The Effect of Spent Coffee Grounds on the Multicyclic Adsorption of Lead

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Heavy metal water pollution is a growing concern worldwide due to the ongoing operations of battery manufacturing, paint/pigment production, glass industries, etc. Current methods of heavy metal removal from the water are extremely costly, therefore it is crucial to find more economical alternatives for metal removal from wastewaters. The objective of this research was to determine the effects of sodium hydroxide-treated spent coffee grounds and untreated spent coffee grounds on their ability to adsorb lead after multiple cycles of adsorption and desorption and it was hypothesized that the treated coffee grounds would display a higher lead adsorption percentage than the untreated coffee grounds. The spent coffee grounds adsorbed lead from a lead nitrate solution for two hours, which was then desorbed using EDTA for two hours for three cycles. The results revealed that the sodium hydroxide-treated coffee grounds produced a 3.96% higher adsorption percentage in the first cycle, 2.96% higher adsorption percentage in the second cycle, and a 1.32% higher adsorption percentage in the third cycle. A t-test was completed at $\alpha = 0.05$ and revealed the data in each cycle to be statistically significant. It is believed the results of the experiment occurred mainly due to an ion exchange mechanism between the cationic lead and the anionic surface of the spent coffee grounds, which consists of numerous functional groups of organic compounds. From the results of this experiment, it can be supported that spent coffee grounds are an effective low-cost alternative to traditional methods of water filtration.