

Secondary Plume Abatement

Ron Hawks, Presenter

Environmental Quality Management, Inc., 3325 Durham-Chapel Hill Blvd., Durham, NC 27707-2646
E-mail: rhawks@eqm.com; Telephone: (919) 489-5299; Fax: (919) 489-5552

Robert G. McCullough, Co-author

Environmental Quality Management, Inc., 1800 Carillon Blvd., Cincinnati, OH 45240-2788
E-mail: bmccullough@eqm.com; Telephone: (513) 825-7500; Fax: (513) 825-7495

Summary

The utility industry has been required to install nitrogen oxide (NO_x) removal equipment consisting of selective catalytic reduction (SCR). The SCR systems have been known to convert a portion of the sulfur dioxide (SO₂) produced by coal combustion to sulfur trioxide (SO₃) by oxidation. The oxidation reaction occurs on the surface of the SCR catalyst. As a result of this reaction, the relative emission rate of SO₃ can increase by more than 100 percent above the normal emission levels. As the flue gas passes through the air heater, SO₃ is converted to sulfuric acid (H₂SO₄) vapor and aerosol. Further cooling through the flue gas desulfurization (FGD) wet scrubber converts the majority of the acid vapor to aerosol. The FGD scrubber is ineffective at removing the majority of these fine aerosol droplets. Because the aerosol is not collected, a highly visible aerosol plume is present in the flue gases exiting the stack. The light scattering properties of the acid aerosol result in a visible and lengthy residual plume after dissipation of water droplets. In addition, the SO₃ can be an irritant to surrounding populations.

PROPOSED PROJECT TECHNOLOGY IMPROVEMENT & BREAKTHROUGH

Environmental Quality Management, Inc. (EQ), in partnership with EnviroCare International, has developed the MicroMist ML System which is a cost-effective SO₃ removal and reactive plume abatement solution. The technology is covered under U.S. Patent 6,060,030 dated May 9th, 2000. With the MicroMist ML System, SO₃ vapor is absorbed into the injected droplets and reacts with activated lime or caustic to form a salt. The absorption, reaction rate, and cooling allow progressive removal of SO₃ in the vapor phase without suppressing the gases to the acid dew point. This prevents the formation of acid aerosol. The product of the reaction will be retained in semi-dry particles produced by evaporation of the spray droplets. The particles are large enough to be effectively removed by existing particulate collection devices such as ESPs, fabric filters, and wet scrubbers. The technology has been demonstrated for SO₂ removal in pilot-scale trials at several cement plants. A pilot-scale trial at a utility to demonstrate the applicability to SO₃ removal is planned for mid 2002.

EQ proposes to successfully demonstrate (at a fossil fuel plant) that the process will absorb SO₃ vapor. The primary objective of this project will be to prove that EQ's proposed SO₃ absorption removal process performs successfully and does remove SO₃ caused by the oxidation of SO₂ passing over the SCR catalyst used for NO_x removal.

The proposed demonstration is designed to demonstrate the selective absorption of the oxidized SO_2 (resulting SO_3) in the vapor phase into a liquid droplet in which lime hydrate is dispersed. The droplet size, lime content, and its evaporation rate are controlled to maintain the droplet chemistry as the absorbed acid consumes the lime hydrate. Evaporation rate is controlled to prevent cooling of the flue gases to the acid dew point and, therefore, prevent formation of acid aerosols in the flue gases. By controlling the rate of evaporation, droplet size, slurry rate, and lime hydrate concentration, SO_3 vapor is selectively absorbed and dew point is depressed as SO_3 is removed from the gas. The final product of the reaction is either a semi-dry droplet containing reaction products calcium sulfate (CaSO_4), residual lime hydrate ($\text{Ca}(\text{OH})_2$), and water (H_2O) of sufficient diameter and mass to be removed in existing particulate abatement systems.