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Removal of Methylene Blue from Aqueous Solution by Adsorption onto Untreated Coffee Grounds

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Abstract : Introduction: Water contamination caused by dye industries, including food, leather, textile, plastic, cosmetics, paper-making, printing and dye synthesis, has caused more and more attention, since most dyes are harmful to human being and environments. Untreated coffee grounds were used as a high-efficiency adsorbent for the removal of a cationic dye (methylene blue, MB) from aqueous solution. Characterization of the adsorbent was performed using several techniques such as SEM, surface area (BET), FTIR and pH zero charge. The effects of contact time, adsorbent dose, initial solution pH and initial concentration were systematically investigated. Results showed the adsorption kinetics followed the pseudo-second-order kinetic model. Langmuir isotherm model is in good agreement with the experimental data as compared to Freundlich and D–R models. The maximum adsorption capacity was found equal to 52.63mg/g. In addition, the possible adsorption mechanism was also proposed based on the experimental results. Experimental: The adsorption experiments were carried out in batch at room temperature. A given mass of adsorbent was added to methylene blue (MB) solution and the entirety was agitated during a certain time. The samples were carried out at quite time intervals. The concentrations of MB left in supernatant solutions after different time intervals were determined using a UV–vis spectrophotometer. The amount of MB adsorbed per unit mass of coffee grounds (qt) and the dye removal efficiency (R %) were evaluated. Results and Discussion: Some chemical and physical characteristics of coffee grounds are presented and the morphological analysis of the adsorbent was also studied. Conclusions: The good capacity of untreated coffee grounds to remove MB from aqueous solution was demonstrated in this study, highlighting its potential for effluent treatment processes. The kinetic experiments show that the adsorption is rapid and maximum adsorption capacities qmax= 52.63mg/g achieved in 30min. The adsorption process is a function of the adsorbent concentration, pH and metal ion concentration. The optimal parameters found are adsorbent dose m=5g, pH=5 and ambient temperature. FTIR spectra showed that the principal functional sites taking part in the sorption process included carboxyl and hydroxyl groups.

Keywords : adsorption, methylene blue, coffee grounds, kinetic study
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