CLIMATE-FRIENDLY FLARING
VENT GAS ANALYSIS TO ENSURE COMPLETE COMBUSTION

Combustion of natural gas results in almost zero particulate emissions and almost no sulphur dioxide. However, methane is a potent greenhouse gas with a global warming potential around 50 times worse than carbon dioxide (CO_2). Natural gas leakages through the entire value chain from upstream gas extraction through to transmission in pipelines or transportation as LNG must be eliminated.

Considering its abundance, flexible logistics, clean burning characteristics and cost-effectiveness the future of LNG looks bright. Whilst usage of some energy commodities such as coal may peak during this decade, the peak consumption of LNG could be as late as 2045. Since it will be around for a long time, climate-friendly production and use of LNG is essential.

Many offshore oil rigs are designed to recover crude oil and are not able to process methane (CH_4) and lighter hydrocarbons. These are sent to the flare where they are mixed with ambient air and burned to form CO_2 and water vapour. Flaring natural gas and releasing the resultant CO_2 to atmosphere contributes less to global warming than emitting the same amount of natural gas directly into the air.

If there is not sufficient air in the flame the hydrocarbons are not fully combusted. If methane, propane, and butane slip through the flare, they pollute the atmosphere and in particular, methane contributes significantly to climate change. Process control of a flare is a complex balance of parameters in real time which requires accurate and responsive gas analysis instrumentation.

Controlling the ratio of oxygen to fuel in the vent gases flowing to the flare is an effective way to ensure complete combustion. Measurement of the heating value (Wobbe index) of the mix of hydrocarbons in the vent gas can be used to adjust process parameters and ensure complete combustion.

Additional combustion air can be fed to air-assisted flares by increasing the flow from the air supply compressor. On steam-assisted flares, a higher steam flowrate can be used to entrain more air into the flame. For these control strategies to function effectively, precise measurement of the combustion air requirement of the vent gas flowing to the flare is required.

Wobbe index measurements in steady state systems such as the gas transmission pipeline grid are made using gas chromatography. The composition of the gas stream is analysed and the concentration of each chemical such as methane, propane, butane and butene is multiplied by its known heating value to calculate a weighted average which will equate to the Wobbe index. The Wobbe index is used for invoicing and ensures that the energy value of the pipeline gas meets consumer requirements.

However, gas chromatography is not a continuous process and the delay between extracting the sample and yielding the measurement result can be between 2 and 10 minutes. In the gas pipeline grid, this time delay is acceptable since changes in the gas composition are comparatively slow.

Rapid response micro GCs fitted with TCD detectors are ideal for these applications and are available from multiple suppliers including ABB and Siemens. More sensitive laboratory instruments to analyse natural gas and hydrocarbon streams may be set up in a GC-FID configuration.

On the other hand, time is of the essence in flare gas measurement. A smoky flare will be seen immediately by neighbours and even a short period of un-combusted methane emissions would have a negative climate impact. Furthermore, regulations in several countries require that process control of combustion air to the flare is affected within a 15-minute period.

A widely used method to measure the amount of combustion air required in the flare is to burn or catalytically oxidise a sample of the vent gas in a stream of air. The residual oxygen concentration in the post-combustion gas mixture is measured after complete oxidation of the hydrocarbons has taken place. The difference between the pure air concentration and the residual oxygen represents the amount of oxygen required by the flare.

A benefit of this method is that it reports results almost instantaneously and avoids the time-lag associated with gas chromatography. Gas analyser providers such as COSA XENTAUR and Hobré Analyzer Solutions offer instruments of this type.

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