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# Bench and pilot scale process evaluation of reburning for in-furnace $no_x$ reduction

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This paper describes a combined experimental and theoretical study which was undertaken to quantify the impact of fuel and process parameters on reburning effectiveness and provide the scaling information required for commerical application of reburning under highly varied industrial conditions. Initially parametric screening studies were conducted in a 25 KW refractory-lined tunnel furnace. These studies were supported by large scale testing in a 3.0 MW pilot scale facility. The work at both scales focused on the importance and the fate of the reactive nitrogen species within the reburning zone.

The results of this study confirm the potential of the reburning process for significant $NO_x$ reductions, but they also demonstrate that a constant reburning effectiveness cannot be assumed under all conditions. The $NO_x$ reduction possible through reburning depends primarily on the NO concentration at the end of the primary zone; the stoichiometry, temperature, and residence time in the fuel-rich reburning zone; the

mixing and stoichiometry of the reburning fuel jet; and the temperature in the final burnout zone. At the optimum reburning stoichiometry ($SR_2$=0.9) the exhaust emissions correlate linearly with the sum of the primary $NO_x$ and the equivalent reburning fuel nitrogen. Optimum effectiveness requires adequate primary zone residence time to insure complete combustion of the primary fuel. Reburning zone residence times of at least 400 ms are desirable and high temperatures favor molecular nitrogen formation. Rapid mixing of the reburning fuel enhances the effectiveness of the $NO_x$ destruction process but it can potentially detract from the overall process efficiency with coal reburning due to increased conversion of reburning fuel nitrogen unless the fuel is transported with an essentially inert gas stream. Extremely low exhaust emission levels can be achieved with coal reburning if the final burnout zone can be operated at a temperature low enough to promote in-situ thermal de-$NO_x$.

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