



**Breen Probe – SO<sub>3</sub>/ABS/ADM**

**SO<sub>3</sub> /Ammonium Bisulfate/Acid Dew Point  
Detection & Measurement**



MISSISSIPPI®  
LIME

Discovering what's possible with calcium

# Breen Probe Sulfuric Acid/SO<sub>3</sub> Detection & Measurement

## SO<sub>3</sub> FORMATION IN FLUE GAS STREAMS

There are many boiler operational parameters that influence the degree of total SO<sub>3</sub> formation. Among these are:

- Fuel sulfur content
- Ash content and composition
- Convective pass surface area
- Gas and tube surface temperature distributions
- Excess air level
- 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<sub>3</sub>. Assumption of the level of total SO<sub>3</sub> based on any one variable is clearly inadequate.

## THE CHALLENGE – Control Of Sulfuric Acid

High sulfuric acid levels produce multiple detrimental effects including:

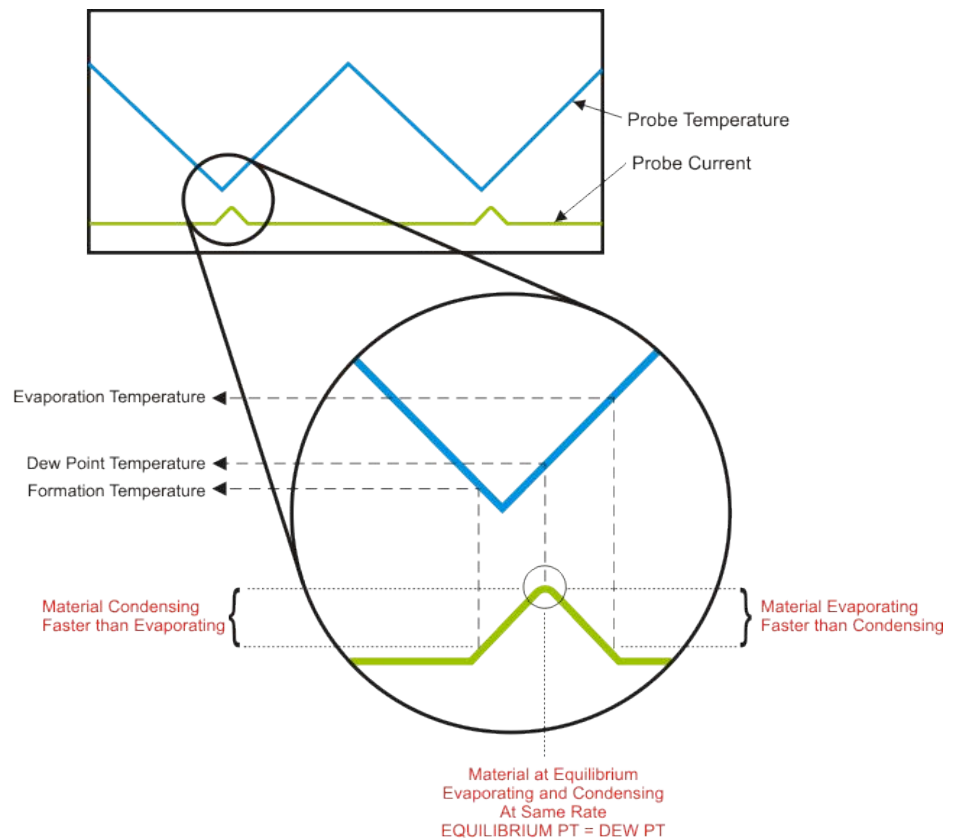
- Corrosion and fouling of heat exchangers and ductwork
- Increased carbon emissions through elevated air heater outlet temperature
- Formation of acid mist in the stack plume

Conversely, sulfuric acid has the beneficial effect of promoting fly ash collection in cold-side electrostatic precipitators. Successful control of sulfuric acid levels can have a significant impact on the overall performance of any electric-generating unit.

## Direct Measurement of Sulfuric Acid Vapor

The Breen Probe for Measuring SO<sub>3</sub>/ADM/Ammonium Bisulfate is an industry proven instrument for measuring the species and levels of the target vapors in utility flue gas streams. It can be placed anywhere downstream of the economizer, from the SCR outlet to the scrubber inlet.

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 formation temperature, evaporation temperature and process gas dew point of the flue gas condensables. In the case where the vapor is pure H<sub>2</sub>SO<sub>4</sub> the system combines this information with gas moisture levels using proven mathematical analysis provides real time information on SO<sub>3</sub> concentration.



## Breen Probe Technology

The Breen Probe 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. 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
- Dew Point
- SO<sub>3</sub> Concentration



## Optimize the Processes with The Breen Probe

There are a great many processes within the power plant environment that can be optimized by controlling sulfuric acid vapor concentration using High Reactivity Hydrated Lime (HRH). By using the Breen Probe, one is able to enjoy the operational benefits of Minimum Load Reduction through controlling the SO<sub>3</sub> concentration into the SCR; Heat rate improvement through both the control of Ammonium Bisulfate, and air heater cold-end temperature; ESP back-end and duct corrosion avoidance; ESP performance improvement through control of the acid dew point, and using the Acid Dew Point/ESP Inlet temperature relationship; and Blue Plume (acid mist) mitigation.

For sulfuric acid processes, we offer the Breen SA Probe. This probe was specifically developed for this challenging environment. It detects moisture leaks and provides a periodic measurement of sulfuric acid dew point. Please see product brochure number PDS103.

## Specifications

### Measurement Specifications

Dew Point Range	180 to 650 °F (82 to 343C)
Accuracy	Within +/- 1 degF of operating range <sup>1</sup>

### Environmental Specifications

Probe	Process wetted materials 304 SS, Pyrex <sup>2</sup>
Max Process Temp	900 °F (482C)
Probe Terminations	-20 to 356 °F (-29 to 190C)

### Installation Specifications

Insertion Depth	60" (1524 mm)/84" (2134 mm)/132" (3353 mm) +/- 0.75" (19 mm)
Probe Mounting Range	Vertical or Horizontal mounting, 4" (101.6mm) class 150 size flange, 9" (228.6mm) O.D. X 0.5" (12.7mm) thick, with a 7-1/2" (190.5mm) dia. Bolt circle. <sup>3</sup>
Air Requirement	75psi (5.17 Bar) @ 25 SCFM (708 l/min)

### Control Cabinet

Ambient Temp Limits	32 to 122 °F (0 to 50C)
Electrical Requirement	120/240 VAC 50/60Hz, 20 Amp, 300 Watt dedicated circuit with fuse or circuit breaker protection hardwired to EPCC.
Analog Outputs	Four 4-20 mA signals
Modbus	31 data points via Ethernet or Serial (232/485)
Alarm Relays	Pressure Relay: SPDT rated 10A, 120V AC/240V AC Power Relay: PDT rated 10A, 250V AC/DC
Probe Cable (supplied by Breen)	3 twisted pair conductors, 20 ga shielded cable to connect Type R TC, Type J TC & Probe Current
Heater Cable	3 conductor 14 ga cable; Type K thermocouple

<sup>1</sup> Sensor is calibrated to a NIST Traceable thermocouple which is accurate within +/- 1 degF of operating range. NIST Certificate available upon request.

<sup>2</sup> 316 SS available by special order

<sup>3</sup> Flanges are flat faced and are for mounting only. Flanges are not pressure rates. A 4" minimum diameter hole is required into the process. Adapter flanges are available to mate to existing larger size flanges.

## Flue Gas Treatment

Mississippi Lime Company (MLC) is a leading global supplier of high-calcium lime products and technical solutions. With over a century in business, the company has built a reputation on the purity of its products, commitment to research and development, and a tradition of customer satisfaction.

For industrial facilities that are legislated to reduce SO<sub>2</sub>, SO<sub>3</sub>, HCl or other emissions, The Mississippi Lime Flue Gas Treatment Product line offers calcium-based sorbents that target and mitigate these pollutants.

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PDS102



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Discovering what's possible with calcium