

Renewable Refining®



ZeaChem's Cellulosic Biorefining Demonstration Plant Tests Biofuel Commercialization

Biorefining allows manufacturers to create sustainable, renewable, high-value end products from biomass, or renewable feedstock. These end products — with applications in gasoline, diesel and jet engine fuel, specialty chemicals, chemical intermediates, biodegradable plastics, pharmaceuticals, and other consumer products — could eventually displace a number of petroleum-based fuels and chemicals in the marketplace.

Biorefining company ZeaChem is on the leading edge of cellulosic conversion technology. It has developed a unique process to manufacture ethanol, other fuels and chemicals from cellulose harvested from hybrid poplar trees and other renewable materials. ZeaChem describes its patented process as “offer(ing) the highest yield at the lowest cost with the lowest carbon footprint of any known biorefining method.” The sustainability and economics of ZeaChem’s

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biorefining technology has not only captured the attention of private investors and energy giant Valero, another Burns & McDonnell client, but also the U.S. Department of Energy (DOE), which recently awarded ZeaChem a \$25 million grant as part of the American Recovery and Reinvestment Act (ARRA) program to accelerate the development of renewable fuels from biomass.

Unlike the traditional corn-to-ethanol process, ZeaChem’s cellulosic biorefining technology produces no carbon dioxide during fermentation. This is accomplished by using an acetogen derived from the digestive system of common termites to convert sugars into acetic acid. During esterification, this weak acid is processed into ethyl acetate, which can then be converted into ethanol or a number of related chemical intermediates.

Scaling Up for a Demonstration Plant

Established in 2002, Lakewood, Colo.-based ZeaChem began with founders Dan Verser and Tim Eggeman’s new cellulosic biorefining technology and a business plan for commercialization. Today ZeaChem has 30 employees, half of whom work in the ZeaChem Research & Development facility in Menlo Park, Calif., where ZeaChem scientists and engineers conduct laboratory-scale research to prove the theoretical chemical viability of each step in the manufacturing process. ZeaChem also performed pilot plant trials at the Hazen Research Institute in Golden, Colo. Currently, ZeaChem is scaling up its process from pilot scale to

demonstration plant scale, which will examine the commercial feasibility of the cellulosic biorefining process. Valero stated that ZeaChem’s “proposed project is critical to answer scaling and integration questions” relative to cellulosic biorefining.

After completing the initial conceptual design of its demonstration plant, ZeaChem asked engineering firms to bid on the detailed design and construction management needed to finish its 250,000 gallon-per-year plant in Boardman, Ore. ZeaChem selected Burns & McDonnell to provide engineer-procure-construct (EPC) services for the independent core processing unit and, later, the front- and back-end processing units. The front-end involves processing, pre-treatment and hydrolyzation of cellulosic biomass; the back-end converts ethyl acetate into ethanol or other products.

ZeaChem appreciates the value in Burns & McDonnell’s single-source expertise, comprehensive project coordination and favorable pricing structure — a guaranteed maximum price and cost-sharing for under-runs. The DOE and other funding providers view this pricing structure as an effective cost-containment measure.

“It gives the entities providing ZeaChem financial support comfort to know that they are committing a defined amount of capital for this scope of work,” says George Stegner, project manager at ZeaChem.

“We need the strength, breadth and depth of a firm like Burns & McDonnell to execute this project. Even though we have seasoned employees, we can’t do it ourselves.”

As a start-up biorefining company, ZeaChem faces other unique challenges in implementing a demonstration plant. To find the right design solution for each of ZeaChem’s challenges, Burns & McDonnell paired its engineering and construction professionals with those in corresponding disciplines at ZeaChem. Burns & McDonnell has also been working closely with ZeaChem to incorporate the latest data from its laboratory research into the design of the demonstration plant, which is expected to pay dividends in enhancing system performance.

ZeaChem’s cellulosic biorefining demonstration plant will convert 10 dry tons of cellulosic feedstock into ethanol daily. Compared to conventional gasoline refining, corn ethanol production reduces greenhouse gas emissions by approximately 24 percent, and ZeaChem’s process reduces emissions up to 98 percent. ZeaChem and its investors are paying for the core structure, while its DOE ARRA grant is funding the front- and back-end processing units.

Evaluating Biomass

In addition to flexibility in end products, ZeaChem’s patented biorefining process can accept a variety of biomass feedstocks. Due to the low cost, hybrid poplar trees will initially be ZeaChem’s primary feedstock. Poplar trees, rich in cellulosic biomass, grow abundantly in the United States and can be harvested every three years — ideal renewable feedstock characteristics. ZeaChem contracted with GreenWood Resources to supply hybrid poplar trees from a 28,000-acre tree farm near the plant, which reduces transportation costs and associated emissions. ZeaChem will also test other renewable, cellulosic feedstock such as corn cobs, corn stover, woody biomass and herbaceous grasses to verify that its technology can be implemented nationwide.

Fulfilling Special Considerations

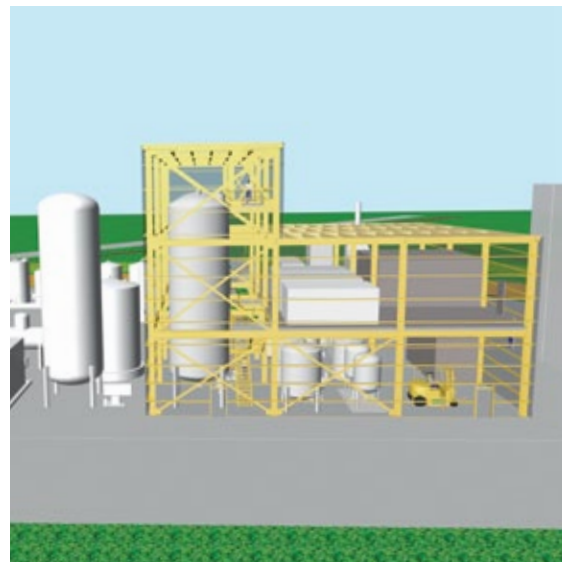
Since private investors and a DOE ARRA grant are funding ZeaChem’s demonstration plant, there are two separate sets of requirements each portion of the project

must meet. As a single-source EPC contractor, Burns & McDonnell helps ZeaChem manage its preferred subcontractors and follow two separate sets of rules, while coordinating all portions of design and construction.

Through Burns & McDonnell’s EPC approach, ZeaChem benefits from an expedited design and construction timeline, which is key to meeting cost and schedule targets required of a DOE ARRA grant recipient project. Preliminary planning and design began in June 2009, detailed design commenced in October 2009, and groundbreaking followed in June 2010. With an accelerated construction schedule, the demonstration plant will be completed by late 2011.

“We’re grateful for the validation that comes from recognition in the industry as one of the top solutions for alternative fuels and chemicals,” Stegner says. “Many people are rooting for us; now we just have to execute. We are confident that Burns & McDonnell can help us do that.”

For more information, contact Ron Jones, 314-682-1571.



As engineer-procure-construct contractor on the front-end, core and back-end processes of ZeaChem’s cellulosic biorefining demonstration plant, Burns & McDonnell is helping advance the future of biofuels.

ZeaChem’s Cellulosic Biorefining Process

