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SPECTROPHOTOMETRIC DETERMINATION OF COPPER (II) AFTER ADSORPTION OF ITS PYRIDINE–2–CARBOXALDEHYDE AND 2–AMINOBENZOTHIAZOLE SCHIFF BASE COMPLEX ON POLYURETHANE FOAM

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ABSTRACT

The spectrophotometric determination of trace amount of copper (II) after adsorption of its complex derived from pyridine–2–carboxaldehyde and 2–aminopyrimidine (SB) using polyurethane foam has been discussed. Beer's law was obeyed over concentration range of 8–135 μg of copper (II) in 10 mL of chloroform. The molar absorptivity and sensitivity were found to be 3.57×10^4 L mole^{-1} cm^{-1} and 1.36×10^{-2} μg cm^{-3} of copper (II) for the absorbance of 0.001. The proposed method has been applied satisfactorily for the determination of microamount of copper (II) in alloy samples.

Key words : Copper (II), Schiff base complex, Polyurethane film, Pyridine–2–carboxaldehyde, 2–Aminobenzothiazole

INTRODUCTION

Copper metal has been used widely for various purposes viz. manufacture of glass, pesticides, microfertilisers, catalyst, alloys, electric cables, etc. In order to meet the requirement of copper, schiff base has been employed as an analytical organic reagent to determne micro amounts of copper (II). Metal complexes of schiff bases have been a subject of intensive research for over several years because of their use as a model in analytical[1], industrial[2], biochemical[3] and biological[4] systems. A survey of literature reveals that many reagents have been reported in the determination of trace amount of copper (II)[5–7].

The present note describes a new method[8] of extraction based on solid–liquid extraction technique using polyurethane foam as an adsorbent for photometric determination of copper (II). The proposed method is more sensitive and selective as compared to liquid–liquid extraction technique. The use of polyurethane foam in extraction studies offers low solubility of extractant, easy separation of phases, easy use of large phase ratios and a synergistic extraction effect. This method is very convenient and less time consuming and traces of copper (II) have been determined spectrophotometrically.

EXPERIMENTAL

All chemicals used were of Analytical reagent grade. A standard solution of copper (II) (1000 ppm) was prepared by dissolving requisite amount of hydrated copper sulphate in distilled water. Solutions of different concentrations were prepared from stock solution by dilution. A 0.1% schiff base (SB) solution was prepared in 100.0 mL of ethanol. Buffer solutions of different pH were also prepared.

Polyurethane foam (commercial U foam) pieces of $1cm^3$ size were prepared by the method of Hamon et al.[9] The foam pieces were first soaked in 1 M hydrochloric acid for about 1.0 hours for the removal of all possible inorganic contaminants. The pieces were rinsed thoroughly with distilled water, squeezed and air dried at room temperature and dried pieces were ready for use. The polymeric properties were found to remain intact as a result of these treatments.

A GS–5701 EC spectrophotometer and systronics digital pH meter Model No. 335 were used for absorbance and pH measurements, respectively.

An aliquot of 2.0 mL of standard copper (II) solution was taken in a flask. To it, was added a 2.5 mL of (0.1%) schiff base solution. The pH was adjusted to 3.0 with buffer solution and the volume was made to 10.0 mL by addition of distilled water. The contents were allowed to stand for two minutes for complete development of colour. Some polyurethane foams (six) were added and the flask was stoppered and vigoursly shaken for five minutes to ensure the complete adsorption of complex on foam. The foam pieces with adsorbed complex were manually squeezed with a glass plunger. These were then transferred to a glass beaker. The complex was eluted from foam by squeezing with two portions of 10.0 mL chloroform. 0.2 g anhydrous sodium sulphate was added to remove traces of water. Finally, absorbance of solution was measured against reagent blank solution.

RESULTS AND DISCUSSION

The absorption spectra of complex containing 90.0 µg of copper (II) and 0.1% reagent solution was studied in the range of 360–620 nm against reagent blank solution. The maximum absorbance was observed at 450 nm whereas, reagent blank showed neglibile absorbance at this wavelength. Therefore, all absorbance measurements were carried out at 450 nm.

The optimum shaking time for complete adsorption of metal ligand complex was studied in the range of 10–640 seconds. It was found to be 300 seconds since, shaking time remains unchanged in the range of 200–400 seconds. Hence, it was chosen for all absorbance measurements.

The absorbance was found to be adsorbent dependent. Studies showed that maximum and almost constant absorbance was observed at 450 nm wavelength with 3 to 9 pieces. So, six pieces of foam were used for all extraction studies.

The absorbance studies were found to be pH dependent. The absorbance was found to increase upto 2.0 mL and remained maximum and also constant in the range of 2.0–4.5. Hence, pH 4.0 was taken as standard for all absorbance measurements.

The absorbance was also found to be reagent concentration dependent. The absorbance increased upto 1.2 mL and then remained constant in the range of 1.2–4.8 mL. Hence, 2.5 mL of 0.1% reagent solution was taken for all absorbance measurements.

Calibration Curve

Under optimum condition as specified the calibration curve of copper (II) was constructed. Beer's law was obeyed over concentration range of 8–135 μg of copper (II) present in 10.0 mL of chloroform. The molar absorptivity and sensitivity was found to be 3.54×10^4 L mole^{-1} cm^{-1} and 1.36×10^{-2} μg cm^{-2} of copper (II) for absorbance of 0.001, respectively.

Effect of Diverse Metal Ions

Tolerance of diverse metal ions on copper (II) reagent complex was examined. The results are shown in Table 1.

Table 1. Effect of diverse metal ions on the determination of copper (II)

Metal ions	Amount of ions added (mg)	Found (μg)
Ag (I)	25.0	88.7
	50.0	90.2
Mg (II)	50.0	90.3
	120.0	90.8
Ni (II)	60.0	89.3
	110.0	90.5
Co (II)	50.0	90.7
	100.0	88.6
Fe (III)	80.0	90.4
	130.0	89.0
Zn (II)	60.0	90.3
	120.0	91.2
Pd (II)	60.0	90.7
	120.0	90.5
V (V)	25.0	88.8
	50.0	89.5
U (VI)	40.0	90.7
	80.0	91.3
Pt (IV)	50.0	89.6
	100.0	89.8

Determination of Copper (II) from Alloys Sample

Alloys samples (three) containing copper were selected. A 25.0 mL aliquot solution was taken in a 250 mL beaker. It was dissolved in minimum quantity of 40% nitric acid and the solution was evaporated to dryness several times to remove oxides of nitrogen. It was diluted to 100 mL and precipitate of oxides were filtered off. The residue was washed with hot water followed by addition of few mL of hot dilute acetic acid. The above mixture was filtered and the filterate was diluted to 250 mL by addition of distilled water. A 25.0 mL aliquot of solution was pipetted out into 500 mL beaker and copper contents were determined employing the above schiff base. The results have been summarised in Table 2.

Table 2

BCS Sample	Copper found %	Certified value	Standard deviation
5f Brass	70.72,70.84,70.79 average = 70.78	70.60	±0.06
6f Gun metal	87.92,88.01,87.93 average = 87.95	87.90	±0.07
Sc White metal	4.06,4.06,4.11 average = 4.08	4.10	±0.03

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