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Remediation of manganese in mine impacted water by clay/ manganese oxide hybrid adsorbent: equilibrium, kinetics and thermodynamic studies

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ABSTRACT:

The present study investigated the potential of clay/manganese oxide (CMnO) hybrid adsorbent for the removal of manganese (Mn^{2+}) from mine impacted water (MIW). The adsorbent was characterised by X-ray diffraction, Fourier transform infra-red (FT-IR), scanning electron microscopy (SEM), Brunauer–Emmet–Teller and X-ray photoelectron spectroscopy (XPS) techniques. The equilibrium sorption capacity was depended on solution pH, MnO content of the clay, concentration and temperature. Isothermal adsorption highly inclined towards Freundlich isotherm model while thermodynamic parameters directed that the adsorption process was spontaneous and endothermic in nature. The adsorption kinetics of Mn^{2+} onto CMnO fitted well with the pseudo-second-order model and the value of activation energy of adsorption (E_a) was 32 kJ/mol, inferring that the adsorption proceeded by activated chemisorption process. Both intra-particle and film diffusion mechanisms were found to be the sorption rate-controlling steps. Experiments with real MIW water revealed that CMnO exhibited high Mn^{2+} removal efficiency in the presence of interfering ions but anions removal posed a great challenge. The XPS, FT-IR and pH analyses suggested that oxidation, complexation and ion-exchange mechanisms were responsible for Mn^{2+} removal by CMnO. These

findings demonstrate that CMnO could serve as an inexpensive adsorbent for polishing Mn^{2+} polluted water.