

MINOR RESEARCH PROJECT

Title of Research Project : Synthesis and characterization of copolymers & their applications as ion exchange resins.

Subject : Chemistry

Project Duration : 2 years (2010-2012)

Principal Investigator : Dr. S. V. Bawankar

Summary of research-

Research on high polymers or macromolecules has been carried out principally due to its importance, currently attached to problems of producing materials with high temperature resistance. Thermally stable materials which could be used as high temperature lubricants, surface coating, adhesives, fibres, elastomers, plastics, constructional materials for high speed aircraft for space vehicles and ion-exchangers are polymers. Resins are copolymers which form special class of polymers are widely known for their applications. The present thesis includes the studies on newly synthesized terpolymer resins and their applications as ion-exchangers.

The report has been divided into six chapters-

Chapter-I includes general introduction to high polymer, a brief account of literature survey and the aim and object of present investigation undertaken.

Chapter-II deals the experiments in which the synthesis of new terpolymer resin by using orcinol-guanidine hydrochloride-formaldehyde in four molar proportions are incorporated. All the synthesized terpolymers were purified by general method of purification. It was observed that melting point of all the terpolymer sample increases with the increase in molar proportion of monomers. The solubility of all the terpolymers has been tested in various organic and inorganic solvents. All the terpolymers are found to be soluble in NaOH and KOH, slightly soluble in DMF, DMSO but insoluble in various organic solvents. Various experimental techniques used for characterization of these terpolymer resins are described in this chapter.

Chapter-III incorporates results and discussion on the basis of characterization of the newly synthesized terpolymers by various physico-chemical techniques as described in chapter II. The techniques involve elemental analysis, molecular weight determination, intrinsic viscosity,

ultraviolet and infrared spectral studies, nuclear magnetic resonance studies, thermogravimetric analysis, electrical conductivity studies in solid state, ultrasonic study and ion exchange studies. From the elemental analysis, the empirical formulae and their weights were suggested for each of the newly synthesized terpolymers. The number average molecular weight of all the terpolymer resins was determined by non-aqueous conductometric titration in purified double distilled DMF. The results indicated that the molecular weight increases with increase in molar proportion of orcinol, guanidine hydrochloride and formaldehyde.

Intrinsic viscosity of all the terpolymers determined in DMF and has found to be increases with increase in molecular weight of terpolymer. The presence of various functional groups has been ascertained with the help of UV and IR spectra. The signals displayed in NMR spectra are indicative of the position and number of protons present in different electronic environments. Thermogravimetric analysis shows that terpolymer containing higher molar ratio of orcinol-guanidine hydrochloride-formaldehyde exhibited higher thermal stability. The order of thermal decomposition reaction was found to be near to unity for all terpolymer resins. Electrical conductivity measurements revealed that all the terpolymers behave like a semiconductor. The ultrasonic study these terpolymers shows behaviour of polymer chain in a ultrasonic field. The most probable structures have been proposed to terpolymer resins on the basis of the results obtained in their physico-chemical studies. This contention has been further supported by similar studies reported in the literature.

Chapter-IV includes the chelation ion-exchange study of synthesized terpolymers.

From ion-exchange studies, it was observed that the metal ion uptake by the terpolymer in the presence of different electrolyte solution at particular pH increases with increase in molar proportion of orcinol-guanidine hydrochloride-formaldehyde in the terpolymer sample and the rate of metal uptake follow the order : OGF-1 < OGF-2 < OGF-3 < OGF-4.

All the terpolymers take up Cu^{2+} ion more selectively than other metal ions at lower pH. This behaviour of ion exchangers may be useful for the separation of metal ions at particular pH and thus these materials may have applications in industries and scientific laboratories.