Dry Mill Corn Processing

FEEDSTOCK CLASSIFICATION

Starches & sugars, plant-based oils, plant-based proteins

FEEDSTOCK EXAMPLES

Field corn, sweet corn

PROCESS DESCRIPTION

Corn is ground into coarse flour and combined with water and enzymes to convert starch to sugar. This mash is then cooked and sterilized. Once cooled, yeast is added to convert sugars to ethanol and carbon dioxide by **fermentation of 6-carbon sugars & starches**. The mash is then distilled to remove ethanol, and the leftover mash is separated into its solid and liquid components for various uses.

The following are some of the important innovations used in modern ethanol plants.

Molecular sieves: If there is one predominant advance in the ethanol industry, it is the introduction of the molecular sieve, or molsieve. The molsieve is basically compared to a bed of ceramic-like beads that absorb the water molecules as vaporized ethanol passes through the bed. Molsieves replaced azeotropic distillation systems using cyclohexane or benzene, which were expensive, costly to operate, energy intensive and potentially hazardous.

Thermal integration: Engineering companies are providing turnkey services enabling a more streamlined production process and integrated energy saving technologies. Heating and cooling liquids is part of the ethanol production process; capturing the process heat and re-using or redirecting it to other areas of the plant can significantly reduce energy requirements and costs.

Enzymes: Improvements in enzyme technology and reductions in the cost of producing enzymes have lowered the price of ethanol by more than 6 cents per gallon. Enzyme manufacturers have increased enzyme production yield fivefold in the last 15 years. Furthermore, the new enzymes are more productive in hydrolyzing the starches to fermentable sugars and they no longer require the addition of lime for pH balance. Ammonia is now used, providing nutrients (nitrogen) to the yeast, making it more effective during fermentation.

Yeasts: Most ethanol plants today propagate their own yeast. The practice of “pitching,” which was the discarding of spent yeast and replacing it with a batch of new yeast, is no longer used.

High-gravity fermentation: This evolving technology will provide the opportunity to ferment “beer” mash containing considerably higher levels of solids. In doing so, it will reduce the amount of water required, which will then reduce the cost of handling and treating the water later in the process. In addition, higher solids result in higher “beer” yields in the same or less time.

High-temperature yeast: The development of yeast strains that withstand higher temperatures will not only increase the alcohol content of the beer but also reduce energy costs.

Quick steeping: The quick-steep process may evolve to be a major change for the dry-mill ethanol

industry. Presently, the entire kernel of corn is processed, sending all of the corn oil into the distillers' dried grains. The quick steeping process will allow dry millers to capture the corn oil prior to processing and to sell it as a separate product.

PRIMARY BIOBASED PRODUCTS

Flour, meal, grits, germ, corn oil, ethanol. It is technically possible to use corn flour from dry milling to make corn syrup and high fructose corn syrup, but this is not commonly done or considered economical.

PROCESS BYPRODUCTS

Distillers' dried grains and solubles, brewers yeast, carbon dioxide, thin stillage (sweetwater) or thick stillage (concentrated distiller's solubles), whole stillage, blends for cattle feed

MAJOR EQUIPMENT

Grinders, cookers, fermenters, sieves, evaporators, dryers

ENERGY REQUIRED

High

CAPITAL AND OPERATING COSTS

The cost of building a dry-mill ethanol plant has been reduced by 25-30 percent over the past 20 years, while the cost of production has been reduced by nearly half. This is primarily the result of the development of a "fuel-grade" process technology, as opposed to utilizing industrial/beverage grade processes and streamlining production.

COMMERCIALIZATION STATUS

Established

COMMERCIAL SUPPLIERS

The Corn Refiners Association, http://www.corn.org/; the Renewable Fuels Association, http://www.ethanolrfa.org/; and the National Corn Growers Association, http://www.ncga.com/ethanol/main/; can direct you to commercial suppliers.

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