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Reaction kinetics of non-catalyzed jet aeration oxidation of magnesium sulfite

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Abstract:

Magnesium sulfite oxidation is a key factor influencing the desulfurization efficiency and effluent quality of magnesium desulfurization processes. Non-catalyzed jet aeration is a promising method for the oxidation of magnesium sulfite because of its high gas-liquid mass transfer efficiency. In this work, the reaction kinetics of the jet aeration oxidation of magnesium sulfite were investigated by the two-film theory. The experiments of clean water aeration showed that the oxygen transfer coefficient of jet aeration increased with the liquid flow rate. The results of jet aeration oxidation of magnesium sulfite revealed that the oxidation process could be divided into two stages according to the concentration of magnesium sulfite, i.e., the saturated stage controlled by the oxygen transfer and the unsaturated reaction stage controlled by the oxygen transfer and the sulfite concentration. In the saturated reaction stage, the oxidation rate was found increasing linearly with the increase of the oxygen mass transfer coefficient. The oxidation reaction occurred in the fast reaction regime. In the unsaturated reaction stage, the oxidation reaction rate was 0.62 order in sulfite ion and zero-order in oxygen, whereas the reaction rate constant was found increasing linearly with the oxygen transfer coefficient. The oxidation reaction transited from moderate to slow reaction regime. Results from this work can serve as a useful reference for designing highly efficient jet aeration systems for oxidation of magnesium sulfite.

Keyword: magnesium sulfite, non-catalyzed oxidation, jet aeration, reaction kinetics, two-film theory, oxygen transfer