CONFERENCE ON SELECTIVE CATALYTIC AND NON-CATALYTIC REDUCTION FOR NO_X CONTROL
Pittsburgh, PA, May 16-18, 2001

Low Cost, Combined Post-Combustion NO_x & SO_2 Control in Fossil Fuel Fired Boilers

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

Coal Tech has developed a low cost combined NO_x and SO_2 reduction process in which an aqueous mixture containing the combined reducing reagents is injected in the post-combustion zone of a fossil fuel fired boiler. Tests in an industrial scale, 20 MMBtu/hr boiler yielded over 80% SO_2 and up to 80% NO_x reductions. A Selective Non-Catalytic (SNCR) process reduces the NOx. A heterogeneous reaction with dispersed solid particles reduces the SO_2. For utility scale boilers, the estimated installed equipment cost is several dollars per kilowatt, and the operating cost is estimated at under $200 per ton of NO_x and under $200 per ton of SO_2 removed. The control equipment can be installed while the boiler is operating. Therefore, the NO_x and SO_2 reduction achievable in a utility boiler can be determined at negligible cost prior to permanent installation. These features are particularly advantageous for intermittent use in power plants during peak operating seasons or for continuous operation.

The combined SO_2 and NO_x reduction process was developed during an extensive, 2-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/SO_2 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 and SO_2 reducing reagents are introduced in the transition section at locations where the gas temperatures are in a range that favors both the NO_x and SO_2 reducing reactions.

In Coal Tech's NO_x and SO_2 process, one or more specially designed injectors are used to introduce the aqueous mixture, containing the reducing reagents, into the post-combustion gases. Much of the development effort focused on the preparation, pumping, and injection of the reagent mixture. A key goal was to accomplish this at low cost, which was achieved by utilizing novel components.

To simulate very high sulfur coals, the fossil fuel was co-fired with sulfur to achieve untreated SO_2 emissions as high as 5 lb/MMBtu. The magnitude of SO_2 and NO_x reduction was a function of the gas temperature in the injection zone and the mol ratio of reducing reagent to SO_2 and NO_x. As noted, SO_2 reductions over 80%, and NO_x reductions as high as 80% were achieved in the 20 MMBtu/hour, combustor-boiler.

The combined NO_x and SO_2 reduction process was validated in several brief tests on a 50 MW coal fired utility boiler. All the key components needed for a permanent installation were tested, from the mixing tank at the ground level of the power plant to the reagent injectors high up in the boiler furnace. A peak NO_x reduction of 38% was measured with the combined process. This essentially duplicated the 40% reduction previously obtained in this boiler using only Coal Tech's SNCR process. However, the peak SO_2 reduction was only 20%. This indicated that more injectors are needed to disperse the SO_2 reducing reagent than the NO_x reducing agent in the combustion gas zone of a large boiler. In all other respects the combined process performed satisfactorily. At present this plant meets its emission requirements. Therefore, no additional tests were performed to optimize the number of injectors. Since the plant has suitable, presently unused, mixing tanks, a fully commercial installation of the combined NO_x and SO_2 process could be installed in this plant in a matter of a few days.