Featured in

SYNGAS Refiner

Market and Technology Analysis for Syngas-Derived Products from Any Hydrocarbon Source

Vol. II, No. 15; October 1, 2006

LPP Combustion System Converts Liquid Fuels Into Synthetic Natural Gas

"The patent award for the LPP Combustion System, along with the benefits of fuel savings and flexibility, places LPP Combustion LLC in a strong position in its markets," said John Sams, COO. "We see great success for the technology that can be used in a range of combustion applications and global markets."

LPP Combustion LLC, Columbia, MD, has been awarded a patent for its **System for Vaporization of Liquid Fuels for Combustion and Method of Use** that is called the Lean, Premixed, Prevaporized (LPP) Combustion System. The system converts coal liquids, diesel, kerosene, #2 fuel oil, naphtha, ethanol and methanol into a synthetic natural gas (SNG) or LPP gas that can then be burned in place of natural gas in low-emissions gas turbines providing the flexibility to burn most fuels while meeting the local environmental regulations.

Gas turbine operators want to use cheaper fuel alternatives, but gas turbines tuned for natural gas are often unable to handle liquid fuels without extensive system tuning or hardware modification. To provide greater fuel flexibility, the company developed a standalone, skid-mounted system that first vaporizes and then conditions liquid fuels, so their combustion properties, emissions, heating values, and auto-ignition characteristics are more closely aligned with those of natural gas (See Figure). The self-contained skid consists of conventional compressors, heat exchangers, vaporizers, piping, valves, control-hardware and passive air separation membranes, which use ambient air to create diluent to vaporize the liquid fuel. No additional pretreatment of most liquid fuels is required. The system allows for rapid switching between liquid fuels and natural gas, as well as operation on liquid fuels, even for gas turbines that have no current capability to burn liquid fuels. This innovative technology can provide fuel cost savings by allowing generators to operate on either oil or gas, whichever is cheaper, during seasonal fluctuations in energy prices, while generating similar low emissions on either fuel.

Utilizing US Coal Reserves

The LPP system provides a less complicated technology for utilizing US coal reserves to produce clean, reliable electrical power and allows coal liquids to be used at significant fuel cost savings. Use of coal liquids is supported by the DOE and may be subsidized. The process has the advantage that the coal liquids can be produced remotely and shipped to any power plant that currently burns natural gas in a low-emissions turbine. The system requires no turbine hardware changes and decouples the production of the coal liquids from power production.

Calpine has approved the system's technological viability and further discussions are being scheduled to better understand the economic viability, especially as the technology relates to coal liquids. South Carolina Electric & Gas has met with LLP to discuss its involvement in a DOD project involving coal liquids and sees the value of LPP technology as a tie-in to the project. Drummond Co. has information on the LPP technology and its applicability to coal liquids. LPP and Drummond are working to set a meeting to further explore the opportunities.

When faced with higher natural gas prices or lack of availability, power producers are forced to idle their resources because operation on liquid fuels is generally not permitted due to higher emissions levels. Although the advantages of low emissions and longer component life provided by burning liquid fuels in a lean, premixed, pre-vaporized mode are known, no commercially viable combustion systems using this technology currently exist in the marketplace. The LPP System has focused on changing the nature of the fuel. LPP can achieve natural gas-like emissions with liquid fuels, which previously was not possible.

Providing Low Emissions

Nearly 1,200 dry low emissions (DLE) natural gas-burning turbines have been installed in North America over the last ten years that provide extremely low emissions for power generators by burning natural gas in a lean, premixed combustion system. This combustion technology has not been available for use with liquid fuels because of the problem of auto-ignition when liquid fuels are pre-vaporized prior to premixing.

Operation of turbines on liquid fuels, when permitted, still relies on spray flames with water addition that produces substantially higher NOx and carbon monoxide (CO) emissions than burning lean, premixed natural gas. Consequently, even those gas turbines that have the capability to burn liquid fuels are, in general, severely restricted on the number of hours per year they can operate on liquid fuels because of the significantly higher emissions.

The system solves the auto-ignition problem associated with lean, premixed, pre-vaporized combustion of liquid fuels, allowing operation on liquid fuels while producing low emissions similar to natural gas operation. Turbines using the system can operate for a much higher number of hours per year on liquid fuels.

When equipped with the new system, a gas turbine is started up using natural gas, and in a few minutes, the fuel is gradually transitioned through a range of intermediate compositions, from 100% natural gas to 100% LPP Gas, with no shutdown. The LPP Gas skid vaporizes the liquid fuels into an inerting gas stream ahead of the turbine combustion system, eliminating the risk of auto-ignition or elevated emissions levels, said Rick Roby, a LPP managing member.

Meanwhile, the LPP gas stream has the added benefit of providing some power augmentation to the turbine due to the higher mass flow rate of the LPP Gas that is produced in the presence of the inerting gas.

The prefabricated system is appropriate for use with Dry Low NOx (DLN) combustors that need natural gas for their optimal operation. The characteristics of LPP Gas are so close to those of natural gas that they provide comparable NOx and CO emissions when burned in existing DLN combustion hardware.

The company's first demonstration-scale unit is a skid-mounted LPP Gas System that will be retrofitted to an industrial 1.5-MW Kawasaki turbine with a combustor that is similar to that of larger DLN technology that is widely used in power generation and is part of a chemical plant's cogeneration facility. LPP expects to have at least two commercial-scale contracts by 2007.

Switching From Natural Gas

The LPP technology has been tested on a variety of burners including commercial turbine hardware. Tests have been completed in a combustor at typical gas turbine temperatures and pressures using a test rig at a turbine manufacturer. The technology has proven viable, allowing stable operation under a variety of conditions while producing emissions on the same order as natural gas. Testing has also demonstrated that switching from natural gas to LPP gas is easily accomplished without interrupting normal operations.

This technology provides the flexibility of being able to choose between burning liquid fuel (LPP gas) or natural gas, depending upon the price and availability of the two fuels, while maintaining low pollutant emission levels. When liquid fuel cost is less than natural gas, substantial fuel cost savings can be realized. Through the use of financial models, the long term (multiple year) cost benefits derived from utilizing the LPP system can be projected.

Fuel flexibility will allow a broader range of fuel trading options. When lower cost liquid fuels are used, some gas turbine sites can run for extended periods of time, decreasing the cost associated with turbine startups and shutdowns.

The system will operate below the permitted NOx emission levels from conventional combustion of liquid fuels, allowing the customer to sell or trade NOx credits. Alternatively, if operating under an emissions cap limit, the system would allow additional operating hours.

Combustion hardware maintenance costs will be consistent with natural gas operation, as opposed to the typically higher maintenance costs and operational problems normally associated with liquid fuels. No water or steam injection, normally associated with liquid fuel operation, will be required when burning LPP gas in the turbine, reducing operating costs as applicable.

The more stable LPP gas flame provides the option of operating the unit at a lower firing temperature that would extend the life of the combustion hardware and reduce maintenance costs and/or increase unit availability. The LPP gas skid is designed to have a preventative maintenance schedule that coincides with the gas turbine annual shutdown schedule.