

TRACE LEVEL CO MONITORING

USING NDIR GAS FILTER CORRELATION TECHNOLOGY

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TRACE LEVEL CO MONITORING

- Why do we need trace level monitoring?
- How does a trace CO instrument work?
- How does it differ to a standard analyzer?
- Issues with installation and system integration?

“TRUE” TRACE CO

This information is sourced from NESCAUM

- CO Data from the existing compliance-oriented monitoring network can not be used as an indicator of anything other than compliance with CO emissions criteria

Why?

- “Effective” LOD is on the order of the mean CO concentration (at most sites – 0.3 to 0.8 ppm) much higher than vendor LOD specs (0.05 ppm)
- Cause: Excessive baseline drift, water vapor and other interferences
- Need: “True” LOD of 25 ppb or better to get good precision at 0.1ppm

EC9830T GFC CO ANALYZER

- USEPA Ref. Method RFC A-0992-088
- IR Photometer Gas Filter Wheel Correlation method
- Autoranging 0 – 20,000 ppb
- Lower Detection Limit: 25 ppb
- Samples in the most useful range of CO background measurement (25-500 ppb CO in air) i.e. levels that represent the range of global CO mixing ratios in the unpolluted atmosphere.

STANDARD ANALYZERS AND LOW LEVELS

**When trying to measure at low levels (below 1ppm)
standard analyzers can suffer from :**

1. Interference from H₂O absorption
2. Interference from CO₂ absorption
3. Temperature effects on the sample path and measurement
4. Electronic noise (Detector)

HOW DO WE IMPROVE?

- Remove Moisture
- Reduce CO₂ interferences
- Reduce temperature effects and sources
- Increase the sensitivity

REMOVING INTERFERENCES

- Remove moisture from the sample through the use of permeation dryers or similar method
- Permeation dryer maintains sample gas at -20°C dew point, reducing the H_2O interference to $<2\text{ppb}$ on the measured sample.
- Gas filter correlation wheel technology minimizes CO_2 interferences
- Scrubbed sample air is used for auto zero to maintain the same RH & CO_2 as in the sample, reducing H_2O & CO_2 interference.

INCREASING SENSITIVITY

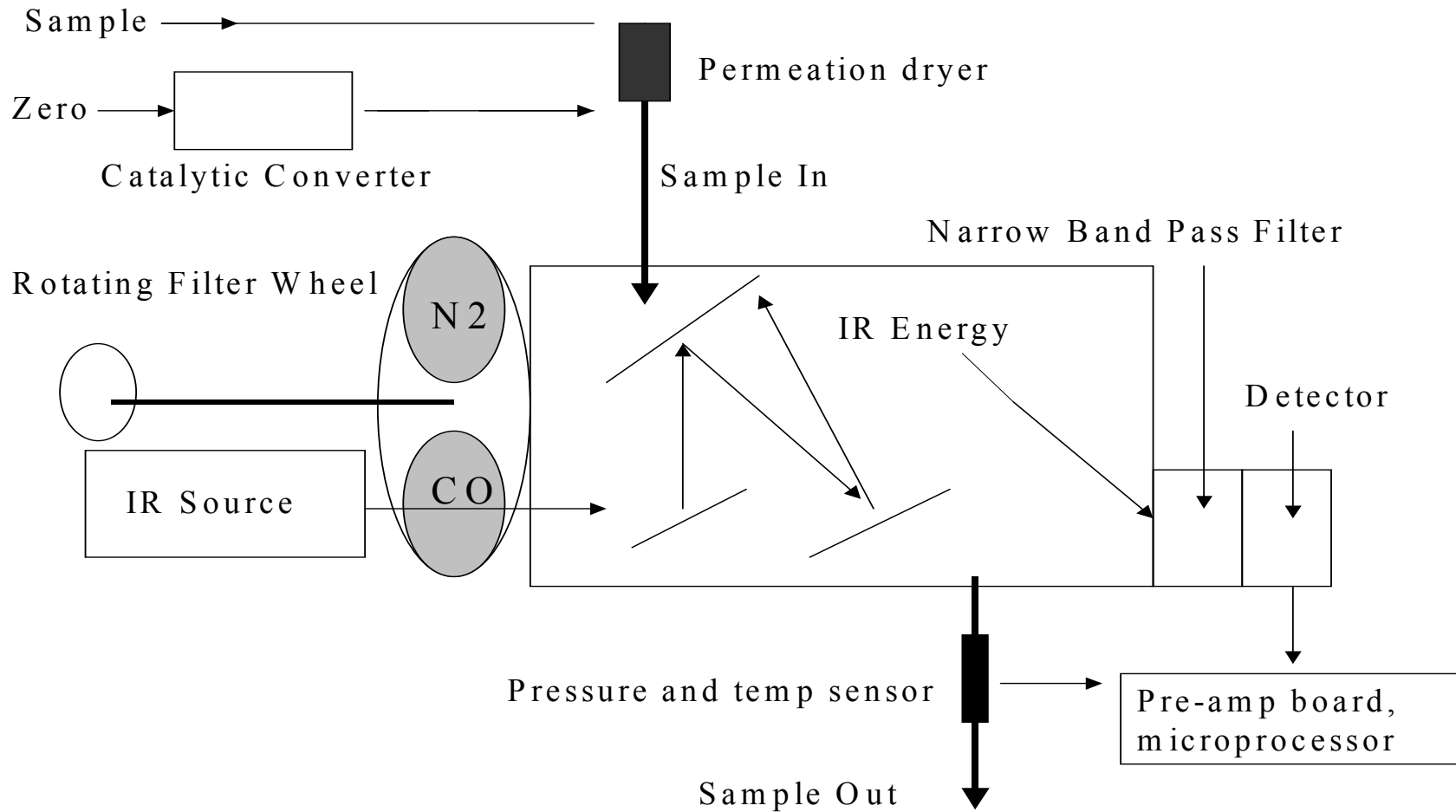
- Specially selected low noise detectors used
- The IR detector operates at -50°C . This operation temperature increases sensitivity and reduces thermal noise.
- Cell mirrors are gold plated and adjusted for 26 light passes to generate an optically longer measurement path
- A fifth order polynomial curve is used to maintain linearity of less than 1% in range of 0-20,000 ppb.
- The sample Cell is thermally insulated from the chassis to decrease temperature effects

MEASUREMENT TECHNIQUE

One of the key components of CO measurement is the use of Gas Filter Wheel correlation.

- Sample is first drawn into the analyzer across a particulate filter and through a permeation dryer
- The sample then enters the measurement cell where it attenuates IR energy proportional to the CO concentration
- Essentially the IR source sits behind a rotating wheel such that the generated light first passes through either an N₂ filled measurement 'window', or a high concentration CO reference 'window', before entering the sample cell

MEASUREMENT PATH



MEASUREMENT TECHNIQUE

- The N₂ window allows the full range of generated IR energy to pass into the measurement cell and thus light attenuation is only due to the sample (measure)
- The CO filled reference window essentially 'scrubs' all of the IR energy in the CO absorption range of the spectrum such that there is no light attenuation from CO in the sample (zero reference)
- The GFC method basically provides a reference/measurement pulsing effect to provide constant reference measurement and improve the accuracy and sensitivity of the analyzer.
- IR light passes through the measurement cell through a narrow band-pass filter centered around 4.67 μm , and then to the detector
- The detector signal is then processed along with temperature, flow and pressure measurements to produce an accurate concentration to the front panel.

TRACE MONITORING SYSTEMS

Issues For Site Operators

- Temperature variation in the shelter and the rack
- CO₂ interferences from people – purge?
- Reference air sources and background interval
- The gas sampling manifold/system
- Calibration methods
- **Zero air sources**
- Digital loggers
- Remote calibrations

EC9830T GFC CO ANALYZER

Analyzer Specifications

- Range: 25 to 20,000 ppb
- Resolution: 0.01 ppb
- Precision: $\pm 5\%$ range 0-1000ppb
 $\pm 1\%$ range 1000-20,000ppm
- Lower detectable reading: 25 ppb with 300 sec filter
- Noise: <10 ppb with 300 sec filter
- Sample Flow Rate 1.0 slpm
- Rise/Fall time, 95% of scale: Less than 60 seconds
(Kalman filter)
- Temperature range: 20°C to 35 °C stable

Note! Analyzer requires 12 hour stabilization period on cold start-up