Journal of Molecular Liquids

High-performance towards removal of toxic hexavalent chromium from aqueous solution using graphene oxide-alpha cyclodextrin-polypyrrole nanocomposites

Vongani P. Chauke [a], Arjun Maity [b,c,], Avashnee Chetty [a]

[a] Polymers and Composites, Council for Scientific and Industrial Research (CSIR), Pretoria, South Africa
[b] DST/CSIR National Centre for Nanostructured Materials, Council for Scientific and Industrial Research, Pretoria, South Africa
[c] Department of Applied Chemistry, University of Johannesburg, South Africa

Abstract

Graphene oxide (GO) was functionalized with alpha cyclodextrin (aCD) through a covalent bond to form GO-aCD nanocomposites (NC). GO-aCD NC was further modified with polypyrrole (PPY) to afford an advanced GO-aCD-PPY NC for the removal of highly toxic Cr(VI) from water. The prepared GO-aCD-PPY NCs were successfully characterised with AT-FTIR, FE-SEM, HR-TEM, BET and XRD techniques. Adsorption experiments were performed in batch mode to determine optimum conditions that include temperature, pH, concentration of Cr(VI) and contact time. It was deduced from the experiments that the adsorption of Cr(VI) by the GO-aCD-PPY NC is pH and temperature dependent, where optimum adsorption was achieved at pH 2 and it increased with increasing temperature. The adsorption kinetics followed the pseudo-second-order model and the adsorption isotherms fitted well to the Langmuir isotherm model with maximum adsorption capacities ranging from 606.06 to 666.67 mg/g. Effect of co-existing ions studies revealed that cations and anions had no significant effect on the adsorption of Cr(VI). Desorption studies also illustrated that the NC can be re-used up to 3 cycles.