OIL AND GAS PRODUCTION GAINS THROUGH

ENHANCED PROCESSING TECHNOLOGY

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INTRODUCTION

Significant gains in production can be realized by reducing crude oil and natural gas processing costs. One area of the production process where significant economic gains can be realized is in the incorporation of enhanced processing technology into the surface production equipment used to process crude oil and natural gas to pipeline standards.

One such product specifically developed to minimize the amount of energy required to process a barrel of oil to pipeline standards will now be discussed. It was recently recognized by the Department of Energy through issuance of a Special Recognition Award under their National Awards Program for Energy Innovation.

ENHANCED BURNER TECHNOLOGY

The primary type of equipment currently and in the past utilized by the oil and gas industry to transfer the required energy into a process has been the U-Tube burner. The technology developed by Gattlin Research to maximize the overall thermal efficiency of the process and minimize production costs per barrel of crude oil processed is a radical departure from the technology currently utilized.

The technical differences and advantages of the enhanced burner technology over the conventional burner equipment are significant.

Heat Transfer Mechanism

Incorporated in the enhanced burner design, patent pending, is state of the art heat pipe, heat transfer technology. A heat pipe uses the phenomena of evaporation, condensation and surface tension pumping of a liquid in a capillary mechanism to transfer heat from its hot gas side evaporator section to its cold side condenser section. The condensation process of the internal heat transfer fluid in the condenser section of the heat pipe is the physical phenomenon that results in the transfer of heat to the emulsion by the release of the heat transfer fluid's heat of vaporization when condensing. The actual physics and overall transfer mechanism taking place within a heat pipe is complicated.

Heat pipes have the ability to effectively transfer large amounts of energy, exhibit relatively low pressure drop and are highly reliable. The condenser portion of the burner's heat exchanger immersed in the crude oil/water emulsion is bare tubing and by comparison to a U-Tube, small in diameter to effectively negate fouling. The evaporator portion of the burner's heat exchanger is finned for both temperature profiling and maximum extraction of the latent heat contained in the combusted gas stream of natural gas or other burner fuel.

Equipment Thermal Efficiency

The heat transfer mechanisms in conventional equipment of gas radiation and conductance can significantly affect a unit's thermal efficiency.

The range of thermal efficiency of conventional burner equipment has been found by Gattlin and others through field testing to be 25 to 35%. The average thermal efficiency of the enhanced burner technology has consistently been found through field testing to be 80%. In one instance where monitoring of an enhanced burner was done over an eighteen month period, the average thermal efficiency of the burner decreased from the initial value of 87% to only 86%.

Factors affecting the thermal efficiency of a conventional U-Tube burner which have been specifically addressed by the enhanced burner technology are the following:

Excess Combustion Air

The general design percentage of excess air above the stoichiometric ratio for most burner fuels is 15%. With conventional burners, as the percentage of excess air increases above the stoichiometric level, the energy content per cubic foot of heated air passing through the burner is lowered and the log mean temperature differential of the process is reduced with the net result being a potentially significant decrease in process thermal efficiency.

Equipment adaptable to conventional burners to control excess air has demonstrated an inability to proportionally control the amount of excess air over the firing range of the burner, is sensitive to seasonal changes in geographic atmospheric changes and requires the field use of combustion analyzing equipment for any adjustment.

This condition was specifically addressed in the enhanced burner by incorporating into its overall heat exchange design an effective thermal transfer rate of 80% with an excess air ratio in excess of 400%. Consequently, no seasonal or scheduled adjustments to the percentage of combustion and excess air entering the burner are required.

Burner Drafting

In conventional equipment, the drafting of cold air through the burner after the burner has either shutoff or modulated to a low fire position has the immediate negative effect of reverse heat exchange from the process to the cold, drafted air.

This condition was addressed in the design of the enhanced burner by one of the characteristics of heat pipe technology, namely - it can function as a diode to allow significant thermal transfer in one direction only.

Equipment Surface Thermal Conductance

Internal and external surface conditions will significantly affect overall conductance factors and the thermal efficiency of the process.

In conventional burner design, high heat flux density levels or hot spots are created from a combination of flame impingement and gas radiation. This equipment characteristic can cause metal fatigue, high amounts of solid precipitation onto the immersed surface of the U-Tube and oxidation of the internal surface of the U-Tube. A significant decrease in surface conductance factors and the overall thermal efficiency of the process will directly result.

This condition was addressed with the enhanced burner by incorporating into its design the combustion of the burner fuel totally external to the vessel. The result is uniform heat distribution over the immersed surface of the heat exchange, turbulence and uniform combusted gas distribution. The typical surface temperature of the heat exchanger in direct contact with the emulsion is 350 degrees Fahrenheit or less.

Exchanger Corrosion Coatings

Due to the physical constraints of conventional burners such as high heat flux densities or hot spots, rigid structural design, high thermal expansion gradients and the handling procedures used in the field during installation, application and longevity of effective corrosion coatings is limited.

This condition was addressed in the enhanced burner through the isothermal characteristic of its heat exchanger, profiling, low surface temperature in contact with the emulsion, non-rigid structural design of its exchanger and provision of balanced lifting points to prevent loss of coating integrity during installation.

Heat exchanger corrosion coatings such as phenolic, 316L stainless, monel 400, teflon and conventional ceramic based coatings can be applied.

ENHANCED BURNER TECHNOLOGY ECONOMICS

Due to the manufacturing cost of the Gattlin technology, the initial capital investment of the enhanced burner technology is higher. The following was prepared as an indication of the economics and potential payback period of this technology based solely on process energy savings.

Assumptions

- o Equipment operating period : 365 days per year
- o Process temperature differential : 60 F
- o Hourly process load : 300,000 BTUH

- Thermal efficiency of conventional burner : 30%
- Thermal efficiency of enhanced burner : 80%

Case No. 1 - Burner Fuel - Natural Gas

VESSEL SIZE	COST OF ENERGY [MCF]	PROJECTED EQUIPMENT PAYBACK - MONTHS
6 x 20	$2.00	13.8
6 x 20	$2.50	8.3
6 x 20	$3.00	6.9
6 x 20	$3.50	5.9

Case No. 2 - Burner Fuel - Propane Gas

VESSEL SIZE	COST OF ENERGY [GALLONS]	PROJECTED EQUIPMENT PAYBACK - MONTHS
6 x 20	$0.40	4.7
6 x 20	$0.45	4.2
6 x 20	$0.50	3.8
6 x 20	$0.55	3.4

<u>SELECTED REFERENCES</u>

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