PRODUCT / APPLICATION INFORMATION

CO Absorption/Migration in Analyzer Sample Lines

Increased electrical power generation with gas fired combustion turbines brought new challenges for Continuous Emissions Monitoring Systems (CEMS). This was particularly true where combined cycle co-generation units with Heat Recovery Steam Generating (HRSG) systems and steam turbines were installed.

One of the gases measured in flue gas analyzer systems is carbon-monoxide (CO). Carbon-monoxide gas is very common in the air we breathe but can sometimes be a measurement challenge in sensitive gas analyzers used in CEMS applications.

"Heated Umbilicals" or "Heated Transport Bundles" such as TubeTrace® heated instrument tubing are commonly used to ensure a gas sample remains above its dew point.

Pre-insulated Fluoropolymer Tubing with Power-Limiting Electrical Heat Tracing

A difficult issue that was identified several years ago related to abnormally high CO levels in flue gas streams. Could the generating units truly be "out of compliance" or could there be an extraneous source of CO contaminating the gas samples?

Flue-gas monitoring often takes place at different locations in a power generating unit's exhaust gas streams. What was unusual in a few installations was whether the sample point was at the combustion turbine (the HRSG by-pass) or at the exhaust stack for the cogen power train, after the HRSG. Efforts to "zero-out" background levels of CO became even more challenging, as levels were inconsistent and brought risks of potential fines for suspected off-spec performance.

Flue gas samples are collected by the probe and transported under a slight vacuum to the gas detector and analyzer system. In many applications fluoropolymer tubing is specified because it is lightweight and more flexible than metal tubes, plus it is inert to most gases. In cases where flue gases contain sulphur, chlorine, and/or nitrogen as combustion by-products, any acids that condense may attack metal tubes.

Fluoropolymer tubing can absorb trace amounts of CO into its surface from other materials used in fabrication of pre-insulated tubing bundles. These trace amounts can then appear as background emissions and affect the accuracy of the CO detection system. Sources of CO include the fiberglass insulation material, as well as Mylar tapes used in bundle fabrication. Compensation for this "background noise" can generally be accommodated during the calibration of the analytical instrumentation system.

Different lengths of heated instrument tubing seemed to yield different CO levels.

Fluoropolymer resins and tubing absorb low molecular weight gases in trace amounts. Because of this characteristic, some grades of fluoropolymers are often used for manufacturing semi-permeable membranes. As a tubing material, various gas molecules can pass through or migrate through the fluoropolymer tubing wall from the outside.

Fluoropolymer tubing can absorb trace amounts of CO.

FEP diffusion rates are presented below[1]. Note that CO diffusion will be considerably higher than CO_2 as the relative molecule sizes are 40-50% different.

According to a report from one specific installation, the amount of CO detected rose at a dramatic rate after start up when the temperature approached 200°C (392°F). At that point it remained relatively stable for some period of time, after which the levels began to decrease; suggesting that after some period[2] there would be reduced CO "off-gassing".

Relative Diffusion Rates for FEP Fluoropolymers			
H_2O	O_2	N_2	CO_2
0.2	715	320	1670

Some users have addressed this phenomenon by choosing stainless steel. A good value for its corrosion resistance, it's even more important here because of its lack of permeability. Fused silica coatings such as SilcoSteel[3] are also common, though the permeability of the stainless steel itself is not affected.

Many users are choosing tubing that is impervious to CO

For more information on TubeTrace® pre-insulated and heat traced tubing or other heat tracing products, visit www.thermon.com, or call 1-800-820-4328.

Notes

1. Data complements of Extrusions Plus, Spring, Texas.
2. Sometimes referred to as "burn in" this refers to the procedure of heating the sample line for an extended period of time prior to commissioning to deplete the contamination source. However, the length of time required to achieve satisfactory results has been difficult to predict.
3. SilcoSteel is a high performance coating as applied by Restek of Bellefonte, PA, USA.

