Energy Flow Metering

Application of Gas PTi & VE Technology

Background

This note has been prepared for the purpose of illustrating the effects which natural gas sampling, conditioning and analysis can have on energy flow metering applications.

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, unconventional gas and shipped LNG. The pipeline operators require accurate monitoring of gas quality and flow at numerous points in order to satisfy process control and energy accounting standards.

Issues

Traditional methods for gas quality analysis have used gas chromatographs to provide CV measurement

Speed of response of traditional GC analysers is several minutes. This can be an issue if the CV is changing and so mismatched time data of instantaneous flow and delayed CV are used to calculate energy flow. This is recognised in OIML R140 Measuring Systems for Gaseous Fuels which states "In principle, the energy to be determined should be the sum of the instantaneous energies delivered. However, in practice this is not possible and it is acceptable not to associate the instantaneous calorific value to the instantaneous corresponding volume…"

Figure 1 shows that Energy Flow calculations may be in error. Also volume correction, due to delayed density and compressibility data, will be erroneous. Finally, speed of sound calculations, used to calibrate ultrasonic meters, may also be in error.

Solutions

GasPTi is a unique integration of gas sampling, gas conditioning and gas analysis which provides rapid and accurate monitoring of gas quality, with T90 response time from 10 seconds or less and to a CV error typically less than ±0.5%.

The system mounts directly onto a pipeline or can be post-mounted nearby with a short gas sample line.

Depending on the application, GasPTi signal outputs can be either serial, Ethernet or analogue interfaces. CV, RD, Wobbe, and Compressibility are all standard physical properties which are output from GasPTi.

In addition to ATEX, IECEx and CSA approvals, American Bureau of Shipping approval has been obtained for GasPTi marine LNG tanker applications. (Certificate Number: 13-LD1105876-PDA)

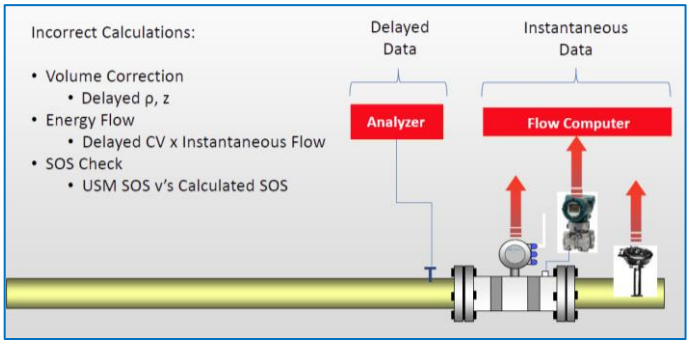

Figure 1 – Mismatch between flow and CV.

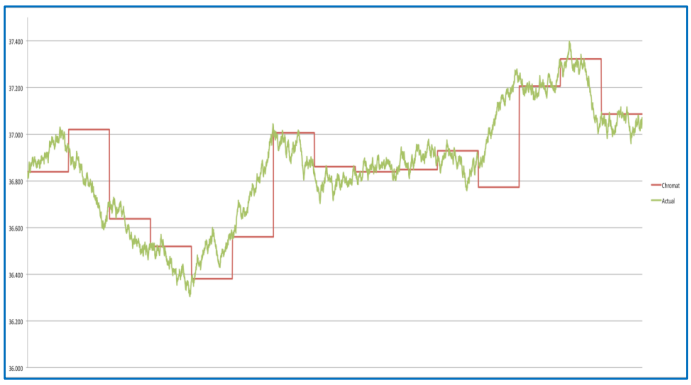

Figure 2 – Graph showing varying gas quality. GasPT offers near real time response and data.

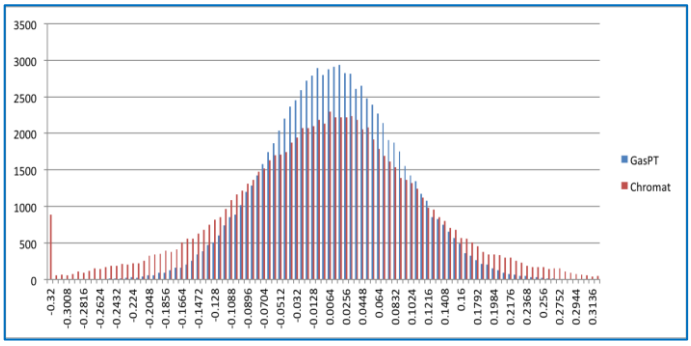

Figure 3 - Graph shows GasPT® has a lower uncertainty of measurement compared to a GC with a varying gas CV.

Figures 2 and 3 show that where the CV of the gas does not change by more than 0.2 MJ/m3 between GC analyses, the frequent measurements made by the GasPT do not offer an advantage.

However, if the CV of the gas changes by more than 0.2 MJ/m3 during this time then the more frequent, and now comparatively more accurate GasPT results do offer a benefit over the GC's less frequent results.

This is more noticeable where the CV consistently increases or decreases during the day.

Orbital Global Solutions,
Cold Meece, Stone, Staffordshire ST15 0QN
United Kingdom

| T: 01785 857007 |
| W: www.orbitalglobalsolutions.com |
| E: enquiries@orbitalglobalsolutions.com |

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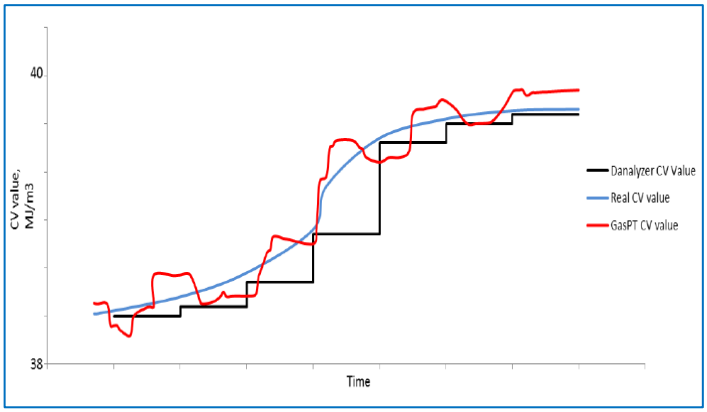

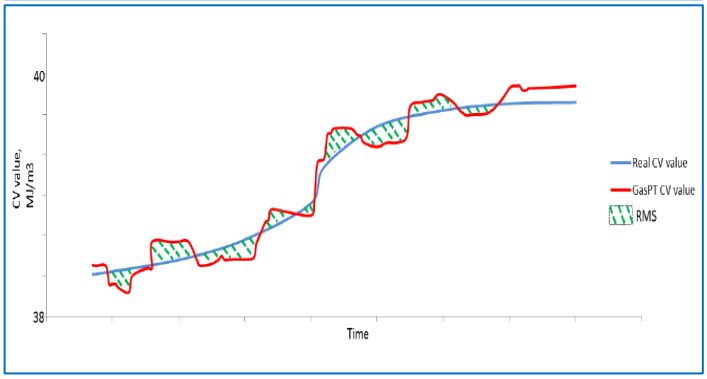

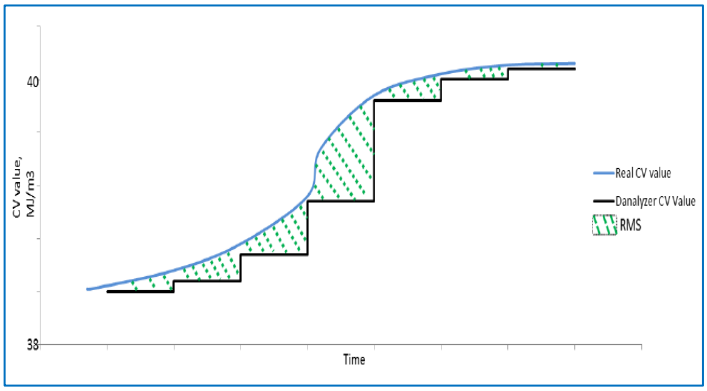

Figures 4, 5 & 6 (above) – Graphs showing root mean square.

The root mean square, RMS, provides an estimate of the overall error between the real true CV and the measured CV, taking into account the delay in the reported result, (a combination of sampling time and analysis time). The RMS for the GasPT is smaller than the GC, this is shown schematically above

Conclusions

1. CV data in near real-time from GasPT will produce more accurate Energy Flow data than mismatched instantaneous flow vs delayed CV data from a GC.
2. A GasPT with a maximum error in measurement of 0.2 MJ/m3 will provide the same daily averaged CV as a GC.
3. Near real-time monitoring of CV will improve the calculation/correction of metered volume.
4. GasPT delivers the opportunity to have real time management of the network.
5. GasPT eliminates the risk that temporary excursions in gas quality could be completely unnoticed.

Example Energy Flow Applications

Project	Company	Location	Application
Flow weighted CV averaging	National Grid	UK	Energy flow metering
Network compressor stations	National Grid	UK	Fuel gas flow metering
City gate custody transfer	Snam Retegas	Italy	Energy flow metering
Gas Transmission	Gasunie	Netherlands	Energy flow metering
Gas Transmission	Alliance Pipelines	US	Energy flow metering
Gas Transmission	TGI	Columbia	Energy flow metering
Business Park Distribution	Fermaca	Mexico	Energy flow metering

Figure7 - Gas PTi pipeline mounted installation – Fermaca, Mexico City Business Park.

Publications:

Development and Testing of a New Gas Properties Transmitter INGAS International Gas Conference, Istanbul, 2013.

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

Bryant, N & Laughton, L - DNV GL. (2014) *GasPT Measurement Error Dependence on Measurement Frequency*. Loughborough.

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