ANALYSES OF RATE OF FORMATION OF SO_3 IN COAL FIRED BOILERS

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SUMMARY

The formation of sulfur trioxide (SO_3) in coal fired boilers varies greatly with boiler design, fuel properties and boiler operating conditions. Some of the SO_3 is formed in the convective pass of the boiler and, for those boilers with SCR reactors, additional amounts are generated in the SCR. This paper describes the status of a project to develop a chemical kinetic model for computing SO_3 formation between the furnace exit plane and the SCR inlet. The model being developed accounts for homogeneous gas phase reactions in the flue gas, catalytic formation on boiler tubes and on fly ash, and depletion of SO_3 by alkali compounds.

Data obtained from pulverized coal boilers show that SO_3 concentrations are affected by boiler operating conditions and also vary quite widely from one boiler to the next. This suggests that in addition to depending on boiler operating parameters such as unit load and excess air level and on fuel sulfur and alkali content, the rate of SO_3 formation also depends strongly on boiler convective pass configuration/thermal profile and deposit formation.

Calculations of SO_3 concentration are being made for a 700 MW boiler which fires a Bituminous coal. Detailed SO_3 measurements are available for that boiler along with data on the boiler operating conditions and fuel and ash properties obtained at the time the SO_3 measurements were made. The calculations are using data on the geometric details of the various heat transfer sections, convective pass temperatures, ultimate analyses of the coal, ash mineral analyses and data on boiler process conditions.

The paper describes the model being used and provides a comparison of the results of the simulations to the SO_3 measurements. One expected outcome of the investigation is a determination of the relative importance of the various SO_3 formation mechanisms and identification of the most appropriate models for calculating SO_3 formation. It is expected this will

lead to ideas for mitigating SO_3 formation via less intrusive approaches than alkali injection, as well as make it possible to predict SO_3 levels for boilers of different designs, fuel properties and operating conditions.

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