Adsorptive removal of phenol from aqueous solutions and coking wastewater by coke produced from hard and soft coking coals

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Received 21 April 2017; Accepted 7 August 2017

\textbf{Abstract}

A series of coke samples were prepared by carbonization of different blending of hard and soft coking coals, characterized by different physicochemical methods and a selected sample was used for adsorptive removal of phenol from its aqueous solutions as well as effluent of coke oven plant. The solution pH influenced the phenol adsorption showing highest adsorption in the pH range 4–6. Langmuir, Freundlich and Temkin isotherm models were used to express the sorption phenomena. Both Langmuir and Freundlich isotherm model fitted well to adsorption giving maximum adsorption capacity of 2.1 mg/g. The pseudo-first-order, pseudo-second-order kinetic and intraparticle diffusion models were used to analyze the kinetic data of phenol adsorption. Although pseudo-second-order equation was best fitted in terms of $R^2$ value, the large difference between the theoretically calculated and experimental amount of phenol adsorbed on coke (mg/g) supported the pseudo-first-order kinetics. Efficiency of the selected sample was also tested for phenol removal from coke oven plant effluent of Neelachal Ispat Nigam Limited containing phenol (307 mg/L), CN$^-$ (13 mg/L), NH$_4^+$ (285 mg/L), P (20.39 mg/L), chemical oxygen demand (2,850 mg/L). Under optimized conditions, 95% of the phenol was removed along with substantial amount of other contaminants.

\textbf{Keywords}: Adsorption; Kinetics; Activated charcoal; Phenol; Water treatment