Magnesium Oxide Wet Scrubbing System for Flue Gas Desulfurization

**BACKGROUND**
Wet scrubbers are used in utilities, paper mills, and chemical plants to remove sulfur dioxide (SO₂) and other pollutants from gas streams. Undesirable pollutants are removed by contacting the gases with an aqueous solution or slurry containing a sorbent. Lime/limestone systems are most common for SO₂ removal but magnesium oxide (MgO) slurry is sometimes used as an alternative.

**PROCESS**
After fly ash removal, the flue gas enters the scrubber (Figure 1) where it comes in contact with the MgO slurry. The SO₂ is absorbed in the scrubber slurry and forms insoluble magnesium sulfite (MgSO₃) as in the equation below.

\[ \text{MgO}^{(s)} + \text{SO}_2^{(g)} \rightarrow \text{MgSO}_3^{(s)} \]

Oxygen injected at the base of the scrubber further oxidizes the MgSO₃ to magnesium sulfate (MgSO₄). A bleed line from the scrubber recirculation line carries the slurry to a centrifuge where MgSO₃ crystals are separated from the scrubber slurry. The MgSO₃ and MgSO₄ is used in the acid plant to produce SO₂ for sulfuric acid production. The MgO reagent is regenerated and returned to the scrubber system.

The pH of the slurry must be carefully maintained between 4.5 and 5.0 because the MgSO₃ has a very limited solubility above pH 5.0. Proportional control, using the 4-20 mA current output, is desirable when hold-up time in the recirculating tank is five minutes or less. When hold-up time is fifteen minutes or more, a less expensive on-off control by the pH analyzer is adequate.

If the pH of the scrubber slurry is too low, SO₂ will not be absorbed, corrosion will result, and SO₂ regulatory emissions standards will be violated. SO₂ will be absorbed if the pH is too high, but reagent usage will be excessive, and scale will form inside the scrubber leading to plugging due to formation of calcium carbonate (CaCO₃).

**INSTRUMENTATION**
Since the MgO slurry has a tendency to coat the pH sensor, the Model 3400HT PERpH-X or the Model 396 TUpH¹ pH sensor should be used in line, with a sample flow of at least 3 ft/sec. The 3400HT features a rebuildable reference while the 396 is a disposable design. Appropriate analyzers include the dual input Model 1056, which offers a large display, intuitive menus, and four optional alarm relays for basic process control. If more advanced control features are required, the Model 54e offers three programmable relays with TPC and an optional PID controller. Applications requiring a loop-powered device are well served by the Model XMT transmitter. Please contact us for more information.

¹ TUpH is a trademark of Rosemount Analytical
Model 1056 Dual Input Intelligent Analyzer

- Dual configurable inputs and outputs
- Large, bright LCD display
- Intuitive menus with advanced diagnostics
- Four alarm relays with timers
- Optional HART or Profibus DP
- Polycarbonate NEMA 4X (IP65) enclosure

Model 54e pH/ORP Analyzer

- Dual 4-20 mA outputs for pH and temperature
- Three programmable alarm relays plus one dedicated fault alarm
- Optional PID controller and TPC capability
- Optional HART communications
- Heavy epoxy-painted aluminum NEMA 4X (IP65) enclosure
- Optional PID and TPC control capability.

Model 396 TUpH™ pH/ORP Sensor

- Polypropylene reference junction and helical pathway mean longer sensor life in process solutions containing heavy solids.
- Disposable one-piece construction is convenient and economical where minimal troubleshooting and maintenance downtime are of prime importance.
- Helical pathway to prevent sulfide poisoning.
- Suitable for flow-through and submersion applications.

3400HT pH and ORP Sensor

- Fast, Accurate, & Stable Measurement
- Rugged, Versatile Design
- Quick Connect Cable or Integral Cable
- Long Lasting Rebuildable Reference
- SOLUTIONS Compliant Design

FIGURE 1. Magnesium Oxide Scrubbing Systems for Boiler Flue Gas.