READY for RESEARCH

The National Corn-to-Ethanol Research Center, Edwardsville, IL has opened its doors to those who want to test the latest ethanol technology.

The National Corn-to-Ethanol Research Center (NCERC) is ready.

The facility, which celebrated its dedication at Southern Illinois University, Edwardsville in September 2003, opened its doors to clients this fall. It has confidentiality agreements in place with four private clients and is working with those clients on developing research protocols. Research on two grant funded projects also has started.

At it's most basic, the NCERC is a research facility that emulates the wet-mill and dry-grind commercial ethanol processes and provides a place to validate new technologies. Nearly 10 years ago, it was conceived as a means to bridge the gap between lab research and commercial ethanol production.

In a short time, the NCERC is becoming much more, says NCERC Director Dr. Martha Schlicher. The one-of-a-kind facility is playing a role in coordinating research programs and advocating for the industry. It is in the process of developing the capability to provide lab testing services and hands-on training for tomorrow's ethanol plant workforce.

But the goal remains finding ways to secure the future of fuel ethanol production by continuing to improve the economics of the process and by finding new and higher value coproducts.

"It all falls under the same mission of feeling accountable for the long-term sustainability and success of the industry," Schlicher says. "It's a critical time for the industry to make some advancements and it's critical for us to be here to help."

Getting Started

The original idea for the NCERC came from the Illinois Corn Marketing Board and the state of Illinois, Schlicher says.

"We realized it was both difficult and expensive for ethanol plants to test new technology as part of regular operations while researchers couldn't run large-scale tests in a lab setting," says Rodney Weinzierl, executive director of the Illinois Corn Marketing Board.

With broad bipartisan support, the project received $15 million in U.S. Department of Agriculture, Agricultural Research Service funding. The Illinois Department of Commerce and Economic Opportunity (DCEO) provided a $6 million match.

"At a time of rising oil prices, the NCERC can play a key role in improving our energy independence thanks to Governor Rod Blagojevich's support," says Jack Lavin, director of DCEO.

Construction of the 36,000-square-foot facility took about 18 months, Schlicher says. Contractors left the site in July, and commissioning of all the plant's unit operations began. While

The NCERC developed this logo that can be used on processes and/or equipment tested at the facility.

initial commissioning of the dry-grind operation occurred in October, updates and changes will occur in parallel with work for the industry.

The expertise and on site support of several companies was critical to the dry grind start up. Genencor International, Rochester, NY, donated expertise, supplies, equipment, and a startup crew. Archer Daniels Midland Co. (ADM), Decatur, IL, donated and transported 4,800 gallons of starch slurry for early testing and provided technical guidance for the testing. Bliss Industries volunteered time and hands on assistance in hammermill operations. ICM, Inc., Colwich, KS, provided weeks of startup expertise and manpower. Monsanto, St. Louis, MO, and Pioneer Hi-Bred International, Des Moines, IA, supplied corn for early testing.

"Donations like those provided at startup are critical because our vision is to have a state-of-the-art facility at an affordable cost," Schlicher says. "If the facility isn't being used all the time because it's not affordable, we aren't advancing the industry."

The Illinois Ethanol Research Advisory Board, consisting of representatives from the industry, the university, and the state, provides guidance to the NCERC. It reviews the facility's strategic plan and provides assistance in securing funding for the facility.

"The board makes sure we are meeting the needs of the industry and addressing the right priorities," Schlicher says of the group that meets twice a year.

Schlicher started at the NCERC in January as associate director for administration and finance. Schlicher, who has a doctorate degree in organic chemistry from the University of Illinois and an MBA from Northwestern University, held various leadership roles at Monsanto for 15 years.

Schlicher and Dr. Rodney Bothast have rearranged the management structure so that Bothast, previously the NCERC director, will serve as director of research. Bothast, who has a doctorate degree in microbiology, is a recognized authority on fermentation technology. Bothast spent more than 30 years at the USDA ARS in Peoria, IL.

Scaled Down Production, Scaled Up Labs

The facility itself is a significantly scaled down version of a commercial plant and a scaled-up version of a laboratory. It can process 200 bushels of grain per day or 1,000 bushels per week. The plant can run on a continuous or batch basis.

"The facility fully emulates a commercial facility with all of the unit operations from corn grinding to distillation; it is just dramatically reduced in size to accommodate the broadest array of research," Schlicher says.

The NCERC plans to sell the fuel ethanol and animal feed products it produces, which should help cover the cost of other inputs.

Pilot plant. The facility is versatile with the ability to accommodate dry grind or wet mill fuel ethanol production processes as well as any individual unit operation or unit operation change or upgrade. The facility can run multiple experiments for the same or different clients at the same time, depending on their needs.

Labs. The NCERC has analytical and microbiology laboratories equipped with benchtop fermentation capabilities and gas chromatography (GC), high performance liquid chromatography (HPLC), and near infrared (NIR) analytical instruments.

One of the two NIR instruments was donated by the Illinois Corn Marketing Board and a corn mill was donated by Romer Industries. Genencor International donated the six 3 to 5 liter benchtop fermenters.

Laboratory Manager Dr. Yanhong Zhang oversees a number of undergraduate chemistry students who help perform analyses in support of the pilot plant and the industry.

The National Corn-to-Ethanol Research Center emulates both the wet and dry mill ethanol production process. Equipment for the wet mill process is one side of the facility, and equipment used in both processes is on the other.

Using the Facility

The facility is available to private companies, academic groups, and government laboratories. Private companies could include input providers such as Monsanto; equipment and materials providers like Broin Companies and Genencor Interna-

NCERC Details

400 University Park Drive,
Edwardsville, IL
618-659-6737
wwww.siue.edu/ethanol

- 200 bushels per day corn usage (dry or wet grind).
- Flexible operation.
- 500 gallons per day average recovery.
- 36,000 square feet.
- Full support lab (3,000 sq. ft.).
- Operational facilities (24,000 sq. ft.).
- Administrative/research/ operation offices (9,000 sq. ft.).
- Automatic data recording integrated with automatic control.
- Training capabilities.

tional; and operating ethanol plants.

If a private company is interested in utilizing the facility, the process starts with a conversation on what it wants to accomplish. From there, the NCERC and the client work out a confidentiality agreement.

Together, they develop a research protocol, including identifying questions to be answered before going to a scale-up of the experiment.

"That has led us to developing more capabilities in the lab for benchtop fermentation and other supporting experiments," Bothast says. "We want to help clients get the answers they need to determine the commercial viability of their project."

By starting in the lab, the Center can help a client reduce the overall cost of a project, Schlicher says.

Costs will vary for each client, depending on factors such as the difficulty of the process and how many days they use the facility.

The plant is staffed with NCERC engineers, but companies are welcome to bring in their own staff. They can also bring their own lab or process equipment.

"The plant has a central open bay allowing you to bring in some separate unit operations that could be plumbed with existing equipment," she says.

It's important the facility represent both current practices and practices people are interested in down the road, Schlicher says.

"If we don't maintain leading-edge equipment as an option, we're moth-balled before we even get started," she says.

The NCERC 's equipment is the smallest commercially available. The four fermentation tanks have a capacity of 6,000 gallons each.

Three of six benchtop fermenters donated by Genencor International . They each have a capacity of 3 to 5 liters.

Scheduling. So far, Schlicher says there haven't been any problems in scheduling projects in the facility. The facility design is very flexible, allowing several experiments, or parts of experiments, to be run at the same time.

If a client has a confidentiality agreement, they will likely be the only group in the facility at that time. However, work could be going on in parallel, Schlicher says, such as experiment modelling or work in the labs.

The NCERC has an 8,000-gallon tank to store its finished ethanol.

"Ideally what we'd like to do is piggy-back experiments," Schlicher says. "The entire time an experiment is running, we may be able to use the process or products for other experiments, if clients agree."

Most likely, clients will use the facility a minimum of one week and a maximum of six to eight weeks.

If the center does run into scheduling conflicts, a technical subcommittee of the board would prioritize the experiments. Those promising the most significant and immediate results to the industry would go first. None of the members of this committee are currently in the industry so there is no chance for conflict of interest, Bothast says.

Research Projects

So far, the NCERC has entered into agreements with four private companies. Because of these confidentiality agreements, Schlicher cannot describe what the experiments involve. However, she can talk about the two grant-funded projects.

The first is research from the University of Illinois, Champaign-Urbana, that is being funded with a grant from the state of Illinois. That project focuses on oil and protein extraction.

The second will develop a model to understand how corn inputs and the production process impact the quality of the distillers dried grains with solubles (DDGS). This project is a good example of how the NCERC is working to coordinate research projects, Schlicher says.

Martha Schlicher

The Illinois Department of Commerce and Economic Opportunity provided $200,000 in seed money, and Emerson Process Controls donated more than $400,000 worth of Delta V ® hardware and software for model development. Washington University, St. Louis, MO, is providing the model development expertise.

The project will involve meeting with animal nutritionists to understand what DDGS compositional elements are important to them. Novus International is helping to coordinate this meeting. Researchers will also talk with ethanol plant managers about what factors they feel impact DDGS quality and consistency.

"It will involve many runs in the plant to vary inputs such as temperature and drying time," Schlicher says. "We will have in place the methods to analyze the DDGS for all of the components deemed important by the industry and be able to predict what process parameters are responsible for the results."

Serving Many Roles

Along with its role of validating research, the NCERC is finding itself acting as a coordinator of research programs, says Schlicher.

"We're in a unique spot where different parts of problems or solutions come to us from different people and we can act to bring them together," she says.

Several ideas have cropped up this way, Schlicher says, and now the NCERC is keeping an eye out for any grants that would be appropriate for these projects.

Lab testing. Schlicher says they're finding the NCERC could serve another role of providing lab testing to the industry at the cost it takes to run the tests.

"We could perform the non-routine analysis that a single ethanol plant can't afford to have the expertise or equipment around to do," Schlicher says. "We can train students for the industry while performing analysis for the industry."

Schlicher says the Renewable Fuels Association (RFA) has agreed to send a survey to ethanol plant operators asking what kind of services they would like the NCERC to provide.

Certification. The NCERC staff has developed and filed a logo (see pg. 21) with the U.S. Patent Office to allow for products or processes tested in the plant to be certified. Clients would then be able to use this logo on equipment or processes that have been tested at the facility.

Advocacy. Because the Center received so much media attention early on, Schlicher says the NCERC did a lot of advocacy work. More than 1,700 people, including school groups, community organizations, and foreign dignitaries, have been through the facility since it's been in a physical shape that permitted tours, she says.

Educating Future Workers

The NCERC could play a unique role in educating future ethanol plant workers, Schlicher says. Chemistry and biology students at Southern Illinois University, Edwardsville are already gaining hands-on experience in the facility's labs and engineering students are learning the production process.

But Schlicher says they also hope to develop a certification program that a student could tack onto an undergraduate degree. The idea came from conversations with Duane Carrow, process plant program director from Minnesota West Technical College, which offers a training program, and Minnesota ethanol plant managers.

"Our program would offer elements of what's being taught by Duane as well as hands-on training for each of those course components," she says.

Schlicher says they also would like to add the option of managerial training, people management, environmental stewardship, public speaking, fund-raising, and perhaps weekend courses for those already employed at ethanol plants.

"Training is a role we're anxious to play, but we need to develop our own plant expertise first," Schlicher says. "It will ultimately help us with staffing and provide assistance to the industry."

Susan Reidy, editor