White Paper

Title: Comparison of Chemical Sensor and NDIR Technologies for Measuring CO in Vehicle Exhaust
TSN Number: 29
File:S:\Bridge_Analyzers\Customer_Service_Documentation\White_Papers\EGA_Material_Handling\29 Chemical Sensor vs NDIR CO.docx
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Last Revision Date: 28-Jan-10

Chemical Sensor Carbon Monoxide Measurement:

Because CO is a chemically reactive gas, sensors based on the oxidation of CO to CO2 have been used for many years to detect and measure CO. They produce a small current when the CO in the test gas is oxidized in the sensor, and the current produced varies with the gas concentration. They are zero stable – as no current output will be produced unless CO is present – but they are span unstable, as the current they produce is a function of the chemical reaction rate as well as concentration, so it is temperature and time dependant.

Temperature and Calibration Stability:

As the output is produced by a chemical reaction to CO gas, their gas sensitivity is intrinsically temperature and time unstable. Typically, the chemical sensors used in these analyzers have a 5% sensitivity increase for every 10 Deg C temperature change, and an additional 25% sensitivity reduction per year. The user should expect frequent (monthly or weekly) gas calibration of these types of CO gas analyzers to maintain accuracy. However, this does not assure the user that measurement is correct between calibrations due to temperature and gas mix variations. The care and attention these analyzers require makes them troublesome in industrial applications.

Sensor Life:

Chemical sensors not only need frequent calibration to keep them accurate, but they also 'wear out' with time – 12 to 24 months – and will require replacement at or before that time.

Gas 'cross-talk' effects:

Gas analyzers which use a chemical sensor to measure CO are sensitive to Hydrogen – which can be over 1/3 the CO concentration in engine exhaust gas. This will produce about a 20% high measurement error for the CO in exhaust gas, and since Hydrogen is not measured, is corrected by an 'average' correction – yielding unknown accuracy when compared to calibration gas which does not have Hydrogen in it.

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Because they rely on a chemical reaction, chemical sensors take seconds to respond the gas being measured – as opposed to infrared which is essentially instantaneous, being optical in nature.

Benefits of NDIR (Infrared) CO Measurement:

Infrared technology is fast, does not require periodic calibration to remain stable and does not "wear out". The measurement method uses the fact that the CO molecule absorbs infrared energy at a specific wavelength, and the analyzer measures that infrared absorption optically.

While the initial cost of infrared technology is higher, the ease of use and cost of ownership is much lower, as the user does not ever need to recalibrate the instrument nor buy replacement sensors. The user simply needs to "Zero Calibrate" the analyzer on room air periodically to maintain accuracy. Because of these benefits, NDIR has been the standard for exhaust gas CO measurement in the industry for more than 30 years, and has been shown to be the best technology to use.

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