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TECHNOLOGY****SIMULTANEOUS DETERMINATION OF PLATINUM GROUP METALS USING
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ABSTRACT

A simple and rapid solvent extraction separation of platinum group metals were studied involving complexation of these metals with 4-(4-ethoxybenzylideneamino)-5- methyl-4H-1,2,4-triazole-3-thiol (EBIMTT) sulphur containing extractant. The extraction was fast with short shaking time (30s). The results obtained showed that the average recovery of these metals from an aqueous solution containing 100µg/ml of mixture analyte was 96-98%. The method is effectively applicable for the separation of platinum group metals from synthetic mixtures.

I. INTRODUCTION

The liquid-liquid extraction technique has become increasingly popular in comparison with the other extraction methods because of its several major advantages, such as simple to operate, high pre-concentration factor, rapid phase separation and the ability to combine with different detection techniques. Hence it becomes one of the more exciting areas of analytical research amongst the other separation techniques [1-4]. Platinum group metals and gold play an important role in the world economy due to their unique inertness. This property leads to their labeling as "noble metals". These elements have paramount significance in technology, mainly these are used as metallic catalysts in automobiles to reduce air pollution and applicable for surgical appliances, electronic devices, and hydrogen storage materials. It is very difficult to fulfill the present demand of these elements just based on natural resources, hence secondary resources should be tackled to meet the present requirement. However, the most important factor in the solvent extraction of metals is the selectivity of the extractant towards the specified metal ion to be recovered. The comparative ease of stripping of the complexes from the organic phase can be achieved by fully exploiting the differences in the reactivity of metals to extractant and back into the aqueous phase by stripping reagents. In the present work, extraction of rhodium (III), ruthenium (III), and their separation from other metals using 4-(4-ethoxybenzylideneamino)-5- methyl-4H-1,2,4-triazole-3-thiol (EBIMTT) from hydrochloric acid media were investigated. The experiments which were carried out indicated that the efficient extraction of PGMs and their separation from different metals could be understood by controlling the extractant and acid concentration. Optimization of equilibrium conditions including pH of aqueous phase, acid concentration in aqueous phase, concentration of EBIMTT, solvents and equilibrium time were performed. We have also studied the stripping of PGMs from organic phase which confirms the selectivity. However, we have found that the use of EBIMTT as extractant not only enhanced the extraction efficiency but also increased the selectivity in the presence of other metals in comparison to existing methods. Due to greater selectivity of sulphur containing extractants towards the noble metals, a number of sulphur containing extractants have been reported in the literature [5-10], but variety of sulphur containing reagents was still limited. Therefore, we have preferred the sulphur containing ligands for the extraction of platinum group metals.

II. MATERIAL AND METHODS

Glass wares used were made up of pyrex and corning glass. The burette, pipette, and standard flask were calibrated in accordance with the method described by Vogel [11]. For the measurement of pH an Elico digital pH meter model LI-120 (± 0.01) was used throughout the work.

All measurements of absorption spectra were made on the JASCO V-530 UV-Vis spectrophotometer with 1 cm quartz cells. The calibration of spectrophotometer was checked by measuring absorption spectrum of solution of potassium permanganate in 1M sulphuric acid. All the chemicals used were of A.R. grade. Double distilled water was invariably used for the measurements. It was prepared by distilling water in all glass apparatus containing alkaline potassium permanganate.

III. RESULT AND DISCUSSION

Analysis of synthetic mixtures:

Separation of Rh (III) from Ru (III) was carried out by taking advantage of differences in their optimum extraction and stripping conditions. The proposed method was successfully used in the determination of Rh (III) from Ru (III). A solution containing mixture of Rh (III) from Ru (III) was taken. Under the optimum extraction conditions of rhodium(III), there is a quantitative extraction of Ru(III) also but the co-extracted metal ions cannot be back-stripped by 1M hydrochloric acid solution. Thus, the reagent is made selective towards rhodium(III) by taking an advantage of the stripant used.

Extraction of Rhodium (III):

After equilibration, the mixture was allowed to separate and the metal was stripped from the organic phase with two 10 ml portions of 1M hydrochloric acid solution. The extracts were evaporated to moist dryness in order to remove excess of hydrochloric acid. The residue was dissolved in minimum amount of 1M hydrochloric acid and transferred into 50 ml volumetric flask, 10 ml of 20% potassium iodide was added, the solution was mixed well and heated for 15 minutes in boiling water bath. To the cooled solution, 10 ml of 10% stannous chloride solution was added and diluted with distilled water containing 1M hydrochloric acid in final concentration. The unstopperd flask was placed in boiling water bath for 2 minutes. The solution was cooled and the absorbance of reddish brown solution was measured at 460 nm against a reagent blank.

Extraction of Ruthenium (III):

After equilibration, the mixture was allowed to separate and the metal was stripped from the organic phase with two 20 ml portions of 1%NaCl solution. 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 at 620nm with pyrimidine-2-thiol.

Table: 1 Separation of Ruthenium(III) from Rhodium(III)

Composition of mixture of metals ions(μg)	Average % recovery Ru(III)	Average % recovery Rh(III)	R.S.D. (%)
Ru(III) 100;Rh(III)100	97.8	98.1	0.20
Ru(III) 200;Rh (III) 400	98.2	98.0	0.16

IV. CONCLUSION

The effectiveness of extractant has been evaluated for the simultaneous determination of ruthenium and rhodium from. The important feature of this method includes selective separation of ruthenium(III) from rhodium (III), low reagent concentration is required and time needed for equilibration is very short, (about 30 seconds).

V. REFERENCES

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