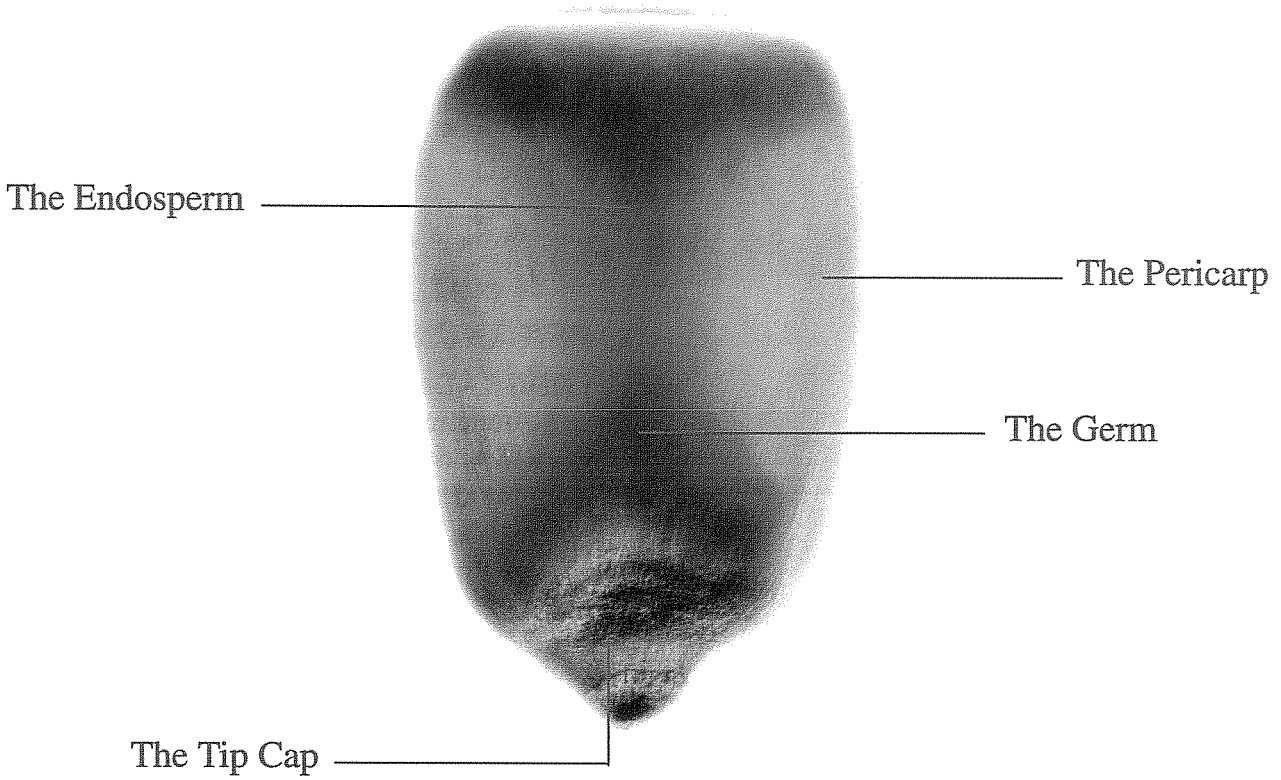

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Corn fractionation for the ethanol industry

By Glen Foster

Corn fractionation is probably the most talked-about "new/old" technology in the ethanol industry. The benefits appear to be large with no real known negatives except for minimal starch loss. Everyone in the process industry is trying to solve the fractionation puzzle, and there are many different processes available.

The wet milling process industry has been fractionating corn and making ethanol for several decades. Currently, the largest ethanol plants are wet mills which produce many valuable coproducts, some for the human food industry. If it weren't for the fact that ethanol provides such a large revenue stream, it could almost be considered a byproduct in the wet milling process. The cost of these wet mills is in the hundreds of millions of dollars and is not a viable fractionation solution for many fuel ethanol plants.

Dry mill fractionation, on the other hand, has been around for a long time and is mostly used for production of human-edible corn flour and meal. The dry mill process is very horsepower intensive, and the premium product yield is in the 60 percent to 70 percent range, with the rest of the product going to animal feed.

Many companies are trying to develop a modified dry mill fractionation process to be effective in a smaller ethanol plant range. The main objective is to remove the non-fermentable components from the fermentable component. The corn kernel has four main components: the pericarp, the endosperm, the germ and the tip cap.

The tip is the component that attaches the kernel to the cob. The germ is a small portion of the kernel that can be seen on one surface. The germ has oil, protein and enzymes that start the germination process for growth. The outer fibrous layer is the pericarp, or bran, which protects the kernel. The majority of the kernel is endosperm. The endosperm contains approximately 98 percent of the starch in the kernel and is approximately 83 percent of the dry weight of the kernel. For the ethanol process, starch is the constituent of the corn that is converted to alcohol. The object of fractionation for ethanol plants is to separate the endosperm from the other components because it contains 98

percent of the starch.

There are approximately 50 patents that address processes to break the kernel into its components; there are approximately another dozen or so patents in application, or patent pending. The challenge is to determine which method will provide the most economical solution to the new fuel ethanol plants that were built in the last two decades and for the new plants coming on line in the future. The benefits of corn fractionation are:

- By removing non-fermentable products (fiber and germ) at the front end of the process the percentage of starch in the slurry is higher, and a 9 percent to 10 percent increase in ethanol yield per batch can be achieved.
- It is conceived that with less non-fermentable product in the process, the enzymes can more easily access the starch and reduce the enzyme requirement by up to 30 percent.
- The non-fermentable product, if left in the process, becomes wet and requires drying at the back end of the process. Removing the germ and fiber reduces the drying load.
- By removing the germ, a large percentage of the oil is taken out of the process; oil tends to clog up and coat the heat exchangers, distillation, beer columns and evaporators. This requires periodic shutdowns for cleaning.
- Removing the bran reduces the amount of fiber in the DDGS, which by concentration increases the protein content of the DDGS by approximately 40 percent, as well as reducing the non-detergent fiber (NDF) by over 50 percent. This protein-enhanced DDGS will now be welcome into the hog and poultry feed markets at a much higher value.
- The germ byproduct contains a high enough oil content that can now be extracted by either pressing or hexane extraction, or can be toll extracted at existing corn oil facilities.
- The fiber fraction also has many new opportunities, which include cattle feed, human fiber additive, corn fiber oil extraction, or even on-site burning to reduce natural gas costs.

All of these benefits will greatly increase the bottom lines of ethanol production facilities. Fractionation has many benefits, but it also has some challenges, such as:

- There may be a requirement to add an anti-foaming agent to the fermentors when utilizing fractionation.

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- A small amount of starch is lost. The starch loss is a major concern to most ethanol producers, however if the coproducts are sold at a premium to corn, it can no longer be considered a loss but a new opportunity to increase revenues.

There are a number of groups in the industry promoting different solutions for fractionating corn from enzymatic germ removal to complete dry mills to wet mill expansions. All these solutions hold the promise of good financial returns. The required investment varies from $5 million to $100 million. The challenge is to seek out and find the solution that best suits your needs.

While the idea of fractionation is widely talked about, there are only a few companies that are in production and a few more under construction. Most of these plants are not accepting visitors at this time.

When evaluating a process, it is best to look at all the coproducts. Each stream will have to be evaluated. Be sure to see if the coproducts streams need further processing (i.e., drying of germ and fiber). Also review the products themselves for handling and storage.

The germ stream can be toll crushed for $35 to $45 per ton. The processing cost for hexane extraction is between 1 cent to 2 cents per pound, or $20 to $40 per ton. The fiber product, if sold as cattle feed will be somewhere between forage and corn prices. The endosperm going to process should be high in starch.

Over the past three years, I have been investigating a variety of solutions for corn fractionation for fuel ethanol. The conclusions of my investigation led me to decide to develop my own process. In December 2004, I sold my idea to FWS Technologies and have continued to refine and perfect the system with the assistance of a number of team members.

FWS Technologies has invested in a pilot-scale plant to run corn for ethanol production. Our pilot plant has been live since January 2005, and we continue to make final adjustments to perfect our process. We applied for a patent in early 2005 and currently have a patent pending.

To date we have allowed both potential clients and partners to tour our facility, allowing them a first-hand look at our system and the results achieved. The feedback they have provided, and the level of interest they have shown in our process, has been very positive. Presently, we are in negotiations with a couple of existing ethanol plants for the installation of our fractionation system.

There are indeed many exciting developments currently facing ethanol producers as they explore new and innovative ways to expand the efficiencies and profits for their plants. FWS Technologies' dry fractionation process presents a new technology for ethanol manufacturers to fractionate corn that will ultimately help them increase their plant's efficiencies, reduce costs and deliver higher-valued coproducts than previously available to the ethanol industry. EP

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