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Reversed Phase Partition Chromatographic Separation of Gd(III) From Hippuric Acid on Poly[Dibenzo-18-Crown-6]

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Abstract

A simple method has been developed for the separation of Gd(III) in hippuric acid medium by using poly[dibenzo-18-crown-6] as stationary phase. The effect of hippuric acid concentration, different eluting agent, foreign ions etc. was studied and the optimum conditions were established. Breakthrough capacity of poly [dibenzo-18-crown-6] for Gd(III) was found to be 0.572±0.01 mmol/g of crown polymer. The separation of Gd(III) from other elements in multicomponent mixtures has been achieved. The method was extended for determination of Gd(III) in real sample. The method is simple, rapid and selective with good reproducibility (approximately ±2%).

Introduction:

Extraction and preconcentration of these valuable metal ions from other fission products is extremely important not only from the point of view of their limited resource availability, but also to reduce their quantum for disposal as radioactive wastes .Various methods were adopted for separation of lanthanides and actinides, which include precipitation and co-precipitation and ion exchange chromatography systems [6]. But over the years extraction chromatography (EC) has been proved to be promising in this aspect because of simple operation. Macrocyclic polyethers generally called as "crown ethers" have gained attention due to their special selectivity arising presumably from their ring-size comparable with the ionic radii of certain alkali metals [7–11]. The resistance to certain chemicals like organic solvents e.g. acetone, alcohols, chloroform as well as mineral acids like hydrochloric, sulfuric, bromic acid by poly[dibenzo-18-crown-6] could potentially be advantageous with respect to the sorption of various cations using column chromatography. Crown ethers are widely popular and used as complexing agents that can selectively capture certain metal cations in their cavity based on their size. This special chemical property exhibited by poly [dibenzo-18-crown-6] has been continuously explored in our laboratory for selective cation exchanger by column chromatography. To our knowledge, no successful attempts were reported in the literature for the separation of Gd (III) using hippuric acid media and column chromatography. The present communication describes a simple and sensitive method for the determination of Gd(III) using poly[dibenzo-18-crown-6] as stationary phase in hippuric acid medium. In our study we use hippuric acid as the counter ion. The counter ion plays an important role in the complexation of crown ether and the metal ion. The proposed method affords an attractive feature as compared to the solvent extraction technique i.e. it is free from any organic diluents, leading to potential green chemistry applications.

The effect of foreign ions on the sorption of Gd(III) was investigated by adding known amount of foreign ion to a standard Gd(III) solution and by comparing the final absorbance with standard. An aliquot of solution containing 100 µg of Gd(III) was mixed with foreign ions and hippuric acid was added so that its concentration was 1×10-4 M in total volume of 10 mL. The tolerance limit of other ions which do not cause a deviation of more than 2% in the absorbance in determination of Gd(III) is given in table 2. The column was equilibrated with 1×10-4 M hippuric acid and binary mixture solution was passed through a poly[dibenzo- 18-crown-6] column at flow rate of 0.5 mL/min. Various foreign ions were not sorbed and hence passed through the column. The results show that most common ions do not interfere with the determination. The effluent was collected and analyzed for foreign ion content. Zn (II), Cd (II), Ni (II) and Th(IV) were sorbed quantitatively and there separation is carried out in our subsequent study employing multicomponent mixtures.

Conclusion:

Proposed method is simple, rapid, highly selective and easily reproducible for the separation and determination of Gd(III). Low reagent and acid concentration are required for quantitative recovery of Gd(III). The poly[dibenzo-18- crown-6] could be recycled many times without affecting its sorption capacity i.e. it has higher stability as a stationary phase. It permits the separation of Gd(III) from other elements. Precision in terms of the standard deviation of the present method are very retainable for the determination of Gd(III).

Keywords: Gd(III), poly[dibenzo18-crown-6], hippuric acid, sorption, separation