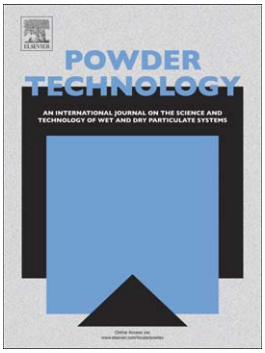

Engineered nano-zirconium oxide-crosslinked-nanolayer of carboxymethyl cellulose for speciation and adsorptive removal of Cr(III) and Cr(VI)

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Engineered nano-zirconium oxide-crosslinked- nanolayer of carboxymethyl cellulose for speciation and adsorptive removal of Cr(III) and Cr(VI)

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Abstract

A novel nanosorbent is designed via crosslinking of nanolayer carboxymethyl cellulose (CMC) onto the surface of nano-zirconium oxide (Nano-ZrO_2) using glutaraldehyde for the formation of Nano-ZrO_2-glu-CMC. The nanosorbents were characterized using TGA, SEM, HR-TEM, FT-IR and surface area analysis. The particle size of Nano-ZrO_2-glu-CMC was 22-39 nm. The potential implementation of Nano-ZrO_2-glu-CMC sorbent for selective speciation and extraction of chromium ions from real water samples and aqueous solutions was explored and compared versus Nano-ZrO_2 sorbent using the batch technique in presence of various values of pH, time, mass of sorbent, concentration and competing ions. The maximum metal capacity values of chromium (VI) by Nano-ZrO_2-glu-CMC and Nano-ZrO_2 were identified as 680 and 120 µmol g^{-1}, respectively in pH 1.0-2.0, while the identified maximum values of chromium (III) were 1120 and 500 µmol g^{-1}, respectively in pH 7.0. Nano-ZrO_2-glu-CMC and Nano-ZrO_2 sorbents were further successfully applied for speciation of Cr(VI) and Cr(III) as well as adsorptive removal from tap water, sea water and industrial wastewater samples adjusted to pH 7.0 and 2.0, respectively. The identified percentage values of chromium species by the multistage microcolumn technique confirmed the superiority of ZrO_2-glu-CMC versus Nano-ZrO_2 based on the determined recovery range 97.9-100.0% and 89.6-100.0%, respectively.

Keywords: Zirconium oxide, Carboxymethyl cellulose, Glutaraldehyde, Chromium speciation, Adsorption.