NO_x-Oxidant Chemistry in Plumes

The atmospheric chemistry involving oxides of nitrogen in plumes from major fuel burning installations is essentially that described earlier. However, the relatively high concentrations of NO and NO_2 in such plumes compared with those in the ambient urban atmosphere leads to certain chemical phenomena particularly characteristic of plumes. For example, ambient ozone is quickly scavenged in the plume by the large quantities of NO through reaction 23. Because the rate of the NO-O_3 reaction is fast relative to that of dilution of the plume the rate of conversion of NO to NO_2 is controlled by the rate at which ambient O_3 is entrained into the plume by turbulent mixing (Kewley, 1978; Shu et al., 1978; Hegg et al., 1976; White, 1977). There is some nitric acid produced in power plant plumes during the daylight hours through the oxidation of nitric oxide (reaction 20) and the subsequent photodissociation of NO_2 (reaction 21), then followed by the combination of NO_2 with NO_3 and H_2O (reactions 29 and 27). The generation of nitrous acid is also probable since the stack gases will contain NO, NO_2, and H_2O (reaction 32). Since nitrous acid will photodissociate to given hydroxyl radicals (reaction 36), more nitric acid can be produced by reaction 38. Thus, although the free radical concentration is expected to be low in power plant plumes, some NO_x will be converted to nitric acid. In addition, after sufficiently long travel times during which ambient hydrocarbons have been mixed with the plume constituents, the usual free radical reactions described earlier occur, possibly leading to O_3 production.

There are several studies in which measurements have been made of the concentrations of pollutants in power plant plumes (Hegg et al., 1976; White et al., 1976; Davis et al., 1974). The most difficult current problem is predicting the rate at which NO is converted to NO_2 in such a plume.

Computer Simulation of Atmospheric Chemistry

A key problem underlying the development and evaluation of kinetic mechanisms for atmospheric chemistry is determining the sensitivity of the concentration predictions to those uncertain aspects of the reaction scheme.