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New Ethanol Process Reduces Costs, Recovers More Coproducts

In the ongoing effort to squeeze every penny possible out of a bushel of corn, researchers at the University of Illinois are working to modify and combine the two processes that govern ethanol production—wet milling and dry grind. The resulting process is called a biorefinery.

In the past, agricultural engineers Vijay Singh and Kent Rausch have worked on modifications to both the wet milling and dry grind processes. "Now we want to combine those modifications," says Singh, "to reduce the cost of the process and recover more valuable coproducts."

"The key is in the coproducts," says Rausch. "Low-cost ethanol production depends on the value of coproducts resulting from the process."

Wet milling accounts for 40 to 45 percent of the total ethanol produced in the United States. The wet milling process soaks the corn in water with sulfur dioxide for 24 to 36 hours so that the kernel can be separated into its four component parts—germ, protein, fiber, and starch—in a process called fractionation.

After fractionation, the starch is fermented into ethanol, and the three remaining parts are sold as

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coproducts, such as germ, corn gluten meal, and corn gluten feed. In the corn milling industry, the value of these coproducts is relatively high.

Dry grind, on the other hand, starts with raw corn that is finely milled and cooked. The starch is fermented and converted into ethanol, and the three nonfermentables (protein, fiber, and fat) are carried through the process and recovered at the back end as a feed product called distillers dried grains with solubles (DDGS).

Because the initial hydration process in wet milling takes up to about 21 percent of a plant's total capital, wet milling is almost three times as expensive as dry grind. The added expense is partially recovered in the higher-valued coproducts and the overall large scale of wet milling. The average wet milling plant processes 200,000 to 300,000 bushels of corn per day.

Dry grind costs less, but production runs at 50,000 bushels per day and produces only one low-value coproduct, DDGS. DDGS can be used for feed for livestock, but because of its high-fiber content, it can be fed in only limited quantities to nonruminant animals, such as swine and poultry.

Rausch and Singh hope to take advantage of the high-value coproducts produced in wet milling and the relatively low capital cost of dry grind by combining the latest advances in both technologies.

Essentially, the biorefinery process adds wet milling technology to the front end of the dry grind process. It also incorporates the most recent advance in wet milling technology—enzymatic milling. Instead of soaking corn in water with sulfur dioxide for a day and a half, researchers have developed a process that uses enzymes rather than sulfites to fractionate the corn. The enzymatic technology takes only six hours and eliminates health or environmental concerns caused by the use of sulfites.

After this shortened fractionation step, the pericarp fiber (outer coating of a kernel) and germ can be removed prior to fermentation. This is a departure from the conventional dry grind process, which is designed to ferment as much of the corn kernel as possible.

Germ recovered from the modified dry grind process is of a quality that can be used for oil extraction. In addition, pericarp fiber recovery at this stage allows a producer to pack more fermentable material in the fermentor, thereby producing more ethanol per batch and further improving cost savings.

The removal of germ and pericarp fiber also reduces and refines the DDGS that is recovered at

the back end of the modified dry grind process. According to Singh, this solves two problems. "The U.S. market for DDGS is saturated. By pulling the germ and pericarp fiber out, you reduce the volume of DDGS by 45 percent. You also diversify the market for DDGS because the DDGS that you're getting now is a potentially higher-protein feed that can be fed to poultry and swine."

Coproduct value is a major factor in the sustainability of the ethanol industry. And value is the bottom line, Rausch says. Biorefinery, which focuses on coproduct recovery, has the potential to reduce ethanol production costs and improve the profitability of the corn processing industry. With ethanol production using more than 980 million bushels of corn per year, that adds up to a lot of pennies.

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