MEASURING HEATING VALUE OF FLARES

Keywords:
- Flaring efficiency
- Significant fuel gas cost savings and energy efficiency
- Instrument selection

Flare Gas Measurement

Flares are used to eliminate waste gas which is not feasible to use or transport. Legislation around flaring is increasingly intensified as flaring is an undesirable process both environmentally and economically. Moreover, it results in health and safety issues and in waste of energy which can be utilized for future generations.

For this reason users are forced to minimize their flaring activities to a minimum. Flare gases are increasingly blended into the fuel gas systems to be combusted in for instance industrial boilers *(see application note fuel gas systems)*. Besides the elimination of waste gas, flares are an important part of a plants safety system. Non-waste gas released during an upset condition is typically combusted in a flare system.

Flaring efficiency

If conditions in the flame zone are optimum the volatile organic compounds (VOC's) in the flare gas may be burned with an efficiency near to 100%. Properly operated flares achieve at least 98% combustion efficiency. Based on recent studies gases having heating values less than 300 BTU/SCF (approx. 11,2 MJ/Nm3) are not ensured of achieving 98% destruction efficiency when they are flared. In these cases it is necessary to add supplementary fuel (natural gas). In a permit review case, if the heating value of the emission stream is less than 300 BTU/SCF and no supplementary fuel has been added, the application is considered unacceptable. In order to operate a flare properly, continuous monitoring of the heating value is therefore required.

Plant efficiency

Besides monitoring the efficiency of the actual flare, the measurement can also be used to determine the overall plant efficiency as the heating value of the flare gas is a measure for the amount of energy wasted. In some countries end users have to report their flare emissions based on wasted energy.

Significant fuel gas cost savings and energy efficiency

Whether speciation of components or only heating value is required depends on local regulation. In general users consider the response time of a flare gas measurement of minimum impact as legislation requires measurements with multiple minutes interval. However, flares are in general subject to large and frequent fluctuation in gas composition. In order to guarantee the heating value of 300 BTU/SCF at all times, end users using slow responding measurements are forced to establish an additional safety bandwidth in there flare by burning increased quantities of natural gas. A faster response allows end users to save on natural gas consumption without violating local legislation.

Hobre Instruments has delivered BTU analysers for flares on multiple occasions with the main purpose to minimize natural gas consumption. Pay back time depends on the size of the flares and process but is typically well within 1 year.

Instrument installation and selection

When it is decided to install an analyzer for measuring the heating value of flare gas, following requirements should be fulfilled:

1. Wide dynamic range: As the flare is used as a safety device, the flare gas composition can change widely. In case low values are expected and the measurement is required to control the blending of back up gas, it is mandatory that the analyzer can measure down to zero. The Hobre WIM Compas analysers are using an electrical heated (catalytic) oven for combusting the sample. Therefore flame out errors can not occur.

2. High dew point at low pressures: typically a liquid knockout vessel is installed upstream the actual flare stack. Consequently the flare gas can be saturated with water and/or hydrocarbons. As flares are operated at low pressures, the need for a pump should be avoided as water and HC's can condensate by elevating the pressure. The WIM Compas with injection system can work at low (even atmospheric) pressure, and is available as "hot application" unit which can be heated up till 150C.

3. Corrosive / toxic components, for instance H2S, are likely to be present in flare gas. When combusted H2S causes serious corrosion / clogging to the internals of the analyzer. Acid condensate (sulfuric acid) will be formed when the flue gas condensates (H2O in combination with SO2/SO3). The Hobre WIM Compas F for flare gas applications, injects very small amounts of gas in a carrier of instrument air. Due to the relative large excess of air, no condensation after combustion will occur and corrosion / clogging issues are prevented for.

4. Local venting of gas should be prevented for. Besides the environmental effects, flare gas is likely to contain toxic elements causing safety issues. The WIM Compas F can be set up as zero emission unit. Excess gas can be returned to flare for instance by using an eductor.

5. For safety reasons, flares are typically installed on remote locations. For this reason the measurement has to be installed at remote (hazardous) locations as well. The WIM Compas F, is suitable for outdoor installations. No expensive shelter with HVAC is required. The WIM Compas F is available for installation in hazardous areas (ATEX, IECEX, CSA).

Heating Value	Accuracy	+/- 1% MV Typical
	Response time	Depending on application / configuration
	Ambient temperature	5-40C (40-104F)
	Hazardous area	Safe area, zone 1, zone 2
	Detector	ZrO2 cell

Did you know that:

- 150 billion cubic meters of gas is flared annually (equivalent of 2.4 million barrels of oil per day)
- 5% of the world's natural gas production is wasted by flaring unused gas, an amount equivalent to 20% of the United States' gas consumption or 33% of the European Union's gas consumption per year
- Flaring emits 400 million metric tons of CO2 annually, the same as 77 million Cars
- Nearly 20 billion USD in wasted natural gas could be to generate reliable, affordable electricity
- 10 countries account for 70% of gas flaring and venting
- Fewer than 20 countries account for more than 85% of gas flaring and venting
- Methane is 23 times more powerful a greenhouse gas than CO2