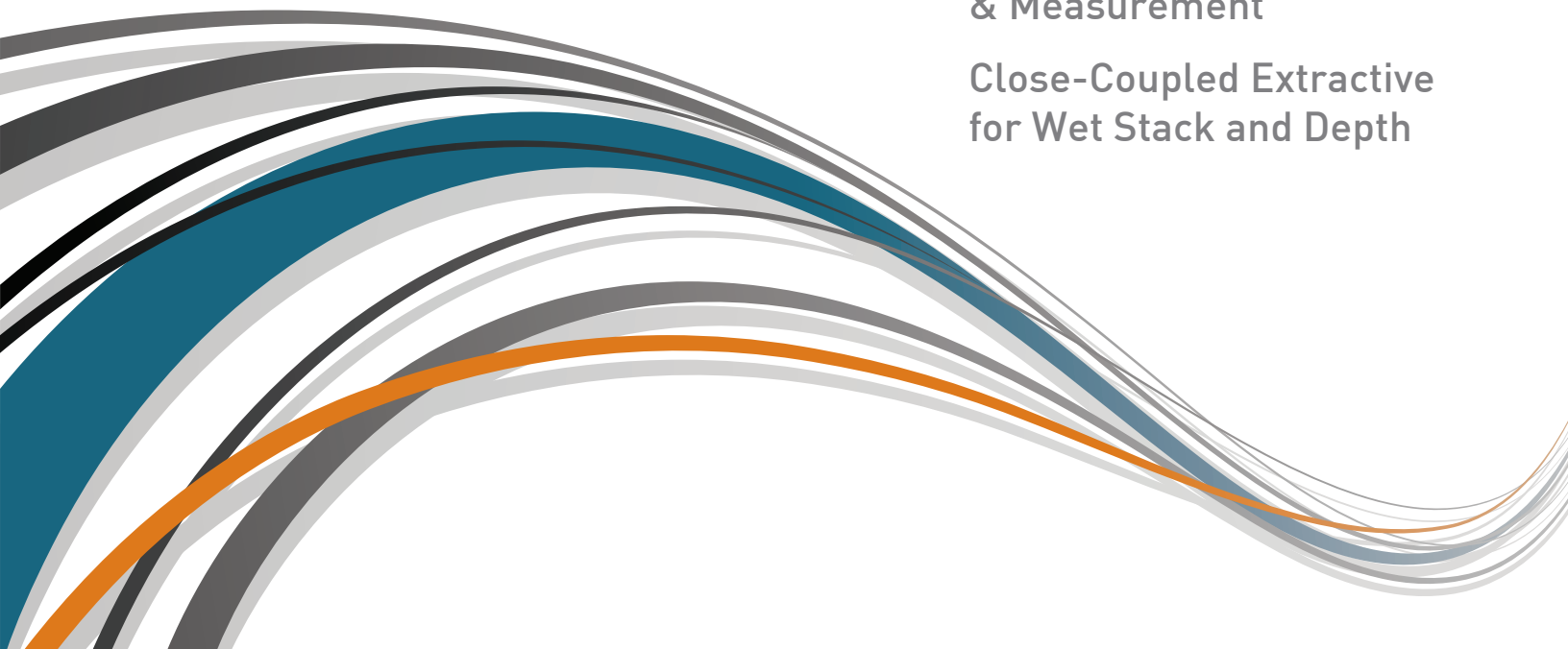




Sulfuric Acid/SO₃ Detection
& Measurement

Close-Coupled Extractive
for Wet Stack and Depth



ASO₃ and Sulfuric Acid Vapor On-Line Detection and Measurement

SO₃ FORMATION IN FLUE GAS STREAMS

There are many boiler operational parameters that influence the degree of total SO₃ 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 SO₃. Assumption of the level of total SO₃ based on any one variable is clearly inadequate.

AbSensor – SO₃ Technology

The AbSensor-CCE-SO₃ condensables device measures conduction across a uniquely constructed probe surface resulting from condensed sulfuric acid 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.

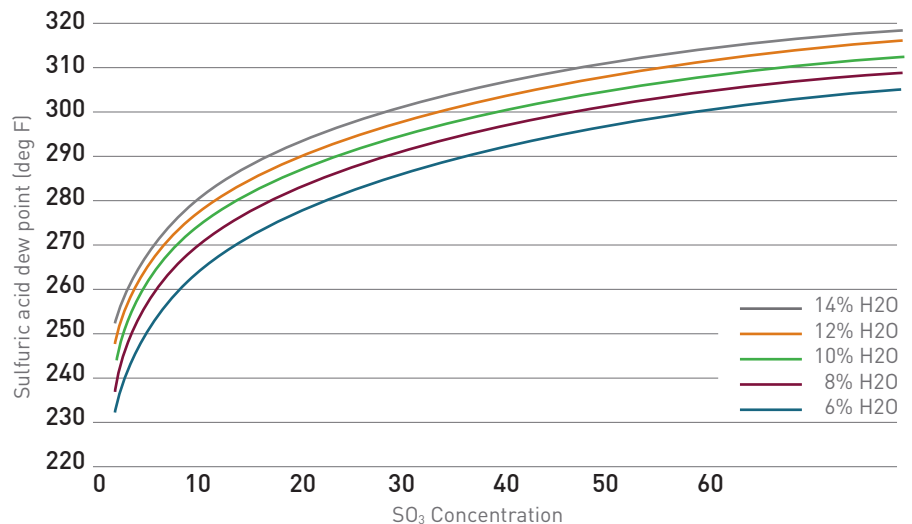
The detection process consists of cooling the initially hot detector surface by controlled application of cooling air until a condensation is detected. The surface is then allowed to heat up by removing the cooling air in a controlled fashion until all condensation is re-vaporized. The temperature at which this occurs is recorded and reported as:

- Formation Temperature
- Evaporation Temperature
- Dewpoint
- SO₃ Concentration

Direct Measurement of Sulfuric Acid Vapor

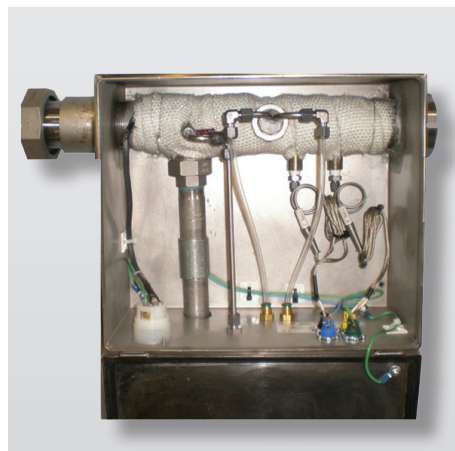
The AbSensor – SO₃ condensables probe from Breen Energy Solutions is an industry proven instrument for measuring the concentration of sulfuric acid vapor in utility flue gas streams. It is effective in measuring acid vapor levels from the SCR outlet to the scrubber inlet and, by combination with gas moisture level, the corresponding levels of SO₃.

However, this device will not work in Flue Gas conditions where the temperature is below the dewpoint or where the acid is condensed in the gas-phase (aerosolized). Also, there is a limitation to the depth to which the condensables probe can measure (Max: 10 feet). The AbSensor – CCE – SO₃ works in these conditions and can sample gases without depth limitations.



Representation of the relationship between SO₃ concentration, Sulfuric acid vapor dewpoint and flue gas moisture. *

AbSensor-CCE



Acid Vapor / SO₃ Relationship

For applications related to acid condensation (Blue Plume and back end corrosion) it is actually more important to know the dewpoint than the SO₃ concentration. This is because the dewpoint provides the real-time summation of gas moisture, gas pressure and SO₃ level. Where the SO₃ concentration must be expressed in parts per million, addition of a moisture level variable is required.

Close-Coupled Extractive

The key to this device is that it samples the gas stream using a Vacuum motive force generated by an Eductor and returns the gas sample back into the flue gas duct via a secondary sample port. Since the input and output sample ports are effectively at the same duct pressure, the device is in effect close-coupled, and the motive force required is reduced to the amount of pressure drop in the system.

The second key design feature is that the gas sample is conditioned before it is passed across the AbSensor probe. For a flue gas sample where the gas temp is below the dewpoint, such as a wet stack application, the gas sample is passed over a heater element which raises the sample temperature above 300°F, thereby ensuring that all the condensables are re-vaporized before the probe measures the concentration. Similarly, for applications where the duct temperature is above 400°F, the gas sample is allowed to cool down to 400°F so that all the SO₃ gas gets converted to H₂SO₄ Vapor and can then be measured by condensation. Finally, in cases where NH₃ is present and can interfere, it can be catalyzed to NO_x allowing the full SO₃ concentration to be measured.

AbSensor – SO₃ Technology

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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.

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

- Formation Temperature
- Evaporation Temperature
- Dewpoint
- SO₃ Concentration

AbSensor-CCE Probe



Specifications

Measurement Parameters	Range	Units
Acid Dewpoint Temperature	150 - 350 °F	Displayed in °F (°C optionally available)
Flue Gas Temperature	32 - 800 °F	Displayed in °F (°C optionally available)
SO ₃ concentration	0.1 - 200	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
480 VAC 3-Phase Power	7 KVA	
Air Requirements		
Instrument Quality Air	12 CFM @ 80 to 100 PSIG	Operating Press: 40 PSIG
Service Air	25 CFM @ 100 PSIG	For cabinet cooling
Motive Air	125 SCFM @ 40 PSIG	For Eductor
Ambient Conditions		
Cabinet	0 to 120 °F	
Flue Gas Temperature	750 °F	Up to 800 °F intermittent with cooling.
Process Connection		
4" 150 lb 8-Bolt Flanged - 2 Ports		



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