

The O_3 reaction rate expression has an additional non-linearity; it is dependent upon the inverse of the H^+ concentration. This causes the reaction to become unimportant as the atmospheric water's pH declines to about 4. This reaction can be as important as the one for H_2O_2 only at pH's greater than about 7, which are unlikely in the eastern U.S. and Canada. The HNO_2 rate expression has a dependence on the inverse squared H^+ concentration, causing it to be unimportant except in unusual circumstances where the HNO_2 concentration is greater than about 10 ppb. This might occur in urban air masses and combustion source plumes during the night. Generally, these reactions are not thought to be significant if H_2O_2 is present in the atmosphere.

The SO_2 catalyzed oxidation rate equations due to Mn(II), Fe(III), and C(O) are presented in Table 4.1. The Mn(II) and C(O) reaction rates are independent of SO_2 concentration, and they depend only on the concentration of the catalyst in the liquid water. So, these acidification reaction rates will not change as the SO_2 concentration is lowered. For this reason, these reactions are non-linear. The Fe(III) catalyzed reaction rate has a first order dependence on SO_2 concentration, but is non-linear since it has an inverse hydrogen ion dependence. Thus, the three most significant catalyzed reactions are non-linear. Their importance in H_2SO_4 formation is not known. While the rate for the Mn(II) reaction is very high, it is not known whether Mn(II) is sufficiently distributed in cloud and raindrops for it to be effective. That is, most of the Mn(II) may be in only a small number of the droplets, making it unavailable for oxidizing large quantities of SO_2 .

Important aqueous phase reactions also include those bases such as ammonia, calcium carbonate and calcium oxide. These basic chemicals react in water to remove H^+ resulting in a decrease in acidity. However, they may also cause an increase in the amount of sulfate formed leading to an increase in the total amount of sulfur wet deposited as sulfate and sulfite.