Modeling the impacts of corrosion product formation on simultaneous sorption and reductive dehalogenation of organochlorine pesticide aldrin by high carbon iron filings (HCIF)

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**ABSTRACT**

The extensive use of organochlorine pesticides and their persistence in the environment has led to it becoming a major contaminant in the ground water and soil. This study concerns the interaction of organochlorine pesticide, aldrin, with high carbon iron filings (HCIF) and the impact of rusting on the performance of HCIF. Two types of HCIF were investigated: fresh (with no oxide coating) and rusted (with Fe(II)/Fe(III) oxide coatings). Substantial partitioning of aqueous-phase aldrin to the fresh HCIF surface was observed and the residual aqueous aldrin underwent slow reductive dehalogenation due to interaction with metallic iron. The overall rate of change of total aldrin concentration with time, i.e. \( \frac{dC_t}{dt} \), can be expressed as a function of aqueous concentration \( C_a \) as \( -k_1 M \left( C_a \right)^n \), where \( M \) is the concentration of HCIF. The values of \( k_1 \) and \( n \) were determined to be \( 3.45 \times 10^{-3} \) h\(^{-1}\) g\(^{-1}\) iron L\(^{-1}\) and 3.115 for fresh, and \( 7.73 \times 10^{-3} \) h\(^{-1}\) g\(^{-1}\) iron L\(^{-1}\) and 2.572 for rusted HCIF, respectively. Equilibrium partitioning of aldrin between aqueous and solid phases in both the cases was described by Freundlich isotherm, \( C_s = K \left( C_a \right)^m \), where \( m \) (1.485 fresh; 0.6985 rusted) and \( K \) (1.5 \times 10^{-2} for fresh and 9.01 \times 10^{-4} for rusted) were determined. Assuming desorption rate constants as 1 for fresh and 0.1 for rusted, the expressions developed for describing the evolution of \( C_s \) and \( C_a \) with time resulted in an adequate model fit to the experimental data. The rusting of HCIF decreased adsorption and reductive dehalogenation reactions, and was supported by X-ray diffraction, scanning electron microscopy, and energy dispersive X-ray spectroscopy data. The changes in the rate of reductive dehalogenation and adsorption of aldrin due to formation of iron oxides on the HCIF surface were observed in the present study.

**Keywords:** High carbon iron fillings; Aldrin; Iron oxide coating; Reductive dehalogenation; Sorption

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