

Application of GasPTi

Background

This note has been prepared for the purpose of illustrating the effects which variations in the quality of natural gas can have on energy efficiency and safety within downstream markets. In particular we study the impact of changes to Calorific Value (heat content) and Wobbe Index (combustion performance) on end user combustion equipment.

In many countries in recent times there has been a significant shift from a single source of indigenous natural gas towards multiple sources of gas from new interconnector pipelines and shipped LNG. Many countries are now net importers of natural gas and this results in greater variation in gas quality for downstream users. GasPTi has been developed to provide accurate and rapid measurement of gas properties so that users can monitor and compensate for variations.

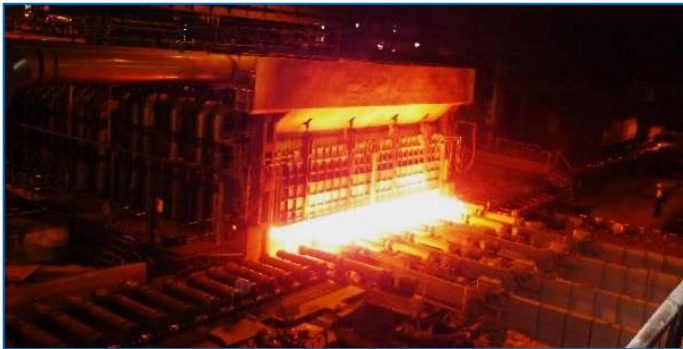


Figure 1 – Gas PTi used with large industrial furnace control.

Issues

The heating power or gross thermal load (Q) of any gas burner depends on the gross calorific value (CV) and the volumetric gas flow rate (F):

$$Q = CV \times F$$

At constant pressure the flow F through a gas nozzle is inversely proportional to the square root of the relative density of the gas:

$F \sim 1/(\text{SqRt RD})$ and so burner thermal load $Q \sim CV/(\text{SqRt RD})$

Also Wobbe Index is defined as $WI = CV/(\text{SqRt RD})$

The conclusion is therefore that:

1. The Burner Thermal Load is directly related to the Wobbe Index of the Fuel Gas
2. This is important in considering the energy efficiency of gas-fired equipment.

Large Industrial Users

Modern industrial boilers and other large gas-fired heating plant typically operate at 10% excess air or more to ensure minimum flue stack temperatures and optimum boiler efficiency. If the CV of the fuel gas changes then the optimal efficiency of the plant will be lost and this could cause problems with production quality, burner combustion instability and increased emissions of CO or NOx. Typically

there would be an infrequent check on gas quality (3 months or more).

The variation in gas quality will change both the flame length and flame temperature of industrial burners. This has significant impact on certain processes such as glass, glass fibre and ceramics production where production quality and volume depends on stable flame temperature.

Ideally what is required is a low-cost, fast and accurate instrument to detect any gas quality changes, with flexible communications options for process control.

Solution

GasPTi is a unique integration of gas sampling, gas conditioning and gas analysis which provides rapid and accurate monitoring of gas quality in a pipeline, with T90 response time less than 10 seconds and to a CV error less than $\pm 0.5\%$. The system mounts directly onto a pipeline or can be post-mounted nearby with a short gas sample line.

A low-cost, low pressure version of GasPTi is available which will operate at supply pressures less than 10 barg and this has been developed specifically for the downstream user, typically on combustion systems requiring fast and accurate monitoring of CV and Wobbe.

Depending on the application, GasPTi signal outputs can be either serial, Ethernet or analogue interfaces.

Applications of the GasPTi have included steel and glass production and metal heat treatment where the rapid analysis can be used as part of combustion process control rather than relying on oxygen trim feedback or slow GC analysis.

Calorific Value (Gross and Net), RD, Wobbe, Compressibility, Methane Number, Motor Octane Number are standard physical properties which are output from GasPTi.

A communications interface controller has been used in some applications to provide extra calculated parameters such as carbon dioxide emissions factor and molar mass.

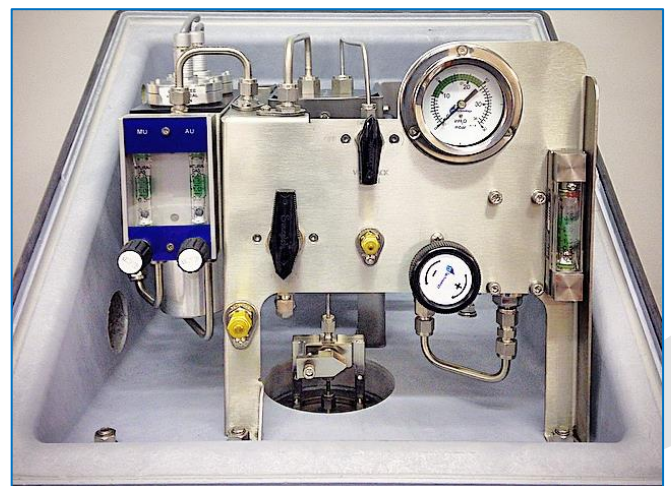


Figure 2 – GasPTi – Complete integrated solution for sampling, conditioning and analysis.

Large Industrial Users

Application of GasPTi



Figure 3 – Glass Production monitoring CV and Wobbe for optimum production quality.

Conclusion

1. All downstream users of natural gas will be affected by variations in the Wobbe and Calorific Value of the gas supplied.
2. The effects of gas quality variation will be on product quality, equipment efficiency, emissions and safety.
3. GasPTi provides rapid and accurate CV data which can be used for process control.

Example Downstream LIU Applications

Company	Location	Industry	Gas Properties
Clogrenanne Lime	Ireland	Lime Production	Density
Corus	UK	Steel Manufacture	CV & Wobbe
United Glass	UK	Container Glass	CV & Wobbe
Pilkington Nippon Sheet Glass	UK	Float Glass	CV
Owens Corning	UK	Glass Fibre	CV & Wobbe
PPG	China	Glass Manufacture	CV

Publications:

Experiences in Gas Quality Monitoring Across Natural Gas Markets
IGU World Gas Conference, Paris, 2015.

Development of Real-time Gas Quality Measurement
International Gas Union Research Conference, Copenhagen, 2014.

Accurate, Real-time Monitoring of Gas Quality
10th European Conference on Industrial Furnaces and Boilers, Porto, 2015

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Figure 4 – Gas PTi pipeline mounted installation.

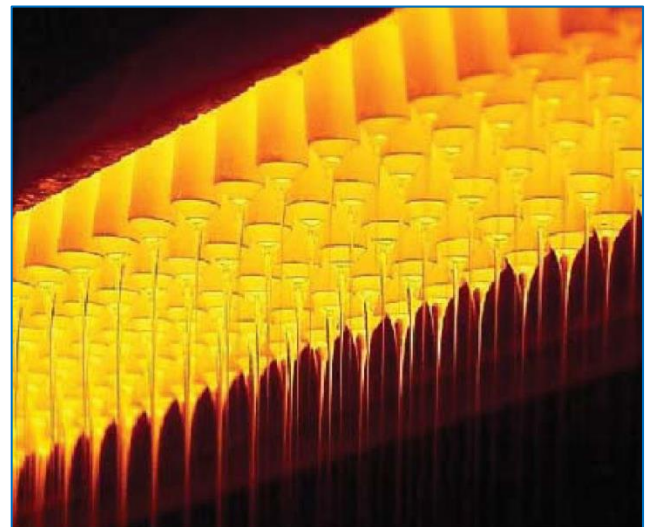


Figure 5 – Gas PTi used with fibre glass production.



Figure 6 – Gas PTi pipeline mounted installation