Manufacturing Process

The proposed distillery plant will operate on molasses as feed stock during season and on saved/purchased molasses as feed stock during off-season. With 45% fermentable sugar in molasses one ton of molasses will yield 256 lit of total ethanol molasses required per days is worked out in the following table.

THE PROCESS

Section-A: Yeast Propagation and Fermentation

GIACL have planned to install the proposed 30 KLPD plant expansion of MOJJ Engineering Systems Ltd., Pune. MOJJ is the leading supplier of distillery plants in India, South Asia, Africa and South Central America, and have continuously developed process technologies and engineering for distilleries.

Over the last fifteen years, MOJJ has supplied several fermentation and distillation plants, which are essentially designed to suit international norms of spirit quality and fermentation efficiency.

The fermentation plant designs include cascade fermentation with cell recycle, cascade fermentation with yeast recycle and cascade fermentation with granulating yeast and gravity settling.

The distillation plants are customized for quality, consumption and operational ease. There shall be state art specially designed equipments enabling efficient separation of impurities with reduced scaling and down time. MOJJ, for the first time introduced the concept of integrated evaporator for substantial reduction of spent wash volume at no extra steam.

As a latest development in the fermentation technology, MOJJ fermentation process has evolved. The technology is designed to specially handle the changing composition of molasses without having the problem of sludge recycle and build up, contamination and resulting low fermentation efficiencies.

The technology uses special type of yeast with self-granulating property. This is Saccharomyces cerevesiae yeast with high specific growth rate and productivity. Due to the self-granulating property, the yeast can be separated by gravity settling and treated to wash away contamination. The treated yeast passes through activation step and is recycled back to fermentation. The MOJJ fermentation process thus gives high fermentation efficiency based on molasses composition and can be flexibly adapted for modernization of existing batch fermentation plants as well as for expansion or for new projects.

The sections comprise yeast propagation section, fermentation section with four fermenters, yeast separation & treatment section and yeast activation section. While starting up the plant yeast propagation is done in propagation system. The grown yeast is used to fill up first fermenter and in a similar manner all the other fermenters are filled. When the fermenters are ready for distillation, the fermented wash is subjected to gravity settling for yeast separation. Sufficient residence time is used for completing fermentation. The residence time is dependent on molasses composition. The reactivated and grown yeast is sent to fermentation.

All fermenters are sparged with Air / CO₂ generated during fermentation. This helps in maximum recovery of pure CO₂ from fermentation. Similarly, it helps in minimum generation of by-products. The CO₂ generated in fermentation is scrubbed through the CO₂
scrubber, for recovering alcohol in it, before realizing for recovery. This minimizes loss of alcohol.

The process is designed to minimize the adverse effects of high volatile acidity and sludge in molasses. Similarly the process is designed to minimize effects of contamination.

**Section-B: Multi-Pressure Vacuum Distillation**

The fermented wash containing alcohol, non-fermentable solids and water is supplied to distillation to separate the alcohol and other impurities as a continuous flow. The distillation system is designed for premium quality Extra Neutral Alcohol. The system details are as below.

The system consist of 7 columns viz. CO₂ Stripper, Stripper, Pre-Rectifier column, Extractive Distillation column, Rectification column, Refining column and Fusel Oil Concentration column.

Wash is fed to CO₂ stripper column to remove CO₂ gas in wash. Alcohol is stripped off water in stripper column. The distillate from stripper column is fed to Pre-Rectifier column to remove most of fusel oils and the distillate from Pre-Rectifier column is fed to Extractive Distillation column, after dilution with soft water. In Extractive Distillation column most of high boiling impurities separated from alcohol in presence of water. The alcohol water mixture from bottom of Extractive Distillation column is pre heated by steam condensate and spent lees before being fed to rectification column. In Rectification column product Rectified Spirit is taken out from top tray and fed to refining column. In Refining column mainly methanol impurities are separated and pure Extra Neutral Alcohol from bottom of the column which is sent to storage after cooling.

The impure spirit cuts from top of Pre-Rectifier column, Extractive Distillation column, Rectification column and CO₂ stripper column fed to Fusel Oil Concentration column. Final impure spirit cut is taken out from Fusel Oil Concentration column and balance alcohol is recycled back to Pre-Rectifier column. The alcohol containing fusel oil from Pre-Rectifier column and Rectification column is also fed to Fusel Oil Concentration column.

The top vapors from CO₂ stripper column are partially used for heating fermented wash coming in and partially condensed in condensers. Also the vapours from Extractive Distillation column and Fusel Oil Concentration column are condensed in condensers. The Rectification column, Fusel Oil Concentration column and Pre-Rectifier column get heat from steam at 3.5 bar (g).

Rectification column and Pre-Rectifier column work under positive pressure. Top vapours from Rectification column are condensed at CO₂ stripper column reboiler for giving heat to CO₂ stripper column. Most of the other columns work under vacuum or atmospheric pressure.

Spent wash coming from CO₂ stripper column is partially cooled and recycled back to fermentation where it is used as diluter. Partially spent wash sent to Effluent Treatment. The special design facilities for reducing spent wash quantity from 11 ltr./lit of alcohol to finally 8 lit / lit of alcohol in CO₂ stripper column reboiler without additional steam for evaporation.

Benefits of “Multi pressure” Distillation:

1) Operation of Analyzer column is under vacuum. This minimizes formation of by products during distillation (like Acetal). Hence, the overall quality of spirit is
improved. Also, chances of scaling due to invert solubility of certain precipitating inorganic salts of Calcium and Magnesium are reduced considerably in vacuum distillation.

2) Analyser column with Hyper – state trays ensure high turbulence on tray, this minimizes Chances of scaling. Also, this special construction of trays and access to each tray helps in easier maintenance of column internals.

3) Pre-Rectification column ensures proper removal of Sulphur compounds / mercaptans for ensuring a good odour to alcohol. This column also reduces the load of lower boiling volatile compounds passing on to Rectifier cum Exhaust column.

4) Vacuum distillation system requires low steam consumption i.e. 1.8 kg/lit. of total alcohol of EQRS quality as against 2.0 – 2.2 kg/lit of total alcohol of normal quality in atmospheric distillation.

5) System designed for maximum heat integration for optimum utilization of energy.


7) Use of Term siphon re-boilers in Analyzer column helps in maintaining uniform temperature profile across the column. Also avoid excess spent wash volume generation.

8) Energy saving by recovery of Steam condensate from Thermo siphon re– boiler of Analyzer column.

9) Effective separation of fusel oils from decanter.

**Manufacturing Process of Ethanol**

Rectified Spirit having 95% of alcohol taken from day receiving tank and feed it to feed pre heater through feed filter having capacity 1800 ltrs. In feed pre heater alcohol is heated up to 84°C and feed to evaporator column.

Principal of evaporator column is to evaporate Rectified Spirit to vapour state. The evaporator column is provided with re boiler for heating the spirit externally. Principally for better result of re boiler liquid level in evaporator bottom maintained as per specific norm. Spirit is feed from top of evaporator column and heat is given at bottom from re boiler. In evaporator column temperature of spirit increases up to 90°C and converts in gaseous state from liquid state. This spirit vapours having 90°C temperature feed to super heater where they are super-heated up to 130°C at 0.7 kg/cm2 pressure.

The super-heated vapors feed to molecular sieve beds “A” and “B”. Molecular sieves absorbs water molecules from broth of super-heated vapours and pure 99.9% alcoholic vapours carry over to regeneration pre heater followed by feed pre heater and product cooler. The cooled liquid product collected in product tank and pumped to storage section. The sieve beds are arranged in a cycle. When one is in charging state, other is in regeneration state.