# Mass-Based Fuel Measurement with Micro Motion® Coriolis Flowmeters Boosts Combustion Control

## RESULTS

- Reduced risk of NOx emissions excursions
- Improved combustion efficiency
- Generated an increase in steam production by 25%, to near capacity

***One Micro Motion mass flow- meter replaced several instruments.***

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## APPLICATION

A refinery in southern California uses fuel gas as the primary combustion fuel in its boilers. As shown in Figure 1, temperature in the combustion chamber was used to control the feed rate of the fuel gas. Air intake was controlled in direct proportion to the gas feed, so that the (volumetric) combustion ratio remained constant.

## CHALLENGE

The composition of the fuel gas, and its energy content, varied considerably (Figure 3). Because the combustion ratio was fixed, when the high energy content fuel was burned, hot spots developed and excess NOx emissions were produced. In order to avoid these conditions, the fuel feed was de-rated, with the result that steam production was also reduced, to 80% of capacity. Though excess emissions were curtailed, the refinery's productivity was seriously diminished.

Figure 1: Old Process

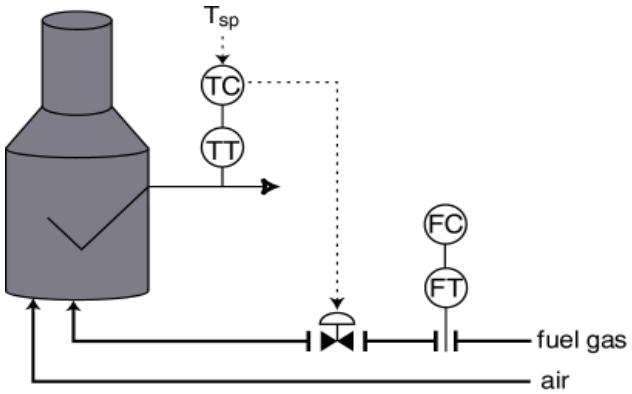
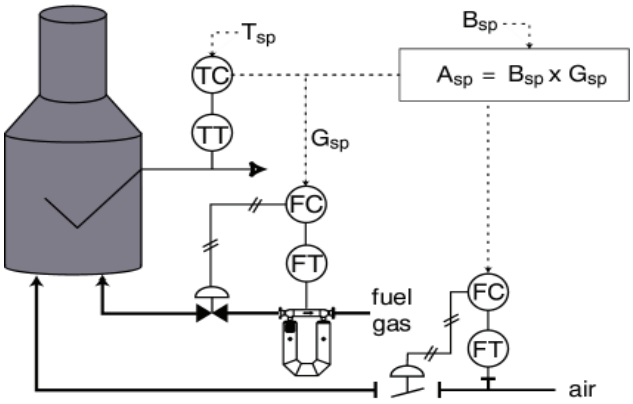



Figure 2: New Process with Cascade Control

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## SOLUTION

The refinery installed a Micro Motion® Coriolis flowmeter in the gas fuel line. Coriolis flowmeters measure flow rate in terms of mass rather than volume. While the energy content of the different gas compositions varied over a range of nearly 58% when measured by volume (Figure 4), the range of variation when measured in terms of mass with the new process (Figure 2), was less than 4% (Figure 5).

By adding a cascade loop to the control system (see Figure 2), and using the mass flow rate to control the air intake, the combustion ratio was adjusted automatically to reflect actual energy content. This allowed the refinery to ramp its steam production back up to nearly 100%, while avoiding hot spots and excess NOx emissions.

Furthermore, because Coriolis flowmeters measure mass flow directly, temperature and pressure compensation are not required. So a single instrument, the Coriolis meter installed with a Micro Motion transmitter, was able to replace several devices necessary for volumetric measurement.

Figure 3

Typical fuel gas composition changes in mol%

| | Comp 1 | Comp 2 |
|---|---|---|
| methane | 30 | 47 |
| ethane | 12 | 15 |
| propane | 6 | 7 |
| butane | 2 | 6 |
| hydrogen | 50 | 25 |

Fig. 4

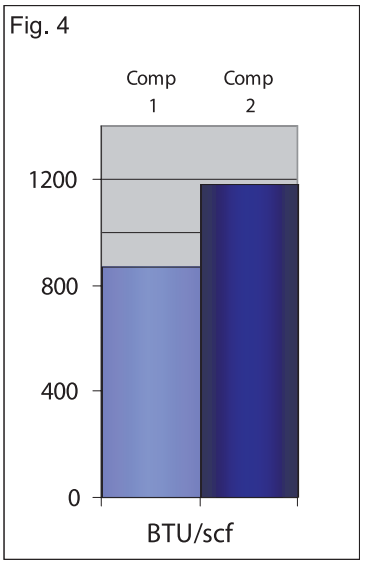
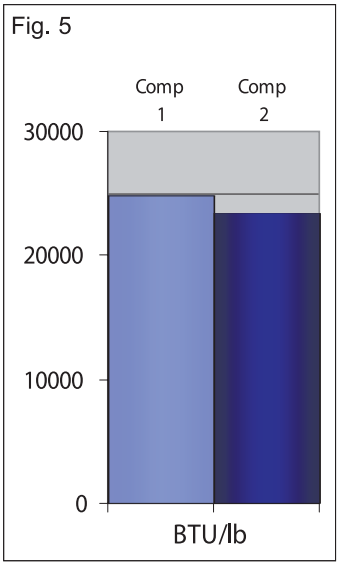



Fig. 5

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