Cured NaOH-Etched Heated Clay-Cellulose Composites:Characterization, Dye Adsorption, and Desorption Study UsingResponse Surface MethodologyAbdellah Mourak Mohamed Hajjaji Abdelhakim Alagui

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***Abstract***

Water contamination by dyeing chemicals has become a worldwide problem. Adsorption by using low-cost adsorbents has been considered as an appropriate and economical method for water remediation. So, the process of the dye adsorption by cured alkali-activated heated clay-cellulose (up to 10 mass%) composites was investigated within the 288–318 K range using methylene blue (MB) as a dye-adsorbate model. For this purpose, X-ray diffraction, Fourier-transform infrared spectroscopy, and scanning electron microscope were used. Moreover, the effects of adsorbent dosage, solution pH, contact time and temperature were assessed. Additionally, the dye release in different experimental conditions was studied by using the response surface methodology. It was shown that the composites were the object of formation of zeolites and geopolymers. The use of low adsorbent dosage (0.5 mg/L) and pH > 7 improved MB adsorption. The adsorption occurred spontaneously (G° < – 35 kJ/mol) and endothermically (0 < H° < 12 kJ/mol). The desorption efficiency of the cellulose-rich adsorbent increased with the increase of pH or T, and with the decrease of the ionic strength. It did not exceed 50% in the optimal experimental conditions. The MB retention took place mainly by pores filling, and its rate was controlled by diffusion. MB was adsorbed as monomer, dimer and H-aggregates. Siloxane groups together with hydroxyls were the main active adsorption sites. The adsorption capacity (about 31 mg/g) was higher than those reported for some low-cost adsorbents. The adsorption cost was in the range of 0.19–0.20 US$/g of MB removed.

***Keywords:*** Zeolites · Geopolymers · Cellulose · Dye · Retention · Doehlert designs