CONFERENCE ON SELECTIVE CATALYTIC AND NON-CATALYTIC REDUCTION FOR NO_X CONTROL

Pittsburgh, PA, May 16-18, 2001

Low Cost NO_x Control with SNCR & Reburn with Liquid & Biomass Fuels

By: Bert Zauderer
Coal Tech Corp., P.O. Box 154, Merion Station, PA 19066

Coal Tech has developed a low cost Selective Non-Catalytic (SNCR) process and a reburn process, which individually or in combination, has reduced nitrogen oxide emissions from excess air combustion of fossil fuels from 40% to over 84%. For utility scale boilers, the estimated installed equipment cost is a few dollars per kilowatt, and the operating cost can be as low as 0.05 cents/kW-hr, or under $200/ton of NO_x removed. The NO_x control equipment can be installed while the boiler is operating. Therefore, the NO_x reduction achievable in a utility boiler can be determined at negligible cost prior to permanent installation. These features are particularly advantageous for use in power plants during the summer ozone control season, or for use in plants that have reached their annual mandated NOx emission ceilings.

The SNCR and reburn processes were developed during an extensive, 3-year, internally financed, test effort in Coal Tech's 20 MMBtu/hour industrial boiler facility. The boiler is fired with a novel, air-cooled, cyclone combustor using gas, liquid and solid fuels. In the present NO_x control tests, primary combustion occurs under excess air conditions inside the combustor. The combustion gases leave the combustor through a transition section, and flow through the water tube boiler to the bag house before exhausting to the stack. The NO_x reducing reagent for the SNCR process and the reburn fuel are introduced in the transition section at locations where the gas temperatures are in a range that favors the NO_x reducing reactions.

The SNCR and reburn test effort was an extension of a previous multi-year test effort in the 20 MMBtu/hour facility on NO_x control with staged combustion, that was partially supported by DOE. In this process, primary combustion of the fuel occurs under fuel rich conditions, and it is followed by final combustion under excess air in the transition section. Using pulverized coal, NO_x emissions at the stack were reduced by up to two-thirds, from initial levels of about 1 lb/MMBtu. With the addition of post-combustion SNCR, NO_x emissions were further reduced at the stack to as little as 0.07 lb/MMBtu.

In Coal Tech's SNCR NO_x process, one or more specially designed injectors introduce an aqueous solution, containing the NO_x reducing reagent, into the post-combustion gases exclusively in the gas temperature zone at which the NO_x reducing reaction is favored. This limits the exhaust of un-reacted reagent to the stack and it limits the formation of compounds that can deposit on boiler surfaces or ash. The SNCR process yielded NO_x reductions of up to 40%, measured at the stack of the 20 MMBtu/hour facility. These test results were duplicated, with the same maximum 40% reduction, in a series of tests on utility boilers, rated at 37 MW, 50 MW and 100 MW.

In Coal Tech's reburn NO_x process specially designed injectors introduce a liquid and, or, a solid fuel into the post-primary combustion zone in an amount sufficient to convert the gas to fuel rich conditions. This reduces the NOx by the same reactions as in staged combustion. Final combustion occurs by mixing the fuel rich gas with additional air. The gas temperature in the reburn injection zone is selected to minimize the formation of thermal NO_x during final combustion.

In the reburn tests in the 20 MMBtu/hour-combustor, the thermal inputs of the reburn fuel ranged from 8% to 41% of the total fuel heat input. It was found that the amount of NO_x reduction was determined by the amount of fuel needed to convert the excess air to fuel rich conditions, and not by the amount of reburn fuel additions. In other words, it is desirable to limit the amount of excess air leaving the primary combustion zone in order to limit the amount of reburn fuel needed. With liquid reburn fuel, NOx reductions as high as 84% were measured at the stack. With solid biomass fuel, NO_x reductions over 50% were measured.

A simple method, similar to the one used for the SNCR process, for evaluating the reburn process with liquid fuel or biomass on utility boilers, without shutdown for installation, has been developed. A fully commercial installation could be installed in a matter of a few weeks.