Red-Ray Manufacturing CO., INC.

Process Heating

UTILIZING LANDFILL GAS

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In this case study for an infrared burner, testing showed that one burner could operate effectively with a mixture that mimics landfill gas.

Landfill gas is becoming increasingly important as a source of fuel for process heating. This is primarily due to its carbon footprint, which can be harnessed to do work instead of being vented or flared into the atmosphere. This study was undertaken to determine if existing infrared burners could effectively be used with this supply gas or if modifications to the burners needed to be made.

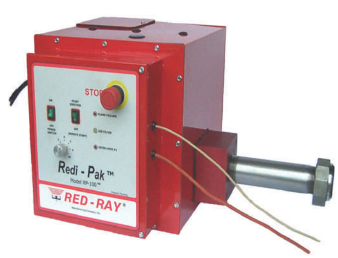
Initial research has been completed with process infrared burners using carbon dioxide modified natural gas. Radiant emissivity was achieved in the 550 to 610 BTU content range maintaining a constant air / gas mixer setting. During combustion, the emitter temperature was 1,700 degrees F. Radiant fire was also achieved and maintained as low as 475 BTU by adjusting the air / gas mixer to reduce the total % of natural gas.

The objectives of this study consisted of two main goals:

- Determine the lower limit of infrared radiance through the downward adjustment of the BTU content in an air/gas/carbon dioxide mixture.
- Define process performance viability with low BTU content gas typically available from a landfill pipeline without expensive upstream control equipment.

An Apollo-Ray all metal burner manufactured by Red-Ray was chosen for the study. The manifold contained two sections, each 12” x 5” in size. This burner has high infrared versus convective energy output, approximately 65% IR, 35% convective. This burner has a stainless steel construction with a sintered metal fiber emitter that burns with a surface temperature of 1,700 degrees F at high fire. It is currently used in a number of industrial applications, including food processing, paint curing, annealing, and paper drying.

A cylinder of carbon dioxide was piped in to dilute down the air/gas stream. A two stage pressure regulator, flow meter and low pressure regulator were connected in series to provide a flow rate of 35-45 CFH and a pressure of 0.25 – 0.5 PSIG.



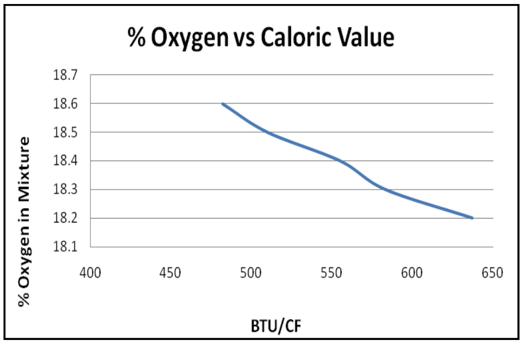
Left: The Redi-Pak is a self-contained operating and control module that was tested as an alternative to a standard air/gas train.

A Redi-Pak operating and control module manufactured by Red-Ray was evaluated as an alternative to a standard air/gas train. This self contained unit includes an air blower, mixer, control valves, pressure switches, ignition control module, flame safeties and PC boards.

The dimensions of the unit are roughly 15" wide x 18" deep x 12" high. The air input orifice to the mixer valve was increased to the maximum possible diameter, but only a minimum of 730 BTU content gas could be achieved. So, a standard air/gas train was used instead with zero pressure regulator, valves and air blower.

The % oxygen in the total mix was measured by a hand held oxygen analyzer. The burner surface temperature was measured by a pyrometer.

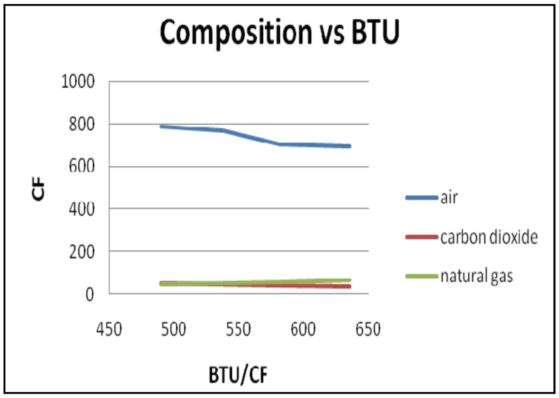
The BTU content was measured volumetrically. The flow rate of natural gas was held constant while the flow rate of CO2 was increased. The flow of natural gas divided by the total flow of gas plus CO2 multiplied by 1,000 BTU/CF equaled the BTU/CF. The inlet pressures of gas and CO2 were approximately equal.



It was necessary to add carbon dioxide to effectively reduce the caloric content of the gas. Only adjusting an air gas mixer to provide a lower energy content mixture increased the flow rate producing a high, yellow luminous flame in the burner.

The average BTU content of landfill gas provided by the city of LaGrange, GA to several companies that use gas from this pipeline was 585 BTU/CF. The range around this norm is 550 to 610 BTU/CF. Bright red infrared radiance in an all metal burner was maintained throughout this range with an emitter temperature of 1,700 degrees F with no mixer adjustment necessary. This indicates viability from a process control standpoint.

With a fixed air/gas mixer, the % oxygen varies inversely with the BTU content. The higher the % oxygen in the total mix, the lower the BTU content of the gas. Thus measuring the % oxygen in the mix can define the BTU content of the gas.



In conclusion, gas stream mimicking landfill gas was evaluated for its ability to support infrared combustion. The results were positive and encouraging for companies seeking to use landfill gas in their manufacturing processes. No large scale upstream investments, such as a feedback loop to a modulating valve, seem to be required to further improve the BTU content and its control.

The effects of landfill gas contaminants such as hydrogen sulfide and other non methane organic compounds were not evaluated. Actual landfill gas needs to be tested in another study to determine long term effects on performance of infrared burners.

Left: The Apollo Ray burner has stainless steel construction with a sintered metal fiber emitter that burns with a surface temperature of 1,700°F at high fire.

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