Monitoring Solutions
Leaders in Environmental Monitoring Systems & Services

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CEMS NEWSLETTER

Monitoring Solutions Volume No. 1 Issue No. 19 September 2010

CEMS FROM A-Z: A MULTI-PART SERIES

This issue continues our presentation of a comprehensive look at CEMS from beginning to end, with descriptions and details on a variety of components including the probe, umbilical, sample conditioning system, analyzers and more - including maintenance and troubleshooting topics.

This issue covers:

THE NO_X ANALYZER:

While there is more than one analyzer technology available for measuring various CEMS gases, a long history of experience has shown that certain technologies lend themselves better to specific gases.

One example of this is using Chemiluminescence technology for the measurement of Nitric Oxides (NOx). Chemiluminescence offers the best sensitivity for low range NOx measurement and is the most common method used today.

Chemiluminescence operates on the principle that nitric oxide (NO) and ozone (O_3) react to create an energy that luminesces. The resulting light can be measured and correlated to a concentration of NO using a photo-multiplier tube.

NOx is equal to NO + NO_2. Since the chemiluminescence reaction only works with NO, Nitrogen dioxide (NO_2) needs to be converted into NO in order to be measured. NO_2 is converted to NO using a molybdenum or stainless steel converter. Stainless steel is the most popular choice for converter material today, but the moly converter has been used extensively for years. The stainless steel converter is heated to 625 °C and the moly converter is heated to 325 °C. The oxide layer of the stainless steel "strips" one of the oxygen atoms off the NO_2 leaving NO.

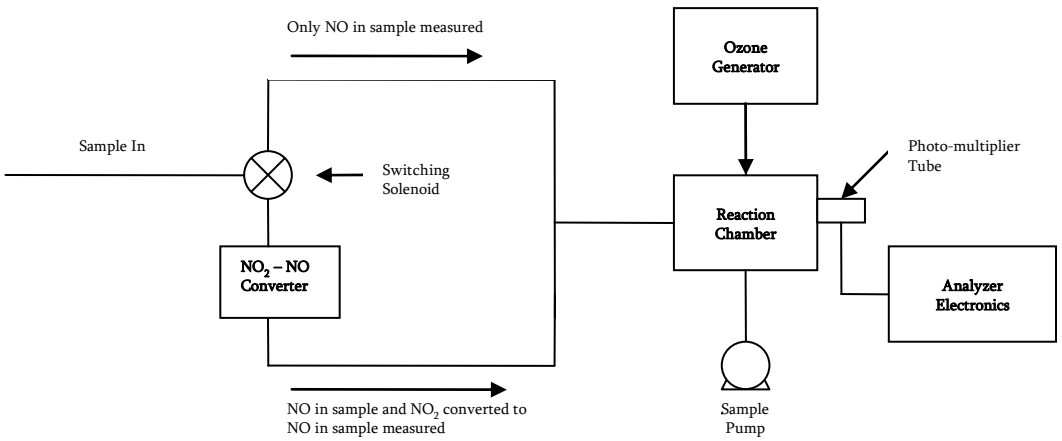
The sample flows into the analyzer, via a 3-way solenoid valve. This solenoid switches every 10 – 15 seconds. The solenoid valve routes the sample either straight to the reaction chamber where only NO is measured, or through the NO_2-to-NO converter where NOx is measured (NO_2 that's been converted to NO and the NO in the sample).

Dry air is pumped in from the air cleanup through a flow switch, into an ozone generator. The ozone generator generates the ozone needed for the chemiluminescent reaction. A flow sensor prior to the reaction chamber measures the sample flow.

In the reaction chamber, the 1-part ozone reacts with the 2-parts NO in the sample and luminesces. A photomultiplier tube (PMT) housed in a thermoelectric cooler set at -3˚C (to eliminate any background noise) detects the luminescence generated during this reaction. From the reaction chamber, the exhaust travels through the ozone (O_3) converter to the pump, and is released through a vent.

The difference between the resulting NO and NO_x concentrations are used to calculate the NO_2 concentration.

The internal pump serves three very important duties; it draws the sample through the analyzer, draws the ambient air through the ozone generator, and it maintains the vacuum for the reaction. Many higher range analyzers require a larger pump which does not fit in the analyzer case and is mounted externally in the CEMS cabinet.



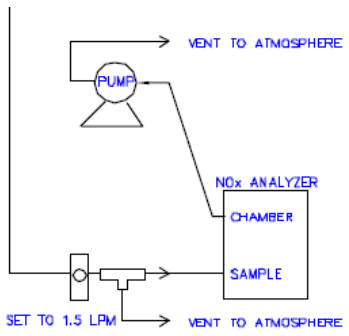
Pressure is monitored in the reaction chamber and the values are adjusted using a pressure transducer. The analyzers are tolerant to changing atmospheric pressures to a degree, but since such small values are being measured, all variables are accounted for.

The air going to the ozone generator should be further dried before being introduced into the analyzer. This can be accomplished with dry air from the air cleanup being drawn through a Nafeon© dryer placed before the ozone generator. Some analyzer systems use a canister filled with drierite just before the analyzer to remove any remaining moisture. Drierite is used more as an indicator versus a method of removing moisture.

SAMPLE PLUMBING TO ANALYZERS

The sample pump in an extraction CEMS can create enough flow to "push" a sample into the analyzers, but NOx analyzers need to operate under vacuum and are very sensitive to pressure. NOx analyzers have their own pump to "draw" a sample through and create the necessary vacuum.

In a CEMS, the sample is sent through a common manifold after the sample conditioner where it has bypassing lines to each of the analyzers. Before each analyzer is a rotometer to regulate the flow. There is a tee at the analyzer inlet which allows the sample that's needed to be pulled into the analyzer by the pump and any excess to vent through to the exhaust.



CONNECTIONS & I/O

All analyzers have 4 basic connections (typically in the backplane). There is a sample inlet, a sample exhaust, a power connection and signal wire connection (normally an analog output corresponding to the sample value). Either a 4-20mA or 0-10V analog signal output is commonly used.

Many analyzers include digital outputs for alarm conditions, etc. Newer analyzers have an Ethernet output for direct communication with a PC.

MAINTENANCE

Preventative Maintenance is recommended quarterly with analyzers:

1. A good practice is to install a final protective Teflon filter just before the analyzer inlet. The picture to the right shows a typical Teflon filter holder which holds a Teflon disk. This filter holder is simply unscrewed for filter replacement. This filter should be changed quarterly.

2. Each analyzer should be calibrated to insure accurate readings.

3. The status of components can usually be checked through various menus on the analyzer display. There are features that display gain and pressure, etc. It is a good practice to record various analyzer values in a daily log. These can be checked for trends as different components start to fail or as an analyzer starts to plug. This log becomes invaluable for troubleshooting.

4. Chassis filters and/or fan screens should be cleaned every quarter to keep dust from accumulating and building up inside the analyzer case.

There are other PM tasks that are done on an annual basis.

1. The pump should be rebuilt with a diaphragm and valve replacement kit. This is inexpensive insurance.

2. Bearings should be inspected. Rather than replace bearings, it's easier to replace the entire pump.

3. Replace capillary o-rings and clean or replace capillaries.

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“Sometimes a CEMS just needs a simple upgrade”

Monitoring Solutions can help to keep your CEMS up to date.

Analyzers

Time to replace an old analyzer?

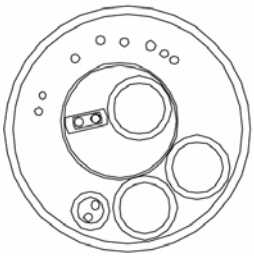
Monitoring Solutions offers a wide variety of gases and manufacturers to insure the best solution for your application.

Sample Conditioning Systems

Moisture removal not up to par? Let us help you select and size the proper replacement.

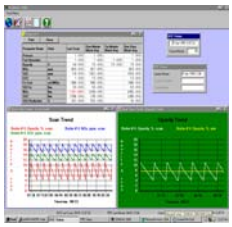
Umbilicals

Time to replace an aged umbilical? Burned up heater? No longer maintaining required temperature? Monitoring Solutions can help with even the most custom requirements.



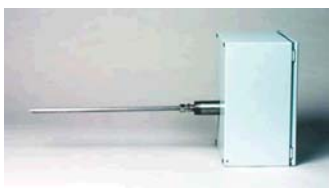
Data Acquisistion Systems

Still running Win2000 or Windows NT? Looking for an easier to use package? Our CEMDAS works with any CEMS and offers the ultimate in ease of use. It’s guaranteed to meet your permit requirements and priced competitively.



Probes

Fighting cold spots? Heater failure? Time to replace that in-situ dilution probe with an easier to maintain out-of-stack dilution probe? We have the solution for extraction and dilution CEMS.



Sample/Cal Controllers & Air Clean-up

Want to simplify your dilution control system? Need more reliable plumbing for sample and cal gas controls? Need better air clean-up? We have the products to help.

Monitoring Solutions can offer Turnkey replacements of any of these components. Before you price out a new CEMS, let us help you determine if some simple upgrades are all you need.

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CEMS NEWSLETTER

"Devoted to helping engineers and users better understand CEMS"

If there is someone else who should be,
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IN THIS ISSUE:

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