



Effect of H_3PO_4 oxidation of corn cob biochar on the adsorption of a commercial glyphosate formulation

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ABSTRACT

The adsorption of commercial glyphosate on biochar (BC) and oxidized biochar (BCox) from corn cob was studied thoroughly to characterize in detail the behavior of these adsorbent materials. Kinetic, isothermal and thermodynamic tests were performed in both materials using Brunauer–Emmett–Teller surface area analysis, accelerated surface area and porosimetry, Fourier-transform infrared spectroscopy, Barrett–Joyner–Halenda pore size and volume analysis, X-ray diffraction and scanning electron microscopy techniques. Adsorption equilibrium occurred in 60 min with an adsorption capacity of $0.58 \text{ mg}\cdot\text{g}^{-1}$ (22.3%) for BC and $1.49 \text{ mg}\cdot\text{g}^{-1}$ (53.2%) for BCox, with the latter showing a higher adsorption rate in the initial stage, reaching a 44% removal in the first 5 min, while in the case of BC, the removal was 5%. The pseudo-first-order kinetic model better adjusted to both adsorbents, although in the case of oxidized biochar, the Avrami model suggested that adsorption can also occur according to the pseudo-second-order model. Experimental data fitted in Langmuir and Freundlich isotherms revealed a more accurate fitting with the Freundlich model. The thermodynamic analysis showed that the adsorption of glyphosate was an endothermic and nonspontaneous phenomenon in this study. Acid oxidation with H_3PO_4 produced smaller pores and caused the collapse of the porous structure of the adsorbent. The results also showed that although acid oxidation enhanced the adsorption of commercial glyphosate, the values were considered low when compared with those obtained for pure compounds presented in the literature.

Keywords: Acid oxidation; Herbicide; Adsorbent materials

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