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Adsorption of distillery spent wash on activated bagasse fly ash: Kinetics and thermodynamics

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Abstract

This study aimed to characterize distillery spent wash and COD removal from it using bagasse fly ash (BFA). The results of the analyses showed that the average value of BOD_5 and COD were 35990 mgL^{-1} and 139671 mgL^{-1}, respectively. High amount of total nitrogen (1217 mgL^{-1}), total phosphorous (45 mgL^{-1}), total solids (156 mgL^{-1}) and low acidity (pH 4) were recorded. Adsorption of this spent wash on BFA was investigated at different temperatures, contact times, initial COD concentrations, pH solutions and adsorbent (BFA) doses. Raising temperature from 15 to 328 K resulted in increasing the uptake of the organic matter from 29.5 to 75.5 %. Varying the initial COD concentration from 1000 mgL^{-1} to 6000 mgL^{-1} increased the adsorptivity capacity (q_e) from 6 to 92.40 mg g^{-1} and resulted in an increase in removal efficiency from 24 to 61.6 %. Adsorptive capacity (116.30 mg g^{-1}) calculated by the pseudo-second order model (R^2 = 0.98) indicated that pseudo-second order kinetic model fitted better with the experimental data. Moreover, the Gibbs free energy change (ΔG) (-5.61 to -11.84 kJ mol^{-1})) showed that adsorption process was spontaneous whereas the positive value of the ΔH (42.29 kJ mol^{-1}) indicates an endothermic process. Similarly, increasing the degree of disorder at the liquid-solids interfaces was observed from entropy change (ΔS = 0.17 kJ $(Kmol)^{-1}$). In general, thermodynamic study