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Ensuring Purity in the Cryogenic Air Separation Process

Product: HALO 3 CO_2

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.

CW-CRDS is ideally suited for process monitoring where performance factors, such as accuracy, sensitivity, low detection limits, speed of response, long-term stability, low maintenance, and low gas throughput, are essential. This report details the use of our CW-CRDS analyzer, the HALO 3 CO_2, for detection and analysis of carbon dioxide in the cryogenic air separation process.

Cryogenic Air Separation

Cryogenic air separation is the most efficient method for production of high purity nitrogen, oxygen and argon gaseous and liquid products. The cryogenic process can be modified to manufacture a range of desired products and mixes. Even so, cryogenic air separation typically calls for the sequential steps outlined in Figure 1 below. Our focus here is on the air pre-treatment step and the necessary contaminant monitoring entailed.

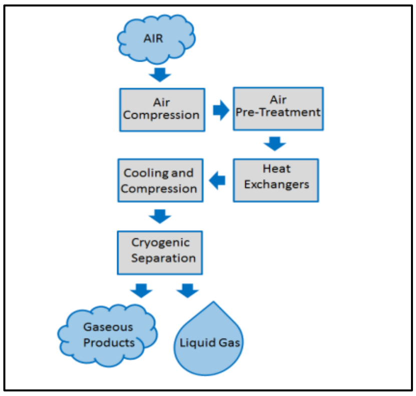

Figure 1. Cryogenic Air Separation Steps

How Tiger Helps

Following air compression, the air pre-treatment step consists of cooling and purification to remove process contaminants, such as moisture, carbon dioxide and hydrocarbons. These impurities are typically removed by Temperature Swing Adsorption (TSA) that exploits the difference in adsorption capacity of adsorbents at different temperatures.

Purification is essential to this process because harmful impurities, such as CO_2, can freeze in the downstream heat exchangers and cryogenic separation equipment. As a result, product quality can be impaired, with potential damage to the system itself. To avoid such mishaps, the HALO 3 CO_2 analyzer monitors air emitting from the TSA to ensure full CO_2 removal prior to entering the heat exchangers.

Tiger's HALO 3 CO_2

The HALO 3 CO_2 measures down to 10 ppb and over a wide range of 0-15 ppm of CO_2 in N_2 (nitrogen). As shown in Figure 2, the accuracy is within 5 ppb, less than half the LDL, and the repeatability is within 2 ppb for multiple intrusions. With a speed of response of less than three minutes to 95 % of intrusion level, the HALO 3 CO_2 provides fast CO_2 detection.

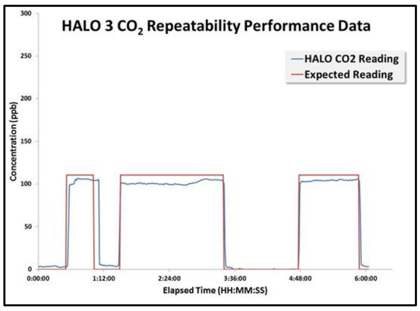

Figure 2. Repeatability of HALO 3 CO_2

How Tigers Work

All Tiger Optics instruments are based on CW-CRDS. The key components of the CW-CRDS system are shown in Figure 3 below.

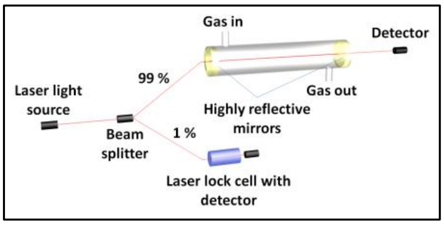

Figure 3. Schematic of CW-CRDS Analyzer

CW-CRDS works by tuning laser light to a unique molecular fingerprint of the sample species. By measuring the time it takes the light to decay 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. Figure 4 below shows the linear response of a HALO 3 unit when measuring CO_2 from low to high ppb levels.

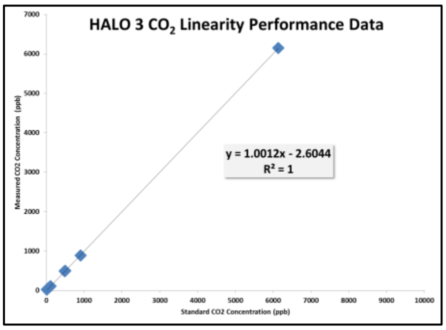

Figure 4. Linearity of HALO 3 CO2

The HALO 3 CO_2 features a touch-screen interface, including integrated trending features, plus on-board data logging – five days at 15 second logging interval, three weeks at 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.

CRDS vs NDIR

A common technique for monitoring carbon dioxide in gas plants is NDIR, which has a high propensity to drift and exhibits temperature dependence. Thus, requiring frequent calibrations, it is labor-intensive and costly to maintain. By contrast, Tiger Optics' CW-CRDS has no drift or spectral interference. These advantages afford low cost of ownership and allow you to operate with confidence and ease in the field.

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