Harvesting Technology’s CoProMax™ Ethanol Co Products Recovery Process

Corn Ethanol Dry Mill technology has matured and potential increases in efficiency have become incremental. Ethanol producers have found by optimizing one component of the process you impact other processes and must balance the potential gain of one process with the impact it will have on the entire production process. In effect any optimization considerations have to be carefully assessed both from benefit as well as implementation cost perspectives.

Harvesting Technology™ recently completed commercial scale testing, under a Joint Development Agreement with a large multi-plant ethanol producer, at a testing facility in Iowa with whole stillage flow rates equivalent to the production of one million gallons of ethanol per year. The flow rates and outputs were fully instrumented to provide mass balances which could easily be sized to any scale dry grind ethanol plant. The thrust of this project was based upon increasing the value of ethanol coproducts, rather than attempting to increase the yield of ethanol, but it was found the data indicated additional ethanol production gains are potentially available from the process.

The primary CoProMax™ (CPM) process was developed and patented by Dr. Aicardo Roa, of Soil Net™. Harvesting Technology provided a grant for the process development and holds the license for commercializing the technology.

The CPM process focuses on improving the capture, yield and value of the coproducts available from ethanol production. This approach to maximizing coproducts value can provide significant additional income from every gallon of ethanol produced, as well as providing significant energy savings and carbon intensity gains. While the extraction of DCO now occurs in more than 90% of the dry grind ethanol plants, its extraction has multiple impacts on ethanol production and its profitability. Because DCO provides the second largest source of coproduct income from the production of ethanol, its impact on coproduct composition and value must be carefully considered, and care must be exercised in any process change which may impact this value. This is also coupled with the fact DCO is frequently utilized as a biodiesel feedstock has a direct impact on the carbon intensity (CI) of the plant. These and many other issues will be evaluated when considering the financial and sustainability impacts when dealing with ethanol coproducts. The proposed CPM process modification impacts these issues by modifying the traditional energy intensive process used to treat whole stillage, and replacing many of them with more effective, lower energy mechanical separation technologies.

The core value proposal of the CPM process is to reduce the energy used while efficiently recovering more high-value components from the whole stillage stream. In effect the CPM technology takes a fresh look at the overall process, opening up opportunities for greater energy reduction than would be possible with the current highly optimized and integrated process flow. The CPM process provides for higher value distillers grains, plus corn oil extraction recovery efficiencies of 1.34 pounds of DCO per bushel of incoming corn, higher than the best in class plants are currently obtaining.

The first step in the proposed process is the Dilution/Mixing step, recycled process liquids are used to dilute and evenly distribute the incoming whole stillage. This process through a low power physical
separation process improves the rapid dewatering of the whole stillage to separate the corn kernel fibers and allow a large faction of the proteins and fats to remain in a liquid stream. The wet solids from this process are further dried with a press and when dried to 90% dry matter produce, ~7.6 pounds (per bushel of incoming corn) of CKFiber™ with an average composition of 28.7% protein, 7.8% fat and 55% non-detergent fiber. The liquids from the physical separation processes containing the majority of the proteins and fats are concentrated using a Dissolved Air Floatation (DAF) process. The solids from the DAF are heated to an optimal temperature and then processed with a Tricanter to extract ~5.28 pounds of CoProMax™ (per bushel of incoming corn) when dried to 90% dry matter and contain an average content of +50% protein, 8% fat and <5% NDF and a liquid stream containing ~1.34 pounds of 98% DCO.

The effluent from the DAF averages less than 2.5% dry matter and is recycled for use in the initial dilution of the whole stillage feed, while the remaining fraction is available to be recycled to the front end of the ethanol process as backset for liquefaction in the ethanol process or other fresh water uses. An important consideration is the liquids recovered from this process will replace the thin stillage normally used as back set water. Because this liquid contains much lower levels of solids than thin stillage it offers the potential to allow the addition of increased volumes of corn into the fermentation process to increase in the amount of ethanol produced. We expect the use of the cleaner backset water, coupled with the increased volume of unfermented corn solids to the fermentation process, will result in an increase of up to 8% in ethanol production for the facility.

Conclusions

The use of a low rate polymer DAF process, plus an efficient physical corn kernel fiber separation, allows the capture of valuable coproducts without the use of large horizontal decanting centrifuges common in the ethanol industry. This serves several purposes;

1. By eliminating thin stillage production the majority of the energy used for syrup production can be redirected or eliminated offering significant energy savings.

2. The DCO which currently stays with the distillers grain produced from the decanting centrifuges remains with the CoProMax™ stillage increasing its availability for capture in the DAF process.

3. The CKFiber™ coproduct captured with the Physical Separation and Screw Press process is drier than existing centrifuged Distillers Grain, further reducing drying costs, or depending on market conditions a dryer product for sale as is.

4. The CKFiber™ coproducts composition has lower fat, but 50% higher levels of fiber and a Total Digestible Nutrient value which is similar to standard DDGS, providing an excellent ruminant feed product.

5. The CKFiber™ coproduct captures ~80% of the available corn kernel fiber and is an outstanding feedstock for cellulosic ethanol production as it eliminates the need to develop the complicated logistics trail necessary for other cellulosic feedstocks.
6. The DAF process also produces CoProMax™ a +50% protein coproduct containing a moderate fat and low fiber level which will significantly increase its value as a feed product for Monogastric and Ruminant animals due to a protein level higher than soybean meal. This value is expected to be more than triple the current DDGS price.

7. Because the DAF solids are separated from the thick stillage, the remaining liquids contain very low levels of fat and protein, and when used as backset water an ethanol production gain is possible because the non-fermentable solids which remain in the thin stillage backset have been eliminated and are replaced with ethanol producing corn solids. The addition of more corn solids and the resulting gains in ethanol production can be achieved in some production systems.

8. Carbon Intensity gains are not discussed in this paper in great detail. They are expected to be significant due to reduction in energy use due to the elimination of centrifuges for the separation of distiller’s grains and the evaporators for the thin stillage. If the CKFiber is used as a cellulosic feedstock additional gains will result. A study is currently planned to quantify the potential Carbon Intensity reduction. (The CI study is available in the Harvesting Technology website documents.)

9. DCO recovery levels of ~1.34 lb. of DCO per bushel of corn are unparalleled in the ethanol industry.

As outlined in this report, utilization of this new process can add significant additional revenue to the bottom line of an existing dry mill corn ethanol plant, with a CapEx which can be repaid in less than a year. With onsite plant data, the CoProMax™ model can be further refined and provide a compelling business case for this technology at individual ethanol plants.

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