Optimized Fuel Injector Design for Maximum In-Furnace NO_x Reduction and Minimum Unburned Carbon

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Abstract

Coal burners/injectors are an integral part of PC-fired facilities and their design plays a crucial role in many of the most cost-effective NO_x control strategies (staged low NO_x burners, reburning, or hybrid approaches such as reburning and SNCR). The effort described in this presentation/paper involves two of these techniques, low NO_x burners and reburning, and focuses on the role of the solids—in particular, the impact of heterogeneous chemistry and two-phase mixing on NO_x formation/reduction and carbon conversion.

The inter-related roles of fluid mechanics and char reactivity have been evaluated experimentally and computationally in an effort to understand their effects on NO_x formation/destruction and carbon burnout. Experiments will be discussed that describe chemistry and mixing phenomena relevant to both coal-fired burners and reburning. In addition, simulations focusing on similar issues in a full-scale boiler environment have been performed using simple and advanced models of char oxidation developed during the course of the program. These results provide insight into the importance of heterogeneous NO_x formation/reduction mechanisms and the importance of the interaction between char reactivity and the temperature/oxygen-concentration history of coal particles. In addition, burner and particle size specific sources of carbon-in-ash can be identified.