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SOLVENT EXTRACTION STUDY OF GOLD (III) FROM MALONATE MEDIA

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ABSTRACT

Solvent extraction of Gold (III) was carried out with 4-(4-ethoxybenzylideneimino)-5-methyl-4*H*-1, 2, 4-triazole-3-thiol (EBIMTT) in chloroform as an extractant from malonate media. After extraction it is stripped and determined spectrophotometrically. The effect of diverse ions on the quantitative extraction of Gold (III) has also been studied. The method is applicable for the separation of Gold from binary mixtures, alloys, synthetic mixtures and commercially available samples.

KEYWORDS

Extraction, Gold (III), Malonate media

RESEARCH PAPER

Introduction:

There is wide application of precious metals in the industrial processes and use in jewellery and medicines next to their extremely scarcity due to rare natural abundance and complex process used for its separation. Solvent extraction is one of the most efficient separation technique used for extraction of metals. As compare to other separation techniques, solvent extraction is easy and cost effective technique, it require only a simple separatory funnel.

Gold is belongs to precious metal family or platinum group metals which includes ruthenium, rhodium, palladium, platinum, gold, osmium and iridium. These metals are better known for their uses in art, jewelry, coinage and pharmaceuticals (gold and platinum). These metals are also known for their role as investments and a store of value.

By using Pearson's HSAB (Hard soft acid base) principle and using chemical properties of precious metals, sulphur containing extractant was used. Sulphur containing extractants are highly selective for extraction of soft metals [1]. According to Pearson's concept precious metals act as soft acids and sulphur containing extractants act as soft bases and have high affinity. EBIMTT is a sulphur containing extractant which is highly water repellent and show high affinity towards Gold. EBIMTT has been successfully employed for the extraction of Gold (III) from Malonate media. It is worthwhile here to stress the advantages of organic acid media over mineral acid media as the earlier one is ecofriendly and the ease of adjustment of pH.

During last few years, 1-(2,4-dinitroaminophenyl)-4,4,6-trimethyl-1,4-dihydropyrimidine-2-thiol [2], dicyclohexylamine [3], 5-(2-Hydroxy-5-nitrophenylazo)thiorhodanine [4], 2-Carboxyl-1-naphthalthiorhodanine [5], Ethopropazine hydrochloride [6], 3-Hydroxy-2-methyl-1-phenyl-4-pyridone [7], 1-(3,5-diamino-6-chloro pyrazinecarboxyl) guanidine [8], tri-noctylamine [9], tri-n-butyl phosphate[10] were widely used for the extraction and separation of Gold (III).

Experimental

General Procedure:

An aqueous solution containing 100µg Gold (III) mixed with a sufficient quantity of sodium malonate (0.2g) in a total volume of 25 ml of the solution. Then the pH of the solution was adjusted to 1.0 using dilute hydrochloric acid and sodium hydroxide. The solution was extracted with 0.1M EBIMTT using separatory funnel. After equilibration, the mixture was allowed to separate and the metal was stripped from the organic phase with two 5 ml portions

of ammonia buffer solution. The extract was evaporated to moist dryness and Gold (III) was determined spectrophotometrically at 400 nm against a reagent blank.

Result and discussion

1. Effect of reagent concentration

To optimize the conditions for extraction of Gold (III) extractant solution with varying concentrations were employed. It was found that 10ml of 0.05M extractant is sufficient for complete extraction of 100mg Gold (III) from hydrochloric acid media, but to ensure complete extraction 0.1M extractant in chloroform was used.

2. Effect of equilibrium time

The effect of time was observed on the system for a period of 5s to 30min (equilibrium time/ shaking period) the extraction was found quantitative over the period longer than 10s, but to ensure the complete extraction of Gold (III)1min time was recommended. Prolonged shaking up to 5 min has no adverse effect on the efficiency of extraction.

3. Effect of diverse ions

Gold (III) was extracted in presence of different diverse ions. The tolerance limit was set as the amount of foreign ions cause +2% errors in the recovery of Gold. The results showed that in the extraction and determination of 100mg of the Gold (III) these ions didn't interfere at the level tested, results are as shown in Tablel-1.

Application

1. Separation of Gold (III) from alloys

The proposed method is applicable for the determination of gold content in the alloy. Dissolution of the alloy sample is carried out by using the literature method [4]. An appropriate aliquot of the solution was taken for the analysis of gold content. The results of the analysis are reported in Table 2. The average recovery of Gold (III) was 99.5%.

Conclusion:

The important feature of this method is that, it permits selective separation of Gold (III) from other platinum group metals and base metals which are generally associated with it. It is free from interference from a large number of foreign ions, low reagent concentration is required and time needed for equilibration is very short (about 30 seconds). EBIMTT is able to effectively extract Gold (III) from organic acid media.

Table:1 Effect of diverse ions

Diverse ions added Amount tolerated (mg)	**Diverse ions added Amount tolerated (mg)**
Pd(II), Pt(IV)	0.5
Rh(III)	1
Zn (II) Mo (VI) Cd (II) Hg (II)	5
Ni(II), Ca(II), Ba(II), tartrate, oxalate Cu (II) Sb (III)	10
Fe(III), Bi(III), Ca(II), Mg(II), Be(II), Ba(II)	20

Table 2: Separation of Gold (III) from alloys

Alloys	**Composition of alloys (%)**	**Gold(III) found**	**Gold(III) found by proposed method (%)**	**Recovery ± s (%)**
Gold 22 carat	91Au, 4Ag, 4Cu	9.9	9.7	99.6
Jewelry alloy (Pd–Au alloy)	Pd, 50; Au, 50	49.9	49.8	99.8

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