

# **Current Work on the Impacts of SO<sub>3</sub> Emissions from Selective Catalytic Reduction Systems**

**By**

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With the large scale deployment of selective catalytic reduction (SCR) systems for the control of NO<sub>x</sub> emissions from coal fired powers plants the need to predict and control the increased SO<sub>3</sub> emissions is required. The increased SO<sub>3</sub> emissions resulting from SO<sub>2</sub> oxidation in the catalyst requires the analysis of all down stream equipment including stack emissions. If the increased SO<sub>3</sub> concentration results in adverse equipment performance or stack emissions the need for SO<sub>3</sub> mitigation is required. The ability to accurately predict and understand the impact of the increased SO<sub>3</sub> oxidation resulting from the SCR addition is required to properly design SCR systems.

The combustion of fossil fuels results in the oxidation of fuel bound sulfur compounds to form sulfur dioxide (SO<sub>2</sub>). A small fraction (< 3.0%) of the SO<sub>2</sub> is further oxidized to form sulfur trioxide (SO<sub>3</sub>) in the boiler furnace. The SO<sub>3</sub> vapor exiting the boiler will condense to form a vapor phase sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) at temperatures below approximately 400 °F. Electric Utilities are concerned with the concentrations of SO<sub>3</sub> in the flue gas due to equipment corrosion and plume opacity issues. The condensation of H<sub>2</sub>SO<sub>4</sub> on duct and stack walls below the sulfuric acid dew point results in corrosion, increasing air preheater exit gas temperatures to reduce this corrosion in balance of plant equipment negatively effects plant heat rate. Stack opacity and visible plumes resulting from the acid mist droplet formation, either in plant equipment or in the atmosphere near the stack exit result in emissions compliance and public relations issues. The deployment of Selective Catalytic Reduction (SCR) systems for the control of NO<sub>x</sub> emissions increases the SO<sub>3</sub> oxidation prior to the air preheater by 0.75 to 3% depending on operating parameters and system design. This increase by the SCR can double the amount of SO<sub>3</sub> present in the flue gas at the air preheater inlet. The ability of the balance of plant equipment to remove and operate with the increase SO<sub>3</sub> loading needs to be understood to estimate the impact on operations and emissions.

The effect of the increased SO<sub>3</sub> resulting from SCR installations on plant equipment and stack emissions requires the understanding of the generation and removal of SO<sub>3</sub> throughout the flue gas system. To better understand these relationships and SCR design and mitigation techniques to limit SO<sub>3</sub> formation and emission, field testing of units with and without installed SCR has been under taken. Based on the test results four case studies are presented to illustrate the effect of fuels and balance of plant equipment. Each case study includes the variation of the catalyst conversion rate to investigate system design parameters.

## **Case studies**

1. A slagging unit burning approximately 1.5% sulfur coal. The unit is equipped with an SCR, regenerative air preheater and electrostatic precipitator (ESP).
2. A slagging unit burning approximately 1.5% sulfur coal. The unit is equipped with an SCR, tubular air preheater and electrostatic precipitator (ESP).

3. A dry bottom unit burning PRB coal. The unit is equipped with a regenerative air heater, SO<sub>3</sub> injection ash conditioning system and an ESP.
4. A dry bottom unit burning high sulfur coal. The unit is equipped with a regenerative air heater, ESP and wet FGD system.

From these four test cases a wide variation of operating conditions and equipment characteristics is illustrated. Past work from EPRI has outlined possible and proven mitigation techniques for SO<sub>3</sub> control, these techniques will be reviewed for acceptability to the SCR application.