

Head Office

- Jai Ganesh Vision, 'B' Wing, 3rd Floor,
Jai Ganesh Fame Building, Akurdi, Pune - 411035, India
Tel: +91-20-40710010
Telefax: +91-20-40710009
Email: sales@rajprocessequipment.com
Website: www.rajprocessequipment.com

Regional Offices

- Hyderabad
Cell.- +91-9550151122.
- C-24 Barcelona Business Hub,
Odhav Circle, S P Ring Road, Odhav, Ahmedabad- 382 415
Cell. - +91-7600022352
- Unit No. FF-47, 1st Floor, Omaxe Square,
Jasola District Centre, Behind Jasola Apolo Hospital,
New Delhi - 110 044; Tel. +91-11-40503519
- Second Floor, No: 6/9, Harikrishna colony,
Nandambakkam, Chennai-600 089.
Cell:+91-8220058290

Marketing Representative- International

- Bio-Tropic Industries Sdn. Bhd.
19 -1 A , 1st Floor , Block 6 , Jalan Pahat H / 15 H,
Seksyen 15 , 40200 Shah Alam,
Selangor Darul Ehsan , Malaysia
Tel.- +6 03 5523 2219 , Fax - +6 03 5523 9995
Contact Person - Mr. Ganesan , Cell.- +60355239995
E-mail - sales@bio-tropic.com, ganesan@bio-tropic.com
- PT. Keiso Process & Enviro Industries
JI-Tarum Barat II Blok Kav, Pl.No.30, Cikarang Baru,
Cikarang, Bekasi - Indonesia
Tel. - +62-21-29083225, +62-21-92755156
Contact Person - Mr. Irawan
- Mykhaylo Siyatskyy
Apt 3, Tsupov Block Bld 18, Lugansk, Ukraine-91002
Tel. - +380501435566
Email - michaelsiyatskyy@gmail.com
- OOO Castola Moscow,
Suhevskaya Street 19, Block 4
Tel - 8 (495) 787-95-32, 787-62-27, Cell. - 8 (903) 960-10-15
Contact Person - Mr. Nikolay Kurilovich
Email - cast2305@mail.ru
- FC GIDA VE MAKINA VE DIS TICARET ANONIM SIRKETI
Istanbul dunya ticaret merkezi,
B2 Blok, kat 6, No 227, Istanbul, Turkey
Tel. 0090 212 560 4625
- Simra Intl. Fze.
PO Box 46798, Dubai - UAE,
Contact Person - Mr. Saleem Shaikh
Cell. - +971 50 5586727
Email - simra_intl_fze@yahoo.com

Manufacturing

- Unit-I, Plot No. 166 & 167, Sector No. 7,
PCNTDA Bhosari, Pune - 411 026 (India)
Tel. - +91-20-27119973, 27124145
- Unit-II, Sr. No. 373, Village Kharabwadi,
Chakan, Tal. Khed, Dist. Pune (India)
Tel. - +91-2135-252251, 255654
- Unit-III, Plot No. I-14, SEZ,
Village - Nimgaon, Tal. - Khed, Dist Pune - 410505 (India)
- Unit - IV Gat No. 530, A/p Ahire,
Tal - Khandala, Dist - Satara - 412802
Tel. - 020-40710010

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RAJ PROCESS EQUIPMENTS AND SYSTEMS PVT. LTD.



T urnkey 



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- Distillery Plant
- Detergent Powder Plant
- Starch & Glucose Plant
- MCCP Plant
- Guar Gum Plant
- Zero Liquid Discharge Plants
- Nutraceutical Powder Plant
- Milk Powder Plant
- Herbal Extraction Plant
- Thermal Desorption Unit
- Fruit Processing & Concentration Plant
- Tomato ketchup, sauce, puree and powder plant
- Coconut Milk Powder Plant
- Food Flavors Fragrances Plant
- Spirulina Algae Powder Plant
- Sulphur WDG Powder Plant
- Enzyme Powder Plant
- Active Dry Yeast Manufacturing Plant
- Instant Coffee Plant
- Salt Processing Plant

Distillery Plant

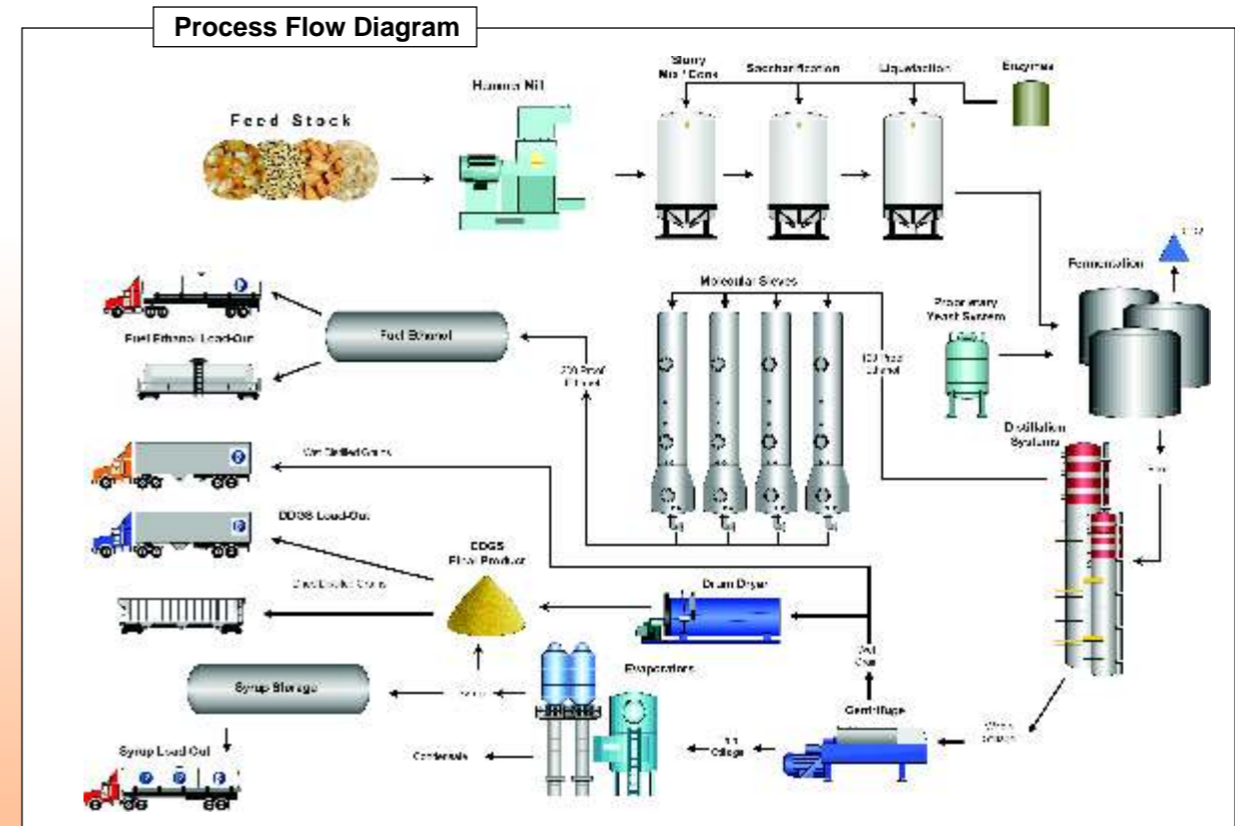
Production & consumption of alcohol is an age old practice. But with time, the usage areas as well as production techniques have gone through a major transformation. Apart from potable purposes, alcohol today finds application in a varied mix of industrial areas.

And with state-of-the-art technology, we now have techniques & systems that bring out much higher quality of the product while effectively lowering production costs.

The process of distillation is one with slow dynamics and is accompanied by side streams, making it essential to have a carefully planned and designed control system.

Processes

- Fermentation processes for cane molasses, juice and grain.
- Distillation processes integrated distillation plant operating at Atmospheric, Vacuum, Multipressure for fuel alcohol, Potable alcohol, Industrial alcohol



- Superior fuel Ethanol Plant.
- Evaporator and Dryer for distillery effluents.

Fermentation

Our Fermentation system design based on crucial parameters which helps to reduce loses of alcohol in fermentors and increase the yeild of alcohol by controlling the unwanted byproducts.

- Fermentation systems for alcohol production are designed to handle a verity of feed stock.
- Sugarcane juice streams (primary, secondary, mixed, syrup, filtrate etc.)
- Cane Molasses
- Grains, (Wheat, Rice, Corn, Millet, Sorghum, Rye, Bajra etc.)



Features :

- High Fermentation efficiency
- Minimal wastewater generation
- Yeast separation and recycle under gravity, eliminating need for expensive yeast separators.
- Flexibility to operate continuous as well as synchronised mode of operations, depending on characteristics of feed stock.
- Rugged operation
- Provision to tap high purity CO2

Distillation Process

We offer separation technologies with higher efficient multiple distillation column systems, Which operate at lower energy consumption and higher yield.



Features

- Multi product distillation systems.
- Low energy consumption.
- State of art in plant automation.
- Consistency in product quality.
- Minimum shutdown.

Features of Evaporation Systems

- Enhance water and waste minimization.
- Operated under vacuum or pressure.
- Fully automated systems to ensure consistent product quality.
- Process fluids with higher viscosities and also be handled effectively.
- No loss in production time.
- Comparatively less maintenance and operating cost.



Features of Drying Systems

- Low temperature drying which maintain quality of product.
- Fully automatic systems to ensure smooth and ease of operation.
- Due to radiation and conduction effects, the moisture get evaporated and product becomes progressively dry as it travels across the dryer and reaches the final moisture level at discharge point.
- Handles granular, free flowing solids.
- Uniform drying and cooling action with higher evaporation rates.
- Continuous operation with compact installations.

Services

- Turnkey Plants
- Manufacture & supply of Equipments
- Engineering and Supervision of Civil, Structural
- Process and detailed Engineering.
- Project Management
- Commissioning and Training
- After sales support



Detergent Powder Plant

Synthetic detergents, which are also known as syndets, were developed to overcome the difficulties faced while using soap as a cleaning agent. Soaps when used in hard water precipitate the calcium and magnesium salts, due to which it's effectiveness as a cleaning agent deteriorates.

In addition, edible oil & fats, which could be put to other uses, are used as raw materials for the manufacture of soaps. These problems are circumvented in synthetic detergents that are highly stable in hard water and do not consume valuable and expensive oil for their manufacture.

Detergent Slurry Formulation



Detergent powder falls into four major groups:

- Heavy duty detergents (high and low foaming)
- Light duty detergents
- Soap powders
- Soda products.

Detergent formulations essentially consists of:

- Active ingredients

- STPP
- Filler (e.g. Sodium sulphate)
- Silicate

Normally active ingredients used for detergents are linear alkyl benzyl sulphonates.

Detergent Spray Drying

Free flowing, non dusty, non caking detergent products in bead form are produced by Spray Drying mostly in counter current flow using pressure nozzle atomization.

Inlet temperatures vary according to product and upto 400°C inlet temperatures are used for some detergents. Hot air from direct fired



air heaters is used for Spray Drying. Exhaust high efficiency cyclones / bag houses are used to control emissions and maximize product recovery are part of the spray drying plant. RAJ offers stand alone spray drying plants on turnkey basis.

Pneumatic Conveying, Perfuming & Packing

The dried detergent powder is pneumatically conveyed from the Spray Dryer to the product silos after sieving. Here filtered

atmospheric air is used as the cooling & conveying media. Dense phase conveying systems are normally preferred.

The detergent product from the silo is then blended along with the perfume in a continuous mixer after which it is packed.

Applications

■ **Washing Powders**

(Detergents, Soaps, Surface Active Agents)
The free-flowing, non-dusty, non-caking products in bead form are produced in counter-current flow dryers with nozzle atomization is the preferred layout for high-bulk-density detergents. Feeds are homogenized and fine-filtered prior to passing through nozzles operating at high pressure. Hot air from direct-fired air heaters enters at the base of the cylindrical part of the tower with slight rotary motion. The exhaust air is drawn from the top of the tower. Inlet temperatures vary according to product. Up to 400°C (750°F) is used for some detergents, but lower temperatures are used for fine washing agents. Product recovery from the drying tower is high (99%). The fines fraction is usually returned to feed preparation. Open - cycle dryers are normally used, Co-current dryers are used for low - bulk - density detergents.

■ **Soda Products**

Detergent formulations basically consist of (a) an active ingredient (b) sodium tripolyphosphate, (c) silicates, (d) sodium sulphate. Normally the active ingredients are fatty alcohol sulphates, primary and secondary alkyl sulphonates and alkyl aryl sulphonates. Synthetic detergents are currently based upon linear alkyl benzene sulphonates. Formulations are with variations as decided by each company.

■ **Heavy - Duty Detergents**

Synthetic detergents are widely used in cleaning of all types and operate successfully with hard water. The coarse

powder granules in bead form are free-flowing, non-dusty and readily dissolve in water. Shelf-life is excellent, with no tendency to instability or lumping. The feed can be formulated batchwise or continuously. RAJ slurry preparation systems ensures the right preparation technique which improves the quality of the final dried detergent powder. Precise weighing / metering, mixing, homogenizing and de-aeration take place before spray drying. As high a solid content as possible is used (50 - 65%) to give the optimum powder bulk density and best economic use of the spray dryer.

The product is dried in a counter-current-flow drying tower at inlet temperature 350 - 400°C (660 - 750°F). The dried powder leaves the base of the drying tower and is transported via a conveyor belt to an air lift. During passage on the belt, product dosing is carried out. Dosing materials can be products that would be damaged during spray drying, e.g. lauryl alcohol, enzymes. Bleach alongwith enzymes are also added at this stage. Perfume is added after the following air lift.

■ **Light Duty Detergents**

Light - duty detergents are used less than heavy duty. They find wide application only in dish washing and light household cleaning (janitorial). Light -duty detergents are produced in nozzle towers with either co-current or counter-current flow. Choice depends upon required bulk density. Inlet drying temperatures are also lower, 250 - 275°C (480 - 530°F).

■ **Detergent Allied Products**

RAJ also provides state of art powder technology for detergent allied products like Sodium Lauryl Sulphate (SLS), Alfa Olefin Sulphonate (AOS), Optical Brightening Agents (OBA), Linear Alkyl Benzyl Sulphonate (LABSA), Sodium Silicate, Sodium Tri-polyphosphate (STPP).

Starch & Glucose Plant

STARCH INTRODUCTION

Starch is a polymer of glucose found in most plants. Starch is produced from various raw materials like maize, Cassava/tapioca roots, potatoes, wheat, rice etc. The technology or the manufacturing process of starch differs according to the raw material used. Customized or specially developed starch is popularly known as Modified starch. This is superior quality starch applicable for varied industrial usages.

To facilitate these aspects of starch extraction or processing, we design & develop starch processing plants that meet varied requirements in starch & its derivative manufacturing units. Our advanced fabrication facilities, team of industry professionals & technical know-how enable us to meet client's specific requirement by developing custom design machinery. We also excel in establishing of complete plants for starch extraction & execute turnkey projects.

Usage of Starch

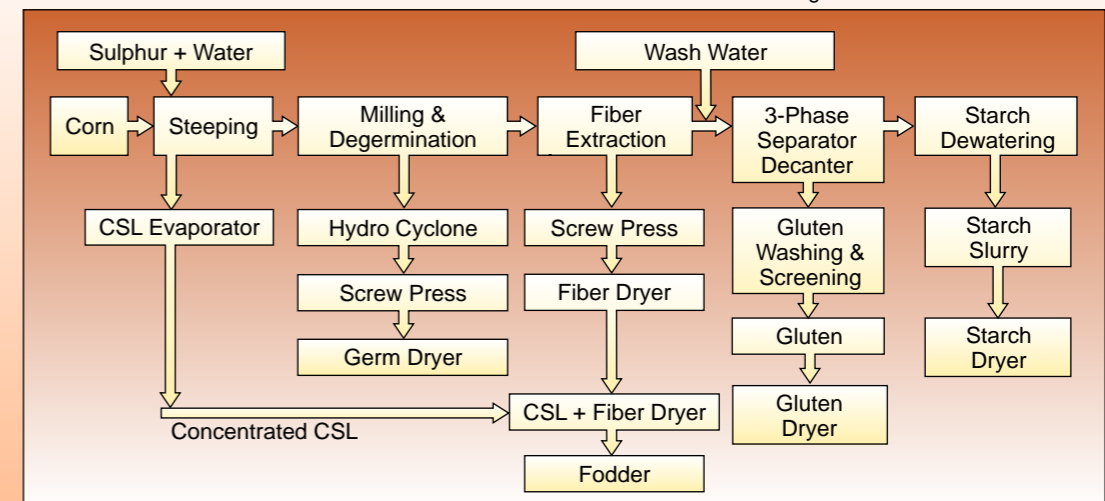
As a pure & renewable natural polymer starch caters to multiple usages. Its significance as a polysaccharide leads to production of Dextrose, glucose, fructose, maltose & sorbitol. Furthermore, starch is also an important ingredient for the sugar industry, which was otherwise relying upon sugar cane and beet sugar. Some of most common industries where starch is used are Ceramics, Textiles, Printing Industry, Bio-Plastics

Body powder, Oil exploration, Bio-ethanol, Hydrogen Production, Papermaking, Adhesives etc.

Manufacturing Process of Starch and Liquid Glucose

Manufacturing process of starch and liquid glucose consists of following major steps

Manufacturing Process of Starch from Maize



Maize Precleaning, Receiving and Weighing

Major operation involved in this process are De-stoning, Dust Removal, Primary Cleaning.

Maize Steeping

The Maize are soften with the help of Sulphur water for primary grinding of the maize.

Sulphur Water Generation

Sulphur water required for steeping is generated in this process either by burning sulphur or by mixing sodium sulphate in water and then passed through absorption column.

Corn Steeped Liquor (C.S.L.) Section

Steeped water generated in steeping process is continuously recycled and it consists of Protein, Sugars and Lactic Acids. This water is concentrated by using multiple effect evaporators.

Coarse Grinding and Degermination

Key Equipments used for this operation are

listed below

- Screening
- De-Germinating Mills
- Hydro-Cyclones
- Screw Press for Germ Dewatering
- Steam Tube Bundle Dryer for Germ Drying

Fine Milling and Fibre Washing

Key Equipments used in this process are listed below

- Screening for separation of Starch and Gluten
- Fine Mills
- Screw Press for Fiber Dewatering
- Steam Tube Bundle Dryer for Fiber Drying

Starch Separation and Starch Refining

Key Equipments used in this process are listed below

- De-Gritting Cyclones to remove small impurities
- Nozzle Separators

- Multistage Counter Washing Hydro Cyclones

Gluten Dewatering and Drying

Key Equipments used in this process are listed below

- Decanter for Gluten Dewatering
- Spin Flash Dryer/Tube Bundle Dryer for Gluten Drying
- Pneumatic Conveying

Starch Dewatering and Drying

Key Equipments used in this process are listed below

- Centrifuge for Starch Dewatering
- Pneumatic Flash Dryer
- Pneumatic Conveyor

Liquid Glucose Plant

Liquid glucose is also known as Glucose or Corn Syrup is aqueous solution of several compounds namely Dextrose, Dextrins and Maltose. Corn syrup is used in foods to soften texture, add volume, prevent

crystallization of sugar, and enhance flavor.

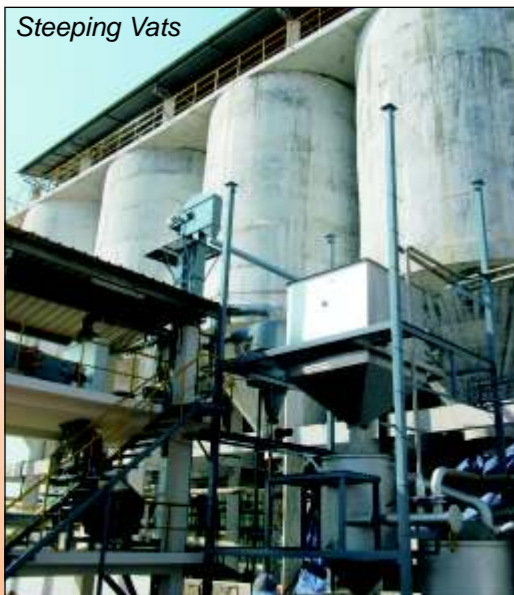
Liquid Glucose is manufactured from starch by incomplete acidic or enzymatic hydrolysis of starch followed by refining and evaporation.

The starch slurry is pumped to the holding tube via Jet cooker, where the slurry will be treated with higher temperature and then passed to flash vessel for cooling then it is fed to liquefaction tank which is two stage process where liquefaction of starch slurry takes place & the partial conversion of starch into glucose molecules takes place. The converted product is then passed to saccharification tanks via inter stage cooler and further fed to ion exchange column to remove the impurities.

After ion exchange treatment the solution is passed through an evaporator to increase the solid contents. This evaporation will remove large amount of water from the liquid. The glucose is passed over UV unit & send to storage tank.

Key process involved in liquid glucose manufacturing are listed below

- Slurry Preparation,
- Cooking section,
- Saccharification,
- Filtration,
- Ion Exchanging,
- Multi Effect Evaporation.



Steeping Vats



Screw Press



Hydro Cyclone



Grinding Mills



Nozzle Separator



Steam Tube Bundle Dryer

MCCP PLANTS

Product

Micro Crystalline Cellulose is a mechanically disintegrated level of D.P. Cellulose. It comprises purified, de-polymerised, Micro Crystalline sub micron size colloidal particles. It is produced by treating Alfa Cellulose obtained as a pulp from fibrous plants with minerals acid.

It is white, odourless, tasteless, extra free flowing powder which is relatively free from organic and non-organic contaminants. It is metabolically inert, and has excellent water absorptive, swelling & dispersion properties, is insoluble in water, dilute acid, common organic solvents and oils. It is partially soluble in dilute alkali.

Process

Rayon Grade wood pulp, the main raw material is hydrolyzed under very carefully controlled conditions. After Hydrolysis, specific inclusion of hydrophobic agents is done. This is followed by thorough washing with de-mineralised water. The depathogenised slurry prepared is pumped for Spray Drying and finally blended and packed.

Spray Drying

The atomization of the feed to be dried takes place concurrent to the drying air in a very robust atomizer revolving at an ultra high speed. The profile of temperatures in the drier can be adjusted to give optimum drying conditions. The feed to the atomizer is governed automatically by the temperature of the air. The powder is collected at two points.

RAJ MCCP Plants Specialty

Direct Compressible Grade of Micro Crystalline cellulose performs as an excipient to assist in the flow, lubrication and binding properties of the ingredients to be tableted and improves stability of drugs. Facilitate rapid disintegration of the tablet.

It can be used in direct compression of most drugs and because of savings in material, capital, equipment and labour, it compensates the higher price of Direct Compressible Micro Crystalline Cellulose over non spray dried Micro Crystalline Cellulose.



Guar Gum Plant

Raw Material: - Guar Seed is the primary raw material for Guar Powder production. The seed consists of 3 main products i.e. Guar Split, Guar Churi, Guar Korma.

Process :

The dried Guar seed from the farms is cleaned pneumatically to free it of dust and any foreign material. Further the guar seed is split using horizontal flour mills. The splits are then pulverized in pin mill and sent for roasting. Under controlled temperature the Splits with the husk are roasted. The roasted splits are then sent to the De-husking where the covering of the split is removed and Guar gum split is obtained from after sieving.

The churi and korma are conveyed pneumatically and stored.

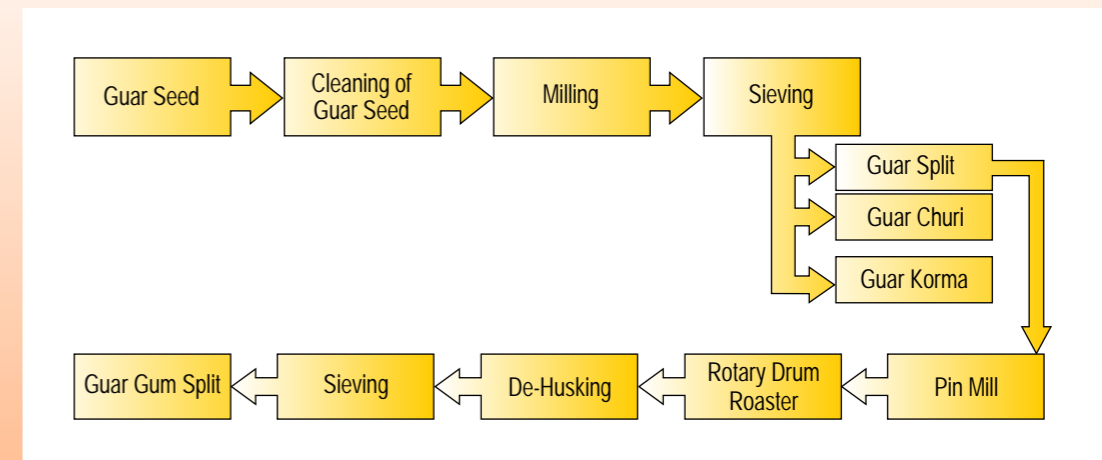
Features of RAJ GUAR SPLIT Plant:

- Use of pneumatic conveying eliminates Mechanical Contamination.
- Option available for dry grinding / Wet Milling.

- Use of technologically advanced rotating drum roaster.
- Optimal space requirement.
- Carefully selected material of constructions taking into account the product properties.
- PLC controlled SCADA operated system with complete process plant automation.

Services:

- Turnkey Plants
- Manufacturing and Supply of Equipments
- Engineering and Supervision of Civil and Structural work
- Engineering packages for Process and Detail Engineering.
- Project Management services
- Commissioning and Training
- After Sales Support



Guar Gum Manufacturing Process:

Depending upon the requirement of end product various processing techniques are used. In India the commercial production of Guar gum is normally undertaken by using process of roasting, differential attrition, sieving and polishing.

The stage wise process of manufacturing food grade guar gum is as under. It is very important to select guar split in this process. The split will be screened to clean and then it will be soaked to prehydrate in a double cone mixer/Washing conveyor. Prehydrating stage is very important in the process as it derives the rate of hydration of the final product.

The soaked splits, which has reasonably high moisture content, will be passed through Flaker. The flaked guar split will be predried in duct dryer. The dried guar flake will be ground to desired particle size in ultrafine grinder followed by drying of the material in flash dryer. The powder will be screened through rotary screens to deliver

required particle size. The oversize particles will be either recycled to main Ultrafine or reground in separate regrind plant, as per viscosity requirement.

This stage helps to reduce the load at the grinder. The soaked splits are difficult to grind. Direct grinding generates more heat in the grinder which is not desired in the process as it results in insoluble or reduced hydration of the product. Through heating, grinding & polishing process the husk is separated from the endosperm halves and the refined Guar Gum split are obtained. Through grinding process the refined Guar split are then treated and converted into powder.

During the split manufacturing process, husk & germ are obtained which are used as a cattle feed as they are rich in protein. It is widely sold in the international market as "Guar Meal" and has contents of "Oil & Albuminoids". These contents are about

50% in germ whereas it is about 25% in husks. Quality of the food grade guar gum powder is defined from its particle size, rate of hydration and the microbial in it. E412 guar gum is an important natural food supplement with high nutritional value.

Equipments for guar gum processing plant:

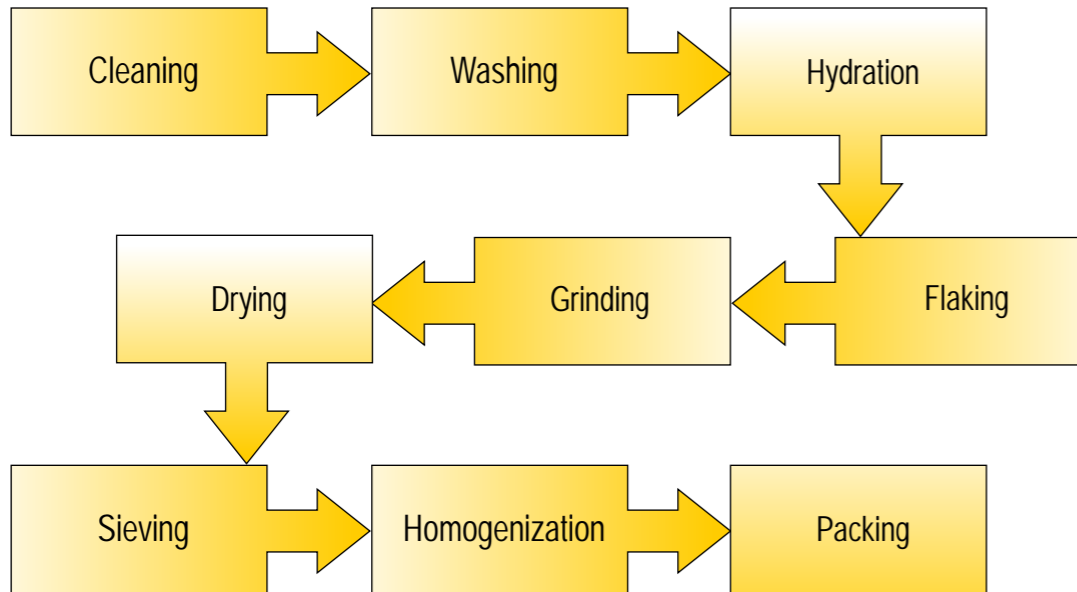
■ Raw Material Conveying

On a pneumatic conveyor system Guar Gum Splits are moved through various tubes via air pressure, allowing for extra vertical versatility. This Pneumatic conveyor is used to carry raw material to raw material storage hopper for further processing. The contact parts in Carbon Steel.

■ Raw Material Storage

The material conveyed through pneumatic conveying system is stored in Mild Steel hoppers. Further it is conveyed to washing system using control valves.





Washing Conveyor

Guar splits are screened to clean and then soaked to pre-hydrate in washing conveyor. Pre-hydrating stage is very important in the process as it derives the rate of hydration of the final product. The soaking and conveying of guar splits is totally depends upon the design and manufacturing of hydration conveyor. So it plays very important role in production of high viscous guar gum powder. Raj Process can manufacture single, two, three, four deck hydration conveyors as per process requirements and space available.

Double Cone/Plough Shear Mixer

Pre-hydrated Guar splits are transferred to this mixer. With help of reacting chemicals the guar splits are processed as per

requirement. This is done to achieve high viscosity. The plough shear has special design plough arms fixed on rotating shaft. These mixers can be provided with the jackets for cooling or heating as per process demand.

Flaker

Crushing of the material is done to meet requirement of coarse material. Three hardened rolls rotate towards each other. They are kept nearer to each other by means of thither mechanical devices or with hydraulic system helps to create the pressure on the rolls and make the crushing possible.

The larger particles of mass, cereals, pulses are pushed between the rolls uniformly spread and with continuous rate through a separate device.

Flaker Dryer

Flakes are passed through a duct wherein excess moisture is removed before grinding operation.

Ultra-fine Grinding

The crushed guar splits can be easily ground in ultra-fine grinder this grinder grinds the material with low generation of heat. The grinding rollers are sintered formation of coarse grain and ultra-fine grains on metal surface. Finally grinded material fed to the flash dryer for further drying.

Flash Drying

Flash drying is a continuous drying plant used for drying of wet flakes of guar split by disintegrating it into fine powder by hot air. The short residence time of one to three seconds requires that the moisture that should evaporate is truly surface water and that the particles in the feed flakes are completely dispersed in the drying air.

Hot Air Generator

A direct fired or indirect fired air heater is provided for heating the ambient air to the required air inlet temperature. The fuel used can be either wood chips, coal or solid agro-waste, furnace oil, diesel, CNG, LPG.

Hot Air Ducting

The hot air ducting for conveying the hot process air from outlet of air heater to the sling fan is provided. The hot air ducting is made from Carbon Steel HRA painted material of construction. Suitable insulation will be done at site for minimum heat losses.

Delivery Blower (FD)

A centrifugal blower driven by a TEFC motor is provided as a delivery blower. The blower is statically and dynamically balanced and is of robust construction. The blower is complete with flap damper for regulating the flow of air. The blower is

in Carbon Steel Epoxy painted construction.

Exhaust Blower (ID)

A centrifugal blower driven by a TEFC motor through V belt and pulleys is provided. The blower is statically and dynamically balanced and is of Carbon

Rotary Air Lock Valve

A motorised rotary air lock valve is fitted on the bottom of the cyclone to discharge the dry powder through the chute.

Bag Filter

Bag filter with top quality media is provided for collection of dust. After collection of dust, dust free air is released to air. Bag filter with Mild Steel construction is designed such a way that it avoids channeling of air.

Roto-Shifter

Unbalanced weight on the motor shaft rotates in a plane close to the center of the mass of assembly. Rotation of the eccentric weight causes vibration in horizontal plane which moves the material across the screen cloth to periphery increasing the horizontal through thus oversize material is discharged at faster rate. The Material of construction for Roto-Shifter is Aluminum.

Blender

For homogeneous mixing of products Cone Screw Mixer or Ribbon Blender is provided as per requirement. The material of construction for blenders is Carbon Steel.

Key Features of complete RAJ Guar Gum Plant.

- PLC based automated system.
- Easy to operate and maintain.
- Low power & fuel consumption.
- Optimum space requirement.

Zero Liquid Discharge Plants

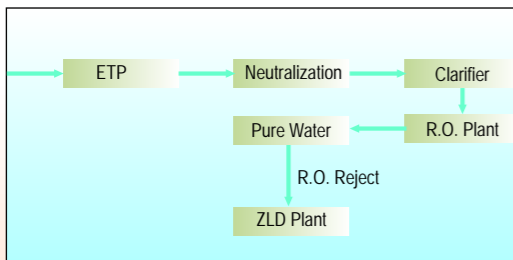
The system is envisaged for treatment of effluent mainly containing turbidity and suspended solids. Service water washing effluent from different areas is collected in common collection pit and then pumped to the flash mixer where chemical mixing takes place. The effluent is dosed with Alum, Lime and Polyelectrolyte to coagulate and flocculate the suspended / colloidal matter. Water then flows through the flocculation tank for flocculation and is finally carried over to tube/lamella settler through gravity where clarification of water takes place. Clarified water is then led to common monitoring basin through gravity. Sludge generated in the process shall be collected and pumped for further treatment.

Reverse Osmosis Plant

Reverse osmosis is a purification technology that uses a semi-permeable membrane. In RO, an applied pressure is used to overcome osmotic pressure, a colligative property, that is driven by chemical potential, a thermodynamic parameter. RO can remove many types of molecules and ions from solutions and is used in both industrial processes and to produce potable water. The result is that the solute is retained on the pressurized side of the membrane and the pure solvent is allowed to pass to the other side. This membrane should not allow large molecules or ions through the pores, but should allow smaller components of the solution (such as the solvent) to pass freely.

Zero Liquid Discharge Plant

Zero Liquid Discharge is a process that is beneficial to industrial and municipal organizations as well as the environment because it saves money and no effluent, or



Effluent Treatment



discharge, is left over. ZLD systems employ the most advanced wastewater treatment technologies to purify and recycle virtually all of the wastewater produced.

ZLD Specific Technology

ZLD systems have become a necessity for all the industries generating liquid effluents. Common effluent treatment plants in most areas have a limited capacity. The ZLD systems are normally incorporated to treat the R.O. reject streams.

Zero Liquid Discharge Plant

In zero liquid discharge plant operation, effluent is treated in three different steps depending upon the effluent specification.

■ Step I: Stripper Column

In this process, the effluent is treated in stripper column to recover the solvent present in effluent & reduce the COD & BOD value. This step is generally used when the effluent is having high COD & BOD value.

■ Step II: Single or Multi-Effect

Evaporator Plant

In this process, the effluent is treated in Multi-effect evaporator plant to concentrate the effluent or slurry. Multi-effect evaporator plant is a combination of different types of evaporator like Falling Film, Forced Circulation & Rising Film Evaporator. In this stage steam economy depends upon the number of stages.

■ Step III: ATFD/Pusher Centrifuge / Tube Bundle Dryer

In this process, the concentrated effluent from Multi-Effects evaporator plant is treated for complete separation of solid & liquid present in effluent.

Process

Zero liquid discharge plants consist of a combination of different types of evaporators depending upon the nature of the liquid and its contents. The waste liquid is concentrated to the maximum level in evaporator which may be either falling film or forced circulation or a combination of both. The number of stages depends upon the

quantity of liquid to be handled. The water evaporated from the evaporators is condensed in the condenser and can be reused in the process.

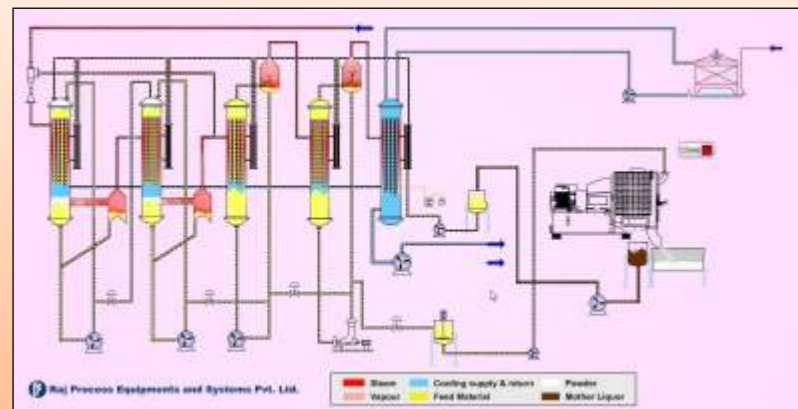
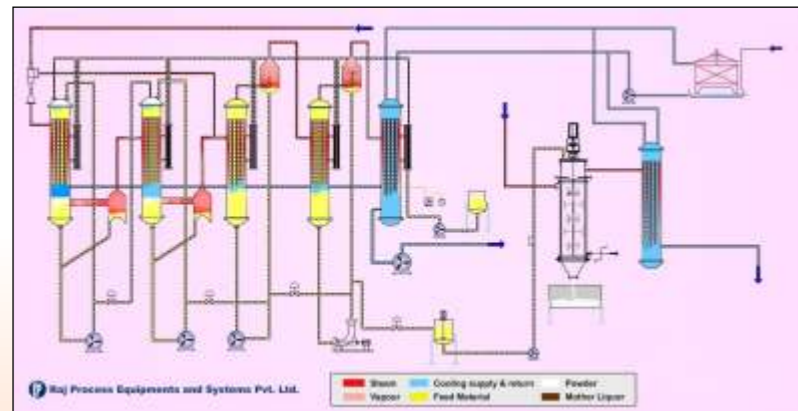
The concentrated liquid is then dried in either a spray

dryer or agitated thin film dryer. The dry product obtained in powder form can either be used as a by-product or can be sent for land filling.



Features of RAJ Zero liquid discharge plants:

- Higher steam and power economy.
- Simple construction which is easy to operate.
- Carefully selected material of constructions taking into account the product properties.
- Optimal space requirement.
- Skid mounted units up to certain capacities.
- Capacity range from 1 KL per day to 10000 KL per day.
- PLC Controlled systems.



■ Pure condensate from the system which can be reused in process.

Application of Zero Liquid Discharge Plant

- Hydrocarbon Processing:
- Textiles: Waste H₂SO₄ concentration, Sodium thiocyanate (NaSCN) concentration, Sodium Chloride (NaCl) and Sodium Sulfate (Na₂SO₄) recovery by crystallization
- Pulp and Paper: Black liquor concentration before burning, bleaching effluents concentration and up-grading, stripping of process condensates, recovery of Na₂SO₄ from incineration residues.
- Chemical Processing: Recovery of salts such as NaCl, Na₂SO₄, etc from organic synthesis, recovery and purification of acidic synthesis effluents such as HCl, H₂SO₄.
- Dairy and Beverage: Numerous dairy, food, and beverage applications including complete whey processing facilities. Whey originates as a by-product from cheese production using milk as raw material. Whey still contains many valuable components that have a wide utilization if treated properly in an appropriate process - such as simple evaporation, drying, or fractionation by ultra filtration followed by other processes, usually also evaporation and drying.
- Food & Pharmaceutical: Citric acid effluents concentration and up-grading, sulphuric acid concentration from ethanol production plants, elimination of inorganic chemicals from specific wastes, food grade phosphoric acid.
- Alumina Industry: Elimination of the

sodium carbonate from the Bayer liquor, salting-out and liquor-burning high concentration evaporators.

- Fertilizer production: Ammonium nitrate residual condensates treatment, recovery of HNO₃ in effluents, recovery of H₂SiF₆ from phosphoric acid concentration units.



Nutraceutical Powder Plant

Nutraceutical Powder is used by many people of different ages as a food supplement as it has very good nutrition values and milk proteins.

Process Description:

Feed Preparation:

The feed preparation is a simple process which involves mixing of various ingredients in a proper proportion by auto weighing system. The large tanks with agitator arrangement are provided to mix the ingredients. The tanks are also provided with the heating arrangement so as to maintain proper temperature. The feed is homogenized in a specially design homogenizer.



Preheating:

The feed is preheated to temperatures between 75 °C and 120 °C and held for specified time from a few seconds up to several minutes. Preheating causes a controlled denaturation of the whey proteins in the feed and it destroys bacteria, inactive enzymes, generates natural antioxidants and imparts heat stability.

Spray Drying:

The feed is then dried to powder form in a spray dryer. The feed is atomized to fine droplets in a large spray chamber by using either disc atomizer or series of high pressure nozzles. These atomized particles come in contact with hot air and water in it gets evaporated. The feed droplet temperature never reaches the temperature of hot air as it is cooled by evaporative cooling. The dried product is discharge at the bottom of chamber and if required it is passed through instantiser. An instantiser consists of a fluid bed dryer cum cooler. The dried product entrained with the exhaust air is separated in a high efficiency cyclone separator and recycled back to the chamber. The exhaust air is further passed through a wet ventury scrubber for recovering the fines not separated in cyclone. Clean air is then vented to the atmosphere the process air is handled by means of two centrifugal fans. The entire operation of the plant is monitored and controlled through a locally mounted control panel or PLC.

Storage, Mixing and Packing :

The dried powder is stored in storage silos from where they are weighed in auto weighing system and mixed with other dry ingredients in right proportions. The mixture is further weighed and sent in the packing section where it is packed in the required quantity.

Features of

RAJ Nutraceutical Powder Plant:

- Low temperature drying which maintains the qualities of the Nutraceutical Powder.
- Fully automatic system to ensure smooth and ease of operation.
- High steam and power economy.
- Optimal space requirement.
- Carefully selected material of constructions taking into account the product properties.
- Complete sanitary design with CIP system
- PLC controlled SCADA operated system

Services:

- Turnkey Plants
- Manufacturing and Supply of Equipments
- Engineering and Supervision of Civil Structural
- Process and Detailed Engineering
- Project Management
- Commissioning and Training
- After Sales Support



Milk Powder Plant

Milk powder is made from fresh, pasteurized skimmed milk. Milk powder manufacturing is a simple process which involves gentle removing of the water under stringent hygiene conditions while retaining all the desirable natural properties of the milk like Color, Flavor, Solubility and Nutrition Value.

Process Description:

Separation:

The raw milk is separated into skimmed milk and cream using a centrifugal separator. If the extra fat is required in the milk powder then some cream is added back to the skimmed milk.

Pasteurization:

The skimmed milk is preheated to temperatures between 75 °C and 120 °C and held for specified time from a few seconds up to several minutes. Preheating causes a controlled denaturation of the whey proteins in the milk and it destroys bacteria, inactive enzymes, generates natural antioxidants and imparts heat stability. The pasteurized milk can be directly converted into powder as per client's requirement.

Evaporation:

In the evaporator pasteurized feed is concentrated in multiple effects from around 9.0% total solids contents up to 45-52% total

solid contents. For this feed is boiled under vacuum at temperature below 72 °C which removes the water vapors.

Spray Drying:

The concentrated milk (Skimmed Milk) is then dried to powder form in a spray dryer. The feed is atomized to fine droplets in a large spray chamber by using either disc atomizer or series of high pressure nozzles. These atomized particles come in contact with hot air and water in it gets evaporated. The feed droplet temperature never reaches the temperature of hot air as it is cooled by evaporative cooling. The dried product is discharge at the bottom of chamber and if

required it is passed through instantiser. An instantiser consists of a fluid bed dryer cum cooler. The dried product entrained with the exhaust air is separated in a high efficiency cyclone separator and recycled back to the chamber. The exhaust air is further passed through a wet ventury scrubber for recovering the fines not separated in cyclone. Clean air is then vented to the atmosphere the process air is handled by means of two centrifugal fans. The entire operation of the plant is monitored and controlled through a locally mounted control panel or PLC.

Features of RAJ Nutrition Powder Plant:

- Low temperature drying which maintains the qualities of the milk Powder.
- Fully automatic system to ensure smooth and ease of operation.
- High steam and power economy.
- Optimal space requirement.
- Carefully selected material of constructions taking into account the product properties.
- Complete sanitary design with CIP system
- PLC controlled SCADA operated system

Services:

- Turnkey Plants
- Manufacturing and Supply of Equipments
- Engineering and Supervision of Civil Structural
- Process and Detailed Engineering
- Project Management
- Commissioning and Training
- After Sales Support

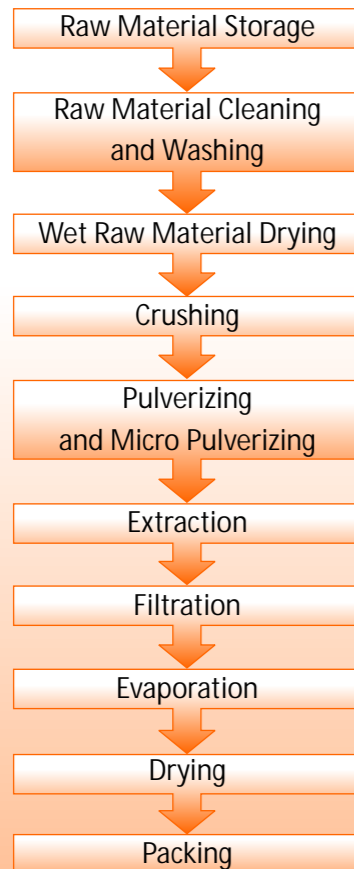


Herbal Extraction Plant

Herbs are the complex compound and are used in various industries like flavoring, food, medicine, perfume, Cosmetics, Textile, Leather and many more. Depending upon the products various processing techniques are used for Herbal extraction.

Process Description:

The process of herbal extraction



The raw material cleaning is provided to remove unwanted materials from the feed. The raw material is washed with the help of a conveyor and washing water tank arrangement. Cleaned raw material is fed to a dryer to remove the moisture from it before crushing and then passes through a crushing system. Crushed feed passes through a series of pulverizers to ensure the right size of the feed material. The grounded particles are screened and fed to extraction unit where with the help of suitable solvent the herbs are extracted. The extract is filtered in a filtration system and concentrated in evaporation system and converted into powder with the help of a spray drying system. The dried product is packed in suitable sizes with the help of packing machine.



Features of RAJ Herbal Extraction Plant:

- Low temperature drying which maintains the qualities of the product
- Fully automatic system to ensure smooth and ease of operation.
- High steam and power economy.
- Optimal space requirement.
- Carefully selected material of constructions taking into account the product properties.

Services:

- Turnkey Plants
- Manufacturing and Supply of Equipments
- Engineering and Supervision of Civil Structural
- Process and Detailed Engineering
- Project Management
- Commissioning and Training
- After Sales Support

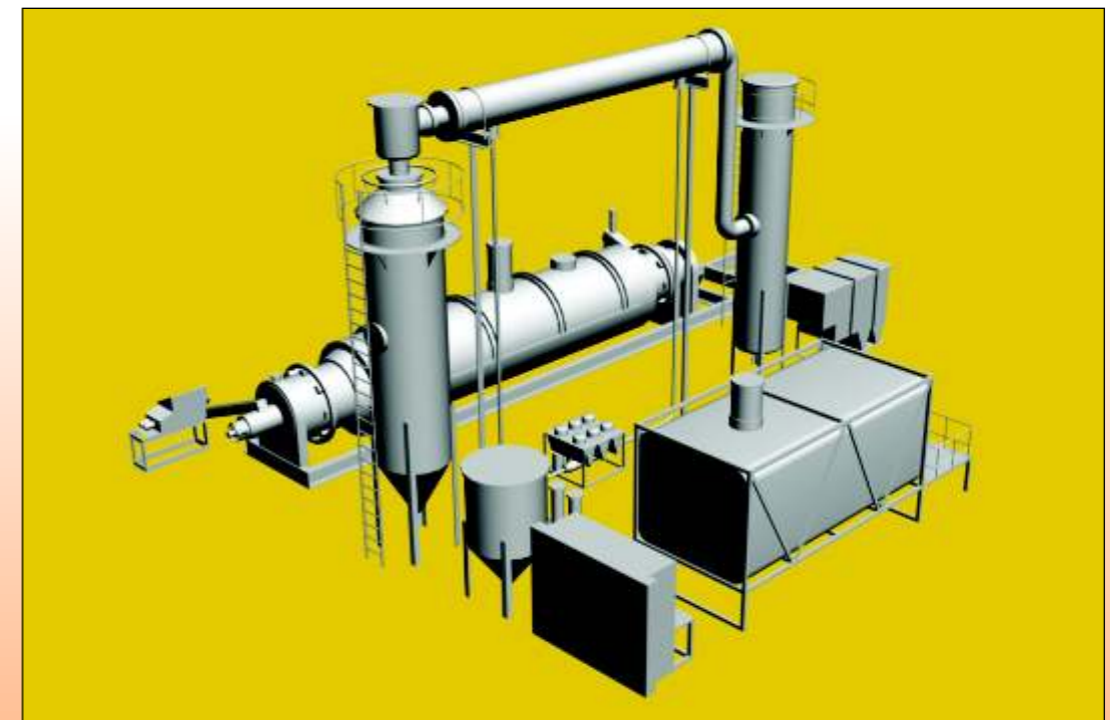


Thermal Desorption Unit

The purpose of this system is to recover the hydrocarbon from the drill cutting mud and from the rig. The mud is fed to the dryer through the feed hopper. The dryer is provided with heavy duty paddles which will churn the material inside. The dryer is provided with external jacket through which hot air generated in hot air generator is passed to heat the material at design temperature. The flue gas coming out from the dryer jacket is recycled back to hot air generator.

As the material inside is heated to design temperature the hydrocarbon trapped inside the drill cuttings will evaporate. This vapors generated are passed through the metallic type bag filter which will separate dust particles. The filtered vapors are then passed through the condenser to condense the hydrocarbon vapors. Condensate is collected at the bottom of the condenser. The vapors are further passed through wet scrubber and clean air is exhausted to atmosphere.

The condensate stored in receiver is pumped to the oil water separation unit. The liquid enters the oil-water separator oil and water is separated. The hot water from the condenser is sent to the cooling tower where it is cooled. The total system is handled by means of two centrifugal fans. The system is controlled by locally mounted control panel with automation instruments and safety interlocks for safe running of system.



Thermal Desorption Unit

Features of

RAJ Thermal Desorption Plant:

- High Efficiency
- Low energy Consumption
- Simple Construction which is easy to operate
- Optimal Space Requirement
- PLC controlled System



Feed for TDU



Recovered Oil



Treated Soil

Fruit Processing Plants

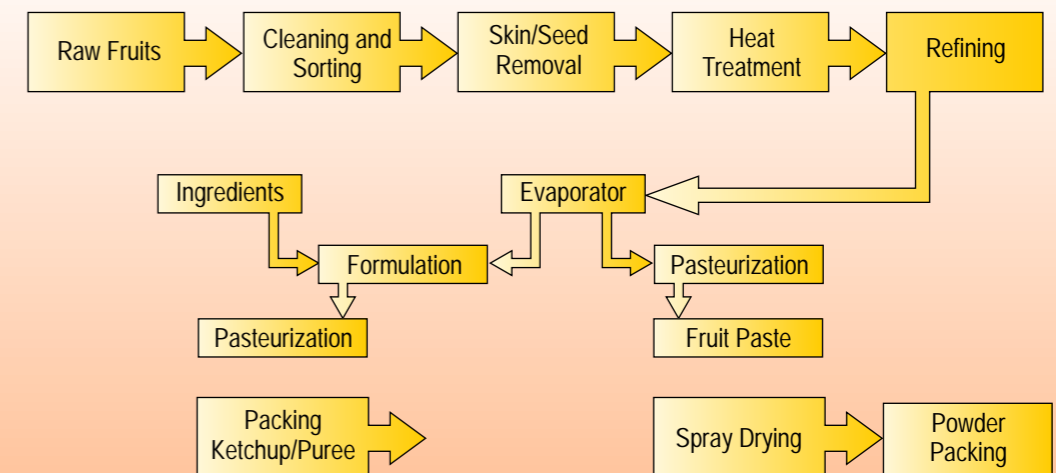
Fruit processing plants to process mango, gauva, papaya, pine apple, grapes, citrus fruits, pomegranate, bananas etc to convert the same to their respective purees of different concentrations and powders.

Fruit juices are spray dried in order to have a long shelf life, reduces storage place requirement and lower cost of bulk packing. Fruit juice powders have many applications in food industry as additive like for sandwich cookies, instant soup, health food, jellies, puddings, biscuits, ice food mixes, breakfast cereals, confectionery, ready-to-drink mixes, bakery, milk powder mixes, flavorings in medicine, dietetic food & nutritional food etc.

Unique feature like thermo syphon heating and zero effluent discharge system utilizing the waste heat available in the process.



Process Description:



Process flow diagram for fruit processing plant

Fresh fruits are conveyed to washing vat and after washing the fruits are sorted on sorting section. The bad fruits are separated and further are broken. The skin and seeds are carefully removed and juice is refined. Further the juice is concentrated with the help of evaporators and the concentrated pulp is then converted to variety of the products like puree, ketchup, paste etc. as per requirement.

The concentrated pulp is spray dried to get fruit powder and packed.

Features of RAJ Fruit Processing Plant:

- Fully automatic system to ensure smooth and easy operation.
- Sterile construction of equipment to maintain high hygiene level.
- Energy Efficient.

- Optimal space requirement.
- Carefully selected material of constructions taking into account the product properties.
- Complete sanitary design with CIP system
- PLC controlled SCADA operated system

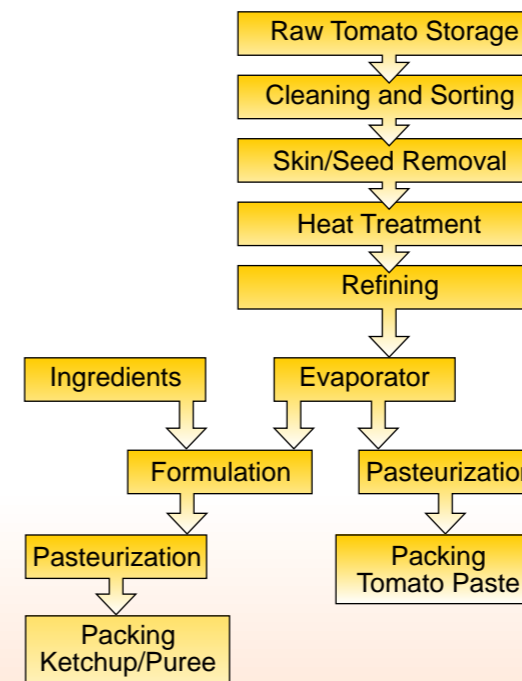
Services:

- Turnkey Plants
- Manufacturing and Supply of Equipments
- Engineering and Supervision of Civil and Structural work
- Process and Detailed Engineering
- Project Management
- Commissioning and Training After Sales Support



Tomato ketchup, sauce, puree and powder plant

Millions of tones of tomatoes are grown each year and pass to the user in various forms like paste, ketchup, powder etc. Fresh ripe tomatoes are conveyed to



Further the concentrated pulp has converted to variety of the product like ketchup, puree or paste as per requirement. The concentrated pulp is spray dried to get tomato powder and packed.

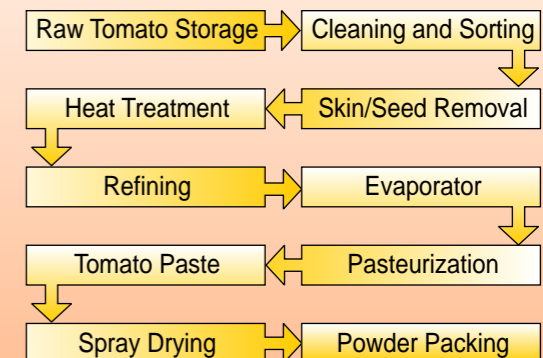
Features of RAJ Fruit Tomato Processing Plant:

- Fully automatic system to ensure smooth and ease of operation.
- Sterile construction of equipment to maintain high hygiene level.
- Energy Efficient.
- Optimal space requirement.
- Carefully selected material of constructions taking into account the product properties.
- Complete sanitary design with CIP system
- PLC controlled SCADA operated system

Services:

- Turnkey Plants
- Manufacturing and Supply of Equipments
- Engineering and Supervision of Civil and Structural work
- Process and Detailed Engineering
- Project Management
- Commissioning and Training After Sales Support

washing vat and after washing the tomato are sorted on sorting section. The bad tomatoes are separated and further are broken. There are two methods of doing this namely "hot break" and "cold break". In hot break process, the tomatoes are quickly preheated before breaking, where as in cold break the tomatoes are broken at room temperature and kept in holding tank for some time. The skin and seeds are carefully removed and are refined. The juice is then concentrated with the help of evaporator.



Coconut Milk Powder Plant

Various products can be obtained from the coconut like Desiccated coconut, Coconut cream, Coconut Milk etc. Coconut milk has a wide range of applications in food industry and food preparation. Coconut milk is spray dried in order to have a long shelf life; less storage place is required, lower cost of bulk packing.

Process Description:

Feed Preparation:

White meat of the coconut is extruded and further use as raw feed to Feed Preparation section. This is a simple process which involves mixing of various ingredients in a proper proportion by auto weighing system. The large tanks with agitator arrangement are provided to mix the ingredients. The tanks are also provided with the heating arrangement so as to maintain proper temperature. The feed is homogenized in a specially designed homogenizer.



Spray Drying:

The feed is then dried to powder form in a spray dryer. The feed is atomized to fine droplets in a large spray chamber by using either disc atomizer or series of high pressure nozzles. These atomized particles come in contact with hot air and water in it gets evaporated. The feed droplet temperature never reaches the temperature of hot air as it is cooled by evaporative cooling. The dried product is discharged at the bottom of chamber. The dried product entrained with the exhaust air is separated in a high efficiency cyclone separator. The exhaust air is further passed through a wet ventury scrubber for recovering the fines not separated in cyclone. Clean air is then



vented to the atmosphere the process air is handled by means of two centrifugal fans. The entire operation of the plant is monitored and controlled through a locally mounted control panel or through PLC.

Storage, Mixing and Packing

The dried powder is stored in storage silos from where they are weighed in auto weighing system and mixed with other dry ingredients in right proportions. The mixture is further weighed and sent in the packing section where it is packed in the required quantity.

Features :

- Low temperature drying which maintains the qualities of the Coconut milk Powder.
- Sterile construction of equipment to maintain high hygiene level.
- Fully automatic system to ensure smooth and ease of operation.

- Energy Efficient.
- Optimal space requirement.
- Carefully selected material of constructions taking into account the product properties.
- Complete sanitary design with CIP system
- PLC controlled SCADA operated system

Services:

- Turnkey Plants
- Manufacturing and Supply of Equipments
- Engineering and Supervision of Civil and Structural
- Process and Detailed Engineering
- Project Management
- Commissioning and Training
- After Sales Support



Food Flavors Fragrances Plant

Flavor is an ingredient or a blend of ingredients comprised primarily of natural and/or artificial aromatic substances plant extracts, essential oils, reaction products, etc. The flavors have wide range of applications in many Industries. The flavor of the food, as such, can be altered with natural or artificial flavorants.

Process Description

Feed Preparation

Oleoresins are mixed with carrier material like Maltodextrin or Starch powder in agitated and jacketed tank. The feed is then homogenized in a high pressure homogenizer.

Spray Drying

The Liquid Food Flavors are dried with the help of spray dryer. The feed is atomized to fine droplets in a large spray chamber by using either disc atomizer or series of high pressure nozzles. These atomized particles come in contact with hot air and water in it gets evaporated. The feed droplet temperature never reaches the temperature of hot air as it is cooled by evaporative cooling. The dried product is discharged at the bottom of chamber. The dried product entrained with the exhaust air is separated in a high efficiency cyclone separator and recycled back to the chamber. The exhaust air is further passed through a wet ventury scrubber for recovering the fines not separated in cyclone. Clean air is then vented to the atmosphere the process air is handled by means of two centrifugal fans. The entire operation of the plant is monitored and controlled through a locally mounted control panel or through PLC.

Features of RAJ Food Flavor Powder Plant:

- Low temperature drying which maintains the qualities of the Flavor Powder.
- Fully automatic system to ensure smooth and ease of operation.
- Energy Efficient.
- Optimal space requirement.
- Carefully selected material of constructions taking into account the product properties.
- Complete sanitary design with CIP system
- PLC controlled SCADA operated system

Services:

- Turnkey plants
- Manufacturing and supply of equipments
- Engineering and supervision of civil and structural work
- Process and detailed engineering
- Project management
- Commissioning and training
- After sales support



Spiriluna Powder Plant

Spirulina has countless uses as a supplement for maintaining good health and for preventing diseases. It has immense number of application in various industries but one of the potential applications that have gained increasing importance during recent years is its utilization in pharmaceuticals.

Process Description:

Spray Drying:

The Spirulina after growing is filtered and dried to powder form in a spray dryer. The feed is atomized to fine droplets in a large spray chamber by using either disc atomizer or series of high pressure nozzles. These atomized particles come in contact with hot air and water in it gets evaporated. The feed droplet temperature never reaches the temperature of hot air as it is cooled by evaporative cooling. The dried product is discharged at the bottom of chamber. The dried product entrained with the exhaust air is separated in a high efficiency cyclone separator and recycled back to the chamber. The exhaust air is further passed through a recovery unit for recovering the fines not separated in cyclone. Clean air is then vented to the atmosphere the process air is handled by means of two centrifugal fans. The entire operation of the plant is monitored and controlled through a locally mounted control panel or through PLC.

Features of RAJ Spiriluna Powder Plant:

- Low temperature drying which maintains the qualities of the Spiriluna Powder
- Fully automatic system to ensure smooth and ease of operation
- Energy Efficient
- Optimal space requirement
- Carefully selected material of constructions taking into account the product properties.
- Complete sanitary design with CIP system
- PLC controlled SCADA operated system

Services:

- Turnkey plants
- Manufacturing and supply of equipments
- Engineering and supervision of civil and structural work
- Process and detailed engineering
- project management
- Commissioning and training
- After sales support

Sulphur WDG Plant

Sulphur WDG has wide applications in agriculture industry. It helps in maintaining the appropriate pH of the soil, thereby better uptake of other nutrients, better crop stand, key ingredient in the process of photosynthesis, helps in the synthesis of proteins, Enzymes & Vitamins, controls metabolic & growth processes within plant cells, Promotes nodulation in the legumes, thereby helps in nitrogen fixation and many more.

Process Description:

The raw material is mixed with water and homogenized in the homogenizing tanks. For making the fine slurry the crude slurry is fed to the dynamill. The fine slurry then fed to the balance storage tanks with the help of screw pumps. The fine slurry is then aged to a specific time. The feed is fed to the atomization system through a variable speed screw Pump .The atomised particles come in contact with the hot air entering the chamber in a co-current fashion through an air distributor.

For agglomeration of the product an integrated fluid bed dryer is provided at the bottom of the chamber.

The product is further passed through the fluid bed dryer for final drying and cooling purpose. The product is collected at the bottom of the fluid bed dryer. Dehumidified air passed through the fluid bed dryer.

Features of RAJ Sulphur WDG Plant:

- Fully automatic system to ensure smooth and ease of operation.
- Energy Efficient.
- Optimal space requirement.
- Carefully selected material of constructions taking into account the product properties.
- Complete sanitary design with CIP system
- PLC controlled SCADA operated system

Services:

- Turnkey plants
- Manufacturing and supply of equipments
- Engineering and supervision of civil and structural work
- Process and detailed engineering
- Project management
- Commissioning and training
- After sales support

Enzyme Powder Plant

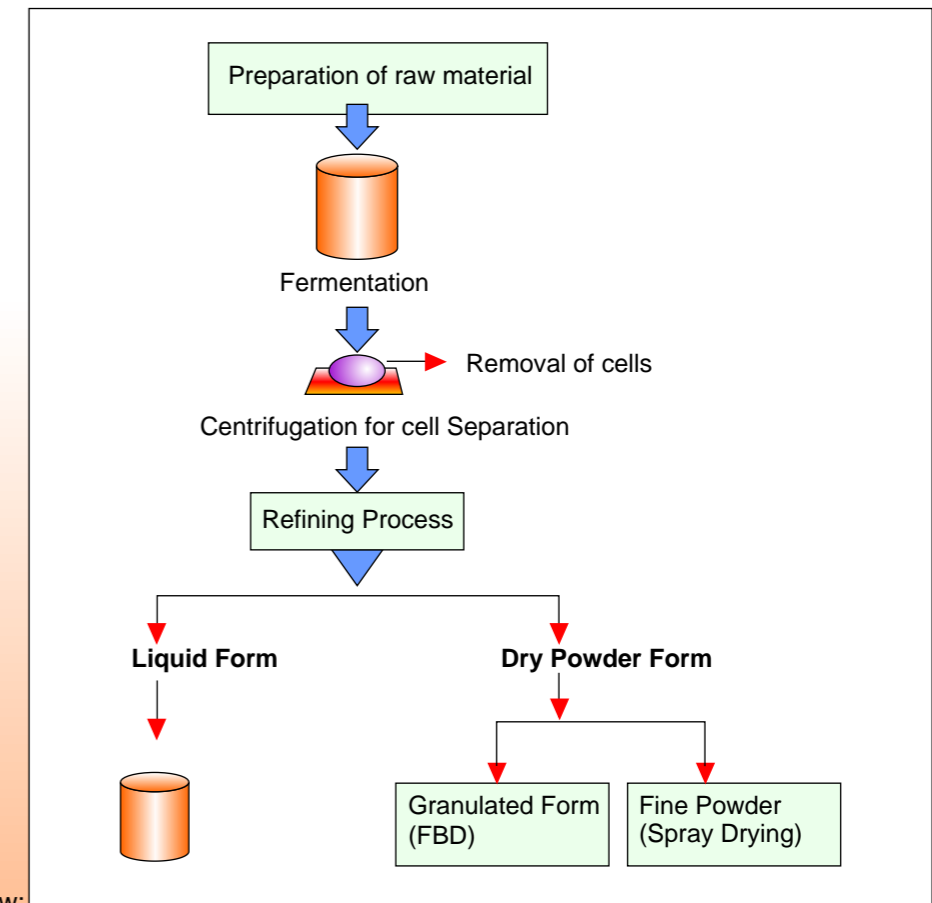
An enzyme has various industrial uses nowadays. It is used in Food processing, Detergent and Textile industry, Brewery & Rubber industry, Biofuel industry, Biological detergent and Pharmaceutical industries.

microorganisms, like bacteria and yeast to produce the enzymes.

After recovery and purification, the enzymes are standardized in a liquid or powder form, depending on the later application. Powder is made with Raj Process's Drying technology.

The production of enzymes

Fermentation is a method of generating enzymes for industrial purposes. Fermentation involves the use of



Process Flow:

Active Dry Yeast Manufacturing

Raw Material: Molasses is the primary raw material for baker's yeast production. It supplies all the sugar that yeast needs for growth and energy along with part of the needed nitrogen.

Fermentation: Baker's yeast begins as a culture of the desired strain, which is inoculated from a small vial. It is transferred into a larger vessel, then through several fermentation stages of increasing volume. The larger-scale fermentations take place in large Fermenters that are equipped for aeration, cooling, incremental molasses feeding, pH control, and anti-foam addition.

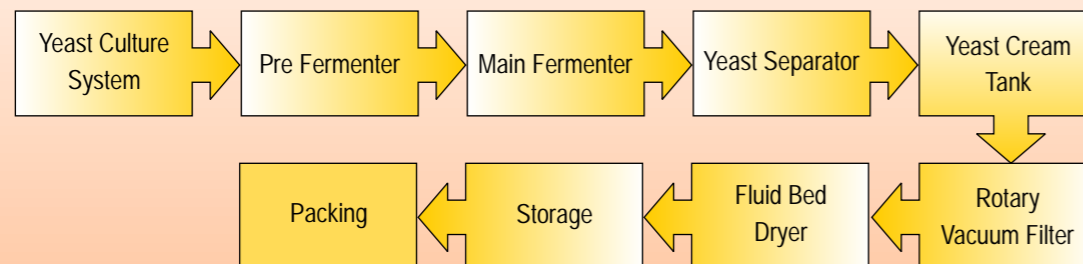
Processing: Yeast broth from the fermenter is separated of about 18 percent solids and washed with water. Cream yeast is this liquid yeast that is cooled. To make compressed (granular and cake) yeast, cream yeast is passed through a filter, which removes water and increases the solids concentration to about 30 percent. This yeast is then fed to a Fluidized Bed dryer to obtain Granular form Active Dry Yeast.

Features of RAJ Yeast Manufacturing Plant:

- Fully automatic system to ensure smooth and ease of operation.
- Energy efficient optimum design in terms of Steam and Electricity consumption.
- Optimal space requirement.
- Carefully selected material of constructions taking into account the product properties.
- Special Aseptic Design.
- PLC controlled SCADA operated system with complete process plant automation.

Services:

- Turnkey Plants.
- Manufacturing and Supply of Equipments.
- Engineering and Supervision of Civil and Structural work.
- Engineering packages for Process and Detail Engineering.
- Project Management services.

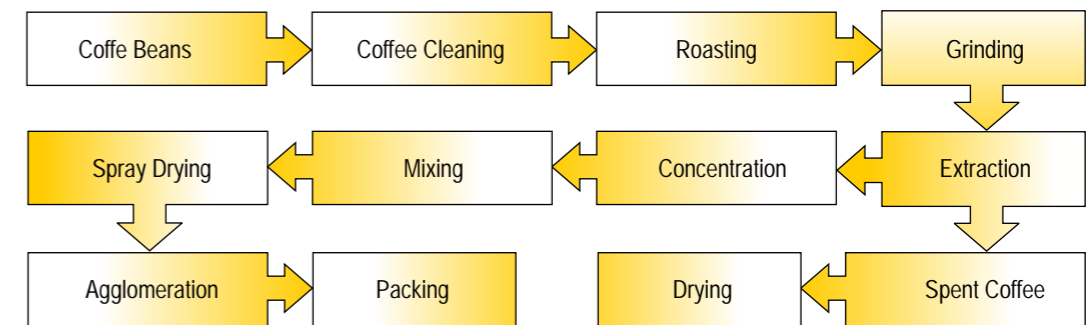


Instant Coffee Plant

Intant coffee is a product derived from coffee beans through manufacturing processes that result in an extract of granules, powder, or a liquid concentrate.

Generally instant coffee comes in the form of powder or granules, to which the boiling water is added to make coffee like beverage.

- Sterile construction of equipment to maintain high hygiene level.
- Energy Efficient.
- Optimal space requirement.
- Carefully selected material of constructions taking into account the product properties.



Process Description:

Impurities from the coffee beans are removed and then it is cleaned. The cleaned coffee beans are roasted to flavor and aroma. The temperature in the roasting defines the various properties of the coffee. The roasted coffee is grounded to make it powder. A series of extractors is provided in order to extract the coffee from the beans. The aroma is recovered in the aroma recovery unit. The extract is further concentrated with the help of evaporators. The concentrated coffee is further spray dried with the help of a spray dryer.

- Complete sanitary design with CIP system
- PLC controlled SCADA operated system

Services:

- Turnkey Plants
- Manufacturing and Supply of Equipments
- Engineering and Supervision of Civil and Structural work
- Process and Detailed Engineering
- Project Management
- Commissioning and Training
- After Sales Support

Features of RAJ Instant Coffee Plant:

- Fully automatic system to ensure smooth and ease of operation.

Salt Processing Plant

Salt is the common name for the substance sodium chloride (NaCl), which occurs in the form of transparent cubic crystals. In industry salt with its converted forms such as chlorine, caustic, soda ash are being used in various industries such as petrochemical refining, petro chemistry, organic synthesis, bulk drug and pharmaceutical industries.

In consideration of edible salt it should be processed hygienically so as to make it consumable for human being, which raises the need of suitable refining process of salt to meet today's demands such as its purity, color, crystalline nature, particle size distribution and free flowing behavior.

Process Description:

Vacuum Refining of Salt:

Crude salt from the source is collected in large storage vessels from where the salt is conveyed for grinding it to fines and segregated through a mechanical sieve. Crude salt is then pre-washed and mixed with water in suitable form to form brine solution. Crude Salt is fed through a volumetric belt Feeder for size reduction in presence of brine solution and fed to washing system. Many impurities categorized to soluble and insoluble in water are gathered in washing system which effects in the removal of soluble and insoluble by flotation from slurry formed in washing system. Make up fresh water is fed at various points of the washing system to keep soluble in permissible limit.

From washing system concentrated slurry is fed to the evaporation system consisting of multi effect evaporators. Water is evaporated

from brine using steam-powered multiple-effect or electric-powered vapor recompression evaporators.

To achieve the economy of operation, evaporator is operated under vacuum to reduce steam consumption. This increases energy efficiency in the multiple-effect system.

Vapor recompression forced-circulation evaporators consist of crystallizer vessel, vapor compressor and vapor scrubber. As the brine enters in crystallizer vessel, salt cake is precipitated out from crystallizer. Vapor is withdrawn, scrubbed, and compressed for further reuse.

The crystallized salt is sent to centrifuge where it is dewatered. There will be formation of cake which will be sent to drier to form crystals of salts.

Features of RAJ Salt Processing Plant:

- Fully automatic system to ensure smooth and ease of operation.
- Energy Efficient.
- Optimal space requirement.
- Carefully selected material of constructions taking into account the product properties.
- PLC controlled SCADA operated system

Services:

- Turnkey plants
- Manufacturing and supply of equipments

- Engineering and supervision of civil and structural work
- Process and detailed engineering
- Project management
- Commissioning and training
- After sales support

