Methane Emissions Monitoring

Products: Tiger-i 2000

Tiger Optics Overview

Tiger Optics introduced the world's first commercial "Continuous Wave Cavity Ring-Down Spectroscopy" (CW-CRDS) analyzer in 2001. Today, our instruments monitor thousands of critical points for industrial and scientific applications. They also serve the world's national metrology institutes, where they function as transfer standards for the qualification of calibration and zero gases, as well as research tools for such critical issues as global warming and urban air quality.

Tiger-i 2000 CH_4

CW-CRDS is ideally suited to the requirements of numerous environmental measurement applications, including emissions monitoring, where factors such as accuracy, sensitivity, low detection limits, speed of response, long-term stability, low maintenance, and low gas throughput are all essential. This application note details the use of our Tiger-i 2000 CH_4 unit for emissions monitoring applications.

Methane – Major Greenhouse Gas

The Global Warming Potential (GWP) of methane (CH_4) is over 20 times higher than that of carbon dioxide over a 100-year period. Over a shorter 20-year period and given its approximately 12-year lifetime in the atmosphere, the GWP figure is substantially higher, in excess of 60 times higher, making methane a prime target to reduce global warming in the near-term. The concentration of methane in the atmosphere has more than doubled since the pre-industrial era, from approximately 700 ppb to its current level of approximately 1.8 ppm.

A better understanding of the complex system of sources and sinks allows scientists to formulate mitigation strategies and to improve the accuracy of climate models. While there is a range of natural and anthropogenic sources of methane, more than half of total emissions are due to human activities.

Methane emissions result from the activity of bacteria under anaerobic conditions. Organic matter decomposes to form methane and carbon dioxide via fermentation, and hydrogen and carbon dioxide are converted to methane and water via hydrogenotrophic methanogenesis:

$$H_3C\text{-}COOH \rightarrow CH_4 + CO_2$$

$$4H_2 + CO_2 \rightarrow CH_4 + 2H_2O$$

Wetlands are by far the most significant natural source, in addition to termites, geologic emissions, forest fires, methane hydrates, and wild animals.

Other significant anthropogenic sources include fugitive emissions from facilities for the storage and distribution of natural gas, mining activities, both active and disused facilities, and intensive agriculture, for example, rice cultivation and the management of livestock.

The quantification of these sources is a key step to future reductions in the output of methane. For example, the verification of emission estimates for natural gas storage and distribution facilities often reveal significant discrepancies between estimated and actual values. To support mitigation plans and the market for emitted carbon trading, current output assessments must be suitably accurate.

CW-CRDS for Methane Emissions Monitoring

Tiger Optics Tiger-i range has been developed for the measurement of trace level gases in samples at ambient pressure, via the use of a vacuum pump to introduce the sample to the analyzer. All Tiger Optics instruments are based on CW-CRDS, as shown in Figure 1 below.

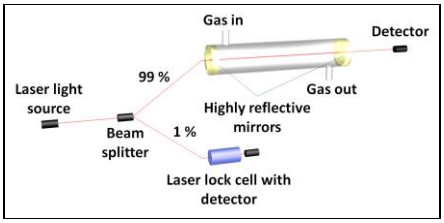

Figure 1. Schematic of CW-CRDS Analyzer

CW-CRDS works by tuning light rays to a unique molecular fingerprint of the sample species. By measuring the time it takes the light to fade or "ring-down", you receive an accurate molecular count in milliseconds.

The time of light decay, in essence, provides an exact, non-invasive, and rapid means to detect contaminants.

The Tiger-i 2000 CH_4 analyzer for emissions monitoring features a sensitivity level of less than 10 ppb, with a dynamic range up to 1000 ppm. It can accurately measure close to an emission source, but is sensitive enough to locate emissions at a distance and above background level. Figure 2 below shows results from monitoring near to a typical landfill site.

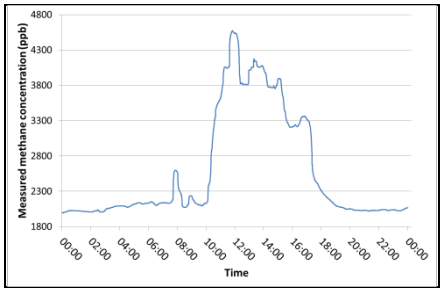

Figure 2. Landfill methane emissions

The unit is compact – ½ rack-width, 5U high - and relatively lightweight at just 33 lbs (15 kg) - making it transportable and suitable for integration into a mobile facility. This is further enhanced by its low power consumption of just 40 Watts maximum.

The touch-screen interface, including integrated trending features, plus on-board data logging – five days @ 15 second logging interval, three weeks @ 1 minute logging interval – provides additional benefits for operation at remote locations. Data is retrievable via an RS232 or Ethernet interface. Real-time data collection to an external data logger or PC is available via the same two options, or the 4-20 mA signal output.

Tiger Optics CW-CRDS analyzers bring significant benefits to emissions monitoring, including:

- Accuracy traceable to the world's major national reference labs
- Sub-ppb detection capability
- No zero or span required
- No periodic sensor replacement/maintenance
- Nano-second speed of response
- Wide dynamic range

The maintenance-free and calibration-free nature of CW-CRDS also affords low cost of ownership and allows users to operate with confidence and ease in the field. And, despite the sophistication and performance associated with this technology; it remains extremely easy to use.

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