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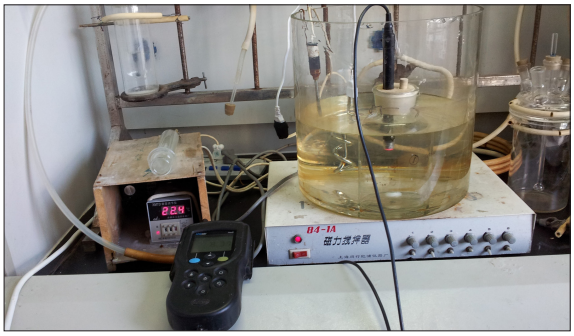
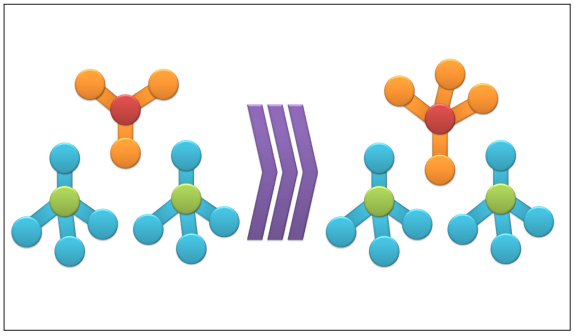
Subject Area	Energie- und Umwelttechnik

The kinetics of ammonium-sulphite oxidation



Experimental set-up for intrinsic reaction

Experimental set-up for macroscopic reaction



Graphical representation of the reaction

Introduction: Wet flue gas desulphurisation is a well-known process in power plants and other industries where flue gas is produced. Different approaches have been taken to reduce the sulphur dioxide (SO_2) ratio in the flue gas. Ammonia is often used for this purpose. In reaction with water, the product is ammonium sulphite. ($NH_3 + H_2O + SO_2 \rightarrow (NH_4)_2SO_3$) Ammonium sulphite is not very stable and therefore is no less dangerous than SO_2. Consequently, attempts have been made to oxidise it to the less hazardous ammonium sulphate. ($2(NH_4)_2SO_3 + O_2 = 2(NH_4)_2SO_4$) Researchers at the East China University of Science and Technology (ECUST) in Shanghai are interested in the kinetics of this oxidation process, using different catalysts. Various parameters which affect the kinetics of the reaction have been investigated, such as temperature, pressure, concentration, air-flow, pH-Level and so forth. As for catalysts, we tested Co^{2+}, Mn^{2+}, Fe^{2+}, Zn^{2+} and Fe^{3+}.

Approach/Technologies: The experiments were divided into two sets. The first set was an "intrinsic reaction" where the ammonium sulphite was put in solution with purified oxygen-saturated water which provided oxygen for the reaction. As the oxidation progressed, the residual amount of oxygen in the reaction vessel was measured with an oxygen-sensitive electrode. Different catalysts and parameters were applied. The second set of experiments involved a "macroscopic reaction". The ammonium sulphite was again put in solution with purified water, but this time oxygen (air) was continuously bubbled into the solution. The concentration of sulphate SO_4^{-2} was measured in order to calculate the oxidation rate of the ammonium sulphite.

Result: Fe^{2+} had been identified to be the most efficient catalyst for accelerating the kinetics of ammonium-sulphite oxidation and a model describing the kinetics of this process was developed.