

# ABB Analytical – pH/ORP Limestone Scrubber pH Measurement

Industry: Power

## Flue Gas Desulfurization pH measurement

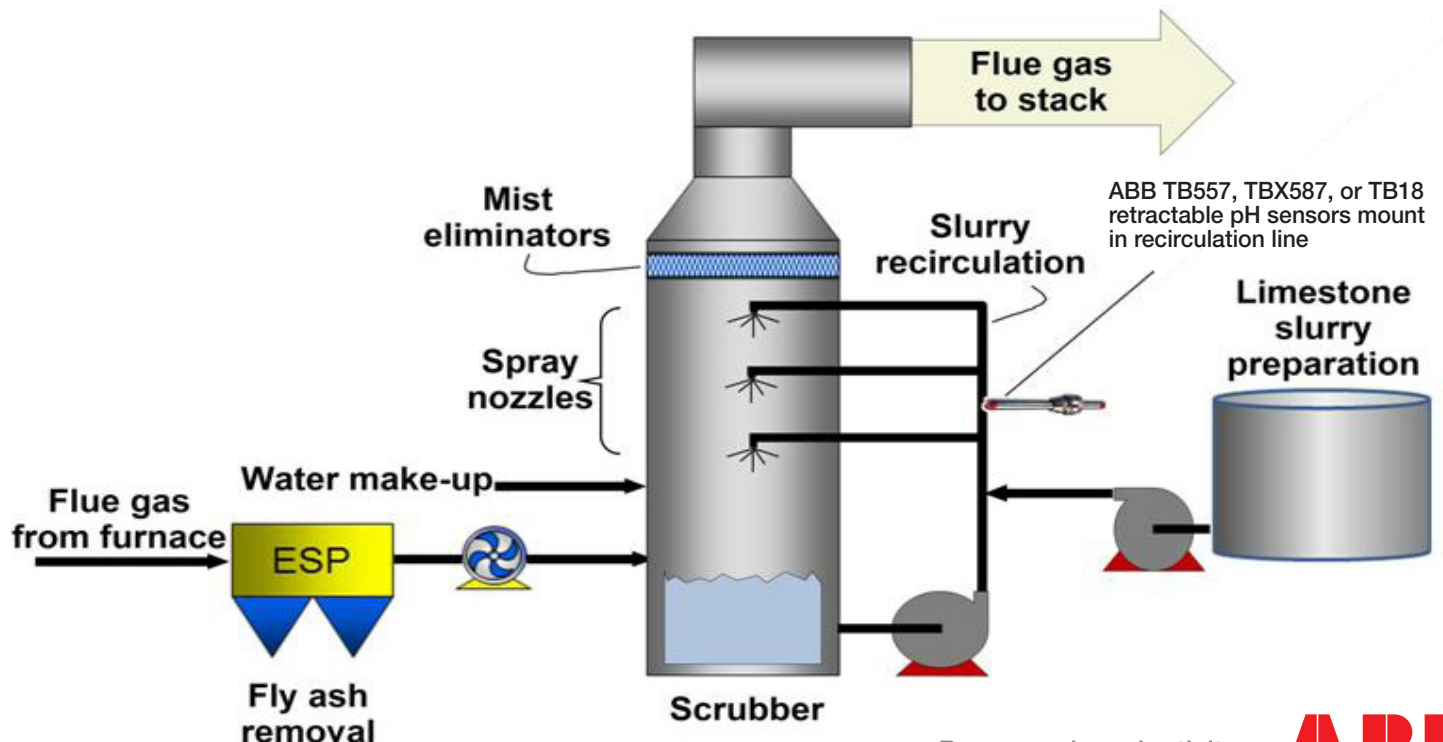
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Wet limestone scrubbers are by far the most common technology for removing sulfur dioxide from coal fired, power station flue gas. As shown in the diagram, the flue gas from the furnace first passes through an electrostatic precipitator to remove fly ash. In the scrubber, the lime or limestone (calcium hydroxide or calcium carbonate) slurry chemically reacts with the sulfur dioxide to form calcium sulfite and calcium sulfate ( $\text{CaSO}_3$  and  $\text{CaSO}_4$ ). These sulfite and sulfate crystals, being only slightly soluble in water, precipitate from solution.

The calcium sulfate crystals can form a hard stubborn scale on scrubber internals, threatening to plug the spray nozzles, mist eliminators, piping and other equipment. Plugged systems

must be shut down and cleaned. To avoid or minimize scale formation, the solution pH must be kept high to favor the creation of calcium sulfite at the expense of calcium sulfate.

The solubility of calcium sulfite increases greatly as pH decreases; conversely it forms a precipitate as pH increases. So if pH is too high, precipitates of calcium sulfite form as large leaf-like masses called "soft pluggage". Obviously plants prefer to maintain equipment with soft pluggage rather than with hard scale. In many cases, crews can remove soft pluggage by simply lowering the pH (increasing solubility).



To recap, scrubber operation at too low pH promotes the formation of hard scale while operation at too high of a pH promotes the formation of soft pluggage. Experience determines the proper pH range. Typically plants add limestone to achieve the desired level of sulfur dioxide removal. The amount added depends on the sulfur content of the burned coal, the boiler load, and the monitored sulfur dioxide concentration of the flue gas. The objective is to maintain the pH in the scrubber at 5.5 to 6.0 through controlled amounts of limestone.

Measurement of pH in flue gas desulfurization systems is relatively difficult. The limestone slurry contains 2 to 15% solids and is highly abrasive and corrosive. Additionally, the scrubber reaction has a tendency to create scaling and plugging. These conditions can lead to clogged sample lines, high sensor maintenance, and short sensor lifetimes. Some utilities have resorted to taking grab samples for laboratory analysis and pH control.

## The ABB Solution: Retractable pH sensors

To cope with these pH measurement issues, ABB recommends hot tap, retractable TB(X)5 sensors. TB(X)557, TB(X)587, and TB18 sensors have all been successfully used in flue gas desulfurization applications.

The measurement point is typically in the slurry recirculation piping of scrubber. The flat glass electrode and Wood Next Step reference design best fit this application. The flat glass will minimize damaging abrasion from the abrasive slurry. The Wood Next Step reference provides the most effective solution against scaling and plugging of the junction. Commonly these sensors offer more than twice the lifetime of conventional double junction pH sensors. Materials are generally titanium or Hastelloy C because of the corrosive nature of the process.



ABB TB(X)557 linear retractable pH sensor is commonly installed in the slurry recirculation line of the limestone scrubber.

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