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Adsorption characteristics of antibiotics trimethoprim by activated carbon developed from low-cost alligator weed: kinetics, equilibrium and thermodynamic analyses

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ABSTRACT

Low-cost activated carbon was prepared from alligator weed by phosphoric acid activation and employed for the removal of trimethoprim (TMP) from aqueous solutions. The activated carbon content in the alligator weed-activated carbon (AWAC) was 55.38%. Scanning electron microscopy showed that AWAC features a rough surface with highly porous structures consisting of micropores and mesopores. The AWAC had a high surface area of 752.6 m^2/g and an average pore size of 5.80 nm, which were responsible for its favorable adsorption ability. The AWAC adsorbed ~92% of a 60 mg/L TMP solution. The maximum TMP adsorption capacity was about ~125 mg/g at 298 K. The TMP sorption kinetic data fitted well to the pseudo-second-order kinetic equation (R^2 = 1). The Freundlich isotherm gave the best correlation (R^2 = 0.9950) with the experimental data at 303 K, indicating multimolecular layer adsorption. Thermodynamics studies revealed that the adsorption process is spontaneous and exothermic. Fourier transform infrared spectroscopy revealed the presence of the AWAC surface functional groups, such as C–H, C–O and C–C moieties. The intensity of the spectral peaks of AWAC decreased after adsorption, owing to reaction of the functional groups with TMP.

Keywords: Alligator weed; Activated carbon; Adsorption; Trimethoprim

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