Business Area
Biomass Chemicals

BIOSTIL® 2000 – Starch

Chematur
Engineering Group

BIOSTIL® 2000
– High Performance Ethanol Production

Profit by our experience in ethanol production

If you intend to invest in ethanol production you would expect a plant with

- lowest environmental impact
- highest resistance to infections
- highest production yield
- lowest water consumption
- uncomplicated operation
- smallest site demand

High plant performance

Biostil® 2000 stands for high plant performance when utilising grain or sugar based raw material and is considered to be a state-of-art technology. Compared with conventional technologies, batch and cascade systems, Biostil® 2000 offers low contamination risk, higher ethanol yield, lower water consumption, higher stillage concentration, higher on stream time and is easy to operate.

Low contamination risk

One of the costliest factors in ethanol production is contamination. In Biostil® 2000, the contamination risk is dramatically reduced due to the nature of the process which includes: high osmotic pressure in the fermenter, a built-in internal pasteurization effect and no availability of sugar in the fermenter, <0.5 g/l of glucose. In the case of a contamination, the economical impact is minimized in Biostil® 2000, as the system is designed with a stand-by fermenter which will go into production when the contaminated fermenter is taken out of production resulting in no down time. Further, there is no available sugar in the Biostil® 2000 fermenter which results in no loss of sugar.

Lower water consumption

In Biostil® 2000 the water balance has been optimized to minimize the use of water. Every drop of water added to the plant needs to be removed, which will require energy. The optimized water balance results in production of high concentrated stillage, about 30% dry solids. The stillage is normally used as animal feed and is often called DDGS (Distillers Dried Grain with Solubles). DDGS has very good nutrient value as it contains around 30 wt-% proteins in dried material together with all the minerals and trace elements originating from the grain and yeast. Farmers in the neighbourhood can also collect and transport the 30 wt-% stillage as it is and mix the stillage with other types of animal feed at the farm. The stillage generated in Biostil® 2000 is sent directly to the DDGS dryer eliminating any need for centrifugal separators (decanters) and an evaporation plant, necessary in conventional ethanol plants. It is by far more economical and creates less environmental impact to de-water 30 wt-% stillage than 6-7 wt-% stillage from conventional ethanol plants. In addition, Biostil® 2000 can be designed to generate zero liquid effluent by recycling all water (lutter water) from the distillation unit. The stillage can be used to produce Biogas as an alternative.

Higher ethanol yield

Several factors contributing to the high ethanol yield: minimized yeast production, steady state operation, dual fermentation system, efficient fermenter temperature control and ethanol recovery from the carbon dioxide leaving the fermenter.

Yeast production is minimized due to recycling of yeast to the fermenter which results in a large population of yeast cells. Due to the yeast recycling, the amount of yeast in the fermenter is higher than needed for the ethanol production. The vitality of the yeast in Biostil® 2000 is therefore not as critical as in a conventional system due to the excess of yeast in the fermenter. Achieving the higher vitality needed in a conventional system requires a higher yeast cell production. Consequently, more sugar is required to produce yeast which will lower the ethanol yield.

The fermenter in Biostil® 2000 operates at steady state. All process parameters in the fermenter are therefore constant and well controlled. The sugar in the raw material is directly converted into ethanol and carbon dioxide. The sugar concentration is less than 0.5 g/l at anytime in the Biostil® 2000 fermenter. The ethanol concentration is controlled by continuously stripping off the produced ethanol by circulating the mash through the mash column. During operation, the ethanol concentration in Biostil® 2000 is kept at 6-6.5%-wt. ethanol. In conventional systems conditions in the fermenters are constantly changing with time. At the start of a batch fermenter or at the beginning of the cascade system the sugar concentration is high and the ethanol concentration is low. This condition promotes the formation of by-products such as glycerol and higher alcohols. Due to this difference in conditions, conventional systems will utilize more sugar for by-product formation, hence lowering the ethanol yield.

Biostil® 2000 is equipped with two fermenters. One fermenter is in operation while the other is stand-by. Optimum fermenter cycles are set based on raw material and local conditions. The dual fermenter design achieves a very high on stream time. The stand-by fermenter together with spares for critical equipment and a CIP system (Cleaning In Place) keeps the plant running continuously. The plant will only be shut down during scheduled maintenance periods. Plant availability is essential to a high ethanol yield as 3 days of down time equals close to 1% in lost ethanol yield. Conventional systems are not equipped with 100% spare fermenter capacity, which increases the down time in a conventional system.

Efficient fermenter temperature control is essential to obtain high ethanol yield. Accurate temperature control of the Biostil® 2000 fermenter is obtained by constantly circulating the fermenter mash through an external cooler.

All carbon dioxide leaving the Biostil® 2000 fermenter is scrubbed before it is released to the atmosphere or sent to a CO_2 recovery unit. The carbon dioxide scrubber fills two functions: recovery of ethanol which results in about 1% increased ethanol yield and meeting environmental requirements regarding VOC (Volatile Organic Compound) emissions.

Easy to operate

One single operator can operate a Biostil® 2000 plant. Biostil® 2000 is a continuous process requiring less cleaning of fermenters. All critical equipment is designed with CIP systems for easy cleaning. The feed of raw material controls the ethanol production. A temporary stop in production due to repair of equipment does not require the fermentation system to be emptied. Instead, the flow of raw material can be stopped and the fermenter can be cooled to stop the production and yeast activity. Once repaired, raw material is fed to the fermenter and the plant is again in operation. In conventional systems it is very difficult to stop the fermentation process, hence, a temporary stop will require the entire system to be emptied, losing raw material that has not yet been fermented.

Facts: BIOSTIL® 2000

Process description

Starch is continuously converted to glucose in a saccharification train of tanks and then fed to one of the fermenters at a pre set flow rate. The glucose is immediately converted into ethanol and carbon dioxide maintaining close to zero concentration of glucose. The ethanol concentration is kept constant at 6.5% by weight by continuous ethanol removal through the mash (primary) distillation column. Fermented liquid (mash) is fed to centrifugal yeast separators where yeast is separated and returned to the fermenter.

De-yeasted mash (beer) is preheated in a regenerative heat exchanger and enters the vaporisation section of the mash column. About 90% of the ethanol is removed as a 40% by weight ethanol/water vapour, which is sent to the rectification and dehydration section where fuel ethanol is produced. Most of the ethanol depleted beer (weak beer) is pumped through the regenerative heat exchanger and a trim cooler prior to being recycled back to the fermenter. The non-fermentables are drawn off from the bottom of the mash column as a concentrated Biostil stillage (about 30% by weight).

Other alcohol qualities can be produced by alternate distillation arrangements after the mash columns.

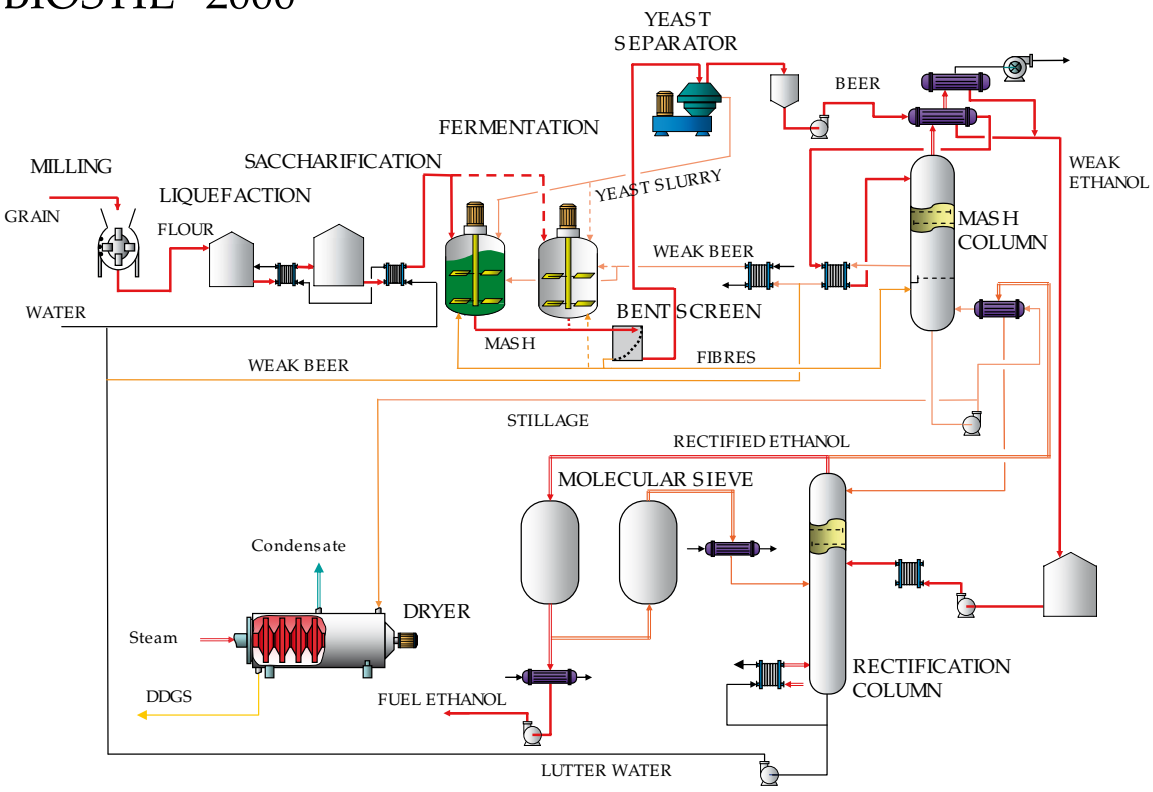
Products

Fuel ethanol, technical ethanol, potable ethanol and concentrated stillage (animal feed, energy production or methane production).

Raw material

Starch.

BIOSTIL® 2000



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