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CFD-Based Chemistry Submodels to Design and Optimize Dry Sorbent Injection Systems for Acid Gas Removal

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Most of existing coal-fired boilers in the U.S. have now been installed with dry sorbent injection (DSI) systems to remove acid gases (e.g. SO2, SO3, HCl) for MATS compliance. Utility owners are now looking to optimize these systems to reduce operating costs for long term operations. This paper discusses about an advanced CFD engineering to assist in identifying the optimizing solutions using an advanced chemical kinetic model for reactions between sorbent particles and acid gas species. The chemistry submodel involves mechanisms of simultaneous reactions of SO2, HCl and SO3 with hydrated lime. When coupled with CFD code, the model allows for predicting flue gas flow characteristics and sorbent mixing and dispersion. But more importantly, it can predict gas species reduction level and species distributions under specified operating conditions (including sorbent properties, flue gas conditions, and injection systems), which is very valuable to evaluating DSI injection system design or mixing device. The paper also presents several recent case studies on how this advanced tool has helped in finding the detailed engineering solutions for improved DSI performance for utility boilers.