

Our Product Range

TURNKEY PROJECTS

Distilleries – Molasses & Grain based
Detergent powder plants
Starch & Glucose Plants
Micro Crystalline Cellulose Powder Plants
Guar Gum Plant
Zero Liquid Discharge Plants

DRYERS

Spray Dryers
Flash Dryers
Rotary Dryers
Continuous Fluid Bed Dryers
Paddle Dryers
Steam Tube Bundle Dryer
Rotary Vacuum Dryer
Cone Screw Dryer

EVAPORATORS

Agitated Thin Film Evaporator
Falling Film Evaporators
Forced Circulation Evaporators
Multi Effect Evaporator

MIXERS

Cone Screw Mixer (Nauta Mixer)
Conical Blender
Plough Shear Mixer
Ribbon Blender
Double cone Blender
Paddle Mixer
Continuous High Speed Mixer
Conche Mixer
Combination Mixer

ALLIED PRODUCTS

Air Pollution Control Equipments
Material Handling Equipments
Heat Transfer Equipments
Pharma Equipments
Agitators
Auto Weighing & Batching Systems
Coded Vessels
Storage Silos

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Turnkey



Distillery Plant

Detergent Powder Plant

Starch and Glucose Plant

MCCP Plants

Gum Plant

Zero Liquid Discharge Plants

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.

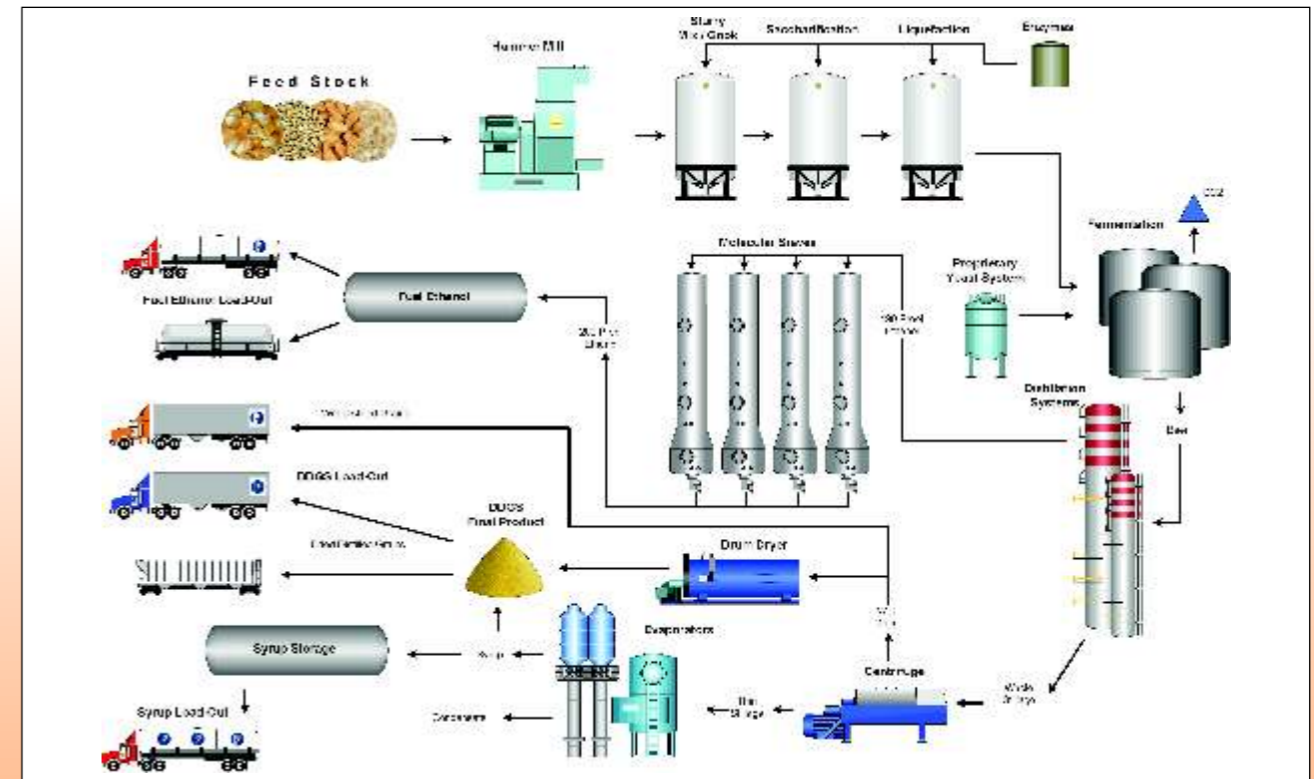
The process of distillation is one with slow

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.

Process Flow Diagram



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, Higher yield.

Features

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

Dehydration Processes

Molecular sieve dehydration plant design based on pressure swing adsorption with thermal heating to maintain quality norms with advantages.

- High Ethanol Dryness.
- Lower Energy Consumption.
- Higher desiccant (Molecular Sieve) life.



Zero Liquid Discharge

RAJ Zero liquid Discharge Technology provide the most comprehensive, cost-effective and reliable operating systems and services. These products and services are designed to help keep your plant safe, or your company profitable.

The Evaporation System consists of single or multiple calendrias (Tubular shell and tube heat exchangers) followed by drying systems. Evaporation systems are designed with consideration of higher fouling fluids, rugged operation, less maintenance and operating cost, easily stable with fluctuation on steam or feed side. For drying we offer rotary and spary dryer considering the suitability and nature of the product to be handle. The dryers are highly efficient having low operating costs and easy to operate. These dryers are highly effective for products, which required gentle drying and higher residence time.



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.

- Handling 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 to 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 consist basically 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 is 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 is a polymer of glucose found in most plants. Starch is organised in 1-140 µm granules in 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. One of the highlighted aspect of starch processing / extraction is that starch is produced according to the requirement of the end users depending upon changing reaction condition (Temp, pH2 additives) and strict process control methods. 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 equipment & starch processing plants that meet varied requirements in starch & it's derivative manufacturing units. Our advance 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.

Starch Manufacturing Process:

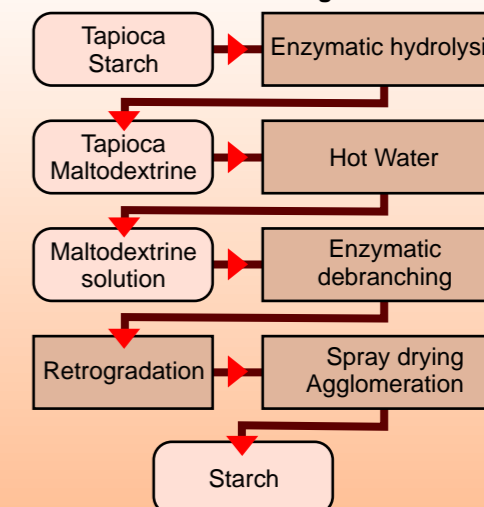
Starch manufacturing process can be schematically represent as follows:

Usage of Starch

As a pure & renewable natural polymer starch caters to multiple usage. Its significance as a polysaccharide (being able to breakdown into their monomeric and or oligomeric components) leads to production of Dextrose, glucose, fructose, maltose & sorbitol. Furthermore, starch is also an



Starch Manufacturing Process



important ingredient for the sugar industry, which was otherwise relying upon sugar cane and beet sugar. Some of most common industrial uses of starch is as follows:-

■ **Ceramics**

Starch is also used to make some packing peanuts, and some dropped ceiling tiles.

■ **Textile chemicals**

To reduce breaking of yarns during weaving, the warp yarns are sized. Starch is one of the main agents used for cotton sizing. Starch is also used as printing thickener.

■ **Printing industry**

in the printing industry food grade starch is used in the manufacture of anti-set-off spray powder used to separate printed sheets of paper to avoid wet ink being set off.

■ **Bioplastics**

starch is used to produce various bioplastics, synthetic polymers that are biodegradable. An example is polylactic acid.

■ **Body powder**

Powdered corn starch is used as a substitute for talcum powder in many health and beauty products.

■ **Oil exploration**

starch is used to adjust the viscosity of drilling fluid which is used to lubricate the drill head in (mineral) oil extraction.

■ **Bio-ethanol**

Glucose from starch can be further fermented to ethanol.

Hydrogen production - Starch can be used to produce hydrogen, using enzymes.

■ **Papermaking**

■ **Adhesives**



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 a 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

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 Flake. 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:

1. 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.

2. 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.

3. Washing Conveyor

Guar splits are screened to clean and then soaked to pre-hydrate in washing conveyor.



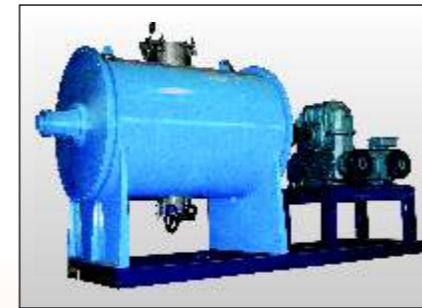
Pre-hydrating stage is very important in the process as it derives the rate of hydration of the final product.

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.

4. 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.

5. 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.

6. Flaker Dryer

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

7. 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.

8. 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 Steel construction with epoxy painted. The blower is complete with anti-vibration pads, air flow control damper for regulating flow of air.

■ **Cyclone**

High efficiency Cyclone separator is provided for collection of the product. The cyclone is provided in SS 304 and is complete with a vortex breaker.

■ **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.

■ **9. 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.

■ **10. 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.**

1. PLC based automated system.
2. Easy to operate and maintain.
3. Low power & fuel consumption.
4. Optimum space requirement.



Zero Liquid Discharge Plants

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

■ **Process**

Zero liquid discharge plants consist of a combination of different types of evaporators depending upon the nature of liquid and its contents. The waste liquid is concentrated to the maximum level in the evaporators 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 a 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 1000 kL per day.
- PLC controlled systems.
- Pure condensate from the system which can be reused in process.

■ **Applications:**

- Pharmaceutical industry
- Distillery
- Chemical and dyes industry
- Paper industry
- Steel industry

