Elessent™
MECS® TECHNOLOGIES

CASE STUDY NO. 54
DYNAWAVE® TECHNOLOGIES

SULFURIC ACID PLANT TAIL GAS SCRUBBING USING ZINC OXIDE

THE DYNAWAVE® APPLICATION

DynaWave® scrubbing system was installed at a zinc roaster in Belgium in 2002 to control SO_2 emissions from the sulfuric acid plant tail gas stream.

Zinc oxide is utilized as the scrubbing reagent to remove the sulfur dioxide in order to produce a zinc sulfate solution that can be further processed within the zinc plant to recover the zinc.

The zinc oxide reagent is supplied in bulk bags of 1 to 1.5 tons and then slurried to produce a zinc oxide slurry used for scrubbing in the DynaWave® technology. As the effluent from the system is required to be a zinc sulfate solution, the DynaWave® technology also provides in-situ oxidation to convert the sulfites to zinc sulfate. The resulting solids are filtered to less than 15% moisture content.

PROCESS PARAMETERS: QUICK FACTS	
Inlet gas flow	~55,000 Nm^3/h (32,400 scfm)
Inlet temperature	<95°C (203°F)
Reagent	Zinc oxide
Inlet SO_2 concentration	~1,100–1,800 ppm v/v
Outlet SO_2 concentration	<200–400 ppm v/v
Zinc oxide utilization	>95%

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) 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 roaster 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 sulfur dioxide according to the following reaction:

$$SO_2 + ZnO \rightarrow ZnSO_3$$

This reaction occurs in the aqueous phase. Zinc oxide, however, is only slightly soluble in water. This means that the dissolution of zinc oxide into the water is the rate-limiting step in the overall reaction with sulfur dioxide.

MECS 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 oxide was overcome.

Since zinc oxide and zinc sulfite are relatively insoluble, a slurry design was employed in the DynaWave® scrubber. Because of the unique design of the DynaWave® reverse jet nozzles, the slurry is used directly in the scrubbing froth zone. These nozzles have large, open bores that allow them to operate efficiently and continuously without plugging even when the liquid contains high levels of suspended solids.

The project also required the zinc sulfite to 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 to further concentrate the zinc sulfate prior to zinc recovery. The plant operates reliably and met the original project's goals, achieving the sulfur dioxide removal efficiency 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.

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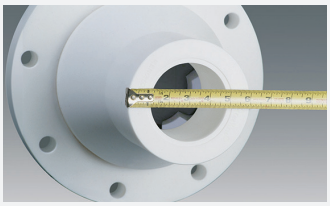
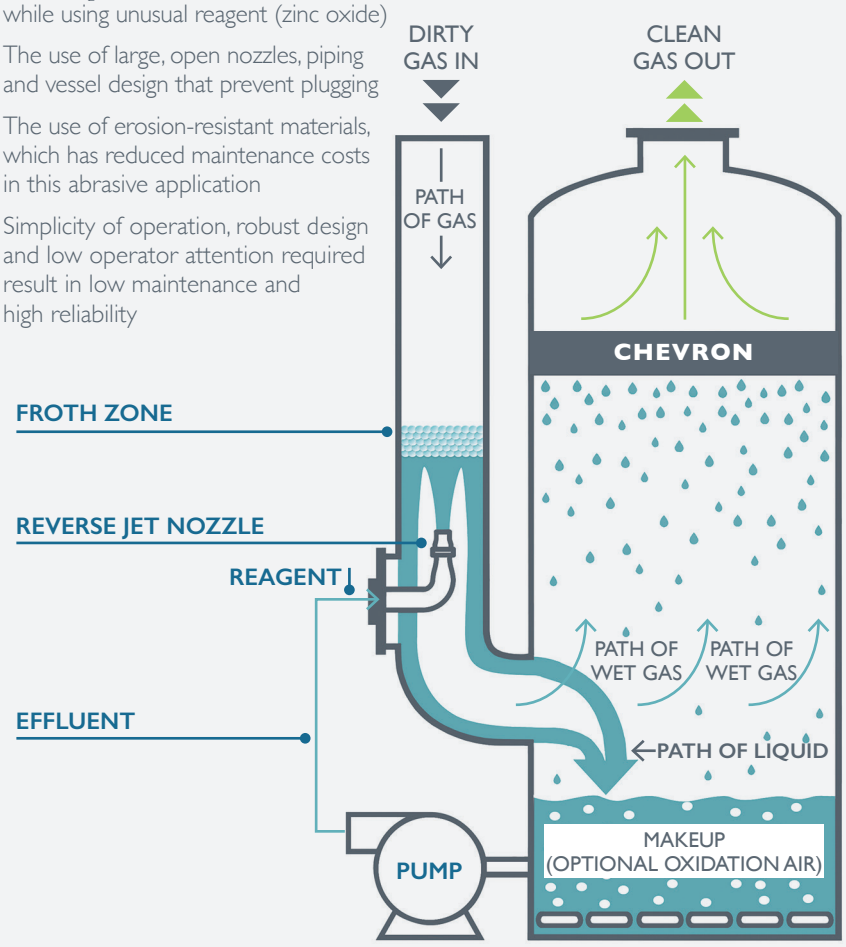
TYPICAL DYNAWAVE® REVERSE JET SCRUBBER

DynaWave® technology advantages:

- Project capital costs and the scrubber footprint are minimized as multiple functions are performed in a single vessel
- Smaller diameter, lower height and smaller overall footprint compared to typical spray towers
- High SO_2 removal efficiencies obtained while using unusual reagent (zinc oxide)
- The use of large, open nozzles, piping and vessel design that prevent plugging
- The use of erosion-resistant materials, which has reduced maintenance costs in this abrasive application
- Simplicity of operation, robust design and low operator attention required result in low maintenance and high reliability



Reverse jet nozzle



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

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GLOBAL OFFICES

NORTH AMERICA

Global Headquarters
Saint Louis, Missouri, USA

ContactUs-NA@ElessentCT.com

LATIN AMERICA

ContactUs-LA@ElessentCT.com

EUROPE | MIDDLE EAST AFRICA | INDIA

EMEAI Headquarters
Hoeilaart, Belgium

ContactUs-EMEAI@ElessentCT.com

ASIA PACIFIC

AP Headquarters
Shanghai, China

ContactUs-AP@ElessentCT.com

Jakarta, Indonesia
ContactUs-INDO@ElessentCT.com