Overcoming Common Gas Sampling Challenges

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Objectives

• Quick CEM/CMS component overview
• Identify examples of solutions associated with:
  ✓ Extraction of gases
  ✓ Sample transport
  ✓ Sample conditioning
  ✓ Moisture carryover to analyzers

* everyone’s processes, experiences and CEMS are different!
Continuous Monitoring Systems:

✓ Sample Probe
✓ Umbilical
✓ Sample Handling System
✓ Analyzers
✓ Sample Probe
✓ Umbilical
Sample Handling & Conditioning System

- Vacuum Pump
- Hydrophobic Membrane
- Gas Chiller
- Peristaltic Pump
- Particle Filter
- Solenoid Valves
- Rotameters
- Central Control Unit (Cals, Heat, Alarms, Power)
✓ Analyzers in shelter / enclosure
Most of the time, your problem will be:

COLD SPOTS RESULTING IN CONDENSATION & BUILDUP

➢ Places where the hot/wet sample gas reaches dew point / acid dew point / salt sublimation temperature

➢ Cold spots are commonly found at the flange, in the sample stinger, sample probe (heated filter), sample umbilical, in the analyzer shelter
More cold spots…

180°C+
Invisible Heated Zone Failures
More cold spots...
Adsorption (scrubbing)
Desorption (off-gassing)
Extraction of gases

Heated Tubes

Coatings (Sulfinert, Tungsten Carbide)

Shields, Quills,
Deflectors

Sintered Prefilters,
shield protection

*Custom Designs*
Extraction of gases

Heated Sample Probe Filter

Filter Elements:
Porosity:
2 μm – 0.05μm

Materials:
Ceramic, Stainless, Hastelloy, Quartz Glass, Titanium

 Blowback (Cleaning):
✓ Tank near the filter
✓ 70psi+
✓ Heated Air
✓ Every 1 – 6 hours
✓ Back-to-back bursts
SAMPLE TRANSPORT PROBLEM: Condensate and Salts

Condensate?: Improve insulation, increase temperatures, add heated enclosure

“Down n’ Up” is NOT good and can harbor “junk”!

It only takes a 1” cold spot to cause problems!

Salts Causing Problems? (especially on FCC): NH3, SO3

IT GETS COMPLICATED... BEAR WITH ME...
Salt Formation: Fixes

- Option 1: Upgrade to a “screaming hot” umbilical heated to 250°C, and add acid scrubbing vessel in analyzer shelter. Note: 250°C umbilicals don’t last very long.

- Option 2: Keep standard umbilical and add Acid Scrubbing Vessel (glass marble media) integral to sample probe.

- Option 2.1: Embrace the “cold spot”: Do Option 2, and dose liquid phosphoric acid onto glass marbles (heated just below acid dew point) to enhance scrubber performance.

- Other Enhancements: Nafion dryers can be added if SO2 losses are a concern, as slight losses of soluble gases will occur.

AKA: “Permeation Dryer”
Acid Scrubbing Vessel
FCC Sample System in Analyzer Shelter
✓ Sample conditioning improvement

I’m not stubborn...
My way is just better.
✓ **Sample conditioning improvement**

- Gas coolers, chillers and deep chillers: There are hundreds of variations to meet your requirements and process changes.
- Seeing moisture carryover into your analyzers? Improve drainage and/or chiller capacity!
- Make sure drain lines aren’t freezing up in winter.
- Lower you sample inlet temperature (if possible)
- Reduce flow rate thru chiller to longer residence time.
- Damaging your analyzers? Add liquid alarm sensors to STOP SAMPLING if your analyzers are at risk!
Changes in your process or APCs could require CMS changes!

Examples

➢ Ammonia in a SCR causing salts in CEMS
➢ Sorbents being injected and getting on probe filter
➢ Wet scrubber creating a more cool / wet environment
Verify all heated / chilled components annually:

✓ Sample probe heat
✓ Umbilical heat (full length; all zones)
✓ Heated filters
✓ Gas chiller
IF YOU CAN'T CHANGE A BAD SITUATION

YOU SHOULD CHANGE YOUR

CEMS
“Dilution is the Solution”

➢ **Straight-Extractive:** Transporting Raw Sample Gas, and “conditioning” the sample by removing moisture.

➢ **Dilution-Extractive:** Diluting raw sample gas with bone-dry Air or N2 (e.g. 100:1 ratio) with no need for any further “conditioning” between the sample probe and analyzer.
Dilution Ratios

50:1 to 500:1
Why is dilution a standard in many industries, but rare in Petrochemical/Chemical?

➢ Dilution was not a popular technique when most refineries installed CEMS and established their monitoring plans for “dry basis” reporting of emissions.

➢ CEM analyzers did not have the low detection limits that they do nowadays

➢ PAPERWORK and CHANGE: Dilution is a “wet basis” measurement, which requires changes in permits / monitoring plans / emissions calculations (tedious for the Env Manager)

➢ THE RUMOR MILL: “Dilution is not as accurate as straight-extractive”. FALSE

➢ FACT: A dilution-extractive CEMS has less cost of ownership, requires much less maintenance and should be strongly considered as a viable option.
- Get to know your suppliers!
- Demand visits and free training from your manufacturers!
- Hold vendors accountable!
- They can’t help if YOU don’t let them in...
THANK YOU!

QUESTIONS?

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