Faculty of Science
Ain shams University

RECOVERY OF SOME RARE EARTH ELEMENTS DURING SEPARATION OF YTTRIUM FROM EGYPTION CRUDE MONAZITE USING SOLVENT IMPREGNATED RESIN (SIR) TECHNIQUE

A Thesis

Submitted for PhD. Degree of Science in Chemistry
(Inorganic Chemistry)

By

MOHAMED ESMAIL MAHMOUD EL AWADY
(M. Sc. Inorganic Chemistry 2010)
Nuclear Material Authority

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Chemistry Department

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First of all, I am deeply thankful to "Allah" by the grace of whom the progress of this work was possible.

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كلية العلوم
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ABSTRACT

Over the last few decades, the need for highly purified rare earth oxides has increased as applications expanded and diversified. Yttrium is an extremely important rare earth element and it is important to have a supply of it for future generations. This research focus on the separation of yttrium using direct precipitation and the impregnated resins as to produce purified rare earth oxides. In this work a systematic study on the separation of yttrium from rare earths concentrate derived from Egyptian black sand monazite was made. it is explored the ability of the carbonate for the precipitation of the REEs and an easy separation of yttrium was achieved using sodium carbonate to form complex yttrium carbonate followed by oxalic acid precipitation. The precipitation using sodium carbonate sodium carbonate only or sodium carbonate and hydrogen peroxide was more sufficient than oxalic acid. The obtained precipitates from sodium carbonate only or sodium carbonate and hydrogen peroxide contain 27.56 and 29.73% yttrium respectively from the first precipitation of effluent solution after uranium removal. Commercially available chelating ion-exchange resins were applied to the separation of a mixture of heavy rare earths. This research was performed to further the understanding of lanthanide separations and improve upon current separation techniques. Separation coefficients of several rare earths were calculated based on their degree of adsorption in batch isotherm experiments. Yttrium showed particularly high separation coefficients compared to light rare earth, Sm, Eu, Gd, Tb and Dy which made up the balance of the mixture studied. Further experiments were conducted to determine conditions which optimize ion-exclusion behavior. DEHPA impregnation of Amberlite XAD-7 carried by DEHPA concentration of 75% in kerosene, contact time for 24 hr and solvent to resin ratio (S/R) of 10. Extraction of yttrium at pH 1.0, contact time for 30 min., at

room temperature, initial yttrium concentration 50 ppm and solution to resin ratio (S/R) of 20. Elution using 1.0 M HCl + 2% hydrogen peroxide was more effective. Analysis of variance was utilized to determine significant response across the conditions considered. It was found that conditions conducive to increased absorption behavior favored for yttrium upgrade.

From the results of the two aforementioned separation procedures, a process was suggested and applied to the naturally mixed rare earth oxides concentrate. The procedure of the suggested process is characterized by economic operation, high degree of selectively; ease, fast, applicability advantages and high overall yield for yttrium separation.

AIM OF WORK

The present thesis is thus formulated for separation of yttrium from rare earths with different purities during processing of Rosetta beach black sand monazite mineral concentrate. To realize this objective, a number of topics have actually been studied.

The aim of the present work is to develop selected process for separation of yttrium from rare earths from the effluent solution produced after extraction of uranium and thorium on chemical precipitation method and ion exchange resins (impregnated resin). Beach black sand monazite was digested with sulfuric acid and dissolved in ice water to its sulfate leach liqueur. The acid leach liquor was directly precipitated by carbonates to give a good concentrate of yttrium. After thorium and uranium separation from the acidic leach liquors, the effluent solution was subjected to precipitation by oxalate precipitation then study dissolution process by carbonates and different acids. Upgrading of yttrium in this concentrate from carbonate media was also studied through the prepared impregnated resin.

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