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Performance of Reactivated Carbon Nanotubes in Adsorbing Cadmium from Aqueous Solution

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This study was intended to determine the optimum desorption condition to reactivate exhausted cadmium loaded carbon nanotubes (CNTs) for re-adsorption of the same metal cadmium (Cd). The desorption of cadmium ions (Cd^{2+}) by batch mode laboratory experiments was investigated for hydrochloric and nitric acids, where the former gave better desorption compared to the other acid. Initial experiments revealed that hydrochloric acid (HCl) was better than nitric acid (HNO_3) for the desorption of Cd^{2+} from the CNTs. Optimization study was conducted by design expert software using various molarities of HCl, which resulted in pH of 1.39 (0.1 M), pH 2.43 (0.01 M) and pH 3.53 (0.005 M). Contact time of 20, 50, 80, 110 and 140 minutes were used with fixed agitation of 200 rpm to study the effect of time on the desorption process. Statistical model was developed for the optimum desorption process, which provided a regression model with R^2 value of 0.987. The desorbed CNTs were washed with deionized water to remove residual acids and then dried for re-adsorption process. The re-adsorption capacity of cadmium was also determined by batch mode experiments. This study revealed that pH and contact time influenced the desorption and re-adsorption capacity of the CNTs. The optimum condition for desorption was pH 1.39 (0.1 M) hydrochloric acid for 50 minutes agitation. This study also revealed that with this optimum condition, three (3) cycles of desorption process was necessary to remove all cadmium ion from the used CNTs. Re-adsorption capacity of the CNTs, after 3 cycles, was reduced from 8.28 mg/g to 4.23 mg/g. This indicated that about 50% of the adsorption capacity of the CNTs were destroyed or reduced due to the desorption process. Such reduction can also be linked to the destruction of the active sites of the CNT adsorbents.

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