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Acid Gas Products

AbSensor – AbS/SO_3

AbS/Sulfuric Acid/SO_3 Detection & Measurement

AbSensor® SO_3

AbSensor – AbS/SO_3 AbS/Sulfuric Acid/ SO_3 Detection & Measurement

AbS & SO_3 FORMATION IN FLUE GAS STREAMS

There are many boiler operational parameters that influence the degree of total SO_3 formation. Among these are:

- Fuel sulfur content,
- Ash content and composition,
- Convective pass surface area,
- Gas and tube surface temperature distributions,
- Excess air level, and
- Coal fineness.

As a result, the same coal burned in two different boilers, or in the same boiler at different operating conditions, can produce substantially different levels of SO_3.

Add to this selective catalytic reduction technology (SCR) for nitrogen oxide control the potential to create Ammonium Bisulphate (AbS) is created.

First of all the catalyst used in the SCR oxidizes a small portion of the SO2 in the flue gases to create additional SO_3. Ammonia (NH_3) is typically injected in the front of the catalyst to reduce the nitrogen oxide in presence of the catalyst to Nitrogen and water. Over time as the catalyst ages, flows and temperatures vary some of the unreacted NH_3 slips past the catalyst. This portion of NH_3 known as Ammonia slip reacts with the SO_3 and forms Ammonium Bisulphate and Ammonium Sulphate salts.

THE CHALLENGE – Control Of Sulfuric Acid & AbS

High sulfuric acid levels produce multiple detrimental effects including:

- Corrosion and fouling of heat exchangers and ductwork,
- Increased carbon emissions through elevated air heater outlet temperature, and
- Formation of acid mist in the stack plume.

Conversely, sulfuric acid has the beneficial effect of promoting fly ash collection in cold-side electrostatic precipitators.

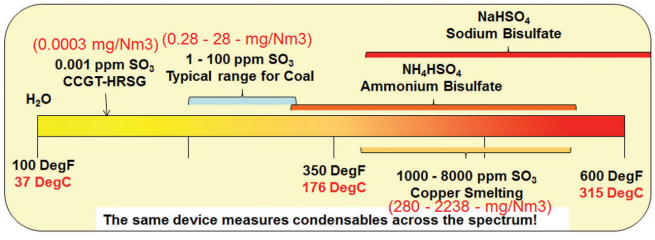
AbS is a problem as these sticky liquid salts melt around 296°F and condense at higher temperatures as they pass through the air heaters and are a major cause of fouling of air air heaters. Fouled air heaters result in higher pressure drop & increased outages for offline cleaning decreasing plant availability.

Successful control of sulfuric acid and AbS levels can have a significant impact on the overall performance of any electric-generating unit in terms of improved operations and maintenance costs.

Direct Measurement of Condensable species

The AbSensor – AbS/SO_3 condensables probe from Breen Energy Solutions is an industry proven instrument for measuring the condensable species in utility flue gas streams. If AbS is present the probe will measure it since AbS has a higher dew point than SO_3. In the absence of AbS SO_3 will be measured. It is effective in measuring condensables & acid vapor levels from the SCR outlet to the scrubber inlet and, by combination with gas moisture level, the corresponding levels of SO_3.

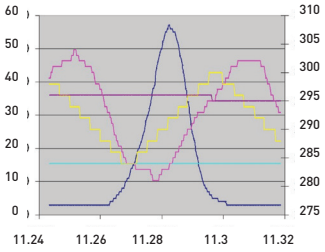
The system works by controlling the boundary layer temperature between the flue gas and the sensor tip of the instrument. Precisely controlled cycling between preset high and low temperatures results in accurate determination of the vapor dewpoint. Combining this information with gas moisture levels using proven mathematical analysis provides real time information on SO_3 concentration.



- In-Situ, Continuous measurement
- Temperature at which material condenses out from the flue gas

This materials could be:

- Moisture (H_2O)
- Sulfuric Acid (H_2SO_4)(H_2O + SO_3)
- Ammonium Bisulfate (NH_4HSO_4) (NH_3 + H_2O + SO_3)
- Sodium Bisulfate $NaHSO_4$



Typical Measurement Cycle

- Current
- Temperature
- Temp Set Point
- Formation Temp
- Evaporation Temp

AbSensor – AbS/SO_3 Technology

The AbSensor – AbS/SO_3 condensables probe measures conduction across a uniquely constructed probe surface resulting from condensed species (AbS, Sulfuric acid etc.) below its dew point. The condensables measurement technique and probe designs are described in United States Patent No. 6,677,765 and 8,256,267 and other foreign patents.

The detection process consists of cooling the initially hot detector surface by controlled application of cooling air. The descent rate is tightly controlled to allow continuous monitoring of condensate conditions on the probe tip. The presence of a condensed liquid phase is determined by the resistance between two electrodes. When current is detected, the kinetic dew-point (or formation) temperature has been reached.

Following detection of condensate, the cooling gas is removed and the probe is allowed to return to localized gas temperature. As the probe heats, the instantaneous current is measured and reported back to the controller. When the liquid evaporation temperature is reached (detected by a rapid decrease in probe surface current) the process has completed and a new measurement cycle is initiated.

The instrument reports a multitude of information variables to the plant control room via 4-20 mA loop, Modbus or OPC link. Examples of reported data:

- Formation Temperature
- Evaporation Temperature
- Dewpoint
- AbS levels
- SO_3 Concentration

Optimize Plant Processes with AbSensor-AbS/SO_3

There are a great many processes within the power plant environment that can be optimized by controlling sulfuric acid vapor concentration including:

- Heat rate improvement through control of the air heater cold-end temperature,
- Plant availability and efficiency improvement,
- ESP back-end and duct corrosion avoidance through control of ESP outlet temperature,
- ESP performance improvement through control of acid dewpoint/ESP inlet temperature relationship, and
- Blue Plume (acid mist) mitigation.

Breen Energy Solutions offers closed-loop control solutions for each of these applications. These solutions include:

Thermap

Breen Thermap Air Heater model which uses the formation and evaporation temperature data to predict if deposition will occur in the air heater, the depth & location in real time and the effect of process variables on deposition. Operators can then take this data to make necessary process adjustments &/or apply mitigation control measures to minimize fouling issues.

DySC – Dynamic Speed Controlled Soot Blower System

In many power plants the soot blower systems tend to have problems with AbS fouling & other tenacious deposits in rotary air heaters. Cleaning is fairly effective on the inner baskets but ineffective on the outer baskets, This is because of higher tangential velocities as the soot blower traverses from the hub to the perimeter. Breen's patented DySC system uses a Vector drive to dynamically change the speed of the air heater rotation to ensure full penetration of soot blower media from innermost to outermost baskets. This results in lesser outages and higher availability of the unit.

DSI Systems

Breen offers portable (transportable) Dry Sorbent injection systems for SO_3 mitigation using Lime, Trona and other sorbents. Using feedback from the AbSensor probe these injection systems can be used to optimize sorbent selection, injection location and usage and generate long term operating cost savings for the plant.

Specifications

Measurment Parameters	Range	Units
Acid Dewpoint Temperature	80 - 750 °F	Displayed in °F (°C optionally available)
Flue Gas Temperature	32 - 800 °F	Displayed in °F (°C optionally available)
SO_3 concentration	.01 - 8000	ppm (calculated from Acid Dewpoint)
Accuracy	2.7 °F or 0.25% dewpoint temperature	
Resolution	1 °F	
Cabinet		
Cabinet Rating	NEMA 4	With Climate Control (heating and cooling)
Outputs		
Discrete	2	Power and Air Failure Alarms
4-20 mA	2	User selectable from 10 parameters (4 optionally available)
Ethernet-OPC		Free Windows OPC Server available
Modbus	Serial (RS232/RS485), Ethernet	
Electrical		
120 VAC 50/60 Hz Critical Power	300 VA	240 VAC optionally available
120 VAC 50/60 Hz Utility Power	400 VA	240 VAC optionally available
Air Requirements		
Instrument Quality Air	22.5 CFM @ 40 to 60 PSIG	
Ambient Conditions		
Cabinet	0 to 120 °F	
Flue Gas Temperature	750 °F	Up to 800 °F intermittent with cooling. Not suitable for Wet Stack applications.
Process Connection		
4" 150 lb 8-Bolt Flanged		

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