Reduction of hexavalent chromium using zerovalent iron spheres packed in a rotating basket reactor: kinetic and mass transfer study

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**ABSTRACT**

Kinetics of hexavalent chromium reduction to trivalent chromium onto iron spheres, packed in a rotating basket reactor was investigated under different conditions, such as H₂SO₄ acid concentration, basket rotational speed, sphere diameter, and solution temperature. The rate of Cr(VI) reduction was found to increase with increasing basket rotational speed, H⁺ ions concentration, and temperature. On the other hand the rate decreases with increasing the diameter of iron spheres. The activation energy was found to be 4.9 kcal/mol which confirm the diffusion controlled nature of the reaction. The thermodynamic parameters for the present study were calculated at 25°C and was found to be 17.99 kJ mol⁻¹, 278.98 J mol⁻¹ K⁻¹, and 103.6 kJ mol⁻¹ for ΔH, −ΔS, and ΔG, respectively. Rate of Cr(VI) reduction expressed in terms of the rate of mass transfer was correlated to the controlling parameters by the dimensionless equation

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Sh = 0.3463 \, Re^{0.55} \, Sc^{0.33}
\]

The present mass transfer data was found to agree with the surface renewal theory.

Keywords: Hexavalent chromium; Reduction; Packed basket; Iron spheres; Kinetics; Mass transfer; Thermodynamic; Rotating reactor