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INTRODUCTION

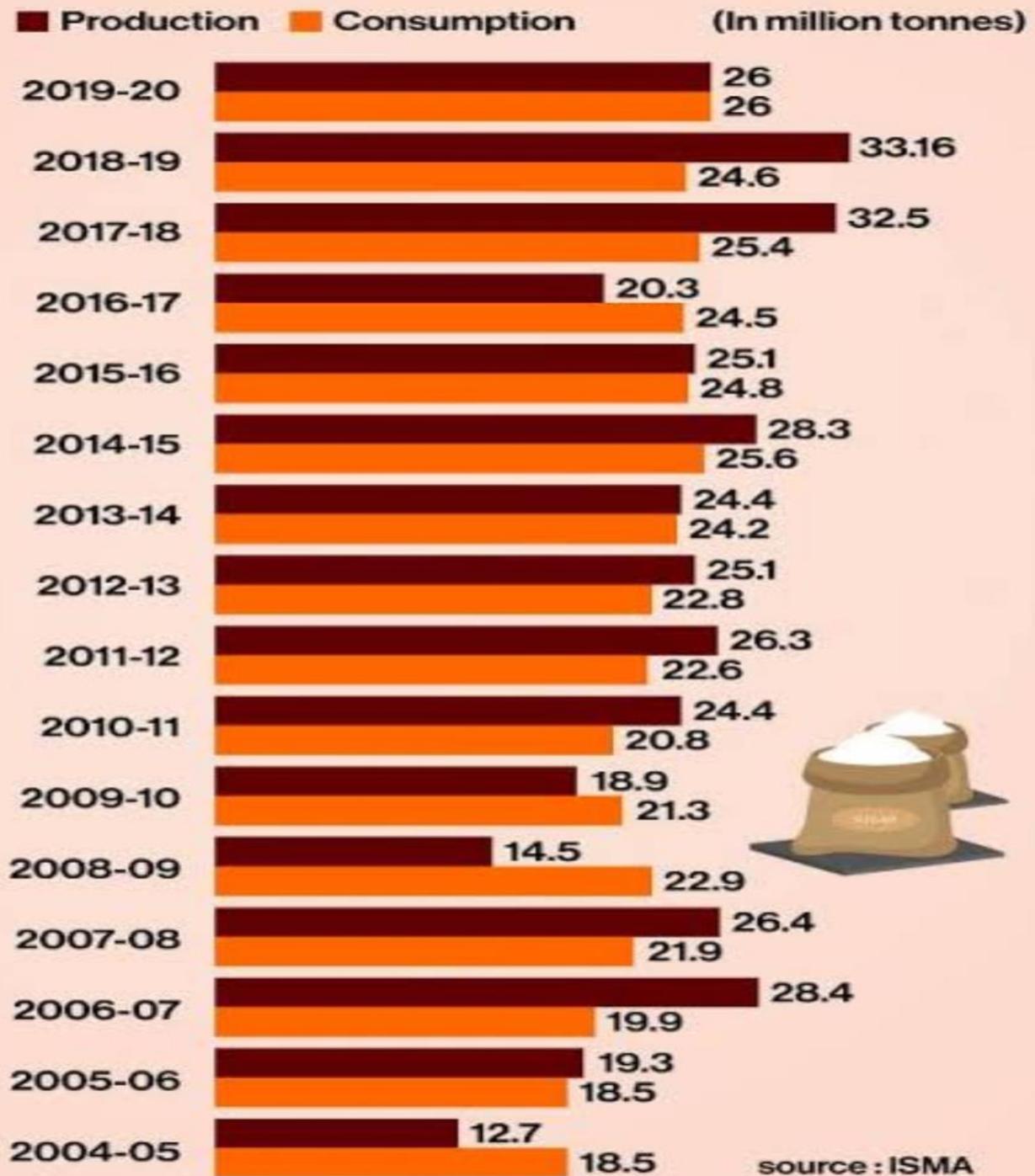
Sugar industries development is backbone to economic development of the nation. In India, Sugar industry is the second largest agro-based industry and it contributes significantly to the Socio economic development of the nation. Indian sugar industry is also a major sector to create Employment probably 7.5 per cent in Indian economy. The sugar industry plays a leading role in Global market being the world's second largest producer after Brazil, producing nearly 15 and 25 Per cent of global sugar and sugarcane respectively. The sugar industry produces around 300-350 million tonnes (Mt) cane, 20-22 Mt white sugar and 6-8 Mt jiggery and khandasri to fulfill the Domestic consumption of sweeteners. The industry is able to export around 1300 MW of power To the grid. Sugar industry is also involve to make avail of sugar complexes by manufacturing Sugar, bio-electricity, bio-ethanol, bio-manure and chemical. These contribute about 1 per cent To National GDP. Sugar industries in India remains regulated and are a source of livelihood for

50 million farmers and their families. It provides direct employment to over 5 lakh not only for Skilled labourers but also to semi-skilled labourers in sugar mills and allied industries across the Nation. The annual turnover of the sugar industry in India was estimated at Rs.41,000 crore and It has been paying taxes to the government Rs.2,500 crore per annum. The present paper Mainly outlines overview of the sugar industry in Indian industries.

What is sugar?

Sugar is the generic name for sweet-tasting, soluble carbohydrates, many of which are used In food. Simple sugars, also called monosaccharides, include glucose, fructose, and galactose. Compound sugars, also called disaccharides or double sugars, are molecules composed of two Monosaccharides joined by a glycosidilc bond. Common examples are sucrose (glucose + Fructose), lactose (glucose + galactose), and maltose (two molecules of glucose). In the body, Compound sugars are hydrolysed into simple sugars. Table sugar, granulated sugar Or regular sugar refers to sucrose, a disaccharide composed of glucose and fructose.

India's sugar production and consumption scenario



SUGAR MAKING PROCESS

- ***Extraction of the Juice:***

The canes are thoroughly cleaned and cut into small pieces. These small pieces in the form of a compact blanket are made to pass through two roller crushers and four sets of mills. After major quantity of the juice has been extracted by the crushers and the first two mills, cold or hot water is sprinkled over the bagasse whereby residual juice gets diluted and can be easily extracted by further milling. About 90-95% of the juice is usually extracted.

- ***Clarification of Juice:***

The raw juice is dark opaque liquid containing about 15% sucrose and small quantities of glucose, fructose, vegetable proteins, mineral salts, organic acids. There are two main processes for clarification of juice:

(i) Sulphitation:

Adding milk of lime and treating with sulphur dioxide.

(ii) Carbonation:

(iii) Adding milk of lime and treating with carbon dioxide.

(a) Defecation:

The juice is strained to remove suspended matter and treated with 2-3% lime till pH value reaches 7.2 in tanks heated with steam coils. Heating of the juice helps the coagulation of albuminoids by lime. The vegetable proteins are thus coagulated and the organic acids neutralized. The scum at the surface and the mud settling at the bottom are mechanically removed by passing the whole through a filter press and the clear solution sent on to the conical tanks for carbonation or sulphitation.

(b) Carbonation or Sulphitation:

A current of carbon dioxide is passed through the defecated juice, which contains unreacted lime and calcium sucrosate (carbonation). This removes the excess of lime as calcium carbonate and decomposes calcium sucrosate

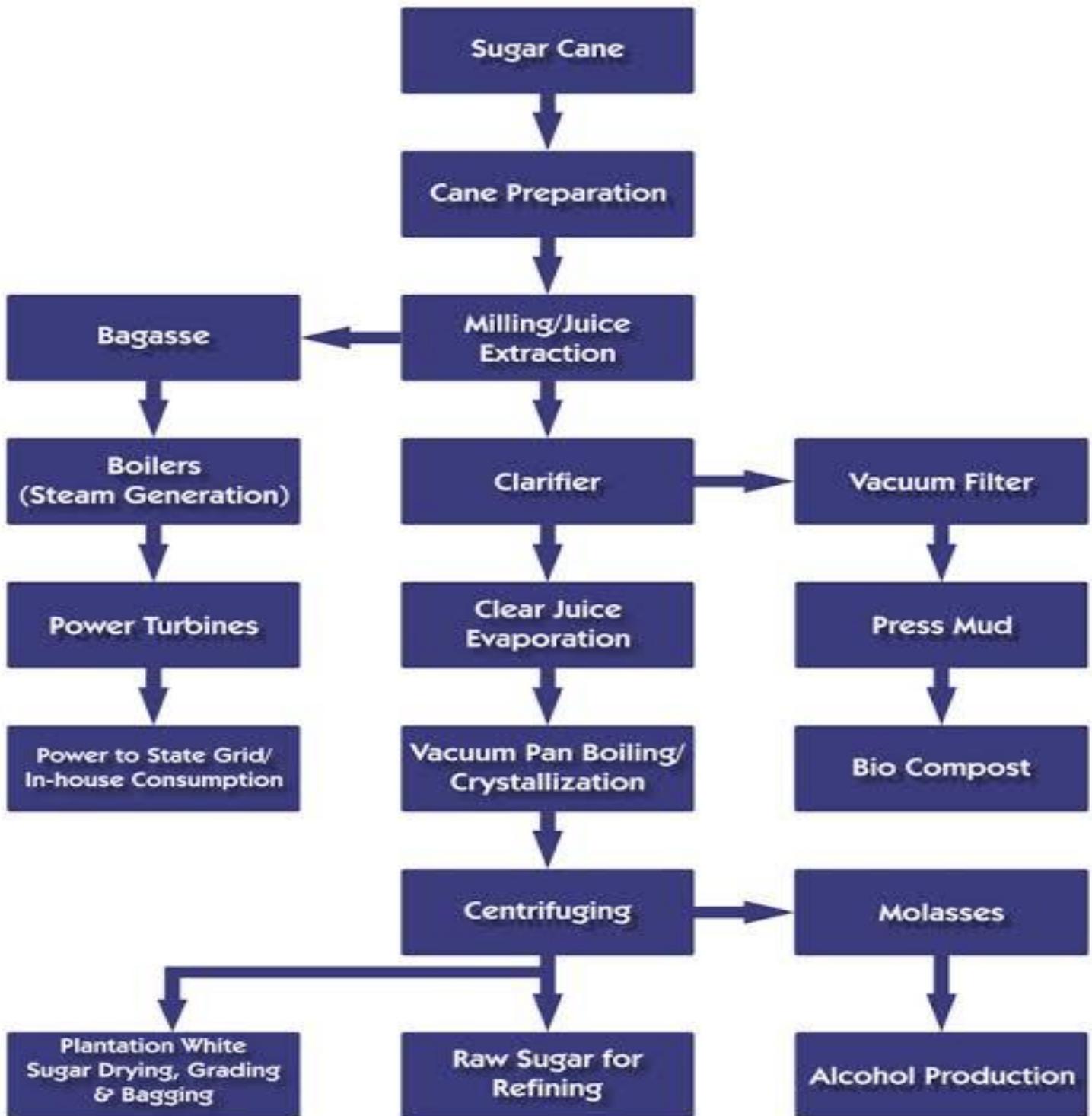
- ***Concentration and Crystallization:***

The clear juice is concentrated in a multiple effect evaporator. To this concentrated juice sulphur dioxide is again applied. All through this process a strict control is maintained over the acidity of the solution otherwise there will be losses due to inversion, destruction or even discolouration may be there. The clear syrupy juice is just boiled in a vacuum pan till formation of sugar crystals begins. The contents of the vacuum pan are taken into the crystallizing tank and allowed to cool slowly when the tiny crystals of sugar grow in size.

- ***Separation of Crystals:***

The crystals along-with the mother liquor (molasses) are whirled in centrifugal machines wherein the molasses is removed. A little molasses adhering to the crystals is removed by spraying cold water and whirling in the centrifuge again. The crystals are given a little blue colour and dried by dropping through a long pipe through which hot air is passing up and bagged.

Fig. Block diagram of sugar making processes



• *Refining of sugar*

❖ AFFINATION

The raw sugar is mixed with a saturated syrup and then centrifuged to extract the crystals. Surface impurities (molasses) dissolve in this syrup and are removed

❖ MELTING

The sugar from 'affination' and 'recovery' is stirred and dissolved in hot water to the correct concentration, whilst strainers and brushes remove 'foreign objects'

❖ CARBONATATION

The solution is treated with Milk of Lime, and Carbon Dioxide is bubbled through it causing the chalk to precipitate removing further impurities

❖ FILTRATION

.....which are then filtered off, the resulting Brown Liquor being sparkling bright and pale yellowish brown in colour.

❖ CHARRING

By running the brown liquor through filters of small granules of Bone Charcoal, it is decolourised and purified, leaving a water-white Fine Liquor.

❖ VACUUM PANS

The fine liquor is now drawn into the Vacuum Pans for concentration and crystallisation. It is Evaporated under reduced pressure to form Sugar Crystals.

❖ CENTRIFUGAL MACHINES

The solution of mother syrup and crystals is then spun in Centrifugal Machines leaving the White Sugar Crystals which are then washed.

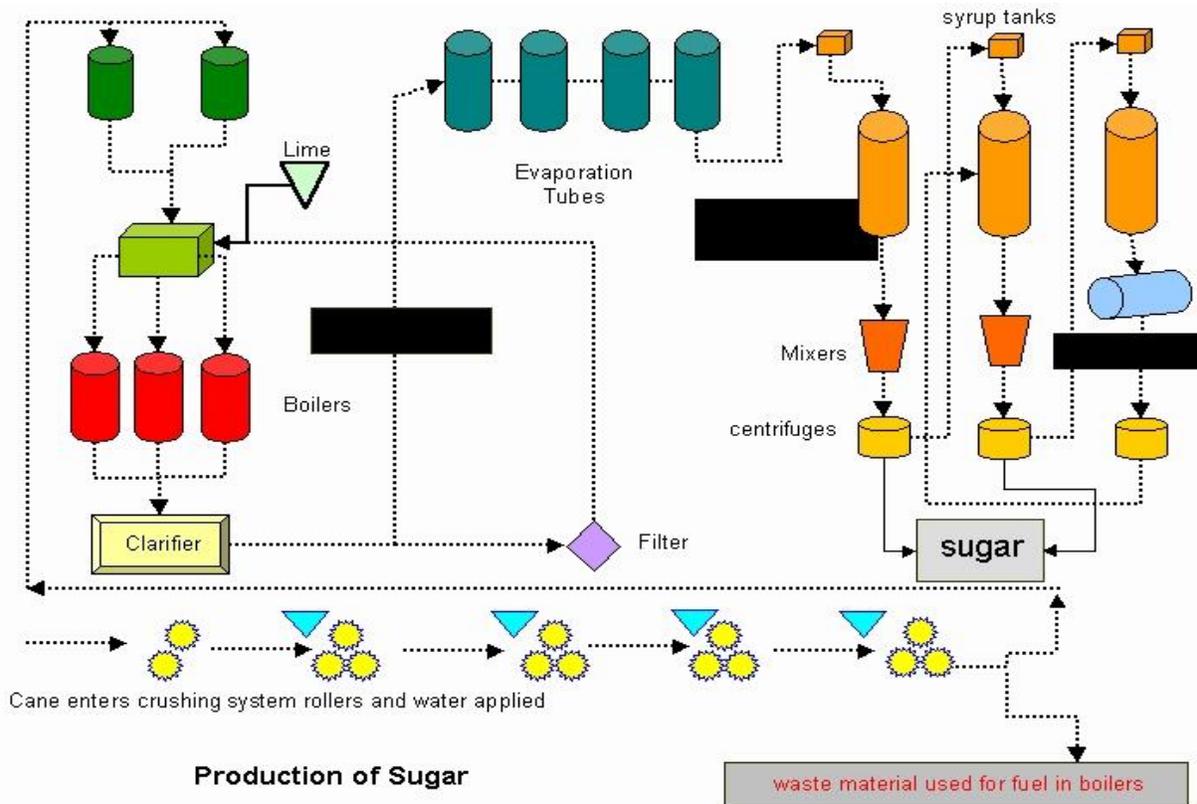
❖ GRANULATION

The wet sugar is Dried in a current of hot air.

❖ PACKAGING

After grading, the Dry Granulated Sugar is packeted for the domestic market, and bagged for the commercial market.

FIG. SUGAR PRODUCTION LINE DIAGRAM



What Chemicals Does White Sugar. Have?

Refining raw cane sugar into white table sugar is a complicated process that involves hundreds of organic, inorganic and electrolytic materials. The sugar cane is cut, washed in hot water and pressed; the juice is then mixed with lime. The canes may also be burned, mixed with soda ash and exposed to a myriad of chemicals in

order to clarify the sugar. Many of these chemicals can cause irritation to different parts of your body and, in high enough Doses, some of them can even be poisonous or toxic.

- ***Sulphur Dioxide***

Cane sugar is naturally brown because of the presence of molasses. During the drying process, Raw sugar cane juice is mixed with lime and evaporated. Sulphur dioxide is added to milled White sugar before evaporation. This is what makes table sugar white. The sulfur dioxide Bleaches the cane sugar. Sulphur dioxide is the chemical that, when released by factories using Fossil fuels, combines with the atmosphere and can produce acid raid. It can also have adverse Effects when inhaled.

- ***Phosphoric Acid***

Phosphoric acid is another chemical used in manufacturing table sugar. It is added to liquid Sugar before evaporation in order to remove any impurities. This acid is also commonly added To carbonated sodas. Phosphoric acid is not innocuous; it has been linked to

tooth decay. Studies show that this additive can be as damaging to your teeth as battery acid. Phosphoric Acid is also a skin and respiratory irritant, which adds to the potential for harm.

- ***Calcium Hydroxide***

Calcium hydroxide is another chemical added to raw sugar in order to purify it before Evaporation. Calcium hydroxide is a poisonous white powder that can cause many adverse Effects when ingested in significant quantities. These include vision loss, severe throat pain, Severe skin and eye irritation, bloody stool, vomiting, low blood pressure, organ damage, Breathing difficulty and tissue necrosis. Raw cane sugar is less processed than table sugar and Does not contain calcium hydroxide.

- ***Polyacrylamides***

A newer method for clarifying cane sugar into white table sugar involves using anionic inorganic Colloids.

These chemicals, also known as polyacrylamides, are a product of acrylamide, a known neurotoxin. These can damage male reproductive glands and sweat glands. They are Eye and skin irritants that can also cause urinary incontinence, myalgia, speech disorders, Nausea, sweating, numbness and many other symptoms, including feeling “pins and needles” Throughout the body.

Machinery used in sugar manufacturing process

- **Steam transformer :-**

Steam transformer is tubular rising film/falling film evaporator designed for vapour generation from the hot condensate available from the refinery pans and surface condensers.

The purpose of this equipment is to supply the pure exhaust condensate to boiler without sugar contamination, to reduce the high pressure steam consumption in the refinery process house which will avoid the high colour development during the refining process.

- **Syrup Clarification System :-**

Syrup clarification is useful for producing higher quality plantation white or direct consumption sugar with lower IU colour and lower residual sulphur dioxide levels

- **Advantage :-**

- Removal of maximum Bagacillo and suspended solid.
 - Faster crystallization, higher exhaustion and less final molasses purity.
 - High quality sugar with less sulphur content

- **Falling film evaporator : -**

The falling film evaporator is a crucial equipment of the plant as it is highly useful for reducing the steam consumption. No extra energy is required to pass the juice through FFE, as the juice fed from the top descends over the heating surface in a thin film.

- **Multi Down Take Rapid Boiling Batch Pans**

- Suitable for boiling with low pressure and temperature bled vapors, Steam saving.

- Better circulation and high exhaustion up to 65% and high sugar recovery.
 - Rapid boiling and saving of time up to 0.25-0.5hrs per strike.
 - Less boiling point elevation.
 - No sugar loss due to high massecuite boiling temperature.
- **Continuous Type Centrifugal Machine : -**
Use for continuous separation of crystal sugar from molasses

HOW MANY TYPES OF SUGAR?

Four types of sugar

- Glucose is the sugar in blood
- And dextrose is the name given to glucose produced from Corn
- Fructose is the principal sugar in fruit
- Sucrose is table sugar

STATE WISE SUGAR PRODUCTION CAPACITY OF INDIA (2018-19)

| STATE | No. Of sugar mill | PRODUCTION (LAKH TONNES) |
|----------------|-------------------|------------------------------|
| Andhra pradesh | 24 | 122 (including Telangana) |
| Bihar | 11 | 200 |
| Uttar pradesh | 119 | 1705 |
| Maharashtra | 159 | 986 |
| Chattisgarh | 03 | 100 (including Madhya pr.) |
| Goa | 01 | - |
| Gujarat | 19 | 130 |
| Haryana | 14 | 85 |
| Karnataka | 61 | 459 |
| Madhya pradesh | 15 | 100 (including Chattisgarh) |
| Odisha | 05 | 15 |
| Puducherry | 02 | - |
| Punjab | 16 | 80 |

| | | |
|--------------|------------|----------------------------|
| Rajasthan | 01 | - |
| Tamil nadu | 42 | 191 |
| Telangana | 10 | 122 (including Andhra pr.) |
| Uttrakhand | 09 | 69 |
| West bengal | 02 | |
| Total | 513 | |

India became the world's largest sugar producer in 2018/2019, beating out Brazil for the first time in 16 years. India produced 33 million metric tons of sugar. That is 19% of the world's total **sugar** production of 179 million metric tons . In India Uttar pradesh is the largest producer of sugar followed by Maharashtra .Sugar industry of India contribute about 1 % of national GDP .

TYPES OF BOILER used in sugar factory

- Biomass fuel boiler and gas oil fuel boiler are widely used in sugar factory, which are environmental friendly.
- Biomass steam boiler is the best choice for sugar mill. The traveling grate type steam boiler that can burn both coal and biomass fuel. The large quantity of biomass fuel in sugar industry could be reused and save much cost for industry. A high combustion efficiency can be reached with advanced designed chain grate by adjusting the running speed to a suitable value. Therefore, biomass fired boiler is widely used in sugar mill.
- Gas fired steam boiler or oil steam boiler can also be used in rice mill. With packaged style, the boiler is easy to transport and install. It can get the capacity of 6~35t/h under pressure 1~2.5Mpa, temperature 193~300°C. The boiler can burn natural gas, heavy oil, LPG, coke oven gas, etc. It has also many advantages such as large combustion chamber,

strong load adaptability, safe and reliable operation, long service life, environmental friendly and so on.

Pollution control devices for bagasse boiler

- ***WET SCRUBBER*** :-Scrubbers are effective air pollution control devices for removing particles and/or gases from industrial exhaust streams. A Wet Scrubber operates by introducing the dirty gas stream with a scrubbing liquid – typically water. Particulate or gases are collected in the scrubbing liquid. Wet Scrubbers are generally the most appropriate air pollution control device for collecting both particulate and gas in a single system.
- ***Electrostatic precipitator*** :- Electrostatic precipitator, also called electrostatic air cleaner, a device that uses an electric charge to remove certain impurities either solid particles or liquid droplets from air or other gases in smokestacks and other flues. The operation of electrostatic precipitators is fairly simple. The dirty flue gas escaping through the

smokestack is passed through two electrodes . One of the electrodes is charged with a high negative voltage , Further along the pipe, the second electrode carries a similarly high positive voltage. Based solely on the fact that opposite charges attract, the negatively charged soot particles are pulled towards the positive electrode and stick to it. Occasionally these plates must be cleaned to remove the accumulated soot and dispose of it into a hopper.

- ***The CORE SEPARATOR :-*** Core separator is a new technology for particulate separation, based on centrifugal effect. Core separator efficiency is higher than the multi cyclone one, due to the fact that separation and collection processes occurs in various elements .Thus avoiding the particulate carry-over usually happening at the cyclone exit section. The core separator cost is approximately three times higher than the same capacity in a multi cyclone. However, for 10pm particles, the core separator and multi cyclone efficiencies are 94 and 20respectively .

ADVANTAGE OF SUGAR INDUSTRY

1. Ready market all year through. You can . never fail to get market for your Sugar.
2. High demand. Sugar has high demand
3. There is no low or high season in this industry
4. Ready products to use

DISADVANTAGE OF SUGAR INDUSTRY

1. Low Yield of Sugarcane
2. Short crushing season
3. Fluctuating Production Trends
4. Low rate of recovery
5. High cost of Production
6. Small and uneconomic size of mills

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