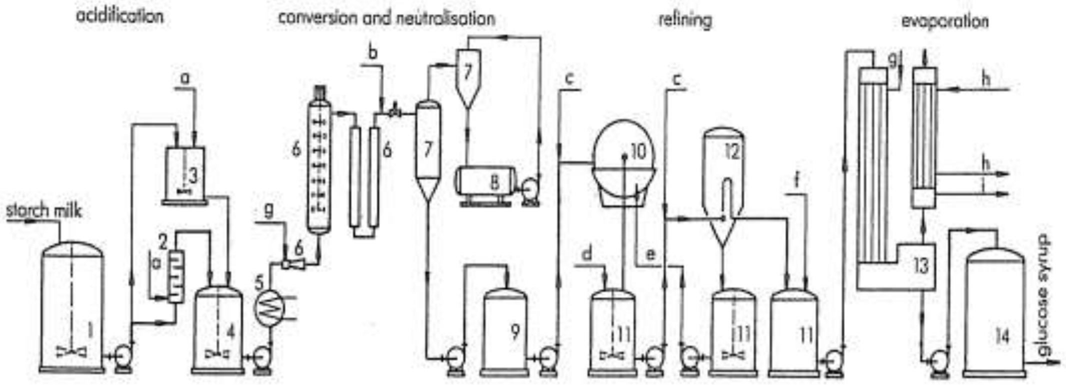
The acid hydrolysis, acid-enzyme breakdown and double – enzyme process makes it possible to produce substances having different Des and a different sugar spectrum.

acidity of 0.30 n HCI , in a converter the acidified starch is converted at high temperature into a mixture of glucose, maltose and higher sac-charidies. With the aid of such process parameters temperature, P H value, concentration and residence time (which have to be checked very carefully) it is possible to choose a degree of saccharification (DE) being equivalent to a defined sugar spectrum.

Synoptic Chart of Starch Derivatives



Process Flow Diagram for Glucose Syrup



1 starch milk tank
2 continuous acidification
3 batch acidification
4 acidified starch milk tank
5 heat exchanger
6 continuous converter
7 flash cooling

8 hot water aggregate
9 neutralisation tank
10 filter
11 tanks
12 candle filter
13 evaporator
14 product tank

a HCl
b Na_2CO_3
c filter aid
d activated carbon
e used activated carbon
f $NaHSO_3$
g steam
h cooling water
i vapour condensate

After hydrolysis, the hydrolysate is cooled down, and soda is added for neutralization in order that the impurities in the starch (protein, fat) flocculate can be removed by mechanical means, either by separators or by rotary precoat filters.

In general, decolourization of the hydrolysate proceeds in two stages in the presence of activated carbon. The filters (rotary filters, candle filters, filter presses) required to filter the juice and to separate, the activated carbon are of the precoat type. If need be, ion exchangers can be employed to demineralize the glucose. Finally the purified glucose is evaporated in a vacuum to the final concentration of 81% to 85 % dry substance, and at 45 % be it is a very viscous product.

The starch generally used for acid hydrolysis is corn starch or root starch which has to be purified very thoroughly. Since starch to be hydrolyzed has to be suspended in water, a glucose factory quite often is combined with a starch factory so as to avoid the necessity of drying the starch first and then re-dissolving it in water.

For another thing, the factory should be located in the centre of its market area in order to minimize syrup transport costs. For root starch which in most cass is produced in places far away from the centre sod glucose consumption, it might therefore be expedient to use dry starch.

2 - Special Glucose syrups

Maltose syrup and high-DE glucose syrups can be produced by two - stage acid / enzyme or enzyme / enzyme saccharification. Though their DE is the same as that oof standard glucose syrup, theses syrups have a different sugar spectrum and, as a result, specific properties such ass more sweetness, a better crystallization – inhibiting effect upon sucrose, and less hygroscopicity .

The applications of these syrups are the same as those of standard as those of standard glucose syrup, and owing to their favourable properties they are being used to an increasing extent – in spite of the fact that their price is higher.

Generally speaking, low – DE syrup is highly viscous and imparts texture and body to the product ; high – DE syrup is used for its sweetness .

The principal fields of application of these glucose syrups are as follows:

* Low - DE syrup, 20 - 38 DE :

Frozen dairy products, beer;

* Normal – DE syrup, 38 – 58 DE :

Confectionery such as drops, gelatin and jelly sweets chewing gum, marzipan, etc, beverages, frozen dairy products;

* High – DE syrup, 58 – 70 DE ;

Soft drinks, jams, pastries, ice cream.

Special glucose factory practicing the acid hydrolysis technology, provided the plant is supplemented by the equipment required for enzy-matic saccharification.

Some maltose syrup varieties are made by the enzyme – enzyme process, but this process requires the same equipment as dextrose syrup production

Table of Typical Sugar Spectra of Glucose Syrups

DE	*Process*	*Sugar spectrum (%)* glucose	maltose	oligo-sacch.	*Glucose variety*
32	Acid	11	10	79	low-DE
42	Acid	19	14	67	normal-DE
55	Acid	31	18	51	normal-DE
47	Acid/ enzyme	12	50	38	maltose syrup
63	Acid/ enzyme	37	31	32	high-DF
97	Enzyme/ enzyme	96	3	1	dextrose syrup

3 - Dextrose Syrup

Dextrose syrup is a sweet, colourless, concentrated solution having a DE of 97 - 89 %, a typical sugar spectrum of 96% glucose and $% maltose and oligosaccharides, and a concentration of 71 % dry substance. It is made from starch milk by two-stage enzyme-enayme liquefaction and saccharification.

Very high DE dextrose syrup is used for pastries, soft drinks, etc. in general, however, dextrose syrup is an intermediate which quite often the producer himself transforms into high fructose syrup, dextrose monohydrate and sorbitol. This intermediate should contain a very high percentage of glucose and the least possible amount of other saccharides; this can be achieved by using enzymes specifically breaking the starch molecule in both liquefaction and saccharification

Usually, starch liquefaction proceeds in two stages in the presence of thermostable alpha-amylase. In this case, part of the enzymes is added to the starch milk. And the starch is pre-liquefied in a staem-heated converter. Liquefaction to the required DE of approx. 12 then proceeds in a retention zone at a temperature of 95°C for a period of 90 to 120 minutes.

Starch liquefaction is followed by saccharification in the presence of amyloglucosidass. Saccharification is a slow process which takes about 48 to 72 hours. A larger amount of enzymes reduces the reaction period. Saccharification takes place in tandem-arranged tanks ensuring a continous flow. Prior to saccharification, the hydro-lysate has to be cooled to approx. 60°C and set to a PH of 4.5.

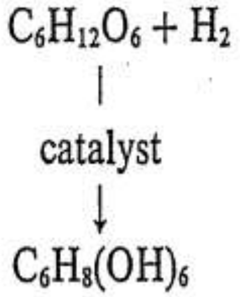
This is followed by multi-stage purification of the thin dextrose juice to give the required product quality. The purification process comprises : separation of insolubles such as protein, fat, etc. decolourization with the aid of activated carbon, and elimination of all salts in ion exchangers. Finally, the demineralized product is evaporated in a multi-effect evaporator plant to the degree of concentration required for further processing.

4 - Sorbitol

Sorbitol is a hexahydric alcohol (sugar alcohol) and is a resultant product of dextrose. It is available in liquid form (granular or powdered).

In the food industry sorbitol is used as a substitute of sugar for diabetics' food. Today sorbitol is the only raw material that permits economical production of ascorbic acid (vitamin C) in the cosmetics industry it is an essential consistency-stabilizing constituent of toothpastes and creams. Moreover, sorbitol is used for tobaccos and in the chemical industry for plastics, resins, adhesives and platicizerd (paper, leather, textiles).

Sorbitol is produced by catalytic hydrogenation of dextrose (glucose) at an increased temperature by the following empirical formula :



$$C_6H_{12}O_6 + H_2 \xrightarrow{\text{catalyst}} C_6H_8(OH)_6$$

For sorbitol production a continuous high-oressure hydrogenation process is applied, proceeding at 150 bar and 180 °C, its special Raney nickel catalyst being continuously separated from the sorbitol solution after hydrogenation and being recycled .

After hydrogen removal, the sorbitol/ catalyst mixture is reduced to normal pressure and the catalyst is separated from the sorbitol in such a way that the active particles only are recycle for re-use. The inactive particles are filtered off and can be regenerated.

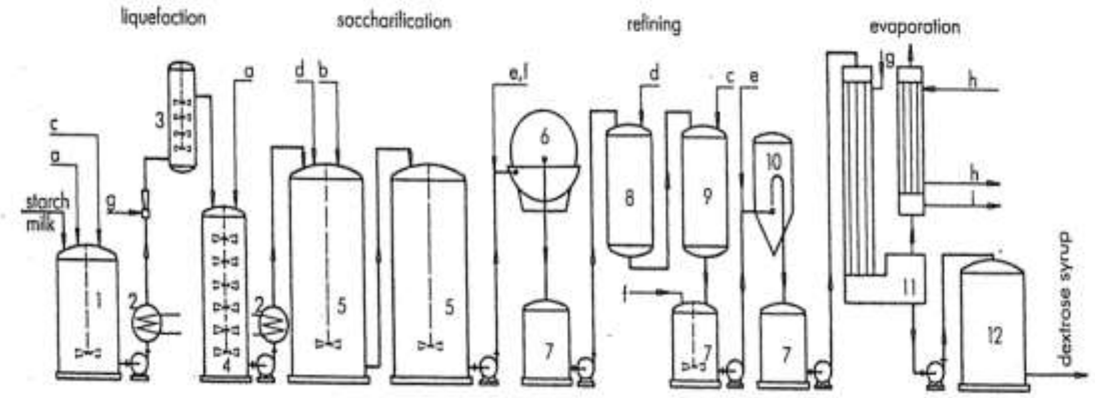
The sorbitol is decolourized and demineralized in ion exchangers and then evaporated to a dry substance content of 70 % .

Dry sorbitol can be produced from liquid sorbitol either by crystallization or by drying.

Either dextrose monohydrate dissolved in water or dextrose syrup may be used as a starting material. The syrup is mixed with the recycled catalyst and pumped into the high-pressure hydrogenation reactor with hydrogen gas being added at the same time. The heating and reaction processes proceed in several steps in order to prevent side reactions . when hydrogenation is finished, the mixture is cooled and the hydrogen gas is separated from the sorbitol/ catalyst mixture.

Since the hydrogenation process requires hydrogen, this hydrogen has to be produced by electrolysis of water or has to be made available form another process source. A compressor keeps this gas and the recycled hydrogen at an operating pressure of 150 bar .

Process Flow Diagram for Dextrose Syrup



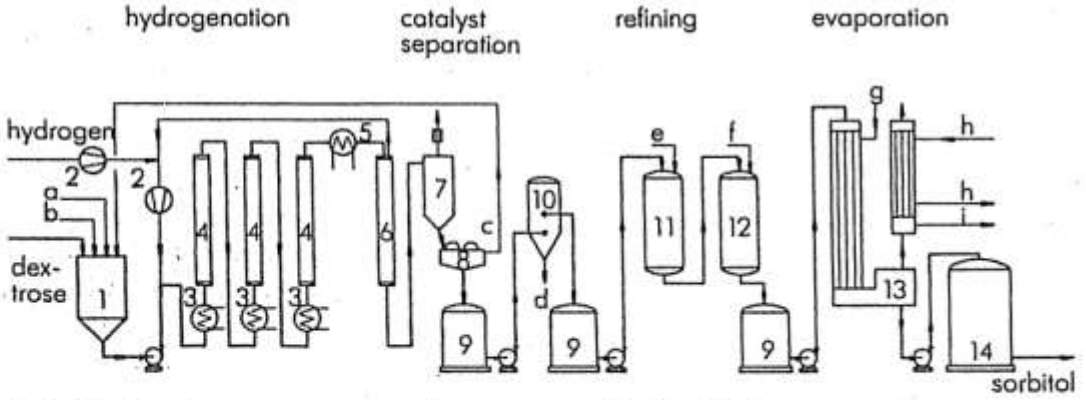
1 starch milk tank
2 heat exchanger
3 preliquefaction
4 liquefaction tank
5 saccharification tank
6 filter

7 tanks
8 cation-exchanger
9 anion-exchanger
10 candle filter
11 evaporator
12 product tank

a α-amylase
b amyloglucosidase
c NaOH
d HCl
e filter aid

f activated carbon
g steam
h cooling water
i vapour condensate

Process flow Diagram for Sorbitol



1 feed tank
2 HP-compressor
3 HP-heat exchanger
4 HP-reactor
5 HP-cooler
6 HP-gas/sorbitol separator
7 LP-gas/sorbitol separator

8 separator catalyst/sorbitol
9 tank
10 candle filter
11 cation-exchanger
12 anion-exchanger
13 evaporator
14 product tank

a catalyst
b NH_3
c recycled catalyst
d non-active catalyst
e HCI
f NaOH
g steam
h cooling water
i vapour condensate

25 - Margarine

Introduction

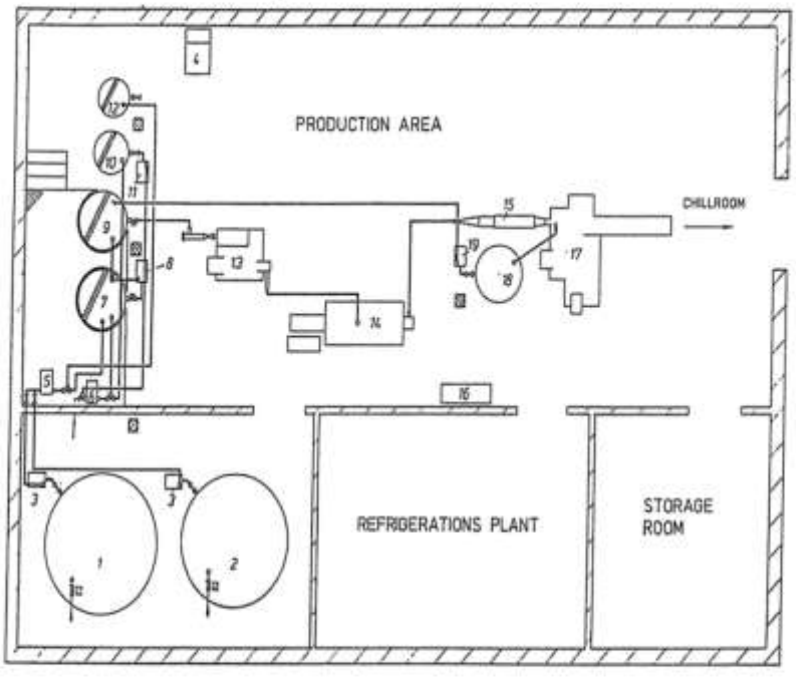
In the course of the past 50 years margarine has been developing steadily into a nutrient fat of high dietetic value that in many cases is even preferable to butter. It is spreadable, an emulsion of certain oils and fats. For oil, soya oil, cotton- seed oil, sunflower oil or peanut oil are the main ingredients; cocoa fat, palmoil or plam-kernel fat the main fats. Apart from these vegetable raw materials, high-value oils from mammals or fish can also be used for the production.

Margarine contains polyunsaturated fast which contribute to the reduction if the choles-terine level thus also reducing the risk of degeneration of arteries and coronary vessels, which is one of the main reasons for heart-attacks and apoplexy of the brain.

Hence margarine also has become an import-ant component of a health diet increasing its appeal to all those who want ‘ to lead a healthy life ‘.

The described plant has been designed for the 500 kg / hour .

Layout of the Production Plant



Description of the production process

Oils and fats in the required quantities are conveyed from the storage tanks 1 + 2 via the volumetric 5 into the stirring vessels by means of centrifugal pumps 3 . whilst in the stirring vessel 7 the margarine consisting of oil, hydrogenated fats, emulsifier, lecithin, water, salt and other ingredients, is formed. The stirring vessel 9 is used as buffer vessel. The emulsifier / lecithin phase is formed in the stirring vessel 12 and manually led to the stirring vessel 7 . the water / salt phase is formed in the stirring vessel 10.

The necessary water quantity for the batch is added via the volumetric meter 6. By means of the centrifugal pump 11 and again via the volumetric meter 6 the water / salt phase is led into the stirring vessel 7. Until the margarine emulsion is pumped into the buffer vessel 6 by means of the centrifugal pump 8, the emulsion is kept circulating in the stirring. Vessel 7 by the same pump to guarantee a steady and continuous mixing procedure.

A gear pump 13 pump the margarine emulsion to the kombinator. This Kombinator is a permanently operating heat-exchanger in which internally rotating knives keep on scraping the product from a cylindrical heat transmission surface. From the kombinator the product is conveyed via the resting implement 15 to the packing station 17.

In case of any faults in the production the margarine can be conveyed to the remelting vessel 18 to be liquefied again and conveyed back to the buffer vessel 9 by the centrifugal pump 19.

In the packing station the final product is automatically filled into the containers .

26 - Maize Starch

Introduction

Like other commercial starches, maize starch has a great many uses. They include domestic use as food in puddings, soup and gravy thickeners, as cold or hot water laundry starch, as a preferential water absorber in baking powder, in the manufacture of confectionery, in sizing and finishing textiles and papers, as a binding agent in papers, in making adhesive pastes, in conversion to dextrins which are the bases of many adhesives, in syrup and sugars, as a binding and diluting agent in the preparation of pharmaceutical products such as pills and tablets, in cosmetics etc. Moreover, the production of maize starch yields some by - products that haven a high commercial value .

Description of the production process

The maize is cleaned and by means of a pneumatic conveying blower transported into the steeping vats. The steeping water has a temperature of max. 52 °C which is maintained by circulation via a heat-exchanger. To facilitate the gluten separation 0.2 to 0.3 % sulphurous acid is added. Apart from the sterilization effect this additive also bleaches the starch.

After draining off the steeping water, the steeped maize is discharged by screw conveyors to the degerminating mill. It breaks up the maize kernels and sets the germs free without damage-ing them. The maize slurry drops into the germ separator where the fat-containing germs are separated from the slurry and flow onto a container. They are pumped into a washing machine and a dewatering press. After this dewatering the germs are dried in the germ drier. Then they are ready for storage. Having a high-value edible oil content of approx. 45 % they can be used for oil extraction .

The maize slurry flows into the container and is pumped to the refiner miil. The maize slurry pump delivers it to the extraction section for-coarse fibre washing. The starch milk is collected in raw milk vessels equipped with stirrers.

The husks, shells and coarse fibres are conducted to the dewatering press where they are mechanically dewatered. The crude starch milk is pumped to the extraction section for fine fibre washing. From the extractors the starch-milk flows to the container. From there the pump conveys it into the first separator via a filtering device. In this separator the gluten is separated from the starch milk. The milk is washed again in a second and third separator or hydro-cyclone plant and concentrated. The gluten water is Collected in a container and then pumped to the concentrator. The concentrated gluten flows into the container to be mixed with the pre-dewatered fine fibres coming from the extraction section and directly dewatered by a vacuum filter.

By means of a screw conveyor the gluten, the pressed fibres and husks are fed into a dryer. The resulting product is a high quality animal feed .

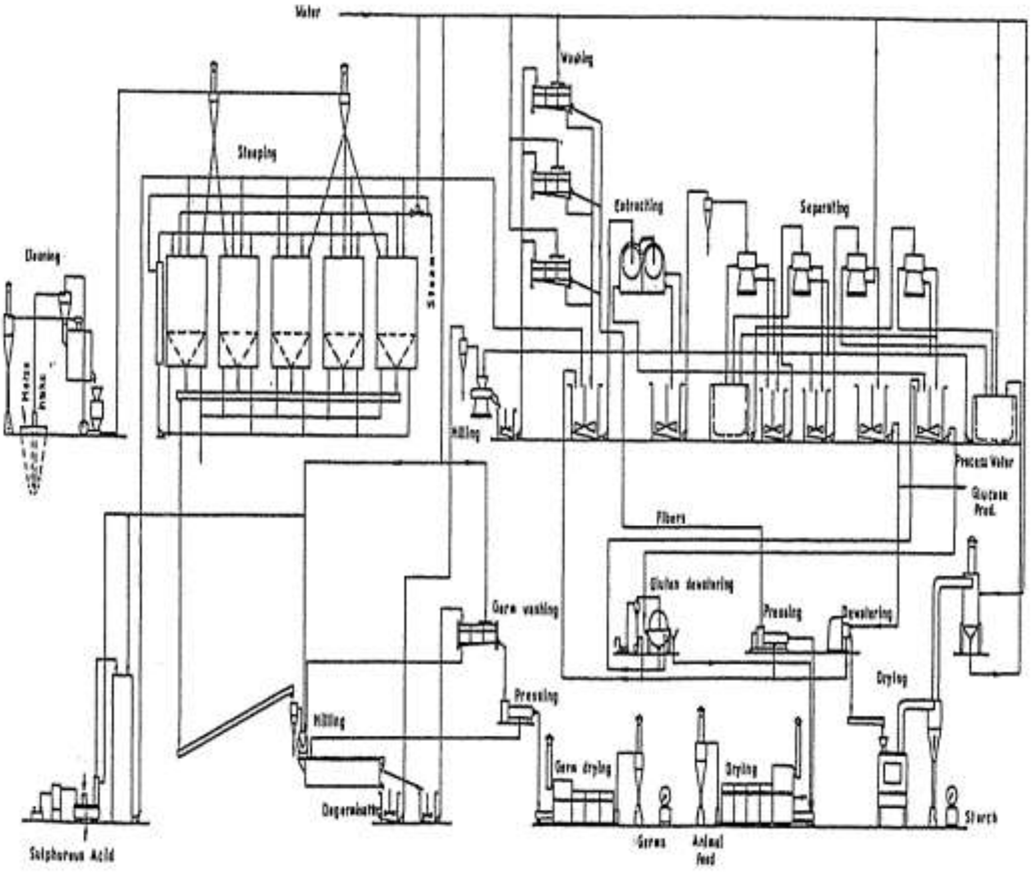
The starch milk that has been collected in the pure starch milk container is pumped to the centrifuge. The scraped starch is transported by a screw conveyor to the starch dryer to reduce the water content. The dried srarch is collected in a cyclone. Via rotary discharge sluice and sacking scale the product is sacked-off.

The resulting starch is of high quality and corresponds to international standards.

Design Data

Maize yield per ha	7 t
Starch yield per ha	4.55 t
Raw material	50 t / 24 h maize moisture Content 14 % H_2O
	32.5 t commercial Starch moisture
Product	Content 13 – 14 % H_2O
	10 t animal feed 10 – 12 % H_2O
	3.5 t germs moisture Content 2 – 3 % H_2O

Process Flow Diagram



27 - Wet – blue leather

Developing countries that export raw raw hides and skins often wish to make better use of this indigenous raw material – often one of the few resources available – by producing leather locally. However, building a complete finished – leather factory could result in economic failure. Entering the international leather market and obtaining a satisfactory price for finished leather are extremely difficult, especially at first. Therefore, finished leather should be produced only if a reliable outlet, providing an adequate pries guarantee, is assured . The production of wet – blue leather does not entail the same risks.

Ordinarily it is easy even for a new manufacturer to obtain reasonable prices, since the customer does not need much time to determine whether the product is suitable for his needs. International demand for wet-blue leather is generally very high.

The process

The process for making wet-blue leather is described blow and illustrated in figure I. Soaking is aimed at restoring hides and skins to the state they had immediately after the flaying from the animals. Flayed hides and skins are in most cases cured to prevent putrefaction before reaching the tanneries. In industrialized countries fresh hides are wet salted, while in developing countries they are usually salted and dried or air dried without salt. Dried stock requires pre-soaking and a more intensive mechanical treatment (fleshing) than wet - salted hides.

Trimming is carried out to remove those parts of raw hides which would of no use as leather and which could cause difficulties in later operation.

Fleshing is performed to break up the fibres of the hide substance and to remove , flesh tissues. Wet - salted stock of good condition may not need tho fleshing after soaking, but all stock should be fleshed after liming .

Liming / unhairing is required to open up the hide structure and to dissolve the hair roots, leaving a clean grain side free from hair .

Deliming / bating removes the lime and certain hide oonstituents and degradation products that are detrimental to a satisfactory result in the subsequent Pickling conditions the hide for easy and sound chrome tanning .

Wringing is used to remove mechanically as much water as possible from the wet - blue leather. This also facilitates grading, which is usually necessary for successful marketing. A combination of wringing and setting-out will enhance the appearance of the product and is therefore economically advantageous . this could be omitted by simply piling the hides for a considerable period of time, but the result is usually unsatisfactory.

The factory

A medium – sized tannery using dried cattle hides as its main raw material is described below as an example. Capacity can be expressed in numbers, in weight of processed stock or in produced surface area. Since the type, source, source, weight, cure etc. of the hides or skins have considerable influence on the conversion factors, these may vary widely, the factory's approximate capacity for dried cattle hides as well as wet-salted cattle hides or dried goat skins is shown in table l. Machinery and equipment required for the tannery shown in table l is listed in table 2 . Annual raw material and utility requirements are shown in table 3.

Figure I. Process flow sheet for wet-blue leather production

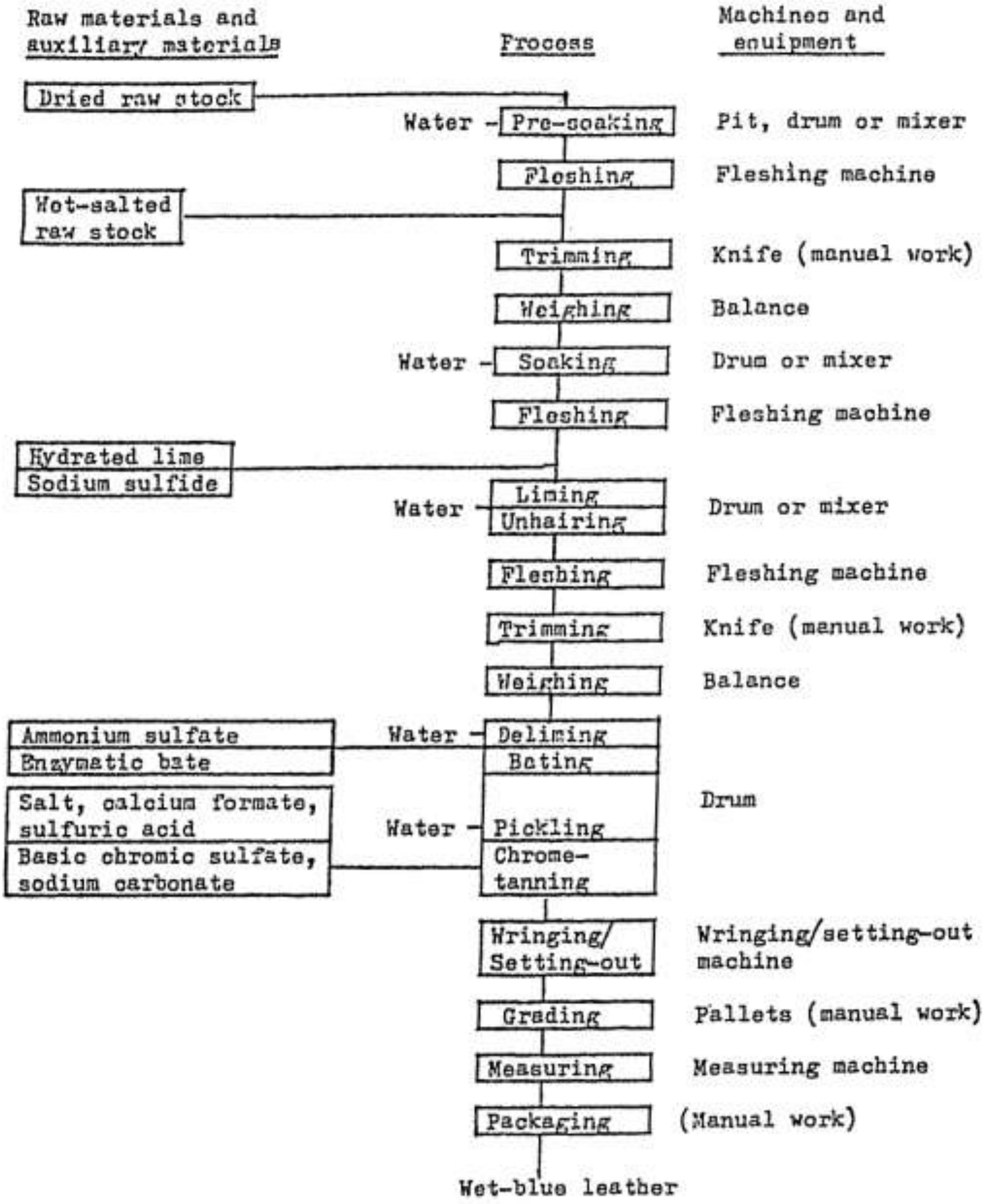


Table 1. Estimated annual capacity a/

	Dried cattle hides	Wet-salted cattle hides	Dried goat skin
Pieces (number)	60,000	50,000	400,000
Weight (kg raw)	600,000	1,000,000	200,000
Area (m^2, wet-blue)	190,000	200,000	220,000

a/ The figures given are only indicative and must be adjusted with respect to the condition of the local raw hides and skins.

Table 3. Estimated annual requirement of raw materials and utilities

Item	Amount
Raw cattle hides, dried	600 tons
Chrome salt, 26% Cr_2O_3	70 tons
Common salt	60 tons
Calcium hydroxide, powder	40 tons
Sodium sulfide, 60%	40 tons
Ammonium sulfate	15 tons
Sulfuric acid	12 tons
Sodium carbonate	10 tons
Enzymatic bate	6 tons
Calcium formate	5 tons
Fuel oil	5 m^3
Electricity	120,000 kwh
Process water	25,000 m^3

An ample supply of process water is absolutely necessary for a tannery.

Although in recent years there ahs been a clear trend towards less water use, the quantities needed are still considerable . for a wet-blue tannery a consumption of 25 m^3or more per ton of wet – salted hides or skins is still fairly narmal. Water may be taken from a river or from a deep well.

Generally it does not need any treatment. Drinking water has to be supplied separately.

The effluents from tanneries have caused growing concern everywhere. As a rule some kind of treatment is necessary in order to comply with sanitary laws or to avoid serious complaints. Locating the tannery close to a fast - flowing river will usually make the problem easier to solve. The river may supply the process water and at the same time serve as an acceptable recipient for the tannery effluent.

The tannery given as an examole here would need approximately 100 m^3 of water per day , but the supply of larger quantities should be ensured for expansion .

The factory building (see table 4) may be of a fairy simple construction but the concrete foundation in the production area should be designed with the disposal of the different effluents in mind. The total factory site should be about 5,000 m^2 to include space for effluent treatment which might be necessary and for future expansion.

28 - Crust Leather

Compared with wet – blue leather the marketing of crust leather is much more difficult, above all because customers have fewer options for further processing. The visible properties such as size, thickness, fullness, looseness of grain and grain damages together with the physical and chemical properties such as tensile and tear strength, chrome and fat content etc, constitute the leather quality and have a decisive influence on the obtainable price it aslo takes time, often years, to convince prospective customers of the consistency in quality and deliveries from a new leather supplier.

The added value and the lighter shipping weight of crust leather are, however, obvious advantages. The experience gained in the production and marketing of wet- blue leather and a gradually increasing volume should in time make crust leather production profitable.

The process

The crust leather production process is described below and illustrated in figure I.

Most bovine crust leather is sold as sides (haves) ; whole hides are cut into two sides along the backbone line. It is usually an advantage to perform side cutting before splitting, in which the hides are cut parallel to the grain (upper surface) in order to get an even and appropriate thickness.

The piece of material obtained from the backside is normally processed into split leather.

Neutralizing, retanning, dyeing and fat-liquoring will confer the more or less final characteristics to the body of the leather.

Today these steps are generally combined as one operation in the same drum.

Wringing lowers the water content in the leather mechanically. Removing water by evaporation, I.e heat drying the leather is much more costly.

Setting - out aids in obtaining a smooth leather and a larger surface.

Vacuum drying will help in fixing a smooth grain; air drying in a tunnel will then dry out the leather to the required final water content. Other drying methods are possible and could be preferable in specific cases .

The factory

As a second stage, the – blue tannery could be integrated into crust leather making plant, the capacity remaining the same. Some of the process sequences in the wet – blue tannery could be changed to suit the new processes better;

For example, splitting could be done in lime instead of in blue. This would be more difficult but would give certain advantages in the processing of the splits.

Figure I. Process flow sheet for crust leather production

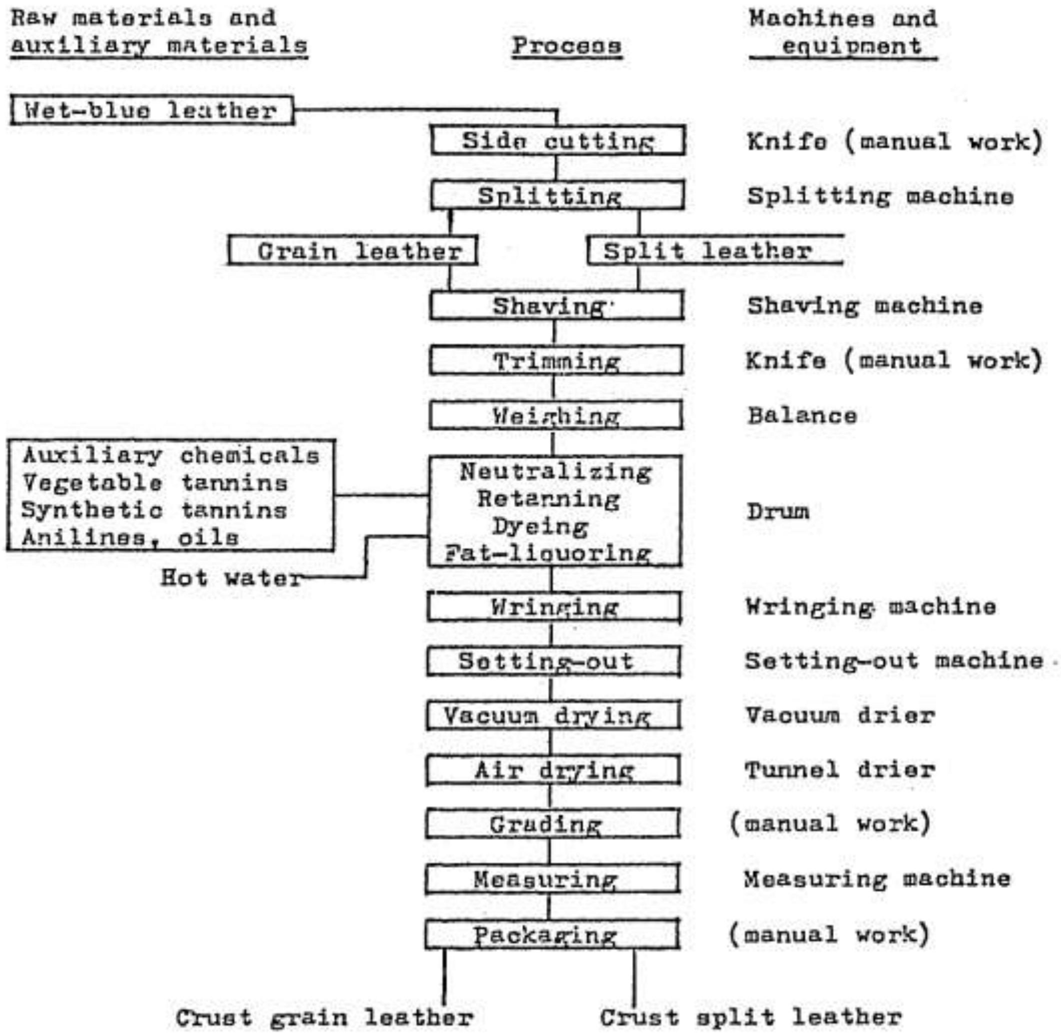


Table 1. Estimated annual capacity [a]

	Dried cattle hides	Wet-salted cattle hides	Dried goat skins
Pieces (number)	60,000	50,000	400,000
Weight (kg, raw)	600,000	1,000,000	200,000
Area (m^2, crust)	180,000	190,000	210,000

[a] The figures given are only indicative and must be adjusted with respect to the condition of the local hides and skins.

Tables 3 show machines and equipment, raw materials and utilities, plant size and personnel required for the combined wet-blue and crust leather plant .

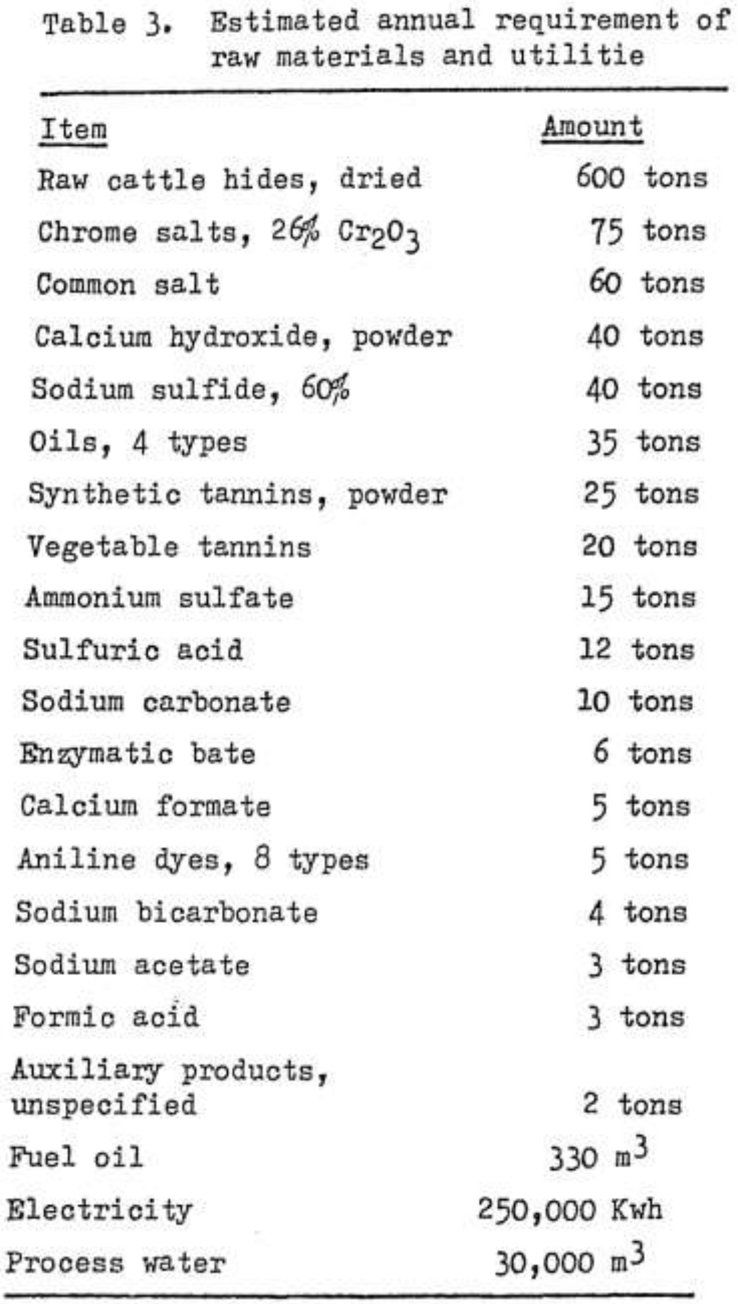


Table 3. Estimated annual requirement of raw materials and utilitie

Item	Amount
Raw cattle hides, dried	600 tons
Chrome salts, 26% Cr_2O_3	75 tons
Common salt	60 tons
Calcium hydroxide, powder	40 tons
Sodium sulfide, 60%	40 tons
Oils, 4 types	35 tons
Synthetic tannins, powder	25 tons
Vegetable tannins	20 tons
Ammonium sulfate	15 tons
Sulfuric acid	12 tons
Sodium carbonate	10 tons
Enzymatic bate	6 tons
Calcium formate	5 tons
Aniline dyes, 8 types	5 tons
Sodium bicarbonate	4 tons
Sodium acetate	3 tons
Formic acid	3 tons
Auxiliary products, unspecified	2 tons
Fuel oil	330 m^3
Electricity	250,000 Kwh
Process water	30,000 m^3

29 - Finished leather

As noted earlier, it is much more difficult to market leather at acceptable prices, finished than crust leather. This is especially true when trying to export. Therefore, sufficiently large domestic market, i.e . local leather shoe and leather goods industries that require substantially more finished leather than the tannery plans to produce would be a good prerequisite for establishing a finished leather factory.

This prerequisite should de disregarded only if there is a firm agreement to purchase tannery's finished leather. A local market must be available in case for lower grade leathers that cannot be sold on the international market or only at ruinous prices there.

A long introduction period must also be allowed for, a fact that wet-blue, then crust and finally finished leather.

The process

The process for finished leather production is described below and illustrated in figure I.

Conditioning by uniformly increasing the water content in the dried leather is necessary before staking.

This operation will mechanically soften the leather . too low a water content will cause a loose grain, while too high a water content will make staking easy but the stiffness of the leather will return after drying out again. Different parts of the leather area may need more intensive mechanical treatment, necessitating a second partial staking.

A grain - damaged :

leather can be improved considerably by buffing the grain surface; the resulting product is called corrected leather.

After buffing the leather dust has to be removed because it would interfere with a proper finishing. The whole operation should be avoided when producing higher quality leather (full-grain leather).

Plating will close and smooth any coat of binders and resins.

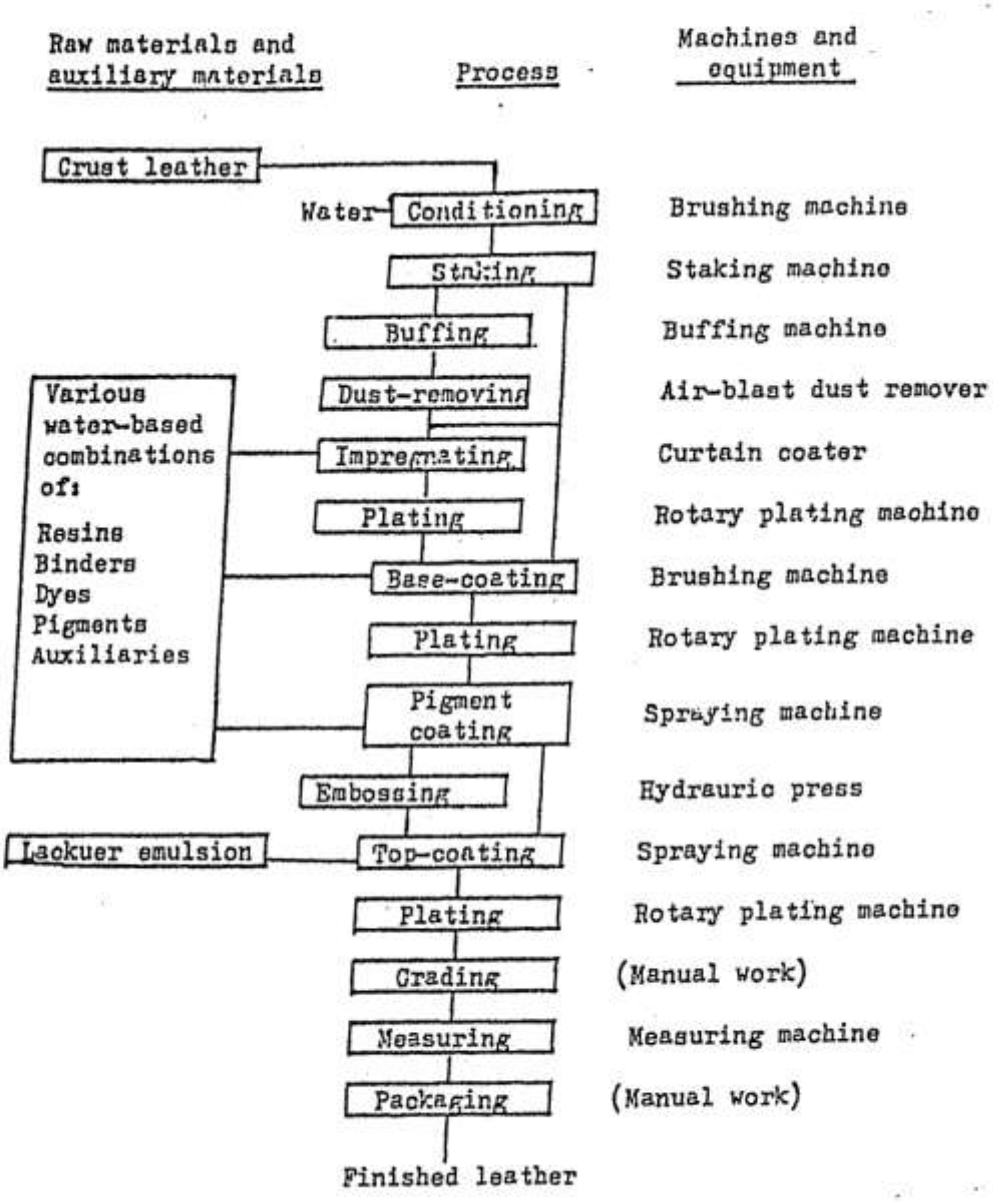
Several coatings of various kinds are normally necessary to supply colour and wear resistance to grain side.

Embossing is a way of pressing a specific pattern, e.g. a reptile grain, into the cattle hide grain. The new pattern will cover many grain damages and is consequently used primarily on the lowest leather qualities.

The factory

Table 1 to 5 show the effect of adding a finished – leather plant to the wet – blue and crust leather tanneries, the capacity remaining the same . the integration might again necessitate the reorganization of a few processes such as grading / sorting etc

Figure I. Process flow sheet for finished leather production



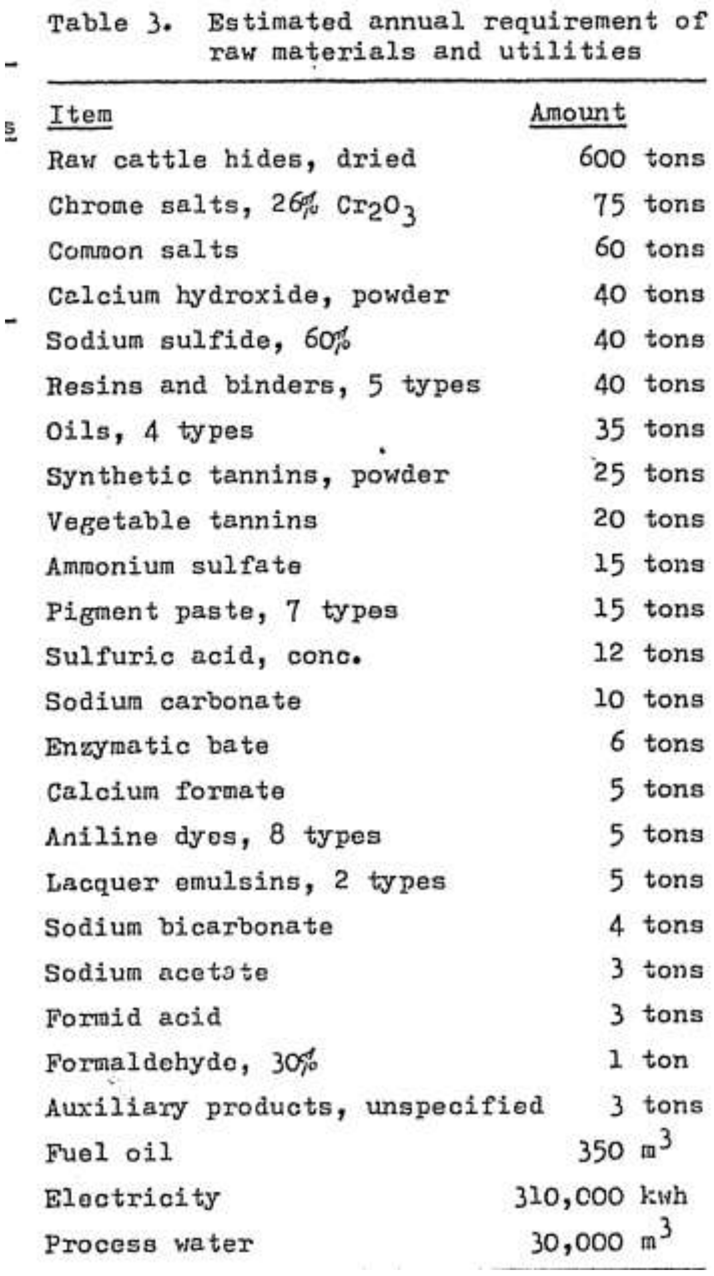


Table 3. Estimated annual requirement of raw materials and utilities

Item	Amount
Raw cattle hides, dried	600 tons
Chrome salts, 26% Cr_2O_3	75 tons
Common salts	60 tons
Calcium hydroxide, powder	40 tons
Sodium sulfide, 60%	40 tons
Resins and binders, 5 types	40 tons
Oils, 4 types	35 tons
Synthetic tannins, powder	25 tons
Vegetable tannins	20 tons
Ammonium sulfate	15 tons
Pigment paste, 7 types	15 tons
Sulfuric acid, conc.	12 tons
Sodium carbonate	10 tons
Enzymatic bate	6 tons
Calcium formate	5 tons
Aniline dyes, 8 types	5 tons
Lacquer emulsins, 2 types	5 tons
Sodium bicarbonate	4 tons
Sodium acetate	3 tons
Formid acid	3 tons
Formaldehyde, 30%	1 ton
Auxiliary products, unspecified	3 tons
Fuel oil	350 m^3
Electricity	310,000 kwh
Process water	30,000 m^3

30 - Plywood Making Plant -1

Plywood is a product in which several even numbers of boards are plied with glue to dissipate or compensate respective particular defects and to offer a wide size. Plywood thus produced has the particular features of being a wood with the least defects, wide size, long length and high strength mechanically (physically). Plywood is widely used in our daily life and contributes much to the development of culture and welfare. Its demand is ever on the increase ..

Outline of the plant

This plant aims to use logs produced in tropical and semi-tropical regions and it is planned to utilize most effectively logs of large diameter class, straight and 0.45 – 0.55 of absolute dryspecific gravity .

Type and quality of products are as follows with a daily output capacity of 4,000 sheets (8 hrs .).

Size : 122 cm x 244 cm x 4 mm , (4’ x 8’ x 4 mm)

Quality : Type II AA (1 st class), AB (2 nd class) and BB (3 rd class)

The production is used for general construction purposes such as interior material for housing, ships, vehicles, and furniture, and secondary processing is done on the face and used for similar purposes .

During the course of production of plywood, edge of logs, peeled core, and other waste from plywood and veneer are produced, and these wasters are shipped and used as materials for paper, fibreboard, and particle board. At this plant, they are also used as fuel for the boiled. Some of the edge wood and peeled core are collected and together with unqualified veneer logs, they are sawed into lumber and sold .

Process Descripion

Preparation of logs

1. Cutting of logs

Logs stored in a pond are conveyed to the factory yard and are cyt by the chain saw to the desired length for feeding to the veneer lathe or to the length of the veneer sheets to be produced

2. Cooking or steaming

High – density logs require pre-treatment by cooking vats or steam chambers because they are hard and frequently too resinous to permit fresh cutting .

Veneer Manufacturing

1. Veneer cutting

1) Rotary cutting

In automated mills, log chargers with log centering devices are usually installed for speedly, automatic feeding of logs to the veneer lathe. As the log is centered by the centering device before feeding, it can immediately by fixed on the spindles of the veneer lathe and peeled in an endless sheet by utilizing veneer reeling and unreeling machines, the speed of the cutting and reeling is fully synchronized. Full reels are so stored on the deck of the system.

2) Slicing

The " edge-grain" veneer required for the production of decorative plywood is cut by the veneer slicer, which slice across the grain of the log .

Fig. 1: Construction of Plywood

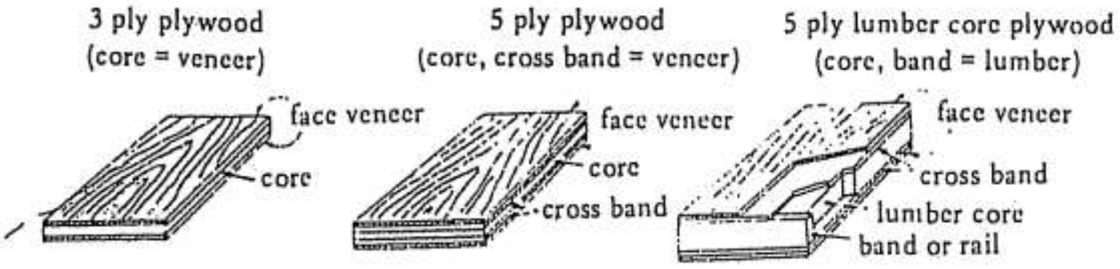
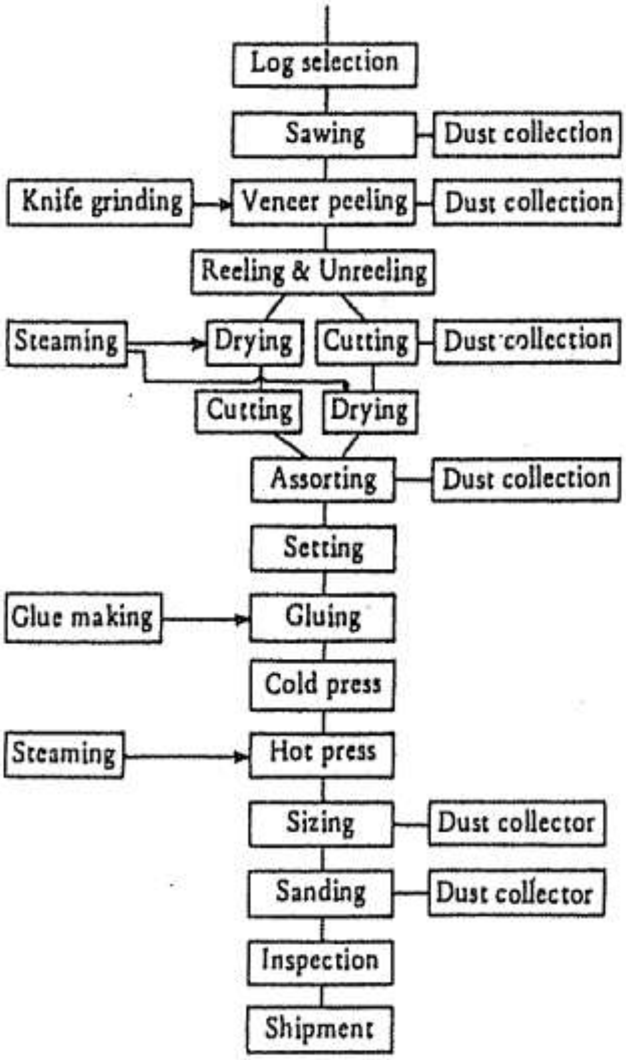


Fig.2 : process flow sheet for plywood , manufacturing plant



2 . Green veneer clipping

The sheet of green veneer peeled by the veneer lathe is cut by the automatic or manual veneer clipper into the desired dimensions. Full rolls of the reeling machine are transferred to the unreeling unit, and the veneer is unrolled and cut by the veneer clipper .

Where the tray deck system is used the veneer can be sent directly front the tray to the veneer clipper of dryer.

3 . Veneer drying

In order to ensure the maximum hding effect of adhesive, veneer sheets must be dried adequately before gluing them together. The moisture content of veneer sheets is the most important factor in gluing. There are two types of veneer dryers, namely her and continuous veneer dryers.

4 . Veneer preparation

Narrow strips of veneer arc joined together into full size by the following methods.

1) Veneer jointing

For the practical use of narrow on irregular pieces of veneer, the edges must be cut straight for precise jointing. The Arisun clipper or the veneer guillotine jointer are for this purpose.

2) Veneer taping

After the veneer is processed by the veneer jointer, the veneer taping machine is used to join the veneer edge to edge to prescribed dimensions. This machine is usually used for the jointing of the back veneer sheet.

3) Veneer edge gluing

The veneer edge- gluer is used for continuous glue – coating and splicing of the edges of veneer pieces which are carried with the grain at right angle to the direction of the feeding, automatically cutting the veneer to the desired length. Thermo-setting or thermo-plastic glue can be used with this machine . the veneer splicer is used to Join the edges of veneer with glue instead of tape and is suitable for both back and core veneer sheets.

Manufacture of plywood

1. glue mixing the glue mixer is used to mix the liquid or powder with the proper amount of water, harder, filler and other ingredients.

2. Glue spreading

The glue spreader spreads the glue uniformly on the core veneer sheets in the first process to produce plywood from veneer sheets.

3. Pre - pressing

Veneer sheets glued together are stacked and pre-pressed by the cold press. Pre-pressing minimizes overlapping or gapping of the center core veveer which may occur during the carrying of the glued veneer sheets to the hot-pressing process.

4. Hot pressing

After pre-pressing, the plywood is fed to the hot press, where it is put under pressure of 10 – 15 kg/ cm^2 in a temperature of 110 – 120 ْC.

Finishing

1. Sizing

After being hot pressed, the plywood is cut to prescribed specification by the double sizer, which consists of rip – saw and cross-cat machine.

2. Sanding

The wide belt sander is generally used to finish plywood panels. It utilizes an abrasive belt which runs on serrated rubber contact rollers or platens. The number of heads, the combination of contact rollers and platens and the hardness of the rubber are determined by the kind and grade of finish desired.

3. Grading and inspection

After sanding, the plywood panels are carried by an automatic conveyor for grading and inspection . the panels are inspected and selected for delivery while they are on the conveyor.

Required plant site Area

The required building site is 32,000 m^2 (400 x 80 m) plus 10,000 m^2 for future expansion.

The detailed description of machinery and equipment for 4,000 sheets / day plant are omitted here.

Locational condition

1. Site where collection of logs is
   (1) site facing unfrozen rivers, lakes and sea.
   (2) If there is no available water surface, site must be convenient for log collection .
2. Convenient site for sale and trans portation of products .
3. Site wher labour force is available .
4. Site where procurement of utilities is convenient.

Table 1: Requirement of Raw, Sub Materials & Utilities

Item	Spec.	Quantity
Logs	Suitable for plywood	106 m^3/day
Gum tape	For veneer lathe	23,000 m/day
	For patching	7.000 m/day
Urea resin		3,220 kg/day
Wheat flour		705 kg/day
Ammonium chloride		0.65 kg/day
Electricity		980 kWh
Steam		10 tons/hr.
Water		20 m^3/hr.
Nitrogen gas		150 ℓ/50 hr.
Lubricating oil	JIS No. 1 turbine oil	5,000 ℓ/300 days

31 - Plywood Plant - 2

The plywood industry has achieved a relatively rapid growth since the invention of plywood by veneer lathe in 1880 .

Reaching a peak in 1973 with the global production of some 42 milion cubic meters of plywood, it then turned sluggish due to so- called worldwide oil shock but shows signs of gradual recovery in recent years.

Major producing countries are in order of the United states, japan, Canada, Korea and Russia, while mian exporting nations are Korea, Taiwan, Singapore, Canada and Finland. Importing countries are in the order of the United states, England, west Germany and the Netherlands .

In the plywood industry, logs need forst to be dried, requiring to be located in dry areas. Since logs constitute a large volume freight, the place should also be where a manual handling is possible in most cases or a convenient means of transportation is available. The river, sea coast, or port area are preferable in this respect.

Compared with other wood - related industries, workers for the plywood manufacturing need to be highly skilled, and as products are standardized and made uniform in quality, many good engineers as well as skilled workers are also required.

Among the plywood-related industries, the industry for urea and melamine resins as adhesives first contributes to the development of paint and varnish manufacturing industries in a sort of chain reactions. The transportation of logs also contributes to the development of a shipping business.

With the improved living standard and sophisticated products, the plywood is used not only as basic building materials but also as materials for television and radio cabinets, vehicles, interior decoration of vessels and other packing containers .

As referred to in the above, the plywood industry is definitely suitable for many countries in southeast Asia and middle and south America where rich resources of logs and skilled work force are available, not to speak of well-developed traffic .

Products and specifications

The plywood is a most widely used commodity among the processed wood products. It is produced by putting numbers of thinly sliced wood sheets together by means of adhesives, usually being 3-ply, 5-ply, 7-ply and 9-ply with the thickness of 1-30 mm. Depending upon its uses, the sixe is usually 91 cm x 182 cm or 122 cm x 243 cm .

Depending upon its manufacturing process, the plywood is divided into the rotary cut veneer, sliced veneer, sewn veneer and half-round veneer with a wide range of uses for uses for wood products, furniture, metallic furniture and electronics goods.

Logs as its raw material are of teak, kapur kapor, apitong Keruing, beech, birch, oak and other needle leaved trees. As adhesives, resorcinol resin, phenolic resin, melamine resin and the like are used.

The plywood produced in various kinds of raw materials in accordance with its uses can be easily worked on including bending, is sturdy compared with its weight, low in thermal conductivity even in dried plywood condition and excellent in adsortivity of sound or mechanical oscillation with wide uses .

In this plant ,an example of the most widely used product out of diversified veneers is given for explanation in terms of its manufacturing plant.

Size : 1,200 mm x 2,00 mm x 2,400 mm x 4,0 mm
Veneer composition : face 0.95 mm , core 2.4 mm back 0.95 mm
Moisture content : 10 – 20 percent

Contents of technology

1) Process Description

i) Kogs transported from the storage yard are first sorted in accordance with uses and then cut laterally prior to peeling .

The log roller conveyor in use is a long drum type roller with the dimension of 300 mm in diameter and 950 mm in length and feed speed of 10 m/min .

The chain saw ahs the maximum cutting diameter of 1800 mm with the chain speed of m / sec. the permissible length of a log for the log charger is 1,800 . 2,760 mm and the maximum diameter of the log to be loaded is 1,650 mm , the charging speed being 25 m / min .

The rotary lathe is a heavy duty, high speed and precision type with hydraulic unit for both spindles.

The permissible peeling length is 1,800-2,760 mm with the maximum block diameter of 1,650mm and spindle revolution of 200 rpm. The thickness of a veneer of a veneer is 0.5 - 6.0 mm.

ii) The next processes are the reeling and unreeling. The reeling machine in use is of automatic circulation system with the length of 9 feet . in the case of 9-ft reeling machine, the length is 15,000 mm and the width is 3,500 mm, the maximum diameter to be reeled being 1,000 mm . in case of 5-ft reeling machine, it is of single deck with the length of 10,000 mm, width of 2,550 mm and maximum diameter of 1,000 mm .

iii) Raw single veneer sheets thus prepared are dried in a dryer to the moisture content of 5 - 1 percent . the face and back are dried in a continuous net dryer while the core is dried in a roller veneer dryer. The continuo us net dryer with the width of 2,740 mm is of three decks, the heating section measuring 28,000 mm(2,000 x 14 sec) and the cooling section 4,500 mm (1,500 x 3 sec) .

There are 20 sets of fans for charging the steam with the pressure of 15 Kg / cm^2. The roller veneer dryer for drying the core is of 4-deck type with the width of 4,450 mm , the heating section measuring 28,000 mm in length. The pressure of steam used is also 15 kg / cm^2 and its feed speed is 0.9-9.0 m / min

iv)The face, core and back thus prepared are coated with glue by means of a glue mixer . the glue spreader used is of rubber roll and doctor roll system.

The glue roller diameter is 305 mm while the doctor roll diameter is 230 mm with the feed speed of 70 – 90 m / min.

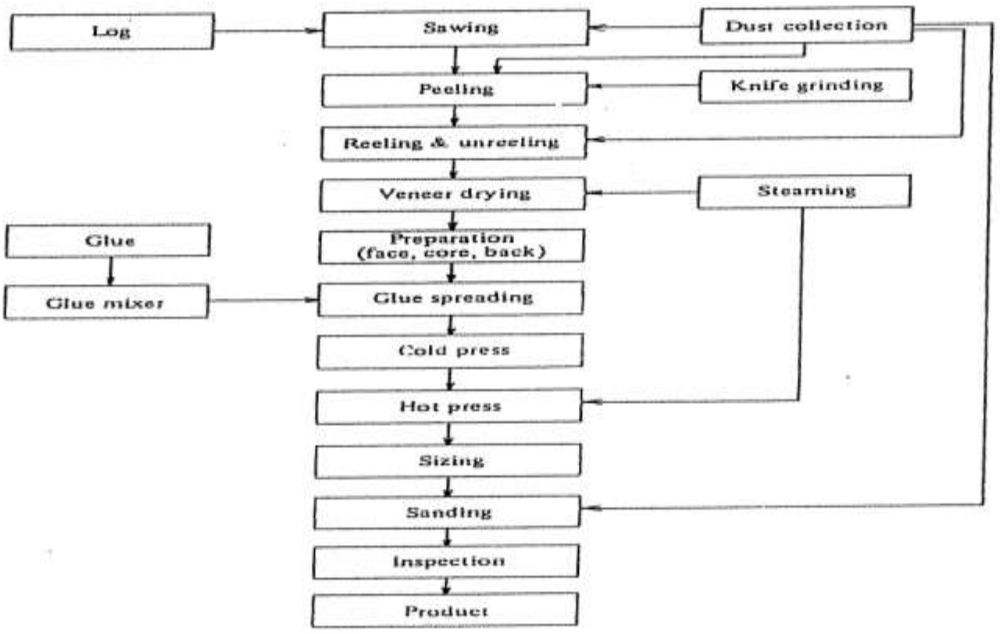
v) A fixed quantity of unifinished products are left alone under constant pressure. The pressing is first done by a hydraulic cold press which is of down stroke type making use of an infeed conveyor . the total working pressur is 500 tons with the table size of 1,400 x 2,700 mm and the rising and descending speed of 50 mm / sec . the hydraulic hot press is then used, pressing 40 veneer sheets each time. This press is of fully automatic hot press type with 200 kg / cm^2 working pressure .

vi) The glued products undergo the sizing and finishing . the surface treatment is carried out by sanding.

There are two different types of bottom sander and top sander. The bottom sander is of heavy duty type maximum working width being 1,220 mm and the permissible thickness 2.5 – 25 mm with the feed speed of 25-92m / min. the top sander is of three-head tupe with maximum working width of 1,220 mm and the permissible thichness of 2.5 – 25 mm.

vii) The finished product are moved by a sorting conveyor for inspection packing .

Plywood Manufacturing Process
Block Diagram



32 - Veneer Plant

Although nowadays the use of veneer has spread all over the world to an extraordinary extent and the production of veneer developed into a significant industrial branch, the first beginnings of this craft data back as far as to the early history of man. When the sepulchral chamber of Tut Anch Amon of the 18 th Dynasty of Egypt was disclosed, evidence was found that the artisans of the time of 1350 B.C. had, mastered the craft of veneering. We also Know masterpieces of the Hellenic times of Greeks and Romans.

However, up to modern times veneering as inlaid work was a mere craft. It was the technical development of the 19 th century that also brought immense progress to the production of veneer. The ever-increasing demand of large parts of the population for a refined style of living and the possibilities offered by a technology that developed in leaps and bounds, also opened vast chances for the establishment of an industry that produced veneer.

The various uses of veneer had also multiplied in accordance with the development of industrial manufacture of furniture, interior design, decoration cars and vehicles, ships, aircraft. Decisive for this breakthrough of industrially manufactured veneer were the low price, relatively easy handling and the scarceness of luxury – or hardwood. The described production line consisting of the machine units slicer, veneer drier and clipper, are Laid out to handle 20 cubic meters per shift.

Description of the Manufacturing process

For the production of luxury-wood veneer mainly hardwood of fine colouring and interesting grain is used.

These are the kinds of wood that are most frequently used for veneering:

In Europe oak, maple, ash, birch, nutwood, pear, plum, cherry .

overseas mahogany, teak, macore, jacaranda, and others .

Contrary to metal, wood is a living material following its own laws, and its processing requires specific knowledge on how to prepare the wood and set the tools and machinery.

The first step of manufacture is done at a so-called slicer. This machine is laid out for a cut-length of up to 4 m at a veneer thickness of 5.2 mm at most. The block to be measured is clamped down by a clamp activated by an electric motor. The maximum cutting capacity is 60 cuts per minute. The product is discharged by a discharging device which also prevents ruptures.

The cut sheets of veneer must have the following properties:

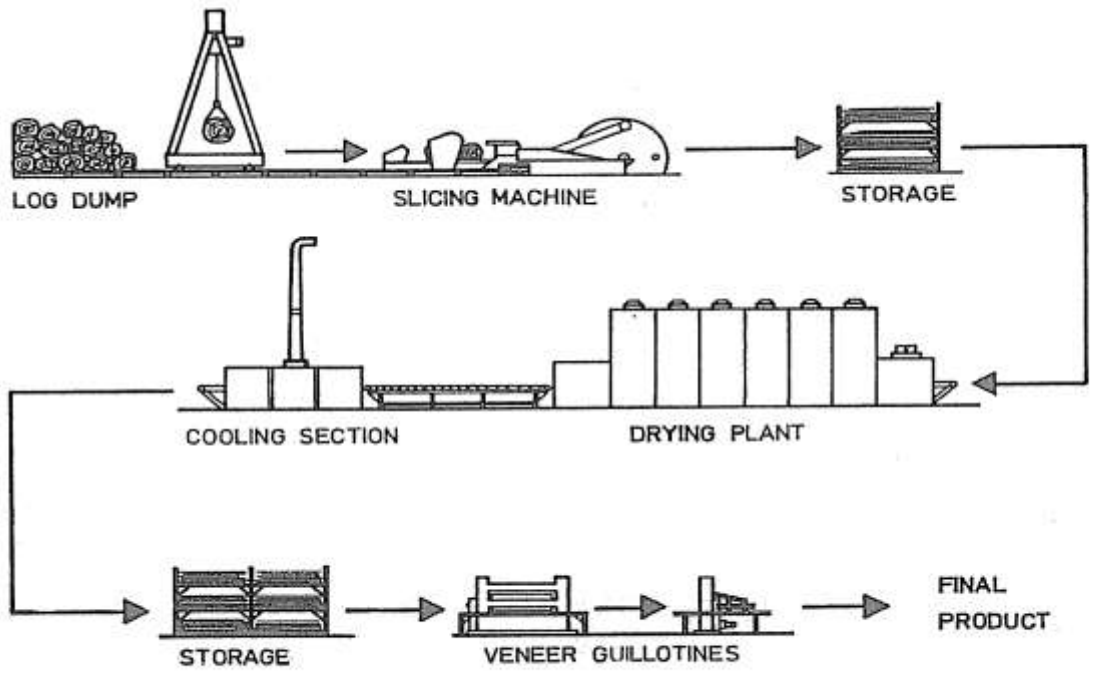
- They must not show the slightest irregularities;
- The product must be free of nodges;
- It must have a smooth silky surface;
- The sheets of veneer must be unstained.

The drying and cutting play an important part in every veneering plant. The classic drier for luxury wood is a jet aerated belt drier. The jet aereation is achieved by radial fans with the jets guaranteeing a high speed and even distribution of the air over the entire surface of the veneer.

Apart from the drying of the product and simultaneously; with the drying, a so - called ironing effect is achieved, which actually means a straightening of the veneer.

Despite all rationalization, the processing of high-quality veneer remains a predominantly manual procedure. The simultaneous cutting of the veneer packages and judging their quality by the personnel is the main factor for the optimum evaluation of the veneer. Longitudinal and cross-cut guillotines have been foreseen in the plant to keep the process flow smooth and disturbance-free.

Process Flow Diagram



33 - Toilet paper plant

It was as late as in 1803 or so that the paper industry came into being in Canada, which is one of the leading paper manufacturing countries in the world.

Development of raw materials and the invention of paper machines have ushered in an era of high quality and mass-production, and paper is now called the symbol of culture.

Toilet paper is in large and increasing demand and its manufacture can easily be embarked upon by small industry and parties who have had little experiences in paper making.

In japan, mass - producin mills gene-rally use wood pulp as the raw material for toilet paper. But smaller mills use wood pupl and waste paper together, or use waste paper 100 per cent. Waste paper is recovered at a high rate, and selection of quality is well controlled.

Wood resources are not distributed uniformly in the world. There are many countries which are poor I wood resources. It would, therefore, be meaningful to use waste paper which could be recovered easily as material for pulp.

Outline of the plant

Broadly speaking, there are two methods for processing waste paper, namely, continuous and batch systems. In general, the batch process is recommended when the daily production capacity of the mill is less than 100 tons.

Introduced here is a 5-15 tons / day batch system plant using waste paper as raw material. The raw materials and utilities required for this plant are as shown in table in table 2 . in this plant, other kinds of sanitary paper may be produced besides toilet paper.

Toilet paper is packed 100 or 120 rolls to a case of corrugated board for delivery to the primary wholesaler.

The Japanese standard of toilet paper is :

Roll width : 114 mm ± 1mm

Inner dia. Of winding core: 37 - 39 mm

1: Finished measured length : 45 , 55 , 64 , 75 m

2 : Substance of paper (crepe) : 21 - 23 g / cm^2

1: Out of the four lengths, the most popular on the market are 45 and 55 m.

2: Makers employ their respectively their respectively unique patterns of crepe.

Process Description

The manufacturing process begins when waste paper is moved up to the sorting yard above the digester by elevator. The sorted waste paper is fed into the global digester. Simultaneously with the feeding, sodium sulphite, soda ash, etc. are sprinkled thoroughly over the waste paper.

After stuffing of the digester has been completed, the gut for the digester is tightly as it is rotated .

The next step is the charging of the material into the blow pocher.

Girculation is performed by a propeller agitator, and the digesting chemicals are thoroughly washed in the washing drum.

When the washing is over, the material is transferred into the dump chest, from where it is moved up into the head box by pump. Water is added for dilution in the head box .

The material is then sent through the sliver screen and the jonsson screen for removal of dust. The material which comes out of the screen is transferred into the extractor for washing and dickering.

The material coming out of the extractor is stored in the bleaching chest.

When a chest becomes full, bleach liquor is added .

After the material has been left in the bleaching chest for a fixed time following the bleaching, it is flow-fed into the mixing chest, in which bleach liquor is thoroughly washed away.

Washing takes place in the washing drum. After the washing, fluorescent dyestuff or rhodamine is applied for colouring as may be required by consumers.

Now that this process has been completed, it is dropped into the stock chest, and sent into the machine chest.

Out of the machine chest, the stock is fed into the head box for flow-fed into the mixing tank at a regulated feed level.

In the mixing tank, the stock is diluted with white water coming out of the wire part, of which more hereafter, and then sent onto the vertical screen.

On the vertical screen, stock with a comparatively larger specific gravity and non-digested stuff are removed.

The material which has passed through the vertical screen goes into the tank and, via the high-pressure pump, is fed into the cleaner, with only accepted material fed into the paper making machine .

The accepted material goes into the flow box of the paper machine, out of which a fixed amount flows out into the wire part in consistency of about 0.15 – 0.2 per cent.

The stock which flows out is dehydrated by the table roll and suction box for transformation into a wet web, which is sent into the press part over a blanket.

The wet web is dewatered under the pressure of the roll, and pushed against the yankee dryer.

The wet web is dried by the heat of steam inside the yankee dryer. At the outlet of the dryer, the web is creped by a special crepe doctor, after which it is wound into rolls .

The base paper of the toilet paper, which has been reeled, is cut into the fixed width by the slitter on the toilet machine and wound into rolls in the required length.

The above plant can be easily extended, and it may be constructed in large numbers as a common enterprise.

Recently many medium and small scale industries in japan employ paper machines with cylinder type wire part and yankee dryer. The width of wire is 3-3.5 m, and the running speed of wire in most case is 350 m, 450 m, or 600m, the production output is ap-proximatety 20-50 tons per day.

Locational Condition

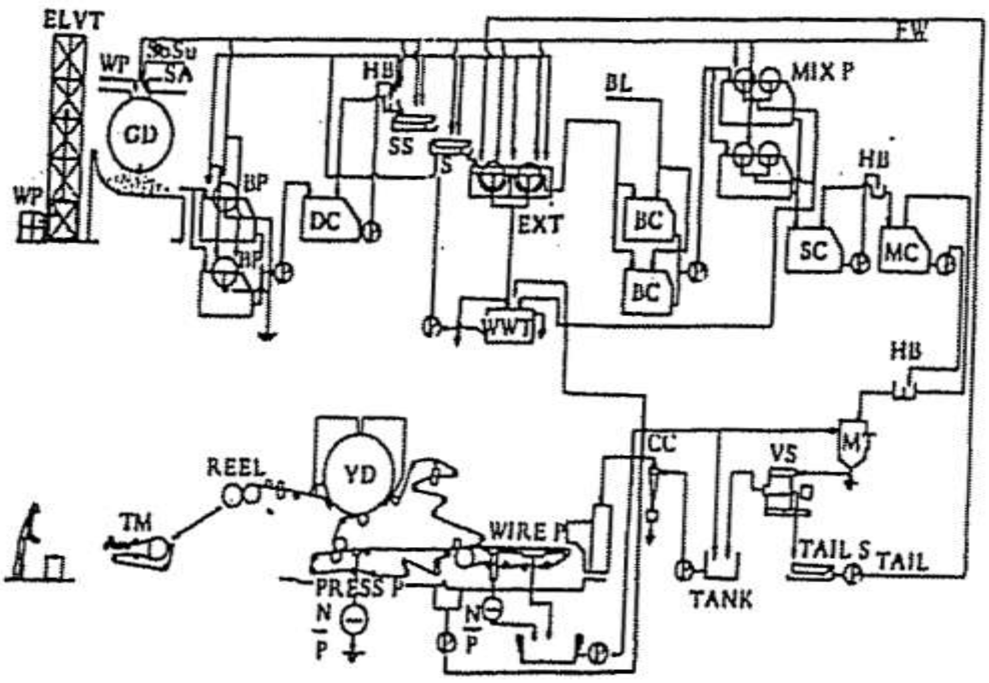
(1) It is absolutely necessary to ensure a supply of good quality water as well as to have a good drainage system available.

(2) As the products of the plant offered are necessaries for the home, if the secondary expenses, such as for warding charges, are too heavy, the end selling price would be affected. The plant should also have access to locations where raw materials and electric power supply are easily available.

The total plant site area for the five tons / day toilet paper plant is 5,300 m^2 (53 x 100 m) . if however, a plant of the same capacity should be built additionally, the site should be 6,500 m^2 (65 x 100 m).

The machinery and equipment to be imported listed in table 1

Process Flow Diagram for Toilet Paper Making Plant



ELVT–Elevator, Sosu–Sodium sulphite, SA–Soda ash, GD–Global digester, BP–Blow pocher, DC–Dump chest, HB–Head box, SS–Sliver screen, JS–Jonsson screen, EXT–Extractor, WWT–White water tank, BC–Bleaching chest, MIX P–Mixing pocher, BL–Bleach liquor, SC–Stock chest, MC–Machine chest, FW–Fresh water, MT–Mixing tank, VS–Vertical screen, TAIL S–Tail screen, CC–Centri-cleaner, WIRE P–Wire part, N/P–Nash pump, P–pump, Press P–Press part, YD–Yankee dryer, TM–Toilet machine,

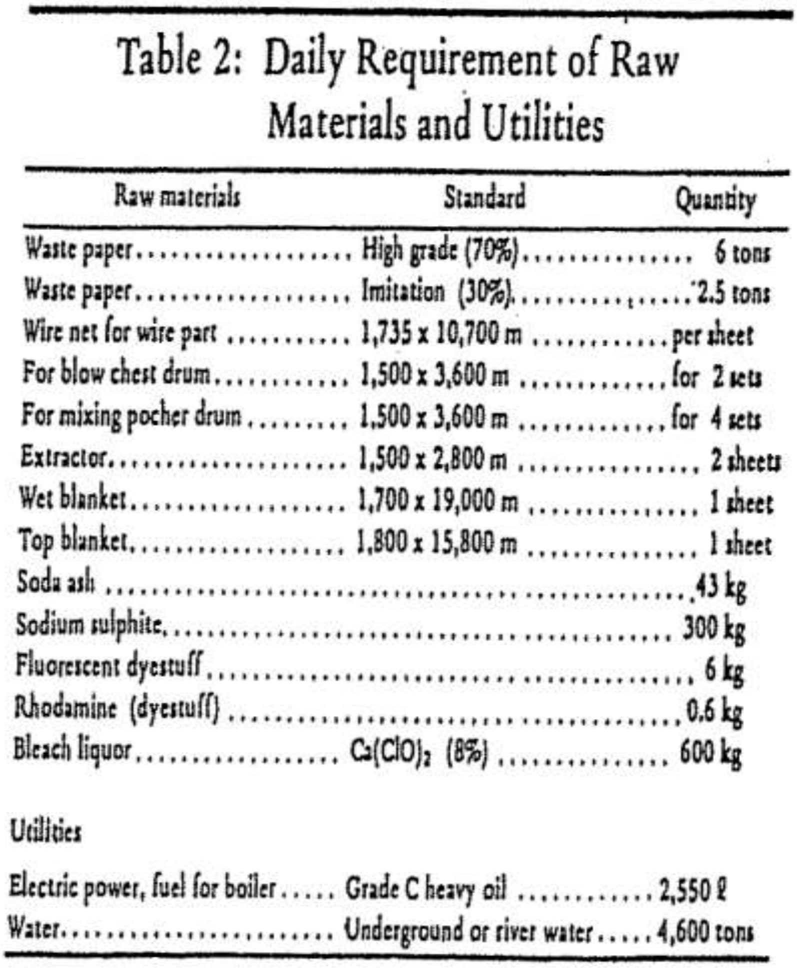


Table 2: Daily Requirement of Raw Materials and Utilities

Raw materials	Standard	Quantity
Waste paper	High grade (70%)	6 tons
Waste paper	Imitation (30%)	2.5 tons
Wire net for wire part	1,735 x 10,700 m	per sheet
For blow chest drum	1,500 x 3,600 m	for 2 sets
For mixing pocher drum	1,500 x 3,600 m	for 4 sets
Extractor	1,500 x 2,800 m	2 sheets
Wet blanket	1,700 x 19,000 m	1 sheet
Top blanket	1,800 x 15,800 m	1 sheet
Soda ash		43 kg
Sodium sulphite		300 kg
Fluorescent dyestuff		6 kg
Rhodamine (dyestuff)		0.6 kg
Bleach liquor	$Ca(ClO)_2$ (8%)	600 kg
Utilities		
Electric power, fuel for boiler	Grade C heavy oil	2,550 ℓ
Water	Underground or river water	4,600 tons

34 - PVC paste Resin 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 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 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 complication 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 specification

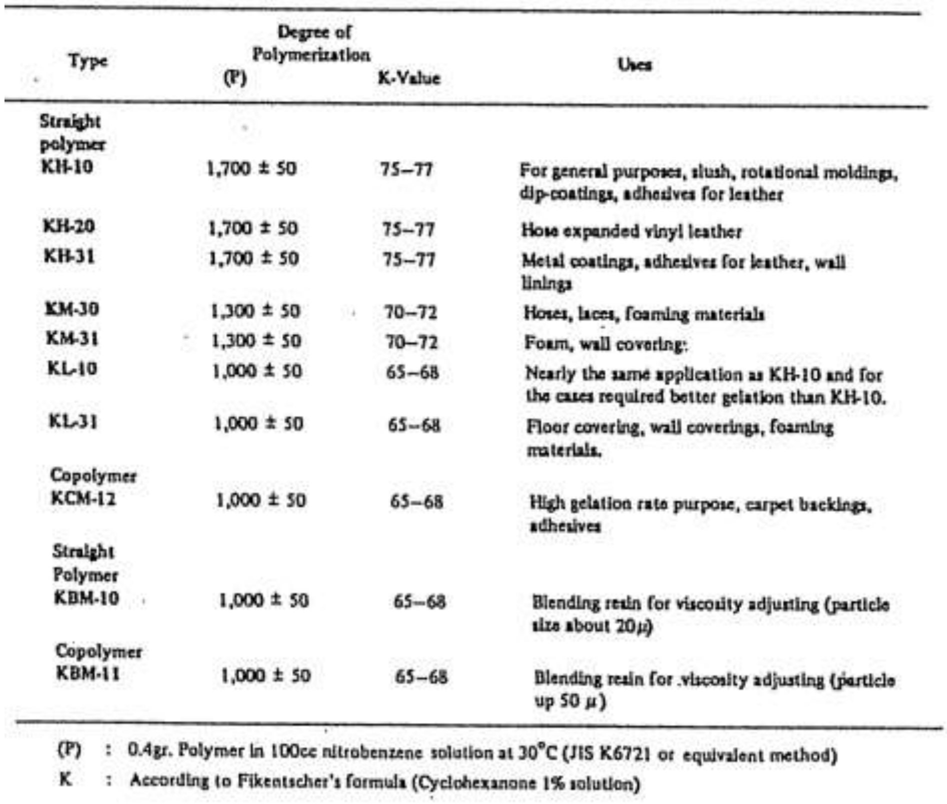
This plant can make various grades of high quality products and, the representative paste resin and its general properties and characteristics can be briefly outlined as follows:

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 led 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. Ets. 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

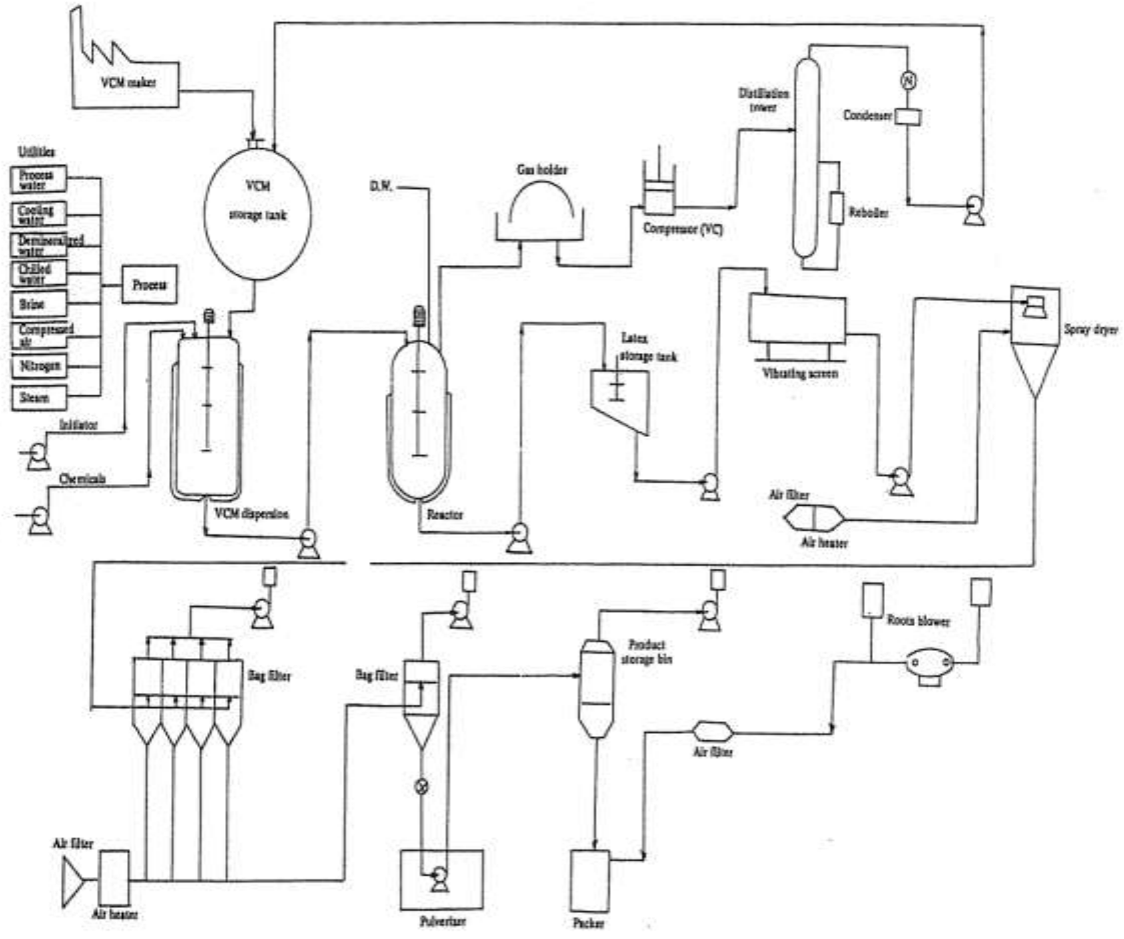
VCM receiving & storage

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 the formation of natural polymerization. Furthermore VCM can form an explosive mixture with air.

PVC Paste Resin Manufacturing Process Flow Sheet



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 retuned 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 ingredient are dissolved in this process.

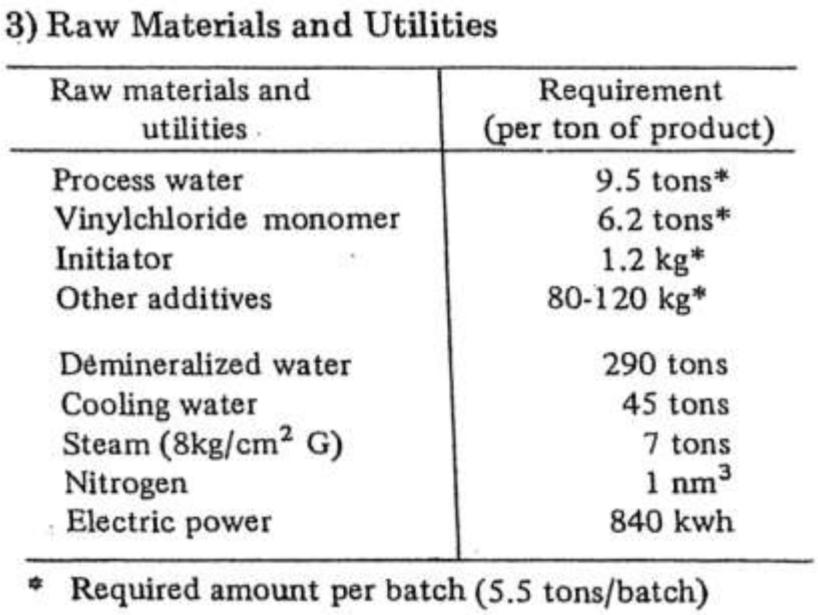
Polymerization process.

In this process, the VCM is polymerized and the unconverted monomer is recovered. These procedures are conducted automatically. The polymerization is 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 powered resin is collected by the bag filter. It is then crushed and finally stored in the storage bin.



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)

35 - Saccharin plant

After discovery of saccharin in 1877 by professor I. Remen and professor C. Fahrbeg of the united states, a small-scale plant was up in New York in 1884, heralding its commercialization.

With the rush of industrialization that followed in respective advanced nations, the market of saccharin has greatly expanded to occupy the weightiest position as an artificial sweetening agent .

About 500 times as sweet as cane sugar, saccharin is in wide use as a substitute of sugar for foodstuffs, medicines and cosmeties. Due to the limitation in sugar cane resources as raw materials of sugar, the demand for saccharin is on a steady increase.

Since the artificial sweetening agent is manufactured by chemical synthesis technology, unlike the natural sweetening, a steady improvement in its production skills or enlargement of scale has been realized, with the technological development actively underway forreducing production costs among the industrial circles .

There are a variety of saccharin manufacturing processes in industrial use today. Of these, these, the perchromate process using sodium perchromate as an oxidizing agent in accordance with electrolysis are no longer in use due to high installation costs as well as inferior product quality. The chrome anhydride process making use of mainly chrome anhydride is currently in the widest use.

This plant introduced here adopts the chrome anhydride process with improved facilities capable of recovering chrome anhydride as an oxidizing agent and sulfuric acid as a catalyst for reuse. It enables to economically produce the existing soluble saccharin, insoluble saccharin and imide with no changes in the manufacturing process.

The plant has the facilities for the production of OTSA (O-toluenesulfonamide), main raw material of saccharin, and it can also simultaneously produce such related products as PTSA (p-toluenesulfonamide) and PTC (P-toluenesulfonyl chloride) .

Products and specifications

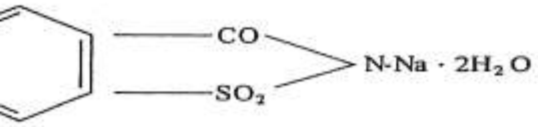
This plant produces soluble, insoluble and powdery saccharin in response to customers demand, with a variety of grades available in these products depending upon particle size or OTSA content. In the case of saccharin sodium, there are both granular type products, generally 3 to 150 mesh in particle size, and saccharin in powdery form, while OTSA and PTSA contents are from 10 to 100 ppm . in the case of insoluble saccharin, it is 60-100 mesh in particle size and 10-25 ppm in OTSA content .

OTSA (O—toluenesulfonamide), main raw material for saccharin, is simultaneously produced with byproducts PTC (p-toluenesulfonyl chloride) and

PTSA (p-toluenesulfonamide). Of these, PTSA is produced in three different grades with less than 2% , 5% and 30 % o-isomer content .

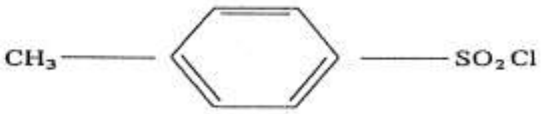
Table 1. chemical & physical properties of products

Saccharin Sodium
Structural Formola



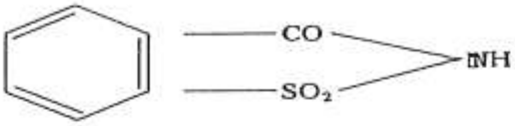
arance	Colorless and transparent crystal
y	Not less than 98%
tness	450-550 times as sweet as sugar
ture	Not more than 15%
te	Not more than 100 ppm
y metal	10 ppm maximum
bility	One gram dissolves in 1.2 ml water and in about 50 ml alcohol. Aqueous solutions are neutral or alkaline to litmus.

enesulfonyl chloride
ural formula〉



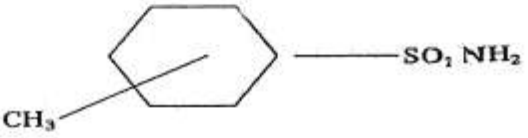
rance	White crystal
osition	p-Toluenesulfonyl chloride
	Not less than 96%
lity	Soluble in alcohol, and hot water, Sparingly soluble in cold water.

o Saccharin insoluble
〈Structural formula〉



Appearance	Colorless monoclinic crystal
Mesh	60-100 mesh
Melting point	226-230°C
Specific gravity	0.83
Purity	Not less than 98%
Sweetness	In dilute aqueous solution it is 500 times as sweet as sugar; the sweet taste is still detectable in 1,100,000 dilution
Moisture	Not more than 1%
Sulfate	200 ppm maximum
Heavy metal	10 ppm maximum
OTSA	10, 25 ppm at customer's request
Solubility	One gram dissolves in 290 ml water, 25 ml alcohol, 12 ml acetone, about 50 ml glycerol. Freely soluble in solution of alkali carbonates. Slightly soluble in chloroform and ether.
Acid reaction	PH of 0.3% aqueous solution 2.0

o p-Toluenesulfonamide
〈Structural formula〉



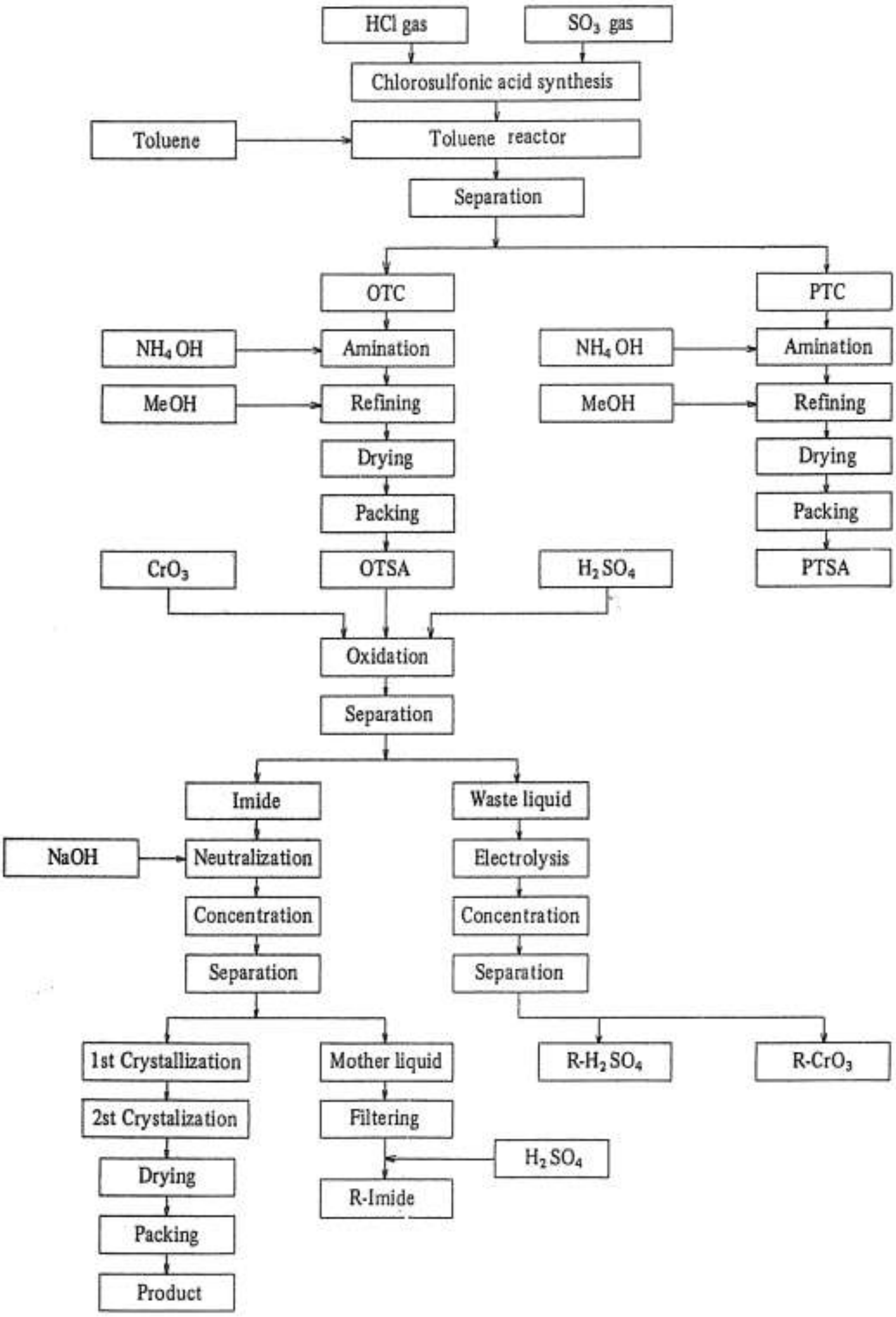
Appearance	Fine, white to light cream, granular particles
Purity	O-isomer content is not more than 2%
Moisture	Not more than 0.5%
Melting point	132-137°C
Ash	Not more than 0.05%
Acidity, pH	6.5-7.5
Heavy metal	10 ppm maximum
Iron	10 ppm maximum

Contents of Technology

1) Process Description

The saccharin manufacturing process is generally composed of the following unit processes:

Saccharin Manufacturing Process Flow Diagram



Chlorosulfonic acid synthesis

Sulfur trioxide gas generated by heating fuming sulfuric acid and hydrogen chloride gas are reacted in a reaction tower for the preparation of chlorosulfonic acid .

Sulfonation

The synthesized chlorosulfonic acid is reacted with touene in a toluene reactor , and then on completion of the reaction, the product is transferred to a storage tank.

While feeding the reaction product to a decomposition tank filled with sulfuric acid, the chlorosul-fonic acid still remaining in excess is decomposed and removed. The reaction product, removed of the excess chlorosulfonic acid, is cooled in a cooling tower to be converted into oily OTC and crystalline PTC for subsequent centrifugal separation.

Amination and refining

The separated OTC is reacted with ammonia in an amination tank to obtain crude OTSA and then it is dissolved in alcohol for recrystallization. The final product is obtained by the separation and drying Link OTC, PTC is also made into PTSA through amination and then obtained as final product by refining and crystallization.

Oxidation process

After crushing, OTSA is reacted with chrome oxide ($c_{r}o_{3}$) as an oxidizing agent and sulfuric acid as the catalyst in an oxidation tank. The reaction product is separated by centrifuge into imide and waste liquid. The separated imide is neutralized again with caustic soda.

Concentration and crystallization

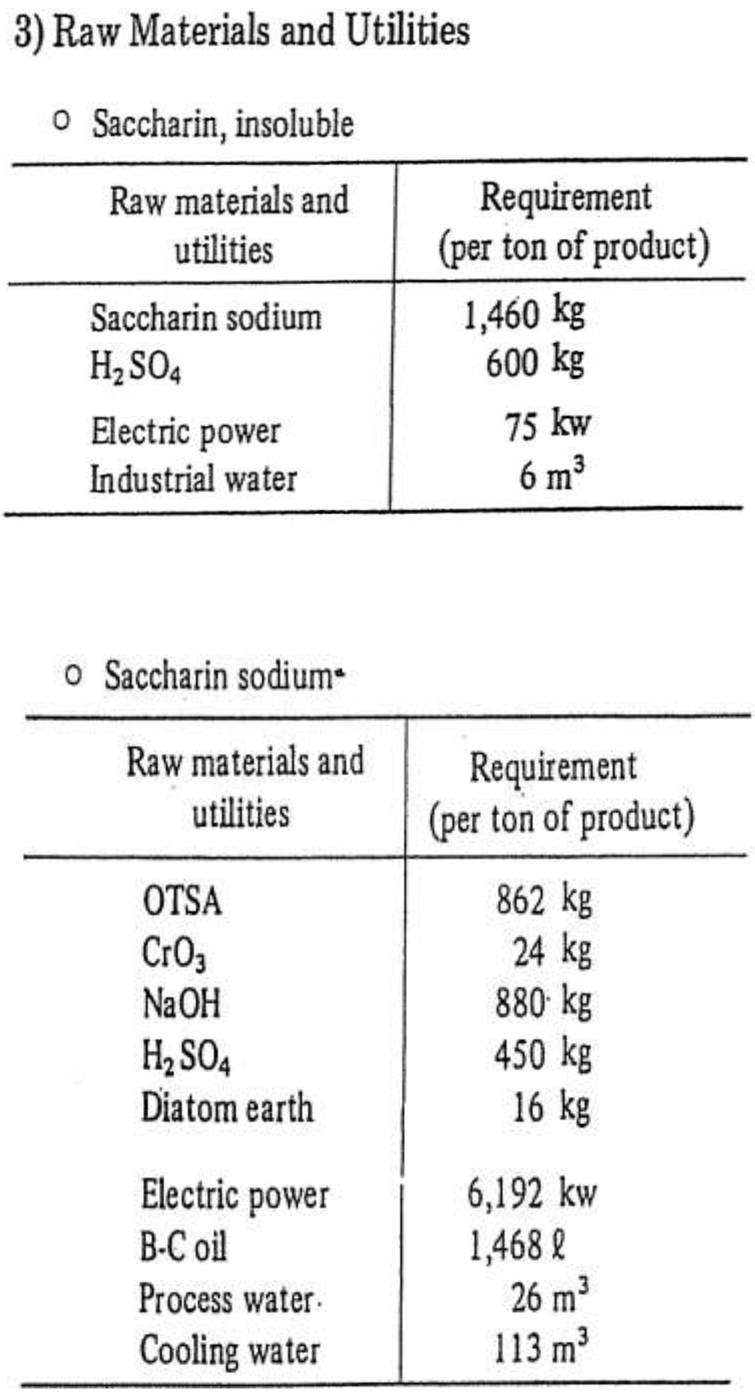
After making imide soluble, it is concentrated in a vacuum evaporator, and then subjected to the primary crystallization by agitating and cooling in a crystallizer. It is recrystallized for enhancing its purity.

Drying and packing process

The recrystallized saccharin is dried in a fluidizing dryer, and then separated and packed to fit specification depending upon particle sizes.

Recovery of oxidizing agent and catalyst

An electrolytic solution is prepared by making use of the oxidizing agent from the oxidation process on completion of the reaction, and then its oxidizing capacity is restored by electrolysis in an electrolysis tank. The electrolytic solution is concentrated in a vacuum evaporator, and then cooled again and separated into chrome oxide ($C_{r}o_{3}$) and sulfuric acid for reuse in the oxidation process after replenishing the partial shortage.



3) Raw Materials and Utilities

- Saccharin, insoluble

Raw materials and utilities	Requirement (per ton of product)
Saccharin sodium	1,460 kg
H_2SO_4	600 kg
Electric power	75 kw
Industrial water	6 m^3

- Saccharin sodium

Raw materials and utilities	Requirement (per ton of product)
OTSA	862 kg
CrO_3	24 kg
NaOH	880 kg
H_2SO_4	450 kg
Diatom earth	16 kg
Electric power	6,192 kw
B-C oil	1,468 ℓ
Process water	26 m^3
Cooling water	113 m^3

36 - Match Plant

The development of matches was preceded by centuries of experiment with many methods of fire making, but the production of fire by spontaneous chemical reaction was unknown until the 17 th century.

A variety of experiments continued until the firction match, introduced in the 19 th century, provided a means of making fire that was pocketable. Reliable, safe and speedy.

With early methods of fire production it was common to use specially made splinters tipped with some combustible substance, such as sulfur, to transfer the flame.

n increased intrest in chemistry led to experiment to produce fire by direct means means on the splinters.

The raw materials used by the match industry generally include wood splints, paper and chemicals such as potassium chlorate and red phosphorus. A global survey of the present state shows that the match industry is a monopoly in many countries.

Under this system matches are bought from private industry by the government, which monopolizes sales.

The consumption of matches steadily increase with the advance of sales of tobacco and increase in the population. Match makers can look forward to a continued increase in consumption as living standards go up .

Generally the consumption of match is three pieces per person. However, as can be seen in advanced nations, the supply would be eight pieces of match per person if match for advertisement could be anticipated.

Products and specifications

- Wooden splint match (stick type)

  The stick type match is generally square. But there are round and rectangular sticks. There are many kinds of woods for raw materials, such as white poplar is most widely used as splints.

  The color, hardness and combustibility of white poplar are very superior.

- Paper splint math

The paper splint match is made from impregnated cardboard. It is widely used because it is suitable for advertisement. In order to preserve resources of wood and in countries where are shortages of wood for match making, the paper splint match is used domestically.

Contents of technology

1) Process Description

Splint manufacturing

Lumber is cut to suitable lengths by a circular saw . After the peeling of the bark, the log is peeled into veneer-like thin long shavings by the peeling machine. Then the veneer-like shavings are split and chopped to the designated splint size by the chopping machine. These splints are impregnated by the splint impregnating machine and dried until 7% humidity.

The dried splints are selected by the splint selecting equipment after drying, and the unsuitable splints are rejected.

Match manufacturing

The process starts from the feeding of suitable polished splints into the splints selecting and feeding machine . this machine is called the automatic match making machine. The selected splints are placed on trays where the splints are paraffined and dipped with head chemical; then, they are dried by the automatic match making machine.

Match box manufacturing

In this process, match boxes are manufactured to contain match sticks. Printed sheets for outer boxes delivered from printing houses are cut on a slitter, and cut and creased cardboard is delivered from paper stores. Then, paper boxes are by the paper box making machine and side boxes are formed.

Filling

The match splints are filled into the match box by the automatic filling machine.

Finishing process

In this process, the side chemical coating machine applies chemical to the match boxes, which have been filled with match sticks by the box fillingmachine as they come on trays. Then the boxes are wrapped 12 boxes to a packet and 120 such packets are placed in a carton, and the matched are ready for marketing.

Raw Materials

Lumber for splint - $KCIO_3$ - Red phosphorus - raffin wax - Glue - Sulphur Resin powder - Mn O_2 - Antimony sulphide - Glass powder - Potassium bichromate - Zinc oxide - Carbon black - Box paper - Wrapping paper

Example of plant capacity and construction cost

Plant capacity : 2,000 gross boxes / day

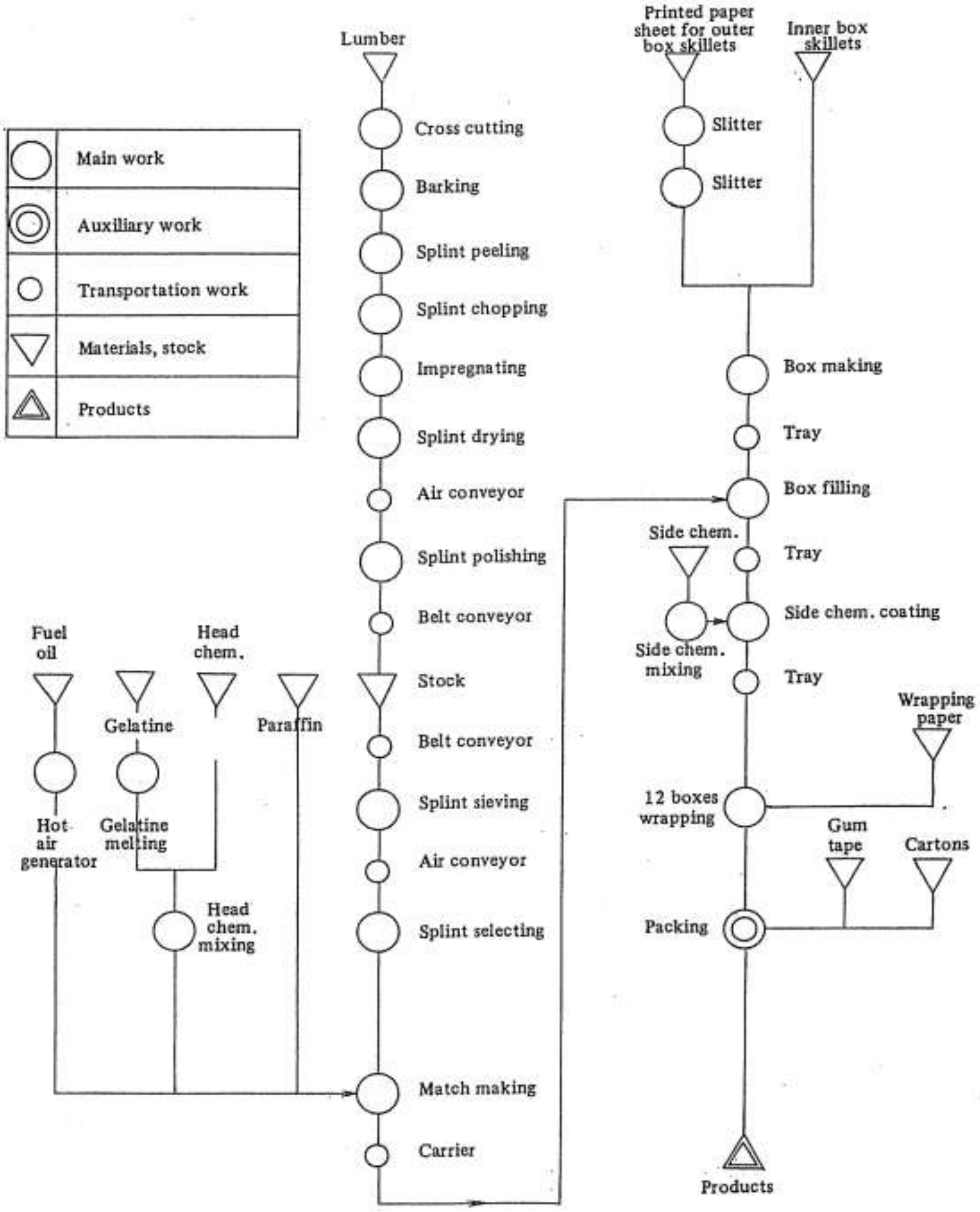
* Basis : Box dimension ….. 51 mm x 36 mm x 61 mm

Length of splint … 45.5 mm x 2^2 mm

No. of splint … 40 plints / box

Scattering Papers In Chemical Industry

Match Manufacturing Process Flow Diagram



2) Equipment and Machinery

- Circular saw
- Peeling machine
- Chopping machine
- Impregnating and colouring machine
- Drying chamber
- Polishing machine
- Broken splint selecting machine
- Grinder
- Splinter collecting machine
- Automatic match making machine
- Oil furnace
- Ignition composition mixing machine
- Gelatin melting machine
- Slitter
- Box making machine

37 - Sodium Chlorite Plant

Sodium chlorite, first commercialized 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% N_aClO_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 NaClO2)…………………... 25 %

Contents of technology

1) Process Description

The sodium chlorite manufacturing process largely consists of three unit processes of SO_2 gas generation, $C1O_2$ generation and N a Cl O_2 synthesis .

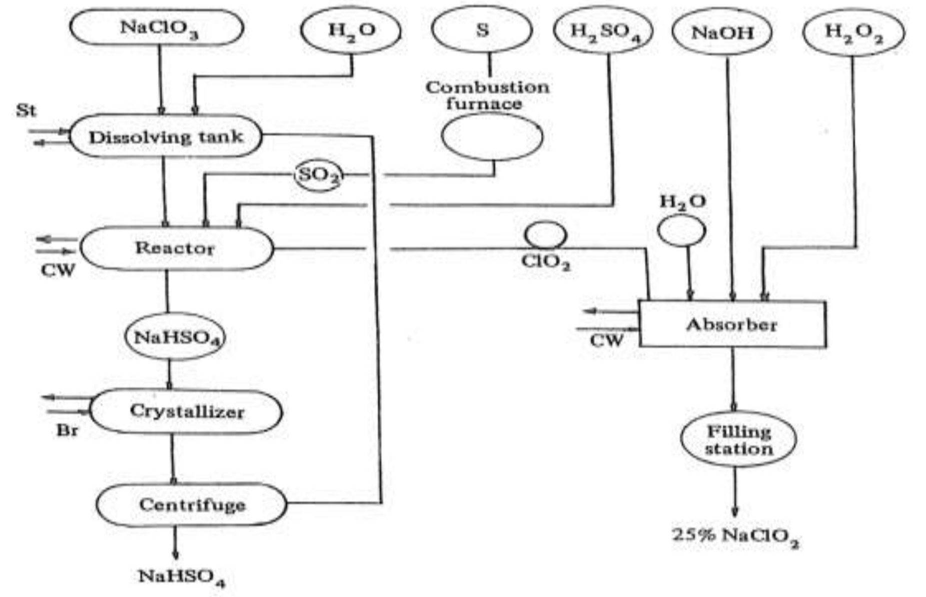
The SO $_2$ generation process is designed to produce gas containing SO_2 by burning sulfur. That is to say, flake –like sulfur is melted in the sulfur melting tank and pumped to the sulfur combustion furnace for combustion with fuel. The combustion furnace usually comprises two stages.

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 ClO2 generation process as reduction agent.

In the ClO_2 generation process, $NaClO_3$ is reduced to generate ClO_2, obtaining hereby $NaHSO_4$ as byproduct. 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 $MaClO_2$ synthesis process, ClO2 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.

Sodium Chlorite Manufacturing Process Diagram



Example of plant capacity and construction cost

1) Plant capacity : 13,000 mt / year

- Basis : 24 hours / day, 330 days / year

Raw Material	Requirement (per ton of product)
Sodium Chlorate	321 kg
Sodium Hydroxide	262 kg
Sulfuric Acid	258 kg
Hydrogen Peroxide	145 kg
Sulfur	67 kg

38 - Phosphate Fertilizer 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 with out 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 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 from 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. There fore, 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 super- phosphate, was the first commercial fertilizer of importance .

The plant which is to be introduced here is one which produces calcium phosphates, such as super phosphate, fused phosphate and the complex fertilizer which was made by mixing superphosphate and fused phosphate. And this plant ahs 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 specification

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 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.

o When used in a vinyl house, there will be no damage by ammonia gas.

o It prevents sulfur deficiency and increases the sweet taste.

o It increases volatile matters of such spice vegetables as garlic, onion, ginger and mustard.

o When mixed with compost, its maturation is quickened.

o 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.

o Chemically acidic fertilizer, but it becomes physiologically neutral when used.

Component

It contains 20 % of soluble phosphorus as well as gypsum (sulfur and lime stone) 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 super phosphate.
- Contains not only ortho-phosphate but also me-tapyrophosphate 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 hygro - scopies .
- Granules prevent the soil adsorption and eventually improve phosphate effect.

Effects

o ince 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.

o 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, aactivate 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 into the screw conveyor type mixer together with phosphate rock powder.

The feedstock mixed for 204 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 refractiories cannot be used , requiring . Particular industrial technology to prevent such a corrosion . in the quenching tank, the fused substance is sprayed with high – pressure sooling 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 .

(a) Fused and superphosphate complex fertilizer plant

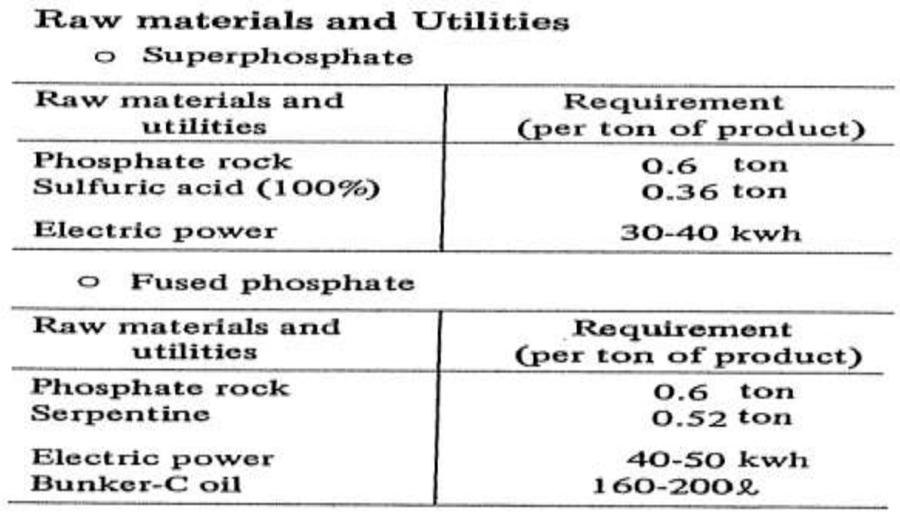
The fused phosphate and superphosphate respectively manufactured in the plant mentioned above are crushed, screened, weighed and put into a mixer.

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.

Example of plant capacity and construction cost

Plant capacity : 120,000 m / t

- Basis : 24 hours / day, 300 days / year



Raw materials and Utilities

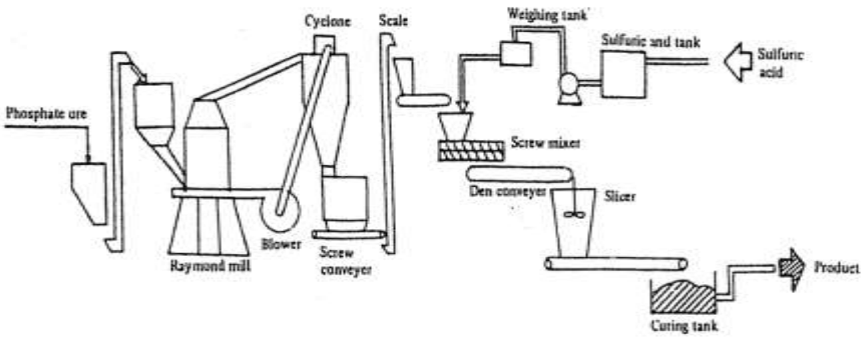
○ Superphosphate

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

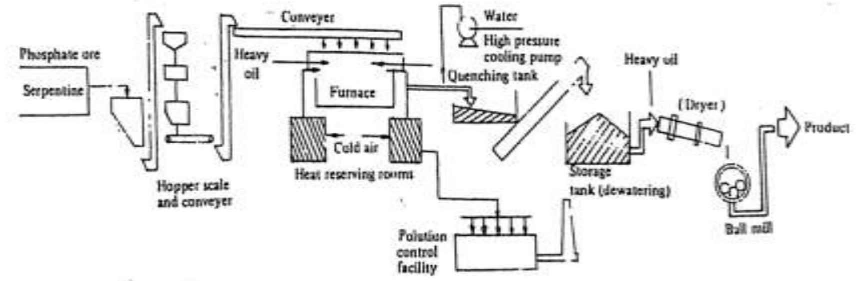
○ Fused phosphate

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

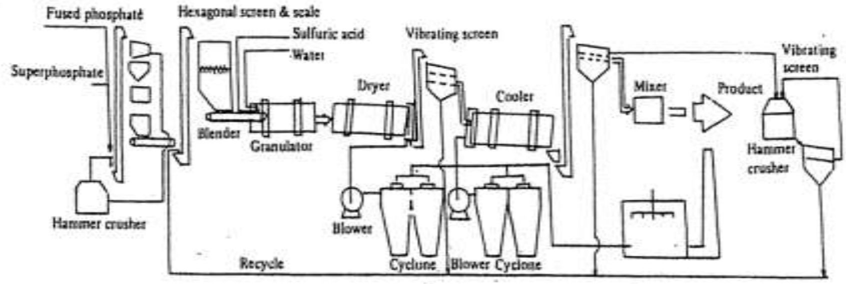
Superphosphate Manufacturing Process Flow Sheet



Fused Phosphate Manufacturing Process Flow Sheet



Fused and Superphosphate Fertilizer Manufacturing Process Flow Sheet



39 - Epoxy Resin plant

Epoxy Resin Making plant

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.

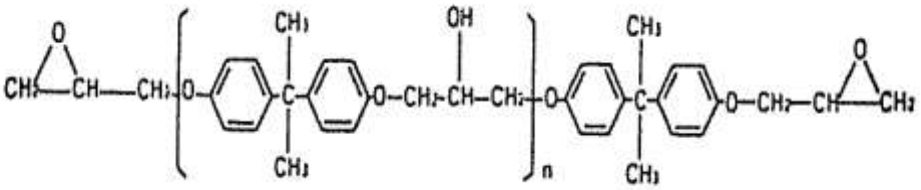
The main applications of epoxy resins are as follows :

- Surface coatings : Air drying, baking, powder coating, etc.
- Electrical filed : casting , dipping, encapsulation, laminates, PCB and so forth .
- Mechanical and : tools, tooling aids, foundry metal industries 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 specification

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

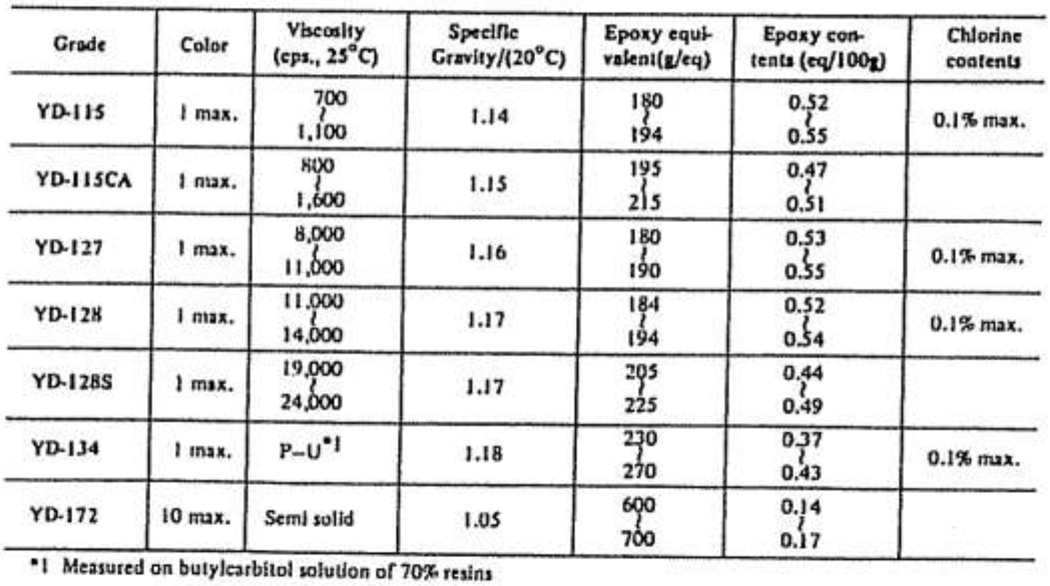


The characteristics of products can be described as follows:

- 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.

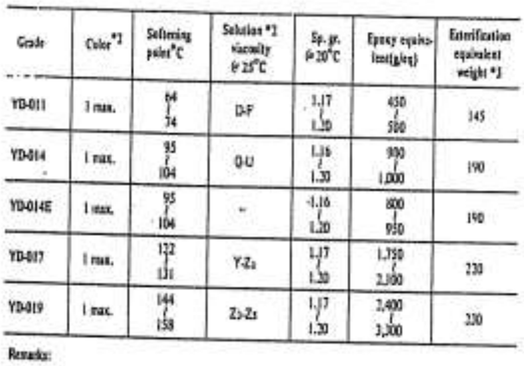
Table 1. Specifications of Liquid Type Epoxy Resins



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

Table 2. Specifications of Solid Type Epoxy Resins



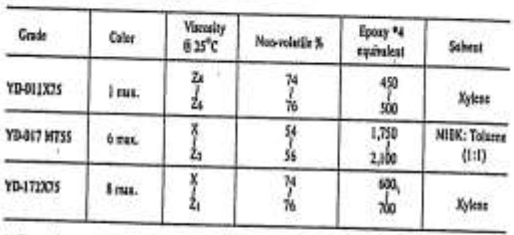
Grade	Color*3	Softening point°C	Solution *2 viscosity @ 25°C	Sp. gr. @ 20°C	Epoxy equivalent(g/eq)	Esterification equivalent weight *3
YD-011	1 max.	64 ~ 74	D-F	1.17 ~ 1.20	450 ~ 500	145
YD-014	1 max.	95 ~ 104	Q-U	1.16 ~ 1.30	900 ~ 1,000	190
YD-014E	1 max.	95 ~ 104	–	1.16 ~ 1.20	800 ~ 950	190
YD-017	1 max.	122 ~ 131	Y-Z_1	1.17 ~ 1.20	1,750 ~ 2,100	230
YD-019	1 max.	144 ~ 158	Z_5-Z_7	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

Table 3. Specifications of Solution Type Epoxy Resins



Grade	Color	Viscosity @ 25°C	Non-volatile %	Epoxy *4 equivalent	Solvent
YD-011X75	1 max.	Z_2 ~ Z_4	74 ~ 76	450 ~ 500	Xylene
YD-017 MT55	6 max.	X ~ Z_3	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.

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 show n in tables 1,2 and 3

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

Table 4. Specifications of Polyamide Resins

Type	Equivalents to other firms		Amine values	Viscosity (CPS)	Colors	Specific gravities	Acid values	Uses
	Versamid	Tohmide						
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%

4.

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 hydroxyl radical, thus producing chlorohydrine ether.

In the second-stage reaction, the produced chloro-hydrine ether causes a dechlorination reaction to pccur in the presence of sodium hydroxide, producing a terminal epoxy radical. It is characterized, 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 whit 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 toor 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 .

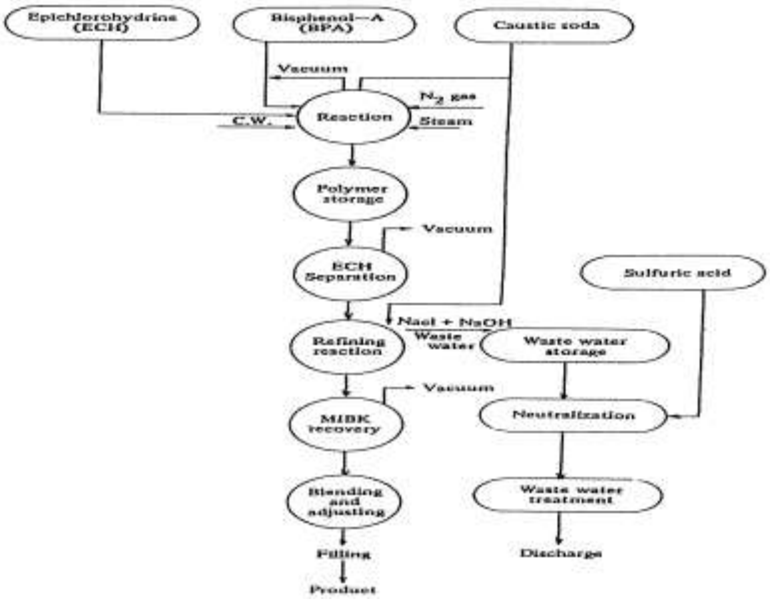
(b) Polyamide resin

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 and 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 .

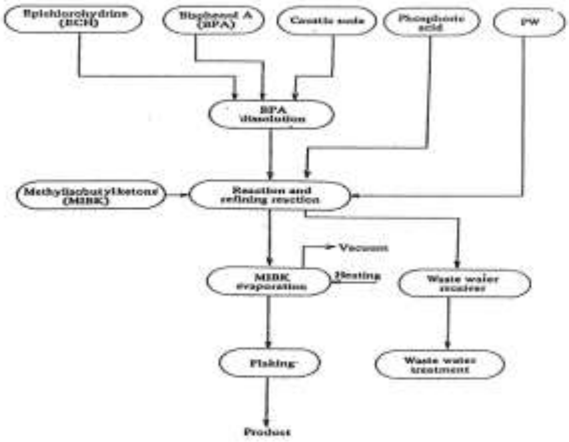
The formed salt, as the temperature is raised by heating, produces a dehydration phenomenon, and at the same time, it causes the amide combination to occur, completing the reaction. The viscosity drops again due to the amide combination.

In order to improve the water solubility, operation 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 .

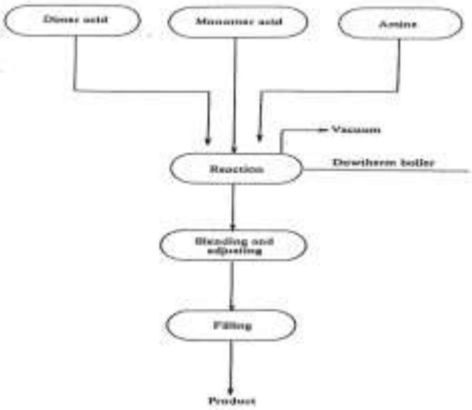
Liquid Type Epoxy Resin Manufacturing Process Diagram



Solid Type Epoxy Resin Manufacturing Process Diagram



Polyamide Resin Manufacturing Process Diagram



3) Raw Materials

○ 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

○ 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

40 - Tricalcium phosphate 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 deficiency 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 . There fore, to achieve increase in the productivities of live stocks 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 phosphors 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 specification

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 modem factories.
- It is tasteless and odorless.
- Low cost per unit of phosphourus and calcium .
- Phosphorus and calcium are easily assimilated and absorbed .

The general properties of tricalcium phosphate is as follows :

- Appearance : A tasteless and adorless powder .
- Particale size : 100 mesh sieve pass 77 % min .
- Constituents : P 18 % min
  Ca 31 % min, 34 % max .
  F 0.18 % max

Contents of technology

1) Process Description

Tricalcium phosphate involves essentially the following process steps :

- ***Rock grinding and pelletization***

Grinding phosphate rock of low moisture content (2to 3 %) and sodium carbonate utilizes a ball mill or a tube mill . all oversized particales 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 .

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.

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

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.

41 - Compound Fertilizer Plant - (Odda – process) (Nitrogen and phosphate)

Introduction

Main nutrients for crops are Nitrogen, phosphorous, potassium and calcium. These among others must be made available continuously and in correct proportions by the soil.

The individual effect of each of these nutrients is the following:

Nitrogen promotes :

* Plant growth-speeds development both above and below ground, influencing the size, weight and colour of the plant yield, e.g. grain, tuber or fruit.

* The synthesis of amino acids, protein and lipids, thus contributing in large part to the nutritional value of vegetable foodstuffs

* Technical characteristics dependent on the protein content, e.g the baking properties of wheat.

Phosphorus promotes:

- The synthesis of organic phosphorus compounds in the plant organism e.g. phosphoric lipids, nucleic acids, and enzymes necessary for the formation of proteins, carbohydrates and other lipids and enzymes.
- The plant’s reproductive phase, e.g. the ripeness and quality of seeds and fruit.
- The mineral content of plants used in food stuffs and animal feed .

Potassium promotes :

* Nearly all metabolic processes leading to the synthesis of valuable components such as proteins and carbohydrates.

* The vitamin and mineral content (especially of fruit and vegetables)

* Technical properties dependent on the carbohydrate content (e.g. the processing properties of potatoes of the malting properties off barley)

* The development of strong plant tissue resistance to cold, drought, peste and disease .

Calcium promotes:

* The intake of nutrients and transpiration and metabolism in the plant .

Soils which are subjected to intensive agricultural usage especially after application of pure nitrogenous fertilizers over long periods such ad ammonium nitrate or urea show a deficiency and unbalance in nutrients. This can be leveled by applying compound fertilizers.

They offer the following main advantages :

* Compound fertilizers can be produced with different nutrient contents. It is thus possible to provide a fertilizer with optimum nutrient properties taking into account the needs of the crop, the soil conditions and the climate .

* The nutrient components can be dispensed in on operation only.

* Uniform distribution of the nutrients in the soil, since the main nutrient components are present in the desired ratio in every fertilizer granule .

* Separate calcium fertilizing is unnecessary, since many of the available fertilizer types contain calcium.

* Improvement of plant growth by using fertilizer types containing trace nutrients like Mg, cu, Mn, Fe, Zn, B, Mo, Co as an additional component .

* The nutrient content of compound fertilizers is quoted in % by wt . N .
for the nitrogen content % by wt . P_2O_5.
for the phosphate content % by wt K_2O .
for the potassium content**.**

Fertilizers with only 2 main nutrients (NP types) - namely nitrogen and phosphate – are monoammonium phosphate, diammonium phosphate . Fertilizer with elevated nitrogen content are urea phosphates and the nitrophosphate fertilizers. NPK fertilizers are produced by adding potassium compounds in the form of potassium chloride (KCl) or potassium sulphate (K_2SO_4) .

Several processes are available to produce NP (K) fertilizers. The optimum process can be selected taking into account the availability of raw materials, the prevailing soil and climatic conditions and the tye of crop whether the immediate effect or an expanded effect or a combination of both is desired.

Nitrogen in form of nitrate is of immediate effect as well as phosphorus in a water soluble form (mono – or diammonium phosphate and monocalcium phosphate).

Nitrogen in form of ammonium is of expanded effect as well as phosphate in form of dicalcium phosphate, the latter being citrate soluble.

The use of fertilizers with maximum water solubility of the P_2O_2 is recommendable for neutral soils and for plants with a short growth period .

The raw material phosphate rock is available and mined in many places of the world. The rock contains phosphorus in form of tricalcium phosphate which is water insoluble. The phosphorous ahs therefore to be transformed to a water and / or citrate soluble form, by " attack" with mineral acid such as sulfuric acid and / or nitric acid and / or phosphoric acid .

In cases of local availablility of natural gas or other suitable fossil energy sources being raw materials for the production of ammonia which in turn is the raw material for nitric acid and if sulphur or pyrites, the raw materials for sulphuric acid are not available locally then the attack by nitric acid can be the most economical choice.

The process applying this principle is world wide Known as : Odda – Process .

Process description

Phosphate rock is attacked by nitric acid in the digester according to the main reaction equation.

$$Ca_3 (PO4)_2 + 6 HNO_3 = 3Ca (NO_2)_2 + 2 H_3 PO_4$$

The waste gases containing F , N_x and CO_2 are Scrubbed with water.

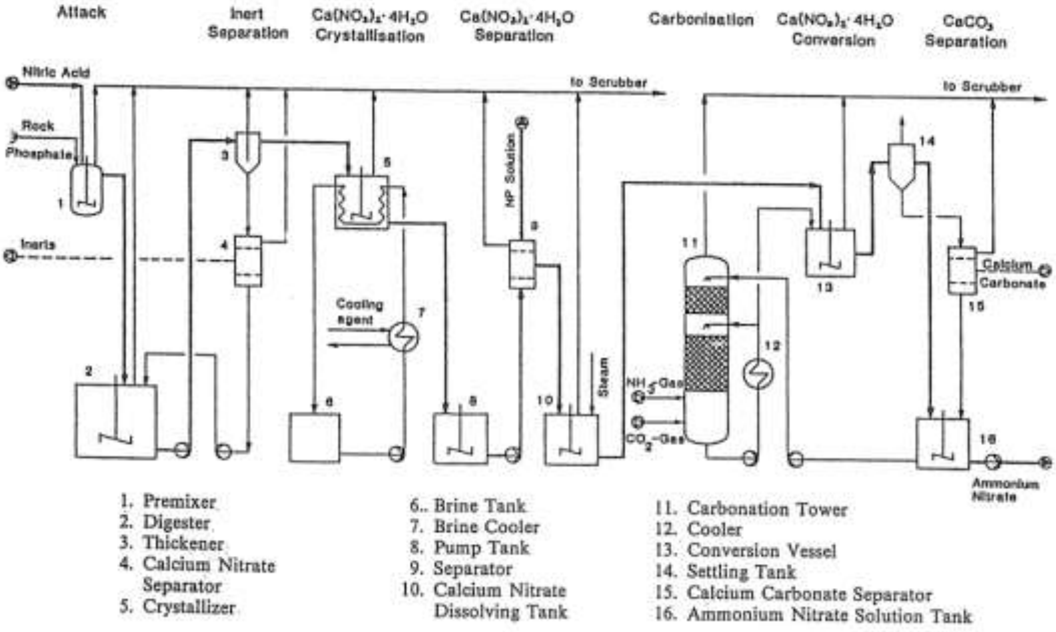
By cooling the solution, part of the calcium nitrate crystallizes to calcium nitrate tetrahydrate.

The cooling temperature and, consequently, the degree of crystallization is determined by the de sired water solubility of the P_2O_5 in the final product.

By this process a water solubility of the phosphorous content of over 80 % can be achieved the remaining portion is present in form of dicalciumphosphate.

The calcium nitrate tetrahydrate crystals are separated. The remaining solution is then neutralized with gaseous ammonia according to the following main reaction equations:

Process Flow Diagram



1 – $H NO_3 + NH_3 = NH_4 NO_3$

2 – $Ca (NO_3)_2 + H_3 PO_4 + 2 NH_3 = CaHPO_4 + 2 NH_4 NO_3$

3 – $H_3 PO_4 + NH_3 = NH_4 H_2 PO_4$

4 - $H_3 PO_4 + 2NH_3 = (NH_4)_2 HPO_4$

The nitrogen content can be increased by adding ammonium nitrate or nitric acid. The phosphate portion can be increased by adding phosphoric acid, DAP or MAP.

Part of the water introduced with the nitric acid is evaporated during neutralization by the head of reaction. The NP melt is granulated jointly with return material in a granulator.

The granules are then dried in a drum and subsequently classified. The fined, crushed oversize and the dust removed from waste air are returned to the granulator .

The on - size material is cooled . the storage properties are improved by conditioning, e.g with an oil amine mixture. The exhaust gases from the drying drum and cooling facilities are cleaned in the dust removal facilities.

The product can be bagged ex-bulk storage or directly .

Bags at 50 kg weight are normally used.

To obtain NPK fertilizers, potassium salt is admixed to the NP slurry prior to granulation.

Calcium nitrate conversion :

The by-product calcium nitrate crystals obtained in the ODDA process is converted to ammonium nitrate and calcium carbonate.

The crystals are dissolved in hot ammonium nitrate solution.

Further ammonium nitrate solution in which CO_2 and ammonia is dissolved is added in an agitator tank. Then the conversion reaction according to the following formula takes place :

$$Ca(NO_3)_2 + 2\ NH_3 + CO_2 + H_2O + CaCO_3 + 2\ NH_4NO_3$$

The precipitate calcium carbonate is filtered off the ammonium nitrate solution. The latter is concentrated to about 95 % and under addition of calcium carbonate further processed to calcium ammonium nitrate fertilizer.

The production of NP (K) fertilizers using phosphoric acid as intermediate raw material causes in most cases environmental problems, since high amounts of gypsum, the by-product of phosphoric acid, have to be disposed of this problem does not arise in case of the Odda-process.

(Example of the plant for 3 Different capacities)

- o Raw materials Rock phosphate - Nitric Acid - Ammonia
- o Consumption figures per metric ton of product

(N : P_2O_5 : K_2O = 22,0 : 22.0 : 0, rel. wat. Sol. 80 %)

Rock phosphate	681 Kg		
Nitric acid (60 % HNO_3)	785 kg (as100% HNO_3)		
Ammonia	253 Kg (as100 % NH_3)		
CO2	300 Kg (as 100 % CO_2)		
Steam (LP)	0.3 Kg		
Electr. Energy	140 KWh		
Cooling Water	$60\ m_3$		
Process water	$1.1\ m^3$		
By product Ammonium nitrate	440 kg		
Plant capacity	300 MTPD	800 MTPD	1,000 MTPD

42 - Dynamite Making Plant

Before use of the glycerol nitrate as an industrial explosive by Nobel in the 1860 s, the black powder with half the explosive power of TNT was the only blasting explosive.

However, with the subsequent development of various types of explosives with strong explosive power and diverse performances as dynamite, work efficiencies as dynamite, work efficiencies in the fields of mining, tunneling, construction and excavation have been broadly improved, thus industrial explosives emerging as an essential product to save time and expenses.

In the meantime, the economic development of a nation has greatly expanded in construction demand to enlarge industrial and private installations as well as the demand for mineral resources as basic raw materials for industry.

At the same time, the demand for industrial explosives has also greatly expanded . Above all, particularly that for industrial explosives in sectors of coal mining, quarrying, metal mining, railway and other constructions has shown a rapid increase.

In chemical industrial aspect, the industrial explosives belong to a kind of fine chemicals and are evaluated as one of major key industries in the development of the national industry because of the high added value .

Therefore, by manufacturing basic chemicals with high added value, the industrial explosives manufacturing plant occupies an important position in the development of overall chemical industry. In addition, it is an industry with an important weight in the national economy including construction, mining and the like . its necessity is well recognized in that it greatly contributes to drastically increasing the productivity in industries.

Products and specification

The products which can be produced in this plant are as follows :

Venus dynamite (Gelatine dynamite)

This is specially intended for underwater blasting.

The cartridge can lie in water for a week without being damaged and also suitable for mechanical charging .

The principal ingredients of this product are nitroglycerine, nitrocellulose, sodium nitrate, wood meal and dextrine.

Mercury dynamite (Ammonia gelatine dynamite):

This is an all - round explosive which can be used for all known types of blasting work with optimum results.

Moreover, being manufactured by automatic process.

It is suitable for mechanical charging as well as manual charging . the principal ingredients of this product are nitroglycerine, nitrocellulose, sodium nitrate, wood meal and dextrine.

Komite (blasting gelatine) :

This is the most powerful dynamite among those used for commercial uses and is mainly made of nitroglycerine and nitrocellulose.

Finex - 2 - this is powder form explosive primarily used as column charge for smooth blasting combined with finex -1 on contour area of the blasting section.

As finex - 2 is long plastic pipe charge, very effective and easy to handle and charge.

The detail specifications of above-mentioned products is shown in table1. This explosive plant also has the technology to make various accessories, such as blasting cap, electric detonator and fuses.

Contents of technology

1) Process Description

This process description relates mainly to an explanation on dynamite, a typical industrial explosive.

The dynamite manufacturing process generally consists of raw material preparation and mixing, kneading, cartridging and packing .

Raw material preparation and mixing

First of all, nitroglycerine and nitrocellulose are blend in a mixer to produce gel - like master mix.

Other blending components like nitrocompound, ammonium nitrate and starch are dried, crushed or filtered prior to mixing as required.

Kneading

The prepared master mix and other blending raw materials are fed into a kneader for uniform kneading .

Cartridging

After kneading, the blended mixture is supplied in belt conveyor to the cartridging machine by menas of a dosing machine in a way to assure the optimum operational condition. It is then cartridged by the cartridging machine.

At this juncture, the blended mixture is pressed flat by rollers on the belt conveyor, cut in appropriate sizes and formed into catridges with cartridge paper.

Cramping of both ends finishes the cartridge.

To improve the water - proofness of the cartridge paper used here, it is coated whith paraffin and depending upon the circumstances paraffin may be sprayed over the finished cartridge.

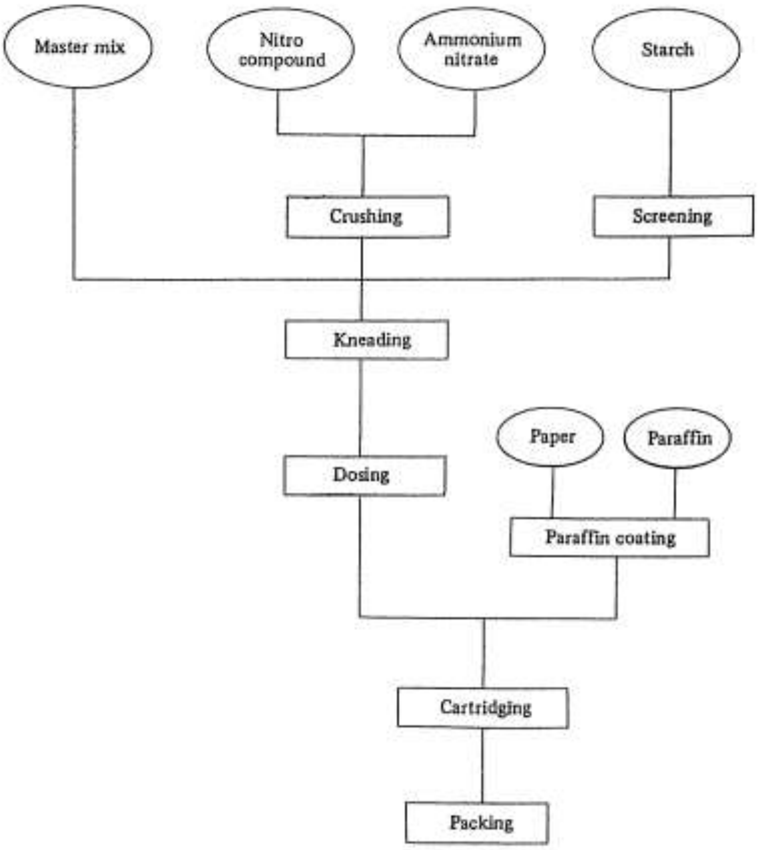
Packaging

More or less 20 pieces of cartridge are packaged in a vinyl bag or 10 small vinyl bags are packed in a large vinyl bag and delivered in a carton box

Example off plant capacity and construction cost

Plant capacity : 5,000 mt / year
Basis : 8 hours / day, 250 days / year

Dynamite Manufacturing Process Block Diagram



Raw Materials and Utilities

- Dynamite plant

Raw materials and utilities	Requirement (per ton of product)
Master mix	0.3 ton
Ammonium nitrate	0.66 ton
Starch	0.04 ton
Electric power	14.7 kwh
Water	3 tons

43 - Paint plant

The paint is a material forming a thin film on the surface of an object to be painted for the purpose of protecting its body, while providing suitable designs.

It generally breaks down to the paint, lacquer, varnish, enamel and auxiliary material .The synthetic resins used as color developers in the manufacture of paints involve respective production technologies for alkyd, emulsion, melamine, urea and acryl depending upon necessary properties of the paints requiring waterproofness, durability, resistance to chemicals, and mechanical and electric properties.

Diverse in uses, exerting influences on the quality of other industries and having higher added values in terms of investment scale, the paints introduced here are indispensable for the basic industries in developing nations.

The paint manufacturing technology, along with other technologies for synthetic resins, raw materials of paints, have been accumulated over the past 30 years at this plant, while such special technologies as the polyester resin varnish production technology and its application skills, ship paint production technology and other special paint production technologies have been steadily developed. As a result of introducing quality control techniques, these paints have been globally recognized in the quality and diversity of products.

Products and specifications

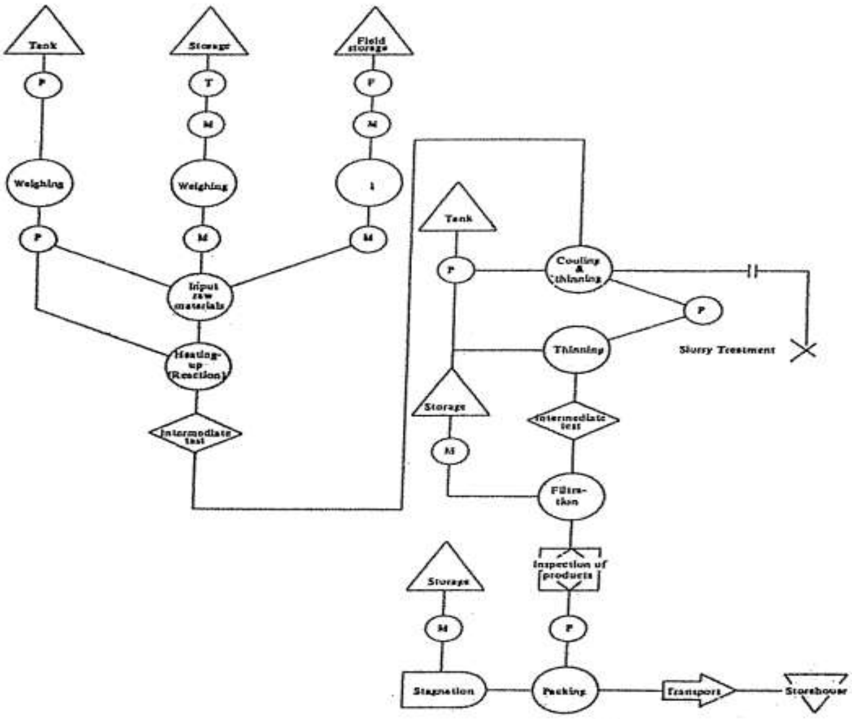
The items produced by this plant are divided by use as follows:

- Paints for building
- Paints for industrial uses
- Paints for structures and engineering works
- Marine and anticorrosive paints
- Paints for automobiles
- Paints for electric appliances
- Wire and coil coatings
- Paints for synthetic leather
- Can coat
- Paints for electrodeposition

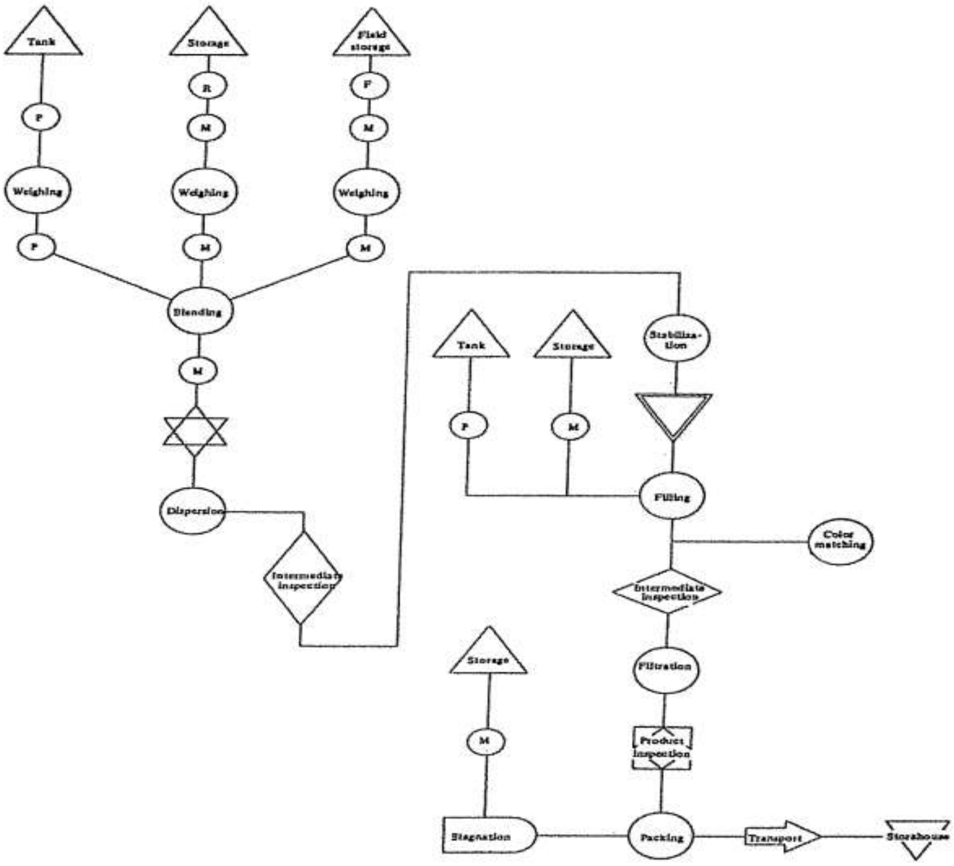
The products are classified by raw material synthetic resin and paint production technology as follows:

- Alkyd resin paint
- Emulsion resin paint
- Acryl resin paint
- Urethane resin paint
- Rustproof paint
- Special paint
- Kiquid - phase and solid-phase epoxy resins

Resin Manufacturing Process Flow Diagram



Paint Manufacturing Process Flow Diagram



Contents of Technology

Process Description :

Paint producing technology :

Paints are divided into the transparent paint not containing any pigment and the colored paint containing pigments. The transparent paint process comprises the dissolving process, in which the film-forming portion and additive are uniformly dissolved in the solvent, the filtration process, in which foreign matters mingled in the raw material or dissolving process are eliminated, and the packing process in which the final product is filled into cans for delivery.

The colored paint additionally requires processes in which pigments are dispersed in the course of the transparent paint process and the color desired by the users is respectively adjusted. Namely, it is divided into the kneading, dispersing, dissolving, color matching, filtration and packing .

Synthetic resin producing technology :

Each synthetic resin section based on the batch production system needs exclusive facilities, with from 0.5 ton up to 3 tons in capacity to meet users' requirements.

The production process is composed of four steps of reaction, dilution, filtration and packing. In the reaction process, each unit compound is reacted in a reactor to be synthesized into a high-polymer resin, while the synthesized high-polymer compound is diluted with solvent in the diluting process.

In the filtration process, the gel-like material occurred in the reaction and other foreign matters are eliminated, while the filtered resin is filled into drums or tanks for storage.

Example of plant capacity and construction cost

Plant capacity : paint 3,000 m / t / year
Synthetic resins ; 10,000 m / t / year
Basis : 8 hours / day, 300 days / year

44 - Carbon Black plant

The carbon black industry is growing rapidly after world war II together with the expansion of synthetic rubber and automobile industries. By 1975, the total free world production of carbon black was estimated at 4.2 million tons per year. Approximately 55 % of this tremendous annual production is used for reinforcing agent in rubber tires, 35 % for non-tire rubber, 10 % for non rubber application such as pigments as under-mentioned. Especially in the developing countries, the demand for carbon black is expected to increase more rapidly than before with the development of automobile industry and other rubber products making industries. Carbon black, a very large family of colloidal and non-graphite carbon, is used as follows:

- Reinforcing and filling agents for rubber and plastic .
- Light screening agents for plastics.
- Pigments and coloring agents for paints, inks, molded goods and foodstuffs.
- As important ingredient in many miscellaneous articles of commerce such as electrodes, dry cell, electrical resistors, explosives, pencil leads, polishes, leather finishes, cosmetics and mold release agents.

There are a number of carbon black manufacturing processes developed with respect to the grade of carbon black, including impingement process, furnace process and thermal black process. These processes may also be classified with respect to whether the primary raw material is gas (usually natural gas) or heavy hydrocarbon liquid (creosote oil, fluid catalytic cracking oil, naphtha cracking bottom oil, etc).

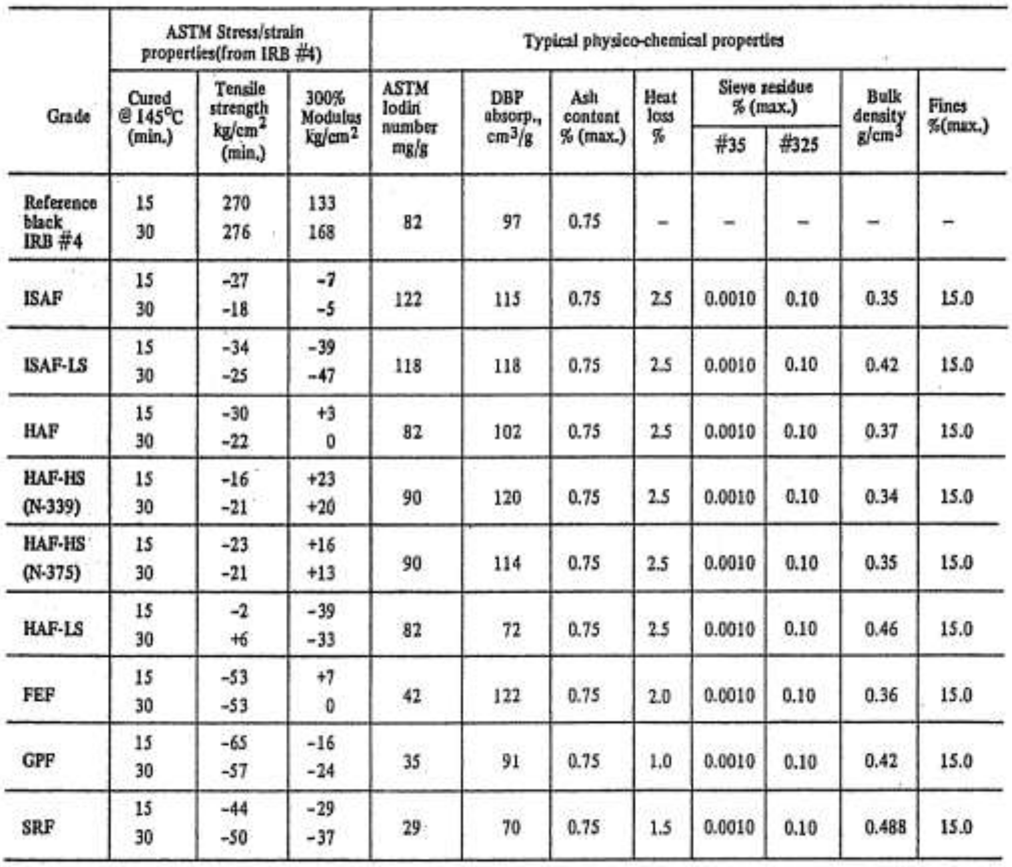
But, in recent years, nearly 95 % of the total world capacity of carbon black is devoted to the furnace process. Among the furnace processes, oil-furnace process occupies a dominant position since it began to replace gas – furnace process in 1950' S .

The plant introduced here is also adopting oil furnace process and has some merits. The plant is simple, compact and energy conservative, and can make high quality products at low cost.

Products and specifications

Carbon blacks being produced in the plant introduced here can conform to pertinent specifications depending upon types of products for which carbon blacks are used. Current products include eight kinds such as ISAF (intermediate super abrasion furnace), ISAF-LS (intermediate super abrasion furnace-low structure), HAF (high abrasion furnace), HAF-HS (high abrasion furnace-high structure), HAF-LS (high abrasion furnace-low structure), FEF (fast extrusion furnace), GPf (general purpose furnace) and SRF (semi-reinforcing furnace). Specifications are as shown in table 1

Table 1. Specifications of Carbon Blacks



Grade	ASTM Stress/strain properties(from IRB #4)			Typical physico-chemical properties							
	Cured @ 145°C (min.)	Tensile strength kg/cm^2 (min.)	300% Modulus kg/cm^2	ASTM Iodin number mg/g	DBP absorp., cm^3/g	Ash content % (max.)	Heat loss %	Sieve residue % (max.)		Bulk density g/cm^3	Fines %(max.)
								#35	#325		
Reference black IRB #4	15 30	270 276	133 168	82	97	0.75	–	–	–	–	–
ISAF	15 30	-27 -18	-7 -5	122	115	0.75	2.5	0.0010	0.10	0.35	15.0
ISAF-LS	15 30	-34 -25	-39 -47	118	118	0.75	2.5	0.0010	0.10	0.42	15.0
HAF	15 30	-30 -22	+3 0	82	102	0.75	2.5	0.0010	0.10	0.37	15.0
HAF-HS (N-339)	15 30	-16 -21	+23 +20	90	120	0.75	2.5	0.0010	0.10	0.34	15.0
HAF-HS (N-375)	15 30	-23 -21	+16 +13	90	114	0.75	2.5	0.0010	0.10	0.35	15.0
HAF-LS	15 30	-2 +6	-39 -33	82	72	0.75	2.5	0.0010	0.10	0.46	15.0
FEF	15 30	-53 -53	+7 0	42	122	0.75	2.0	0.0010	0.10	0.36	15.0
GPF	15 30	-65 -57	-16 -24	35	91	0.75	1.0	0.0010	0.10	0.42	15.0
SRF	15 30	-44 -50	-29 -37	29	70	0.75	1.5	0.0010	0.10	0.488	15.0

Contents of technology

1) Process Description

A number of processes have been developed with respect to the grade of carbon black.

The first one is impingement process in which the carbon black is formed by impingent of open flames upon a surface from which the carbon black is recovered. This category includes the channel and oil impingement process, which is old - fashioned and hardly used these days.

The second one is thermal black process in which combustion and carbon black formation do not proceed simultaneously. This category includes cyclic thermal black and acetylene black process.

The third one is furnace process in which combustion and carbon black formation occur simultaneously in a confined reactor or furnace. This category includes gas-furnace and oil – furnace. This category includes gas-furnace and oil furnace process, which are most worldwide processes .

The plant which is introduced here is now adopting oil-furnace process.

This plant consists of sections such as reaction, filtration, pneumatic conveying, pelleting, drying and storage and shopping.

Reaction section :

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

Process air which was preheated by air preheater is supplied by one set of blowers to all plant reactors.

Simillary feedstock oil which was heated by steam to an appropriate temperature is pumped through a spray nozzle shrouded by a small axial stream of unheated air . both nozzle spray and longitudinal nozzle position affect black properties, and oil preheat which affects spraying characteristics must be closely controlled. The excess tangential air and axial air burn a portion of the feedstock oil, providing additional heat for the reactions converting the balance of the oil to carbon black.

Auxiliary fuel is burned in the tunnels of the reactor with the preheated air, the air usually being 40 to 100 % in excess of theoretical volume depending upon the combustion temperature limitations of the refractories and economic consideration (combustion temperature is a function of air preheat and percent excess air and is maintained at a safe level by establishing and controlling the tangential heat input expressed as air enthalphy plus net heating value of fuel per standard cubic foot of air).

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

Filtration

Smoke leaving the preheaters is combined with that from the other reactors and enters collection system. Collection system uses bag filters which are made of silicone of silicone coated glass fiber .

Pneumatic conveying

Carbon black from the filter product outlet is usually pneumatically conveyed through a pulverizer to the surge tank feeding the pelletize. The carrier gas is smoke withdrawn from the filter with the black.

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

At the surge tank a cyclone separator separates the black and delivers it to the surge tank. The cyclone operates with only a few inches of water pressure drop and, under the conditions of carrier gas black loading, may recover 90 to 95 % of the entering black . the cyclone effluent gas, still carrying a little black, returns to the filter or may be directed to a separate small filter.

Pelleting

To facilitate shipping and handling, the carbon black is pelleted, giving a free-flowing product.

The preferred size range is such that the majority of pellet diameters are 0.25 to 2.0 mm . excessive fines (less than 0,125 mm diameter) may cause handling problems. Pellets must be hard enough to resist breakage in shipping and handling, but if too hard the black may be difficult to disperse in end use.

Carbon black is fed from the surge tank therough a rotary valve. Water enters the pelletizer through sprays downstream of the black inlet, mixes with, and is absorbed by the black. The mixing and cutting cutting action of the pins converts this damp mass into pellets, rounded to roughly spherical shape. To attain desired pellet properties, pelleting additives are frequently introduced with the pelleting water.

Optimum carbon black water ratio, additive level and revolutions per minute may vary with type of black, temperature of materials and pin condition, and must be adjusted by trial and error.

Drying

Wet pellets from the pelletizer are fed by a screw conveyer 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 the black or even create a fire hazard. Therefore close control, though difficult, is essential .

Storage and shipping

Storage tanks are elevated so that loading of bulk shipment and delivery to packaging equipment can be gravity to packaging equipment can be gravity flow. Product leaving the dryer is lifted by a bucket elevator, passes over a magnetic separator and a screen separator, and is delivered to the proper storage compartment by a screw conveyer system.

The magnetic separator guards against inclusion of magnetic material, infrequently found, in the product.

Since any magnetic material probably results from steel corrosion, its appearance calls for corrective action. The screen separator removes oversize pellets and is paticulary needed for some types of black for which pelleting control is difficult .

Pelleted carbon black is shipped in bulk or packaged in bags or other containers.

2) Raw materials & Utilities

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

Typical feedstock for oil furnace process of carbon black is :

- Catalytic cracker decant oil.
- Ethylene plant residium from naphtha cracking .
- Ethylene plant residium from gas oil cracking.
- Extract from solvent refining of catalytic cracker cyclic oils.
- Coal tar distillate, etc.

Unit consumptions of raw materials and utilites are shown in table 2 .

Carbon Black Manufacturing Process Flow Sheet

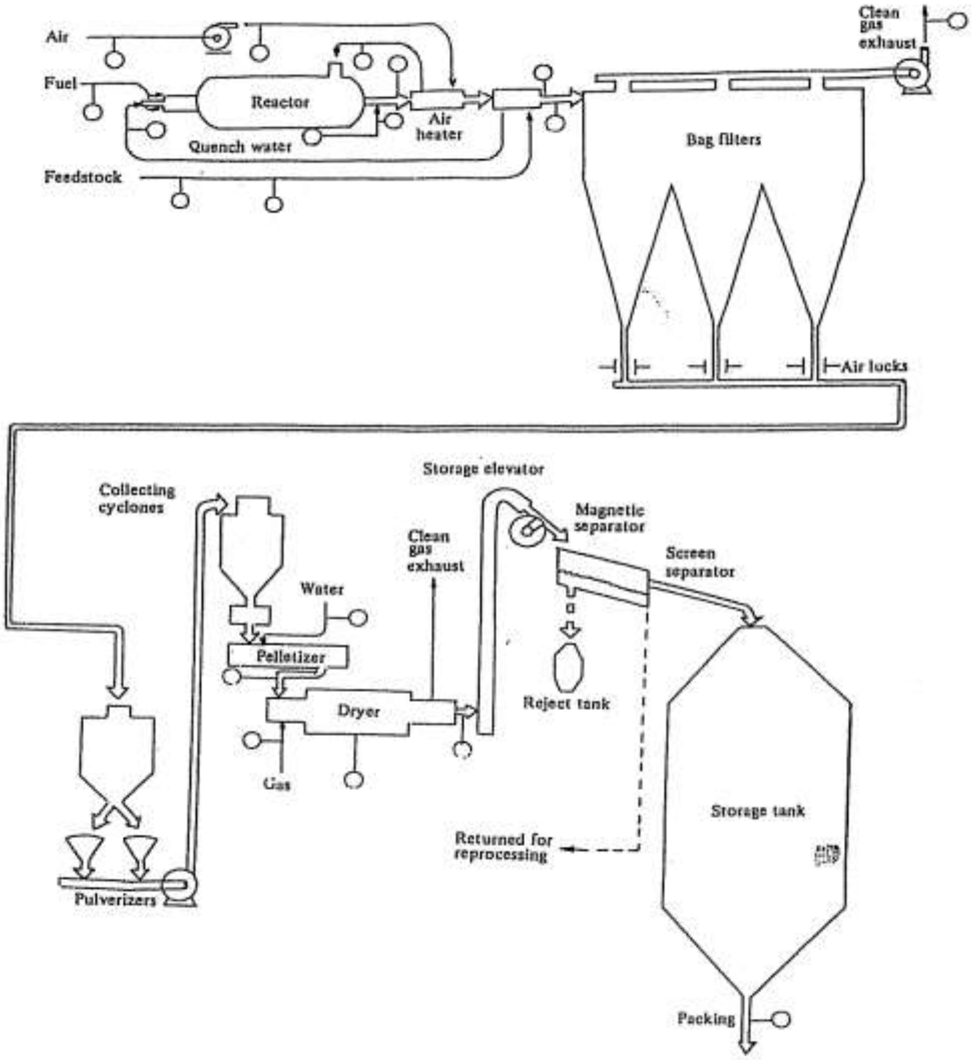


Table 2. Raw Materials and Utilities

Raw material and utilities	Requirement(per cubic meter of product)
Oil	2.2 tons
Fuel (natural gas)	2.45 mmkcal
Electric power	400 kwh
Process water	2.0 tons

Example of plant capacity and construction cost

Plant capacity : 50,000 m / t / y

Basis : 330 fays / year

45 - Adhesive plant

Adhesives have been closely related to the daily life of human beings to the extent of having been used thy ancient Egyptians. In early days, the jelly-like glue, prepared by making use of leather or bones of animals was mainly in use as an adhesive.

During the second world war, casein glue and nitrocellulose glue. Were developed for military uses.

However, it was not until in 1930 that such adhesives as utilizing urea resin and resorcinol resin in terms of plastic resins were put on sale in the market.

Achieving a rapid development, the adhesive man ufacturing technology has seen the development of various products with useful characteristics including hot melt adhesive, contact adhesive, emulsion adhesive, top cement, rubber-latex adhesive, synthetic resin solvent type adhesive, etc.

In the case of korea, the first platic adhesive was produced in the 1950s, with technologies accumulated for more than 30 years now. There has been the development and accumulation of technologies capable of providing suitable, high-performance adhesives depending upon the kind of adhesive materials, special working conditions and diverse conditions of use.

Adhesives are extensively used nowadays in various industries including wood processing, plywood, textile finishing, paper making, footwear manufacturing, electric equipment, musical instruments, packing, ceramic industry, construction, shipbuilding, etc.

Therefore, adhesives show a quick expansion in demand with the growth of these related industries, while the quality of the adhesives has great influence on the quality of such related products. It is said to be one of the fine chemicals occupying an industrially important position.

In particular, relatively simple in its manufacturing process, the adhesive plant requires small installation costs, with an advantage of increased added values if only know-how is properly secured, it is one of the most essential plants for the developing countries.

Products and specification

The plant introduced here produces products of diverse specification depending upon the kind of adhesive materials, working conditions and conditions of use. These products are largely grouped into emulsion type adhesive, elastomer type adhesive and solvent and paste type adhesive as follows:

Emulsion type (1)
Adhesives of VAc emulsion.
Adhesives of VAc – Acryl emulsion.
Emulsion type (2)

Adhesives of EVA emulsion.
Binding agents of VAc, Acrylic ester for textile and paper.
Adhesive of synthetic resin .
Sealants of synthetic resin.
Adhesives of synthetic resin for tile attachment .
Solvent & paste type
Adhesives of chloroprene rubber .
Adhesives of synthetic resin and rubber .

Table 1. specifications of Adhesives
Emulation type (1)

Product No.	Composition	N.V.Conlant (%)	Vicolity (Cps / 25 C)	use
201	Vlnyl acolate resin	27 ± 2	7000-10000	General adheglves for paper, wood cloth. Bamboo and p.c mortar. used for furniture, plywood, lays, wall paper, paper bags. Construction. Hard ware, sports and musical instruments, and the like. Fur binding various building. Materials sound absorbing textiles, decorative veneer and flush door.etc
210		30 ± 1	10000-15000	
205		42 ± 1	15000-25000	
209-SR		42 ± 2	17000-20000	
205		45 ± 2	30000-40000	
208-S		45 ± 2	40000-45000	
270		50±2	35-40000	
209		60±2	30000-45000	
205-TB		42 ± 1	2000-4000	For porous materials and turbo jet jointing
229-HD		55 ± 2	4000-6000	For edge bending of board; furniture particle board.etc
129-D		57 ± 2	18000-22000	Used for manufacture of paper tube, and for other mechanical application
240		32±1	18000-24000	
260		42 ± 2	15000-25000	
205-H		42 ± 2	8000-8600	For paper lamination to plywood
240-B		30 ± 2	30000-35000	For overlay of aluminium foll
270-A		50 ± 2	25000-30000	Used for binding ceramic tile net
250		42 ± 2	18000-22000	For wood working

				and cork ware,etc
H-40		40 ± 1	37000-43000	Protective coating on surface of furniture. Etc
H-30		32 ± 1	28000-32000	

Emulation (2)

Product No	Compotation	N.V, content (%)	Viscidity (cps / 25 ̊C)	use
100	Ethylene vinyl acetate Ruska	47 ± 1	12000-16000	For bonding: sheet or film of soft PVC, metallic foll and plastic foam to paper. Plywood and particle board. Bonding of p.c mortar and floor tile to concrete. Binder of p.c mortar
110		42 ± 1	15000-20000	
120		55 ± 2	2000-6000	
130		47 ± 2	15000-20000	
123	Vinyl acetate titan	33 ± 2	6000-10000	For padding and non. Woven fabric binder (pe.pp)
123-p		35±2	8000-12000	
151	Vac/ Acryl rein	45 ± 2		Binder for textile coating, padding and non, woven applications. For fabric backing and flocking adhesives
155	Styrene / acryl resin	45 ± 2	18000-22000	
156	Acrylic ester resin	45 ± 2		
161	Vac/ acryl resin	45 ± 2		
165	Acrylic osier resin	45 ± 2		
166		45±2		
157	Vac/ acryl resin	45 ± 2		For manufacturing wall paper and abrasive paper.
158		45 ± 2		
501	Styrene/ acryl resin	48±2		coating for pigmented paper
503	Acrylic ester rein	41 ± 2		Vehicle of emulsion paints (for

503-A	Styrene/ Acryl resin	42 ± 2		construction)
505		48±2		
505-H		48 ± 2		
540	Vac/ acryl resin	45 ± 2		(for coating the surface of wood)

mulation type

Product No	**Compotation**	**N.V. content (%)**	**Viscosity (cpa/20̊ C)**	**Use**
601	Chloroprene rubber phenolic resin	25±1	5000-10000	Bonding of rubber to metals. mutual bonding of rubber, leather, cloth wood, and others. Melamine or polyester laminated sheet to plywood.
630		22±1	5500-8000	
602-A		24±1	20000-24000	
PR-601	Synthetic rubber	17±2		
601-D	Chloroprene rubber phenolic resin	28±2	5000-10000	Sticker adhesive for label, and the like .
603		31±2	4000-6000	Cone paper to cr plate frame, damper and voice coll. Magnet to the frame, bobbin, and duct cores.
601-B		31±2	4500-7000	
D-730	Synthetic resin	5±10		For ABS, HIPS and acryl resin products.
609		31±2	6500-7500	For plastics, Al plates, name plates, leather lining.
37-A	Chloroprene rubber phenolic resin	35±1	35000-40000	For insulating felt or carpets to metal.
701-SP		23±1	200-900	For v-cut line (chipboard etc), edge bending of veneer core, insulating materials. (glass wood, urethane foam etc)
700-H		30±2	5000-8000	For shoe making Attachment shos soles; chloroprene rubber, SBR resin,
706		24±1	3000-6000	

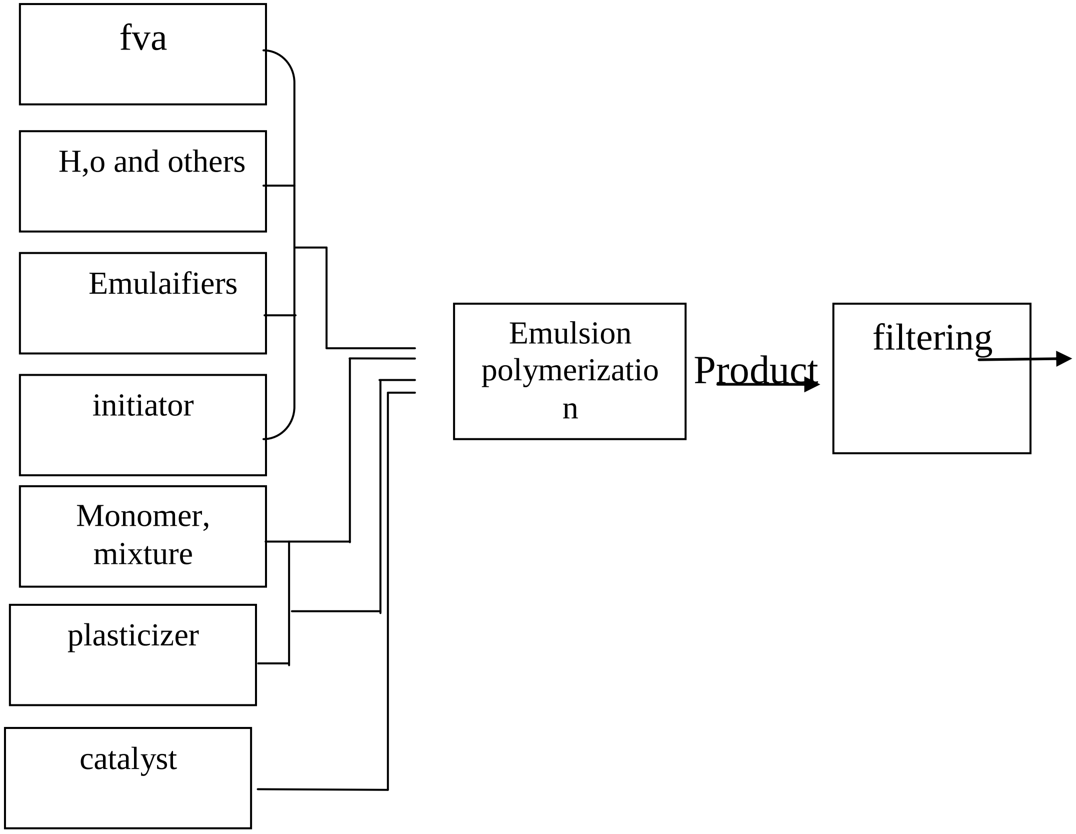
820	Chloroprene raft polymer	4±1		etc, to leather and vinyl heather.
815	Urethane resin	20±2	4000-7000	For bonding urethane foam to soft PVC and les ther

Solveai & paste type

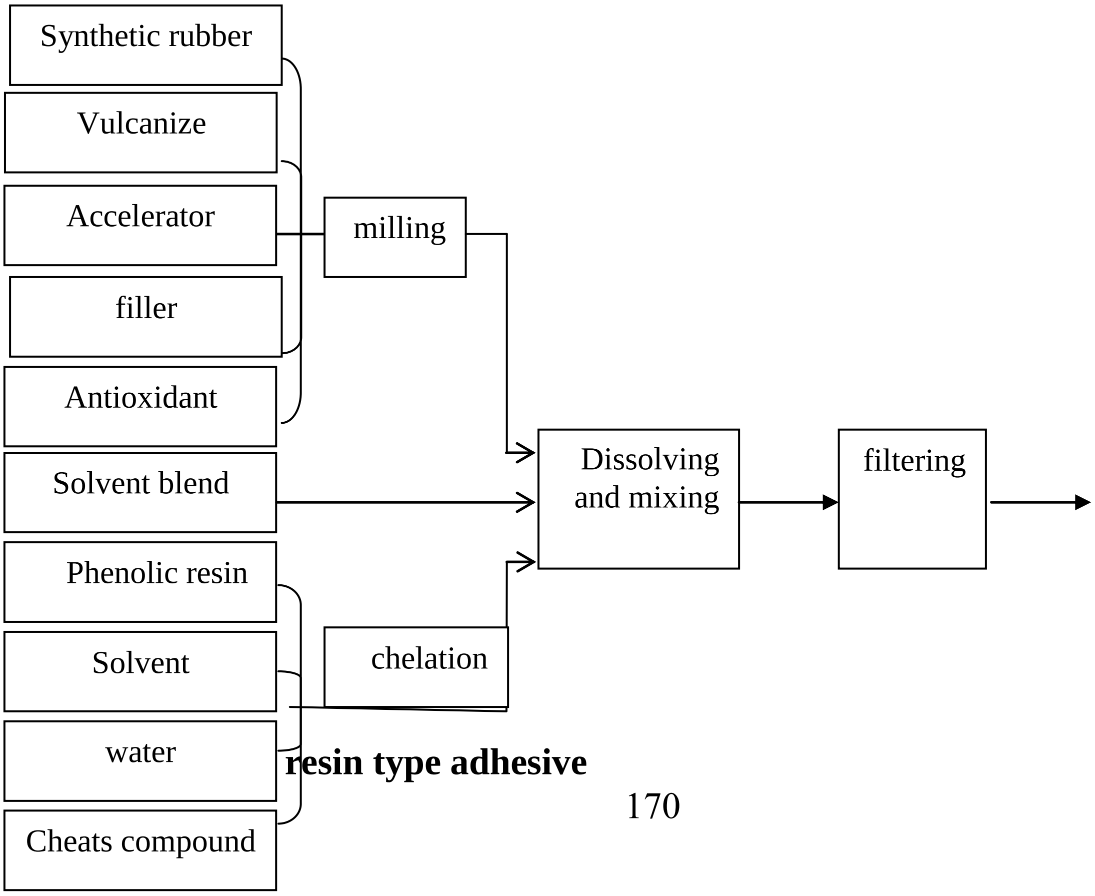
Product No	Composition n,v content (%)	N.V. content (%)	Viscosity (cpa/20̊ C)	Use
700 – C	Cellulose	24±1	8000-11000	For paper, wood, cloth, and celluloid glass.etc
300	Vinyl acetate resin	35±1	5000-12000	Mutual bonding of wood, paper cloth and leather. Bonding of styrene foam to concrete and p.c mortar etc
301		55±2	30000-40000	
R - 50	Resorcinol resin	50±2		For manufacturing plywood, multilayer plywood. Baoding of various exterior thick plywood, and timber, etc
Pw-70	Phenolic resin	70±2		
Po-70		70±2		
825	Vinly chloride resin	25±2	500-1500	Hard and soft PVC sheet , plate and plpos
825-A		10	50-300	For hard pvc plate and pipea jolnting
Sb-1000	Butyl rubber	75 up	Paste	Sealing of joints in curtain wall construction, and structure joint of concrete and metals.
St-1000	Polysulfide		Paste	
SA-1000	Acryl resin		Paste	
T-3000	Vinyl acetate resin		Paste	For fixing wall tiles, mosaic, floor tiles, to smooth backgrounds of plasior, concrete or light weight concrete.
T-3001				
t-4000	Synthelic resin			
t-4010				
t-4200				
t-4100-f			powder	

Adhesive manufacturing process flow diagram

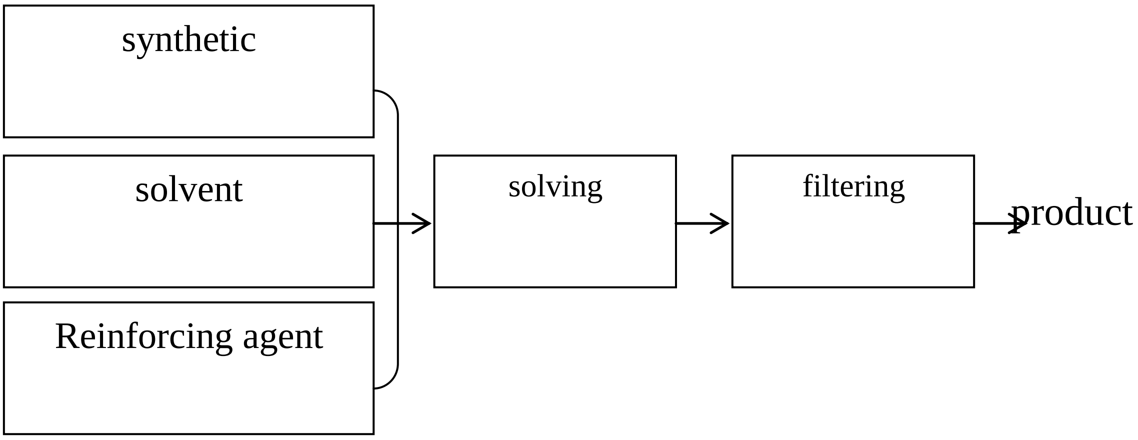
Emulation type adhesive :



Eastover type adhesive



resin type adhesive



Contents of technology

Process Description

The manufacturing process for adhesives varies depending upon product types . in the emulsion type, it is produced by the polymerization of monomers, of VAC or EVA in emulsion, whereas synthetic rubber, and solvent and paste type adhesives require raw material synthetic rubber or synthetic resins to be processed with solvents for the production of adhesives suiting various uses. Respective manufacturing processes are as follows:

Emulsion type adhesive :

In the emulsion type adhesive, monomers are dispersed in water as a solvent for polymerization as products by the use of a water-soluble polymerization initiator .

Thos process description primarily concerns with the polymerization of VAc. Emulsifier, polymerization initiator, protective colloid and monomer are filled into the reactor equipped with an agitator, reflux cooler, and heating and cooling devices, with the reactor temperature at 60 – 90 °C .

Since the temperature in the reactor gradually rises due to its reaction heat to make the control difficult, it is better to feed the monomer batchwise at proper time intervals. Stabilizer, plasticizer and anticeptic are also added at this stage.

On completion of the reaction, the product is cooled and inspected for filling into containers for delivery as final products.

Elastomer type adhesive

Synthetic rubber is pulverized in a two-roll milling machine for five minutes, and then filler, vulcanizer and vulcanization accelerator are added in succession. The entire milling time is within 30 minutes, with the temperature so controlled not to exceed 60 °C . when the milling is finished, the synthetic rubber is placed in the reactor for chealte reaction with the addition of phenolic resin, chelate compounds and solvent .

The produced maser batch is dissolved by solvent in a dissolving tank and then chelate phenolic resin is added for a sufficient blending. The blended product is filtered and inspected prior to delivery as finished products.

Solvent and paste type adhesive

Un the form of various plastic adhesives , it is usually called “top cement”. The selected synthetic resin, solvent and reinforcing material suting various uses are dissolved in a dissolving tank to produce this type of adhesive .

3) Raw Materials

Vinyl acetate emulsion type adhesive (solid 50%)

Raw materials	**Requirement (per ton of product**
Vinyl acetate monomer	422.0 Kg
Polyvinyl alcohol	33.7 Kg
Sodium carbonate	2.0 Kg
Emulsifier (Non – ion type) (HLB 14-18)	21.0 Kg
Potassium persulfate	16.9 Kg
Plasticizer (DOP,DP)	29.4 Kg
Water	525.0 Kg

Chloroprene rubber type contact adhesive

Raw materials	**Requirement (per ton product)**
Synthetic rubber	140.0 Kg
Antioxidant 2246	2.8 Kg
Znic oxide	7.0 Kg
Magnesium oxide	11.2 Kg
Phenolic resin	63.0 Kg
Solvent blend	798.0 Kg
Water	2.8 Kg

Synthetic resin type adhesive

Raw materials	**Requirement (per ton of product)**
Synthetic resin	300 Kg
Plasticizer	5 K
Solvent mixture	700 Kg

46 - Tin plate plant

Tin plate may be described as full-finish black plate additionally processed and coated on both sides with commercially pure tin.

The wide-spread use of tin plate arise from its combination of the strength of steel with the protective properties and solderability of tin.

Tin coating are applied to steel sheet either by electrolytic deposition or by immersion in molten bath of tin.

When coated by the hot-dip process, the tin plate is termed “coke tin plate” or “charcoal tin plate” .

When coated by the electrolytic process, it is termed “ electrolytic tin plate “ . But most of tin plates are produced by electrolytic process now .

The importance of tin plate to the food industry is well recognized and its wide spread utilization attests to the unique properties of this product in which ar combined the strength of steel and the corrosion resistance of tin.

The largest use of tin plate is for containers, and many of the improvement in its manufacture have been the result of research directed toward meeting the requirements of the container-manufacturing industry.

Tin cans are used not only for food and beverages, but also for paints, oils, tobacco, insecticides and proprietary drugs.

Table 1. temper grade

	Temper	**Expected average control hardness (Rockwell 30t)**	**Steel type**	**Example of usage**
Box annealed	T – 1	49 ± 3	L, MR	Drawing requirements, nozzles, spouts, closures
	T – 2	53 ± 3	L, MR	Rings and plugs, pie pans, closures, shallow drawn and specialized can parts.
	T – 2.5	55 ± 3	L, MR	Can ends and bodies
	T – 3	57 ± 3	L, MR	Can ends and bodies, large diameter closures, crown caps
Continuously Annealed	T – 4 CA	61 ± 3	L, MR	Crown caps and closures
	T – 5 CA	65 ± 3	MR	Can ends and bodies
	T – 6 CA	70 ± 3	MC	Very stiff application
Double reduced	DR – 8	73 aim	L, MR	Bodies and ends for small – diameter cans requiring high strength
	DR – 9	76 aim	L, MR	Bodies and ends for large diameter cans requiring high strength
	DR – 9M	77 aim	L, MR	Ends for beer and beverage can requiring higher strength
	DR - 10	80 aim	L,MR	

Notes:

L : base metal low in metalloids and residual elements, sometimes used for improved internal corrosion resistance for certain food product containers .

MR : base metal similar in metalloid content to type l but less restrictive in residual elements, commonly used for most tin mill products.

MC : base metal rephosporized, with residual elements similar to type MR, employed where greater strength is required and internal corrosion resistance is of lesser importance.

DR : base metal produced by the double cold reduction process:

Offers greater rigidity and strength than conventional base metal and, consequently, provides the same strength in lighter sections. Because of this advantage, more cans can be made per unit weight of tinplate .

Products and specifications

Our electrolytic tin plate comes in a wide range of types to allow selection ot the tin plate most suitable for any specific application .

- Wide range coatings available
- Wide range of tempers available ; Double – reduced tin
- Plate is also available
- Wide variety of surface finishes
- Various types of base metals
- Comes in both cut and coils

Table 2. tin coating weight

Type	Coating number	Nominal coating weight (gr/m^2)	Minimum average coating weight test value (gr/m^2)
Equally Coated weights	# 25	5.6	4.9
	# 50	11.2	10.5
	# 75	16.8	15.7
	# 100	22.4	20.2
Differentially coated weights	# 25/50	2.8/5.6	2.25/5.05
	# 25/75	2.8/804	2.25/7.85
	# 25/100	2.8/11.2	2.25/10.1
	# 50/75	5.6/8.4	5.05/7.85
	# 50/100	5.6/11.2	5.05/10.1
	# 75/100	8.4/11.2	7.85/10.1

Notes :

1. Coating weight for equally coated one indicate the weight of tin per square meter of both sides. Coating weights for differentially coated indicate the weight of tin per square meter of one side.
2. Various coated tin plate not specified in the above table can be subject to negotiation.

Table 3. surface finish

Type	Remarks
Bright finish	Standard finish, smooth base with flow brightened tin coating
Matte finish	Such as used for some crown seals, grit roughened base with unflowed tin coating
Stone finish	Grinding stone roughened base with flow brightened tin coating. This finish exhibits a linear surface texture parallel to rolling direction
Silver glow finish	Melted finish produced on a specially treated base metal.

Table 4. size availability

	Conventional size		**Double reduced size**	
	Sheets	**Coil**	**Sheets**	**Coil**
Thichness Mm(lb)	0.18-0.50 (65-175)	0.18-0.50 (65-175)	0.1-0.27 (55-95)	0.15-0.27 (55-95)
Width Mm (in)	710-940 (28-37)	710-940 (28-37)	710-940 (28-37)	710-940 (28-37)
Jength Mm (in)	458-1.104 ((18-43 ½)	-	458-1.104 (18-43 ½)	-
Inside dia. Mm (in)	-	6.4& 5.8 (16&20)	-	406&508 (16&20)
Weight (m/t (lb)	-	3-15 (6.500-33.000)	-	3-15 (6.500-33.000)

Contents of technology

Process description

Entry process

The entry end of an electrolytic line is usually so designed as to provide two uncoilers in line. This permits the operator to “ pay off “ from one uncoiler while charging a coil into the other .

In preparing a coil for processing, the lead edge of the strip is manually engaged in a set small pinch rolls which can be opened and closed by air pressure and which are usually motor driven. The function of these rolis is to permit the operator to advance the laed edge of a new coil into the welding assembly.

It is desirable to maintain a high strip speed in the plating baths, so facilitates are provided to join fresh coils to the strip without reducing line speed . As the coil in process is being unrolled, the operator take care that the maximum amount of strip is contained in the looper located just after the entry bridle .

Main process

From the looper the strip enters the main process section of the line .

The tension bridle is to produce sufficient drag on the strip to maintain a positive strip tension throughout the line .

In the acid – electrolyte units, the strip passes from the drag bridle to the alkaline electrolytic cleaners .

The strip passes from the alkaline cleaner into a rinsing unit . its function is to remove all alkali from the strip in preparation for the pickling operation.

This rinsing unit is usually comprised of water sprays playing both sides of the strip and of rotary bristle brushes which rotate vigorously against the strip .

The strip-pickling units is the hot immersion type, and this tanks are filled with hot sulfuric acid of 2 strength varying up to 12 percent .

After pickling, the strip is again rinsed in a unit similar to the one used after the alkaline cleaner and enters the plating tank .

A halogen electrolyte consists of a series of small cell, each with its own circulation system, com-tact roll and anode tank.

After passing through a number of these units, the strip is defected upward and backward so that the original top of the strip now becomes the bottom. It then passes through another series of similar plating cells unit the desired amount of tin is deposited on this side of the strip .

The tin coating, as it emerges from the plating bath, is gray – white and semi-lustrous. It does not in appearance resemble tin plte as it is commonly known.

It is melt and quench the electrodeposited tin which gives it the brilliant luster typical hot-dipped plate .

Unlike hot dipped tin plate, the electrolytic plate is not oily as it emerges from the coating operation;

Hence it is necessary to deposit a controlled film of lubricant on the product in order to improve its handling properties in succeeding operations .

The strip next enters the unit which supplies trac-tive power to the strip to pull it entirely through the electrolytic line .

Delivery process

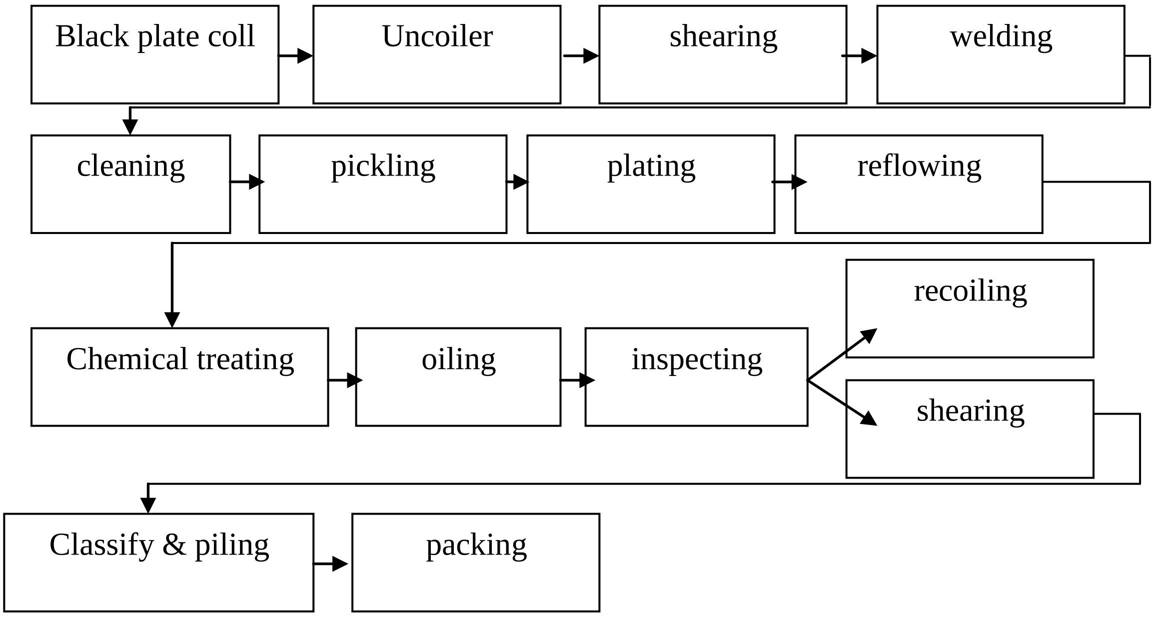
Delivery process lines are provided with large poopers and a single recoiler at the delivery end into which the strip pass from the drive bridle .

The coil of coated product is sent to the sharing unit where it is sheared to sixe, assorted, counted and piled .

The methods of inspection and classification of electrolytic tin plate on these flying shears are rather Ingenious. Located somewhere after the melting unit is a noncontacting thickness gage .

A device sometimes called a pinhole detector utilized a photoelectric cell to continuously scan the coated strip and cause sheets with perforation to be deflected into he piler.

Electrolytic tin plate manufacturing
Process block diagram



Raw materials and utilities

Raw materials and utilities	**Requirement (per ton of process)**
Black plate	1 ton
Tin	6.3 kg
Electric power	160 kwh
Steam	0.3 ton
Compressed air	50 m^3

47- Zinc making plant

The main product zinc obtained from its smelting is an important item for wide use in suck key industries as steel-making, automobile. Shipbuilding and chemical industries. Its major uses are : 1) corrosion inhibition of steel products (galvanized steel sheets and steel pipe products), 2) basic metal die casting for precision component parts, 3) brass – alloy manufacture and 4) Raw materials for paint industry. Sulfuric acid as its by-product is an essential item for such key industries as fertilizer, steel – making and textile industries.

It can also supply cadmium metal and copper products (copper ingot and cupric sulphate) as by-products to enhance its profitability, thus significantly contributing to motivating the progress of key industries, as well as development of available resources (zinc metal ores).

Contrary to the dry smelting process, the wet smelting process can directly produce high-purity products (a bout 99.99 % in purity) . However, what matters here are the yield of products and the unit consumption of auxiliary matetials and utilities in addition to plant facilities in terms of overall profitability and operation management. Accordingly, the technology based on ample experiences is most important in this connection .

Products and specifications

The zinc metals produced in this plant are electrolytic zinc, zinc alloy for die casting, zipper and galvanizing, and zinc anode, Also, as by products, cadmium stick, cupric sulfate and sulfuric acid are produced and their specifications are shown in table 1

Table 1. specifications of cadmium ingot, cupric sulfate, and sulfuric acid

Product	**Item**	**Chemical compositions (%)**					
		Unit	Cd	Pb	Cu	Fe	Zn
Cadminum stick	CDI	13m/mØ 26m/mØ	99.99	0.006	0.003	0.002	0.002
Cupric sulfate $CuSO_4.5H_2O$	98.5 % up						
Sulfuric acid (H_2SO_4)	9 % up						

Contents of technology

Process description

As shown in the flow sheet below, the zinc concentrate as raw materials is roasted to obtain acid – soluble roast. Its zinc metal portion is dissolved in thw neutral dissolving process for the removal of various impurities in the subsequent refining process.

In the electrolysis process, the zinc metal, electrolytically deposited on the cathode is stripped by the new solution and melted in the lowfrequency induction furnace to produce zinc ingots.

The zinc metal portion, not dissolved in the preceding metal dissolving process is additionally dissolved in the residue dissolving process in accordance with the concentrated acid and high temperature method for recovery in the main process. It improves the real yield in the long run.

As the by-product of this process, sulfuric acid is produced by utilizing the sulfur dioxide gas generated in the roasting produced by making use of cadmium and copper cake from the purifying process.

Equipment and machinery

Roasting process

Roaster
Waste heat boiler
Air blower & hot gas fan
Dust cottrel
Bag filter

Acid making process

Humidity and cooling tower
Mist Cottrell
Drying tower and absorption tower
Irrigation cooler
Converter
Heat exchanger
Storage tank

Leaching process

Calcine bin
Leaching & y – site tank
Leaching thickener
Leaching solution tank
Belt filter & drum filter
Heat exchanger
Vacuum pump
Purifying tank
Filter press
Hydraulic pump

Electrolysis process

Cooling tower
Electro tank
Anode plate
Cathode plate
Rectifier

Casting process

Melting furnace
Moulding machine
Bag filter
Ingot case

Cd making process

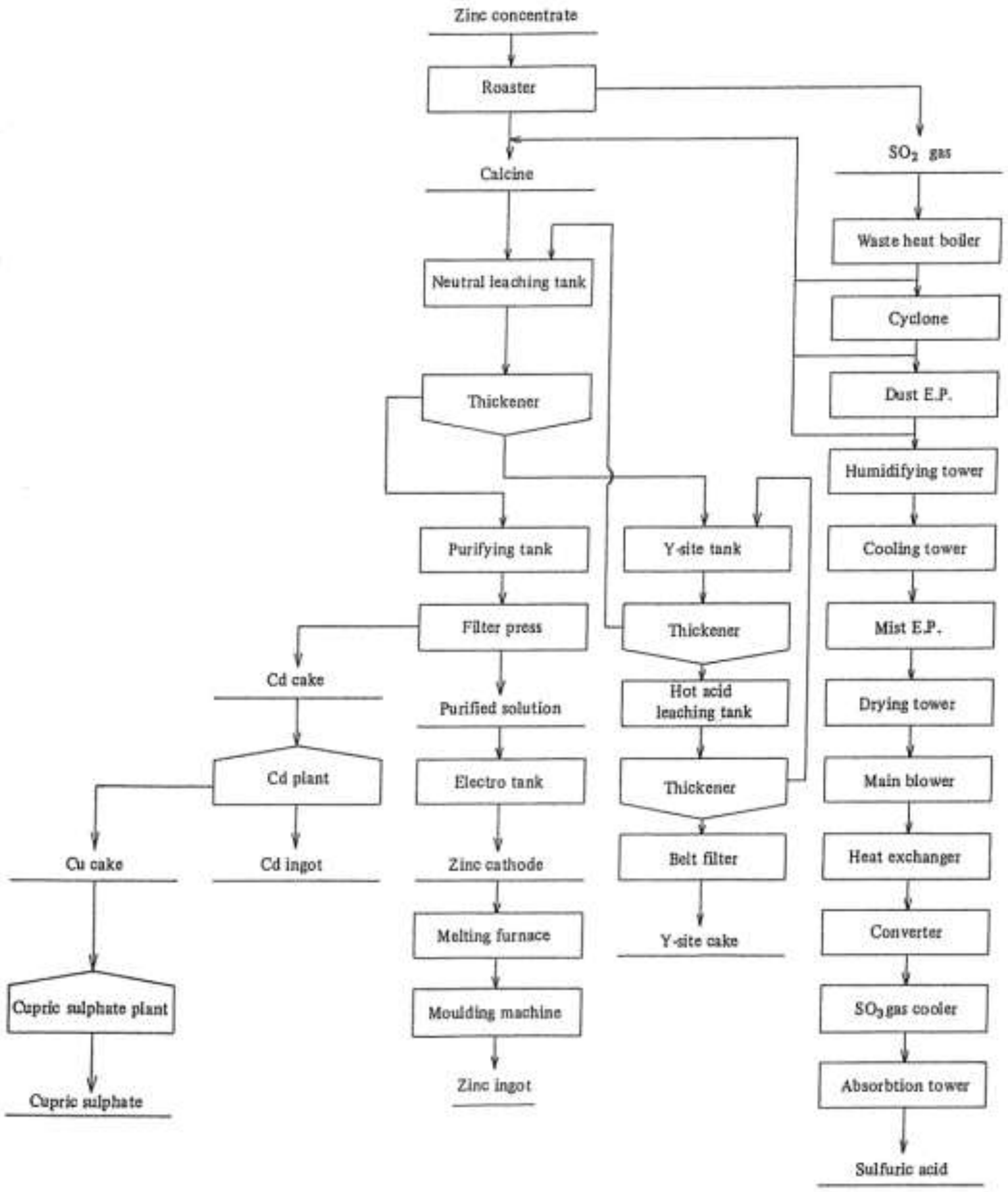
Leaching tank
Filter press
Electro tank
Cathode and anode plate
Melting pot
Ingot case

$CuSO_4$ making process

reverberating furnace
leaching tank
concentration tank
centrifuge

Example of plant capacity : Plant capacity : 50,000 m / t / year

Zinc manufacturing process flow diagram



48 - Atomized Metal powder plant

There exist a variety of powder metallurgical products, but this product introduced here is mainly in use as raw materials for the manufacture of copper related oilless bearings applicable to household electric appliances, general industrial machinery, cars and audio equipment.

Depending upon its way of manufacturing, the metal powder is classified into the electrolytic metal powder, atomized metal powder and stamping milled metal powder. It also breaks down to the bronze powder, bress powder, kelmet powder, copper powder, tin powder, lead powder and aluminum powder depending upon respective raw materials.

Developed by the korea advanced institute of science and technology (KAIST), the manufacturing technology of this product is related to the production of copper powder and tin powder in accordance with such processes as atomization. Oxidation and reduction.

The produced powder is adjusted to have suitable characteristics as a raw material of oilless bearings, while maintaining its apparent density below 3g / cm^2 as a blending source before forming. It is also the technology improving the workability of the oilless bearing itself by providing the necessary property of fluidity, and mass-producing bronze powder on the basis of water atomization process.

Products and specifications

This plant produces bronze, copper, brass, kelmet, tin, lead, zinc, aluminum and colder powders. Among these, specifications of the brass powder are as shown in table 1.

Table 1. specifications of brass powder

Spec	model No	ABra – 20	ABra – 30
Apparent density (g/cm^3)		2.7 ~3.3	2.7 ~ 3.3
Fluidity (Sec/50g)		Max .35	Max . 35
Composition (%)		Cu 80 Zn 20	Cu 70 Zn 30
Size distribution	Mesh 100 ±	Max. 5	Max.5
	150 ±	5 ~ 15	5 ~ 15
	200 ±	10 ~ 20	10 ~ 20
	325 ±	20 ~ 30	10 ~ 30
	325 -	40 ~ 50	40 ~ 60

Table 2. uses of metal powders

product	Use	Powder Metallurgy	Friction Disc	Contact-Electrode	Metal-Likon	Pigment	Catalyst	application
Bronze Powder	Cu -sn	-	-	-		-		5,10,13,15,17,22,30
Cu powder	Cu	-	-	-	-	-	-	1,5,6,7,8,9,10,11,12,13,14 15,17,19,20,21,25,27,28,30 31
Brass Powder	Cu-z	-	-	-		-	-	6,9,11,12,15,17,30
Kelmet Powder	Cu-pb	-	-	-		-		5,9,11,12,15,17,30
Sn powder	Sn	-	-	-		-	-	5,10,11,12,17,23,24,31
Pb powder	Pb	-	-	-		-	-	4,5,6,11,12,14,15,16,17,18, 25,27,31
Zine Poder	Zn	-	-			-		9,15,17,31
Al Powder	Al	-	-			-	-	1,2,3,4,5,15,17,20,21,30,31
Solder Powder	Sn - pb	-	-			-		5,13,17,21,22,23,24,28,

1 pyrotechnics
2 thermit reactions
3 cold solder
4 rubber compounds
5 bearing
6 brazing
7 contact – electrodes
8 brush
9 corrosion resistance
10 filter
11 friction disc
12 machine & ordance parts
13 grinding wheel
14 anti-fouling paint
15 plastics
16 grease
17 plating
18 sound equipment
19 welding rods
20 iron & steel foundries
21 ammunition
22 radiator
23 jewelry
24 special solder
25 x-ray & radiation control
26 printed circuit
27 sound dampening compound
28 additions to iron powder
29 infiltrating powder
30 friction parts
31 catalyst

Contents of Technology

1) Process description

The melting process makes use of an ordinary metal melting process, while the atomizing process breaks down to the air and water spraying methods depending upon the kind of products .

In the spraying process, the metal powder having required form and particle size can be manufactured by appropriately adjusting the spray nozzle, spray pressure and spray medium. While its particle size can be adjusted up to – 325 mesh.

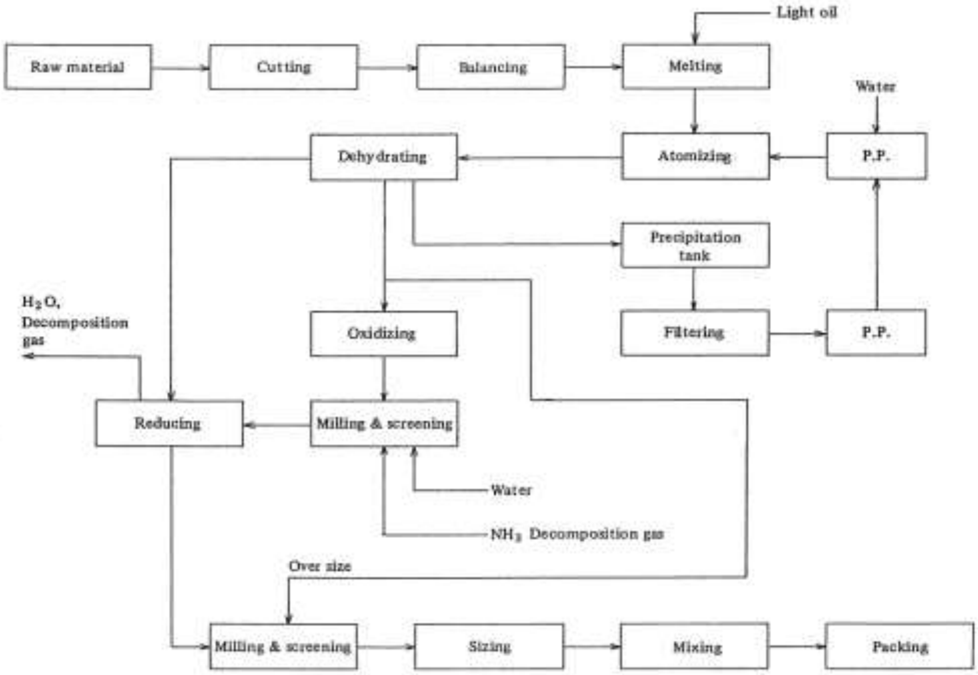
When water-sprayed, a dehydration process is necessary . the powder of irregular and porous form can be produce by oxidation and reduction processes depending upon the use of products.

The particle size adjustment as well as the addition of a lubricant are required for conforming to such conditions as its flow rate and expansion when sintering.

2) Equipment and machinery

Mechanical press
Melting furnace
Atomizing chamber
Plunger pump
Oxidizing furnace
Crusher
Sieve
Reduction furnace
Duble cone mixer

Atomized metal powder manufacturing process flow diagram



3) Raw material and utilities

Bronze powder

Raw material andUtilities	**Requirement (per ton of product)**
Electrolytic copper	934.5 kg
Tin	118.8 kg
Electric powder	340 kwh
Water	20 m / T
Light oil	4 D / M
NH_3	5 kg

Example of plant capacity and construction cost

Plant capacity : 200 m / t / year

49 - Electro Plating Work Shop

1. Preface

Electroplating workshops are primarily service workshops, offering their services to a wide range of industries .

The electroplating workshop can plate various materials, such as cast iron, steel, sn / pb (centrifugally cast), brass, copper and various alloys.

In the plant, the materials can be zinc – plated, nickel- plated or chrome- copper, brass and auralloy.

The equipment and the plant can be easily tailored to suit different requirements, ranging from plants using production methods which require a high proportion of manual work to others equipped with automatic machinery lines which require a relatively small amount of labor.

2. Potential customers

Potential customers for the services of an electroplating workshop are:

- The machinery industry
- The electrical industry

3. Capacity of the plant

The capacity of the electroplating workshop for zinc, nickel and chrome plating is small. The raw materials passage may be to 100 tons per year, with individual components of 0.05 to 0.5 kg.

The plant’s capacity can be increased by increasing the number of shifts.

4. Brief description of the process

In general, the metal pats to be plated are inserted into the galvanizing cylinder at the despatch unit and are removed by the removing unit at the end of the process.

During processing, the parts pass through different stages: boiled degreasing, electrolytic degreasing, rinsing, hot rinsing, decantation, passi-vation, zinc plating, nickel plating and chrome plating.

The process flow sheet shows all the possible necessary treatments in one series. The actual processing stages must be laid down individually for each basic plating material and plated surface.

5. Required basic and auxiliary materials

The quantities of the various materials needed depend on the nature of the work which is done in the plant and the methods used .

Below are the approximate materials requirements of the plant for one year’s operation:

- Electrolytic degreasing mixture 2,400 kg
- Boiling degreasing mixture 2,400 kg
- Decantation HCL / water = 1 / 1
- 2,000 1 (supplement after)
- Nickel 500 1 * analysis
- Passivation 30,000 1 *

- Chrome	500 1 *
- Zinc	1,000 1
- Water	5,760 m^3

*) occasionally necessary depending on analysis results .

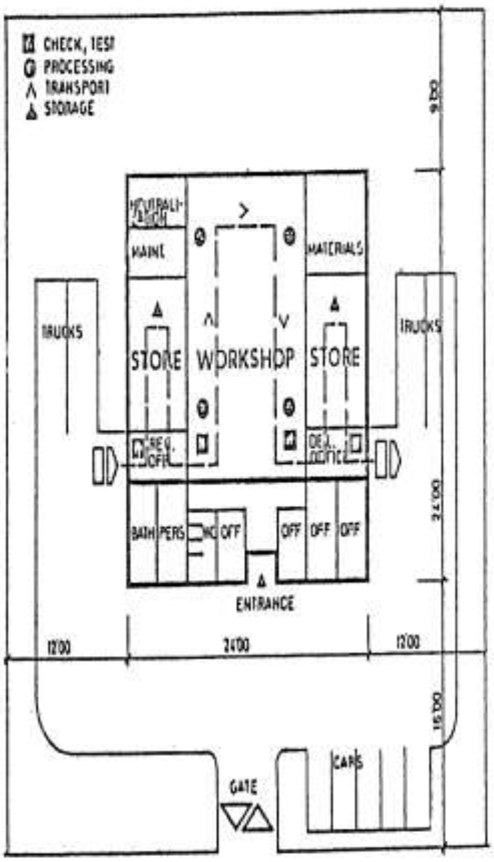
6. area requirements

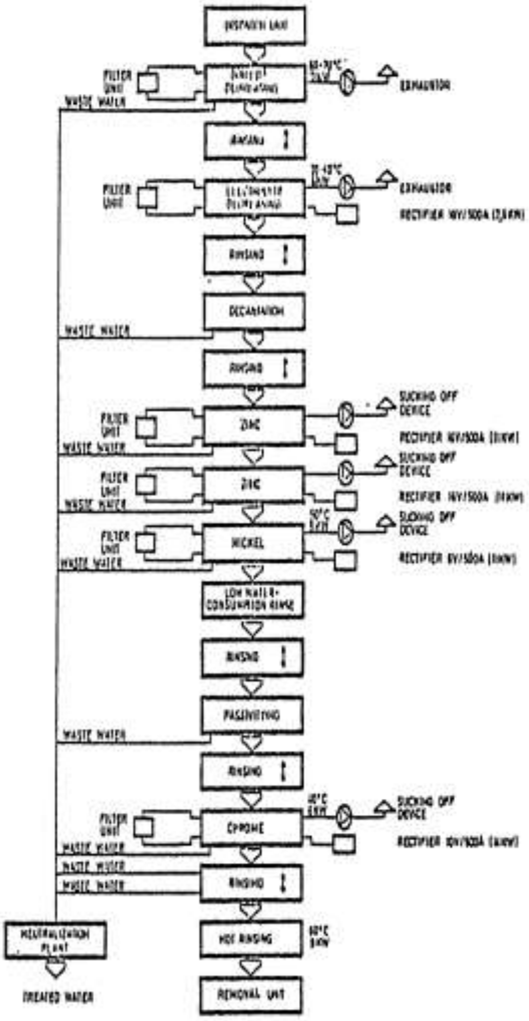
Required site area :	2,350 m^2
Required building area	
Production hangar :	288 m^2
Storage hangar :	144 m^2
Office building :	138 m^2

Structural :

Production hangar, storage hangar, office building

Columns and beams	- prefabricated concrete
Walls	- brick – lined, plastered
Floors	- concrete, PVC – Paved
Roof	- concrete ceiling with metal sheeting





7 . Machinery and equipment

description :	quantity :	description	quantity :
tank : 1000×1000×750 mm	10	additional control unit	1
tank : 1200×1000×750 mm	12	Air compressor	1
Galvanizing cylinder :		universal lathe	1
450 mm dia × 750 mm	6	pillar drill	1
Longitudinal feeder	2	framed saw	1
Transverse feeder	2	universal milling machine	1
Mounting frame	22	shaper	1
Exhaustor	6	Arc protective gas welding	
Rectifier 10 V / 500 A	2	unit	1
Rectifier 6 V / 500 A	1	gas welding unit	1
Rectifier 16 V / 500 A	2	Metal worker' s tool kit	1
Cylinder drive	6	electrician' s tool kit	1
Filter unit	6	crinding machine	1
Metering and control system	1	portable tool box	2

Workbench, assembly bench, shelf unit, too cabinet, cupboards, machine tools, hand tools, etc.

8 . Power requirements

Power type : 3 × 380 v, 50 Hz
Built – in capacity : 170 kw
Power consumption during
Simultaneous operation : 140 kw
Power consumption per year : 280,000 kwh

9.Work – time base

Number of shifts taken into consideration :1 shift per day
Work – time taken into consideration : 8 hours per day
Number of work – days : 250 days per year
The plant id is also suitable for operation in more shifts.

50 - Electro Plating Plant

Most of the articles of living or transportation vehicles are usually coated with paint or plating, because iron is corroded in the atmosphere. As the industry developes, the demand for iron products has significantly increased, also increasing the plating products.

With much progress in plating techniques, the plating has wide applications including ornamental articles and household goods. To cope with such an increasing demand, the electroplating plant should be so constructed as to be equipped with the latest facilities taking into consideration the emerging problem of how to reduce the labor force.

The electroplating facilities described here are of the I – c carrier type as well as hydraulic elevator type, with the following characteristics:

I - C carrier type

* ROM I - C males simple changes in plating process as well as future expansion possible.

- The use of an approach switch makes it semiper manent .
- The use of a remote control panel makes an automatic operation possible. If necessary, it can be switched over to an ordinary control panel to be semiautomatic or manual in operation.
- It is fitted with a shock – absorbing control device providing the soft start and stop by the use of a pole change motor.
- It is fitted with a device preventing erroneous actions.

Hydraulic elevator type

- It is automatic and continuous, making the consistent preliminary treatment, plating and sfter-treatment possible.
- It is the return type capable of doing one-man loading and unloading.
- Fitted with a warning device against erroneous actions, it can prevent hazards.
- Fitted with a special carbon on the hanger. The passage of a current is perfect.
- The change of working hours is possible.

Products and specifications

This plant is capable of carrying out the copper plating, nickel plating, decorative and industrial chromium plating, zinc plating, cadmium plating and tin plating, with explanations focused on the zinc plating.

Contents of technology

1) Process description

The surface of a metallic article has to be first removed of impurities prior to electroplating, because the oil and fats, oxide, hydroxide and dirt are deposited on it during manufacturing treatment process, transportation or storage. Mainly pickling and degreasing are carried out as the preliminary treatment.

Polishing

The polishing improves the adhering strength of the final plating as well as the appearance. There are two polishing methods for the plating, namely the buff polishing and barrel polishing. The buff polishing breaks down to the belt-type polishing and electromotive polishing. Excellent in cutting property, the belt-type polishing is suitable for polishing the surface of a metallic article. The electromotive buff polishing has separate steps of initial cutting, intermediate buff and finishing buff. The barrel polishing is used in a mass polishing for small component parts.

Pretreatment

In order to obtain a good plating surface, the Impurities deposited on the surface of a metallic article have to be removed, and the surface must be activated.

Approximately 50 – 70 % of the defective plating is caused by the inappropriateness and negligence in the pretreating process. As such a pretreatment in the plating, the degreasing and acid treatment are mainly used.

The degreasing is an operation of eliminating the grease deposited on the surface of a metallic article, having such methods as solvent degreasing, alkali degreasing, electrolytic degreasing, emulsion degreasing and mechanical degreasing.

The object of the acid treatment is to remove oxides, hydroxides and salts on the surface of a metallic article, with the methods of pickling, acid etching and acid dipping mainly used.

Plating

On completion of the pretreatment, the metal is conveyed for plating, which is mainly electroplating and divided into the rack type and barrel type depending upon the form of component parts. At the cathode, the metal ions are reversed to metal and deposited on the metal surface in plating, while at the anode there ia s dissolving metal plate and replenishes the metal ions consumed. Each plating solution contains an appropriate lusteringagent which improves the state of the surface plated.

After-treatment

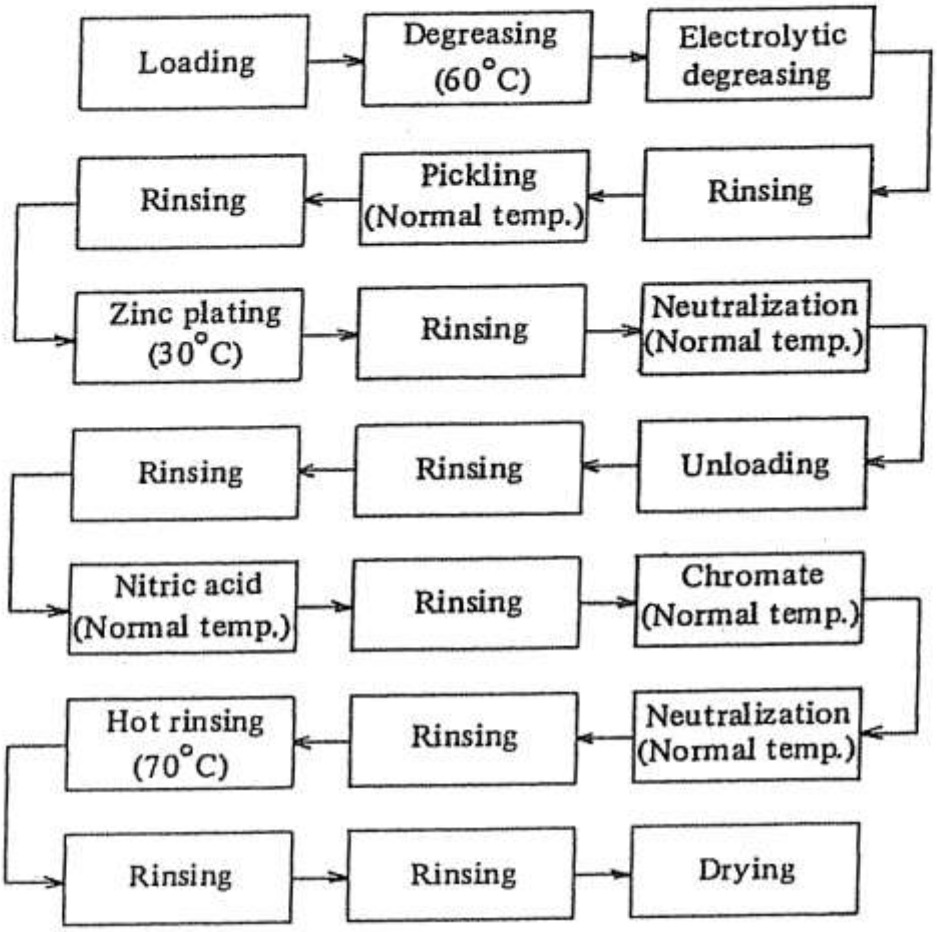
On completion of the plating, the component parts are washed with hot water and then dried Depending upon the type of plating, some are subjected to an appropriate treating process for preventing changes in quality or hue .

2) Equipment and machinery

Semiautomatic barrel zinc plating apparatus

Control board - Barrel - Rectifier - Filter - Exhaust equipment - Thickness tester .

Electroplating process block Diagram



3) Raw materials

Bolt and nut

Raw material	Requirement (per one barrel)
Alkali cleaner	100 kg / 900 ℓ * 1
Sodium cyanide	15 kg / 500 ℓ * 2
Caustic soda	15 kg / 500 ℓ
Sulfuric acid	45 kg / 500 ℓ * 3
Sodium carbonate	20 kg / 500 ℓ * 4
Zinc oxide	92 kg / 2,500 ℓ
Sodium cyanide	200 kg / 2,500 ℓ * 5
Caustic soda	92 kg / 2,500 ℓ *
Nitric acid	0.2 kg / 110 ℓ * 6
Chromic anhydride	20 kg / 110 ℓ *
Sulfuric acid	1.5 kg / 110 ℓ * 7
Nitric acid	1.5 kg / 110 ℓ *
Sodium carbonate	5 kg / 110 ℓ * 8

Note

* 1: Degreasing
* 2 : Electrolytic degreasing
* 3 : pickling
* 4 : neutralizing
* 5 : zinc plating
* 6 : nitric acid treatment
* 7 : chromite
* 8 : neutralizing

Example of plant capacity :

Plant capacity : 1,500 kg / day

* basis : this electroplating plant example is applicable to zinc plating accompanied by chromate treatment of iron bolts and nuts with 5 barrels (30 kg / barrel)

51 - Charcoal Production

Charcoal is a fuel which has important industrial as well as domestic uses . being made from wood, potentially a renewable resource, the environmental implications of charcoal production require careful consideration.

The process described in this profile operates with two kilns which are loaded and fired alternately. The basic sub - process involved are wood preparation, carbonization and packing of the finished product.

1. Introduction

The art of making charcoal is at least 6,000 years old. Interest in charcoal as a fuel, both for domestic use and for industrial purposes, has recently increased because of a steep rise in the prices of all fuels and power.

Charcoal is made from wood, a renewable resource. It should be noted that charcoal industries have caused large-scale environmental damage. The ecological effects of removing trees must be understood and measures be taken to prevent such damage, prior to starting a charcoal industry.

The reason for the use of charcoal instead of wood is that heat value of charcoal is twice as high as that of wood (1,700 kj/kg compared to 850 kj / kg) . therefore the shipping cost of is reduced. Charcoal burns without smoke and can be used in smaller and more efficient stoves.

Charcoal is also used in industry in the process of manufacturing lime and cement, for the extraction of metals, particularly iron, from their ores. Iron and steel made with charcoal are of higher quality than that made with coal. Charcoal is used for forging and producing thigh quality castings . Activated charcoal is produced by treatment with zinc chloride; it is used as absorbent in chemical processes and medicine.

2. Production processes

Charcoal is produced when wood is burned under limited supply of air, Gaseous components and water are removed, so that charcoal consists of about 90 % carbon. The yield should be 50 - 70 kg of charcoal out of 1 cubic metre of wood.

3.Material requirements

Nearly any wood can be taken for charcoal production ; commonly used species, which are fast growing, are Eucalyptus and wattle trees .

Production can start two months after investment. The first monthshould partly be taken for training of the labourers if necessary ..

52 - Solar desalination unit

The solar still is used as a source of distilled water for both industrial and domestic purposes. In many parts of the world the supply of drinking water during the dry season is a problem of vital concern. The size of still described in this profile is sufficient to cater for the needs of up to 250 inhabitants. The plant requires only one attendant and has a capital cost of less than $ 18,000 .

1. Introduction

By means of solar energy potable water is produced from seawater or brackish well water in the process of desalination or distillation.

The solar still consists of a shallow pool of brine covered by sloping panes of glass. The water is evaporated by absorbed solar radiation and the vapour condenses on the underside of the glass coves, which are cooled at the outside by convection. The water droplets trickle down the glass to be collected in narrow drains along the bottom.

2. Location

The solar still is used as a source of distilled water for battery maintenance in garages and analytical laboratories in hospitals and schools.

In many parts of the world, supply of drinking water during the dry season is one of the most crucial problems for villages .

Solar stills offer a solution for the problem of potable water supply first in places near the sea, using saline seawater ; secondly in places which are rich in underground water, but when the water is unfit for human consumption; and thirdly, where only brackish or polluted surface water is available.

Furthermore on small islands distilled water may be the only source of fresh water .

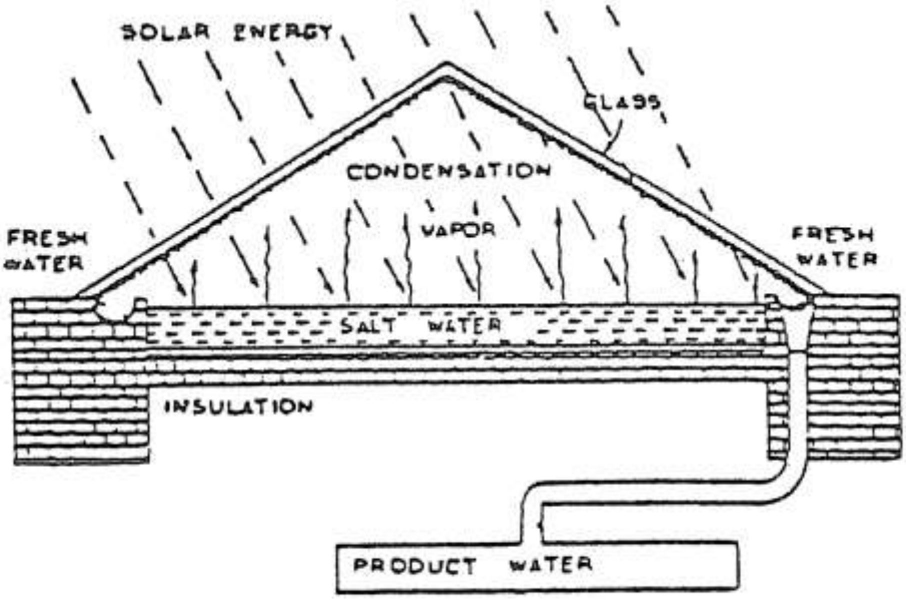
Installations of solar desalination plants are widely sued in the USA, Greece , Australia , niger and mali. The great advantage of the solar still is the flexibility it offers in choice of size. The output of the still is above all a function of area – typically 2 - 4 1/m^2 day or about 1 m^3 / m^2 year Solar stills can be built in any size from a few square meters area up to some 100.000 m^2.

If the output has to be greater than 1,000 m^3 / day, conventional fuel fired desalination plants are more economical today .

3. Designs of solar stills

Although small community – scale stills are competitive with other desalination systems, the process must be regarded as experiment . new plants have to be designed according to local conditions rather than being chosen from standardized units.

The variation in designs is mainly in the use of materials, so that one can distinguish between permanent and semi – permanent constructions . the basic design is shown in the figure below .



The most durable stills use concrete for the trough painted with asphalt.

The cover is glass in aluminum frames; aluminum is also taken for the collection drains. Cheaper and less durable stills take plastic foils for the trough and the cover and frames are made of wood . single slope roofs are used in off – equator regions whereas are made of wood . single slope roofs are used in off – equator regions whereas gable roofed stills are more common in equatorial areas. The following section describe a solar still, which has been erected in Haiti, on a small island which during the dry season has only a saline water well as its water source.

4. Water production by a solar still

(a) Capacity

The components of the desalination plant are :

- The saline well with a windmill driven pump and a standby hand pump ;
- Upper feed tank for saline water ;
- The fresh water reservoir.
- The schematic concept is shown in figure 2 , and the design of the still itself in figure 3.

The water output from the still is 1,250 1 / day on average including rain water catchment . this is sufficient for about 250 residents in the community .

The area of the still is about 400 m^2 (25m x 16m), giving an average production rate of 3 1 / m^2 day, out of which 10 % comes from rain water (precipitation is only 100 mm/year).

(b) Material requirements

Locally available materials were used as much as possible, that is bricks, cement, sand and concrete blocks for the basic construction. The drain troughs for the distillate and the rainwater are cast in the wall structure, so that no material is no material is used for this. As insulation material dried coffee husks were used. If no very cheap insulation material is available, insulation can be excluded, since it improves the efficiency of the still only slightly.

Imported items are the glass panes (400 m^2) the rubber basin liner (400 m^2) and the sealing compound to hold the glass in place . the pumps, PVC-pipes and fittings were also imported.

(C) work force requirements

various levels of skills and capabilities are necessary to install the desalination plant. Carpenters are required to build the concrete formers.

Bricklayers and masons are needed for construction of the solar still basin;

Basic plumbing and tinsmith work is also required . All these skills were available within the community . An engineer is needed for supervision and management during installation, which can be carried out in one year .

(d) operating characteristics

The plant needs little maintenance. The still has to be flushed once a day in the morning with fresh saline water, the windmill pump has to be serviced after heavy storms so only one attendant is employed to run the whole plant.The solar still has now been in operation for 10 years is expected to last 20 to 30 years.

5. Alternative stills

6.

(a) Small still for a single household

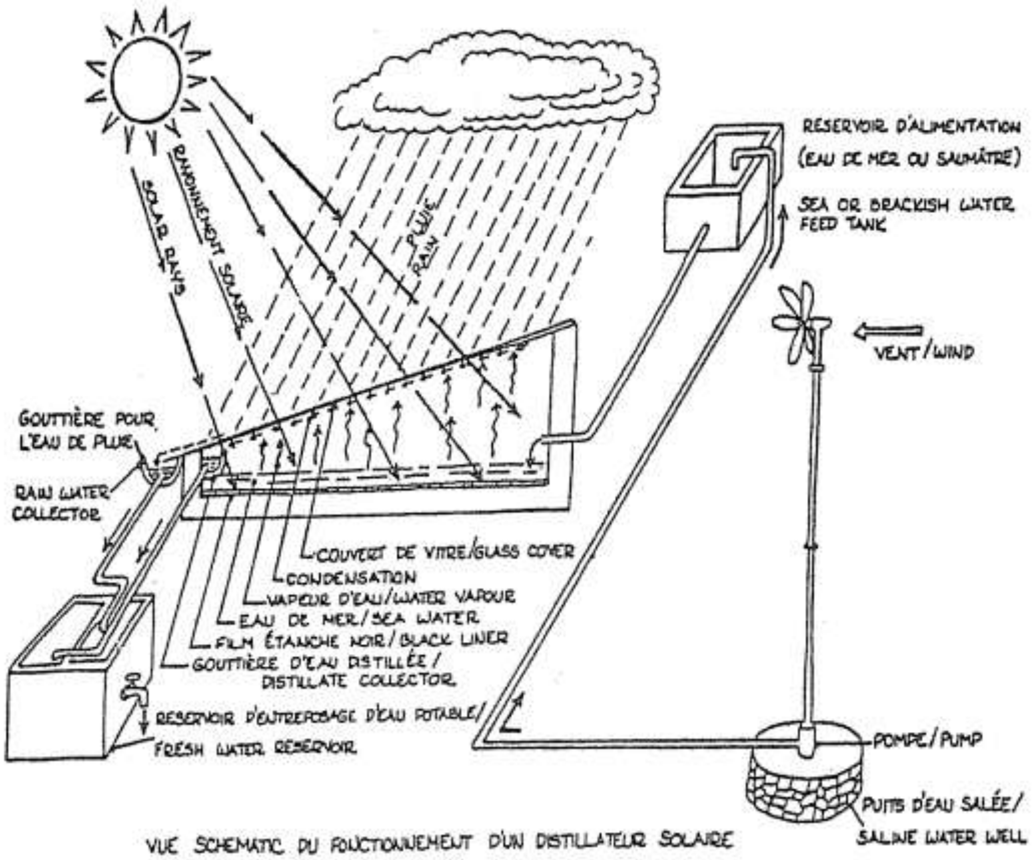
Form india the design of a small still with gabled roof is reported with 10 m^2 area. It is also a concrete and glass system but without any delivery piping . the still has to be filled daily by hand and therefore installation and running costs, are much lower. The installation cost is $ 200 and the still can deliver 25 1/ day on an annual average, ranging between 7 and 37 1 / day according to season

.

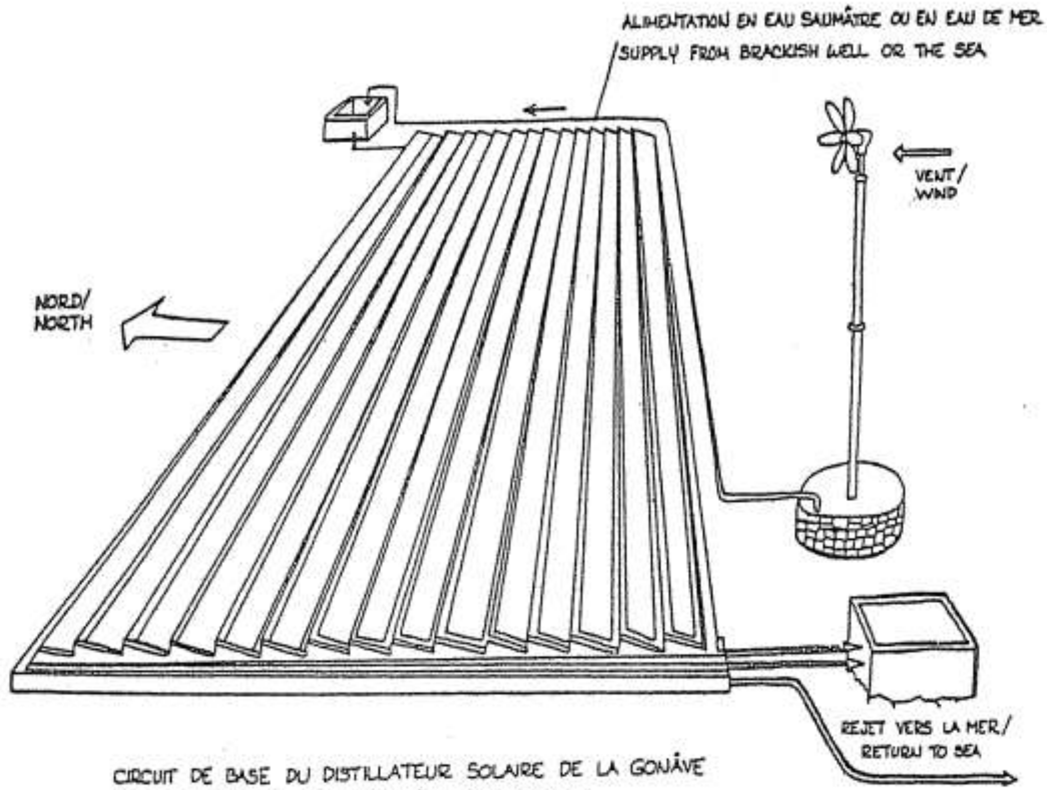
(b) Plastic covered still

From Canada the design of a 40 m^2 solar still is abailable which can be erected at a price of $ 450 . production rate is about 120 1 / day or 44 m^3 per annum. The economic life of the still is 15 years, but the transport plastic cover has to be renewed every two years.

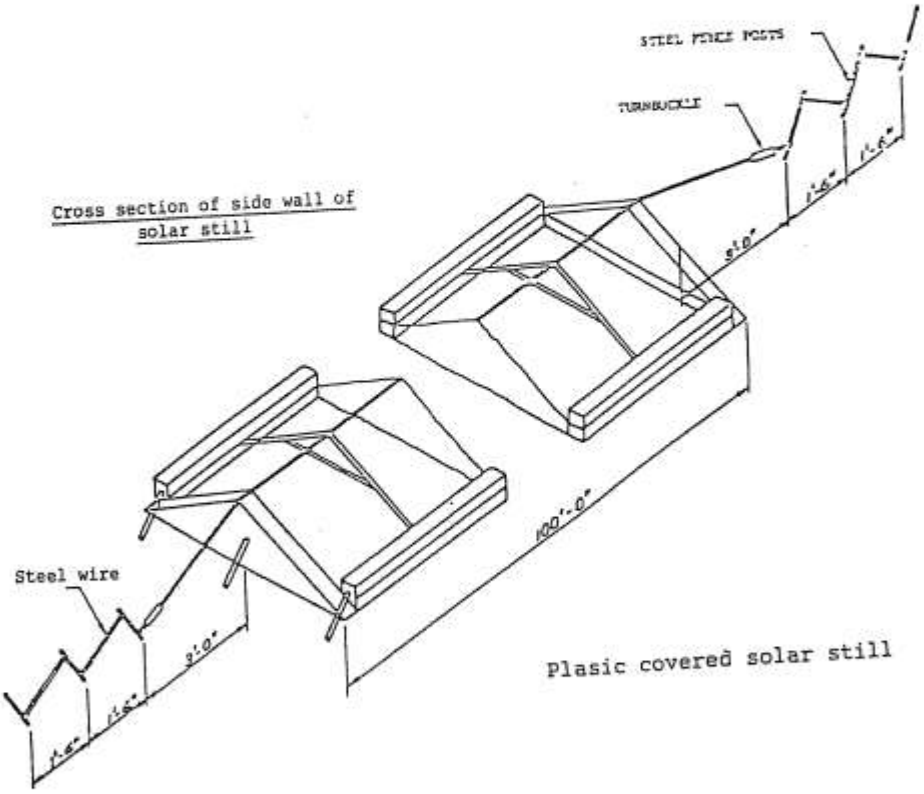
Scattering Papers In Chemical Industry



VUE SCHEMATIC DU FONCTIONNEMENT D'UN DISTILLATEUR SOLAIRE
SCHEMATIC CONCEPT OF SOLAR STILL OPERATION

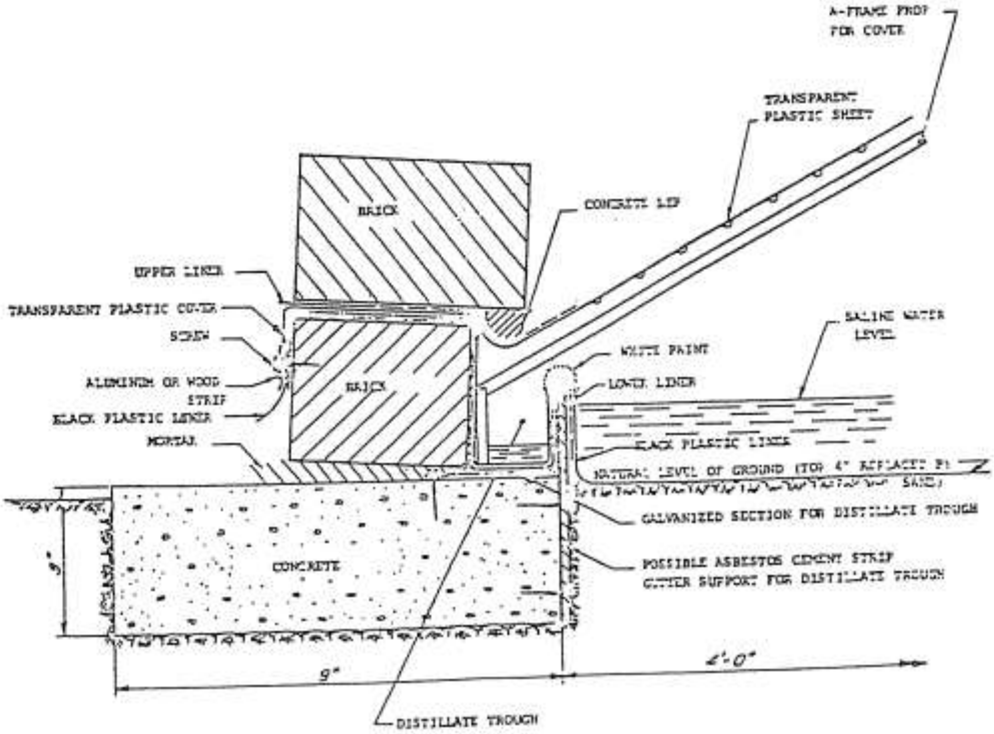


CIRCUIT DE BASE DU DISTILLATEUR SOLAIRE DE LA GONÂVE
BASIC FEATURES OF LA GONÂVE SOLAR STILL



Plasic covered solar still

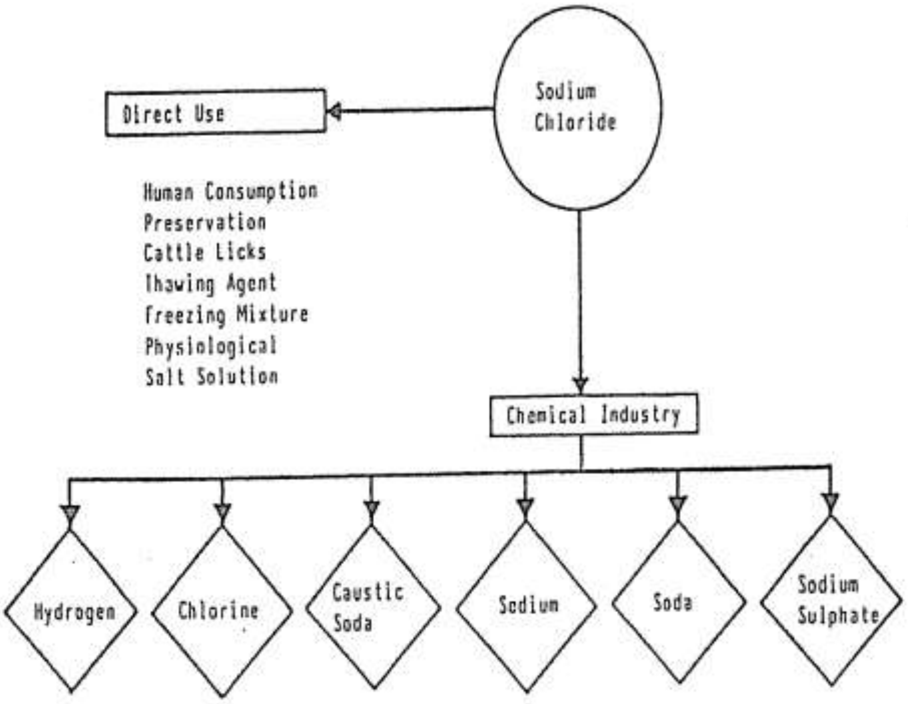
Cross section of side wall of solar still



53 - Salt production plant

Introduction

Salt has always been indispensable for human and animal consumption, gradually developing into one of the most important raw materials of the inorganic – chemical industry. Nowadays the figures of salt consumption can be used as an indicator for the extent of a country’ s industrialization.



Plant description of solar evaporation

By solar evaporation seawater is concentrated in a pond system. These ponds are designed according to the various stages of brine concentration: ponds for pre – concentration, concentration gypsum and crystallization.

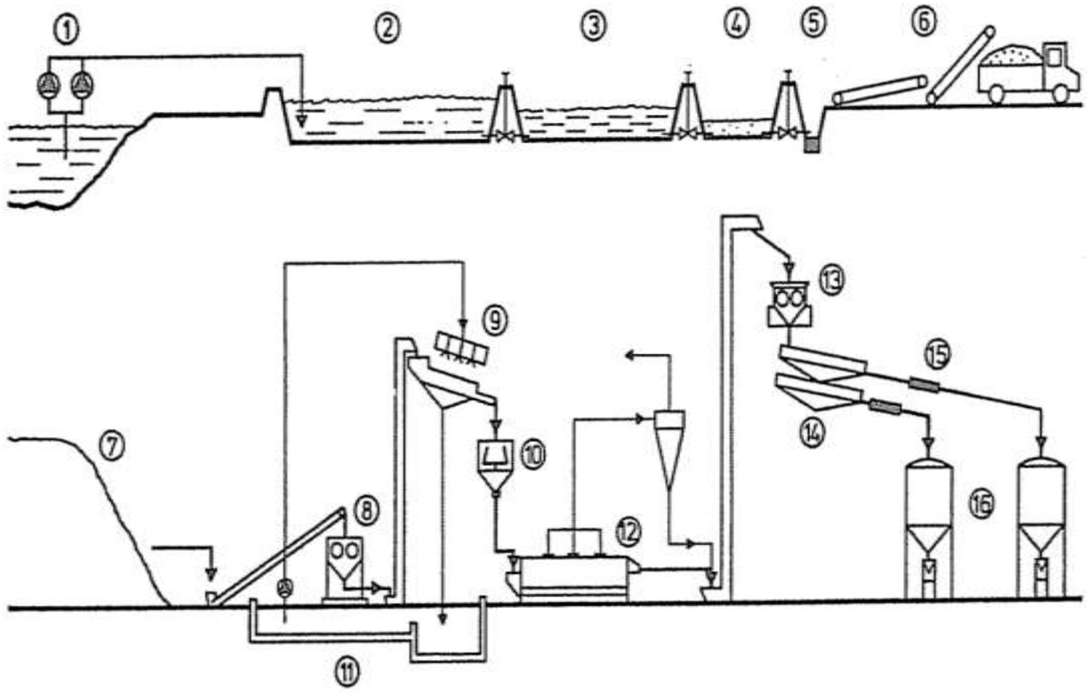
The first link in this chain is the seawater intake, a pumping station. Form there the seawater flows to the pre - concentration and concentration ponds. The pre - concentration ponds also serve as reservoirs.

Leaving the concentration ponds the brine is conveyed to the gypsum ponds where the gypsum that was diluted in the seawater, will precipitate.

The thus saturated brine then enters the next stage, the so called crystallization ponds where the sodium chloride crystallizes.

After the discharge of the mother liquor and its bitterns the sodium chloride can be harvested.

Process flow diagram



1 pumping station – seawater intake
2 pre – and concentration ponds
3 gypsum ponds
4 crystallization ponds
5 bittern discharge
6 coarse salt transport system
7 central coarse salt stackyard
8 crushing mill
9 washing screen
10 centrifuge
11 washing brine basin
12 drying unit
13 final product mill
14 sieve
15 dosing system
16 product silos and packaging units

Locational conditions

The ideal place for a solar salt plant is a flat coastal region with impermeable clay soil that is practically worthless for agriculture. The meteorological conditions require that there is little rainfall, or rather, that in the dry season the evaporation rate must be positive, and a hot dry wind should be blowing all the year round.

A favourable infrastructure – such as roads, railway connection or harbor facilities – would be another asset.

The harvest can be done both manually and mechanically. The mechanical salt harvest is not economical unless done at large scale.

The harvested salt is kept at intermediate storage. As coarse salt it can be marketed with an average purity of 97 % NaCl . Is it, however, to be used as raw material for the chemical industry, then it must undergo a further processing.

For energetic reasons, solar salt plants have to be planned in such a way that the energy demand is kept as low as possible. Hence, whenever the topographic situation permits it, the pond systems with canals, dikes and gates have to be thus arranged that by gravity alone the seawater will flow to the next pond.

Processing of coarse salt by a salt washing plant :

The processing of coarse salt is done in consecutive stages.

* In the first stage coarse salt is reduced in size by a crushing mill .
* In the washing stage with non – saturated brine the purity of the product is improved by dissolving the bitterns and eliminating gypsum crystals and foreign matter.
* To meet the market requirements the salt grains must be ground in an additional mill.
* In the next stage the salt slurry is centrifuged and then discharged to the drying unit.
* If required, iodine and anti-caking agent can be added.
* The grain fractions of the finished product are classified by sieves. The design of the packing section will follow the market requirements .

Required machinery and equipment

Solar salt plant

(Manual salt Harvesting, capacity 30,000 t/ yr)

Required Area

1. Solar salt plant	180 ha
(capacity : 30,000 t / y)	
2. Salt washing plant (capacity : 5 t / h)	
Production building	270 sq.m
Packaging	180 sq.m
Finished products storage	2,400 sq.m
Work shops	300 sq.m
Office building	200 sq.m
Lab, canteen, changing room	180 sq.m
	3,530

Required power and utilities

Salt washing plant (per 1 t / h salt produced)

Electricity	50Kw fuel
Fuel	10 kg / hour
Water	0.5 mm / hour

54 - Salt refining plant

Introduction

Sodium chloride NaCl, generally known as common salt or as ‘ salt for short has had a long history as a seasoning, preserving agent and base material for a great variety of products. The compound occurs abundantly in nature, both solid in minerals or in solution. Seawater containing 3 % NaCl serves as a major source for 30 % of the world salt production.

Usually there are three grades of salt on the market:

- Common salt
- Industrial salt
- Commercial salt

Common salt :is produced in several grain sizes. As table salt it usually has an average grain size of 0.4 to 0.5 mm. the NaCl content of this grade of salt of approx 99.5 % in order to prevent caking, several tenths of a percent of magnesium carbonate or calcium carbonate, or sometimes up to 20 ppm of potassium ferrocya-nide are added .

Industrial salt requires compliance with more stringent requirements than common salt where purity is concerned . it is used in the chemical industry, e.g . as raw material for the production of caustic soda, chlorine, sodium hydrogen or sodium sulphate.

Commercial salt Is a coarse-grained product having a NaCl – content of approx. 97 % NaCl .

The main impurities are gypsum and the so-called bittern – salts.

The described refining plant is designed for the production of 5 t / h common salt . As a raw material coarse salt will be used .

Description of the production process

Raw salt is dissolves in a solvent water or seawater that flows throough the dissolving basin containing the raw salt . this basin is provided with a water – supply inlet at one end and with an overflow connection at the other end leading to the settling basin. As soon as the insoluble substances have settled, the brine via heat – exchangers is pumped to the concentration and crystallization section. The treatment in this section is the most important one in the whole refining process, since it will determine grain – size and purity and hence the quality of the product.

The crystals in the solution form in a low – pressure atmosphere while the water is evaporated.

In other words : an oversaturated solution is prepared with the quantity of salt contained in it beyond the point of solubility, thus making the crystals fall out in lentil or spherical grains.

Mixed with motherliquor, the crystals are led to the two – stage separation section. At the first stage, the motherliquor content in the crystal slurry is reduced by gravity separation, at the second stage the mechanical separation is achieved by a centrifuge . Finally the salt is dried in a fluidized bed drier and discharged to storage silos and the packaging section.

Required Areas and buildings

Administration	280 sq.m
Production and packaging	1,080 sq.m
Raw material storage	600 sq.m
Final product storage	1,080 sq.m

Required power and utilities

Electrical	435 kw
Fuel oil	410 kg / h
Sweet water	10 cu.m / h
Sea water	30 cu.m / h

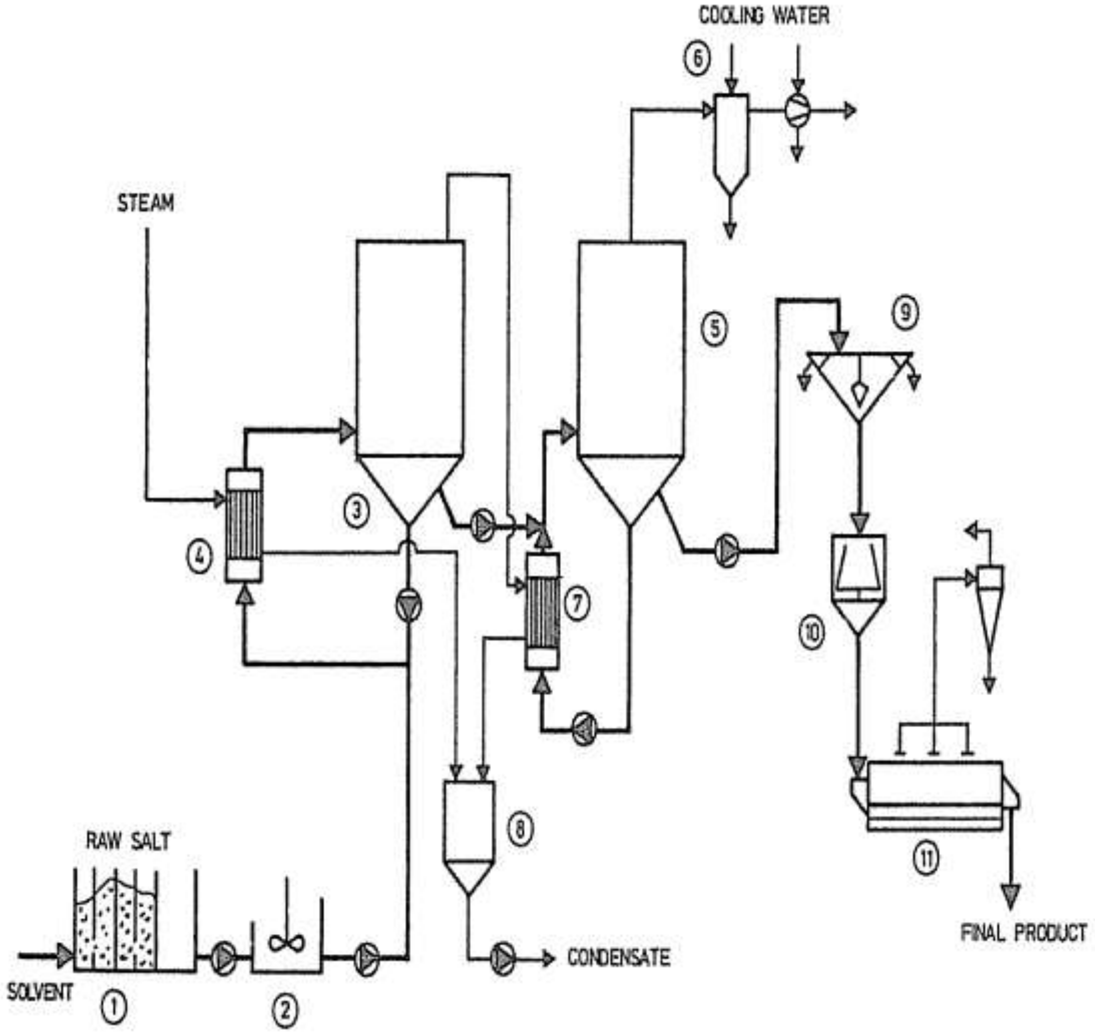
Required Raw Material

Raw salt	5 t / h

Outline of the plant

Capacity of the plant	5 t / h Refined salt
Operation of the plant	3-shift

Process flow diagram



1 dissolving and settling basin
2 feed tank
3 crystallizer
4 Heat exchanger
5 crystallizer
6 condenser
7 Heat exchange
8 condensate collecting vessel
9 Gravity separator
10 centrifuge
11 fluidized bed drier

55 - Trans Former Oil Plant

Petroleum has long been used as insulating oils serving the purpose of insulating and cooling media for high-tension electric equipment. In particular, as the insulating oil was produced by using wax – free crude oil in early days of this century, it was possible to produce a product easily used in cold winter.

Depending upon uses, insulating oils are divided into various kinds, including the insulating oil for circuit breakers and transformers, condenser oil for high-tension condensers and oil- filled cables and cable oil for insulating the core wire of impregnated power transmission cables. The technology introduced here is related to the insulating oil for circuit breakers and transformers .

The transformer oil generally needs to be highly refined and free from the occurrence of degeneration due to impurities. It should also be large in insulating strength and excellent in cooling action, while having low pouring point to suit the use at low temperatures.

The production of this item require high degree of refining and processing skills, since it should be low in evaporation loss at the level of 100 °C and appropriate in inherent resistivity and total oil power factor.

Because of such a need for refining, the transformer oil is generally 3-5 times as high as aviation oil in prices.

Therefore, the transformer oil is one of the industrial products capable of maximizing the utility of petroleum resources and creating high added values.

Furthermore, this product is closely related to the service life of electric equipment having higher weight in industrial plants, justifying the need for its production from the standpoint of protecting industrial facilities of respective countries. Since its production is possible on the basis of relatively simple processes such as acid refining, neutralization, adsorption and filtration, while the burden of funds for the construction of a production plant is affordable, this transformer oil is a product particularly suiting economic conditions of the developing countries.

Products and specifications

The transformer oil produced is this plant is an electrical insulating oil of high quality specially refined and carefully processed with the experiences of the past 20 years. The products are classified into two different series – Mictrans and mictrans suffix I . the former is uninhibited mineral oil while the latter is inhibited one. The general properties of these products are as follows:

- Superior electric properties.

High dielectric breakdown strength, low power factor and high resistivity.

Fine physical and chemical stability Excellent oxidation stability and non - corrosive for long operations .

- Good in cooling effect
  Swift heat absorbing and discharging property.

* High flash point and low evaporation loss

Table 1. typical specifications of transformer oil :

Properties	**ASTM Test method**	**Mictrans**		
		A	**B**	**C**
Color	D 1500	L 0.5	L0.5	L0.5
Flash point °C	D 92 / D 93	156 / 152	154 / 150	154 / 150
Interfacial tension @ 25 °C, dyne / cm	D 971	45	45	45
Pour point , °C	D 97	-22.5	-32.5	-47.5
Specific gravity, 15/15 °C	D 1298	0.874	0.878	0.880
Viscosity, cst, @100 °C	D 445	2.50	2.50	2.50
@ 40 °C		9.38	9.45	9.60
@ 20 °C		22.10	22.35	22.65
@ 0 °C		54.0	55.0	57.0
@-15 °C		155	158	165
Visual examination	D 1524	clear & bright		
Dielectric breakdown voltage @ 60Hz				
Spherical electrodes, Kv	(BS148)	45	45	45
Disk electrodes, Kv	D877	35	35	35
Power factor @ 60Hz , %, @ 25 °C	D924	0.01	0.01	0.01
@ 100 °C		0.07	0.07	0.07
Resistivity, ohm-cm, @ 50 °C	D1169	$5x10^{14}$	$5x10^{14}$	$5x10^{14}$
@ 80 °C		$5x10^{14}$	$5x10^{14}$	$5x10^{14}$
Corrosive sulfur	D 1275			
Water content, ppm	D 1533	20	20	20
Neutralization number, mg KOH/ g	D974	0.01	0.01	0.01
Oxidation stability				
72 hrs @ 110 °C sludge, % wt	D2440	0.03	0.03	0.04
tan, mg koh/g		0.01	0.01	0.01
164hrs @ 110 °C sludge, % wt		0.06	0.06	0.08
tan, mg koh/ g		0.18	0.18	0.20
75 hrs @ 120 °C, sludge, % wt	(JIs	0.06	0.06	0.07

	C2101)			
tan, mg koh / g		0.12	0.12	0.13

Contents of technology

1) Process description

The production of insulating oil consists of four processes with the following general descriptions:

Sulfuric acid refining process :

It is a process in which such impurities as aromatic compound, resin, asphalt and nitrate contained in the raw material oil are removed by adding a small amount of sulfuric acid . After sulfuric acid treatment, the impurities are eliminated from the product by setting at normal temperature, and the product is subjected to the next process of neutralization.

Neutralization process

Following the acid treatment, the oil is neutralized with caustic soda for the removal of naphthenic acid and free acid still contained. The treated oil is sent to the adsorption process after setting and reheating to the temperature of 60-80 °C

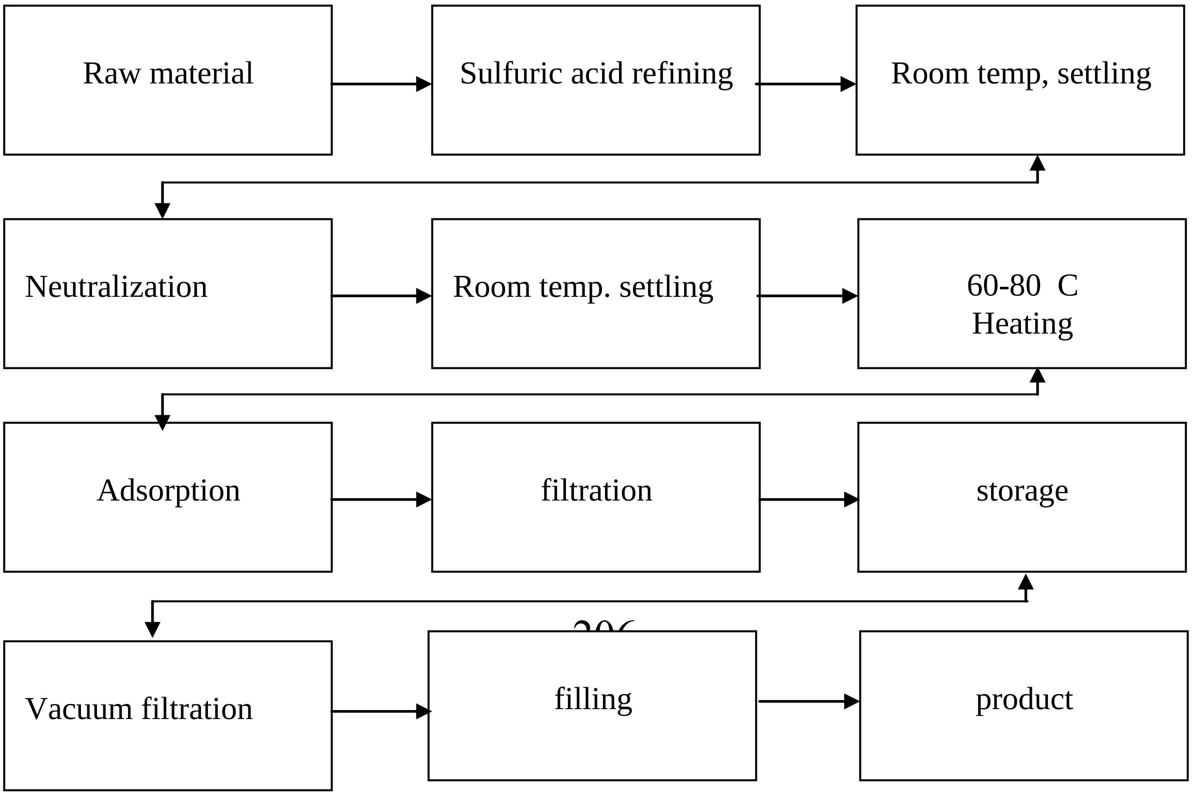
Adsorption process

It Is a process in which the oil is refined by treating with active clay under the condition of heating to remove residual impurities or free water.

Vacuum filtration

The oil removed of almost all impurities is subjected to vacuum filtration to completely eliminate some moisture, ozone and oil still remaining in the oil and could influence the deterioration speed of the trans former oil. Following the vacuum filtration, the oil undergoes product inspection to be filled in containers as final products.

Transformer oil manufacturing process block diagram



3) Raw Materials

Raw materials	**Requirement (per ton of product)**
Crude oil	
(Naphthenic or paraffinic crude oil)	1.18 ton
Sulfuric acid	0.1 ton
Sodium hydroxide	0.01 ton
Active clay	0.08 ton
Filter paper	-
Filter cloth	-
Additive	-

Example of plant capacity and construction cost

Plant capacity : 30,000 ℓ / day

Basis : 8 hrs / day

56 - Lipstick production

Introduction

The production of lipsticks was until a few years ago one of the more complicated techniques in the cosmetic industry. Manufacturing methods have been improved considerably. The development of the casting system and the introduction of the corundum stone mill for the preparation of colour pigments have contributed to simplifying and economizing the production process. Moreover the traditional method of premixing pigments with a kneadermixer and then grinding them on a triple roller mill did not sufficiently guarantee the dispersion of the co-lour in the past .

Process description

The manufacturing process consists of two main steps , I,e preparation of the bulk material and moulding the sticks.

1. Preparation of the bulk material

The normal kind of lipstick formulation requires three phases : oil, wax and pigment, to be dispersed or premixed and then to be blended together .

Outline formula

Oil phase (mixture of castor oil, vegetable oil, lanolate solid, etc)	60 – 70 %
Wax phase (beeswax , candelilla wax, carnauba wax ,etc)	22 - 28 %
Colour pigment phase (colour pigments, pearl glimmer, etc)	5 - 15 %

Main Equipment

* A device for dispersing the colour pigment in a part of the oil phase .

* A corundum stone mill for pulverizing the colour pigments. The advantages of this mill over the conventional triple roller mill are the low investment (only about 40 to 50 %) and the low service cost, the better degree of grinding the colour pigments (8-9 microns with only one course. The reproducibility of a certain degree is possible through precise adjustment of the gap between the grinding stones.

* A double jacketed melting vessel for melting the wax phase with a simple propeller – type agitator for mixing the molten components .

* The processing plant with the mixing vessel, also double – jacketed and connected to a cooling water system, and to be used as a vacuum vessel. It is equipped with an anchor – type agitator with wiper, a dissolver with exchangeable discs and a built- in thermometer for exact temperature control. All mixing elements are fixed to the kettle lid, which can be lifted by a hydraulic device for easy cleaning.

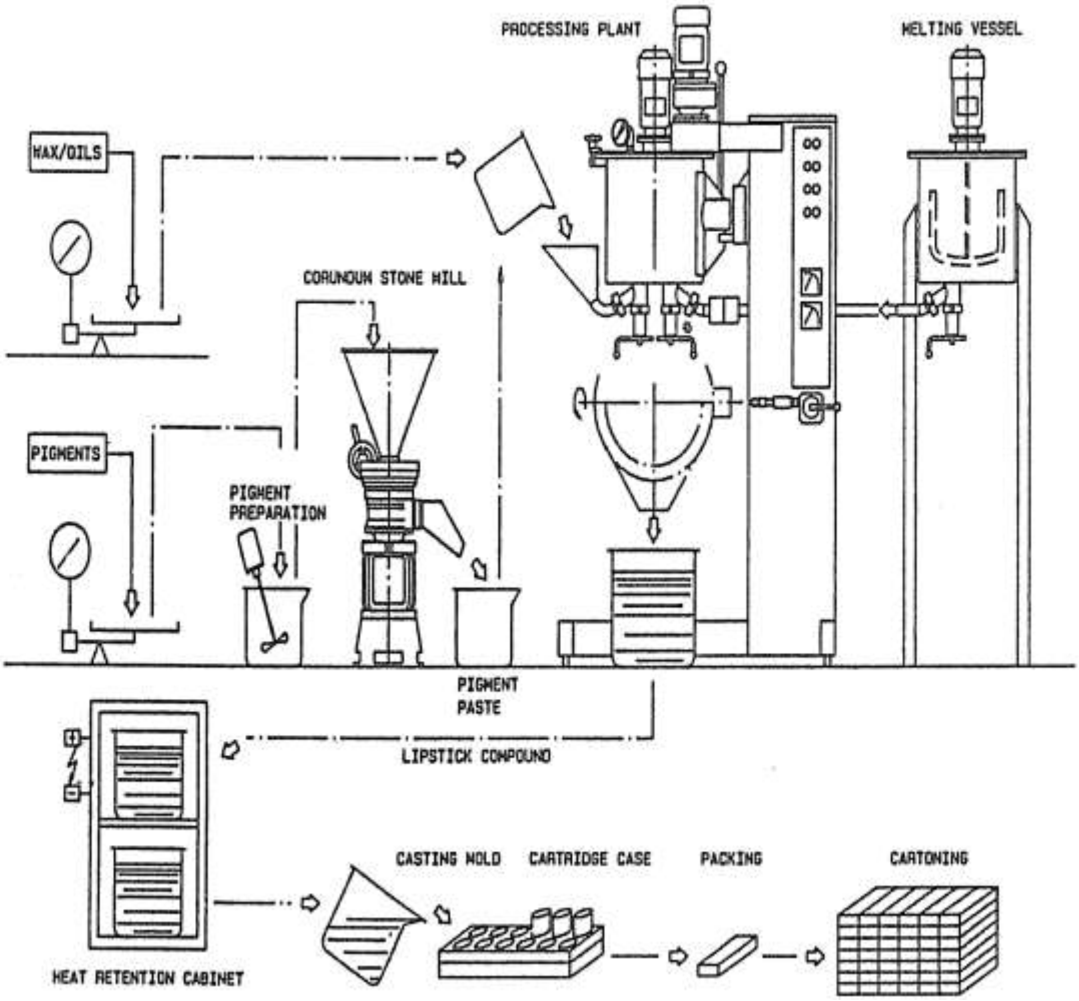
* Storage containers for the bulk material to be stored in small batches of approx. 8 kg for achieving faster solidification.

Proparation of colour pigments

The colour pigments are mixed at 1,400 rpm, with part of the oil phase in a proportion of one part pigment to three or four parts oil. After 15 minutes of mixing, the pigments are ready for the grinding operation.

If colour correction is necessary, as in the case of raw materials that are not resistant to shearing (such as pearl and mica), such correction is done after the grinding course. A small amount of colour dispersion is mixed with an equivalent amount of molten base . to correct the colour, additionally needed pigments are mixed with oil to a paste . the ground corrective amount is then mixed into the pigment dispersion. Normally, from one to three corrections may be necessary to achieve the exact shade called for the pigment phase can be prepared and corrected a day or two before the planned production of the lipstick. Thus on additional time will be needed during the regular production operation.

Process flow diagram



Preparation of the wax phase

The required waxes are weighed into the vessel and melted at 80 ° – 85 ° C . Adding a part of the oil phase to the wax phase accelerates the melting process.

Preparation of the oil phase

This phase is fed into the mixing vessel and heated to 80° – 85° C . when the proper temperature is reached, the vessel is deaerated. Then, the wax phase can be drawn through the suction pipe with built-in 60 micron filter.

Final mixing

After the oil and wax phases have been mixed for 20 to 30 minutes under vacuum, the colour-corrected pigment phase is added to the batch mixing the colour pigments into the batch normally can be completed in 30 to 60 minutes.

Approximately 10 minutes before the end of the mixing period, pearl and mica (if the formulation calls for them) are added At this point a sample should be drawn for final colour test.

Since the pigment phase has already been corrected, normally no additional correction should be necessary.

After approval of the colour, the perfume oil is added and the batch is cooled to slightly above the dripping point (60° – 62 ° C) . At this temperature the content of the mixing vessel is filled into the storage container. Solidification of the batch should start within a few minutes so that pigment settling will be avoided.

2. Moulding the lipsticks

The final production, I.e the casting and moulding, is the more sophisticated part of the lipstick manufacture.

The storage containers with molten lipstick mass have to be kept ready for casting at the mass have to be kept ready for casting at the suitable temperature by means of the heat retention cabinet. The temperature can be regulated with a thermostat to ± 1 °C, indicated by the built – in thermometer. Exact observation of the temperature is most important and mandatory for moulding an excellent final product.

One casting form has 50 lipstick moulds and is fitted with removable strips and a stripping comb. This type of casting mould enables the cartridges to be put on the sticks easily by hand whilst they are still in the mould. It can be heated up and cooled down by water to reach the required operation temperatures .

Casting procedure

The moulds are heated to between 56 ° and 58 °C . the dew point being 62° , as is normally the case, it is advisable to cast at a temperature of 65 °C to avoid the product becoming hard and funnel – shaped . the residence time between casting and cooling should be about 1 minute.

Cooling can be carried out in about 4 minutes at a water temperature of 20 °C.

In general one operation course – casting moulding and capping – can be performed in approximately 12 minutes.

The packing and cartooning of the finished lipsticks is carried out manually.

Example of the plant

Daily capacity : approx. 6.000 pieces

57 - Candle manufacturing

Introduction

Form ancient times candles have been important as sources of light, and although they were replaced first by kerosene lamps and later by incandescent electric lamps, their use has actually expanded because of their ornamental value in spite of the technical progress in lighting, the term " candle power " is used as a unit for measuring the brilliance of any given light.

Candles were manufactured by moulding a blend of fats and wax around a flax or cotton wick and so are their modern varieties. Machines have replaced manual labour, new wax formulations have been introduced for decorative. Effects. The first waxes used were mutton tallow and beeswax.

Spermaceti obtained from whales were introduced to candle manufacture at the time of the American Revolution . since the middle of the nineteenth century paraffin wax was added to the list of waxes recommended for candle manufacture .

Description of the production process

The classical household candle is the basis of any candle factory. It ensures steady sales and low production costs. Sizes of household candles differ slightly in various parts of the world . A candle size which is very frequently found and which we have taken as an example for this documentation is a 40 – gram candle with a diameter of 19 mm (3/4) and a length of 200 mm (8) . the output of the described plant will be approx 28,000 household candles per 8 – hour day.

The main raw material required for the manufacture of household candles is paraffin wax, a by – product of the oil refining industry.

The paraffin wax to be used for the manufacture of household candles on the machinery and equipment described hereafter should have a maximum oil content of 0.5 % and a melting point of 56 to 62 °C.

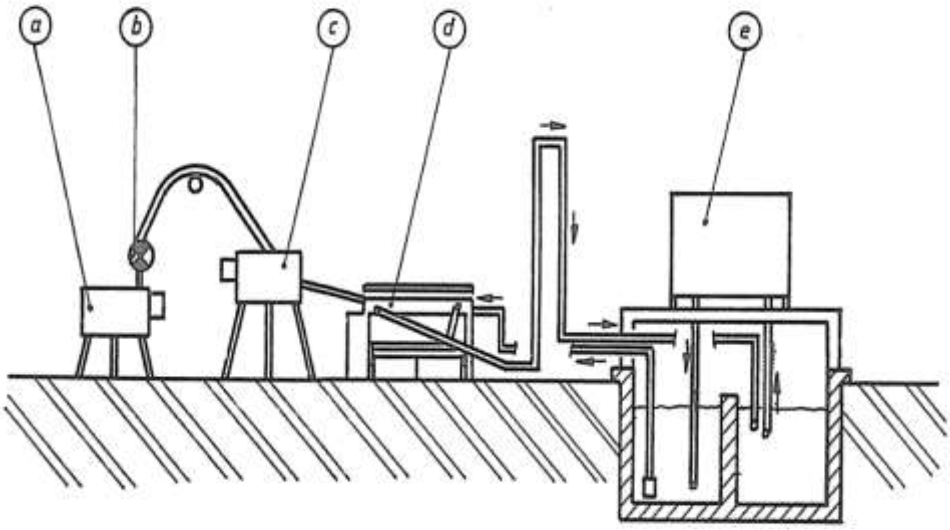
The paraffin wax which is normally supplied in solid slabs of 5 kg each, is melted in electrically heated melting pans (a) , pumped by means of a special wax pump (b) into the higher positioned wax feeding tanks (c), from where it flows into the moulds of the moulding machines (d) where the candle wick has already been placed in the right position.

As soon as the moulds are filled, cooling water from the water cooling unit (e) flows through the moulding machines to solidify the paraffin wax in the moulds.

After a solidification time of approx. 20 minutes the finished candles can be ejected and packed.

Packaging machinery has not been included since in countries with comparatively low labour costs the packing is better done by hand. In many countries the household candles are simply packed in blue paper, in cellophane bags or cardboard boxes.

Flow sheet



Required raw materials

For an 8 - hour production of 28,000 candles	
Paraffin wax	approx 1,120 kg
Candle wick (braided cotton yarn)	approx 6,440 m

58 - Tyre Making plant

Since the development of practical cars at the end of the 19 th century, the automobile industry has attained a rapid advancement, resulting in the realization of a great revolution in the means of transportation.

In the 20 h century, in particular, the car industry hs 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 on 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 of tires in 1962, a rapid export growth of 40 to 50 percent was recorded during the 1970 s . it is foreseen that such a rapid export growth will be sustained with the expansion of 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 inevitably fostered for the economic development of a nation in recognition of the importance of the tire manufacturing plant from this view-point.

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 material 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

Adhesive manufacturing

Rubber, synthetic resin and other additives are blended with a solvent in a mixer for dissolving as an adhesive with sufficient adhesiveness.

Opp film printing

It is a roll printing process based on the gravure printing system (frontal printing).

Adhesive coating

The adhesive is coated on the film by making use of a knife coater.

Paper tube manufacturing

Kraft paper is roll- slitted at uniform intervals and adhered in overlap by the centrifugal force of the shaft .

Drying (by heate r)

Forced draft system based on the circulation of boiler steam.

Winding

Rubber roller pressing rotating system based on the insertion of a paper tube into the rotating shaft.

Cutting

The system of cutting by pressing down with a ring knife while being motor-driven after insertion of the semifinished product the shaft.

Packing

Finished products are put in polypropylene bags to be packed in carton boxes in uniform numbers after bags are sealed. The boxes are taped and banded for delivery .

Delivery

To mixing as to its calendaring 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 (calendaring and extruding).

Treating and building process

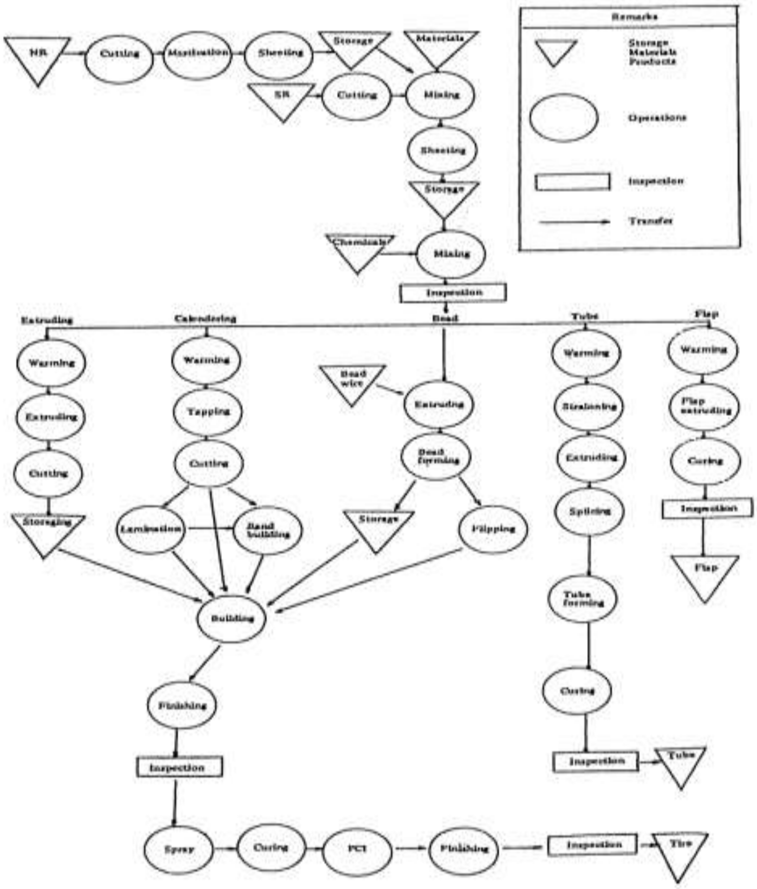
In this process, the blended rubber (rubber sheet), prepared in the mixing process, is calendered (cord) and molded as component part required for subsequent building. The required number of topped cord sheets are pasted together and beads are fixed on its both sides, with cushion rubber pasted together 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 In serted 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 .

Tire Manufacturing Process Digram



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 taken out immediately for cooling. The finished product is inspected and stored .

raw materials and utilities 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 – coil	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.

1) **Plant capacity :** 1,560,000 pcs / year
Basis : 24 hours / day, 320 days / year

59 - Insulation glass fiber making plant

The following processes are currently used for the production of glass fiber :

- Steam – blown process
- Spinning process
- Flame – attenuation process
- Textile or long – fiber process
- Rotary process

Among the processes, the flame – attention process is introduced here .

Major advantages of the process are :

- Low manufacturing cost

In this process, crushed glass can also be used as raw materials. This may be a primary factor in lowering the manufacturing cost .

- Easy start-up and shut – down

This process is designed to be started and stopped easily. For the purpose of maintenance or temporary cease of operation, the whole line can be stopped at any time without trouble. So this system is suitable to a small – capacity plant.

Products and specifications

The glass fiber products produced in this plant are board, mat and pipe cover. These products are used for various uses as follows :

- For housing – wall, ceiling, floor and basement.
- Air conditioning facilities – heating and cooling equipment insulation for warehouse.
- Transportation equipment – automobile, train, air craft, ship and refrigerating container.
- Electronic equipment – electronic jar, refrigerator and cooler .
- Others – audio facilities, industrial equipment, farming facilities and power plant.

Contents of technology

1) Process description

Pieces of cleaned crushed glass or glass marbles accumulated in raw material preparation area fed into the electric furnace to be melt. The molten glass is drawn through the bushing installed at the bottom of furnace to form fine filament by the drawing rollers located underneath the furnace. the blast from burners further attenuates the filament and it is transformed into long an even finer fiber . while spraying binder over it, the fiber is deposited uniformly on a continuously moving belt by suction fan to form mat.

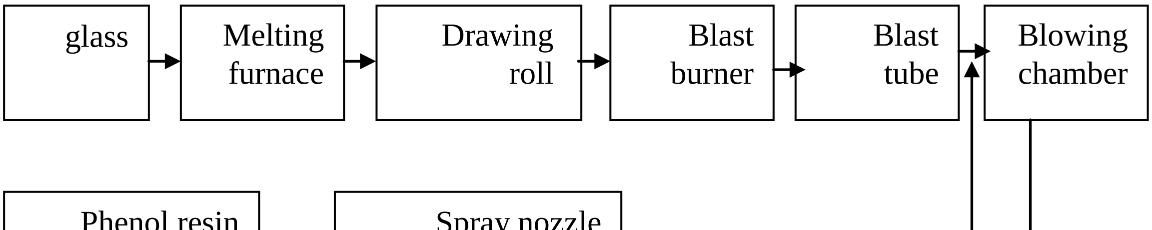
The uncured mat is fed into curing oven to be cured to the desired thickness and density. Several kinds of finishing machines are prepared to complete the product. Edge trimming machine is used for cutting off both edges of the mat with exact width and shape, and then facing machine is used for pasting glass cloth or asphalt paper on one side of the mat, if required . then, the mat goes through width cutting machine and guillotine cutter to get exact dimension as required .

At the receiving station, a conveyor is prepared. When the board is produced, the end of conveyor is raised up to level height, and the end of conveyor is raised up to level height, and the end of conveyor is lowered for the mat to be rolled by roll - up device.

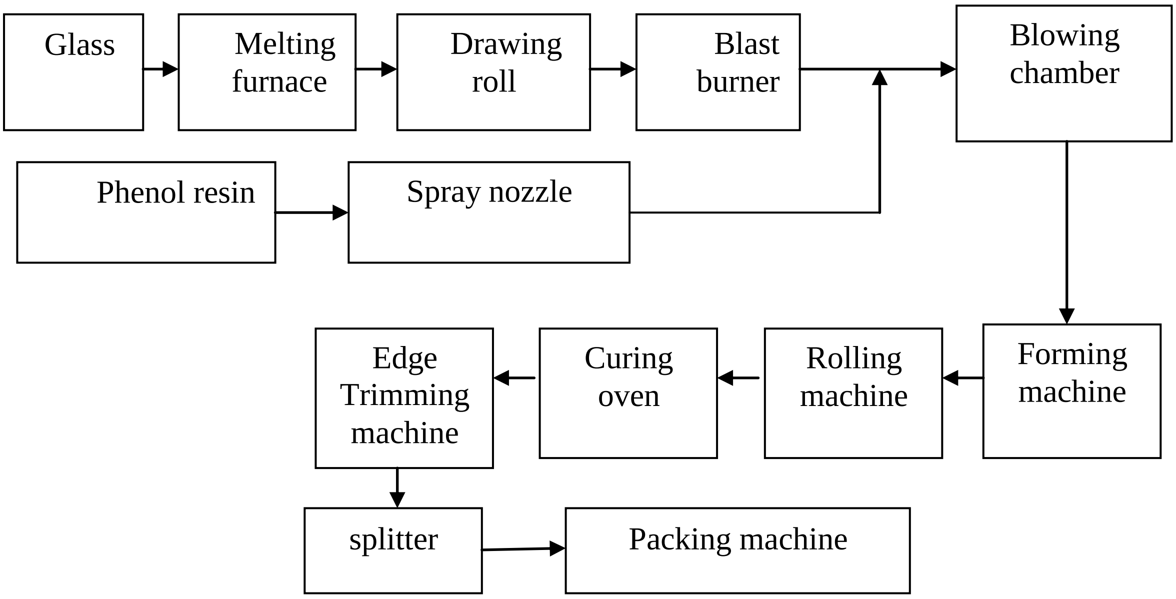
Almost the same processes are used for manufacturing pipe cover product, but there are some differences in the processes following fiberizing process. The uncured mat fed from blowing chamber is cut to a certain length and rolled around pipe-mold by the rolling machine to get exact shape and smooth surface and cured in the curing oven by hot air.

The mold is taken out after cuing, and the cove goes through edge trimming machine for its edge to be cut off and through splitter to be slitted for easy application.

Glass fiber mat & board manufacturing process block diagram



Glass Fiber pipe cover manufacturing process block diagram



2) Raw materials and utilities

Raw materials and Utilities	Requirement

Crushed glass	* 1,100 kg
Binder	* 1,400 kg
Electric power	** 600,000 kwh / month
Fuel (light oil)	** 341,000 Liter / month
Compressed air	** 360,000 cu. m /month
water	** 1,500 cu. m /month

*) based on 1 ton of product
* *) based on 2,000 tons / year

60 - Tube and Bulb Glass Plant

The glass processing technology has a very long history, but it was not until after the turn of the 20 th 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 .

According, 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 typed of products.

Products and specification

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 froth 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 specification of tube glass and glass bulb are shown in table2 .

Table 2. specifications of tube and bulb Glass products

Soda – lime glass (S.G)

Size				**Remarks**
Symbol	**Outside**	**Thickness**	**length**	

	diameter			
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)

Size				**Remarks**
Symbol	**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 f1. Lamp 15w, 10w
FLE – 1	4.0 ± 0.20	0.80 ± 0.10	1.200	Exgaust tube f1. 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	602 ± 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 30-w
CL – 20	32.0 ± 1.50	1.10 ± 0.10	540	Tube for circline 20-w
M – 5.25	5.25 ± 0.20	0.38 ± 0.08	1.250	Tube for miniature lamp

Boro silicate glass :

Size				**Remarks**
Symbol	**Outside diameter**	**Thickness**	**length**	
2 cc	11.2 ± 0.35	0.45 ± 0.03	1.820	Ampoule 20 cc
20 cc	24.5 ± 0.50	0.60 ± 0.06	1.520	Ampoule 20 cc
1.000 cc	5.3 ± 0.20	0.70 ± 0.10	1.520	Ringel 1.000 cc
5 cc outer tube	14.9 ± 0.30	0.40± 0.07	1.820	Injector
5cc innter tube	12.4 ± 0.30	0.40± 0.07	1.820	Injector
5ccinner tube	18.4 ± 0.30	1.60 ± 0.07	1.820	Injector
10cc outer 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 Equlpment
/	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**	**remarks**	**symbol**	**Outside**	**Remarks**

	diameter			**Diameter**	
A-55	55 mm	Glow lamp 40w	C-36	36 mm	Decorative lamp
A-60	60 mm	Glow lamp 60w	C-40	40 mm	Decorative lamp
A-70	70 mm	Glow lamp 100w	C-50	50 mm	Decorative lamp
A-30	30 mm	Decorative lamp	C-40	40 mm	Decorative lamp
A-32	32 mm	Decorative lamp			

Contents Of Technology

1) process Description

(a) tube glass

raw materials put into the furnace are malted and refined. The molten glass flows to the rotating sleeve through a trough of the feeder installed ar 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.

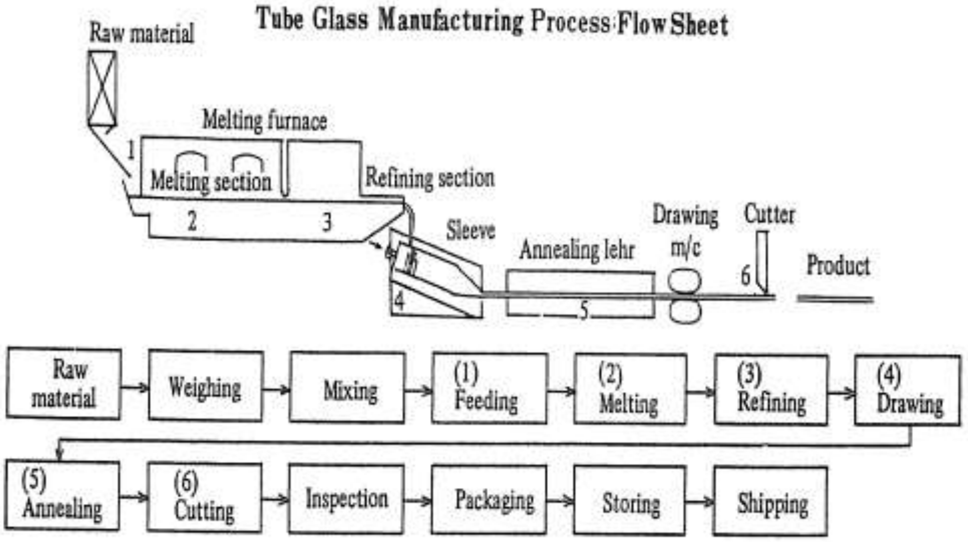
An annealed tube in the annealing lehr is cut by the cutting machine in appropriate sizes and then checked for outer diameter. Defective tubes are picked up and discarded while the passed tubes are moved to the other table for recutting to conform to specifications. The cut part is heated and polished prior to final inspection and packing .

Depending upon the composition of raw materials, various types of glass tubes including those of sodalime, borosilicate and lead are produced.\

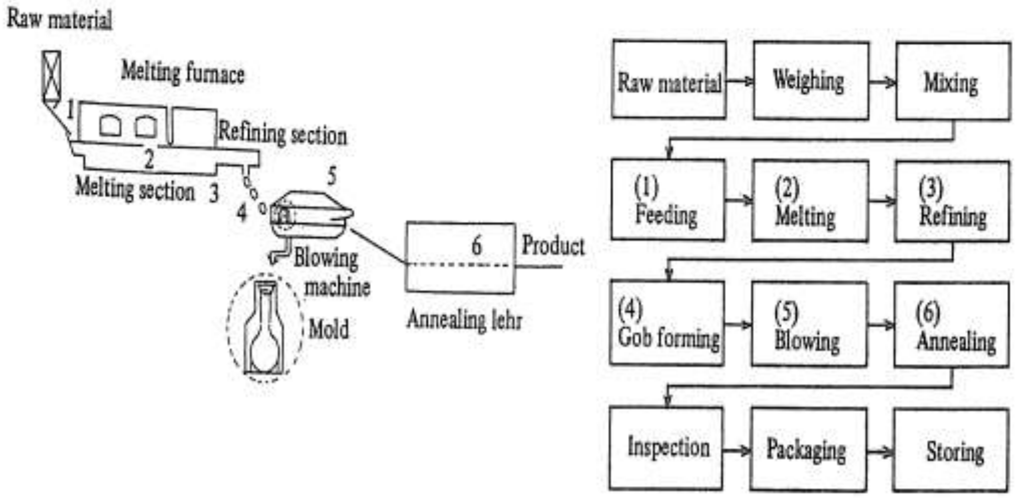
(b) Bulb glass

The molten glass produced by melting raw materials is supplied by a pluger 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



Bulb Glass Manufacturing Process



2) 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 : 10 w : 18.000 ea / day

15 w : 7.000 ea / day
30 w : 15.000 ea / day
40 w : 15.000 ea / day
8.0 ton / day , 2.800 ton / year
* basis : 24 hours / day, 340 days / year

61 - Molasses From Wood

1 – Introduction :

Hydrolysis of carbohydrates is already well known in the synthesis of such goods as furfural , alcohols , starch syrups and dextrose . Now it's being used successfully to win nutritive molasses from wood.

In the new version, developed by masonite corp , Chicago the conversion of wood cellulose to sugars depends simply on a high – pressure steam treatment of wood fibers – without the aid of acids , alkalis , salts or other accelerating agents that are practically indispensable in conventional hydrolysis reactions . At a new plant in laurel, miss, the company extracts cellulose molasses during the manufacture of hard board.

The molasses produced, called **masonex** , contains both pentose and hexose sugars and has a total carbohydrate content of 55 % or more . It is a brown, free – flowing liquid (10.8 lb) gal . density) that resembles conventional cane molasses in total carbohydrate and feeding value . but it' s cheaper . cane molasses sells at 30 $ / ton , while masonex costs 20 $ / ton .

Already established as a valuable ingredient in live stock feeds, masonex is said to have good prospects as a chemical raw material for furfural, acetic acid, levulinic acid, and purified xvlose (which used as a low – caloric sweetener in human diets) ; as a carrier for high - value live stock pharmaceuticals such as vitamins and antibiotics ; and for new fermentation – derived compounds dependent on a high ratio of five – carbon sugars in the substrate.

First steps – the company's process for hard board manufacture separates wood fibers by blowing . Although only a portion of the cellulose is solubilized to simple sugars and poly saccharides, the total amount of dissolved carbohydrates is large enough to warrant recovery for the molasses operation.

In the first hard board processing steps, wood chips (typically green, mixed, hard wood) are charged into a 26 – cu . ft stationary steel digester , cooked by direct high – pressure steam (up to 1.000 psi) for one to two minutes, then suddenly released and blown to a collecyor cyclone . From there , coarse fibers fall into an agitated slurry and are further reduced via disk refiners. The resulting milled pulp is washed in a triple – stage counter current vacuum – drum washer and is then further processed to hardboard .

Making molasses – wash water from the first stage (having the highest concentration of dissolved solids) is split into two streams : one recycles to the cyclone receiving tank ; the other goes to the molasses plant.

This byproduct wash liquor about 500,000 gal / day) norm ally has about 5 % dissolved and colloidal solids, including simple sugars and polysaccharides . it is fed to a battery of spray dryers in which the solution, now atomized by a spinning impeller, falls against a stream of exhaust gases from gas – turbine power generating plant . A small percentage of the droplets are dried to slid particles in the hot gas suspension. This causes a darkening of the solution that forms from the dryer effluent, and leads to some polymer formation and slight thermal degradation.

The inlet gas temperature is about 800 F , but temperature at the surface o the droplet probably does not exceed 220 F as the liquor approaches a concentration of about 45 % solids.

Final concentration – A vertical – tube , falling – film evaporator (steam heated) further concentrates the liquor to 65 % solids. This evaporator is necessary because of the difficulty in securing satisfactory atomization in spray dryers when the liquor's concentration reaches 45 %.

After concentration on in the evaporator, the slightly acidic solution (pH 3 to 4) produced 50.000 gal / day neutralized to a pH of 6.0 to 6.5 with lime slurry, this molasses solution is pumped to storage tanke for ultimate transfer to tank cars or trucks.

2 - The utilization of molasses :

Abstract : the composition of molasses makes it valuable as a raw material from which compounds such as ethyl alcohol , acetic acid and citric acid , as well as yeast and other products , can be obtained by fermentation . Methods for the production of some of these substances are described in this article.

Developments in industrial microbiology and biosynthesis have made possible the utilization of many raw materials formerly considered waste products. Among these : wastes' molasses is a most important raw product due to its composition: approximately 50 % sucrose, 30 % non sugars, and 20 % water. As well as sucrose , molasses contains about 1 - 2 % raffinose, and a small quantity of invert sugar . The total content of nitrogen in beet sugar molasses comes up to about 1.5 - 2.0 % (mainly betain, asparagine, glutamic acid and other nonsigars) ; the salt content is about 10 per cent . the figures given in table represent the total content of nitrogen found by analysis of various samples of beet and cane sugar molasses. Table 2 gives the results of a complete analysis of a beet sugar molasses as used in the german sugar industry. Fermentation depends on the composition of the molasses : the reaction is mainly alkaline and shows, in contrast to cane sugar molasses, rather constant buffering to acid , the colour of molasses depends to a largeextent on the presence of melanoids (i.e. condensation products of the reacting of amino acids with sugars) and on the caramelization of sugars, especially invert sugar.

The sugars in molasses are available in dissolved form, but molassed does not from a homogeneous solution, varying quantities of solids being present in suspension. These can be separated by skimming or by filtering a dilute solution through alluvial filter systems. Not much is known about the substances which can be separated from beet sugar molasses by these methods, but it has been proved that fermentation can be influenced favourably by their removal, e.g. in the biosynthesis of citric acid .

The processing of molasses has changed gradually from desaccharification, which nowadays is of practically no importance, to fermentation, with a view to producing alcohol and compressed yeast. Molasses has therefore found its way into the fermentation industry as a substratum.

3 - A review on the industrial utilization of sugar and sugar by – products :

Presently, the horizon of the sugar industry in the philippines is darkened by cloudseof pessimism and uncertainty come 1974. Despite this state of despondency coupled with insecurity the industry can console itself and cling to the old adage which states that "behind the dark clouds there exists a silver lining".

Sucrose is by far the most widespread, frequently the most abundant sugar present in the sap of plants . it is easily isolated and refined as a pure carbohydrate and as such lends itself readily to chemical synthesis . it is uniform in quality and it may be stored for long periods without deterioration sucrose has a low molecular weight and is highly soluble in water. In qualities endow it with a great potential as a chemurgie crop .

I. Non – Food uses of suar (Sucro - Chemistry) :

A. Sucrose ester surfactants what is a surfactant ? :

A surface active agent (surfactant) is a compound having a fat – soluble (lipophilic) and a water – soluble (hydrophilic) end when oil,water and a surfactant are mixed, the surfactant concentrates at the interface between the oil and water where the hydrophilic end can dissolve in the water and the lipophilic end can dissolve in the oil. This has the effect of lowering the interfacial tension between oil and water and frequently are detergents (cleaning agents)

Basically, the trans esterification process that evolved consists in heating under reduced pressure a solution of sucrose a methyl ester of fatty acids and potassium carbonate in dimethyl formanide , methanol is distilled out of the solution. The dimethvlformanide is recovered by distillation and the unreacted sucrose is extracted in diluted brine from the ester in a solvent the product is freed of residual solvents and dried to yield the useful surfactant .

Sucrose ester surfactants constitute a new class of substances whose properties depend on the umber and kind of fatty acid groups attached to the sucrose molecule they range from crisp solids to free-flowing oils, from water insoluble waxes to self – dispersing butters. If saturated fatty acids are used the products tend to be waxy solids, moderately soluble in water, and becoming less soluble as the number of fatty acid groups increases. Unsaturated fatly acids give buttery products which , as the degree of esterification is incressed, tend to become oils. Acids of lower molecular weight give crisper solids of lower surface activity.

The principal attributes of the sucrose-and di-ester surfactants are their emulsifying properties. By proper selection among the fatty acid and control of the degree of esterification . water soluble or oil soluble emulsifiers may be produced and oil – in – water – in – oil soluble emulsifiers may be produced and oil – in – water or emulsions obtained . studies of drying oil esters suggest that self – emulsifying drying oils may be obtainable .

Research oil esters suggest that self – emulsifying oils may be obtainable research at the case institute of technology has developed drying oil esters of sugar or 6unsaturated fatty acids attached to single molecule of sucrose which on a laboratory scale, give rise to hope for production of fast drying, hard, high class and ability to adhere to metal types of drying oil from sucrose.

H.B. hass, in an article on the current status of sucro - chemistry gives a report on the progress towards commercialization of a number of sucrochemicals. Although most of the future. Since most of them are non-toxic and digestible they will eventually find use in food processing as well as in pharmaceuticals and cosmetics. The following is a resume of the uses of a number of sucrochemicals – still in the laboratory stage .

Since the advent of synthetic detergents, soap manufacture has been greasy reduced and subsequently the amount of its glycerol by – product has also been decreased the atlas powder co is developing a process for making glycerol bybthe hydrogenolysis of mannitol and / or sorbitol . a similar process, also in the laboratory scale, is reductive aminolysis which is the hydrogenation or rose in the presence of ammonia . the principal product, 2 methyl piperazinesis a sourse of excellent polyamide fibers. A compound intermediate beiweer pastics and plasticizers . SAIB . may be obtained by treating isobutyric acid with ketene and allowing to react with sucrose . the conversion product is ucro acetate isobutyrate – SAIB . one important characteristic of sucrose oerivatives to be noted is that when they are highly substituted , their thermal stability is increased . hyprose, produced by Do chemical co , is an addition product of one mole of sucrose with 8 moles of propylene oxide which use as a surfasctant. Latest report on sucrose, phenol, formaldehyde condensation is the production of resins of controlled hygroscopicity which has proven satisfactory in the pilot plant stage. Sucrose polyallyl ethers formed as the condensation product of sucrose and ailyl chloride, in the presence of concentrated aquous sodium hydroxide, is an excellent drying oil. Its disadvantage lies in that only half of the allyl group is transferred sucrose. Sucrose acetals of the unsaturated aldehydes have shown particular importance as starting points for high polymer compounds. Synthesis is achieved by condensing aldehydes with sucrose using sulfuric acid and hydrochloric acid as catalysts. Production of good sucrose acetal crystals have been reported. Sucrose monoester (e.g. monostearate) has been found to be a good precipitant for starch in cane juice.

B. Oxidation product :

Two of the most important oxidation products of sucrose are oxalic and tartaric acids. Production of oxalic acid from sucrose cannot compete with other raw material as a source of this acid. Tartaric acid, at the moment manufactured form waste products of the wine industry is a high priced commodity and its production from sucrose would be more advantageous. Soltzberg oxidized sucrose with 70 % nitric acid and a vanadium catalyst and obtained up to 42 % yield of tartaric acid and 44 % of oxalic acid these new methods of obtaining tartaric acid may well compete with the older sources and in addition increase the availability of tartaric acid uses of which already abound. When oxidation is carried out under mild conditions other products are formed such as gluco – saccharic acid etc. attempts have been made to utilize these acid as components of nylon – like polyamides .

C. Reduction products :

Much study and several valuable products have been obtained through the hydrogenolysis of sucrose. Sucrose readily hydrolyzes in the presence of very small amounts of acids. The mixture of hydrolysis products, D - glucose and D – fructose, has been reduced catalytically to give D - mannitol, D-sorbitol. Alternatively, sucrose, without preliminary inversion may be hydrogenated to give the same products – S - mannito, D - sorbitol, and a mixture of glycols . these are obtained with the aid of catalysts and at high temperature cracking. Sorbitol is of importance as a source of sorbose for the synthesis of vitamin C. in addition , sorbitol has been used as a substitute for glycerol, as a humidifying agent in confectionary , for tobacco and leather processing and in sizing for textiles and papers. It has been used as a sugar substitute for diabetes . sorbitol may also be used for making resins and literature on this subject has been reviewed by long mannitol and its derivatives find use in the explosive industry as well as in medicine . the hexamtrateis a vasodilator and may be used in hear disorders . mannitol itself has been used as a mild laxative for children. It is also useful in making inoculate as of nitrogen – fixing bacteria for soil improvement A sevelopment of promise lies in the dehydration of mannitol and Eorbiotol to give anbydro compounds . these anhydro compounds can copolymerize with methyl metacrylate and give a product whith is hander than pure methyl metacrylate powder, an important material in the plastic industry . the dianhydrides of mannitol and sorbitol form 2 crystalline dinitrates both of which are blood pressure – depressants.

D. Acid trans formation products :

Levulinie acid is produced by the action of acids on most carbohydrates. Thus, glucose, galactose, sucrose, fructose, glucosamine, chitose, sorbose and hexose sugars as such or joined in disaccharide or polysaccharide union, all give rise to it.

To the synthetic organic chemist levulinic acid is an exceptionally interestin substance because of its several reactive groups. These reactive centers adapt the substance in a unique manner for use in the synthesis of hetarocytic compounds of several different types. Since a great proportion of extremely important dyes, drugs, insecticides , fungicides, and other useful types of materials, it is reasonable to expect that full exploitation of levulinic acid will add new substances to importance to these categories . morton has made a review of recorded synthesis of heterocyic compounds bosed upon levulic acid .

It has been found that addition of small amounts of levulinic acid to roughage feeds may increase cellulose utilization by 100 % .

E. Alkall degradation of sucrose :

Much study has been devoted to alkaline degradation of sugars. one out standing product worth delving deep into is the production of lactic acid by the action of alkali on sucrose. Although commercial production of lactic acid is being done by the fermentation process feasible chemical methods have been reviewed by Montgomery. kilbach, ruckdeschel and windish obtained lactic acid in 45 % yield from sucrose by ruckdeschel and windish obtained lactic acid in 45 % yield from sucrose by treating it with 0.5 N NaOH . wolf treated sucrose with lime water at high temperature and isolated 60 % of lactic acid as the zinc salt . A number of experiments were carried out in which temperature, time of heating the amount of home and the concentration of sucrose were varied. By whatever means it is prepared, lactic acid is an important intermediate in the utilization of surplus sucrose , sucrose can be converted through lactic acid into synthetic resins, rubber and plasticizers.

F. Derivatives of sucrose bode presents a survey of potential productions costs of some 3.000 sugar derivatives :

A cost estimate and a brief process has been outlined . pittenger discussed in detail sugar derivatives in pharmacy.

A list of patents including the digest on the reaction of sugars has been prepared by hunt ,

Efforts to utilize sucrose fully and effectively as a starting material in the manufacture of intermediates and derivative for non – food use will require a degree of knowledge and understanding of the molecular architecture that was never necessary in sugar production .

II . Fermentation products :

The field of industrial microbiology has such vast potentialities espy ally for sugar . this fermentation industry is divided into three categories :

(a) dissimilation fermentations producing solvents and acids – alcohol acetone , lactic acid , 2,3 butylene glycol . etc

(b) assimilation processes where the micro organisms themselyes are of interest e,g , baker’ s yeast , torula yeast or food yeasts; and

(c) by – products processes , where high value substance such as vitamins or antibiotics are produced by fermentations .

Gould has compiled a list of metabolic compounds produced from sugars by molds . one hundred fifteen chemical compounds found form sugar by fermentation process are listed together with the corresponding microorganism and yields .

Ethyl alcohol fermentation is an age – old process and has been pretty well exploited that little need be said about it butanol – acetone fermentation (2) is one of the most important fermentation process . A flow sheet is given by shreve " chemical process industries " where 1 gallon of molasses (6 - 6.6 lb sugar) will produce 1.65 – 1.75 lb. butanol, 0.07 – 0.1 lb . alcohol and 0.65 – 0.4 lb . acetone. A large factory exists in Puerto Rico using 10.000 tons of molasses per annum for its production of butanol twenty one species of microorganisms which will readily give 60 – 80 % butanol – acetone mixtures. Butanol and acetone have large uses in industry as solvents and starting materials for the production of synthetic rubbers, plasticizers, plastics, and even as a constituent in aviation fuels ,

Another potentially important fermentation is that processing **butyric acid** . the commonest butyric acid bacteria are clostridium butyricum which produces mainly **butyl alcohol , butyric acid and isopropyl alcohol, butyric acid and acetone ,** Kluyver (1931), reported that butyric acid formation is effected by certain "true" butyric acid bacteria such as clostridium saccharobutyrceum. In teresting to note is that the organism was isolated from "achuete" (bixe oreltana, linn) and grown on potato destrose agar . many derivatives of butyric acid are used industrially . **the benzyl, methyl, octyl, and terpenyl, esters** are used in the perfumery and essence trade and **amyl butyrate**, has been described as plasticizer for cellulose esters. Moreover, vinyl butyrate is a possible ingredient of poly saccharides are also coming into favor . **cellulose acetate butyrate** is marketed as an ingredient of lacquer and is less inflammable than pure acetate.

Citric acid originally extracted from citrus fruit is now produced more extensively by the fermentation of molasses, as well as sucrose by means of a mold , Asper gillus niger . practically, the whole world production of citric acid is used as such in medical preparations , in making soft drinks and in certain foods industrially , critic acid is a basic raw material and analytically,

Other organic acids which are obtained from either sucrose or molasses by the fermentation process are **propionic acid, aconitic acid, citracomic acid , itaconic acid, fumaric acid, gluconic acid, lactic acid, and aseorbic** . Any one of these acids is useful by itself chemically they are utilized in the plastic, synthetic rubber or varnish industries. Other compounds formed by molds are also reviewed .

Yeast for food or feed purposes is made form sucrose, mainly from molasses in great Britain report has been made that 24.000 tons of molasses per annum are used in yeast production . recent work at the chemical research laboratory of the dept of scientific and industrial research has led to the development of yeasts (torula utilis) which will grow under tropical conditions. Central a zucarera de don pedro in nasugbu , batangas produces yeast utilized for food as well as feeds. Another product obtainable from yeast is also of some interest, namely ergosterol . improved cultural methods have increased the sterol content of yeast essential for production of ergosterol for vitamin D preparation .

III . Molasses :

An account of the uses of molasses in the fermentation process has been well covered in the proceeding by discussion . one large use for molasses is as a food or feed, used either by direct feeding or in prepared foods. The actual food value of molasses is high, since it contains 55 to 60 % carbohydrate material and about 4% protein. In Queensland, Kerr recommends boiling the molasses with milk of lime and then pouring the mixture on a concrete floor coated with oil, so that on cooling it can be cut into cakes. Other methods of using it depend on spray – drying the molasses so that it is converted into a free-flowing powder. Sometimes the molasses is returned to the soil as a manure, though this use is limited in its application by the excessive soil as a it produces. On the other hand, it can be used to advantage in the reclamation of alkaline soils. The use of molasses as a preservative for green crops would be an invaluable aid to dairy farmers. Many investigators working on this problem of ensiling grasses found that molasses was a satisfactory preservative and improved the quality of silage. Casalis reported on the preservation of protein – rich – green crops by using 40 pounds of molasses to every ton of fodder . bender and co-workers as a result of their studies made the following recommendation per ton for preservation of different green cpros:

Grasses or cereal grain	- 40 pounds of molasses
Mixed grasses and legumes	- 60 pounds of molasses
Alfalfa or clovers	- 80 pounds of molasses
Soybeans (immature)	- 100 pounds of molasses

In making silage, green grass or fodder is placed in large containers, compressed and allowed to undergo fermentation to such a degree that at the end of the necessary period of storing, the fodder is preserved in palatable and digestible condition.

Experiments in Hawaii have shown that growing chicks and laying hens utilize final molasses with optimum rage from 7.5 to 23 % on feed or chicks and 6.8 – 13.6 % for hens. Hereford cattle fatted with molasses ration has about 625 l. of total digestible nutrients per 100 pound gain.

Here again are the manifold potentialities of molasses as reviewed ,

IV. Mud press cake and sugar cane wax :

Sugar cane wax is an interesting by – product of the sugar industry it occurs in the so – called “ factory mud “ or “ mud press cake “ the actual crude wax content or press cane varies between very wide limes – apparently from a fraction of 1 % to about 22 “ (dry weight basis) Data on the crude wax content of press cakes from different sugar producing countries are summarized im the following table .

Crude wax content of press cakes :

Source	crude wax	solvent used
Lousiana	3.26 – 18.9	$CC1_4$ or C_6H_6
Puerto rico	12-14	Acetone
Hawaii	9.55-	-
Philippines	9.6-20	Ether
Cuba	16.0 – 20.0	Acetone & Et OH
India	10-15	$CHCl_s$; C_6H_6
Argentina	11.97 – 15.93	$CHC1_3$
Brazil	8.9-17.8	C_5H_6

The commonwealth scientific and industrial research organization (Melbourne, Australia) describes a new solvent for refining sugar cane wax, conventionally extracted with acetone . the solvent consists of ethyl alcohol containing 15 - 30 (by weight of a hydrocarbon or hydrocarbon mixture) chosen form benzene, toluene, toluene, heptane, light petroleum (boiling from 60 – 120 °C) .

Approximate yields of the various fractions obtained from crude wax from lousiana sources by a method of fraction proposed by balch and brace (0) are presented below.

It has been shown extraction, fractionation, and refining of sugarcane wax is possible from the mud press cake. Alternatively, the wax may be extracted directly from the expressed juice before the latter is processed for sucrose manufacture. The wax is of good quality, approaching that of carnauba wax and gives a high polish, especially to leather goods.

The press cake from sugar factories possesses a definite fertilizer value, because it contains approximately 1 % of nitrogen and from 5 - 10 % of calcium phosphate on a dry weight basis . it contains, in addition, small traces of mineral constituents like magnesium, potassium, and a high proportion of bagasse and an appreciable amount of sugar . experiments in Puerto rice placed the fertilizer value of 20 tons of the wet cake per acre as equivalent to 200 pounds each of ammonia, phosphoric acid and potash .

V. Bagasse :

The usefulness of bagasse can be fully assessed in connection with its use as source of pulp, paper, and board: use in the manufacture of plastics: (use as a fuel and, miscellaneous chemically studies. West presented an annotated bibliography of the utilization of sugarcane bagasse for paper , board, and plastics , and chemicals . villa eat discussed the possibilities of manufacturing strawboard form bagasse, rice straws and cogon grass in the Philippines . central Azucarera de bais, in bais, oriental negros has been utilizing bagasse in the paper manufacture .

With the aid of chemical processes such as destructive distillation, hydrolytic processes (acid and alkaline) and digestive processe, many important chemicals with latent potential values can be derved from bagasse .

Experimental work shows the possibility of introducing nitrogen into bagasse pith by addition of anhydrous ammonia in gaseous form, or ammonia in liquid dorm Ammoniated pith forms an attractive product when mixed with molasses and finds use as cattle feed . the oahu sugar Co . has developed a valuable cattle feed using 75 % molasses with 25 % bagasse pith as a carrier . it is apparent that bagasse in a mixture with molasses may be used as a feed . eagasse, because, of its pentosan content, may be used as a source of furfural. Furfural from sugarcane bagasse has been utilized by dupont to make 1,6 – hexane diamine – an ingredient of nylon 66.

At present the bagasse produced at most sugar factories is used as fuel for the boilers. The calorific value is high namely 4765 cal per gram as determined form Queensland bagasse . in this connection bagasse can be made into briquettes by first cooking it rhen mixing with molasses . Activated carbon may then be produced which can be used as industrial absorbent . when bagasse is burned the ash remaining is of such a composition that it can be used in the manufacture of bottle glass.

IV. other by – products of the sugar industry :

Sugarcane, as cut consists of the cane itself, the leaves and the tops . generally, the "tops " which contain on a dry basis about 44 % carbohydrate , 7 % protein, 32 % fiber, 2 % fats, and 10 % ash, are turned back to the ground as trash or they are burned. Lonkar and rao have outline a process where by dry leaves can be converted into paperboard or wrapping paper, a process which could be applied on a scale such that factory dealing with 9,000 tons of trash could turn out 3,000 tons of paperboard .

Harmful when thrown in rivers, the waste waters of agricultural mdustries, especially with respect to alcohol distilleries using cane juice or molasses may be used profitably as fertilizers in order to evaluate the economical advantages of the application of waste water directly to the fields as a fertilizer data of the average analysis of waste waters in different alcohol distilleries in brazil are given below :

Volume of waste in cubic meters / 100 Liters alcohol	1.25 – 1.66
Dry matter in g / liter	50 – 65
Organic matter in g / liter	40 – 50
Ash in g / liter	10 – 15

Nitrogen in g / liter	0.3 – 0.9
K_2O in g / liter	4 – 6
P_2O_2 in g / liter	0.02 – 0.05
CaO in g/ liter	0.5 – 1.0

This waste material is usually – applied by sprinkling or alternately, dried press mud is soaked with the spent wash and the soaked mud applied to the fields .

62 - Refining of sugars using Aqueous Alcohols

We, the colonial sugar refining company Limited , a company registered under the haws of the state of new south wales, of 1 - 3 O' Connell street, Sydney new south wales, commonwealth of Australia hereby declare the invention, for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention relates to the purification of sugars. More particularly the invention related to the removai of colouring material and various impurities from such sugars as " mill white " " cane raws " " beet raws " and the like and the production of a refined crystal sugar, using as a refining agent an aqueous solution of an alcohol .

One method of refining sugar at present in use based on washing the raw crystal with an impure aqueous syrup which removes much of the molasses film . this molasses film contains a high percentage of the total colour material and other impurities . the washed sugar is then completely dissolved . and the solution purified by the use of such materials as lime, carbon dioxide, superphophate.Sulphur dioxide, bone char , activated charcoal or slscted combinations thereof. The purified syrup is then crystallized by evaporation and the crystal recovered by centrifuging .

This known method suffers because many organic and inorganic impurities which are found in raw sugars are retained in the form of colloidal matter in the aqueous sucrose wash solutions and have to be removed by chemical / physical means. Further, owing to the high viscosity of the sucrose solutions containing the colloidal matter a continuous refining process by crystallization is not commercially practicable .

It has now been discovered that many impurities normally present in raw sugars which are retained in concentrated, aqueous sucrose solutions are insolubie or substantially insoluble in aqueous solutions of water – soluble alcohois . including alkoxy alcohols . it has alsp been determined that the degree of solubility of the sucrose in such aqueous solutions can be altered and controlied by the selection of a particular water to alcohol ratio. In addition it has been ascertained that the aqueous organic solvent acts on molasses as a diluent and will separate the molasses film from the surface of sucrose crystals . furthermore it has been found for most purposes a ratio of raw sugar to alcohol by weight in the range 0.4 to 1.1 is effective .

According to the invention we provide a method for producing refined sugar from raw sugar, which comprises contacting raw sugar crystals with such a quantity of an aqueous solution of water and 5 0 % to 90 % by weight of a water – soluble alcohol, that the weight of a water – soluble alcohol, that the ratio of raw sugar to alcohol by weight is in the range1: 0.4 to 1:1 and in such a manner that the molasses film on the crystals becomes suspended in the aqueous solution, and recovering refined sugar crystals from the aid aqueous solution.

Alcohols which may be used in the process of the invention include methanol, ethanol, tetra - hydro - furfuryl alcohol, branched – chain alcohols such as 2- methoxy-ethanol and 2 ethoxy – ethanol, and glycols.

One method of producing purified sugar from raw sugar according to the invention comprises washing the raw crystal with aqueous alcohol solvent unit the solvent removes the molasses tilm and then recovering a clean crystal. From a practical aspectit is generally desirable to incorporate suerose in the aqueous solution in such proportion that the dissolution of the sugar crystai in the washing operation is inhibited. Alternatively of preferably additionally the raw sugar crystals are dissolved in hot aqueous alcohol or aqeous alcohol sucrose solution and the suspended solids separated from the liquor which is then cooled to achieve crystailization of the free sucrose . the crystals thereof being separated from the mother liquor and dried . the mother liquor may be stripped of alcohol by distillation, and the resulting aqueous syrup can be treated by conventional methods to prepare a suitable grade of product.

In the manufacture of sugar crystals by the method of this invention the raw crystals are washed in an aqueous alcohol solution having a water content of between 10 per cent and 50 per cent by weight.

For most purposes a water content of the order of 30 per cent and a temperature of from 20 °-40 °C are effective. Where sucrose is incorporated in the alcohol solution. The composition of the aqueous solution is pre ferably from 15 to 20 per cent sucrose, 20 to 30 per cent water and 50 to 65 per cent alcohol, all by weight.

The aqueous alcohol – raw sugar ratio with or without the sucrose in solution may be adjusted to give an easily worked slurry of crystals and to suspend the molasses sludge .

63 - Ethyl Oleate

Introduction :

Ethyl oleate is a new item. ethyl oleate finds application in various industries.

The manufacturing process which is simply esterification ethyl alcohol with oleatic acid under controlled condition, is known for last 100 years .

Properties :

Ethyl Oleate ($CH_3 (CH_2)_7 CH : CH (CH_2)_7 COO C_2 H_5$) :

Light coloured, yellowish liquid, insoluble in water, soluble in alcohol & ether solubility of water in ethyl oblate is 1- 0 cc / 100 cc (20 °C)

Refractive index : 1.45189 (20 °C)
Melting point : - 3.2 °C
Specific gravity : 0.867
Flash point : 348 °F

Oleic acid : - (CH_3 (CH_2)7 CH: CH (CH_2) $_7$COOH)

A mono saturated fatty acid; a common component of almost all naturally accurring fats as wall as fall oil. It is yellow to red like liquid; lard like odor darkens on exposure to air. In soluble in water; soluble in alcohol, ether & most organic solvents, fixed & volatile oils .

The purified grade is water white liquid white liquid with following specifications .

Specific gravity : 0.895 (20/ 4 ° C)
Melting point : 3.2 °C
Boiling point : 286 °C (100 mm)
Refractive index : 1.4598 (20 °C)
Acid value : 196 – 204
Iodine value : 83 – 103
Specification value : 196 – 206

Ethyl alcohol : (C_2H_5OH)

Pure 100 % ab solute alcohol is colourless, limpid limpid, volatile liquid; boiling point 78.3 °C ; freexing point – 117.3 °C

Ethereal, vinous odor .

The 95 % ethyl alcohol is having following specifications :

Refractive index : 1.3651 (15 °C)
Surface tension : 22.8 dynes / cm (20 °C)
Viscosity : 0.0141 poise (20 °C)
Vapour pressue : 43 mm (20 °C)
Sp. Hwate : 0.618 cal / gm (20 °C)
Flash point : 570 F
Boiling point : 78 °C

Uses & market survey

Ethyl oleate finds application in various fields . it is a parecenteral solvent particularly for hormone and vitamin preparations .

Apart from this, ethyl oleate is a good plasticize.

Lubricant & wate resisting agent. It is used for GRAS flavouring .

In these conditions any viable unit (about 150 ton / year) can come up to bridge the gap between demand and supply.

If the quality is checked properly the marketing of ethyl oleate in indigenous market & in other contries is not so difficult. The bulk consumer of this item is drug and plastic units.

Manufacture :

Technological aspects :

The product is carboxylic ester of type Rcoor . the most ususl method for the preparation of esters is the reaction of carboxylic acid and alcohol with elimination of water.

On the basis of studies on the etherification of forty siz organic acid wl th anhydrous ethyl alcohol and catalyst, it can be said , that the rate of e terification of the straight chain fatty acids from porpionithrough stearic is substantially constant . branching of chain causes retaralation , especially wi the acid below valeric.

The choice of the proper catalyst for ethyl alcohol & oleic acid is dependent upon several factors & will vary with the system under consideration . tie most important catalyst used are strong ,ineral acids, but other agents such as salts silica gel, and cation exchange resins are employed on occasion, considering first the mineral acids, hydrogen chloride is the most widely used in laboratory studies . but is not generally favoured for plant operations , because of its corrosiveness & process requirements. Sulphuric acid is favoured for most plant operations .

With sulfuric acid as catalyst the reaction between oleic acid & ethyl alcohol is second order . the reaction rate is proportional to the eatalyst concentration, to the molar ratio of reactants, and to the negative receiprocal of the temperature from 100- 150 °C . An empirical equ ation predicting the rats constant with in a 4 % error for molar rations of error for molar ratios of a cohol to oleic acid up to 10: 1 sulfuric acid concentrations of 0.5 – 1.2 and for temperatures from 100-150 ° C have been developed , the rate of reaction is second order and proportional to the aquare of oleic acid concentration .

Reaction:

$C_{17}H_{33}COOH + C_2H5OH \xrightarrow{120 – 150 °C} C_{17}H_{33}COOC_2H_5 + H_2O$

Oleic acid ethyl alcohol ethyl oleate

Engineering aspects :

On a commercial aspects basis, the production of ethyl oleate may be carried out batch or by continuous processing.

In general large volume production gavours continuous etherification methods however, the older batch processing based on the use of a still pot reactor & an ordinary graetionatly column (bubble cap or packed type) is still very extensively used .

Apparatus of special grades of stainless steel is generally used for commercial scale esterigication units. The material of construction must be fairly resistant to corrosive effect of oleic acid and of sulfuric acid at relatively heghteperature.

As temperatures and concentrations of corrodents and increaded the choice of stainless steel is harrowed to the ferritic chromium alloys and the austentic chromium nickel alloys.

The oleic acid and ethyl alcohol are employed in about molecular proportions. At the start still can be filled to about four fifths of its capacity . the charge is about

1. l mole of oleic acid, alcohol all slight in axcess, 180 ml to luene, and 1-2 % concentrated sulfuric acid. The charge is heated on an oil bath (at 100-120 °C) and the whole distillation is refluxed for a time by closing the take off valve . the heating of the still should be controlled so that the condenser does not run hot or the pre sure bottle show more than the normal back pressure of the column, this being about 1-1 in per plate according to the design .

the ethyl oleater does not ap risibly volatilize with the water that forms or was originally present but stays behind in the still whils the oleic acid & free alcohol gradually diminishes.

The vapors of alcohol water and toluene rises from the till and moves upward in the distillation column and meets the reflux from condenser courrantly . the vapour from distillation still moves to condenser. The vapour is condense by heat exchange with water. The condensate (alcohol, water .

The vapor of alcohol water and tolunene rises frame the & toluene) retuns to the distillation column as reflux . this process continues from more than an hour. Then the reflux line is throtted fully and the distillate is collected in a tank.

The distillati on is dried with potassium carbonate and is returned to the distllting flask . after removing the ternary mixture a second time, the residue in still (ethyl oleate & sulfuric acid) is transferred to a tank.

The solution in tank is treaed with sodium carbonate for the removal of sulphuric acid & treaces of oleic acid.

The refining of the ester distillate comprises neutralizing with sodium carbonate or under agitation, followed by a wa er washing, which removes the undesirables.

The washing is often done counter current in the packed tube.

The water flowing down ward & ethyl oleate flowing uprard the same apparatus acting as decaunter.

The ethyl oleatex layer, holding about 4% of water in solution, has to be redistilled through a column. The first distillate which contains most of the water, is reseperated or rewashed. Finally the ethyl oleate solution is heated in a high vacuum to eliminate low boiling residues.

Other purification freatment such as filteration may be required to yield a first class product.

64 - Oxalic acid

Introduction

Oxalic acid is the simplest of the dibasic organic acids. It was synthesized for the first time in 1776 , by oxidizing sugar with nitric acid and enjoys important position among the organic acids, due to its diversity of uses, it has a vast demand in chemical and allied industry.

This prefeasibility report is prepared basically to give a preliminary idea to the entrepreneur regarding various aspects of this project in a nut shell . Data from this report can be used for carrying out various preliminary formalities with government departments such as allotment of jadustrial approvals or pbtaining a letter of intent once the acrepreneur has made up his mind to go ahead with this project.

Project At A Glance

1.	project	oxalic acid
2.	capacity	300 M.T per annum
3.	raw materials : molasses , nitric acid , sulfuric acid etc	

introduction :

this is a prefeasibility report for setting up a plant to manufacture 300 M.T . per annum of oxalic on three shift basis . the plant is proposed to be set up in category c backward area in any state in the country.

Oxalic acid is the simplest of the dibasic organic acids . it was synthesized for the first time in 1776, by oxidizing sugar with nitric acid and enjoys important position among the organic acids , due to its diversity of uses , it has a vast demand in chemical and allied industry .

The study establishes technical feasibility and economic viability of producing 300 M.T. per annum of oxalic acid production process & equipment

The production plant and equipment proposed, have been selected for the envisaged production capacity and incorporate features that permit smooth operation of the plant “ After making a preliminary study of the sources of supply of such equipment it has been identified that all the equipment will be available indigenously and no imports will be necessary.

3 . Product description , properties , uses & applications :

2.1 : product description :

Oxalic acid, mp 187 C (decomp) , is the simplest of the dibasic organic acids. The crystal structure of the anhydrous form is rhomibic bipyramid and it is odorless, hygroscopic, and white in colour, the product is commercially available as the dehydrate, hooccooh.$2H_2O$, m.p.101 . 5 ̊C , and consists of odorless monoclinic prisms, containing 71,4 % anhydrous oxalic acid and 28,6 % water, supplied in particle sizes ranging from fine powder to coarse granular and packed in fiber drums, oxalic acid is stored in cool areas at relative humidies of between 50 and 70 % to prevent caking .

There is no special hazard attached to handling the dry oxalic acid, however precautions should be taken to avoid inhalation of the dust “ oxalic acid or its salts taken internally can cause death “ . dermal irritation caused by axalic acid is not generally encountered , but like any acid prolonged contact with the skin should be avoided .

2.2.properties :

anhydrous oxalic acid has an appreciable vapour pressure : sublimation starting at temperature blow 100 °C and proceeds rapidly at 125 °C.

Partial decomposition follows complete melting at 185-190 °C. And its decomposition products include formic acid, carbon monoxide, carbon dioxide and water " oxalic acid crystallizes from eater as the dehydrate, but readily looses its water of crystallization when heated rapidly . some of the physical and chemical properties are summarized below in table 2-A.

Table 2 - A : physical and chemical properties of oxalic acid

Oxalic acid , anhydrous $(COOH)_2$ =	
Melting point , °C	187 = 0
Spific heart, cal / g. solid range, -200 to + 50 °C	C + 0.259 + 0.00076 T
Heat of combustion , kcal / mole	60 = 1
Heat of formation at 18 °C, kcal / mole	195.36
Heat of solution (in water) , kj / mole	- 9.58
Heat of sublimation , kcal / mole	21.65
Heat of decomposition, kcal / mole	197.60
Thermal conductivity at O °C, watt / (cm^2) (°C / cm)	
Ionization constant , k_1	9.0 x 10^{-3}
K_2	6.5 x 10^{-5}
Oxalic acid, dehydrate, (COOH) . $2H_2O$	
Melting point, °C	101.5
Density, d_4 20	1.653
Refractive index n_o20	1.475
Heat of solution (in water) , kj / mole (4)	-35.5

The reactions of oxalic acid are typical, including the formation of normal and acid salts and esters. Oxalic acid forms stable soluble complex ions with many metals , fusion of oxalates with alkalies gives carbonates and hydrogen . oxalic acid in aqueous solution is decomposed by ultraviolet, x-rays or v radiation with the liberation of carbon monoxide . apart from these reaction oxalic is involved in many more important chemical reactions & processes .

Corrosion & handling :

Plain cast iron and steel are slightly attached by oxalic acid but the rate of attack is slow enough to make these metals the most economical for handling them, provided contamination can be checked and stopped .

Evaporators used in the production are generally made of cast lead and copper piping the acid corrodes aluminum slightly . while oxalic acid sulphates up to 50 percent are being handled by stainless steel and high silicon pumps . hard rubber equipment is also used to handle this acid durimet -20 and worthite are reported to be more resistant to oxalic .

Acid than 18 - B stainless steel at all temperatures and concentrations.

Copper and monel metal are also reported to satisfactory for handling oxalic acid. Phenolic and vinyl co-polymer resin coating give satisfactory for handling oxalic acid. Phenolic and vinyl co-polymer resin coating give satisfactory results. Ten normal solution of oxalic acid attackes coating of cans rapidly in presence of air.

1. 3 Specification :

oxalic assay may be determined by acidimetry or by oxidimietry, depending on acid or forgien reducing impurities.

Contents		coarse crystals	fine powder
1.	Oxalic acid	99.4 %	99.8%
2.	Free moisture	0.5 %	0.1 %
3.	Sulphates	traces	traces
4.	Ash	0.10 %	0.10%
5.	Impurities (including Pb & Fe)		

1.4 Uses and application :

Industrially , oxalic acid and its salts enjoy a diversity of sues . uses of oxalic acid include a host of industrial and household applications, A large scale use of oxalic acid is in cooling systems, especially those of water cooled internal combustion engines. Oxalic acid is used for removing carbonaceous deposits from steel plates and dips for cleaning and phoshatizing steel . it is one of the components in formulations for cleaning non – ferrous metals such as silver, aluminium, copper and copper alloys. Along with sulphuric acid , it is used in anodizing baths for forming protective oxide coatings on aluminum . its another major application is the use in mosaic floor polishing .

Oxalic acid uses are in the manufacture of chemicals, as a purifying agent, in the manufacture glycerol, forming acid tartaric acid , cream of tarter etc. it is a constituent of cleaning solution used for the removal of ink markings , stains and discolorations cause by bleaching of gyes, oxalic acid also finds use in the textile industry of dye – stipping of wool , degumming of silk, printing of cotton, for cleaning and dyeing of fabrics and for bleaching plant fibres.

Osier uses include cleaners for rust, grease , wax and other soiled soils from printed, varnished and glass surfaces, in the formulations of metal polishes, for refining tall oil, for purification of crude natural gums and as an intermediate or components in the manufacture of dyes and numerous other chemicals.

Uses and applications may be summed up as follows :

1. As a mordant in dyeing and sloth printing
2. In the manufacture of potassium quadroxalate or salt or oral antibiotics.
3. In metal and equipment cleaning .
4. As an antibleach and anti rust agent in laundering
5. In leather tanning
6. In rare earth processing
7. In automobile radiator cleaning
8. In process engraving and lithography

Industrially , oxalic acid and its salts both enjoy a diversity of uses :

Some of the specific applications are mentioned as under :

a. It Is chief constituent in many automobile radiator scale removers.

b. It is employed as a bleaching agent for material such as straw, cork resin and wood .

c. It is used in printing when a solid water soluble non – hydroscopic acid is required .

d. Its sodium salt is used as an antiflash agent in artillery ammunition .

e. It is used to increase he chrome pick – up in the tanning of hides.

f. Its tin and antimonyl salts are used in printing and dyeing .

g. Its iron salts are used fr he manufacture of blue print papers.

h. Both acid and its salts are extensively employed as regents in chemical analysis as wall as in the manufacture of miscellaneous chemical derivatives .

For the various industries , oxalic acid pattern of consumption is more or less as follows :

Chemicals	25 %
Melt cleaning and others	20 %
Textiles	10 %
Leather tanning	5 %
Engraving and lithography	5 %
Miscellaneous uses	35 %

4.1 Manufacturing process :

Introduction of oxalic in “ wood sorrel “ (oxalis acetosella) and in sour dock (rumex acetosa) as the potassium salt was known at the beginning of the 17 th century “ it was not until 1776 that it was first synthesized by carl w. Scheele, who oxidized sugar with nitric acid and, eight years later, proved that it was identical with the acid of the salt of sorrel. Oxalic acid, the name was derived from greek terminology with a special reference to acidity . it was found in plants of the genus – oxalis and isolated, hence the name oxalic Acid.

It is present in many plants and vegetables, notably oxalis and Rumex families, as potassium or calcium salts in the cell sap of the plant, in on barb and sorrel plants. Also it is separated from arjun bark and any – bark.

It is a product of metabolism of many molds, several species of penicillium and aspergillus which convert sugur in to calcium oxalate.

4.2 manufacturing technologies :

Oxalic acid and oxalate have been manufactured by four general methods, each having variations .

1) Alkali fusion of cellulose (wood waste)
2) Fermentation of sugur solutions by molds .
3) Synthetic process from formats .
4) Catalytic oxidation of molasses.
5)

A brief idea of all these methods is presented below :

1. Alkali fusion of cellulose :

This method was first used commercially in the middle of ninteeth century. Cellulosic materials, usually waste products such as saw dust, grain hull, arjun bark , ain / ayn bark , and the like are fused by heating at high temperatures with concentrated aqueous sodium or potassium hydroxide , to obtain alkali oxalate .

Causticization of alkali oxalates followed by reacting calcium oxalate with sulphuric acid gives oxalic acid .

Only small manufacturers employ this method to produce small quantities since these technologies suffer from limitation of collection of raw materials regularly, quality of the product, yields etc. affecting .

Overall economy of the project .

2. Fermentation of sugur solutions by molds :

This method essentially consists of fermentation of sucrose sugar under controlled conditions with specific isolated families of penicillium of aspergillus to give calcium oxalate, which on reacting with sulphuric acid gives oxalic acid .

The fermentation process is probably not economically sound for the production of oxalic acid primarily: this is always an incidental by- pridyct. The ratio of oxalic acid to citric acid is governed by economic considerations : its production , at the expenss of lower yields of higher priced citric acid , would not in ordinary commercial practice, be encouraged . despite its secondary position, oxalic acid from this source is a significant proportion of the total production.

3. Synthetic process from formats :

See of the most important commercial route to oxalic acid is based on sodium formate, which is prepared synthetically from sodium hydroxide and carbon monoxide. The two process are frequenly performed together . the primary raw materials are carbon monoxide, lime and sulphuric acid and the end products are oxalic, hydrogen, and calcium sulphate. Soda is recycled but there are losses during the yarious operations, and the deficit is made up by periodically adding alkali or formate at the appropriate stage. The cyclic process is based on four reactions :

$$NaOH + CO \xrightarrow{\text{under pressure}} HCOONa$$

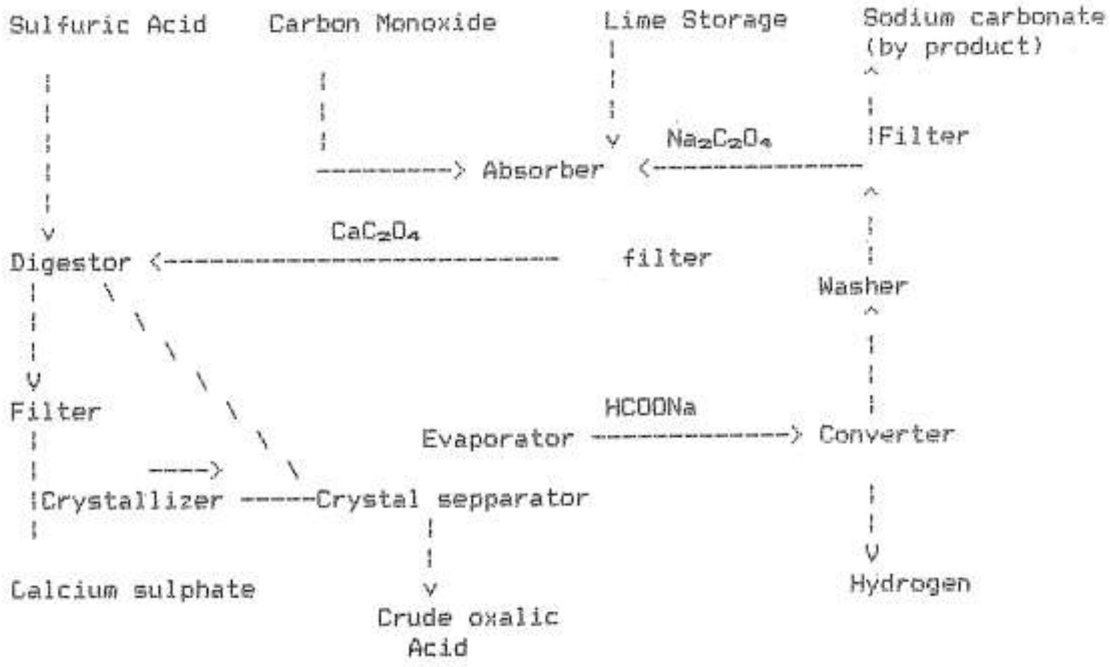
$$2\ HCOONa \xrightarrow{\text{Heat}} (COONa)_2 + H_2$$

$$(COONa)_2 + Ca(OH)_2 \longrightarrow (COO)_2Ca + 2NaOH$$

$$(COO_2)Ca + H_2SO_4 \longrightarrow (COOH)_2 + CaSO_4$$

The synthetic oxalic acid process is shown diagrammatically below :

Oxalic acid from carbon monoxide via formate :



4. Catalytic oxidation of molasses :

Catalytic oxidation of molasses using concentrated nitric acid or in some cases fuming nitric acid, as an oxidizing agent gives oxalic acid is the oldest method of artificially preparing oxalic acid . the potentialities of this method as means of manufacturing has long been recognized, but it was not before second quarter of 20 th century when it was success fully developed as a commercial process . technical advantages in the manufacture of nitric acid particulary in the recovery of nitrogen oxides in the form suitable for cyclic use, were mainly responsible for the attainment of economic viability of this technology .

4.3 proposed process :

catalytic oxidation of molasses " has been considered the most favourably process for the proposed oxalic acid plant as the process is most suitable to the Indian conditions with the latest modern process developed in india.

Process details :

Oxalic acid is produced by the oxidation of carbohydrates or sugars, such as glucose in high yields . these sugars are obtained from molasses by treating with sulphuric acid to hydrolyse sucrose into d-glucosen and d- fructose .

Favourable conditions for the production of oxalic acid in high yield include conducting the oxidation in an aqueous sulfuric acid solution:

The addition of one or combination of following catalytic agents, compounds of vanadium, especially venadium pent oxide (V_2O_5) of molybdenum, or iron , or manganese, careful temperature control: and maintaining excess level of carbohydrate during most of the reaction period. Large quantities of nitrogen oxides are evolved and for efficient operation, must be reclaimed for reuse. Any nitric acid that is reduced to nitrous oxide, N_2O is recoverable by installation of absorption tower and scrubbing equipment . minimizing nitric acid losses and better yield of oxalic acid can be achieved by careful temperature control, by avoiding excesses of nitric acid, and by meaintaining optimum sulphuric acid concentration .

Many products of plant origin have been suggested as raw materials. The choice of raw material is however influenced by somewhat complex economic factors. Among carbohydrates, it the raw material choosen is not essentially a mono saccharide, it must be degraded by hydrolysis to this stage before use .

Molasses as a raw material for oxalic acid is widely accepted economical too. The process essentially consists of following steps .

1. storage of molasses
2. dilution of molasses in reactor
3. mixed acid preparation
4. addition of mixed acid for oxidation
5. crystallization and product separation

molasses containing 30 percent sucrose are stored in tanks fitted with heating arrangement as the viscosity of molasses is very high , thus by decreasing the viscosity they can be easily transported using pumps. The storage tanks are fitted are fitted with agitators to avoid settling of heavy particle.

Molasses are then sent to the dilution reactor with the aid ofgear pump. The molasses are diluted with mother liquor obtained after oxalic acid centrifuging. The contents are heated to 65.6 to 71.1 °C and catalyst vanadium pentoxide and iron is added.

Mixed acid is next prepared into an assessed 316 reaction, vessel in which required quantities of nitric acid and sulfuric acid from their respective storage tanks are poured to their respective measuring vessels and from which a measured quantity of nitric acid (36% concentration) and sulfuric acid are mixed under aggressive cooling . the heat of mixing is evolved by rapid circulation of chilled water and temperature is not allowed to rise beyond a stipulated range. The mixed acid thus prepared is first sampled and analysed for its content before being utilized for the oxidation raction . measured quantity of mixed acid at controlled rate is added in to cast iron oxidation vessel containing carbohydrate under controlled reaction temperature of 65.6 to 71.1 ̊C .

The addition continues for about eight hours and during the addition of mixed acid the contents are croled by circulating chilled water through the jacket . the concentration of V_2O_5 and fe are adjusted to fall within the range of 0.001 to 0.005 % V_2O_5 0.39 to 0.8 % fe these catalysts accelerate the oxidation process. The completion of oxidation is tested by finding the remaining sugar in the reaction mixture. Large quantities of nitrogen oxides and other gases are evolved during the oxidation reaction . on completion of oxidation the thick slurry is cooled in a crystallizer where crystals of oxalic acid are formed and the crystals of oxalic acid from M/L is centrifuged . the M/L is then cucycled oxakic acid crystals containing about 8-10 % water is recrystallized by first dissolving in hot water in lead lined vessel, pumped to crystallizer and finally centrifuged . the crystals are dried in a tray dryer at 90 – 95 ̊C and packed.

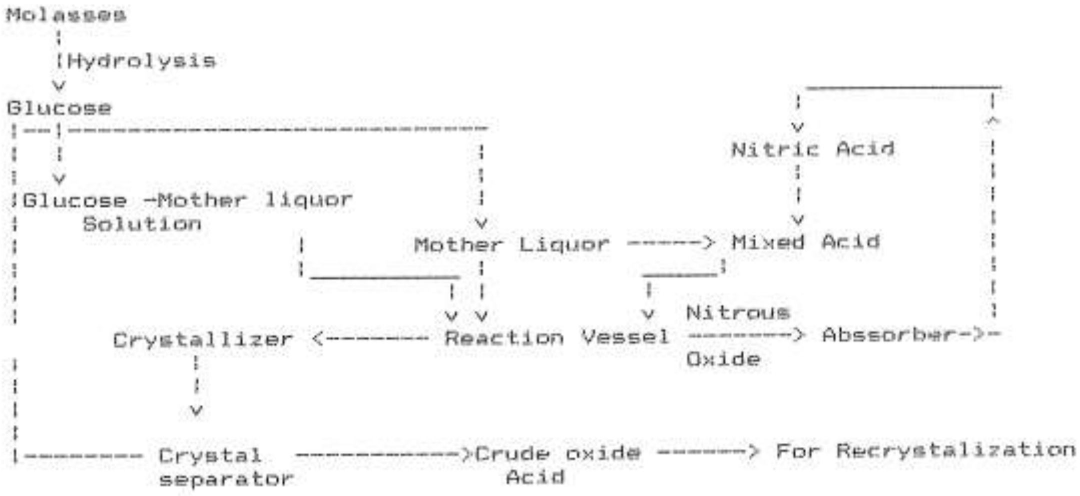
Nitric acid recovery :

Cupious fumes of nitrous oxide gas that come out of oxidation reactor and also from the crystallizer, are all collected and scrubbed, utilizing assed line blowers for collection . the oxides of nitrogen thus recovered are oxidized to a higher step and then absorbed into water or the fresh nitricacid . in order to utilize these excessive fumes, the absorption is done in series of assessed 316 packed towers and in which spent acid is recirculated from which the heat of reaction is removed. After the derived degree of absorption, nitricacid is collected and stored for reuse.

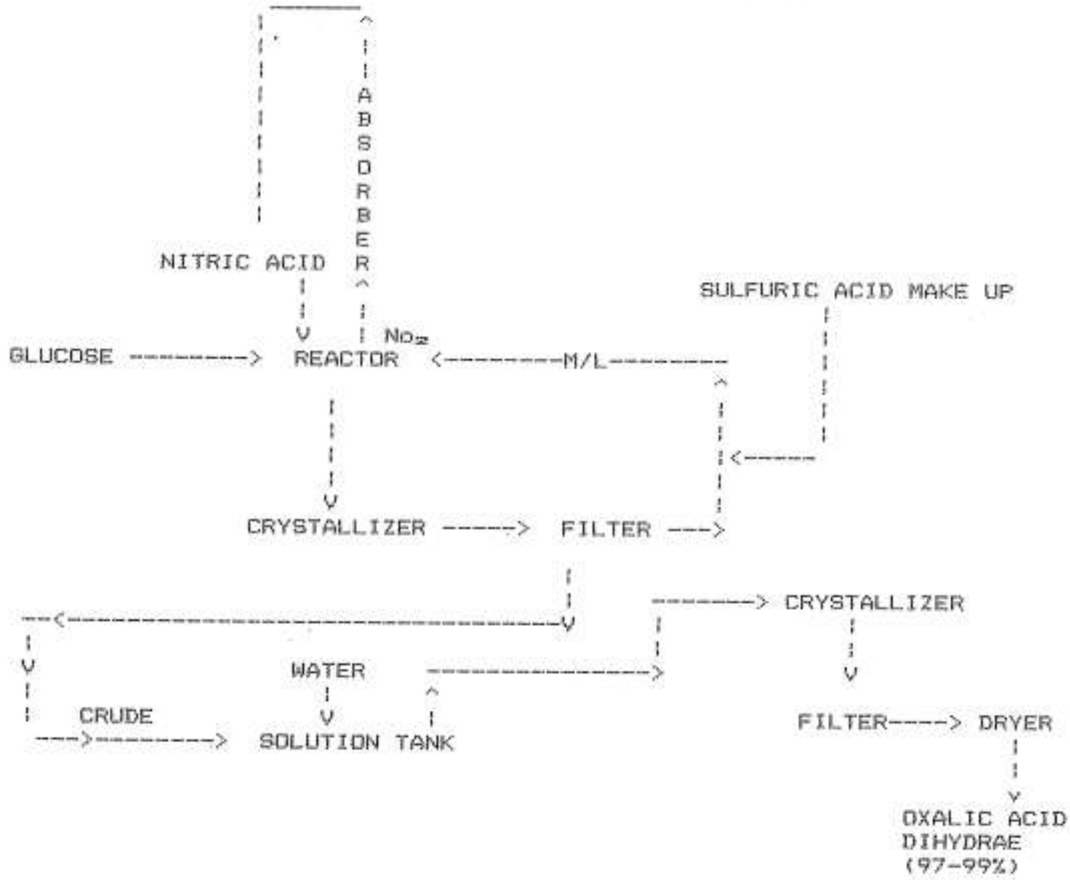
Recovery – Sodium Nitrate :

due to the high cost of nitric acid recovery system the nitrous oxides are utilized in making sodium nitrate by – product by passing the fumes in to the required strength of caustic lye. The liquor obtained in evaporated, crystallized, centrifuged, dried and packed.

Oxalic acid by nitric acid oxidation :



PROCESS FLOW DIAGRAM - OXALIC ACID



REACTION:

$$C_6H_{12}O_6 + 6HNO_3 \longrightarrow 3\begin{matrix}COOH\\ |\\ COOH\end{matrix} + 6NO + 6H_2O$$

65 - Caffeine

Introduction :

The major raw materials for caffeine are tea waste and coffee – beans. Tea waste is , however, used more widely on commercial scale because of its availability in surplus and low cost of production.

Tea waste is the sole by produce of the tea industry. It is available in the form of weeping of fluff, stalk and leaves during processing and subsequent handling of tea in tea factories. It amounts to about 3% of the total tea production . it is estimated that the total tea production of indis is 24 million kg . per year.

The waste on an average contains 2.5 % caffeine. Regional research laboratory, jorhat has developed a process for economic recovery of caffeine from tea – waste.

The process consists of extraction of tea waste with lime :

End water whloh are boiled together for about 2 hours.

The filterate from this mass is allowed to cool and then extracted with benzene. Caffeine is subsequently recovered from benzene. Solution. It is redissolved in water and recry stylized for further purification.

Caffeine is specified for purity in the british pharma copoes (B.p.c) as a free base and is widely used in medicines, in various forms for renal stimulation, head – ache and migraine relief and increasing mental activity.

The recommend plant capacity for an economically viable unit for manufacture of caffeine is 40 kg . per day the estimated capital investment for the proposed capacity plant is Rs. 10.98 lakhs. The detailed profitability studies reveal that the return would be of the order of 25 % on the total capital investments .

Caffeine is moderately toxic in dosage of 1 grain or more. Concentration of 200 micrograms perm has been found to inhibit of the enzyme INA polymerase. Its use in soft drinks is not to be exceed O.O2

Properties & specifications :

Heine ($C_8H_{10}N_4O_2 - H_2O$) , the hydrate of caffeine is a white fleecy mass or long flexible silky crystalline. It is an alkaloid and loses water at 80 °C . it is efflorescent in air .

It is odorless, bitter in taste and forms solutions which are neutral to litmus . its melting point is 256.8 °C

And it sublimes at 1.76 °C . it is soluble in chloroform and is alightly soluble in water and other .

Caffeine is a weak mono acidic base and forms salts only with stong acids such citric, hydrochloric etc .

These salts stimulate the heart and the higher faculties. It is an important die rent . the effective dose of caffeine is 0.15 to 0.25 gm . about 80 % of it is spilt up into urea in the body . with aspirin caffeine citrate.

Relives pain.

Uses & application

Caffeine is wodely used in pharmaceuticals as the free hose and as mixture such as citrates caffeine and caffeine and sodium benzoate. Caffeine is very useful as et implant of the central nervous system end also as diuretic although its aotion as a diuretic is weaker then of thsophylline. Caffine gives definite relief from fatigue and neuralgia. It is also useful in headaches originating from aye strains. It is used in cola beverages. The amounts contained in beverages and incorporated in drugs, it is strictly non toric . in larger doses it can be definitely toxic to these wto have a cardiac conditions .

It is also used in the preparations of theophylline, since theophylline does not occur naturally to a commercially appriciable extent . caffeine is chlorinated in two stops to dichloe – caffeine . to this is passed a vigorous current of steam which results in chlorophylline. This is then reduced in acid medium with a suitable metal, or better catalytically, to ther – ophyllon. Caffeine is also used in several medicines in admixture with acetanilide, acetyl salicylic acid and phenacetic for relief of head ache and migraine . it is also used as a cardiac stimulant . its most important physiological action is on the kidney causing on increased secretion of urine. Caffeine is excreted in the urine partly unchanged but chiefly as dimethyl anthine, methyl anthanate and anthine.

Process of manufacture :

Caffeine is basically entracted from tea waste or coffee beans. Different processes exist for the purpose.

In one process, tea waste is beild with four times its weight of water for about 20 minutes and filtered hot, the hot filtrate is heated with excess of basic lead acetate which precipitates the albuminoids.

The decanted liquor is treated with h_2SO_4 solution for removing recess of lead. The acidic solution is decolourised with animal charcoal. Caffeine is extracted with chloroform. Chloroform is distilled off . caffeine is purified by crystalisation from water. The caffeine which crystalises out is separated in centrifuge and dried at room temperature. In the second process tea dust and similar products are mixed with lime and extracted with water . the resulting mixture is then filtered and the filtrate is concentrated and allowed to crystallize . the crude caffeine is purified by recrystallisation from water with the use of suitable carbon bleak .

In another process tea is heated for about an hour with four times its weight of lime equal to that of tea taken and the mixture is evaporated to dryness. The mixture is powdered and extracted with boiling chloroform or some similer suitable solvent that dissolves the caffeine. The alkaldid is purified by recrystallisation from water.

In the smother process, powdered tea (waste) is extracted for several hours with refluxing (about 400 ml) .

Alcohol per 100 gm . of tea) , the mixture is filtered and the filterate is evaporated in the presence of magnesium oxide (to convert acidic impurities to water insoluble magnesium salts). The resulting solid is extracted with hot water.

(The approximate solubility of caffeine at 25 °C is 2 gm . 100 ml of alcohol; 2 gm / 100 ml . of chloroform. Solubility inereases with increasing temperature) . The aqueous solution is heated with dilute sulphuric scid, carbonated and extracted with chloroform (salts formed in acid, treatment are insoluble in chloroform) solid caffeine is recovered from chloroform solution end purified further by crystallization .

Process :

The commercial process of caffeine nsnufeature involves the solvent extraction of tea waste. Many petroleum solvents have been tried individually and in combination. Conmen solvents are benzene, toluene, chloroform, ethylene, chloride and dichloromethane. Then low boiling solvents are used, they can be recovered and re-used. The residual caffeine is purified by crystallization from water.

The various steps in the process are discussed below :

Making

Tea wart of good quality is denatured with anhydrous line . Amount of line used is 12 % of the amount of tea - waste . A typical hatch consists of ;

Tee waste	1,000 kg .
Line	120 kg
Solvent	200 liters
Hater	150 liters

Subtraction

De – natured tea – waste is charged in the extractors .

The extractors are partially filled with suitable solvent, with the help of a pump si that the level of the tea-waste is fully covered by the solvent, this will ensure efficient extraction through contact of the solvent end the solid tee – waste. The solvent is boiled with 20 paisa saturated steam and the temperature is maintained at °C although extraction is carried out at atmospheric pressure, small pressure of the order of 5 - 10 paig, do exist within the extractor. For effcint extraction, the tea waste is contacted in the state of turbuleues with the solvent. This is contacted in the state of turbulence with the solvent. This is achieved ky circulation of solvent in the extractors with the help of a circulation pump. Twelve circulation of hr . duration each have been considered adequate for a given batch size.

Evaporation & on endsation :

The extract is charged into the evaporators where solvent is evaporated, as a result of heating with stem at 20 psig . the solvent is reused after condensing it in a condenser. A temperature rise of 5 - 10 ْC of water should be controlled.

Purification :

The crude caffeine obtained from the bootee , of the evaporators is subjected to purification. It is done in the following stages :

1. Washing

The crude caffeine is treated with boiling water.

2. Bleaching :

This partially washed caffeine is treated with activated carbon for discoloring. This is followed by subsequent treatment with bleaching and than by boiling water.

3. Filtration :

The dissolved caffeine in the boiling water is filtered in the plate and filter pres at atmospheres pressure.

4. Crystallization :

The clear filtrate thus obtained is saturated with caffeine and allowed to cry sallize in an open water tank .

A fresh running stream of cold water is maintained for three hours in the crystallizer . clear crystals of caffeine, saturated with water are thus obtained .

5. Drying & grinding

Crystals of caffeine which contain nearly 40 %
Water are dried in a suitable drier . A tray can be used.
Air heated at 200 ْC is used . the anhydrous crystals of caffeine are grinded and powdered .

6. Packing and despateh :

Powdered caffeine is packed in air – tigh containers and dispatched for marketing .

Bionomics of the project :

A. Capacity ;

The economics of the project has been worked out on the capacity of 40 kg ms . caffeine extraction per day on single shift basis.

The annual production capacity is 12.000 kg ms. Based on 300 working days a year.

Sodium Hydro Sulfite

Introduction

Sodium hydrosulfite is a white or grey crystalline powder . the anhydrous hydrosulfite in $Na_2 S_2 O_4$. it is soluble in cold water and insoluble in alcohol . it decomposes in hot water, it is a powerful reducing agent. It finds extensive application in vat dying of fibers of textiles, as a stripping agent for dyes and in many other chemical and allied industries .

The product is used in India as reducing agent are dying ancillary in dying of textile fabrics, as a reducing / bleaching agent, for wool , nylon and cotton yarns, for bleaching of jiggery , clay and soap and again as bleaching agent in the manufacture of certain antibiotics and analgesics .

Chapter – 11

Product description and specifications

Product description

1. Chemical name : Sodium Hydro Sulfite
2. Physical properties
   a) Chemical formula : $Na_2S_2O_2$
   b) Physical state at room temp : : solid
   c) Colour : white
   d) Bulk density : 0.9 – 1.1 gm / cc
   e) Melting point : 55 °C
   f) Melting point
3. Specifications
   a) Characteristic : white granular powder
   b) Appearance : white
   c) Sodium hydrosulfite content : 84 - 88
   (as $Na_2S_2O_4$) % by weight
   d) Sodium thio sulfate : 1.00 max
   (as $Na_2S_2O_3$) % by weight
   e) Sodium pyro sulfite : 6.00 max
   f) (as $Na_2S_2P_5$) % by weight
4. Mode of packing : Ms drum with poly ethylene Liners (Varies from 20 to 150 kg)

.

Process of manufacture

There are three basic processes available for the manufacture of sodium hydrosulfite, the zinc process, the zinc amalgam process at present there are 8 major units in the country manufacturing sodium hydrosulfite. Out of those most of the units are following the zinc process and very few the zinc amalgam and sodium formate process. The sodium formate process is the latest available process. It is at present considered to be most economical and pollution free process.

The advantage of sodium formate process over the other processes is its low cost of production (as zinc dust is very costly). Besides this, the end product is totally anhydrous and does not contain even small traces of zinc or mercury. The product obtained by sodium formate process has a pungent odour because of its powdery form and spontaneous evolution of sulfur dioxide respectively. It should be handled, stored and used more carefully because it loses its purity much faster . the sodium hydrosulfite manufactured by zinc or zinc amalgam process is more stable, granular in nature and slow reacting .

Process of manufacture

There are many processes available for the manufacture of sodium hydro sulfite . in one process, zinc dust is allowed to reduce sodium bisulfate at room temperature .

$2NaHSO_3 + H_2SO_3 + Zn$ ---------------- $ZnSo_3 + Na_2S_2O_4 + 2H_2O$

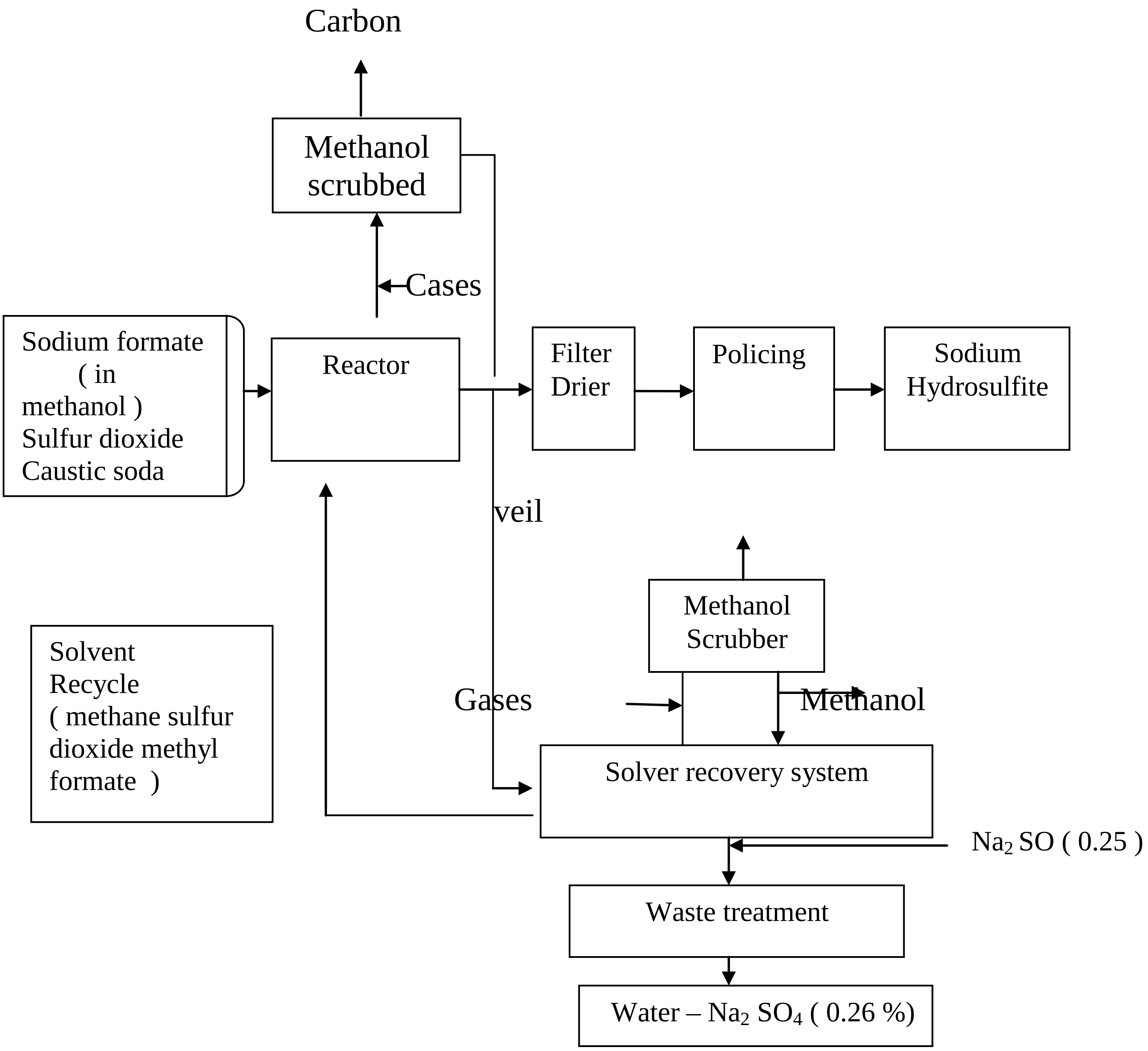
The produce of the reaction are treated with milk of lime to neutralize any free acid which reduces the solubility of $zanso_3$ which is filtered off. Sodium chloride is added to salt out the $Na_2S_2O_4$. $2H_2O_4$. $2H_2O$ which is dehydrated with alcohol and dried . the crystals are stable only in the dry state “ the second process consists of treating an aqueous suspension of zinc dust in formaldehyde with sulfur dioxide at 80 °C . A double decomposition reaction is then carried out with soda ash to form the sodium slats. A pure product is obtained by evaporation under vacuum . Another method is to reduce sodium sulfite solution with sodium amalgam formed in mercury cell process at a controlled ph in the range of 5 to 7 .

Detailed project profile on sodium hydro sulfite

The most economical method for the manufacture of sodium hydrosulfite is the sodium formate process . in this process, sodium formate in an alkaline alcoholic solution is reacted with sulfur dioxide.

$HCOO\,Na + 2SO_2 + Na\,OH$ ----------- $Na_2\,S_2\,O_4 + CO_2 + H_2O$

The reaction results in liberation of carbon dioxide gas which carries over with it methanol which is used as the solvent . the carbon dioxide is scrubbed in a methanol scrubber to recover methanol . sodium hydrosulfite is obtained as solid in suspension form which is filtered and dried in vacuum. The filtrate consisting of methanol “ water “ methyl formate etc “ is sent to a solvent recovery unit were methanol is recovered by elimination of water and recycled to the process.


Carbon
Methanol scrubbed
Cases
Sodium formate (in methanol) Sulfur dioxide Caustic soda
Reactor
Filter Drier
Policing
Sodium Hydrosulfite
veil
Methanol Scrubber
Gases
Methanol
Solvent Recycle (methane sulfur dioxide methyl formate)
Solver recovery system
Na_2 SO (0.25)
Waste treatment
Water – Na_2SO_4 (0.26 %)

Vegetable Oils

Potential oil spec for jatropha curcas to be converted into Bio diesel .

FFa (preferably) : < 2.0 % w / w
Water content : < 1000 ppm
Phosphorus : < 20 ppm w / w
Sulphur : < 50 ppm
Iodine value (mg I_2 / 100 g) : < 120
Saponification Number : > 190(mg KOH /g)
Specific Gravity : 0.840 – 0.920

Fatty Acid profile

Myristic Acid : 0.38 :0.38 %
Palmitic Acid : 16.0 % max
Palmitoleic Acid : 1-3.5 %
Stearic Acid : 6-7.0 %
Oleic Acid : 42-43.5 %
Linoleic Acid : 33 – 34.4 %
Linolenic Acid : > 0.08 %
Arachidic Acid : 0.20 %
Gadoleic Acid : 0.12 %

Jatropha oil hydroscopic – absorbs water and needs nitrogen blanketing on steel tanks.

We are learning more and more about the properties of jatropha . One issue that is quite clear is that, because jatropha is high in acid, it has the tendency to degrade quickly, particularly if not handled properly through the supply chain.

Right from the time of expelling, the oil needs to be kept in storage conditions that prevent undue degradation > Exposure to air and moisture must be minimized – hence the need for nitrogen blanket on the tanks .

The range of fatty acids present in the various seeds will differ but the oil and biodiesel that is produced must be acceptable . However this assumes that oil is fully degummed . the degumming may well be more of a problem than making biodiesel !

Le the phospholipid , protein and phorbol ester contents in edible jatropha seem to be quite different to non 0 edible . it needs to determined if this affects the degumming method.

A modified degumming method may be needed .

If the oil is properly dried after degumming and kept under nitrogen blanketing this may suffice. Bio diesel companies are investigating storage requirements and oxidative stability of jatropha.

Seeds degrade as soon they are picked and so careful storage and handling is required in the warm humid atmosphere, the degradation of seeds can be rapid . Even in the cold countries seeds storage is a problem. Recently an importer had samples of rape seeds that had been harvested and stored in wet weather . the analysis showed that they had 28% of free fatty acid ! they had a strong smell from the yeasts that were growing on the seeds.

Hence at temperature of > 30v ◌̊C the problems can be greater . since the JC seeds are toxic attack by animals and rodents is unlikely to be a problem .

Rubber nitrile tanks are perfect for container shipping as there is no exposure to the atmosphere or the air , this is because it is collapsible and always works in a vacuum .

These can be fitted in a 20 ft – 30 ton container . Each container would hold about 22.4 tons jatropha curcas crude oil . Indian suppliers of these rubber tanks have been identified .

Oil yields and characteristics

Production of fatty oily oils : these are conservative estimates – crop yield can vary widely .

Crop	Kg Oil / ha	Litres Oil / ha	Lbs Oil / acre	US gal / acre
Corn (maize)	145	172	129	18
Cashew nut	148	176	132	19
Oats	183	217	163	23
Lupine	195	232	175	25
Kenaf	230	273	205	29
Calendula	256	305	229	33
Cotton	273	325	244	35
Hemp	305	363	272	39
soybean	375	446	335	48
Coffee	386	459	345	49
Linseed (flax)	402	478	359	51
Hazelnuts	405	482	362	51
Euphorbia	440	524	393	56
Pumpkin seed	449	534	401	57
Coriander	450	536	402	57
Mustard seed	481	572	430	61
Camelina	490	583	438	62
Sesame	585	696	522	74
Safflower	655	779	585	83
Rice	696	828	622	88
Tung oil tree	790	940	705	100
Sunflowers	800	952	714	102
Cocoa	863	1026	771	110

(cacao)				
Peanuts	890	1059	795	113
Opium poppy	978	1163	873	124
Rapessed	1000	1190	893	127
Olives	1019	1212	910	129
Castor beans	1188	1413	1061	151
Pecan nuts	1505	1791	1344	191
Jojoba	1528	1818	1365	194
Jatropha	1590	1892	1420	202
Macadamia nuts	1887	2246	1685	240
Brazil nuts	2010	2392	1795	255
Avocado	2217	2638	1980	282
Coconut	2260	2689	2018	287
Oil palm	5000	5950	4465	635

Biodiesel yield = Oil yield ×0.95 (approx)

Oils and (Bio Diesel) esters characteristics

	Melting Range deg C			Iodine number	Cetane number
	Oil / Fat	Methyl Ester	Ethyl Ester		
Rapeseed Oil, h.eruc.	5	0	-2	97to 105	55
Rapeseed Oil, i.eruc.					
Sunflower Oil	-18	-12	-14	125 TO 135	52
Olive Oil	-12	-6	-8	77 to 94	60
Soybean Oil	-	-	-	125 to	5

	12	10	12	140	3
Cotton seed Oil	0	-5	-8	100 to 115	55
Corn Oil	-5	-10	-12	115 to 124	52
Coconut Oil	20 to 24	-9	-6	8 to 10	70
Palm kernel Oil	20 to 26	-8	-8	12 to 18	70
Palm Oil	30 to 38	14	10	44 to 58	65
Palm oleine	20 to 25	5	3	85 to 95	65
Palm stearine	35 to 40	21	18	20 to 45	85
Tallow	35 to 40	16	12	50 to60	75
Lard	32 to 36	14	10	60 to 70	65

Fatty Acid contents of different Oils

Fats and Oils	Fatty acids Oils %							
	C 4:0 Butyric	**C 6:0 Caproic**	**C 8:0 Caprylic**	**C 10:0 Capric**	**12:0 Lauric**	**C 14:0 Myristic**	**C 16:0 palmitic**	**C16 :1 palmitoleic**
Molecular wt	88	116	144	172	00	228	256	254
Tallow	-	-	-	-	.2	3	27	2
lard	-	-	-	-		1	26	2
Butter	3.5	1	-	2.5		11	30	3.5
coconut	-	-	8	8	8	16	8.5	-
Palm kernel	-	-	3	5	8.5	17	7.5	0.5
palm	-	-	-	-		3.5	39.5	-
Safflower	-	-	-	-		-	5.2	-

peanut	-	-	-	-		0.5	7	1.5
Cottonseed	-	-	-	-		1.5	19	-
Cottonseed	-	-	-	-		1.5	19	-
Maize	-	-	-	-		1	9	1.5
Olive	-	-	-	-	.5	1	13	2
Sunflower	-	-	-	-		-	6	-
Soy	-	-	-	-		0.3	7.8	0.4
Rapeseed / Canola	-	-	-	-		-	3.5	0.2
Mustard	-	-	-	-		-	3	-
Cod liver Oil	-	-	-	-		4	10	14.5
Linseed	-	-	-	-		0.2	6	-
Tung	-	-	-	-		-	-	-

Fatty acids %

Fats and Oils (continued)	Fatty acids %						
	C18:0 Stearic	C18:1 Oleic	C18:2 Linoleic	C18:3 Linolenic	C20:0 C22:0 Arachydic Behenic &others	Mono-Unsaturated Acids <C16:1	C20:1 C22:1 Arachidonic Erucic & others
Molecular wt.	284	282	280	278	326	226	324
Tallow	24.1	40	2	-	0.7	-	0.3
Lard	13	45.2	10.3	-	-	-	2.5
Butt	1	2	3	-	1.6	1.5	0.85

er	2	6			5		
Coconut	2.5	6.5	2	-	-	-	0.5
Palm kernel	2	14	1	-	1.5	-	-
Palm	3.5	46	75	-	-	-	-
Safflower	2.2	76.4	16.2	-	-	-	-
peanut	4.5	52	27	-	7.5	-	-
Cottonseed	2	31	44		-	-	2.5
Maize	2.5	40	45	-	-	-	1
Olive	2	68	12	-	0.5	-	1
sunflower	4.2	18.7	69.4	0.3	1.4	-	-
Soy	2.5	26	52	5	7	-	-
Rapeseed / Canola	2	13.5	17	7.5	0.9	-	56.3
Mustard	1.5	39.5	12	8	-	-	36
Cod liver Oil	0.5	28	-	-	-	1	42
Linseed	5	17.3	16	55	0.5	-	-
Tung	-	8	12	80	-	-	-

Oils and fats	Total	Density	Density	Volu,e	Volume	Stoich. Ratio

	Molecular Weight		@ 50 ̊C	Oil (ml)	Methanol (ml)	Methanol : Oil %
Tallow	858.54	0.895	0.88	981.18	121.52	12.4
Lard	863.73	0.92*	0.9*	959.7*	121.52	12.7
Butter	797.64	0.91	0.89	896.73	121.52	13.6
Coconut	674.51	0.926	0.91	744.57	121.52	16.3
Palm Kernel	704	0.912	0.89	789.33	121.52	15.4
palm	847.28	0.923	0.9	938.29	121.52	13
Safflower	879.1	0.927	0.91	966.44	121.52	12.6
peanut	885.02	0.919	0.9	984.45	121.52	12.3
Cottonseed	867.38	0.918	0.9	963.76	121.52	12.6
Maize	872.81	0.923	0.9	966.57	121.52	12.6
Olive	870.65	0.923	0.9	964.17	121.52	12.6
sunflower	877.22	0.925	0.91	969.3	121.52	12.5
soy	882.82	0.925	0.91	975.5	121.52	12.5
Rapeseed/canola	959.04	0.914	0.89	1072.75	121.52	11.3
Mustard	925.43	0.916	0.9	1032.85	121.52	11.8
Cod liver oil	908.81	0.929	0.91	1000.34	121.52	12.1
Linseed	872.4	0.934	0.91	954.48	121.52	12.7
Tung	873.68	0.944	0.92	945.54	121.52	12.9
* approximate						

Comparison of feed stock for soap manufacture

Fatty acid	jatropha	Palm	Coconut
Caprylic Acid,(c8:0)	-	-	8
Capric Acid,(c10:0)	-	-	8
Lauric Acid,(c12:0)	-	-	48
Myristic Acid,(c14:0)	0.38	3.5	16.0
PalmiticAcid,(c16:0)	16.0	39.5	8.5
Palmetolic Acid,(c16:1)	1-3.5	-	-
Stearic Acid,(18:0)	6-7	3.5	2.5
Oleic Acid,(c18:1)	42-43.5	46	6.5
Linoleic Acid,(c18:2)	33-34.5	7.5	2.0
Linolenic Acid,(c18:3)	0.8	-	-
Production kg/hhecyer	1590	5000	2260

Trans – Estrification Bio Diesel Process

Reaction raw materials :

1. Jatropha Oil
2. Methanol (CH_3OH) 99% + pure
3. Pottasium hydroxide (must be dry)

Materials for Titration :

1. Isopropyl alcohol 99% + pure
2. Distilled water
3. Phenolphthalein solution (not more than a year old, kept protected from strong light)

Materials for washing :

1. Vinegar
2. Water

Manufacturing process

1. Jatropha oil is filtered to remove any solid particles .
2. Jatropha oil is then beated to remove any water content (optiomal).
3. Titration is done to determine how much catalyst is needed .
4. Exact quantity of potassium hydroxide is then thoroughly mixed in methanol till it dissolves completely to get potassium meth oxide .
5. Jatropha oil is heated if required (during winter), and mixed in the potassium methoxide while agitator running.
6. It is then allowed ti settle and glycerine is removed from bottom.

7. BioDiesel fraction is then washed and dried .
8. It is then checked for quality.

In transesterification, KOH and methanol are mixed to create potassium methoxide ($K^+ CH_3O^-$) . When mixed in with the oil this strong polar – bonded chemical breaks the transfatty acid into glycerine and ester chains (biodiesel), along with some soap if you are not careful. The esters become methyl esters.

They would be ethyl esters if reacted with ethanol instead of methanol.

Process in detail

1. Filtering : filter the oil to remove solid particales. You may have to warm it up a bit first to get it to run freely, 35 °C should enough . A Cartridge filter is used for the cartridge filter is used for the same .
2. **Removing the water :** Heat the oil first to remove any water content.

   Waste oil will probably contain water, which can slow down the reaction and cause saponification (soap formation) . the less water in the oil the better . Raise the temperature to 100 °C, hold it there and allow any water to boil off . Run the agitator to avoid steam pockets forming below the oil and exploding, splashing hot oil. Or drain water puddles out from the bottom as they form, you can save any oil that comes out with the water later. When boiling slows , raise the temperature to 130 °C for 10 minutes . Remove heat and allow to cool.

   Regular source of oil does not need to have the water boiled off, in which case do not do it, boiling means extra energy and time .
3. **Basic titration :** Dissolve 1 gram of KOH in1 liter of distilled or deionized water (0.1 % KOH solution) . you can use phenolphthalein solution to get en point . in a smaller beaker, dissolve 1 ml of dewatered oil in 10 ml of pure isopropyl alcohol. Warm the beaker gently by standing it in some hot water, stir until all the oil dissolves in the alcohol and the mixture turns clear. Add 2 drops of phenolphthalein solution .

Using a burette, add 0.1 % KOH solution drop by drop to the oil alcohol phenolphthalein solution, stirring all the time, until the solution stays pink (magenta) for 10 seconds . take the number of mls of 0.1 % KOH solution you used and add 5.0. this is the number of grams of KOH you will need per liter of oil.

4. **Test batches :** the first few times you do this process, it is a good practice to first try out you KOH amounts on a 1 liter bath . this works really well and you do need to heat up the oil too much, just enough so it will spin well. Start by mixing up the exact quantity of KOH and 200 ml of methanol. First make sure that vessels used are dry.

Forming the exothermal potassium methoxide polar molecule will heat up the vessel a bit . keep mixing until all the KOOH has been dissolved .

Once the potassium methoxide is prepared, add to l liter of oil. Make certain all you weights and volumes are precise . if you are unsure of the titration result then use 5.0 grams of KOH per liter of oil. Smaller batches need only be run for about 15020 minutes for separation to be completed before switching off. The settling takes some time to compete . the solution can be poured from the vessel into another container right after switching off the agitator . it is good to do a few batched with varying amounts of KOH recorded, so later when checking results one can choose the KOH quantity that did the best job. When too much KOH is used the result can be a troublesome gel that is tough to do anything with. When not enough KOH is used the reaction dies not not go far enough so some unreacted oil will be mixed with the biodiesel and glycerine . this will from three levels with biodiesel on top above unreacted oil with glycerine on the bottom. If there is too much water in the oil it will form soaps and settle right above the glycerine forming a fourth level in the container . this hayer is not too easy to separate from the unreacted oil and glycerine layers.

5. Preparing the potassium methoxide : Generally the amount of methanol needed is20 % of the jatropha oil by mass. The densities of these two liquids are fairly clos, so 20% of methanol by volume should be about right. To be completely sure, measure out a half-liter of both fluids, weigh, and calculate exactly what 20 % by mass is Different oils can have different densities depending on what type of oil it originally was .

When transesterifying 100 liters of jateropha oil, use 20 liters of methanol. The methanol is mixed into a solution with the KOH, creating potassium methoxide in an exothermic reaction (it gets warm from bonds forming). Keep all utensils the KOH comes in contact with as dry as possible.

CAUTIN : treat potassium methoxide with extreme caution ! Do not inhale any any vapors ! if any potassium methoxide gets splashed on your skin, it will burn you without your feeling it (killing the nerves) . wash immediately with lots of water . Always have a hose running when working with potassium methoxide. Potassium methoxide is also very corrosive to paints. KOH reacts with aluminum, tin and zinc . use glass, enamel or stainless steel containers, stainless steel is best .

6. heating and mixing : pre – heat jatropha oil 48 – 54 °C . A full speed propeller coupled to a electric motor works fine as a mixer . too much agitation causes splashing and bubbles through vortexing and reduces mix efficiency . there should be a vortex just appearing on the surface Adjust the speed, or the pitch or size of the stirrer to get the right effect Alternately an electric pump plumbed to form a mixing loop for stirring the oil would do a nice job. Mount the pump above the level that glycerine will gel at , to prevent clogging up the pump.

Add the potassium methoxide to the oil while stirring , stir the mixture for 50 minutes to an hour . the reaction is often complete in 30 minutes, but longer is better . the transesterification process separates the methyl esters from the glycerine. The CH_3O of the methanol then caps of the ester chains and OH from the KOH stabilizes the glycerine .

7. **settling and separation :** Allow the solution to settle and cool for at least eight hours, preferably longer. The methyl esters (biodiesel) will be floating on top while the denser glycerine will have congealed on the bottom of the container forming a hard gelatinous mass (the mixing pump must be mounted above this level) . An alternative method is to allow the reactants to settle for at least an hour after mixing while keeping the mixture above 38 °C, which keeps the glycerine semi -quid (it solidifies below 38 °C) . then carefully decant the biodiesel . this can be done by draining the reactants out the bottom of the container through a transparent hose . the semi- liquid glycerin has a dark brown color and the biodiesel is honey – colored . keep a watch on what flows through the sight tube . when the lighter – colored biodiesel appears divert it to a separate container . if any biodiesel stays with the glycerine it is easy to to retrieve it later once the glycerine has solidified if you left the mixture in the tank until the glycerine gelled, reheat the tank just enough to liquefy the glcerine again. Do not stir it ! then decant it out as above .

8. Glycerine : the glycerine side stream typically contains a mixture of glycerine, methanol, water, inorganic salts (catalyst residue) free fatty acids , unreacted mono - , di , and triglycerides, methyl esters, and a variety of other matter organic non – glycerol (MONG) in varying quantities. The glycerine from oil is brown and usually turns to a solid below about 38 °C Glycerine from fresh oil often stays a liquid at lower temperatures . Reclaimed glycerine is composted after being vented for three weeks to allow residual methanol to evaporate off or after heating it to 66 °C to boil off any methanol content (the boiling point of methanol is 64.7 °C). The excess methanol can be recovered for re-use when boiled off if you run the vapors through a condenser.

Another way of disposing of the glycerine, though a great bit more complicated, would be to separate its components, mostly methanol, pure glycerine (a valuable product for medicines , tinctures, hand lotions, dried plant arrangements and many other uses) and wax . this is often accomplished by distilling it , but glycerine has a high boiling point even under high vacuum so this method dis difficult . Other idea for disposing of the glycerine is breaking it down to usable methane gas, with a bio Gas methane digester .

9. Soap residue : suspended In the biodiesel will also be some soapy residues . these are the result of K^+ ions from the KOH reacting with water created when the methanol bonds with the ester chains along with any other water that was suspended in the oil. If the reaction produces more than the usual amount of soap, this happens when KOH comes into contact with water before it has a chance to react with the oil . in this case the excess water should have been boiled off first .

The part of the process where it is vital to keep all water out of the reaction is when making the potassium methoxide . keep the vessels KOH comes in contact with as dry as possible . the chances of a good clean splitting of ester from glycerine with little soap by- product are much better on a warm dry summer day than on a damp winter day.

10. Washing and drying : the biodiesel from this stage can be used to the fuel tanks of vehicles . it is to let it settle for a while (about 2 days), allowing the majority of the soap residues to settle before running the biodiesel through a filtration system then into the vehicle fuel tank .

Another method is to wash the soaps out of the fuel with water , one or more times. When washing biodiesel the first time it is best to add a small amount of dilute acetic acid before adding the water .the acetic acid brings the ph of the solution closer to neutral because it neutralizes and drops out any KOH suspended in the biodiesel.

A simple way of washing is using A pvc container with a valve 100 mm from bottom. Fill with water until it is halfway between the container’s bottom and the valve, then fill up with the biodiesel to be washed . After a gentle stirring (keep it gentle, do not agitate up soaps) followed by 12-24 mours of settling, the oil and water will separate, the cleaned oil can be decanted out the valve, leaving the denser soapy water to be drained out the bottom .

This process might have to be repeated two or three times to remove close to 100 % of soaps. The second and third washings can be done with water alone. After the third washing any remaining water gets removed by re- heating the oil slowly, the water and other impurities sink to bottom . the finished product should have a ph of 7, checked with litmus paper or with a digital ph tester.

The water from the third wash can be used for the first or second washes for the next batch. The impurities can be left in the re- heater for the next batch and removed when it accumulates. Transesterified and washed biodiesel will become clearer over time as any remaining soaps drop out of the solution.

Quantity of methanol to be used

The stoichiometric quantity of methanolis the amount needed to convert triclycerides (oils) into esters (biodiesel), the methyl portion of methyl esters.

You also need an excess of methanol to push the conversion process towards completion , without the excess the process runs out (reaches equilibrium) before all the triglycerides are converted to esters, resulting in poor fuel that does not combust well and can be corrosive. The excess methanol acts more like a catalyst. It encourages the process but does not become a part of the final product and can be recovered afterwards.

1. **Stoichiometric quantity :** the stoichiometric quantity is usually said to be 12.5 %methanol by volume, that is , 125 ml of methanol per litre of oil. Of oil . in fact it depends on the amounts of the various fatty acids in the oil and varies from one oil to another . Calculate the average proportions of the different fatty acids in each of the more common oils. Calculate their total molecular weights, and from this calculate the stoichiometric amount of methanol required to convert them. The amount varies from 11.3 % for rapeseed oil (canola) to 16.3 % for coconut oil. These figures are averages, fatty acid quantities vary somewhat when oil crops are grown in different conditions in different parts of the world. But they are close enough for our purposes, and a lot more accurate than the general figure of 12.5 % . if you have an analysis of the fatty acid content of your oil, you can calculate the correct stoichiometric ration .
2. **Excess :** How much excess is needed depends on several different factors: the type of oil, its condition, the type , size and shape of the processor, the type and duration of agitation, the temperature of the process, and it does not make much sense anyway if the stoichiometric ratio is wrong in the first place . However, excess is usually between 60% and 100 % of the stoichiometric amount . the stoichiometric ratio of jatropha oil is 12.5, that is 125 ml of methanol per litre of oil, the excess would range between 75 ml and 125 ml, for a total amount of methanol of 200-250 ml liter of oil. Oils with higher stoichiomeric ratios seen to need higher excesses . So, for fresh soya or canola, you can try 60 % though 67 % or more would be better. For plam kernel or coconut, closer to 100 % excess would be better. If you do not know what kind of oil it is, try using 25 % methanol, 250 ml methanol to 1 litre of oil. If you ve taken care with the titration, used accurate measurements and followed the instructions carefully, you should get a good, clean split, with esters on top and the glycerine and free fatty acids cleanly separated at bottom. If you have trouble washing it, with a lot of frothing, that could be because the process did not go far enough and

unconverted material is forming emulsion, try using more methanol next time. If everything works well, try using less methanol.

You will soon figure out what's best for you.

Glycerine

Glycerine (glycerin, glycerol) is the main by- product of making biodiesel the rule of thumb is 79 ml of glycerine per liter of oil used, 7.9 % . the glycerine by – product burns well, but unless it's properly combusted at high temperatures it will release acrolein, which is toxic . what sinks to the bottom of the biodiesel processor during the settling stage is a mixture of glycerine methanol, soaps and the KOH catalyst. Most of the excess methanol and most of the catalyst remains in this layer. Once separated from the biodiesel, adding phosphoric acid to the glycerine layer precipitates the catalyst out and also converts the soaps back to free fatty acids (FFAs), which float on top. You are left with a light- colored precipitate on the bottom, glycerine/ methanol / water in the middle, and FFA on top . the methanol is typically stripped from this stream and reused, leaving behind, after neutralization, what is known as crude glycerine. The glyceriners.

Will be approx . 95 % pure, a much more attractive product to sell to refiners.

In raw form, this crude glycerine has high salt and free fatty acid content and substantial color (yellow to dark brown) . Consequently, crude glycerine has few direct uses sue to the presence of the salts and other species, and its fuel value is also marginal . the biodiesel industry generates millions of tons of crude glycerine waste each year, and the amount produced is growing rapidly along with the dramatic growth of biodiesel production .

Chemical analysis of jatropha oil

Jatropha curcas L

	Type I	Type II	Type III

FFA	0.03 %	0.18 %	3.69 %
Colour (5 1 /4 " Lovibond)	17 yellow; 1, red	14 yellow; 1,4 red	
Viscosity @ 100 °F	38.8 CST	37 CST	
Saponification number	195.5	193.6	192
Iodine number	94.9	105.2	96
Fatty Acid profile in %			
Myristic	0.06	0.13	
Pemtadecanoic	Trace	0.02	
Palmitic	14.6	3.45	15.6
Palmitoleic	0.85	0.72	0.9
Margaric	0.09	0.09	
Margaroleic	0.05	0.05	
Stearic	7.15	7.46	6.7
Oleic	46.27	34.3	42.6
Linoleic	30.80	43.12	33.9
Linolenic	0.20	0.20	0.2
Arachidic	0.21	0.21	0.2
Gadoleic	0.08	0.09	
Behenic	0.07	0.04	
Lignoceric	0.06	0.05	
Nurvonic	0.05	0.05	

Fish oil

In a factory processing fish , different parts of the fish are separated. The oil from rendering plant, is very rich in Omega- 3 content. It is good for health . in some cases, it decomposes into free fatty Acid, and becomes non edible . this can be used for manufacture of biodiesel .

Product specifications

Product Name	Crude Sardine oil
Physical test	
Colour and appearance	Yellowish brown liquid
Odour	Fishy odour
Specific Gravity	0.930 – 0.965 g / ml
Chemical test	
Iodine value	130 – 160
Acid value (mg KOH/g)	Not more than 20 (FFA below 10%)
Moisture	Not more than 1.1
Pesticide Residue (test method AOAC)	Not detected
Total EPA + DHA	22% minimum (GC method)
Eicosapentaenoic Acid (EPA)	12% minimum (GC method)
Docosahexaenoic Acid (DHA)	10% minimum (GC method)
Storage	Keep close in sealed containers protect from light, air, heat and Moisture.
Shelf life	24 months

Aloe vera Gel profile & information

The word ‘ aloe ‘ has its roots in the Anative plant of somalia with a history dating back to the fourth century B.C Aloe Vera also figures prominently in Egyptian, Chinese, Greek, Indian and Christian literature . As per legend, it was the miraculous healing power of Aloe veral that prompted Alexander the Great to conquer the island of Socotra. Cleopatra the cleopatra’ s famed beauty is also attributed to the natural goodness of Aloe Vera. While the Arabs have a tradition of placing it at graves as a symbol of regeneration and resurrection, the African hunters used its gel as a deodorant. With the recent resurgence of herbal products as a part of ‘ green movement ‘ Aloe vera is witnessing a new renaissance across the world.

Nature & Features

Aloe vera is a succulent that belongs to the liliaceae family . it is one of the 250 known species of aloes, referred to by the scientific terms of Aloe vera and Aloe arbadensis. Called **Ghrita Kumari** in Sanskrut, it is commonly known as Aloe, Aloe Vera, Barbados Aloe , sabila and pita sabila . akin to cactus in appearance, it grows naturally in Africa, America, Europe and Asia .

The ideal environment for cultivating Aloe vera is a tropical climate and low rainfall . the mature plant will grow up to a height of twenty – five feet . it has fibrous roots and bright green gelatinous leaves, enveloped in a fine layer of a yellow liquid or sap. Aloe vera produces flowers and seeds from the same root structure year after year. The yellow to purplish drooping flowers grow in a long raceme at the top of the flower stalk . the fruit is a triangular capsule containing numerous seeds .

The constituents :

The various constituent elements found in Aloe vera include:

Vitamins : Beta – carotene, Vitamin b1, Vitamin B2, Folic acid, Viramin C, Vitamin B3, Vitamin B6, Vitamin E choline.

Minerals : Calcium, Magnesium, sodium, Copper, Iron, Manganese, potassium, Zinc, Chromium, Chlorine.

Amino Acid : Lysine, threonine, Valine, Methionine, Leucine, Isoleucine, Phenylaianine, Tryptophane, Histidine, Arginine, Hydroxy proline, Aspartic acid, serine, Glutamic acid, proline, Glycerine, Alanine, Cystine and tyrosine.

Abthraquinines : Aloin, Isobarbalion, Barbalion, Cinnamic acid, Emodin, Aloe Emodin, Ester of cinnamic acid, Anthracene, Antranol, Aloeric acid, Ethereal oils, Resistannols and Crysophanic acid.

Mono and polysaccharldes : cellulose, Glucose, Mannose, Galactose,

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Aldonentose, L – rhamnoe , uronic acid, xylose, Glucuronic acid and Arabinose.

Enzymes : Oxidase, Amylase, Catalase, Lipase and Alinase.

Applications / uses : the important therapeutic uses of Aloe vera include .

The long chain mannan polysaccharides in it helps activate and boost the immune system.

The magnesium lactate and salicylates in it effectively, a cure for arthritis, and promote good circulation for the heart and nervous system.

The polysaccharides in it bring down the bodies serum lipids, and thus lower triglyceride and LDL level (bad cholesterol) and increase of HDL (good cholesterol) .

As an antioxidant, it guards against damage by free radicals and unwarranted toxins in the body . it also regulates blood pressure, and acts in rheumatism, arthritis, and infections of the kidney, the urinary tract and the prostate .

By the combined and synergic effect of the various ingredients in it , it aids in treatment of peptic ulcers, stomach disorders, acidity, indigestion, gastritis and ulcers, colitis and haemorrhoids, cirrhosis, hepatitis and diabetes.

The list of different illnesses and conditions, aided by the use of aloe vera is indeed impressive, covering everything from burns and slight infections to very serious conditions .

A. Acne, aching joints & muscles, asthama, athletes foot, abscesses, arthritis, allergy rashes, age spots, acid indigestion.

B. Brown skin spots, urns, boils, blood pressure, bruising, bad breath bleeding, bowel problems / conditions, blisters, bronchitis .

C. Cancer treatment (i.e . helps case the radiation effects), cuts & wounds, colon cleansing , constipation, calcium, chapping, cataracts, cradle cap, cystitis, candida, circulation, colitis, colic.

D. Digestive problems, diarrhea, dermatitis, dermatitis, dandruff, diabetes, detoxification, duodenal ulcer, diaper (nappy) rash, denture sores, depression.

E. Eye and ear problems (inflammation, infection), eczema, energy loss.

F. Gum disease, bleeding gums.

G. Hair and scalp, heat rash haemorrhoids,headache.

H. Infection, inflammation, itching, irritable bowel syndrome, indigestion, insomnia, influenza, inset bite.

I. Jaundice

J. Kidney ailments

K. Liver ailments, laryngitis.

L. Moisturizes, mouth ulcers, muscle cramps

M. Nasal congestion, nutrition, cracked nipples, nausea .

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N. Operation recovery

O. Psoriasis, prickly heat, pimple, peptic ulcer, pain relief .

P. Radiation burns, razor burn, rheumatism, rashes.

Q. Sear removal, scalp problems, sinusitis, sore throat, scalding, stomach disorders, sciatica strains, sprains, skin problems, stress shingles, stings, styles, sunburns.

R. Tonsillitis, thrush, teething, tennis elbow.

S. Ulcers (all kinds)

T. Varicose veins, veterinary treatments, venereal sores.

The Demand

A conservative estimate puts the monetary value of current Global trade in medicinal plants at over us $ 60 billion . with the increasing interest in ‘ natural’ products across the world and the resultant upsurge in the demand for medicinal plants, this trade is expected to grow up to Us $ 5 trillion by the year 2050 . Aloe vera is among the few medicinal plants by virtue of their extensive medicinal, nutraceutical and other uses enjoy a major chunk of the market across the globe. The major markets for aloe vera and its extracts are Australia, US and the entire Europe. Despite the ideal climatic conditions for the cultivation of Aloe vera, we have not been able to exploit the excellent potrntial of the miraculous medicinal plant. The reasons are simple lack of cultivation and processing know – how .

Given the exponentially growing demand for it in the international market, Aloe vera presents the finest commercial opportunity among the various medicinal plants. Also, India is among the few countries gifted with the unique geographical features essential for cultivation of aloe vera and other high potential medicinal plants. Yet, the country has not realized and reaped the full potential of such plants. The reason is simple : lack of the requisite expertise. Fortunately, the technology is now accessible to individual and corporate entrepreneurs to make the most of aloe through mainstream cultivation.

Cultivation process

Though aloe vera can be cultivated on any soil for dry land management' sandy loamy soil is the best suited for it . Aloe vera is generally propagated by root suckers by carefully digging out without damaging the parent plant and planting it in the main field . it can also be propagated through rhizome cuttings, by diggings, by digging out the rhizomes after the harvest of the crop and making them into 5-6 cm length cuttings with a minimum of 2-3 modes on them. Then they are rooted in specially prepared sand beds or containers. The plant is ready for transplanting after the appearance of the first sprouts . the process of cultivating Aloe vera involves the following process:

The ground is to be carefully prepared to keep free from weeds and the soil is ideally kept ideally slightly acidic . the soil should be supplied supplement in the form of ammonium nitrate every year.

The plants are set spaced out by 31 inches in rows and between the raws . At that rate, about 5,000 plants are set peracre . An 8-12 inch aloe pop would take about 18-24 months to fully mature.

The plants, in a years' s time , would bear flowers that are bright yellow in colour . the leaves are 1 to 2 feet long and are cut without causing damage to the plant, so that it lasts for several years.

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- The crop can harvested 4 times a year. At the rate of 3 levaes cut from each plant, about 12 leaves are the harvest per year . on an average, the yield per acre annually is about is about 60,000 kg.
- The leaves cut off close to the plant are placed immediately, with the cut end downwards, in a V- shaped wooden trough of about 4 feet long and 12 to 18 inches deep .
- The wooden trough is set on a sharp incline so that the juice, which trickles from the leaves very rapidly, flows down its

sides, and finally escapes by a hole at its lower and into a vessel placed beneath .

- It takes about a quarter of an hour to cut leaves enough to fill a trough .

The troughs are so distributed as to be easily accessible to the cutters.

- The leaves are neither infused nor boiled, nor is any use afterwards made of them except for manure . when the vessels receiving the juice become filled, the latter is removed to a cask or reserved for evaporation . this may be done at once, or it may be delayed for weeks or even months.
- The evaporation is generally conducted in a copper vessel ; at the bottom of this is a large ladle, into which the impurities sink,and are from time to time removed as the boiling goes on .
- As soon as the inspissations has reached the proper point, which is determined solely by the experienced eye of the workman, the thickened juice is poured into large gourds or into boxes, and allowed to harden .

Aloe vera gel

Reputed as one of herbs in the beauty arsenals of Cleopatra and Nephertiti,

aloe vera gel today is showing up as a main ingredient in cosmetics and in bottleson the shelves of health food to grocery stores . from it' s history painted on ancient walls to the controversies of today, this is herb used freely for skin almost as much as water. Aloe vera gel can be used both internally and externally . it is abtained from the plants pulp containing approximately 200 biologically active substances which can be broken down into the following groups :

- Vitamins – Antioxidants, D and B 12
- Minerals – Trace
- Enzymes – Several different types
- Sugars – lmmune system and detoxification
- Anthraquinones – Gastrointestinal absorption, pain relief, anti bacterial ,anti viral .
- Lignin – Helps other constituents penetrate skin.
- Saponins – Soapy substance, cleansing, anti bacterial / microbial .
- Salicylic Acids – Asprin like, anti inflammatory.

The gel consists of 99.3 % water and the remaining 0.7 % is a synergistic mix of the above constituents. Some believe it is the synergistic effect of the constituents is what makes the gel so effective . the gel does degrade quickly so it is important to use gel either from a fresh plant or one that has been preserved without degrading processing.

Externally use this as a base for aromatherapy facial products, especially during troubled and oily periods. After washing and toning the face, lightly massage in cold I kept in the refrigerator) aloe vera gel for a few moments,

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Then blot of the excess. The cold also helps tighten pores . use it as a light moisturizer base by adding selected essential oils. Keep small amounts at room temperature as aloe is not an oil and the essential oils don' t easily mix.

Shake it up prior to using . use it as an after sun treatment with selected essential oils added . for a little more emollient action add a few drops of jojoba or rose hip oil.

Internally it is taken to heal and help the function of the gastrointestinal tract and duodenal ulcera . External uses include wounds, burns , softening, uv protection, regeneration, regeneration and moisturizing. You can drink it with water or juice. Do not care for the taste, about the taste, about the only way to have it taste good is when mixed with spicy tomato or other juices .

Aloe vera Gel profile

- Botanical name – barbadensis miller .
- Extraction – Ground fillet of inner leaf / cold pressed
- Shelf life 12- 14 moths .

Because of the delicate nature of Aloe vera gel. Refrigeration is recommended to prolong shelf life . A good gel is created by hand removing the inner fillet of whole Aloe vera leaves, and then subsequently sending into a cold pressed production facility. It is a naturally ground product and may contain small pieces of pulp within the gel . suitable for food, cosmetic and beverage use. Also add natural preservatives like sodium benzoate, potassium sorbate, and citric Acid .

Specifications	Microbial	Preservatives
• olor – pale / translucent	• erobic plate Count - < 10 CFU / G	• odium benzoate -0.10 %
• dor – Mild / characteristic	• old - < 10 CFU / C	• otassium Sorbate – 0.10 %
• esticide residues – should test negative	• east Model < 10 CFU / G	• itric Acid -0.12 %
• H – 3.9		

- athogens – Absent

Aloe in Aruba : Between 1840 and 1850 the aloe vera plant has been brought to aruba and is since then cultivated in Aruba on a large scale .

Aruba had the ideal climate for the aloe plant and very soon thousands of acres of Aloe were grown and many Aruban families lived from the harvest of the Aloe vera, in those days only for the export of the raw material for laxatives .

In the literature on aloe the quality of the aruba Aloes were undisputedly superior to other aloes and this was also the reason that at the beginning of our century Aruba became the largest exporter of Aloe vera products in the world and soon earned the name " island of Aloe " .

In the code of arme of aruba an aloe plant is shown and the official name for the the laxative raw material is " Curacao Aloes " , named after the harbor from where the aruba aloes were shipped all over the world (Curacao itself had virtually on aloe production).

At the end of the fifties, new, synthetic laxatives replaced the aloes worldwide and other industries (oilrefining and tourism) replaced the Aloe industry in Aruba . the aloe fields, however, remained, and still aruba was the " island of aloe " and the aloe plant stayed in the code of arme of Aruba. Aruba had set the record to be able to be the largest supplier in the world, of the best aloe in the world .

When the parenchyma (the mucilaginous material in the leaves) of the leaves is removed, this so called " gel – filet " is grinned and the fibers are removed .

An opalescent liquid remains that is commonly called " Alove vera Gel " and after preservation this is the liquid that is used in skin preparations and health drinks.

Aloe vera Gel consists for 99.3 % water. The remaining 0.7 % are the solids that consist for a large part of polysaccharides of the glucose and mannose type. Together with the enzymes and amino – acids in the gel they give the gel the special properties as a skin care product.

The get stimulates cell growth and as such enhances the restoration of damaged skin . it moisturizes the skin because it has a water holding capacity. This moist on the skin also has a cooling effect. As a drink it protects the mucous membrane of the stomach especially when irritated or damaged .

The chemistry Of Aloe vera

Everybody has at least heard of Aloe vera, the plant that supplies a skin care ingredient that has very good moisturizing, softening and cooling properties.

With sunburns and minor kithen burns it will bring relief and speeds up the recuperation of the skin .

Especially in aruba where this plant is now known to, and used by the local population for more than 130 years it has become a part of the culture and even an Aloe plant appears in the coat of arms of aruba. The ingredient that is used for cosmetics is a gel that can be abtained from the thick leaves of the plant.

Inside the leaves (the parenchyma) is a transparent structure that contains this Gel and this is the material that is used widely in cosmetic preparations as a powerful moisturizer .

Besides water (99%) the main other ingredients are a combination of so called polysaccharides. Many natural sugar – like molecules that together form very long and large molecules . it is these molecules that give Aloe Vera Gel its gelatinous aspect .

These molecules can hold watr molecules together and that is one of the reaons that Aole vera is such a good moisturizer. Also these molecules are very nutritious , for instance, for microorganisms. Together with the water holding properties of the polysaccharides this forms an ideal environment for bacterial contamination. This is the reason that freshly prepared aloe vera gel can spoil within a few hours at room temperature. While in the intact leaf of the plant it will remain sterile. Aloe Vera producers always have a hard time preserving the aloe Vera gel without losing its properties.

Apart from the polysaccharides the aloe Vera gel contains enzymes and minerals and some vitamins. The activity of the enzymes is often used as a measure of the effectivenss of the gel. Not always is this an accurate way of measuring because not the enzymes account for the activity of the gel as a skin care product. Apart from skin care the aloe vera gel is also used in health drinks.

The gelatinous structure of the gel can form a good protection for the wall of the stomach against stomach acid especially when the stomach wall is irritated or damaged. Many people in Aruba know well how to make a fresh adink from the aloe Vera gel .

When the Aloe Vera is harvested from aloe fileds that are irrigated artificially the gel contains more water and less solids and as such is less effective . the plant that grows in a dry climate produces a more concentrated and more effective Aloe vera Gel like in Aruba.

The semi – tropical plant, Aloe Vera, has a long and illustrious history dating from biblical times. It has been mentioned throughout recorded history and given a high ranking as all – purpose herbal plant.

Aloe' s thick, tapered, spiny leaves grow from a short a short stalk near near ground level .

It is not a cactus, but a members of the lily family, known as aloe barbadensis. Aloe is related to other members of the lily family such as the onion, garlic and turnip families. Aloe' s relationship to the lily family is evident from the tubular yellow flowers produced annually in the spring that resemble those of the Easter lily .

There are over 250 species of aloe grown around the world . However , only two species are grown today commercially, with Aloe barbadensis Miller

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And Aloe aborescens Being the most popular . the Aloe plant is grown in warm tropical areas and cannot survive freezing temperatures.

In the united states, most of the aloe is grown in the Rio Grande valley of south texas, Florida and southern California. Internationally, Aloe can be found in Mexico, the paoific Rim countries, india, south America, Central America, the Caribbean, Australia and Africa .

The leaves of the Aloe plant grow from the base in the rosette pattern. Mature plants can grow as tall as 2 and a half inches to 4 feet with the average being around 28 to 36 inches in length . Each plant usually has 12-16 leaves that, when mature, may weigh up to three pounds. The plants can be harvested every 6 to 8 weeks by removing 3 to 4 leaves per plant .

The original commercial use of the Aloe plant was in the production of a latex substance called aloin, a yellow sap used foe many years as a laxative ingredient. This product became synonymous with the name " Aloe " and recorded in the trade, technical and government literature during the early 20 th century . this terminology created much confusion later when Aloe's other main ingredient, Aloe Gel, a cleat colorless semi – solid gel was stabilized and marketed. This Aloe vera Gel, beginning in the 50 ' s has gained respect as a commodity used as a base for nutritional drinks, as a moisturizer, and a healing agent in cosmetics and OTC drugs. Chemical analysis has revealed that this clear gel contains amino acids, minerals, vitamins, enzymes, proteins, polysaccharides and biological stimulators.

Public interest in Aloe has grown quickly, and now there is a considerable amount of research into the various components of Aloe to find out more amount of research into the various components of Aloe to find out more about their properties and to characterize these components so that more specific research can provide clues to the " magic " that is attributed to Aloe Vera this " nagic " concept brought the industry under the federal food and Drug Administration microscope in the late 70 S and early 80' s . the claims made to the consumer about uses and effectiveness of Aloe were exaggerated.

Aloe vera Gel, like most natural juices, both fruit and vegetable , is an unstable product when extracted and is subject to discoloration and spoilage from contamination by microorganisms. The great success of Aloe as a commodity for use in nutritional foods and cosmetics is due to the proper stabilizing procedures that enable processors to store and ship the Aloe Gel without fear of spoilage throughout the market places of the world. Research conducted around the world leaves little doubt that certain biochemical properties of Aloe will be proven facts. Such attributes as moisturizing and penetrating properties are known, but the attributes such as its healing abilities and analgesic action to bacterial activity has not been clearly defined and documented through properly controlled scientific research and testing .

Today, the Aloe industry has establish high ethical standards for businesses and their Aloe products. Through the international aloe science council, the industry has solidified its dedication to providing the world with the highest quality aloe. The wide acceptance of Aloe by society in so many consumer products suggests that the IASC is moving in the proper direction. The image of Aloe has never been higher . the IASC has a dedicated group of professionals committed to the futher growth, research and marketing of quality Aloe Vera gel and Aloe products made from this Gel . this is because the IASC knows the future of Aloe is full of promise for those willing to make the necessary effort .

What is it ? A succulent perennial plant belonging to the lily family, aloe Vera grows wild in Madagascar and large portions of the african continent .

Because of its many therapeutic uses, it is now commercially cultivated in the united states, japan, and countries in the Caribbean and Mediterranean .

Many individuals also grow aloe as a houseplant.

The aloe plane is best known for its healing aloe Vera gel, a thin clear, jellylike substance that can be squeezed or scraped from the inner part of the fleshy leaf. A soothing juice also made from this gel.

Another substance from the same plant, aloe Vera latex, is taken from specialized cells along the inner leaf skin (called the pericyclic tubules). The latex is extracted as a liquid, then dried into a yellow powder. Because it’s such a potent laxative, the latex is not usually used alone but combined with gentler herbs, such as cascara sagrada. Germany’ s commission E apperoves of using small amounts of aloe Vera latex to relieve constipation, but only for short – term use .

Health benefits : for centuries, the gel of the aloe Vera plant has been sued as a soothing topical remedy for minor burns and wounds . it continues to be popular for treating sunburns and other first – degree burns because it appears to speed healing.

In addition, aloe Vera gel is used to treat minor surface irritations, to reduce psoriasis symptoms, to lessen the painful effects of shingles, and to shrink warts. It even has a reputation as a beauty aid.

Various research studies are underway to explore the potential of aloe Vera components to boost immunity and combat the HIV virus, and to treat certain types of cancer (particularly leukemia) . it may even have a role to play in managing diabetes. Specifically , aloe Vera may help to :

Speed healing first – degree burns, including sunburns. The gel is excellent for easing first – degree burns (including sunburns) and certain minor second – degree burns. If applied after the burn has cooled, it will relieve pain and inflammation and accelerate healing . in one study of 27 people with moderately severe burns, those who used aloe Vera healed in about 12 days on average, whereas the control group, who covered the affected areas with a regular gauze dressing, took 18 days to heal.

Soothe and hasten healing of cuts, scrapes, and other minor wounds and skin irritations . the gel contains a number of active ingredients, including substances known to help relieve pain, reduce swelling, quell itching, and increase blood flow to an injured area.

Some research even indicates that the gel has antifungal, antibacterial, and antiviral properties.

Conversely, aloe Vera gel may not help treat deeper, infected wounds, or those incurred during surgery. In one study at a los Angeles hospital , 21 women were given ether aloe Vera gel or a placebo for wounds resulting from a caesarean section or surgery to the abdominal wall. When the gel was used, it took 83 days for the wounds to heal; when the placebo was applied, it took 53 days. (Both group also received standard anti – infective treatments).

- **Lessen painful effects of shingles .** Applied gently to the painful lesions that characterize this condition, aloe Vera gel acts promptly to soothe these sores and provide relief from itching. It also works to decrease the chances that the blisters will become infected.
- **Reduce symptoms of psoriasis .** the ability of aloe Vera gel to promote healing and quell itching and pain may offer some relief to those who suffer from this troubling condition. In a recent study of 60 people with chronic psoriasis, 83 % of those who applied aloe to lesions three times a day for eight moths experienced substantial improvement . only 6 % of those using a placebo benefited from its effects .
- **Ease heartburn, ulcers, diverticular disorders, and other types of digestive upset.** A juice made from the aloe gel acts as an anti-inflammatory and can be taken internally as a remedy for certain digestive heartburn and ulcers.

  While there is very little substantive evidence to support these internal uses, preliminary research has shown premising results. In one Japanese study, 17 of 18 patients who took aloe Vera juice found some relief for their peptic ulcers . However, none of the participants was given a placebo, so comparisons of its effectiveness could not be made.

  Other reduce the secretion of stomach juices and the formation of lesions .

  Forms :

- Spray
- Lotion
- Liquid
- Gel cream
- Capsule

Dosage information

Special tips :

As a general rule, keep in mind that products that include " aloe vera extract " or " reconstituted aloe Vera " may be much less potent than pure (more than 98 %) aloe Vera . put another way, be sure to look at the label on commercial aloe product to see if aloe if aloe Vera is one of the first few ingredients listed.

- For sunburn preparations, confirm that the product contains at least 20 % aloe era .
- Aloe Vera latex is available I capsule from, usually in combination with other (and more gentle) laxatives.

For burns, cuts, scrapes, shingles, and other skin problems: Apply aloe gel to affected area two or three times a day . for sunburns, you can also add 1 or 2 cups of aloe Vera juice to tub of lukewarm water and soak.

For heartburn : Drink 2 ounces of juice four times a day .

For a day for one month . if you are also taking psyllium for a diverticular disorder . allow at least two hours to elapse before having aloe Vera juice .

For waters : Dab a small amount of fresh or prepared aloe Vera gel on a compress made of cotton gauze or flannel, and place over the wart . change in three to four days.

Be sure to check out our **Dosage Recommendations Chart for Aloe Vera,** which lists therapeutic dosages for specific ailments at a glance .

Guidelines for use .

- The most effective and economical source of the gel is an aloe Vera plant, which is easy to grow, even on a sunny city window sill. Cut off one of its plumper leaves and wash it off with soap water . then slit the leaf lengthwise, and squeeze out the cleat gel from the center .

Apply and gently spread the gel on to the painful area and let it dry ;

Repeat the application as needed .

- Use common sense when treating a wound ; before applying aole Vera gel, first clean the area thoroughly .
- When buying aloe Vera juice, check to make to make sure that the one you select is derived from aloe Vera gel, not from aloe latex . Also make sure the juice product contains a minimum of 98 %

aloe Vera and that it does not have any a loin or aloe – emoin compounds, the key substances in aloe latex .

- Be sure to drink aloe Vera juice between meals .
- When shopping for aloe Vera juice, look for the " IASC – certified " sela;

It is allowed only on products that contain certified raw ingredients that have been processed according to standards set by the international Aloe science council, a voluntary certification organization .

- Creams and ointments should contain at least 20 % aloe General interaction .
- Be aware that the long – term use of any laxative, including aloe vera latex, can cause you to lose an excessive amount of the mineral potassium. The low blood levels of potassium can be further worsened if you are also taking a potassium – draining diuretic (water – pill) like hydrochorothiazide or furosemide.
- Dangerous heart rhythm abnormalities can develop if you take a digitalis heart medication (like digoxin or lanoxin) along with a potassium – losing diuretic and the aloe Vera latex . Consult your doctor for guidance.
- If you are on oral corticosteroids, such as beclomethasone, mwthylprednisolone, or prednisone , it is important not to overuse or misuse aloe Vera juice . A potassium deficiency can develop, and you may experience toxic effects from the medication .
- If you are on the oral corticosteroid fludrocortisones (Florinef), it is important not to overuse or misuse aloe Vera latex . A potassium deficiency can develop, and you may experience toxic effects form the medication .

Possible side Effects

- As a topical treatment, aloe Vera is quite safe. Occasionally, some people develop a mild allergic reaction marked by itching or a rash. If this occurs, discontinue use .
- Due to improper processing, aloe Vera juice sometimes contains small quantities of the laxative compound in aloe latex . Should you begin to have cramps, diarrhea, or loose stools, do not ingest any more of the juice and replace it with a new supply .

Cautions

- Don't take an aloe Vera latex laxative if you are pregnant or breast – feeding ; it may trigger uterine contractions . Also avoid using it during a menstrual period .
- Children and the elderly should not consume an aloe vera latex laxative internally . in addition, laxatives of any kind should never be used by anyone with an intestinal obstruction, an acutely

inflammatory intestinal disease (such as Crohn’s) disease or ulcerative colitis), appendicitis, or abdominal pain of unknown cause.

Ailments	Dosage
Burns	Apply gel to affected areas of skin as needed
Cuts and scrapes	Apply cream or gel liberally to wound 2 or 3
Heartburn	2 oz. juice 4 times a day
Insect Bites and stings	Apply 4 times a day to bitten area for symptom
Shingles	Apply liberal amount of gel to blistered skin as needed
Sports injuries	Apply gel to affected areas 3 or 4 times a day as needed
Sunburn	Apply gel to affected areas as needed
Ulcers	½ cup juice twice a day for one month
Warts	Put a pea – sized amount of gel on a compress Apply as usual

Aloe Vera (intestinal, skin) is native to Africa but is grown today in the west indies and the American Southwest. Aloe is a member of the lily family, although it resembles cautious . it’s been used since ancient times, but only recently has it enjoyed a rediscovery and subsequent popularity explosion.

Due to increased demand, many companies manufacture aloe Vera. Unfortunately, many of these products lose much of the plant’s original benefits by over processing. Some claim to have removed the disagreeable taste of the plant’ s juice, for example. But in doing so , they end up with a product that is only 10- 15 percent aloe Vera, at beat . nature’ s sunshine’ s aloe vera is processed in a special way to avoid the loss of essential vitamins, minerals and other active constituents.

The leaf is filleted ; thes the green outer portion that contains aloin is removed, leaving the gel that remains in the leaf . the gel remains thick when the leaf is first cut, but after a few minutes, an enzymatic reaction causes it to become liquid and freely run out. It is this 100 percent pure liquid that Nature’ s sunshine collects. Because bacteria can thrive on this raw liquid, ascorbic acid (vitamin C) and sodium benzoate are added as preservatives.

Sodium benzoate is effective in very low quantities, and is therefore perhaps the best and safest method for preserving aloe vera juice.

Aloe Vera is a nutritional storehouse, containing vitamins B1, B2, B6, C, niacinamide, choline and 18 amino acids, in addition to many other nutritional substances, Aloe vera juice is an ingredient in many commercial topical also be taken internally with juice or water as an addition to the diet . for external use, Nature’ s sunshine’ s aloe vera gel is the item of choice.

The Aloe Vera gel is created by adding a gelling agent, lrish moss extract, to the juice. Aloe vera gel spreads on quickly and penetrates deeply, leaving no stickiness. It comes in a handy flip – top container . if you enjoy the benefits of regular aloe Vera juice, imagine the value of being able to get the whole leaf !

Whole leaf aloe Vera provides a higher level of mucopolysaccharides than regular filleted aloe vera . Only the intense cleansing components have been removed, leaving a high level of mucoplysaccharides (7,00 mg per liter).

Used externally, it is known for its hydrating and moisturizing properties.

Shake well dietary supplement, drink 2-6 oz . Aloe Vera juice daily as is or mixed with water or juice ; drink 1 oz . whole leaf Aloe Vera juice mixed with 8 oz Aloe Vera juice daily as is or mixed with water or juice, drink 1 oz . whole leaf Aloe Vera juice mixed with 8 oz . water 4-6 times daily .

Commercial product specification

Product Description : A single 1 oz . serving daily delivers the full 1,500 milligram dosage of glucosamine shown in clinical tests to help lubricate nourish cartilage, increase the range of motion and flexibility and help maintain joint comfort. This unique liquid delivery system is easy – to – swallow and easy on your stomach because it' s made with naturally soothing aloe Vera . the aloe Vera harvested for use in Naturade joint formula is organically grown in accordance with the california Organic Foods Act Of 1990 .

Warnings: Keep out of the reach of children .

Warnings: keep out of the reach of children .

Ingredients : Other ingredients : Aloe Vera Gel from

Concentrate, fructose, citric Acid, Natural lemon – lime Flavor, sodium Benzoate, potassium sorbate.

Becommended Use : As a dietary supplement, drink 1 capuful of Naturade joint formula daily . you can also add this refreshing lemon – lime drink to water or your favorite juice. In order to obtain maximum benefit, it is important to take this product regularly for four to six weeks. Individual results may vary .

Herbal Aloe force aloe Vera juice and Gel is bio – protected, meaning that it is never heated at any time from field to bottle and has never experienced temperatures above 90 degrees.

Herbal aloe force aloe Vera juice and gel contain no laxative properties because the aloin are carefully removed from the plant to one part per million or less by a unique, proprietary process which does not damage the healing constituents of aloe vera. Because Herbal Aloe force uses the whole leaf, the juice and gel contain maximum potency while the natural proportions of the aloe vera are maintained. No water is added or removed . At the same time the nutrients of the aloe vera are maximized by organically growing the aloe.

Herbal force Aloe Vera juice 32 oz : Although the use of aloe vera gel on the skin is well – known to relieve burns and sunburn, little attention has been given to the amazing effects of drinking properly prepared aloe Vera juice . in fact aloe vera has an amazing number of healthful effects when in ingested orally.

Aloe Vera juice restores and maintains :

1. Balance of stomach acids : Aloe has been shown to promote and maintain the proper balance of stomach acids promoting complete digestion.
2. Healthy tissue linings : tissue regeneration properties of aloe actually rebuild tissue of the stomach , small, large intestine and colon tissue Research has shown that aloe stimulates the fibroblasts to produce new tissue. Fibrobalsts, when stimulated, produce collagen , proteoglycans and other co – factors to make new tissue . in addition, aloe' s anti – flammatory and analgesic also aid in soothing irritated tissues and promoting healthy tissue linings and repair .

In addition , aloe polysaccharides have many properties that enhance the gastrointestinal system . these polysaccharides improve the activity of immune cells which means the immune cells are better able to kill bacteria and viruses, cleanse and eliminate waste and toxic up, among other activities .

And, finally, aloe contributes to the nutritional absorption and penetration.

Aloe improves digestive functioning and tissues of the gastrointestinal system, which in turn improves absorption of nutrients in general.

Drink up to 4 oz. of aloe vera juice, two to five times a day as needed . it is recommended to begin at smaller doses.

Ingredients : Aole vere, Cat' s Claw Extract' Astragalus Root Extract, Sheep Sorrel Extract, pau d' Arco Bark Extract, Slippery Elm Bark Extract, Rhubarb Root Extract, Sodium Benzoate (0.1 %), and natural fruit Extract.

Pure Aloe Vera juice 32 oz . A recent study presented at the 2002 international Aloe science council conference showed that effectiveness of vitamins increased 3 fold when taken with aloe . the study was done with both vitamin C (water soluble) and vitamin E (fat soluble) . taken with aloe, each vitamin was found to be 3 times more present and to last longer in the blood stream than when taken with water .

Aloe supports the healthy functioning of the kidneys, liver, colon and skin system and supports healthy elimination of toxins .

Aloe has been up mucous and waste, cells pushing out more toxins and supporting the proper elimination of these wastes through the blood, kidneys, liver, colon and skin systems as well as establishing healthy digestive processes and tissues . the enhanced removal of toxins and supporting the reiuvenation of healthy and balanced digestive and elimination processes helps to reduce sensitivities and allergicreactions.

Mix with fruit juice for a super antioxidant drink!

Herbal force Aloe Vera Gel 4 oz : Use aloe Vera on the skin to relieve burns and to keep skin looking clean, smooth, toned, hydrated and glowing with health .

Ingredients: Aloe vera with cat' s claw herb, " essiac " Herbs (Sheep Sorrel, burdock Root, slippery Elm bark Extract, Rhubarb Root Extract), Chamomile, Astragalus, Hawthorne berry, pau d' Arco, Green tea, ionized Colliodal silver, silver, Hyaluronic Acid Glycereth – 26 sodium benzoate and carbomer .

Compared to natural castor oil. These properties are induced by bubbling air thorough it at elevated temperatures. Its main use is as a plasticizer for inks, lacquers and adhesives.

Hydrogenated castor oil hydrogenated castor oil (HCO) or castor wax is a hard, brittle wax that is insoluble. It is produced by adding hydrogen in the presence of a nickel catalyst. It is mainly used for coatings and greases where resistance to moisture, oils and other petrochemical products is required.

Applications

There are many uses for castor oil and its derivatives. Some of these include :

- Plastics
- Textiles and varnishes
- Paints and varnishes
- Cosmetics and hair oils
- Inks
- Adhesives
- Synthetic resins
- Fibres
- Drying oils
- Plasticisers
- Fungistatic (fungus – growth – inhibiting) compounds
- Embalming fluid
- Soaps

- Lubricants, greases and hydraulic fluids
- Dyeing aids

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- The biodiesel section @ oilgae Energy portal .
- Get the latest news on oil and biodiesel from algae at the oilgae blog (oilgae home) .

Did you know ? Even the humble algae could be used to make biodiesel

A variety of biolipids (Biolipds are lipids from biological sources. Lipids are a class of organic compounds essential for the structure and function of living cells, fats are a subset of lipids, belonging to a subcategory of lipids called triglycerides) can be used to produce biodiesel . the main plants whose oils have been considered as feedstock for bio – fuel are are : soybean oil, rapeseed oil, palm oil, sunflower oil, safflower oil & jatropha oil. Others in the contention are mustard, hemp, castor oil, waste vegetable oil, and in some cases, even algae. There is ongoing research into finding more suitable crops and improving oil yield. (Biodiesel – A Brief Overview from ATTRA – provides a table of oil – bearing plants having potential for biodisel)

A complete list of oils that appear to have the potential for biodiesel is provided below in alphabetical order of the plant name).

See separate sections for each :

Algae Oil, Artichoke Oil, Canola Oil, Castor Oil, Coconut Oil , Corn, Cottonseed Oil, Flaxseed Oil, Hemp Oil, Jatropha Oil, jojoba Oil, Karanj Oil, Kukui Nut Oil, Milk Bush, pencil Bush Oil, Mustard Oil, Neem Oil, Olive Oil, palm Oil, peanut Oil, Radish Oil, Rapeseed Oil, Rice Bran Oil, Safflower Oil, Sesame Oil, Soybean Oil, sunflower Oil, Tung Oil, WVO, Waste Vegetable Oil

Algae as Bio – diesel

The production of algae to harvest oil for biodiesel has not been undertaken on a commercial scale, but working feasibility studies have been conducted to arrive at the above yield estimate . in addition to a high yield, this solution does not compete with agriculture for food, requiring meither farmland nor fresh water.

- Widescale biodiesel production from algae – university of north Hampshire .
- Algae – like a breath Mint for smokestachs – Christian science monitor .

- Biodiesel form Algae – from biodiesel Encyclopedia .

Artichoke & biodiesel

Artichoke has been only mainly as a forage crop for many years, but in recent years new applications have been discovered. The seeds of the artichoke plant can be used to obtain edible oil, while paper and pulp can be obtained form the stalks .

Artichoke oil is similar to the oils from sunflower and safflower in its composition . the approximate oil composition is as follows : 60 % linoleic, 25 % oleic, 12 % palmitic and 3 % stearic acid while experiments are still on for this crop, initial experiments and analysis appear to show that this crop has potential for producing biodiesel .

- Cynara Cardunculus as an Alternative Crop for Biodiesel production (MS Word Document).
- Feeding ourselves or Driving our cars- the tale of the humble Artichoke – from transition culture .

Canola Oil Bio – diesel

Canola is a cultivated variety of rapesee, and canola oilseeds are rich oil content (40 %).the interest in canola oil as feedstock for biodiesel appears to be gaining ground, A small group of farmers in Austraila have started producing biodiesel from canola oil for local use, and a company in North Dakota (USA) in investing significantly to produce biodiesel using canola oil.

- Biodiesel from canola oil – university of Ballarat, Austalia
- NDSU to test properties of Canola – based biodiesel
- Canola Biodiesel – from Canolalnfo . org
- Bioenergy Biodiesel from canola Oil (PDF)

Castor Oil as Bio – Diesel

Castor oil has quite a few characteristics that can make it a suitable candidate for biodiesel. One aspect that could queer the pitch for castor oil is its viscosity. Castor oil in its straight vegetable oil form is about 100 times as viscous as diesel fuel, and while trans – esterification does reduce the viscosity significantly, it is still being researched whether the final viscosity for castor oil biodiesel is within acceptable limits for use in diesel engines.

- Castor oil as Bio – diesel & Biofuel – from Castor Oil . in
- Energy In a Castor Bean – from Tierramerica

Coconut Oil as Biodiesel

Coconut has an oil content of about 70 %, and has a yield of about 2500 liters per hectare. The cetane number (60) and Iodine value (10) of coconut oil / copra oil are within acceptable limits for use in diesel engines. Its viscosity after trans – esterification is also in the acceptable range. It thus appears to be a good candidate for biodiesel .

Did you know ? coconut oil is one of the least viscous of plant oils

- Possibility of using coconut oil as fuel substitute for Diesel Engines (Microsoft ppt Format) .
- Coconut Methyl Ester as Coco Biodiesel
- Comparative life cycle Assessment of coconut Biofuel (PDF)
- Coconut Oil asa Biofuel in Pacific lslands – Challenges & Opportunities
- Biofuel Energy from the Coconut – Copra Biodiesel (PDF)

Corn Oil as Bio – Diesel

There is a significant interest, especially in the United states, to experiment with com oil as the feedstock for biodiesel . till a few years ago, com was not favoured as a feedstock because the extraction process was not suitable to produce a grade of oil that was suitable enough for producing biodiesel . However newer extraction processes have overcome this problem .

- Mean Green Biofuels converts Con oil into biodiesel – Oil & Gas online
- Cron Oil Extractor Hits Market – from Argus leader

Cottonseed oil as biodiesel

Cottonseed oil has energy per unit volume than diesel fuel. This means that more than one gallon of cotton seed oil will be required to replace one gallon of petro – diesel . the current production volumes are quite low (0.5 million t per annum in the us) when compared with even reasonable requirements of biodiesel.

- Economic circumstances of cottonseed oil as biodiesel (PDF)

Flax oil as biodiesel

- The oil from linseed / flax plant can also be considered for biodiesel . research is ongoing in this area .

Hemp Oil as Bio – diesel

- Hemp farm Bio – diesel information
- Pollution – petrol vs . Hemp – from hemp Car . org

Process Equipment	Biodlesel glycerin issuo?	Giycorino distillation	Sugar & ethanol brazil
Vegetable oil speciallst extraction and reflnement	Tum crude glycerin cost center into	Mobile and fixed vacuum	Refineries and land for sale buy ethanol plants

www.gaexpertise.com	profit center with membranes www.eetcorp.com	disbllers low foiling 20+ yrs experience www.recialm.com	in brazil ww.brazillanssets.com

Did you know ? jatopha oil is popular biodiesel candidate in parts of Asia

Jatrops Oil as Bio – diesel

Through jatropha is not as well – known a biodiesel feedstock as is palm oil or soy oil. In India and southeast Asia, the jatropha tree has been used as a significant fuel source for many years, though use of its oil for biodiesel is quite recent . in these regions, it is also planed for watershed protection and other environmental restoration efforts. Jatropha is a perennial, yielding oil seed for decades after planting . the tree can grow without irrigation in arid conditions where many other biodiesel candidates such as corn and sugar cane could never thrive . Another useful feature of jatropha is its oil yield – the yield is significantly higher than the yields of many other candidates.

- Biofuel for Electricity in Remote lao villages – from sunlabob (PDF)
- Jatropha, a Different Biofuel, from pratie place
- Oil from a wasteland – the jatropha project in india – from Daimler chryser .
- Bio – diesel from Wastelands – NABARD
- Case study for jatropha (PDF)
- Biodiesel from jatropha plantations on Eroded soils (PDF)
- Jatropha & Moringa – sources of Renewable Energy & fuel
- Jatropha Biodiesel . org

Jatropha in Africa – Enviro pundit

Combating Desertification – the jatropha project of Mali, west Africa

The bumpy Road to clean, Green fuel – scidey

The jatropha opportunity for India

Jojoba Oil as Biodiesel

While jojoba is a new entrant in the biodiesel stakes, it has an attraction – the jojoba plant can be grown in saline soils, and in desert lands. There are reports that some farmers in Egypt have started cultivating jojoba for the oil to be used as fuel . However, with current inputs and data, it appears that this plant is unlikely to make a significant impact on the overall biodiesel scenario, given the small amounts of cultivation .

- Jojoba fuel – from tree hugger

- Jojoba oil could fuel cars & trucks – new scientist
- Economics of jatropha biodiesel
- New fuel derived from jojoba oil could fuel cars (PDF)
- Jojoba oil a better fuel than Diesel

Karanj plant (pongamia pinnata) as biodiesel

Karanj, a plant native to India, appears to have good potential for biodiesel. Considered less exotic than jatropha, there is a good chance that its oil is cheaper as well . however, only recently has this plant come into the research arena for biodiesel, and more inputs are awaited.

- Why karanj is better than jatropha?
- Jatropha vs . karanj – biodiesel now
- Biodiesel project in india based on karanja

Kukui nut oil as biodiesel

While it is possible to have the oil from kukui nut tree as a biodiesel, it is unlikely that it is a serious candidate Since this is not a mainstream crop, and its high price will be a deterrent to its use as fuel

- **Student makes fuel from kukui nuts**

Milk bush / pencil bush (Euphorbia tirucalli) as biodiesel

The pencil bush shrub can grow in arid as well ass more mesophytic zones . A large shrub, Euphorbia tirucalli , is Used as a hedge in brazil. The ability of these plants to grow well in dry regions and on land that are not suitable for Growing food, and the fact that the oil yield from an acre could be comparable to or better than many other biodiesel Candidate (an estimate of oil yield for milk bush / pencil bush is between 10 and 50 barrels of oil per acre, ie, between 25 and 125barrels per hectare) .

- Euphorbia tirucalli from purdue university
- Bio – engineering of Crops for biofuel & Bio – energy (PDF)

Mustard Oil

Specially bred mustard varieties can produce reasonably high oil yields, and have the added benefit that the meal leftover after the oil has been Pressed out can act as an effective and biodegradable pesticide.

- Bio – diesel from yellow mustard oil – university of Idaho
- Mustard hybrids for low – cost biodiesel (PDF)
- Biodiesel Cost lssues – from Oregon Biofuels
- Industrial mustard Crops for biodiesel & Biopesticides (PDF)
- Experiments with biodiesel from yellow Mustard

Did you know? Palm oil is a prominent biodiesel feedstock in Malaysia

Neem it has not yet been produced in a commercial scale, neem oil is being considered for biodiesel, and more research is being done in this area.

- Biodiesel – fuel for future

Biodiesel from olive oil

It has been proven that Olive Oil can produce biodiesel, however, it is unlikely that this crop will be a sustainable candidate for biodiesel, given the opportunity costs of the use of its oil in other segments, and the cost. one interesting area has been the use of waste olive oil for biodiesel production .

- Simulating biodiesel production from Waste Olive Oil
- Chancellor College Biodiesel Research & Biodiesel production

Palm Oil as Bio – diesel

Malaysia and Indonesia are starting pilot – scale production fro palm Oil. Palm Oil so far proved to be efficient as biodiesel .

- Palm Oil Biodiesel form cogeneration . net
- Consultant says palm Oil Miodiesel has More potential – from new energy report
- Consultant says palm oil biodiesel has More potential – form new energy Report
- Malaysia to switch to palm oil bio – diesel – from Hoppy News
- Palm oil biodiesel has more potential for longevity ?

Did you know ? Rudolf Diesel ran his first IC engines on peanut oil

Peanut oil as biodiesel

History tells us that Rudolf Diesel ran his first diesel engine on peanut oil. Even later, during times of fuel shortages, cars and trucks were successfully run on preheated peanut oil. Currently however, peanut oil is used relatively less (when compared to sunflower oil, palm oil or soybean oil) for biodiesel production. One major reason could be the cost .

- **History of Biofuels – from Yokayo Biofuels**

Radish Oil as Bio – diesel

Wild radish can contain up to 48% oil and its is unsuitable for human consumption . this could hence make an interesting biodiesel candidate. Wild radish has adapted itself to be a very resilient weed and possesses a hardy nature with good drought tolerance . However, it is unlikely to become a mainstream biodiesel deedstock.

- Biodiesel – farming for the future

Did you know ? Rapeseed oil is a prominent biodiesel feedstock in Europe

Rapeseed oil as Bio – diesel

Rapeseed oil is one of the more prominent oils used for biodiesel preparation. In Europe, rapeseed is the most common base oil used in biodiesel production.

- Rapeseed Bio – diesel from Cogeneration . net
- The power of Rapeseed – from Deutsche Welle, Germany
- Rapeseed Methyl Ester – From BioMatNet
- Development of Rapeseed Bio – diesel for use in High – speed Diesel Engines – from biodiesel . org (PDF)
- Biodiesel Experiences in Yugoslavia – from Biodiesel . org (PDF)
- Biodiesel production potential from industrial Rapeseed (PDF)
- Economic Evaluation of Biodiesel production from Oilseed Rape (PDF)
- Blooming futures – Fuelling Vehicles with plant Oils New

Rice Bran Oil as Bio – diesel

Rice bran oil is a non – conventional, inexpensive and low – grade vegetable oil. Crude rice bran oil is also source of high value added by – products. Thus, if the by – products are derived from the crude rice bran oil and the resultant . oil is used as a feedstock for biodiesel, the resulting biodiesel could be quite economical and affordable.

- Fatty Acid Ethyl Esters from Rice Bran Oil (PDF)
- Acid Catalyzed trans – esterification of Rice Bran oil for Bio – diesel production (PDF)

Safflower oil as bio – diesel

Quite a number of entities in the united states are experimenting with safflower oil as biodiesel stock, and there is a opinion among some that safflower oil will make a better candidate than canola oil, which is a relatively more popular feedstock for biodiesel . However, the fact that it is a useful edible oil (as is canola oil) throws serious doubts about its potential for large scale biodiesel production .

- Safflower oil in your tank – from clean city news

Sesame oil as Bio – diesel

Soybean oil as Bio – diesel

Soybeans are not a very efficient crop solely for the production of biodiesel, but their common use in the united states for food products has led to soybean biodiesel becoming the primary source for biodiesel in that country. Soybean producers have lobbied to increase awareness of soybean biodiesel, expanding the market for their product.

- Fuelling Diesel Engines with blends of methyl ester soybean oil & Diesel fuel – university of Missouri (PDF)
- Soybean oil in jet fuels – from USDA
- Transesterification of soybean oil with zeolite & Metal Catalysts (PDF)
- Oxidative stability of Biodiesel from soybean Oil

Sunflower oil as Bio – diesel

Sunflower oil is being tested in quite a few places worldwide for its biodiesel capability. While the chemical properties of the oil lend themselves well for biodiesel manufacture, the high cost of sunflower oil casts doubts on whether it can ever be a significant feedstock for biodiesel production .

- Sunflower crop Feasibility for Bio – diesel production in splin – from EECI . net

Tung oil as biodiesel

Research on the use of tung oil for biodiesel is in its initial stages, and more research result and inputs are awaited.

- Details of fuels – Greenhouse . Australia (PDF)

Waste vegetable oil as biodiesel

- On – farm biodiesel production from waste vegetable oil (PDF)

Others

- Local & innovative Biodiesel – new feedstock blending recipes (PDF) (see also this (PDF))

Other References

Some interesting sites :

- Energy & oil Related Questions at Billion Dollar Questions:
- How long with oil last?
- What are the various options in alterative energy?
- Do bio – fuels have the potential to replace to petro – fuels?
- **Plant oils Database – provides resources and link for over 200 different plant oils and related plant extracts**
- BDPedia – the biodiesel www Encyclopedia
- **Reference on Energy & Alternative Energy – from** oilgae – oil from Algae – Energy industry breakthroughs,

Agriculture Directories .

- Crops
  - Cereals
    - Rice
    - Wheat

- Oil seeds
  - Soy
  - Plant oils
    - Castor oil
- Spices
  - Pepper
- Tea
- Coffee
- Cashew
- Guar Gum

BDPedia . com , the biodiesel www encyclopedia, provides links, provides directory and web links resurces for the biofuels biodiesel . it is intended to be useful for research and information as well as for buyers, sellers, manufacturese, traders, suppliers, producers, exporters and importers. It will make an effort to provide biofuel feedstock,plant oil feedstocks, vegetable oil info and link, details on oilseeds, bio – fuel , bio – diesel , bio – fuels, plant oils production and uses, and biofuels trade & market resources, data, statistics such as price, prices, demand – supply for buyer, seller, manufacturer, trader, supplier, exporter and producer .

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DeoDig – Get Local !

Have you checked out the GeoDig directories for over 30 countries? GeoDig provides useful local andregional web resources for over 200 cities around the worls. See the list of cities and countries for which GeoDig provides locality –specific web resources.

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Glycerin * purification

* the simplest trihydric alcohol, formula: C3H5(OH)3. The name glycerol is preferred for the chemical, but commercially the product is usually called glycerin, sometimes spelled glycerine, which are interchangeably used.

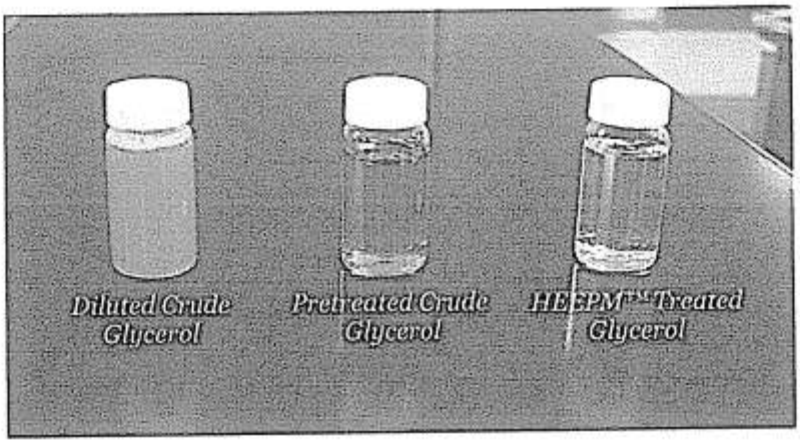
In the transesterification process, oils and / or fats rich in triglycerides are mixed with an alcohol sich as methanol and base such as potassium or hydroxide, resulting in a methyl ester biodiesel stream and a glycerine side stream. This gylcerine side stream typically contains a mixture of glycerine, methanol, water, inorganic salts (catalyst residue) free fatty Acids, unreacted mono – di , and triglycerides, methyl esters, and a variety of other matter organic non –glycerol (MONG) in varying quantities – the methanol is typically stripped from this stream and reused, leaving behind, after neutralization, what is known as crude glycerine. In raw form, this crude glycerine has high salt and free fatty acid content and substantial color (yellow to dark brown). Consequently, crude glycerine has feew direct uses due to the presence of the salts and other species, and its fuel value is also marginal. The US biodiesel industry generates millions of gallons of crude glycerin waste cach year, and the amount produced is growing rapidly along with the dramatic growth of biodiesel production.

One initial step common to all glycerol purification processes is that fat, soap and other organic impurities need to be chemically separated and removed by filtration and / or centrifugation, final purification is typically completed using vacuum distillation followed by activated carbon bleaching for large operations or ion cxchange followed by flash drying to remove water for smaller capacity plants. Vacuum distillation is very expensive in terms of capital cost and energy consumption, cannot always be carried out continuously and is accompanied by considerable losses of glycerol. In order to separate glycerol from higher boiling point impurities the mixture needs to be additionally subjected to severe thermal stresses that further result in additional losses of glycerol and creates more decomposition products. Because of the high salt content, ion exchange is not economically practical, unless it is used to polish a diluted low salt content glycerol – in water solution.

EET s patented and patents pending HEEPM^{TM} technology an economical solution for the purification of crude glycerine streams in the biodiesel production industry. HEEPM^{TM} synergistically combines patented and patents pending high efficiency electrodialysis (HEED) and nanofiltration to purify and recover glycerin. The recovered glycerine, after polishing with ion exchange (if necessary) and water / methanol removal by evaporation, can meet glycerine U.S. pharmacopeia (USP) standards .

HEEPM^{TM} technology avoids many of the issues associated with evaporation and distillation such as foaming, carryover of contaminants, limited recovery, and high capital costs. In addition, HEEPM^{TM} can be integrated easily into existing biodiesel production facilities, and it can be adapted for purification of glycerin of glycerine at a number of locations within the glycerine waste stream handling process . the robustness of the HEEPM^{TM} process allows it to be applied prior to or after methanol removal .

EETs glycerin purification process begins with pretreatment of the glycerine to remove any solids and fouling organics and partially remove color – causing organics . the HEEPM^{TM} system configuration is used, with customized automated controls and control logic, providing optimal desalting of the preatreated crude glycerin. The result is a colorless liquid with low salt content. The table below shows an example of a multi feedstock crude and HEEPM^{TM} purified glycerin compared to typical technical grade glycerin purity .



Parameter	Crude Glycerol	HEEPM™ Purified	Technical grade Glycerin Sample
Glycerin, wt %	65.8	50.6	87.1
High Boilers, area %	1.5	0.04	0.0
Mono – Glycerides, %	0.113	0.00	0.040
Chloride, ppm	45,000	1.0	3
Sulfate, ppm	16.500	2.5	3
Specific gravily	1.1315	1.1309	1.2260
Apha color	Na	2	13

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