Magnesium Oxide Wet Scrubbing System for Flue Gas Desulfurization

Benefits

- Reduced sulfur dioxide (SO_2) emissions
- Improved corrosion resistance
- Reduced sorbent consumption

Background

Wet scrubbers are used in utilities, paper mills, and chemical plants to remove sulfur dioxide (SO_2) 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 SO_2 removal but magnesium oxide (MgO) slurry is sometimes used as an alternative.

Process

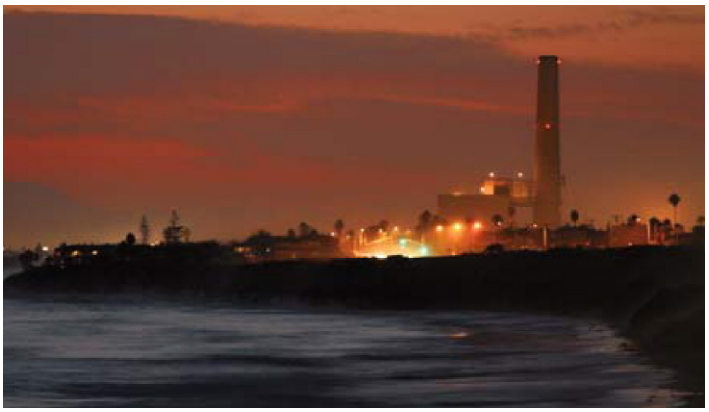
After fly ash removal, the flue gas enters the scrubber (Figure 1) where it comes in contact with the MgO slurry. The SO_2 is absorbed in the scrubber slurry and forms insoluble magnesium sulfite ($MgSO_3$) as in the equation below.

$$MgO^{(s)} + SO_2^{(g)} \rightarrow MgSO_3^{(s)}$$

Oxygen injected at the base of the scrubber further oxidizes the $MgSO_3$ to magnesium sulfate ($MgSO_4$). A bleed line from the scrubber recirculation line carries the slurry to a centrifuge where $MgSO_3$ crystals are separated from the scrubber slurry. The $MgSO_3$ and $MgSO_4$ 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 $MgSO_3$ 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, SO_2 will not be absorbed, corrosion will result, and SO_2 regulatory emissions standards will be violated. SO_2 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 ($CaCO_3$)



Instrumentation

Since the MgO slurry has a tendency to coat the pH sensor, the 3400 HT PERpH-X or the 396 TUpH[1] pH sensor should be used in line, with a sample velocity of at least 3 ft / sec. The 3400 HT features a rebuildable reference while the 396 is a disposable design. Appropriate analyzers include the dual input 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 56 offers four programmable relays with Time Proportional Control (TPC) and PID control outputs.

[1] *TUpH is a trademark of Rosemount Analytical*

ROSEMOUNT® Analytical

EMERSON™ Process Management

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

56 pH / ORP Analyzer

- Large, high resolution full-color screen displays process trends
- Four configurable 4–20 mA current outputs
- Data and event logging accessed via USB 2.0 data port
- PID control outputs and time proportional relays
- HART® communications included

3400HT pH / ORP Sensor

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

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.

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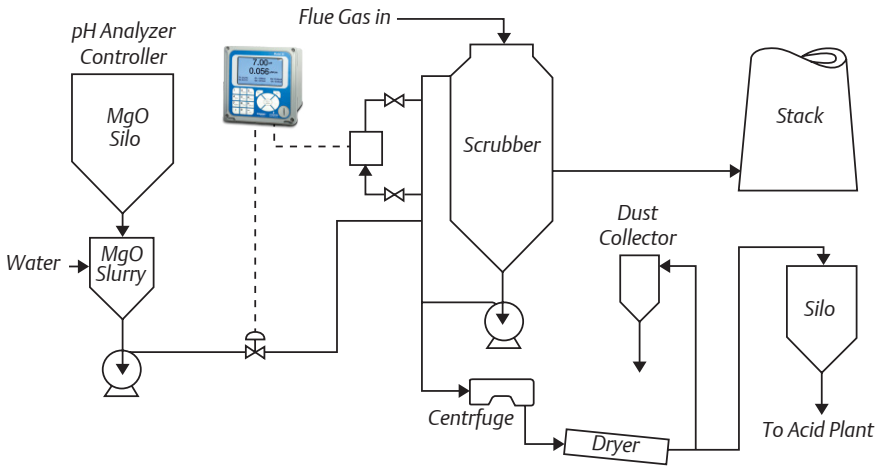
Figure 1: Magnesium Oxide Scrubbing Systems for Boiler Flue Gas



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