Coal-based granular activated carbon loaded with MnO₂ as an efficient adsorbent for removing formaldehyde from aqueous solution

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ABSTRACT

In this study, coal-based granular activated carbon loaded with MnO₂ (ACLM) was tested as adsorbent for the removal of formaldehyde from aqueous solution. The ACLM was characterized by scanning electron microscopy, energy dispersive X-ray spectrometry, Brunauer–Emmett–Teller, and Fourier transform infrared spectra. The optimized pH of formaldehyde adsorption was 7.0. The removal percentage increased from 21.8 to 72.1% by raising the ACLM dosage from 0.1 to 1.0 g. The formaldehyde adsorption rate increased a little at initial formaldehyde concentrations from 0.6 to 1.8 mg/L. The adsorption equilibrium time was 24 h. The adsorption rate of formaldehyde increased from 58.1 to 61.2% with temperature rising from 298 to 308 K and decreased from 61.2 to 54.0% when temperature from 308 to 318 K. Isotherm modeling revealed that Langmuir equation could better describe the adsorption of formaldehyde onto the ACLM and the maximum adsorption capacity obtained was 4.53 mg/g. Kinetic data efficiently fitted with the pseudo-second order. The decrease of ΔG˚ from 298 to 308 K suggested more favorable of formaldehyde adsorption onto the ACLM and increase of ΔG˚ from 308 to 318 K revealed that the sorption was more unfavorable. Results from this study suggest that ACLM is an effective adsorbent for the removal of formaldehyde from aqueous solution in drinking water treatment field.

Keywords: Coal-based granular activated carbon loaded with MnO₂; Formaldehyde; Aqueous solution; Adsorption; Isotherm; Kinetic; Thermodynamic

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