Thesis Abstract

STUDIES ON SYNTHETIC ION EXCHANGERS AND THEIR APPLICATIONS IN THE ANALYSIS OF INDUSTRIAL EFFLUENT

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The first chapter gives the general introduction of the earlier work related to the topic. A critical review of synthetic organic ion exchangers and inorganic ion exchangers with their applications in different fields is given. The literature survey up-to-date consulted through available journals. A part of it is presented in the tabular forms for the purpose of comparisons.

The second chapter describes the Synthesis, characterization and ion-exchange properties of a new and novel 'organic-inorganic' hybrid cation-exchanger: Nylon-6, 6, Zr(IV) phosphate. Organic–inorganic hybrid materials enable the integration of useful organic and inorganic characteristics within a single molecular-scale composite. Unique ion-exchange properties of these types of materials have been observed, and many others can be envisioned for this promising class of materials. In this paper, we describe the ion-exchange and physico-chemical properties of one family of crystalline, self-assembling, organic–inorganic hybrid based on Nylon-6,6, framework with Zr(IV) phosphate an inorganic ion-exchanger. The physicochemical properties of this hybrid material were determined using AAS, CHN elemental

analysis, ICP-MS, UV-Vis spectrophotometry, FTIR, TGA-DTA, XRD and SEM studies. Ion-exchange capacity, thermal stability and distribution behavior *etc.* were also carried out to understand the cation-exchange behavior of the material. On the basis of distribution studies, the material was found to be highly selective for Hg(II), a highly toxic environmental pollutant. Its selectivity was examined by achieving some important binary separations like Hg(II)-Mg(II), Hg(II)-Zn(II), Hg(II)-Fe(III), Hg(II)-Bi(III), *etc.* Thus, the relatively new field of "organic–inorganic" hybrids offers a variety of exciting technological opportunities to decrease the environmental pollution.

The third chapter describes the Synthesis, characterization and ion-exchange properties of a new and novel 'organic-inorganic' hybrid cation-exchanger: Poly (methyl methacrylate) Zr(IV) phosphate. Incorporation of a polymer material in to an inorganic ion exchanger provides a class of hybrid ion exchangers with a good ion exchange capacity, high stability and high selectivity for heavy metals. In the present study a hybrid type of ion exchanger PMMA Zr (1V) Phosphate has been synthesized by mixing poly (methyl methacrylate) in to inorganic material. The physicochemical properties of this hybrid material were determined using AAS, elemental analysis, ICP-MS, UV-VIS spectrophotometry, FTIR, TGA-DTA and XRD studies. Ion-exchange capacity, chemical stability, thermal stability and distribution behavior *etc.* studies were also carried out to understand the cation-exchange behavior of the material. On the basis of distribution studies, the material was found to be highly selective for Pb (II) a highly toxic environmental pollutant. Its selectivity was examined by achieving some important binary separations like Pb(II)-Mg(II), Pb(II)-Cd(II), Pb(II)-Hg(II), Pb(II)-Cu(II), and Cu(II)-Cd(II), *etc.* Thus, the relatively new

field of “organic–inorganic” hybrid offers a variety of exciting technological opportunities to decrease the environmental pollution.

The fourth chapter describes the Synthesis, characterization and ion exchange properties of Zirconium (1V) tungstoiodophosphate, a new cation exchanger.A new inorganic ion exchanger Zirconium (IV) tungstoiodophosphate was synthesized and characterized by IR, TGA, and XRD studies. Its ion exchange behaviour, pH titrations and distribution behaviour have been studied. Distribution studies reveal the exchanger to be highly selective for Pb^{2+} ions. As a consequence, some binary separations of metal ions have been achieved on a column of this material, demonstrating its analytical potential.

The fifth chapter describe the synthesis, ion exchange properties and analytical application of lead selective polyvinyl alcohol supported Zr(IV)phosphate:a composite cation exchanger. A new composite cation exchanger polyvinyl alcohol supported Zr(IV)phosphate was synthesized and characterized by studying the properties like ion exchange capacity, pH titration curves, distribution coefficients for various metal ions, effect of hydrated ionic radii and temperature etc. on ion exchange capacity. Important binary separations were carried out. The synthetic utility of the exchanger is revealed from the separation studies. The separation performed on ion exchanger column is very important for the environmentalist, since the mixture analysed are Zn(II)-Pb(II), Mg(II)-Pb(II), Cd(II)-Pb(II) and Al(III)-Pb(II).

The last chapter is divided in two parts. Part A deals with the Selective removal of mercury from Industrial waste water on nylon-6,6, Zr(IV) phosphate As a conservative technology, ion exchange allows the removal and recycling of metals from liquid effluents.

Part B includes a process applied for the removal of lead from wastewater by ion exchange. This process is based on Zirconium (IV) tungstoiodophosphate cation exchanger capable of removing lead (II) from the effluent followed by selective separation.