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Adsorption of light green anionic dye from solution using polyethyleneimine-modified carbon nanotubes in batch mode

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ABSTRACT

Polyethyleneimine (PEI)-functionalized carboxylated multi-walled carbon nanotubes (MWCNTs) were used as an adsorbent (PEI-CNTs) to adsorb light green (LG) dyes (anionic dye) from solution. The structure and morphology of PEI-CNTs was characterized by transmission electron microscope, Fourier-transform infrared (FTIR) spectroscopy, Raman spectroscopy, and X-ray photoelectron spectroscopy (XPS). FTIR and XPS results showed that PEI was successfully loaded on MWCNTs. Raman analysis showed that the basic structure of MWCNTs did not change after the modification of PEI. The effects of pH and coexisting ions on the adsorption properties were studied. Batch adsorption and kinetic studies showed that the PEI-CNTs nanocomposite materials were efficient to remove LG from solution. The optimum condition for adsorption was pH 3. The adsorption of LG solution reached equilibrium within 5 h of contact time with a removal of 97%. Adsorption quantity was 469 $mg \cdot g^{-1}$ at 293 K. Adsorption equilibrium data can be predicted by Langmuir model and Koble–Corrigan model, while the kinetic adsorption data followed pseudo-second-order model. The thermodynamic results showed that the adsorption was a spontaneous process with endothermic reaction and entropy increasing. LG-loaded adsorbent can be regenerated using 0.010 $mol \cdot L^{-1}$ of NaOH solution.

Keywords: PEI-CNTs; Adsorption; Light green; Regeneration

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