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Wobbe Index and Calorimeters

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Introduction

Hobre Instruments is a leading company in online analysing techniques. Besides manufacturing analysers, Hobre Instruments is a worldwide known and valued system integrator. With our 30 years of experience as analyser distributor / manufacturer and system integrator, Hobre Instruments can supply you complete solutions, from sample take off to output signal!

The Challenge

The gas you use or deliver has to meet contractual specifications. In many refineries and petrochemical plants, furnaces, turbines and boilers can be exposed to frequent and sudden changes in the fuel gas composition. These changes will immediately affect the operating stability of your combustion process and can cause unwanted emissions.

Users are looking for a method to control the air/fuel ratio in such a way that disturbances in the temperature are minimised and that the combustion process occurs with maximum efficiency.

The Solution: Hobré Instruments Wobbe Index Analyser

In cooperation with the Dutch Gasunie, Hobre Instruments has developed a solution for measuring and monitoring the Wobbe Index, Combustion Air Requirement, Calorific value based on a residual oxygen measurement. The WIM9900 Wobbe Index analyser offers an unmatched combination of response time, accuracy and availability over a large range of gas compositions without the concerns of flameouts or the need for support gases.

Definitions

Heating- or Calorific Value (HV or CV): The amount of heat evolved by the complete combustion of a unit certain volume of gas with air.

Specific Gravity (SG): The specific gravity, also known as relative density is the density of gas in relation to the density of air, when both are at the same reference conditions.

$$\text{Specific gravity} = \frac{\text{Density fuel gas}}{\text{Density air}}$$

Wobbe Index: The Wobbe Index (WI) is the main indicator of the interchangeability of fuel gases and is frequently defined in the specifications of gas supply and transport utilities. Wobbe Index is used to compare the combustion energy output with different composition of fuel gases. If two fuels have identical Wobbe Indices then for given pressure and valve settings the energy output will also be identical. The Wobbe Index is a critical factor to minimize the impact of fluctuations in your fuel gas supply and can therefore be used to increase the efficiency of your burner or gas turbine applications.

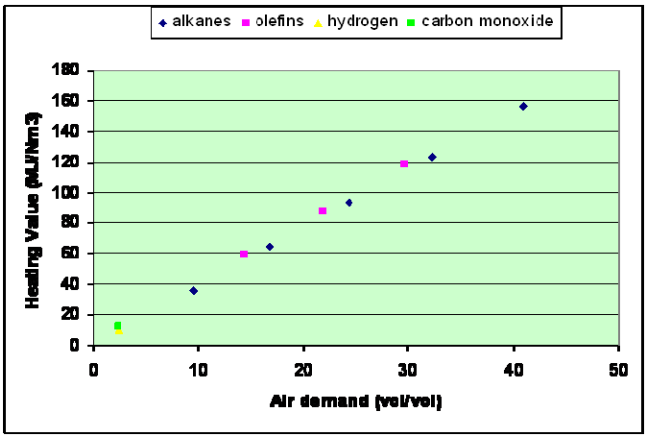
$$\text{Wobbe Index} = \frac{\text{Heating Value}}{\sqrt{\text{Specific gravity}}}$$

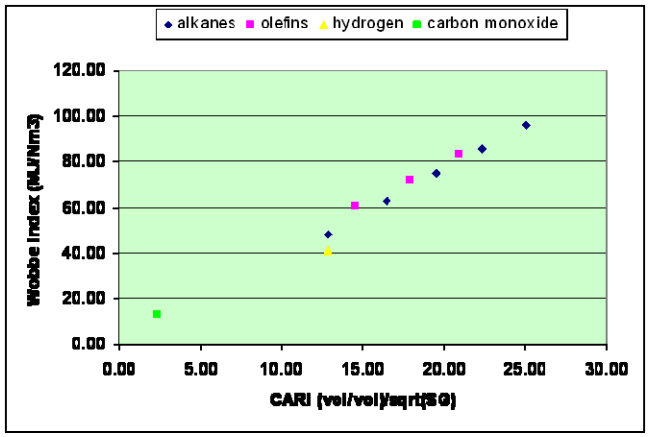
CARI (Combustion Air Requirement Index): The required amount of dry air to burn 1Nm3 of fuel gas compensated for the specific gravity of the gas.

$$\text{CARI} = \frac{\text{Air demand}}{\sqrt{\text{Specific gravity}}}$$

Why measure both CARI and Wobbe Index?

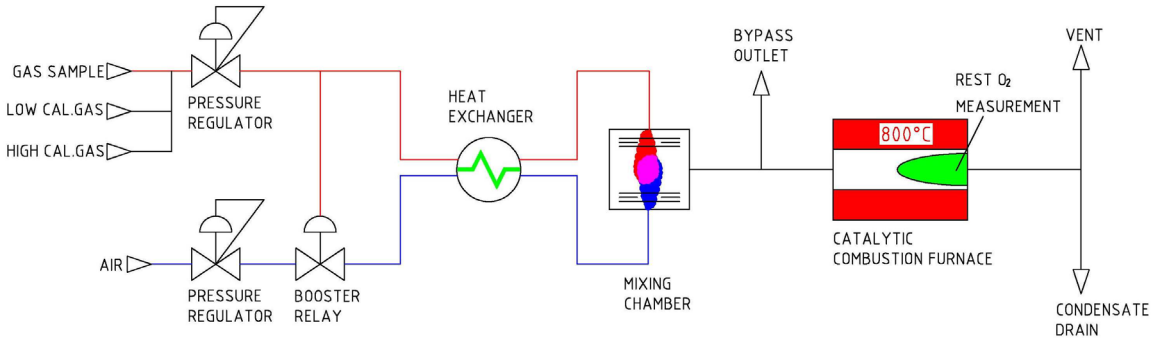
For fuel gases containing CO and H2 there is no direct lineair relationship between the Wobbe index and CARI. For these gases it is therefore important to use both parameters in the control loop. Most important is CARI as the optimim air fuel ratio is essential in efficient combustion and minimising emissions.
Wobbe Index is used for control of energy flow. Minor systematic errors are here less important as energy input can be corrected with feed back control in most control schemes.
The Hobre Wobbe Index meters can be equipped with outputs for Wobbe Index as well as the CARI value for CO and H2 containing fuel gasses.





Measuring Principle

The measurement principle of the Hobré Instruments Wobbe Index analyser is based on the measurement of residual oxygen after catalytic combustion of the flare or fuel gas. A small sample flow is mixed continuously with dry air in a constant fixed ratio. This ratio depends on the gas composition and is determined on a case by case basis. Using an electrical heated catalytic oven the air fuel mixture is fully burned at a temperature of approximate 800ºC. The residual oxygen is measured by a highly accurate and reliable zirconia oxide cell. This residual oxygen content provides an accurate measurement of the Combustion Air Requirement and correlates well to the Wobbe Index of the gas.



Heating- / Calorific value output

In order to generate the heating- / calorific value output, an optional density cell will be installed inside the analyser's gas mixing compartment. Two options are currently available.

- A continuous measurement based on the vibrating spool principle. Typical accuracy: +/- 0.1%
- A Hobre Instruments density cell with updated output every 5 seconds. Typical accuracy: +/- 0.5%

Both measurements are suitable for installation in an ATEX cat. 2G environment. Please consult Hobre Instruments for additional information.

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Benefits Hobre Instruments Wobbe Index analysers (WDM3300 and WIM9900)

- Fast response
- High Accuracy and low noise
- Flameless analyser (no flameout errors or overheating)
- Large effective measuring range 0-100MJ/Nm3
- Minimal maintenance
- Straight forward measuring principle
- Suitable for corrosive gasses and high Sulphur applications
- Standard outputs: WI and CARI
- Optional outputs: SG and HV

WDM 3300

Additional Benefits WIM9900

- Suitable for outdoor installation (no need for expensive HVAC unit)
- Epoxy coated stainless steel enclosure
- Insensitive to ambient temperature fluctuations
- Fastest WI analyser available (T90 within 5 seconds)
- Local man-machine interface without the need of connecting a computer
- Versions available for installation in:
  Safe area
  ATEX Cat 2G EExp dem (ib)IIC T3 (Zone 1)
  ATEX Cat 3G Ex purge (Zone 2)
  NEC/NFPA Zone 2 purge

WIM 9900

Typical Industries

Natural gas production	Feed back and feed forward control of gas blending, control of incoming gas on Wobbe Index
Natural gas distribution	Fuel gas combustion control to boilers, gas turbine control, blending, gas storage, final quality control
Refining, Petrochemical and Chemical industries	Feed forward control of furnaces, fuel- vent- and flare gas monitoring
LNG receiving terminals	Mixing of LNG with Nitrogen
Crude oil tankers and storage	HC Emission reduction by controlling the combustion of vapours during loading and unloading process
Steel plants	Mixing of BFG and COG (with or without natural gas)
Glass factories	Control of oven atmosphere, air fuel ratio control an/or blending of gas at inlet of the plant
Gas turbine control	Gas quality measurement to prevent for damage to the gas turbine

Optional available:

- Heated gas mixing compartment to prevent for water and heavy HC condensation
- Sample probes to ensure proper sampling
- Pressure reduction systems
- Internal fast loop for optimalisation of the entire system
- Hot application unit for compositions with high dew point (up to 100ºC)
- Standard design for low sample pressure, including a sample pump
- Calibration bottles and/or gas bottle rack
- Frames, sunroofs, 3-sided shelter, complete winterized enclosures
- Complete gas stabilisation systems
- Please contact us for more detailed information

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