Cheaper fills possible in the future

Grass to gas: opportunities abound

One thing Oklahoma State University researchers know for sure — opportunities are knocking, especially for agricultural producers. They will soon have the opportunity to grow and harvest grasses that may be in your car's gas tank in the future.

Four years ago, former Gov. Henry Bellmon spearheaded a movement to get OSU involved in converting biomass products such as switchgrass and wheat straw into ethanol through a gasification/bioconversion process. He believed Oklahoma was ideal for the project because of the vast amount of rural area and grassland.

"This project is a huge opportunity to provide a demand for a product [ethanol] that is not in surplus," said Bellmon, who foresees the plants located in small communities where production of biomass products abounds.

Following Bellmon's lead, researchers at OSU got busy. They began work and recruited an investigator from the University of Oklahoma and a researcher from Mississippi State University to help them in their endeavors.

The project, which researchers believe could bring an estimated 150 jobs per plant to Oklahoma, could have a major economical impact on states that use ethanol as a fuel additive.

"We're concentrating on the ethanol because of the need for additional liquid fuel in the United States," said Raymond Huhnke, coordinator of the project and professor in the biosystems and agricultural engineering department at OSU. "This way, we can decrease our dependency on foreign oil."

Decreasing the dependency on foreign oil may be one positive outcome of this project.

When gasoline prices skyrocketed in the summer of 2000, many people began looking for an alternative source of fuel. Ethanol is one such solution to this problem.

> This process will give farmers and ranchers another avenue for revenue.
>
> — *Raymond Huhnke professor*

Huhnke said there will always be a demand for ethanol, which is currently utilized as a fuel additive in the upper Midwest. Ethanol is used as an oxygenate in gasoline because it boosts octane levels, burns cleaner and reduces contaminants. This gasohol is a blend of gasoline that contains 5 percent to 15 percent ethanol.

Huhnke said OSU is taking a holistic approach on this project by utilizing grasses that can be grown on Oklahoma farms and then converting those grasses into ethanol.

Grasses, like switchgrass or perennial ryegrass or even wheat straw, are processed down to a relatively small particle size and then metered into a gasifier. The gasifier, which operates at a temperature of 1,200 to 1,700 degrees Fahrenheit, converts the biomass into a synthesis gas, or syngas. This syngas has the components necessary for the bioconversion to take place.

Carbon monoxide, carbon dioxide and hydrogen — products of the gasification process — are then cooled, cleaned and bubbled into a bioreactor. Microorganisms called acetogens act on the gases and convert them into ethanol. Once the conversion is complete, the ethanol is separated out, filtered and distilled into a fuel-grade product.

With the help of OU researcher Ralph Tanner, investigators at OSU have identified unique microorganisms they plan to use in the bioconversion process.

"We are tailoring these bacteria and optimizing them so they'll grow to make alcohol from these gases," said Randy Lewis, chemical engineer at OSU who is in charge of the bioreactor.

However, researchers are using bottled gases — not syngas — to simulate likely results, as the gasifier has not yet been connected to the bioreactor.

Timothy Bowser, assistant professor in the biosystems and agricultural engineering is working closely with food processing engineer and fellow colleague Danielle Bellmer on this research project. Bowser said researchers are close to connecting the gasifier to the bioreactor and predicts the two processes may become linked within the year.

Researchers have come far in their investigation of biomass to ethanol, but not without struggles along the way.

One challenge that had to be overcome had to do with the excess oxygen in the syngas. In most cases, excess oxygen can be burned. However, because of the type of product trying to be obtained, oxygen is a liability instead of an asset in the case of the bioreactor. The bioreactor requires an anaerobic environment, one that is oxygen-free. Therefore, excess oxygen has the potential to

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Mamosi "Bernie" Lelo loads switchgrass onto a conveyor belt in the agricultural engineering annex. Lelo is a doctoral student from South Africa in the biosystems and agricultural engineering department.

kill the microorganisms needed to convert the syngas to ethanol.

Obtaining funding has also been a challenge for the people involved in this project. But grant money from the U.S. Department of Agriculture made it possible for researchers from MSU to work on several different aspects of the project earlier this year. Huhnke said getting MSU involved will enhance the program.

"If we bring in more people with more expertise, then we'll likely be able to generate higher-quality research results at a higher rate," Huhnke said.

Student involvement is one area, however, that could use some growth, said Bowser. Currently, Bruno Cateni and Mamosi "Bernie" Lelo are working with Bowser, who is in charge of the gasification process. Cateni and Lelo are working as technicians on the gasifier part of the project. Both are biosystems and agricultural engineering department doctoral students whose emphasis is in the area of bioprocessing. Bowser said a need exists for more dedicated and hard-working students like Cateni and Lelo to become involved in the project.

Huhnke anticipates completion of the project will occur in five or six years. However, he hopes a pilot plant will be ready within just four years. Meanwhile, researchers are working on scaling up everything one step at a time. Right now the bioreactor holds four liters, or a little more than a gallon. Lewis is working on scaling it up to a 50-liter model. Their goal is to produce more than 75 gallons of ethanol per ton of dry matter when the project goes commercial.

Andrea Geis

Switchgrass is fed into the hopper then processed through the gasifier.

"We're confident that we will be able to achieve a level that will be cost effective," Huhnke said.

This is something the researchers have been aware of throughout the entire process. Agricultural economist Francis Epplin has been crunching the numbers all along the way. If something is not economically feasible, the researchers find an alternative solution.

"Producers have the resources," said Huhnke, who predicts a full-scale plant could utilize as much as 250,000 acres of grassland or rangeland. "This process will give farmers and ranchers another avenue for revenue."

In the meantime, researchers are regularly tending to the research seeds Bellmon planted in hopes they will someday grow into a plant that will harvest Oklahoma's natural resources. *CJ*

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