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EXTRACTION AND SPECTROPHOTOMETRIC STUDY OF RUTHENIUM (III)

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ABSTRACT

Investigation was made on the extraction and spectrophotometric determination of Ruthenium(III) with 4-(4-dimethylaminobenzylideneimino)-5-methyl-4H-1, 2, 4-triazole-3-thiol (DMABIMTT) in chloroform from hydrochloric acid medium.. In this method Ruthenium(III) is extracted by using solvent extraction technique with DMABIMTT as an extractant which is stripped and determined spectrophotometrically. The method affords quantitative binary separation of Ruthenium(III) and is applicable to the analysis of synthetic mixtures and alloys. The method is highly selective, simple and reproducible. The effect of diverse ions on the quantitative extraction of Ruthenium(III) has also been studied. The method is applicable for the separation of Ruthenium(III) from binary mixtures, alloys, synthetic mixtures and commercially available samples.

KEYWORDS

Ruthenium(III), Solvent extraction, DMABIMTT, Binary mixtures.

RESEARCH PAPER

INTRODUCTION:

At present there is growing demand of platinum group metals, the name platinum group metals include the six elements: Ruthenium, Rhodium, Platinum, Palladium, Osmium, and Iridium. In the past few decades these metals have found new applications outside the jewelry and decorative industries due to its excellent physical and chemical properties and are used extensively for electronic devices, catalysis in the chemical and petroleum refining industries, glass industries, pharmaceutical industries etc. Ruthenium is one of the most expensive platinum group metal and is indispensable for automotive catalytic converters. Several extraction procedures are available for this purpose however most of these are time consuming and costly, however liquid-liquid extraction technique is one of the most suitable, selective, efficient, and powerful technique for the separation and purification of platinum group metals [1]. The synthesised ligand of the class Schiff bases, EBIMTT used for extraction of Ruthenium (III) in real samples, synthetic mixtures and alloys.

MATERIALS AND METHODS

Instruments and Chemicals

A JASCO V-530 UV-Vis spectrophotometer with 1 cm quartz cells was used for measurement**.** Stock solutions of metals were prepared by dissolving metal chloride hydrate in dilute Analytical reagent hydrochloric acid (1M) diluted to 100 ml with distilled water. A working solution of 100µg ml^{-1} was prepared by diluting the stock solution with distilled water. DMABIMTT (0.1M) solution was prepared in chloroform.

General procedure: An aqueous solution containing 100µg of Ruthenium(III), and enough hydrochloric acid and water were added so as to maintain the pH value of the solution to 1, in a total volume of 25 ml. The solution was transferred into a

125 ml separating funnel containing 10 ml of 0.1M extractant in chloroform and shaken for 30 seconds. After equilibration, the mixture was allowed to separate and the metal was stripped from the organic phase. The collected extract was evaporated to moist dryness. The residue was dissolved in 5ml of concentrated hydrochloric acid to afford a clear Ruthenium(III) solution. It was then estimated spectrophotometrically.

Results and discussion:

Effect of diverse ions:

Ruthenium(III) was extracted in presence of different diverse ions such as Ni, Cu, Fe etc. The results showed that in the extraction and determination of 100mg of the Ruthenium(III) these ions didn't interfere at the level tested. Extractant DMABIMTT shows selectivity towards Ruthenium metal, results are reported in (Table 1)

Separation of Ruthenium(III) from binary mixtures:

Binary separation of Ruthenium(III) from iron(III), cobalt(II), nickel(II) and copper(II). The method allowed separation and determination of Ruthenium(III) from a binary mixture containing either iron(III), cobalt(II), nickel(II) and copper(II). In a typical experiment, solution containing 200µg of Ruthenium(III) was taken and known amounts of other metals were added. Ruthenium(III) was estimated spectrophotometrically. The recovery of Ruthenium(III) and that added ions was 99.5% and results are reported in (Table 2).

Table 1: Effect of foreign ions added on extraction of Ruthenium(III) **with DMABIMTT**

Ions added	Tolerance limit (mg)	Ions added	Tolerance limit (mg)
Cu(II)	5	Mo(VI)	20
Ni(II)	5	W(VI)	20
Co(II)	10	Au(III)	0.5

Pb(II)	15	Pt(IV)	0.5
Mn(II)	10	Rh(III)	0.5
Zn(II)	15	Pd(II)	0.5
Cd(II)	15	Fluoride	100
Hg(II)	15	Bromide	100
Sn(II)	15	Chloride	100
Fe(III)	15	Nitrate	100
Cr(III)	15	Sulphate	100
Bi(III)	10	Tartarate	100
Ca(II)	20	Citrate	100
Ce(IV)	10	Acetate	100
Th(IV)	10	Phosphate	100
Zr(IV)	10	EDTA	100

Table 2: Binary separation of Ruthenium (III)

Composition of metal ions(µg)	**Average % recovery* Ru(III)**	**R.S.D. (%)**
Ru(III),200;Fe(III);15000	99.8	0.19
Ru(III),200;Co(II);10000	99.2	0.20
Ru(III),200;Cu(II);5000	99.4	0.23
Ru(III),200;Ni(II);5000	99.0	0.22

*Average of six determination.

Conclusions:

Synthesized extractant DMABIMTT was successfully used for the extraction of Ruthenium (III). It has been proved to be a selective extractant for the extraction of Ruthenium(III). The important features of the method are, shorter time of equilibration was needed, it is free from interference of a large number of foreign ions which are associated with Ruthenium(III) in its natural occurrence. The time needed for equilibration is very short (30s)**.** A large number of foreign ions were tolerated in high ratios. Ruthenium(III) are successfully recovered from binary mixtures, synthetic mixtures.

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