# Application Note

## pH in Ammonia Scrubbing

**Industry:** Chemical (Fertilizer)
**Product:** pH Process Liquid Analyzers

## Introduction

A process and apparatus for removing $SO_2$ from a gas stream having the steps of scrubbing the $SO_2$ with an ammonia scrubbing solution and removing any aerosols generated by the scrubbing in a wet electrostatic precipitator. The scrubbing solution is maintained at a pH between 6 and 8 to increase the speed of absorption of $SO_2$, to Increase the ratio of sulfite to bisulfite which also facilitates the oxidation of $SO_2$, and to avoid the need to use exotic, corrosion resistant alloys. Ammonium sulfate, a valuable fertilizer, can be withdrawn from the scrubbing solution.

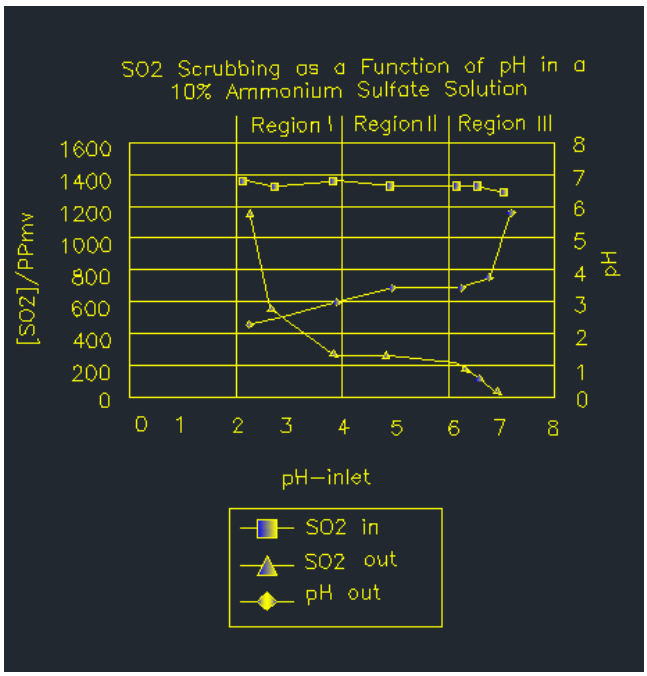


Figure 1.

## Process background

Fossil fuels are burned in many industrial processes. Electric power producers, for example, burn large quantities of coal, oil, and natural gas. Sulfur dioxide ("$SO_2$") is one of the unwanted byproducts of burning any type of fossil fuel. It is known to cause acid rain, and to have serious negative health effects on people, animals, and plants. A great deal of research has been done to find a way to economically remove $SO_2$ from flue gas streams before it enters the atmosphere.

The pH of the ammonium sulfate solution should be kept between about four and six. This range is the result of a compromise between competing factors. On one hand, ammonium sulfate solution is capable of absorbing $SO_2$ more rapidly when its pH is higher. The ability to absorb $SO_2$ better implies that the size of the scrubbing tower can be smaller, thus saving capital costs. In addition, the liquid to gas ("L/G") ratio can be smaller, meaning less liquid will be required and operating costs will be lower.

On the other hand, higher pH levels are also associated with the release of free ammonia from solution, often termed "ammonia slip." In addition to incurring an economic loss because of lost ammonia, free ammonia in the scrubbed flue gas reacts with uncaptured sulfur dioxide and trioxide to create an ammonium sulfate/bisulfite aerosol that is visible as a blue or white plume in the stack discharge, leading to secondary pollution problems. Controlling the amount of free ammonia in the desulfurization process is in part a function of the ammonia vapor pressure, which results from a combination of pH and levels of unoxidized ammonium sulfite that remain in the absence of sufficient oxygen. Therefore, high pH values and high levels of unoxidized ammonium sulfite promote ammonia slip.

## Typical Process Example

- Name of Application / Process: Ammonia Scrubbing
- Location of Sensor mounting (location name): Tail Gas Scrubber Complex
- Operating Temp / Max.Temp: 75 to 80 deg C
- Operating Press / Max. Press: 2 to 2.5 Kg/cm$^2$
- Type of Installation: On Pipe ( Direct mounting ) / Flow through Chamber (By pass mounting ) /
- Process Composition: Liquid - Scrub Acid,
    - $P_2O_5$:105 ppm,
    - AN (Ammonical Nitrogen):1326 ppm,
    - UN(Urea Nitrogen):22 ppm,
    - TN(Total Nitrogen):1348 ppm,
    - Florine:116 ppm.

## Typical problems

Frequent cleaning, glass can be eaten away as the temperature and chemical attack glass

## Remedies

Use of high temperature special sensor

## Product Recommendation

**Measurement System**

***Process Liquid Analyzer:***

- 2-wire FLEXA pH/ORP Analyzer


**Features**

Dual sensor measurement on 2-wire type analyser

Indication of sensor wellness

- 4-wire PH450G pH/ORP Analyzer


**Features**

Easy touchscreen operation

Trending display up to 2 weeks

Advanced Process Temperature Compensation

***Sensor Selection:***

SC25 sensor from Yokogawa is the perfect sensor for this application. High temperature sensor SC25 because of its design can serve purpose.


**Features SC25V**

External titanium Liquid Earth

Pt1000 integration in pH compartment giving highly accurate temperature compensation

CIP and Steam cleaning possible

Large internal KCl volume giving the sensor a longer life time

• SC25V-ALP25 for chemically harsh applications and high temperatures

**Cable:**

WU10-V-S series

**Retractable fitting:**

**PR10 series**

On-line measurements always present extra challenges compared to at-line measurements, for example, when maintenance needs to be done. Applications like this where the sensors have to be removed without interruptions or shut-downs the PR10 is especially suitable. Without any special tools the PR10 can be retracted safely from the process up to 5 bar.

For ease of use optional flush ports are available. In the retracted position the sensor can be kept moist, cleaned or even calibrated. This can all be done without process interruption or disassembly of the armature.

## Tangible benefit

Better life of sensor, improve end product quality.

**Note:** For additional information on this application contact the local Yokogawa Process Liquid Analyzer Department