Propane Maintains Critical Temperatures for Biogas Energy Project

A waste-to-energy biodigester plant in Davis, Calif. designed to produce both methane (biogas) and hydrogen from food and green wastes is using propane-fueled heat to maintain critical internal temperatures. Such temperatures are required to promote optimal bacteria growth and the most efficient natural breakdown of wastes.

The facility also uses propane to supplement the system's own generated energy since it is vital to keep the reactor temperature stable during the hydrogen-producing phase. In particular, propane is essential to the reliable operation of the engine generator and will be the sole fuel source used for starting up and shutting down the system.

Representatives of the Propane Education & Research Council (PERC) and the Western Propane Gas Association joined the University of California-Davis, Onsite Power Systems (Davis, Calif.), and other partners at the recent official start-up of the anaerobic phased solids biodigester system for UC Davis' Biogas Energy Project. The commercial-scale, prototype plant, located at the university's wastewater treatment plant site, will demonstrate an innovative waste-to-energy technology with possible environmental and economic advantages, including potential as a renewable energy source.

How It Began

The project, the idea of Dr. Ruihong Zhang, a professor in the department of biological and agricultural engineering at UC Davis, and students, began with eight years of university lab tests and engineering by Onsite Power Systems. PERC contributed $32,000 toward the purchase of two propane-fueled boilers; a low-emission, California Air Resources Board-certified propane engine; and a generator for the project.

A Laars Heating System Co. (Rochester, N.H.) Mighty Therm (Model PW0325) boiler and heat exchanger provides the heat source for the gasification tank. A KEM Equipment Inc. (Tualatin, Ore.) 5.7-liter 45-kw propane genset provided by project partner TGP West (Atascadero, Calif.) provides start-up and shut-down power. Biodigesters often need supplemental power for start-up, shut-down, and other purposes to ensure uninterrupted operation.

AmeriGas' Sacramento plant, the fuel supplier, provided a 500-gal. propane tank and fittings.

"Our biodigester will use propane to augment the system's own generated energy because it is necessary to keep the temperature stable for the hydrogen-producing phase," said Dave Konwinski, Onsite Power Systems CEO and project manager. "It is more economical and reliable to use propane, because propane burns at a more stable temperature and is readily available."

Propane—in addition to providing the sustained, ideal heat essential to the breakdown of wastes—is crucial to the reliable operation of the engine generator in the biodigester Konwinski added. "We have installed a propane system, making propane the sole fuel source for starting up and shutting down the system," he explained.

Propane is also playing a role in a backup system at the facility. If the

genset shuts down or biogas consumption is interrupted, a pressure relief valve on the inlet manifold to the engine sends the biogas to a flare to preclude raw biogas from being released to the atmosphere. The flare has a continuous pilot light, fueled from the propane storage tank, to assure that any low-Btu biogas is burned.

Another benefit of propane, PERC noted, is that during any biodigester system's start-up and shut-down phases, using propane in place of biogas (methane) provides good preventative maintenance as system operating temperatures are inherently lower during these crucial periods. At lower temperatures, methane introduces the potential for system corrosion due to the condensation of hydrogen sulfide and water vapor, whereas propane mitigates this effect.

Unlike many other biodigesters used in agriculture, the UC Davis facility doesn't process animal waste at the site, but rather food scraps collected from restaurants in and around the Bay Area and trucked to UC Davis by Norcal Waste Systems (San Francisco), another project partner. The system is capable of processing a variety of organic solid and liquid wastes.

The innovative design allows faster microbial degradation of organic wastes—12 days versus the more common 21-30 days—and combines both batch and continuous biological processes in a single system.

The biodigester has the capacity of converting three to five tons of organic solid waste into 11,400 to 22,900 cu ft of biogas per day, enough to run a 27-to 50-kw engine-generator.

The Onsite Power Systems biodigester is testing a new two-step process that produces both methane and raw hydrogen. The hydrogen can be marketed as a fuel source for use in fuel cells or motor vehicles and sold as an industrial product. The biodigester can produce an estimated 22 therms of high-quality biohydrogen and biogas from one ton of food waste or green waste.

Major grants for the project were also sourced from the California Energy Commission and the California integrated Waste Management Board. Other industry partners include the Grand Central Recycling and Transfer Station and Air Products Inc.

UC Davis' demonstration project is scheduled to run for three years, during which time data will be collected with an eye toward commercialization of the system, leading to construction of such facilities to serve agriculture and municipal customers, among others.

—John Needham