

Lime Usage Reduction at the Delaware Valley Resource Recovery Facility

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Introduction

Waste to Energy facilities in the U.S. collectively spend over \$20 million per year on lime for flue gas treatment. Individually, most plants spend between \$300,000 and \$1 million per year on lime. This expense is often the plant's largest for a consumable material and is expected to increase as emission limits become more stringent.

American Ref-Fuel's Delaware Valley Resource Recovery Facility is a 3300 ton per day waste to energy plant located near Philadelphia, PA. The plant is equipped with dry scrubber type flue gas treatment technology using slaked quicklime as the primary reagent. This facility is typical of many waste to energy plants using dry scrubber systems as shown in Fig. 1.

Recent research and practical experience has shown that lime usage in dry scrubbers can be significantly reduced by optimization of flue gas treatment processes. In addition to reduced lime consumption, other financial and operational benefits may include reduced corrosion in downstream components, greater safety and system dependability.

This paper describes a theory of scrubber performance optimization and successful application of that theory to reduce lime usage and achieve other benefits at the Delaware Valley Facility.

Scrubber Performance Theory

Gas temperature in the absorber is known to have a significant effect on acid absorption and removal efficiency. This sensitivity can be modeled by assuming a relationship between acid absorption rate and drying time.

Referring to Figures 1 and 2, reagent initially enters the gas stream (at point A) as a slurry of solid calcium hydroxide particles suspended in liquid water. In waste to energy applications, gas temperature at this point is approximately equal to boiler outlet temperature, typically ranging from 450F to 550F.

Evaporation of the liquid water begins immediately at point A. During the evaporation phase (between points A and B), ion exchange through the liquid water enables the solid lime to dissolve and react rapidly with the acid gas. This rapid absorption process continues until the liquid water is fully evaporated (at point B). In waste to energy applications gas temperature at this point typically ranges from 290F-340F. While acid continues to be absorbed in the dry phase (between points B and C) the absorption rate is substantially diminished.

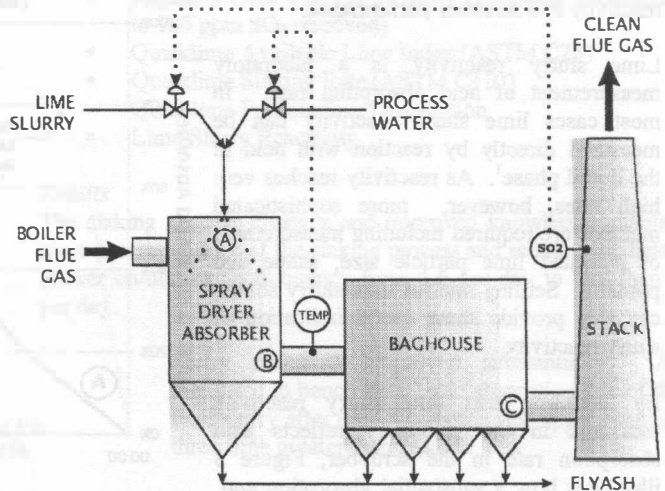


FIGURE 1. Delaware Valley RRF Dry Scrubber System

The effect of gas temperature on lime consumption is predicted by this model. Decreasing absorber gas temperature (shifting the evaporation point B to the right in Fig. 2) prolongs the rapid reaction liquid phase, thereby increasing acid absorption to greater levels (further along the dashed line). Similarly,

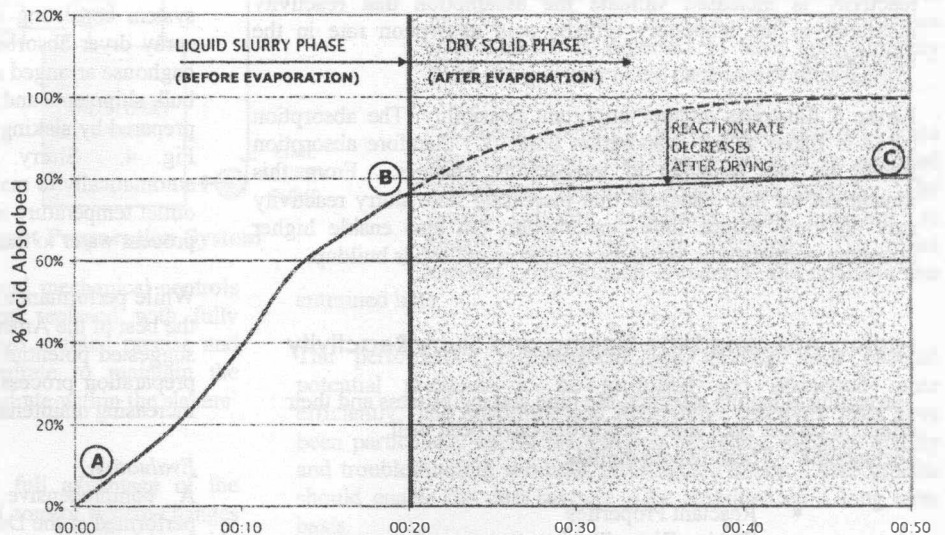


FIGURE 2. Dry Scrubber Acid Absorption Phases

increasing absorber gas temperature shortens the liquid phase (shifting evaporation point B left), thereby decreasing acid removal.

The effect of temperature on acid absorption (SO₂ removal) discussed above and illustrated in Fig. 2 has been observed at numerous dry scrubber installations.