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Extraction of La(III) from Nitric acid media using PC88A and Cyanex 921 in kerosene

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A B S T R A C T

The solvent extraction of La (III) from nitric acid medium using acidic organophosphorous extractant PC88A and neutral extractant Cyanex 921 in kerosene was studied. The effect of various parameters like equilibration time, nitric acid concentration and extractant concentration on the extraction behavior of La (III) has been investigated. The percentage extraction of metal decreased with increase of acid concentration. With the binary mixture of Cyanex 921 and PC88A, the extraction of 0.001 M La (III) from 0.001M HNO_3, the extraction was maximum at 50% when Cyanex 921was increased from 0.01M to 0.1M.

1. Introduction

Solvent extraction or Liquid-liquid extraction plays an important role in separating rare earth elements. Acidic organophosphorous extractants, such as D2EHPA and PC88A are widely used in this separation [1-3].Of these two extractants, PC88A is known to have a higher loading capacity and to yield a higher separation factor [4].These extractants have been widely used in the rare earth industry for the separation and purification of these metal ions [5,6]. So, new extraction systems have been developed for the separation of rare earths as a group or from one another. Synergistic extraction using acidic and neutral organophosphorous extractants have shown improved extraction and separation among trivalent rare earths [7,8].

The present study investigates the extraction behavior of La (III) using PC88A and Cyanex 921 in kerosene. The effect of various parameters like equilibration time, and nitric acid concentration on the extraction behavior of La (III) was studied.

2. Experimental

2.1 Materials

Stock solution of La (III) (Himedia PVT Ltd, AR grade) was prepared by dissolving the required amount of nitrate in concentrated nitric acid solution, then evaporating to dryness followed by making up the volume by adding distilled water. Distilled kerosene was used as organic phase diluent. The commercial extractant, PC88A obtained from Rare earth Division, Kerala was used without further purification. All other reagents used were of analytical reagent grade.

2.2 Procedure

Equal aliquots (10mL) of aqueous phase containing 0.001M La (III) in 0.001M HNO_3 and organic phase with 0.1M PC88A or 0.1 M Cyanex 921 in kerosene were shaken for twenty minutes in a separating funnel.

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Complete equilibrium was achieved only in twenty minutes. The La (III) concentration in the aqueous phase before and after the extraction was determined by using an ELICO UV-Visible Spectrophotometer by Arsenazo (III) method. The distribution coefficient (D) was calculated by taking the ratio of equilibrium concentration of La (III) in organic phase and that in the aqueous phase. From D values, the percentage of extraction was calculated (%E= 100(D/D+1).

3.Results and Discussion

3.1Extraction of La (III) using PC88A or Cyanex 921

3.1.1Effect of Equilibration time

The effect of equilibration time on the extraction of 0.001M La (III) from 0.001M HNO_3 was studied with 0.1M PC88A and 0.1 M Cyanex 921 in kerosene within the range from 1 minute to 60 minutes. The extraction was increased from 6% to 37% with 0.1 M PC88A and 1% to 9% with 0.1M Cyanex 921 when the time increased from 1 minute to 20 minutes and then it decreased with further increase of time (Fig.1).

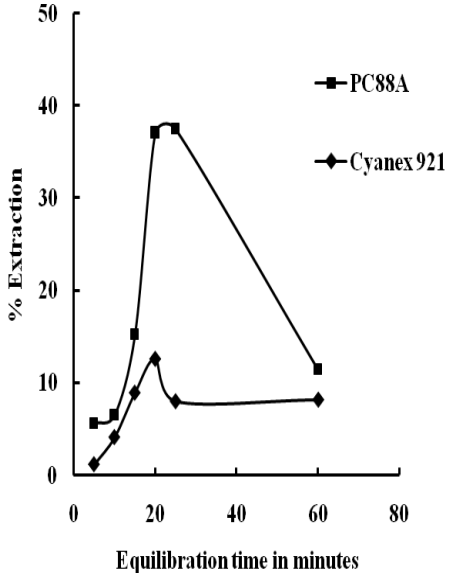

Fig.1. Plot of Equilibration time versus %Extraction for the extraction of 0.001M La (III) from 0.001M HNO_3 using 0.1M PC88A/Cyanex 921

3.1.2 Effect of nitric acid concentration

The effect of varying nitric acid concentration from 0.001M to 0.01M on the extraction of 0.001MLa (III) was studied using 0.1M PC88A and 0.1 M Cyanex 921 in kerosene. The results showed that the extraction of 0.001M La (III) decreased from 37% to 1% with increase in acid concentration from 0.001M to 0.01M with 0.1M PC88A whereas in case of 0.1 M Cyanex 921 the extraction was 12% to 13.4 % with increase in acid concentration from 0.001 M to 0.006 M and then decreased with further increase of acid concentration. The decrease in extraction is because of the extraction of acid by the neutral organophosphorous extractants [9] (Fig.2)

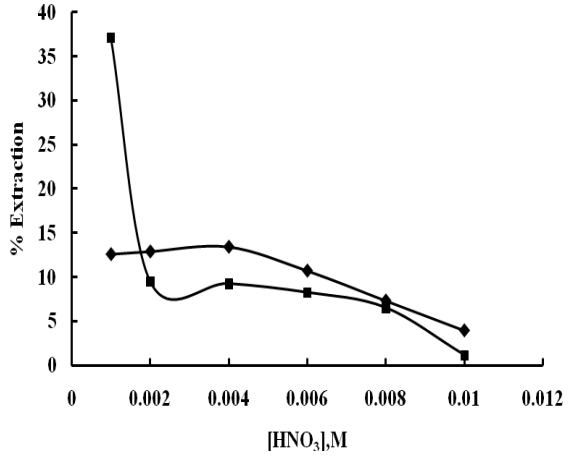

Fig.2. Plot of % Extraction versus [HNO_3], M for the extraction of 0.001M La (III) using 0.1 M PC88A/Cyanex 921 in kerosene.

3.2 Extraction of La (III) with binary mixture of PC88A and Cyanex 921:

The effect of binary mixture of Cyanex 921 and PC88A on the extraction of 0.001M La(III) from 0.001M HNO_3 was studied by varying Cyanex 921 concentration from 0.01M to 0.1 M with 0.1M PC88A. It was observed that the extraction increased from 24.8% to 50% with increase of concentration.

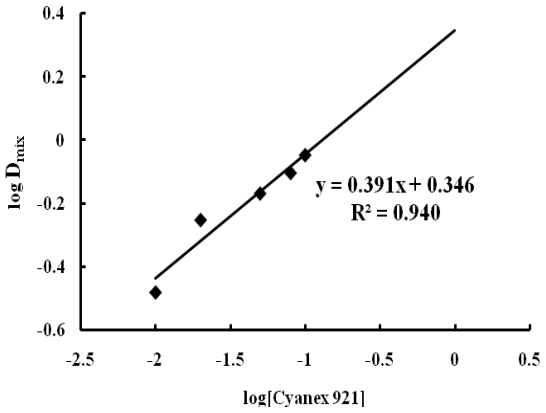

Fig.3. Plot of log D versus log [Cyanex 921] for the extraction of 0.001 M La (III) from 0.001M HNO_3 with 0.1M PC88A.

The plot of log D versus log [Cyanex 921] yields a slope of 0.4 which indicates the presence of one molecule of Cyanex 921 in the extracted complex (Fig.3).

4. Conclusion

From the above discussions, it has been found that the extraction of La (III) decreased with increase in acid concentration with both the extractants PC88A and Cyanex 921.The extraction was found to be 50% with the binary mixture of 0.1M Cyanex 921 and 0.1M PC88A.

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