Cooling Tower Case Study

Biodiesel Production

Case Study No. 17

Project Overview

Western Iowa Energy's Soy Biodiesel Production Facility, Wall Lake, Iowa. *(Tower Tech cooling tower appears near center of photo)*

Western Iowa Energy received regulatory approval in 2005 to build a 30-million gallon per year biodiesel production facility south of Wall Lake, Iowa. The Wall Lake Plant is Western Iowa Energy's third biodiesel plant project, but it is unique because both vegetable oil (soy oil primarily) *and* animal fats may be used in the biodiesel production process. Western Iowa Energy's partners, **Renewable Energy Group** and **Todd & Sargent**, developed the new plant on a turnkey basis and the plant began producing biodiesel in 2006.

Biodiesel refers to alkyl esters made from the transesterification of vegetable oils or animal fats. Biodiesel is biodegradable and non-toxic and its combustion yields significantly lower harmful emissions than petroleum-based diesel fuel. Biodiesel may be used in current diesel engine designs and is a candidate to someday replace fossil fuels as the world's primary source of transportation energy.

Miller Mechanical Specialties (Des Moines, Iowa), a **Tower Tech** sales representative since 1996, developed a relationship with Renewable Energy Group while working on several projects in the 1990s. Renewable Energy Group asked **Doug Miller** to assist in the development of a biodiesel R&D plant to be built for Western Iowa Energy in Ralston, Iowa. Miller concentrated on the design and engineering of plant instrumentation and Miller Mechanical Specialties was ultimately selected to supply most of the plant's instrumentation. A cooling tower was required for the prototype plant, and Miller introduced the development team to Tower Tech's innovative technologies (variable-flow nozzles which help tighten process control, an enclosed high-velocity flow-through cold water basin that reduces chemical use, and built-in redundancy to reduce downtime). The project design and development team was impressed and made Tower Tech the basis of design.

Miller Mechanical Specialties has supplied all controls instrumentation and cooling towers for the biodiesel plants developed by Renewable Energy Group and Todd & Sargent to date. The Ralston

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Cooling Tower

Biodiesel Produc

Cutaway view
of a Tower Tech TTXE
Series 4-fan cooling tower module

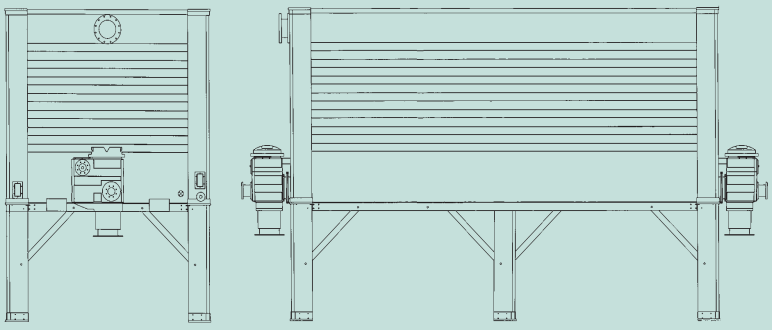
Prototype Plant, completed in 2000, produces 12 million gallons of biodiesel annually and has one Tower Tech modular cooling tower. A second biodiesel plant built in Albert Lea, Minnesota, in 2004 produces 30 million gallons of biodiesel annually. The Albert Lea Plant has two Tower Tech modular cooling towers.

The Wall Lake Plant is the third biodiesel plant to be developed by Renewable Energy Group and Todd & Sargent. The plant produces 30 million gallons of biodiesel annually and has two Tower Tech cooling towers.

Ground was broken in 2006 for a fourth biodiesel plant in Newton, Iowa, and two 10-fan Tower Tech modular cooling towers have been purchased for the project. In addition, Renewable Energy Group and Todd & Sargent are developing two more biodiesel plants in 2006, each designed to produce 30 million gallons of biodiesel annually. Each of these plants will have two Tower Tech cooling tower modules. Two additional plants, each designed to produce 60 million gallons of biodiesel annually, are also in the planning stages for construction in 2007, and each of these plants will have four Tower Tech cooling towers.

Cooling Tower Specifications:

- Tower Tech Modular Cooling Tower™ (Model TTXE-101950), 2 units.
- Tower Tech 6' High Sub-structure (FRP & 304 Stainless Steel Hardware)
- Tower Tech Rotary Spray Nozzles™ (3:1 Turndown Capability with 6' x 6' Square Spray Pattern)
- Tower Tech Fan Motor Control Panel with Temperature Controller (460V, UL-Rated, NEMA 4, additional auxiliary contacts for BMS motor control)
- U.S. Electrical Motors (TEAO, 460V, 12.5 Amps, 215T Frame, 82.5% Efficiency, Inverter-Duty, Class "F" Insulation, L_{10} 100,000 Hr. Sealed Bearings)
- Multi-Wing Fans (Direct-Drive, Model 7-W, 8 Blades)
- Factory Pre-wired (Shielded 12-4 AWG Oil Resistant Flexible Cable)
- Tower Tech Stainless Steel Fan Motor Support
- Brentwood Industries CF 1900 Fill Media & CDX 80 High Efficiency Drift Eliminators



Cooling Tower Design Conditions:

- Flow Rate (GPM): 3,000 GPM Min 6,000 GPM Max
- Entering Water Temperature (HWT): 91° F
- Leaving Water Temperature (CWT): 86° F
- Entering Wet Bulb Temperature (WBT): 78° F

Case Study

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West Central Soy's Prototype Biodiesel Production Facility, Ralston, Iowa
(Tower Tech cooling tower sits atop tall building at right side of photo)

Renewable Energy Group and Todd & Sargent believe their biodiesel projects benefit from the Tower Tech design, citing product reliability, built-in redundancy, comparatively lower chemical requirements and blowdown, better maintenance characteristics, improved service life due to heavy-duty construction, and ease of tower installation. Western Iowa Energy operates the Wall Lake Plant 24 hours a day, 330 days a year. Tower Tech's innovative cooling design is important to the biodiesel transesterification process because its built-in redundancy and the simplicity of its multiple direct-drive fans, combined with reliable variable-speed drives (one for each tower module), improves process control markedly. In continuous-flow processes, every hour of lost production is extremely costly; the only time Western Iowa Energy's process can be interrupted is for planned maintenance.

Operational Overview

Doug Miller specified two Tower Tech model TTXE-101950 modular cooling towers for the Wall Lake Plant, to accommodate maximum tower flow of 6,000 GPM at a 91°F entering water temperature, 86°F tower leaving water temperature, and 78°F entering wet bulb temperature. The two cooling tower modules are mounted on optional 6'-high FRP substructure legs, and the entire assembly is installed on an elevated steel platform. This layout allows cooled tower water to gravity feed into an indoor storage tank. One sump is standard on every Tower Tech module, although Miller decided to specify a second sump be attached to each tower module to provide for higher-than-usual water flow into the indoor 15,000-gallon storage tank.

Miller also specified optional factory pre-wiring be installed from each motor to an optional NEMA-4X junction box mounted on the end of each module, to provide a single-point connection from each tower to an optional NEMA-4 control panel. The two tower control panels are mounted near the cooling tower, at ground level. Each panel contains an optional Siemens PLC temperature controller set to 45°F; a thermocouple in the tower's cold water discharge assures the coldest water possible is delivered to the process at all times. Each control panel also contains 10 dry contacts for the process management system to allow operators to identify tower motor operational status (On/Off/Fault) from the control room console.

Miller also specified two ABB variable-frequency drives; each drive has a single-point connection to one tower control panel. VFDs provide tighter overall process control, enable the tower to supply colder water to the process, improve energy efficiency, provide longer fan motor life, improve freeze protection during winter operations, and lower tower noise emissions. Miller also specified automatic bypasses on the drives and, should a drive fail, the Siemens PLC will automatically take control of that tower's motors and provide across-the-line fan staging in accordance with the temperature setpoint programmed into the Siemens PLC.

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Why are *Tower Tech Modular Cooling Towers*™ Ideal for Biodiesel Production Facilities?

Biodiesel is the leading edge in the fuel additives market. Tower Tech is the leading edge of the cooling tower market. If you have superior technology, you owe it to yourself to investigate the latest and finest cooling tower technology. Tower Tech's Modular Cooling Tower will benefit *you!*

- Unparalleled Energy Opportunities, Higher ROI
- Tighter Process Control
- Built-in Redundancy
- Reduced Maintenance Costs
- Reduced Chemical and Water Costs
- Modularity, for Ease of Future Expansion

Tower Tech Modular *Cooling Towers*™ at Western Iowa Energy's Soy Biodiesel Production Facility, Wall Lake, Iowa