At a given pH, the rate of reaction decreases in the series pyrophosphate, phosphate, chloride, sulfate, and perchlorate.

Cher and Davidson, 1955 (24) examined the kinetics of the Fe^{+2} - O_2 system in phosphoric acid solution. They observed that the rate law for the Fe^{+2}, O_2 reaction in H_3PO_4 , NaH_2PO_4 solutions (1.0 - 1.1 M) is:

"$-d(Fe^{++})/dt = k(Fe^{++})P_{O2}\ (H_2PO_4-)^2$, where

$k = 4.5\ (\pm 0.3)$ atm $^{-1}$ mole $^{-2}$ liter^2 hr $^{-1}$ at 30°.

The activation energy is 20 (± 2) kcal. There is some heterogeneous reaction on a glass wool surface, but it is believed that the above rate data apply to the homogeneous reaction. There is no inhibition by added Fe^{+++}. A one-electron reaction mechanism with the rate-determining step, $Fe^{++} + O_2 \rightarrow Fe^{+++} + HO_2$, is consistent with the results. The marked catalytic effect of added Cu^{++} can be explained by the reactions (unbalanced with respect to H^+):

$$Fe^{++} + Cu^{++} \underset{k_8}{\overset{k_7}{\rightleftarrows}} Fe^{+++} + Cu^{+} + O_2 \underset{k_{10}}{\overset{k_9}{\rightleftarrows}} Cu^{++} + HO_2;$$

$$HO_2 + Fe^{++} \xrightarrow{k_3} Fe^{+++} + H_2O_2.$$

At 30°, μ = 1 M, (H_2PO_4) = 0.434 F, (H_2PO_4-) = 0.302 F, P_{O2} = 150 mm, $k_7 = 1.0 \times 10^3\ M^{-1}\ hr^{-1}$, $k_9/k_8 = 5.1 \times 10^{-2}$ M atm $^{-1}$, and $k_{10}/k_3 = 23.$"

Stumm and Lee, 1961 (25) report that the rate of ferrous iron in bicarbonate solutions follows the law $-d\left[Fe^{II}\right]/dt = k\left[Fe^{II}\right] P_{O2} \left[OH^-\right]^2$.

Thus, the oxidation of ferrous iron is directly related to the available oxygen, the presence of complexing anions, and the concentration of various catalytic materials, such as Cu^{+2}.

Lamb and Elder, 1931 (26) also report catalytic activity due to platinum black and charcoal.