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Ion-exchange studies of ^{110m}Ag(I) using synthetic inorganic ion-exchanger

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In the present investigation, the selective adsorption of silver on synthetic inorganic ion exchanger, zinc(II) ferrocyanide, has been established by batch method, under specific conditions, using ^{110m}Ag as a tracer. The efficiency of adsorption has been determined by γ-ray spectrometry and was found to be greater than 96%. The Ag(I) uptake by the exchanger has also been evaluated. The selectivity of the method was checked by studying the adsorption of Ag(I) in the presence of a number of foreign ions using their corresponding tracers. The interfering ions were removed by washing the ion-exchanger with appropriate reagents, so that it could be applied for the determination of trace amount of Ag(I) in complex matrices, containing trace amount of other metal ions.

Introduction

Synthetic inorganic ion-exchangers

Many inorganic adsorbents, both natural and synthetic, are well known for their high affinity towards various ions in aqueous solution.[1] The high thermal and radiation stability of these materials together with the possibility of fixation of loaded radioactivity in the exchanger matrix itself are some of their attractive features. Unfortunately, not many of these materials can be prepared in granular-column usable form and because of this reason their large-scale use has been rather limited. However, renewed activity is being noted in recent years keeping in mind the practical application of inorganic exchangers for the determination of radioactive waste effluents. This interest has been caused by two recent developments:[2] (i) the successful bulk preparation of some inorganic exchangers in granular form suitable for application in fixed bed columns and (ii) the development of a method for using even finely powdered inorganic exchangers in conjunction with cross-flow filtration.

Synthetic inorganic ion-exchangers are micro-crystalline or amorphous inorganic materials having porous structure with replaceable counter-ions. They are insoluble phosphates, tungstates, molybdates, silicates, sulfides, oxalates, carbonates, ferrocyanides and oxides of zinc, zirconium, thorium, titanium, cerium, aluminum, tin, bismuth, chromium and tantalum, etc., which permit the production of a number of synthetic inorganic ion-exchangers.[3–7]

The main advantages of synthetic inorganic ion-exchangers over organic ion-exchangers are: outstanding resistance to high temperatures, i.e., higher thermal stability, higher capacity on volume basis, greater selectivity towards simple inorganic ions, higher resistance to radiation, etc.

We have synthesized zinc(II) ferrocyanide as described in the literature and it was characterized by different methods.[8–10]

Hazards of silver

Inhalation exposure to silver leads to death, adverse cardiovascular or musculoskeletal effects and respiratory irritation. Acute inhalation of aerosol containing colloidal silver leads to ultra-structural damage and disruption of cell of tracheal epithelium. It also leads to abdominal pain as well as gastrointestinal pain.[11–13] Because of the above mentioned hazards, Ag(I) is an unwanted material in drinking water and food products. Hence, there is always a need for a good separation method of Ag(I) from industrial and photographic wastes.

Separation of Ag(I) from other elements can be achieved by many separation techniques. Ion-exchange chromatography is one of them. However, very few ion-exchangers have been reported during the last few years, which show good selectivity towards Ag(I). The selectivity of the adsorbent for Rb(I), Cs(I) and Ba(II) ions has been determined.[14–16] However, it has not been reported for the study of Ag(I).

GRADER et al.[17] have studied the adsorption properties of natural calcium cliptolite for Ag(I) ions. Fibrous ceric phosphate has been prepared by ALBERTI et al.[18] to study the distribution coefficient and separation factor for different cations including Ag(I) ions. Ferrocyanides of copper and chromium, studied by SINGH et al.[19,20] showed high capacity for Ag(I). Quantitative separation of Ag(I) from Au(III), has been carried out by RAWAT et al.[21] on iron(III) antimonate column. AKITIMITI[22] employed radiotracer method to study the adsorption of Ag(I) on the fluoride, ferrocyanide and monoxide exchangers of Pb(II).

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