Hexavalent Chromium Removal from Contaminated Water by Humic Acid-Coated Metakaolin

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Kaolinite is an abundant and low-cost clay mineral that can be used as an adsorbent to remove hexavalent chromium (Cr(VI)) from water. The purpose of this research was to modify the heat-treated kaolinite (metakaolin) with humic acid to produce an effective adsorbent for Cr(VI) removal from wastewaters. The Meetiyagoda raw kaolin was purified and characterized using X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), and Raman spectroscopy. Strings were prepared from purified kaolin and heated at 400 ºC, 600 ºC, and 800 ºC, respectively. The XRD, FTIR, and Raman spectroscopic analysis conducted on heated kaolin strings revealed that metakaolin is formed at 600 ºC and 800 ºC. In comparison to metakaolin, raw kaolin is easily dispersed in water due to its low physical stability. Based on the adsorption study, physically stable metakaolin produced at 600 ºC and 800 ºC were selected for surface coating with humic acid (HA) and then characterized by FTIR. Isothermal studies for Cr(VI) removal under optimum pH, adsorbent dosage, and contact time were carried out on HA + 800 ºC metakaolin based on information collected from the adsorption study. The maximum Cr (VI) removal was observed in HA + 800 ºC metakaolin treated water 43.39 ± 2.90% compared to raw kaolin 65.18 ± 4.43%. Adsorption data were well-fitted to the nonlinear Langmuir isotherm. The maximum adsorption capacity of raw kaolin and HA+800 ºC metakaolin were 0.25 ± 0.02 and 0.24 ± 0.03 mg/g, respectively at an equilibrium dosage of 15 g/L, equilibrium time of 4 hrs, and pH of 2. Even though the adsorption capacity results were similar, humic acid-coated metakaolin is a more effective adsorbent than raw kaolin for the removal of Cr(VI) from wastewaters in industrial applications due to its physical stability in water.

Keywords: 1:1 clay mineral, Humic acid, Potentially toxic element, Metakaolin

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