Improving Profitability in the Corn-to-Ethanol Plant Using Simulation Technology

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Although process simulations have been heavily used in the chemical process industries for several decades, the biofuel manufacturing industry has begun to take advantage of this technology only during the past five to ten years. In this study, an Excel™-based model was set up to simulate corn-to-ethanol processing in a simple and straightforward manner.

This study focuses on two ways to improve ethanol production. One way is to increase efficiency by decreasing the energy demand and water required per gallon of ethanol produced. A second way to improve the efficiency and yield (gallon of ethanol produced per bushel of corn) is to use new yeast and enzymes or genetically modified corn to increase the ethanol concentration after fermentation.

An advantage of modeling the mass balance in Excel™ is that a variety of dry mill corn-to-ethanol processing options can be simulated according to the user's needs and the actual or proposed plant configuration. The Excel™-based mass balance results are comparable with the USDA Aspen model results. The Excel™-based model, however, allows analysis of water reuse strategies and does not require knowledge of Aspen™. Key assumptions, such as corn composition, were tabulated and examined and effects on the overall mass balance were simulated. Based on detailed information of mass balances, energy demands and manufacturing costs were estimated for different operation scenarios.

Energy evaluation using an *Aspen Hysys* simulation provides a reasonable value for energy demand in each section, and can be used to calculate the energy cost of the total plant. The results show that the distillation/dehydration and dryhouse sections require nearly 80% of the total energy demand, consistent with a typical corn-to-ethanol plant. The net energy value (NEV) for ethanol production from corn is positive.

This Excel™-based model can also provide detailed information for an economic analysis. The cash operating expense is $ 0.42 for a 30 MMgpy plant, which is comparable with a USDA plant survey.

Thus, this Excel™-based model is a reliable tool to study the mass balance for corn-to-ethanol plants, to estimate a realistic basis for energy demand for operation, and to analyze plant economics.