SYNTHESIS OF ION EXCHANGE RESIN FOR SEPARATION OF YTTRIUM AND OTHER METAL IONS

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Introduction

Yttrium is one of the rare earth elements used in many electronic components (Su, 1991). It can be found in xenotime mineral, which is one of the byproducts of tin industry. The mineral also contains other rare earth elements such as cerium, lanthanum, praseodymium, ytterbium, gadolinium and samarium. The conventional method for the separation of these elements is by solvent extraction. However due to environmental problems related to this technique intensive research has been carried out in the use of ion exchange for the separation (Seto and Mori, 1989). Poly (hydroxamic acid) ion exchange resin has been reported to be able to adsorb a few rare earth ions such as Y(III), La(III), Eu(III) and Lu(III) at different pH values (Lee and Hong, 1994; Haron et al. 1995). The objective of this project was to synthesise poly (N-methyl hydroxamic acid) ion exchange resin from poly (methyl acrylate-divinyl benzene) using one step reaction and use the resin for the separation of yttrium and other rare earth elements.

Materials and Methods

Poly (methyl acrylate-divinyl benzene) was prepared by a polymerisation technique using 90.0g methacrylate and 10.0g divinyl benzene solution. The dry copolymer (4.0 g) was treated with water-ethanol solution containing 2.2 g N-methyl hydroxylamine and 4.0 g NaOH for 24 h at room temperature. Metal ion capacity for the resin was calculated from the amount of the metal ion sorbed by the wet resin, which was in equilibrium with 25 cm^3 of its solution (0.005M) at various pH for 16 hr. The presence of hydroxamic acid group was confirmed by the formation of coloured complex with vanadium (V), IR spectrum and nitrogen content in the resin. The ability of the resin to separate several mixtures of rare earth ions was determined by column method.

Results and Discussion

The resin obtained in this study was in the form of a macroporous bead. The presence of the hydroxamic acid groups on the resin was confirmed by the formation of a dark purple colour complex with vanadium (V) in acidic solution. IR spectrum of the resin exhibited C-N stretching bands at 3444 cm^{-1} and 680 cm^{-1}. The nitrogen content of the dry resin was found to be 4.10%, which indicated that there was 2.9 mmol/g of the hydroxamic acid. The capacity of the resin for yttrium, cerium, lanthanum, praseodymium, ytterbium, gadolinium and samarium ions was pH dependent which indicated that the resin could be used to separate the metal ions by solutions of suitable concentrations using column method. It was found that the resin was able to separate the mixture of yttrium-samarium, lanthanum-samarium and neodymium-gadolinium –samarium using HCl solution at pH 2 as eluent (Phillips and Fritz, 1982).

Conclusions

Poly (N-methyl hydroxamic acid) ion exchange resin was prepared from poly (methyl acrylate-divinyl benzene) and N-methyl hydroxylamine in basic solution using a one step reaction. The resin was found to be suitable for rare earth element separations.

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