

3D Modeling Refines Reusable Design for \$150 Million Biodiesel Plant Prototype

Design modifications made on the fly and changes made in one location updated instantaneously and automatically across all locations



In the tiny town of Claypool, Ind. (population: 311), the world's largest integrated soybean-based biodiesel plant is producing enough fuel to propel a diesel motorcar 3.5 billion miles – taking it around the world 140,000 times. The plant owner, Louis Dreyfus Commodities, inaugurated the \$150 million production facility in August 2007 and is now replicating its success in Argentina using a Bentley solutions-based design prototype.

The Claypool plant is the model for biodiesel production facilities to be located throughout the Americas, providing a sustainable source of diesel fuel for the energy supply chain. Each year, the integrated processing plant will crush 50 million barrels of soybeans to produce 1 million tons of soybean meal for use in livestock feed and 88 million gallons of biodiesel converted from soybean oil. By producing both fuel and food in one location, the company extracts maximum value from soybeans.

As a global leader in the value-added agricultural supply chain, Louis Dreyfus Commodities touts the many merits of soy-based fuel. The Claypool plant supports the local farm economy with

the purchase of \$450 million of locally grown soybeans in a single year, or about 17 percent of all the soybeans grown in Indiana. The clean-burning production process emits significantly fewer airborne pollutants, including nearly 80 percent less carbon dioxide than a petrodiesel plant. And as a viable alternative to fossil fuel, biodiesel contributes to the goal of achieving national energy independence.

Building this prototypical plant required collaboration among global design team members. A subsidiary of Paris-based Louis Dreyfus, Louis Dreyfus Commodities directed the initiative from U.S. headquarters in Wilton, Conn., and offices in Claypool. GEA Westfalia Separator, headquartered in Oelde, Germany, supplied the processing equipment. Process Automation Concepts Ltd. (PAC), based in Rock Island, Ill., designed the plant as a subcontractor to Westfalia.

"From the time the contract was signed, we had only 16 weeks to design this large biodiesel plant, and we did it using Bentley solutions," said PAC President Stephen Dudzik. "Using the software

modeling tools and data-based capabilities permitted an agile and collaborative approach to the development of modular, repeatable design."

PAC specializes in providing engineering, design, and consulting services for capital projects in the process industry. A 3D design approach is at the core of the company's strategy to work smarter and faster. In fact, Dudzik believes that using Bentley tools helps the company operate five times more efficiently than a traditional engineering firm. "One of our designers delivers the same amount of work as five designers in another company," he said. "We have fewer people working on a project, producing better designs. That is a huge benefit to the client."

Virtual design reviews

Four PAC engineers/designers worked with two Westfalia engineers to complete the design prototype for the 90 million-gallon-per-year facility within the tight time frame dictated by the owner's startup schedule. As the basis for the design, Westfalia provided plans for an existing facility with a production capacity of 30 million gallons per year.

PAC team members not only had to convert process and instrumentation diagrams from German to ISA standards, but also had to scale up production to three times the capacity. Complete technical data for equipment such as vessel residence times, chemical dosing rates, and process fluid properties were not immediately available, reducing the effective design time from 16 to 13 weeks. This put pressure on the team to submit initial P&IDs, process flow diagrams, plant and equipment layouts, and other deliverables based on general design concepts.

To meet these challenges, PAC initiated a nontraditional approach where all stakeholders were involved in reviewing designs in AutoPLANT. "We met daily using GotoMeeting.com with people in Germany, New Jersey, Michigan,

Missouri, and Indiana all looking at the model and discussing improvements. Even vendors contributed," Dudzik explained. "That daily work with the model, doing a lot of it online, allowed the stakeholders to get involved early in the project and get exactly what they wanted."

The virtual design review process eliminated costly and time-consuming travel to on-site meetings. Design modifications were made on the fly as equipment data became available and specifications were finalized. Using Bentley software, the team was confident that changes made in one location were updated instantaneously and automatically across all locations. This saved hours typically spent in data verification.



Construction cost constraints required substitution of acceptable but less costly materials. Additional cost savings were realized by allowing the structural steel fabricator to provide value engineering based on the steel layout. Reviewing the structural model in Bentley software, the

designers instantly spotted and corrected interferences. This shortened construction time and eliminated errors. PAC estimates that the reduction in change orders reduced project costs by up to 20 percent.

The Claypool plant was completed in about a year and a half, two months ahead of schedule. Within 48 hours of startup, it was running in a steady state — one of the advantages of Westfalia's unique process. Louis Dreyfus Commodities is now building a second biodiesel plant in Lagos, Argentina, at

a considerably lower cost using the Claypool prototype. PAC reused as much as 80 percent of the original engineering design work on this and subsequent projects.

"With Bentley software and intelligent models, we were able to reissue the design for the new location with changes to compensate for the counterclockwise circulation in the vessels," Dudzik said. "Our Bentley templates are so fine-tuned now that we can roll into a new biodiesel project or other biorefineries facilities much more quickly, completing the design and construction 20 percent faster and with total install cost savings of 20 percent."

For the residents of Claypool and vicinity, the plant has brought 70 steady jobs and a ready buyer for the region's soybean crops. Although it is just one of 20 ethanol and biodiesel plants in the state, helping to make Indiana one of the top five biofuel producers in the country, it is possibly the most efficient soybean processing plant in the world. □

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