

Removal of phenoxy herbicides from aqueous solutions using lignite as a low-cost adsorbent

Krzysztof Kuśmierek^a, Lidia Dąbek^{b,*}, Andrzej Świątkowski^a

^a*Institute of Chemistry, Military University of Technology, Warsaw, Poland, emails: krzysztof.kusmierek@wat.edu.pl (K. Kuśmierek), andrzej.swiatkowski@wat.edu.pl (A. Świątkowski)*

^b*Faculty of Environmental Engineering, Geomatics and Energy Engineering, Kielce University of Technology, Kielce, Poland, email: lidiadabek@wp.pl*

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ABSTRACT

This work aims to evaluate the potential of raw lignite as a low-cost adsorbent material for the removal of phenoxy herbicides including phenoxyacetic acid (PAA), 4-chlorophenoxyacetic acid (4-CPA), 2,4-dichlorophenoxyacetic acid (2,4-D), and 4-chloro-2-methylphenoxyacetic acid (MCPA) from aqueous solutions. Batch adsorption experiments at different operating parameters such as pH and ionic strength were carried out, and the results revealed that adsorption of the herbicides was strongly pH- and ionic strength dependent. The adsorption kinetics was fitted with the pseudo-first-order and pseudo-second-order models, while adsorption equilibrium data were fitted using Langmuir, Freundlich, and Langmuir–Freundlich isotherm equations. The obtained data obeyed the pseudo-second-order kinetic and Freundlich isotherm type. Adsorption efficiency of the herbicides increased in the order PAA < 4-CPA < 2,4-D < MCPA and the monolayer adsorption capacities were 20.53, 27.10, 35.21, and 37.04 $\mu\text{mol/g}$, respectively. The results showed that the raw lignite may be used as an effective low-cost adsorbent without any treatment or any other modification for the removal of phenoxy herbicides from the aqueous solutions.

Keywords: Adsorption; 2,4-Dichlorophenoxyacetic acid; 4-Chloro-2-methylphenoxyacetic acid; Phenoxy herbicides; Low-cost adsorbent; Lignite

* Corresponding author.