Carmeuse Lime Case Study

Location: Pittsburgh, PA
Situation: Improved design for MEL-FGD ex-situ oxidizer

Modified magnesium enhanced lime FGD oxidizer demonstrates savings in energy consumption and maintenance

The Problem: The existing external oxidizer technology consists of a vessel with a complex air sparge grid that introduces air and provides agitation to suspend solids. Alternative existing oxidizer designs can include a sparge grid and mixer.

The sparge grid design, although being proven, has some drawbacks. Excess air is required to suspend solids leading to excessive energy use. Additionally, the air grid is located near the floor making maintenance difficult and more susceptible to solids plugging. Air bubbles from the sparger tend to coalesce into larger bubbles producing violent eruptions and reduced mass transfer.

The existing sparge grid with mixer design is an improvement by using a mixer to increase the oxygen transfer efficiency and reducing bubble coalescence. This design introduces higher overall power consumption since the increase in oxygen transfer efficiency is small as compared to energy needed to power the mixer. Overall, costs can be excessive due to higher energy consumption and maintenance demands.

"This new oxidizer design can help power companies reduce energy consumption by up to 30% and reduce costs through easier maintenance procedures."

- Chris Hibshman
Project Manager
Philadelphia Mixing Solutions, Ltd.

PHILADELPHIA MIXING SOLUTIONS, Ltd.

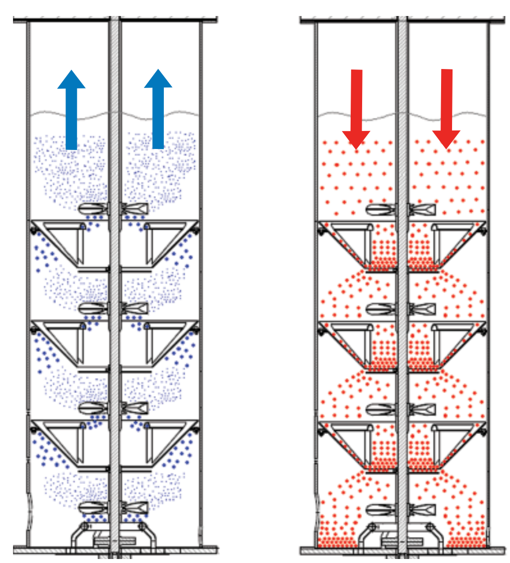
The Solution: Carmeuse Lime & Stone in cooperation with Philadelphia Mixing Solutions Ltd. (PMSL) have tested a pilot scale modified magnesium enhanced lime (MEL) FGD oxidizer consisting of a multistage column with a simple raised air sparger design and mixing capability. This new patent pending design disperses air in multiple stages leading to a higher oxygen transfer efficiency, shorter residence time and smaller vessel size (Figure 1). Chris Hibshman, Project Manager-PMSL, explains, *"This new oxidizer design can help power companies reduce energy consumption by up to 30% and reduce costs through easier maintenance procedures."*

Figure 1

The two drawings to the right illustrate the flow of air and solids through the new MEL lime FGD oxidizer.

The blue particles show the AIR FLOW

The red particles show the SOLIDS FLOW



NATURAL SOLUTIONS

Figure 1 also shows the oxidizer configuration of four agitator compartments. Air from the sparger comes in contact with the bottom agitator, shearing the bubbles which produce a higher surface area and raises transfer efficiency. The bubbles are collected where they coalesce and directed to the next agitator that again shears the bubbles to continue raising transfer efficiency. This pattern repeats two more times though the remaining two compartments. This process enables maximum exposure of the air to oxidize the scrubber bleed in order to produce gypsum.

The Results: The modified pilot scale MEL-FGD oxidizer design by PMSL was placed into operation on three separate test campaigns for a period of 48 hours for each. During each test campaign, the oxidizer was controlled up to 22 weight percent solids. These trials demonstrated complete oxidation at a O_2: S stoichiometric ratio less than 1.5: 1 without slurry recycling. Lower O_2: S stoichiometric ratio leads to a significant reduction in energy consumption when compared to a typical commercial MEL external oxidizer ratio of 3.0: 1.

A simple economic evaluation shows the potential savings of this new oxidizer design (Table 1). This study compares the typical operating parameters of an existing external MEL oxidizer to the new design while assuming an energy cost of \$0.07/kW-h with an operating capacity factor of 0.70. The results revealed an operating energy savings of ~\$288,000 per year not including reduced maintenance costs.

A separate simplified study was used to calculate the reduction of CO_2 footprint assuming of 1.85 lbs CO_2 produced per kW-h with an operating capacity factor of 0.70. This in turn would provide a reduction of 3,800 tons CO_2 per year from the new oxidizer design.

Table 1: Conceptual 500 MW Plant Design

Existing Technology (Air sparge grid)	**New Design** (Multiple stages w/air ring and agitators)
O_2: S stoich = 3: 1	O_2: S stoich = 1.5: 1
2,236 kW (3,000hp) air compressor	1,118 kW (1,500hp) air compressor
No agitator	447 kW (600hp) agitator
Energy cost: 2236kW x \$0.07/kW-h x 8,760 hr/yr x 0.70 CF = \$960,000/yr	Energy cost: 1565kW x \$0.07/kW-h x 8,760 hr/yr x 0.70 CF = \$672,000/yr
CO_2 Footprint: 2236kW x 0.000925 tons CO_2/kW-h x 8,760 hr/yr x 0.70 CF = 12,700 tons CO_2 /yr	CO_2 Footprint: 1565kW x 0.000925 tons CO_2/kW-h x 8,760 hr/yr x 0.70 CF = 8,900 tons CO_2 /yr

Operating Energy Savings = \$288,000 per year
+
CO_2 Foot Print Reduction = 3,800 tons CO_2 / per year

For additional information about Carmeuse lime products and lime related technology call us toll free at: 866-243-0965 or 866-780-0974

Carmeuse Lime & Stone
11 Stanwix Street, 21st Floor
Pittsburgh, PA 15222

Phone: 866-780-0974
Fax: 412-995-5515
E-mail: salesinfo@carmeusena.com
Internet: www.carmeusena.com