

ABSORPTION OF CHLORINE AND MERCURY IN SULFITE SOLUTIONS

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The rate of chlorine absorption into aqueous sulfite/bisulfite, S(IV), was measured using a stirred cell reactor and a wetted wall column. Simultaneous absorption of Hg and Cl₂ in S(IV) solutions was also measured in the wetted wall column. The solution contained 0 to 10 mM S(IV) with pH ranging from 4.5 to 6. Experiments were performed at ambient temperature and pressure using 5 to 300 ppm Cl₂ and 46 ppb Hg. Absorption was modeled using the theory of mass transfer with chemical reaction. The rate constants for the Cl₂/S(IV) and Hg/Cl₂ reactions were determined to be 1.1×10^9 and 6.1×10^9 L/mol-s, respectively.

At the gas/liquid interface, chlorine reacts with S(IV) to form chloride and sulfate, and Hg is oxidized by Cl₂ to a more soluble form of Hg. The enhancement of the chlorine hydrolysis rate by the succinate buffer was quantified. Oxidants, such as HgCl₂ and NaOCl, enhances Hg absorption. The addition of chloride had no effect on the Hg/Cl₂/S(IV) reaction rates. However, chloride did suppress chlorine hydrolysis and significantly enhanced Hg absorption with Cl₂, when no S(IV) was present. Possible reaction pathways are discussed.

These results are relevant in the simultaneous removal of Cl₂, SO₂, and Hg from flue gas. A model was developed to predict the expected Hg removal in a limestone slurry scrubber. Mercury removal decreases with increasing SO₂/S(IV). However, with low S(IV), the Cl₂ exiting the scrubber is greater. Thus, the process feasibility depends on the amount Hg and Cl₂ which can be tolerated.

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