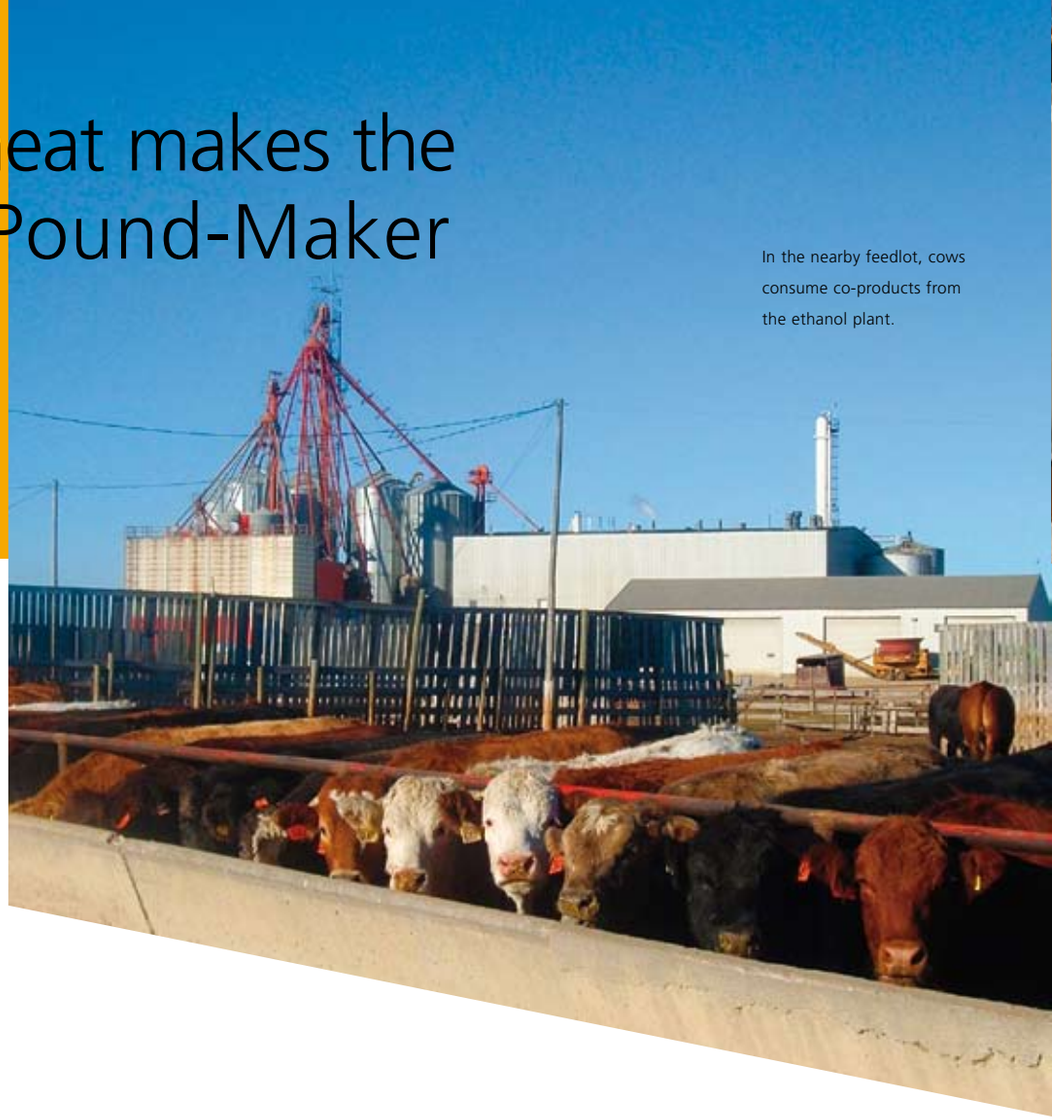
Viscozyme® Wheat makes the mash flow at Pound-Maker



In the nearby feedlot, cows consume co-products from the ethanol plant.

With the introduction of Viscozyme Wheat, Pound-Maker Agventures Ltd. in Canada has been able to significantly reduce its enzyme dosage while effectively lowering the viscosity of its mash.

Pound-Maker Agventures Ltd. is unique in Canada in being the first feedlot for cattle combined with a fuel ethanol plant. The company is jointly owned by approximately 250 farmers located near the town of Lanigan in Saskatchewan.

Cattle and fuel

From the start in 1971, Pound-Maker ran a feedlot for beef cattle, which have a diet consisting largely of barley. In the late 1980s, Pound-Maker began looking for new uses for its grain. It decided to build a wheat-based ethanol plant, which opened in 1991 adjacent to its existing feedlot. The two ventures go together very well. Two of the co-products from ethanol production are wet distillers grain and thin stillage, which are an ideal source of protein for cattle. So Canada's first integrated feedlot and ethanol plant was born.

"By industry standards, we are a small ethanol plant," says Keith Rueve, Plant Production Manager for the ethanol plant since December 2001. "Our capacity is 12.5 million litres a year, whereas most ethanol plants built in the United States are at least ten times bigger. It is thanks to the ability to integrate ethanol production with cattle production that the plant is economically feasible."

In addition, because of high oil prices and government support in Canada, ethanol is becoming a more attractive fuel.

Trial results

The Pound-Maker plant is the ideal size for conducting full-scale production trials with new enzymes, and it is a long-standing Novozymes customer. Consequently, when it was time to test a new enzyme for wheat processors in April 2005, Pound-Maker was invited to participate in the first trial.

"The Viscozyme products, including Viscozyme Wheat, were designed to address the growing cereals-to-ethanol market in Europe. It is therefore ironic that the first place to test new Viscozyme Wheat was in Canada," says Catherine Belaski, a fuel ethanol industry account manager for Novozymes who handles accounts in western Canada and western United States. Most of the customers in the area that she covers use corn.

Two customer solutions experts came to Pound-Maker to conduct the week-long trials in April 2005: Ted Gill from Novozymes North America and Claudio Visigali from Novozymes' headquarters in Denmark. The trials showed that Viscozyme Wheat could cost-effectively reduce the viscosity of wheat slurry. When the product was launched in November 2005, Pound-Maker began using it on a regular basis.

"The biggest benefit from our point of view is that Viscozyme Wheat allows us to reduce the total dosage of enzyme and therefore reduce our enzyme costs," says Keith Rueve.

"Viscozyme Wheat will also allow us to increase our capacity, but we have a bottleneck in our dehydration equipment so we are not able to take full advantage of this yet," he adds. About 100 tonnes of wheat is milled each day in the plant to produce 36,000 litres of ethanol.

Easier to pump

Keith Rueve notes that the mash has a lower viscosity since changing to Viscozyme Wheat. The pumps are not working as hard as before to pump the mash. This means that the electricity used by the pumps has been reduced, cutting energy costs.

The most obvious difference with this ethanol production facility is the lack of a stillage dryer and evaporator. At Pound-

"Wheat-based ethanol production has some unique challenges which are definitely being addressed by Novozymes with Viscozyme® Wheat," says Keith Rueve of Pound-Maker.

THE PROCESS AT POUND-MAKER

Ethanol is produced from high-starch feed wheat. Varieties used at Pound-Maker are Canadian prairie spring wheat, durum wheat, winter wheat and soft white spring wheat. After milling, the grain is mixed with hot water in a mash mix tank, where Viscozyme® Wheat is added to help control viscosity. The mash is then pumped into a continuous jet cooker, where the temperature is increased by the addition of high-temperature steam. The cooking of the mash is to sterilise the grain and hydrolyse the starch into dextrins. The mash then goes into a liquefaction tank, where Liquozyme® SC is added for further hydrolysis to complete the conversion of starch to sugar. It is then pumped through mash coolers, where the temperature is reduced before it enters the fermentation tanks. Spirizyme® Fuel and yeast are added at this point, and the sugars are then converted to ethanol and carbon dioxide. The ethanol is separated from the mash and the water by distillation. Tanker trucks pick up the ethanol and take it to a blending station, where it is blended with gasoline (up to 10% ethanol). The plant produces two co-products, wet distillers grains and thin stillage, which are fed to cattle in the company's feedlot.

Grain is milled and mixed with water to create a mash.

Maker, all of the co-products produced by the plant are consumed in a wet form by the cattle in the adjacent feedlot. The stillage left after distillation is separated into two feed components. The first product, a liquid that still contains about 6% solids, is known as 'thin stillage' and is pumped directly into the cattle watering bowls. The second product is the 'wet distillers grain', which is approximately 25% solids and is mixed and fed with other dry rations in the feed bunks.

Three enzymes

Novozymes supplies all the enzymes used at Pound-Maker.

Viscozyme Wheat is added to the mash mix tank for viscosity control before the cook step, where the mash is heated up in a jet cooker.

Another Novozymes enzyme called Liquozyme® SC is added in two stages - before the jet cooker, and afterwards into the liquefaction tank. Liquozyme SC is an alpha-amylase that converts starch into short-chain dextrins.

A third enzyme called Spirizyme® Fuel, a glucoamylase, is added to the fermentation tank to break down the dextrins, releasing glucose for the yeast to consume and convert into ethanol.

Especially for wheat

"It is almost impossible to process wheat without the addition of viscosity-controlling enzymes," says Keith Rueve. "Most of the enzymes used in North America are designed for corn-based ethanol production, but wheat-based ethanol production has some unique challenges which are definitely being addressed by Novozymes with Viscozyme Wheat. The viscosity issues in wheat relate to pentosans (non-starch polysaccharides), which are not present in such high proportions in corn. The wheat mash flows much easier after adding Viscozyme Wheat."

Government support

The market for fuel ethanol is growing in Canada. The federal government has waived the federal gasoline road tax on ethanol to allow it to be sold at a more competitive price. In addition, a mandate from the federal government is expected shortly stipulating that all gasoline sold in Canada should contain a certain percentage of ethanol.

The province of Saskatchewan in western Canada is known for its flat countryside with vast areas of wheat fields. This province has already implemented a mandate to incorporate 1% ethanol in all gasoline sold in Saskatchewan, and this will increase to 7.5% in the fall of 2006. To meet the demand, a new 25 million litre ethanol plant was opened in Weyburn in November 2005, and a large new plant in Lloydminster with a capacity of 130 million litres per year is scheduled to open in summer 2006. The Pound-Maker plant in Lanigan is also considering plans to expand production.

Rye and barley too

In 2005, Novozymes launched a new portfolio of viscosity-reducing enzymes including Viscozyme Wheat, Viscozyme Rye and Viscozyme Barley (see *BioTimes* No. 4, 2005). As the names suggest, they are designed for ethanol plants using these common cereal crops. Now the challenges of reducing the viscosity of this broad range of raw materials can be met, as experience from Canada with wheat indicates. Fuel ethanol production with enzymes is now fully possible in regions outside the traditional corn-growing belts of North America. ●

FOR MORE INFORMATION
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