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OXY-FLAMELESS COMBUSTION HEATERS FOR REFINERY PROCESS

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ABSTRACT

The next generation of flameless heater technology for refinery and petrochemical process heaters may be Oxy-Flameless heaters. Great Southern Flameless (GSF) is currently developing a flameless heater design concept that will utilize oxy-combustion technology in order to further reduce CO_2 emissions.

Oxy-combustion is not at all a new concept however it will be new to the direct fired process heater industry. Combining oxy-combustion with flameless technology will revolutionize the process heater industry and will be well suited for the carbon capture requirements that may be mandated in the future.

GSF's current flameless heater design can be installed today and then easily modified to Oxy-Flameless at a later date if carbon capture regulations are implemented.

TECHNICAL PAPER

INTRODUCTION

Now that CO_2 has been classified as a greenhouse gas, future regulations may be implemented that will require CO_2 to be monitored and emission limits set by the EPA. Since CO_2 is a natural product of the hydrocarbon combustion reaction, it will be necessary to implement carbon capture technology. Therefore, heater efficiency will become a very important part of refining operations in order to reduce the amount of CO_2 produced.

GREAT SOUTHERN'S OXY-FLAMELESS TECHNOLOGY CONCEPTUAL DEVELOPMENT

The Great Southern Flameless Heater technology which has now been commercially proven for refinery and petrochemical applications is perfectly suited for oxy-flameless combustion. The current flameless heater design can be readily and economically converted to oxy-flameless technology if the regulations take effect.

The reader is requested to review and reference Great Southern's technical paper *"The World's First Flameless Crude Heater"* for the discussion that follows.

Beginning with the standard flameless heater design, the only modifications that would be required to convert the current flameless heater to oxy-flameless technology (Fig.1) are:

1) Addition of (3) oxygen injection nozzles between the existing combustion air nozzles on each FNG.

2) Utilize the hot flue gas duct connection in the stack to connect to the hot flue gas transfer duct. This would transfer the flue gas to the CO2 recovery system: refrigeration, separation and ultimately carbon capture and sequestration.

3) Removal of the air preheater and fans and modification of the air-preheat system ductwork. Replace with a hot ID fan to recirculate hot flue gas back into the heater through the combustion air nozzles.

These items are the only modifications required to convert the current flameless heater design into an oxy-flameless heater.

Start-up would be on natural draft, conventional firing, and gradually bringing on the oxygen injection. Once the heater is up to rate with excess O_2 around 3% and temperature permissives met, the heater can be transitioned into staged firing and then on to flameless firing in the same manner as the typical flameless heater operation.

Hot flue gas is recirculated from the stack back through the existing combustion air nozzles. This provides for both of the flameless temperature permissive requirements and maintains the circulating flue gas volume needed for flameless firing operation. Oxygen is injected through nozzles located between the existing combustion air nozzles. The oxygen jets entrain furnace gases and then diffuse with the fuel gas from the flameless nozzles.

Flameless combustion is still very advantageous even with oxy-combustion. Obviously, NO_x is not a concern with oxy-combustion as the primary source of nitrogen has been eliminated from the combustion process.

However, the other significant advantages of flameless combustion still apply. They are as follows:

1) Uniform heat flux to a double fired coil.

2) Large holes in the gas tips, reduces plugging.

3) Elimination of flame impingement on process coil.

4) Elimination of hot gas impingement on process coil.

5) Cooler tube metal temperatures.

6) Longer tube life.

7) Extended run lengths.

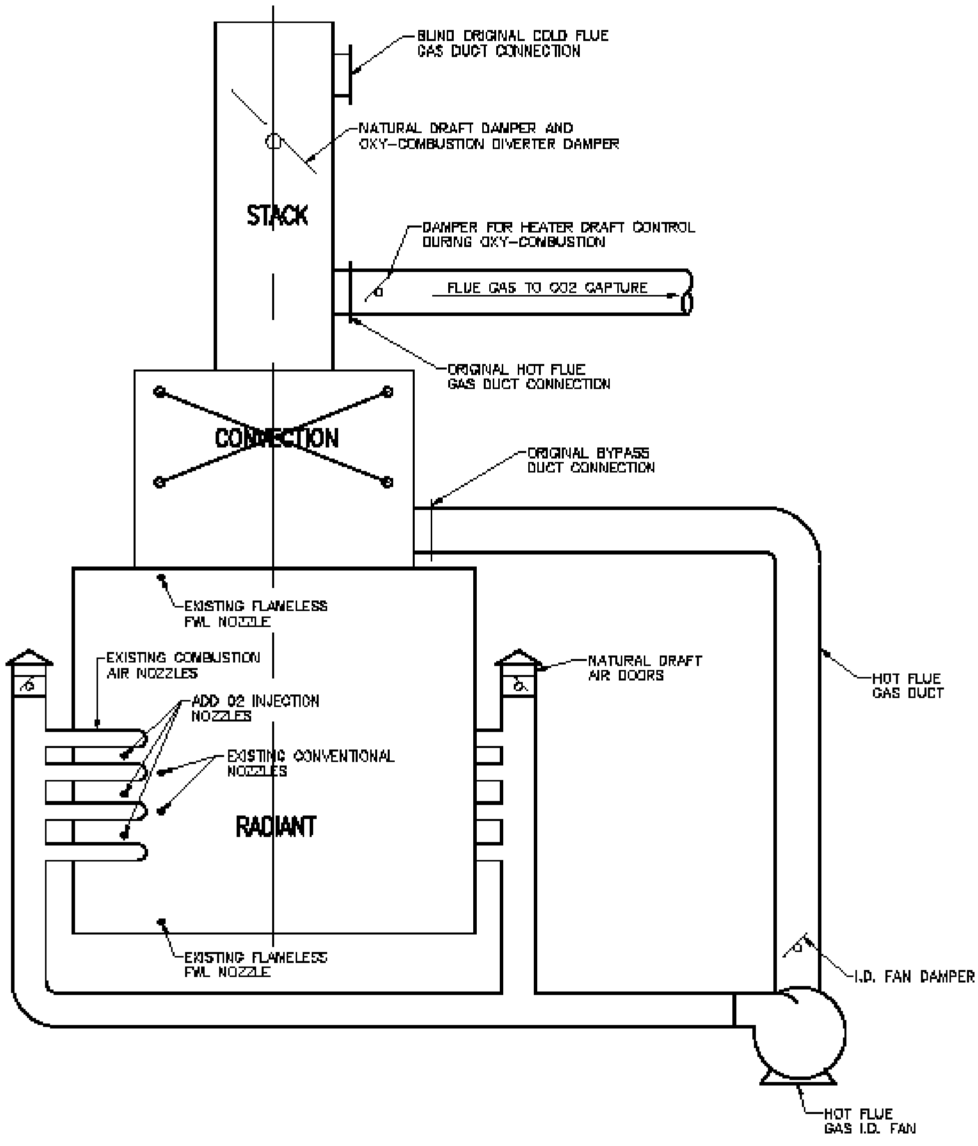

Figure 1. Oxy-Flameless Heater

PREDICTED PERFORMANCE

Without the nitrogen in combustion air contributing to NO_x formation, the expected NO_x would be 0-1ppm, NO_x being generated only by the pilots.

Additionally, without having to heat the volume of nitrogen from the combustion air, the heater efficiency is increased when compared to air combustion (reduction in stack losses).

	Traditional Heater	Flameless Heater	Oxy-Flameless Heater
Excess O_2, %	3	3	3
NO_x, ppmvd	31	4	0-1

Table 1. Oxy-Flameless Heater Predicted Performance

SUMMARY

Plan ahead for CO_2 capture without any additional cost at this time, and with minimal modification costs in the future. A Great Southern Flameless Heater is ideally suited for combustion with air or oxygen. If the requirements for CO_2 capture are put into place, a simple retrofit of the flameless heater will ensure compliance with both CO_2 and NO_x regulations. The Oxy-Flameless heater is simple, safe, reliable and economical.

For more information on our Flameless and Oxy-Flameless technology or to contact Great Southern, please visit us at:
www.GreatSouthernGroup.com