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Synthesis and characterization of a novel hybrid material as amphoteric ion exchanger for simultaneous removal of cations and anions

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Abstract

A new hybrid chelating ion exchanger zirconium diethylene triamine (ZrD) has been synthesized by a simple sol–gel route using inexpensive and easily available chemicals. ZrD has been characterized for elemental analysis (ICP-AES, CHN analysis), TGA, FTIR, X-ray diffraction, SEM and EDX. Physical and ion exchange characteristics as well as chemical stability of the material in various media have been studied. Structural determination reveals that ZrD exhibits amphoteric character. Anion exchange capacity (AEC) for Cl^-, Br^-, $Cr_2O_7^{2-}$, F^- and AsO_4^{3-} has been determined. Cations are exchanged through chelation where coordinating sites are offered by nitrogen atoms present in the amine groups of ZrD. Distribution coefficient K_d for Co^{2+}, Ni^{2+}, Cu^{2+}, Zn^{2+} (transition metal ions) and Hg^{2+}, Cd^{2+}, Pb^{2+} (heavy metal ions) has been evaluated by batch equilibration techniques in aqueous and various electrolyte media/concentrations. Based on α the separation factor, a few binary separations have been performed on a chromatographic column packed with ZrD. The amphoteric behaviour of ZrD has been demonstrated by simultaneous exchange of Cu^{2+} and Cl^- in $CuCl_2$. A study on the regeneration and reuse of ZrD indicates that it is effective upto four cycles without much decline in performance.

Keywords: Amphoteric Exchangers**;** Chelating Exchangers**;** Hybrid Exchangers**;** Inorgano-organic Hybrid Exchangers

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