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Tetracycline adsorption on steam alternative activated carbon: kinetic and thermodynamic parameters

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ABSTRACT

Water pollution by emerging pollutants, such as antibiotics like tetracycline (TC), is a worldwide environmental problem. To eliminate TC from water, the present study used an advanced water treatment technology (sorption) that has shown a very good relation between cost and effectiveness. To develop a sustainable and cheap activated carbon with acceptable sorption capacity for TC removal, it was proved a friendly environmental activation by using an agricultural waste like alternative precursor: pecan nut shells and water-like activating agent. Four different materials were used for the sorption test: pecan nut shell carbonised and water activated (NAC-850), commercial activated carbon as reference (GAC), and both materials were modified with citric acid (NAC-850-mod and GAC-mod). All the materials were characterised by S_{BET}, scanning electron microscopy, energy-dispersive X-ray and Fourier transform infrared. It was calculated that the sorption equilibrium time for the TC, kinetic parameters for pseudo-first-order, pseudo-second-order and Elovich models; the sorption isotherms for Langmuir, Freundlich and Temkin and thermodynamic parameters (ΔH, ΔS, ΔG and Ea) also were applied. It evaluated the effect of pH and temperature and the presence of competitive ions in the aqueous media. The prepared activated carbons that showed the best sorption capacity were those that followed a citric acid activation. The kinetics experiments fitted to pseudo-second-order equation and to isotherm Freundlich model. The efficiency to remove the TC increased with the modification of the surface with citric acid between 5% and 11%. The activation/modification method applied is simple and economical and improves the TC sorption capacity that is equivalent to the removal efficiencies of commercial activated carbons.

Keywords: Activated carbon; Adsorption; Citric acid; Pecan nut shells; Tetracycline

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