USING LIME FOR FLUE GAS TREATMENT

Lime plays a key role in many air pollution control applications. Lime is used to remove acidic gases, particularly sulfur dioxide (SO_2) and hydrogen chloride (HCl), from flue gases. Lime-based technology is also being evaluated for the removal of mercury.

Lime is more reactive than limestone, and requires less capital equipment. SO_2 removal efficiencies using lime scrubbers range from 95 to 99 percent (at electric generating plants). HCl removal efficiencies using lime range from 95 to 99 percent (at municipal waste-to-energy plants).

There are two main methods for the removal of acidic gases: dry scrubbing and wet scrubbing. Both methods are used for cleaning flue gases from the combustion of coal to produce electric power. Dry scrubbing is also used at municipal waste-to-energy plants and other industrial facilities, primarily for HCl control. Lime is used in both systems.

DRY LIME SCRUBBING: In dry scrubbing, lime is injected directly into flue gas to remove SO_2 and HCl. There are two major dry processes: "dry injection" systems inject dry hydrated lime into the flue gas duct and "spray dryers" inject an atomized lime slurry into a separate vessel.

A spray dryer is typically shaped like a silo, with a cylindrical top and a cone bottom. Hot flue gas flows into the top. Lime slurry is sprayed through an atomizer (e.g., nozzles) into the cylinder near the top, where it absorbs SO_2 and HCl. The water in the lime slurry is then evaporated by the hot gas. The scrubbed flue gas flows from the bottom of the cylindrical section through a horizontal duct. A portion of the dried unreacted lime and its reaction products fall to the bottom of the cone and are removed. The flue gas then flows to a particulate control device (e.g., a baghouse) to remove the remainder of the lime and reaction products.

Both dry injection and spray dryers yield a dry final product, collected in particulate control devices. At electric generating plants, dry scrubbing is used primarily for low-sulfur fuels. At municipal waste-to-energy plants, dry scrubbing is used for removal of SO_2 and HCl. Dry scrubbing is also used at other industrial facilities for HCl control. Dry scrubbing methods have improved significantly in recent years, resulting in excellent removal efficiencies.

WET LIME SCRUBBING: In lime wet scrubbing, lime is added to water and the resulting slurry is sprayed into a flue gas scrubber. In a typical system, the gas to be cleaned enters the bottom of a cylinder-like tower and flows upward through a shower of lime slurry. The sulfur dioxide is absorbed into the spray and then precipitated as wet calcium sulfite. The sulfite can be converted to gypsum, a salable by-product. Wet scrubbing is used primarily for high-sulfur fuels and some low-sulfur fuels where high-efficiency sulfur dioxide removal is required. Wet scrubbing is a primary use for magnesium-enhanced lime (containing 3-8% magnesium oxide), which provides high alkalinity that increases SO_2 removal capacity and reduces scaling potential.

COMPARING LIME & LIMESTONE SO_2 SCRUBBING PROCESSES: Over ninety percent of U.S. flue gas desulfurization (FGD) system capacity uses lime or limestone. This trend will likely continue into the next phase of federally mandated SO_2 reduction from coal burning power plants. The National Lime Association sponsored a study to compare the costs of

leading lime and limestone-based FGD processes utilized by power generating plants in the United States. The study included developing conceptual designs with capital and O&M cost requirements using up-to-date performance criteria for the processes. The results of the study are summarized in two reports: Wet FGD Technology Evaluation and Dry FGD Technology Evaluation. The reports present the competitive position of wet and dry limestone and lime-based processes relative to reagent cost, auxiliary power cost, coal sulfur content, dispatch, capital cost, and by-product production (gypsum and SO_3 aerosol mitigation chemicals).

HCl REMOVAL: Because lime also reacts readily with other acid gases such as HCl, lime scrubbing is used to control HCl at other types of municipal and industrial facilities:

- At municipal waste-to-energy plants, dry lime scrubbing is used to control emissions from about 70 percent of the total U.S. capacity (as of 1998). HCl removal efficiencies using lime range from 95 to 99 percent.
- At secondary aluminum plants, for example, the U.S. Environmental Protection Agency identifies lime scrubbing as a maximum achievable control technology for HCl. EPA tests demonstrate removal efficiencies greater than 99 percent.

MERCURY REMOVAL: Many different methods for controlling mercury emissions are being evaluated in the U.S. One control technology being evaluated combines hydrated lime with activated carbon. The reagent, a registered product, consists of 95-97 percent lime and 3-5 percent activated carbon. Other calcium-based sorbents are also being evaluated as cost-effective alternatives for combined SO_2 and mercury removal.