



Biofine Renewables spearheads second generation biofuels research with Siemens PCS 7 process control

United States motorists know ethanol.

It's mixed in with 50 percent of the national petroleum fuel supply. Production has risen from 1.3 billion gallons in 1997 to approximately 9 billion for 2008. Reducing dependence on foreign oil and cutting pollution emissions are two of many reasons why many Americans embrace this form of renewable energy.

Additionally, published reports show that alternative fuel production has a substantial net positive direct energy balance – 1.5 to 1.6 more units of energy are derived from ethanol than are used to produce it.*

But while ethanol is apparently here to stay, most agree there are limits on how much corn and other edible feed stocks – like sugar cane, wheat, and sugar beets – should be harvested to meet the country's growing demand for ethanol.

Today, researchers are exploring the next wave of feedstock options that will increase the production of ethanol and other alternative fuels and biochemicals. These second generation biofuels and biochemicals are based on non-food crops and include wood, switch grass, pulp and paper waste, and even garbage.

Spearheading this important research and development work are engineers at Biofine Renewables' demonstration plant in Gorham, Maine. President Steve Fitzpatrick says since the demonstration plant opened in 2007 the company has successfully converted cellulosic biomass feedstock into levulinic acid intermediates used in a variety of chemicals, plastics, and fuels. These intermediates are now, in turn, finding their ways into commercial patents.

"Our product is data," Fitzpatrick says, "and our goal is to prove to our investors and potential clients that second generation biofuels are worthwhile and profitable."

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Many of these clients have immediate access to a low cost feed stock that is high in cellulose, such as waste wood pulp. However, today the waste is often used as boiler feedstock, or they must pay to move this waste to landfills. Fitzpatrick says by taking advantage of second generation biofuels technology, companies can turn losses from waste into higher value products to increase profits.

"Instead of having to pay to haul the waste away or just burning it in a boiler, they can convert it into chemical intermediates that have high values," Fitzpatrick says. "The process also generates a by-product called lignin that can be burned to provide energy to the plant or nearby consumers."

There is also academic and commercial research underway focused on using lignin in biochemicals. Additionally, paper mills and other forest product companies can use lower value feedstocks as boiler fuel.

Control system improves process, yields

At the heart of the demonstration plant is the SIMATIC® PCS 7 process control system from Siemens Energy & Automation, Inc. The control system, installed and programmed by Siemens solution partner Optimization/Dumont Associates, includes redundant dual screen operator stations communicating over Industrial Ethernet to the control processor. The PCS 7 system uses a PROFIBUS fieldbus network to communicate to I/O modules and 20 Siemens Micromaster variable frequency drives (1-5 HP) controlling agitators and pumps.

Joe Doherty, project manager at Optimization/Dumont Associates, says his company has worked with Biofine Renewables on previous biopharm related projects over the years. Optimization/Dumont Associates also has a long established relationship with Siemens as a member of the solution partner network.

Doherty says the focus of the project was to enhance the productivity of the plant's startup and shutdown processes by capitalizing on past successes.

"We won the project when Biofine Renewables moved its plant from Glenn Falls, NY, to Gorham," Doherty says. "Fitzpatrick operated another plant that used the Siemens PCS 7 control system. It worked out so well for him that he wanted to use the same control system for this newly located plant."

Flexible controls

Operators at the demonstration plant visualize every step of the continuous operation from a central control room equipped with an engineering station and two redundant operator stations.

Doherty says there are 50 different interlocks programmed into the system. Operators have the ability to safely and efficiently override interlocks when required, allowing the process to continue under close supervision.



"If something does happen, the PCS 7 system can quickly identify the cause," Doherty says. "In a continuous process, something like a low level alarm in one tank can cause the entire downstream process to shut down, so it is critical to quickly identify the issue. The PCS 7 system consistently maintains the steady state and makes adjustments automatically."

The PCS 7 system automatically controls the sequential startup and shutdown process, beginning when wood chips, or other feed stocks such as pulp and paper waste, are fed from a large feed hopper into a grinder where the chips are ground down to small wood particles. The sawdust sized cellulose is then mixed with acid, heated, and fed into reactors. Operators in the control room use 10 to 15 process graphics to visualize each step of the process. Sequential PCS 7 function charts are used to smooth startup and shutdown sequences, providing a visual guide for the steps and associated interlocks.

"There is one master station and one slave station that operators can use to run multiple operations in parallel," Doherty says. "They see real-time data, including flow, pressure, level, temperature, and acidity. Throughout the process, sensors automatically send signals from the plant to the PCS 7 controller via PROFIBUS and to the graphics computers via Industrial Ethernet."

Custom process data

Eventually making its way to an Excel spreadsheet, the data generated by the process is Biofine Renewable's bread and butter. Fitzpatrick must prove to investors and potential clients that the intermediates will help make second generation biofuels and biochemicals available to the market.

Doherty says Optimization/Dumont Associates worked extensively to link process data with a custom database and laboratory sample data allowing operators to complete their material balance calculations throughout the day and determine process yields.



"We have integrated the PCS 7 system with our lab information system," Fitzpatrick says. "We can get a complete download of process data from PCS 7 and coordinate it with independently generated laboratory analytical data."

That coordination of data is important to Biofine Renewable's investors and potential clients because it identifies areas requiring further investigation and helps tailor the experimentation accordingly.

"Sure, you can look at one sheet of data and compare it with another – but to have it coordinated, complete, and together, is a nice feature that enables us to more effectively use our resources and minimizes duplication," Fitzpatrick explains. "The PCS 7 system provides data that is systematic, businesslike and understandable. We do not have to cross reference complex data sets with operations. That is done automatically."

Remote monitoring saves time, money

Another control system benefit for Biofine Renewables is the ability to work remotely with Optimization/Dumont Associates. Doherty says engineers at Optimization/Dumont Associates have Internet access to Biofine Renewables' engineering station. By troubleshooting over the phone and Internet, Doherty estimates he spends 20 minutes diagnosing and solving problems, eliminating the two hour trip to the demonstration plant.

"We can go online and look at the process, identify the issue, and make or suggest changes," Doherty says. "We can respond from home or work any time of the day. In the beginning, they had some mechanical process issues with their equipment. It was not obvious if it was a software issue, a process issue, or if something broke. We were able to point them in the right direction to confirm that it was a hardware issue."

Higher yields, future plans

Today, Fitzpatrick says the demonstration plant's reliability and control has improved substantially, probably by more than 10 percent compared to operations in New York.

"The increased yield is primarily due to the tighter plantwide control provided by the PCS 7 control system and its integration with the electrical and lab systems," Fitzpatrick says. "The control system responds to our needs and requirements. It is also certainly flexible enough to deal with the different types of feed stocks."

Fitzpatrick says the company is considering two potential large scale projects in the near future. Now in the planning stages, the projects would produce heating oil as well as biodiesel fuel.

"We intend to standardize on the Siemens system as we scale up," Fitzpatrick says. "The graphics are intuitive and the trending and alarm functions are very good. The customer service support from Optimization/Dumont has been impressive as well. It is always better in a scale up to have consistency with proven partners and technology."

* September, 2008 Study by University of Nebraska-Lincoln.

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