3.2 Experimental Results

A large number of field investigations have been carried out into the oxidation of sulfur dioxide in urban, industrial and power plant plumes. Since, on the basis of our present understanding of atmospheric chemistry, there is a fundamental difference between urban plumes and those from strong point sources (at least, before the latter have been well-mixed into the "background" air), the two will be considered separately. Also, in view of the suggested importance of latitude when considering winter and summertime differences in photochemical processes (see above), the geographic location of each experiment will be noted whenever possible in the following discussion.

Newman (1980) has recently summarized the available results on atmospheric oxidation of SO_2 from power plant and smelter plume studies. Table 5 is largely based on the most relevant references taken from his paper. In preparing this table, we have concurred with Newman in that some of the early, and often-cited, studies of plume oxidation, such as that by Gartrell et al. (1963) and Stephens and McCaldin (1971), are probably flawed, and the results are unreliable. Rather we have emphasized those particular more recent studies which have a direct bearing on seasonal effects on the plume oxidation rate.

An inspection of Table 5, and the references cited therein, leads to the following general conclusions about the sulfur dioxide oxidation rate in power plant and smelter plumes.

1. The "dry" oxidation rate is usually small--no more than a few percent per hour.

2. Although there is still a debate about the relative importance of homogeneous gas-phase reactions, and heterogeneous processes involving catalytic plume aerosols, most of the evidence suggests the former are important, and can lead to SO_2 transformation rates of up to about 4% h^{-1}. Heterogeneous reactions may dominate near the point of emission where the particle concentration is high, or under high humidity conditions.