**PROCESS OF ETHANOL MANUFACTURING**

Plant is using 1G technology of grain to ethanol. Plant is designed to use – broken rice, maize and other starchy grain. Main process steps are –

1. **Grain handling** – it includes, grain received, pre-cleaning and grain storage in grain silos.
2. **Milling** – stored grain is further cleaned and all dust and foreign material is removed. It is then crushed to fine particle in milling machines. Desired particle size is 200 micron for grain flour.
3. **Liquefaction** - grain flour is mixed with water and cooked. Also enzyme is added for starch conversion. It is cooled to 30 deg C.
4. **Fermentation** – converted starch is fed to the fermenter and saccharification enzyme is added to convert into sugar. Also dry yeast is added to convert sugar into ethanol. It is a batch process and sugar is converted into ethanol, carbon dioxide and some other by products. Once complete starch is converted, it is fed to the distillation column. Product from fermenter is called fermented wash.
5. **Distillation** – fermented wash received from fermenter is fed to the series of columns. Total four columns are used.
   1. Analyser Column
   2. Degasifying Column
   3. Rectifier cum Exhaust Column
   4. Alcohol Scrubber

Ethanol concentration after distillation section is 95% v/v. it is fed to the ethanol drying section.

Other products extracted out are –

1. Impure alcohol/technical alcohol – stored separately.
2. Fusel oil - stored separately.
3. Other constituents in grain, mainly fibre, protein and other products in grain. – these are slurry and fed to the decanter
4. **Ethanol drying** – ethanol received from distillation having purity of 95% v/v. it is fed to the molecular sieve columns and dried upto the desired concentration of min. 99.5% v/v.
5. **Decantation** – decanter is the machine where solid products are separated with liquid. Slurry received from distillation column is fed to the decanter. Decanter separate water from the slurry and final moisture in product is upto 50%. Solid product coming out from decanter is fed to the dryer and liquid product coming out is fed to the evaporators.
6. **Dryer -** solid received from decanter contains upto 50% moisture is fed to the dryer and dried. Moisture in solid is reduced upto 12%. Product received from dryer is mixed with concentrated syrup received from evaporators. Final products is **“Distiller Dried Grain Soluble (DDGS)”**.
7. **Evaporators** – water received from decanters contained water soluble proteins and other valuable grain constituents. The solution is concentrated in evaporators and concentration increased upto 35% w/w. these concentrated syrup are send back to the DDGS dryer section for mixing.
8. **CO2 section** – Carbon Dioxide (CO2) evolve during fermentation is collected, washed and liquefied. It is stored in insulated tanks and used in carbonated drinks.

**Basic process flow diagram**

Grain Handling & storage

Grain Milling

Liquefaction

Fermentation

Distillation

Ethanol drying

Decanter

DDGS Dryer

Evaporators

**Grain – Broken Rice / Maize**

**DDGS**

**Impure Alcohol**

**Fusel Oil**

**Anhydrous Ethanol 99.5%**

**Liquid CO2**

**Enzyme & Yeast**

**Enzyme**

**Commissioning protocol –**

Following protocol is being followed –

1. Format system –
   1. a team comprising process, asset integrity and maintenance checked every line and equipments as per P&ID
   2. all discrepancies are recorded and rectified
2. Trails of the various rotary equipments at no load and at load.
3. Water trail of the complete sections where water is involved in process.
4. Mechanical trail of the equipments where water is not involved in process - grain handling, milling and dryer section.

**Testing procedure –**

1. All chemicals and raw materials are tested as per defined standards – IS code or defined international code.
2. All products are tested as per IS code or defined international code.
3. Anhydrous ethanol is tested as per defined IS code

**Certification of the production and quality –**

As per Oil Marketing Companies, a Third Party Inspector to be appointed for 15 days. He will certify the continuous production of the anhydrous ethanol for 15 days. He is release the certificate for same.