Elessent™
MECS® TECHNOLOGIES

CASE STUDY NO. 52
DYNAWAVE® TECHNOLOGIES

ZINC OXIDE REAGENT FOR SO_2 REDUCTION

THE DYNAWAVE® APPLICATION

In 1999 a DynaWave® scrubbing system was installed at a zinc smelter in Australia to control the SO_2 emissions in the acid plant tail gas stream. Within the DynaWave® scrubber, zinc oxide is utilized as the scrubbing reagent to remove the sulfur dioxide. The zinc oxide reagent is a collection of waste zinc slurries from various plant processes. This waste product is collected and utilized in the scrubber in order to reduce reagent costs. As part of the project, the DynaWave® scrubber also provides in-situ oxidation to produce a zinc sulfate solution that is further processed within the zinc plant to recover the zinc. This project demonstrates the ability of the DynaWave® technology to effectively utilize zinc hydroxide slurry to treat SO_2 emissions.

PROCESS PARAMETERS: QUICK FACTS	
Inlet gasflow	~113,700 Am^3/h (66,900 acfm)
Inlet temperature	~100°C (212°F)
Reagent	Zinc oxide
Inlet SO_2 concentration	~1,600 ppm v/v
SO_2 removal efficiency	>90%

THE DYNAWAVE® TECHNOLOGY

Wet gas scrubbing applications to remove sulfur dioxide from gas streams typically utilize alkaline reagents to react with the sulfur dioxide. The most common alkaline reagents utilized are sodium hydroxide, lime and limestone. In this application, MECS, Inc. (MECS) technologies has successfully implemented the DynaWave® technology to efficiently remove sulfur dioxide from a flue gas stream using zinc oxide as the scrubbing reagent.

Since only a limited amount of sulfur dioxide can be dissolved in water, a reagent is added to react with the sulfur dioxide. The project site was a zinc smelting plant. By utilizing a waste zinc oxide source as the reagent, the plant was able to save on reagent costs.

After being dissolved in water, the zinc oxide will react with the sulfur dioxide according to the following reaction:

$$SO_2 + Zn(OH)_2 \rightarrow ZnSO_3 + H_2O$$

This reaction occurs in the aqueous phase. Zinc hydroxide, however, is only slightly soluble in water. This means that the dissolution of zinc hydroxide into the water is the rate-limiting step in the overall reaction with sulfur dioxide. MECS® technologies solved this problem utilizing the unique advantages of the DynaWave® wet gas scrubber. The DynaWave® technology utilizes the reverse jet to create a froth zone. The froth zone is a very intense mass and energy transfer region.

It is here that the flue gas is quenched and the sulfur dioxide is transferred from the flue gas to the liquid. The reverse jet is capable of a very high rate of liquid renewal within the reaction zone of the scrubber. As a result, the limited dissolution rate of zinc hydroxide was overcome.

Since zinc hydroxide and zinc sulfite are relatively insoluble, a slurry design was employed in the DynaWave® system. The unique design of the DynaWave® reverse jet nozzle, allows the slurry to be used directly in the scrubbing "froth zone." These nozzles have large open bores which allow them to operate efficiently and continuously without plugging, even when the scrubbing liquid contains high levels of suspended solids.

The project also required that the zinc sulfite be oxidized to zinc sulfate in order for the zinc to be recovered. An in-situ oxidation system was designed to convert the zinc sulfite to zinc sulfate according to the following reaction:

$$ZnSO_3 + \tfrac{1}{2}O_2 \rightarrow ZnSO_4$$

The final product from the scrubbing system is then processed through a thickener prior to the zinc recovery. The plant operates reliably and met the original project's goals which included a sulfur dioxide outlet removal efficiency of greater than 90% and the resulting zinc sulfate slurry meeting product specifications. This project successfully demonstrated that the DynaWave® wet gas scrubber can utilize zinc oxide to efficiently remove sulfur dioxide from gas streams.

DynaWave® technology advantages:

- Smaller diameter, lower height and smaller overall footprint compared to typical spray towers
- Very high SO_2 removal efficiencies obtained while using an unusual reagent (zinc oxide)
- The use of large, open nozzles, piping and vessel design that avoid plugging
- The use of specific materials to limit erosion in this highly abrasive application
- Costs and the scrubber footprint are minimized due to the multiple functions performed in a single vessel
- Simplicity in operation with low operator attention required and high reliability

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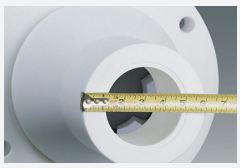
TYPICAL DYNAWAVE® REVERSE JET SCRUBBER



Reverse jet nozzle

DynaWave® technology effluent bleed tank

See how it works. View the video on the MECS website at: MECS.ElessentCT.com

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