

## Photometric determination of uranium(VI) with 1-phenyl-3-(2-thiazolyl)thiourea after preliminary adsorption on polyurethane foam

Priti Chandak, Nidhi Mathur, Sumeet Singhal & S P Mathur\*

Department of Applied Chemistry & Chemical Technology,  
Maharshi Dayanand Saraswati University, Ajmer 305 001  
(Rajasthan)

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The photometric determination of uranium(VI) with 1-phenyl-3-(2-thiazolyl)thiourea using polyurethane foam as adsorbent has been discussed. Beer's law is obeyed over the concentration range 10-170  $\mu\text{g}$  of U(VI) in 10 ml chloroform. Molar absorptivity and sensitivity are found to be  $3.56 \times 10^4 \text{ l.mol}^{-1} \text{ cm}^{-1}$  and  $0.019 \mu\text{g cm}^{-2}$  of U(VI) for 0.001 absorbance respectively.

Thiourea and its substituted derivatives have been reported as excellent analytical reagents in the determination of metal ions<sup>1-4</sup>. A survey of the literature reveals that analytical applications of thiazolyl thioureas have not been investigated in detail. The compounds are found to react with many metal ions to give colour reactions of analytical importance.

The present note describes an inexpensive, accurate, reproducible, selective and sensitive method for the photometric determination of uranium(VI) with 1-phenyl-3-(2-thiazolyl)thiourea. Diverse methods for the photometric determination of uranium(VI) have been reported<sup>5,6</sup> in the literature. A new method of extraction based on solid-liquid extraction as modified by Bowen<sup>7</sup> using polyurethane foam as adsorbent has been used for the photometric determination of uranium(VI). The use of polyurethane foam in extraction studies offers low solubility of the extractant, easy separation of the phases, easy use of large phase ratios and a synergistic extraction effect. This method is very convenient and less time consuming. Traces of uranium(VI) have been determined spectrophotometrically.

### Experimental

A standard stock solution of uranium(VI) (1000 ppm) was prepared by dissolving requisite amount of uranyl nitrate in distilled water. A 10 ppm so-

lution of uranium(VI) was prepared by diluting 10 ml of standard stock solution of uranyl nitrate to 1000 ml with distilled water. A 0.2% solution of 1-phenyl-3-(2-thiazolyl)thiourea was prepared by dissolving 0.2 g of this reagent in 100 ml ethanol. Buffer solutions of different pH values were prepared.

All chemicals used were of analytical reagent grade.

A GS-5701 EC spectrophotometer and Systronics digital pH meter 335 were used for absorbance and pH measurements respectively.

Polyurethane foam (commercial 'U' foam) pieces of about  $1 \text{ cm}^3$  size were taken and prepared by the method given by Hamon *et al.*<sup>8</sup>. Foam pieces were soaked in 1 M hydrochloric acid for about 10 hr to remove possible inorganic contaminants. The pieces were rinsed with distilled water, squeezed and dried in air before use.

### Procedure

To an aliquot (2.0 ml) of uranium(VI) solution, 3.0 ml of 0.2% reagent solution was added and the pH adjusted to 3.5 using 3.5 ml acetate buffer solution. The contents were diluted to 10 ml using distilled water and allowed to stand for 2 min for complete colour formation. To the coloured complex formed, five prepared polyurethane foam pieces were added followed by vigorous shaking of flask to ensure complete adsorption of the metal complex on foam pieces. The foam pieces were completely squeezed and the complex eluted by squeezing with two portions of 5.0 ml chloroform. Traces of water were removed by adding anhydrous sodium sulphate. Finally, absorbance of the solution was measured against reagent blank.

### Results and discussion

Absorption spectra of the complex containing 95  $\mu\text{g}$  of uranium(VI) gave maximum absorbance at 405 nm against reagent blank. Therefore, this wavelength was chosen as a standard for all absorbance measurements.

The maximum absorbance of the complex containing 95  $\mu\text{g}$  of uranium(VI) at 405 nm was obtained in the pH range 2.0-5.0. Hence, 3.5 was taken as standard pH for all absorbance measurements.

The reagent (0.2%) in different quantities was

Table 1 — Effect of diverse metal ions on the determination of uranium(VI) (95 µg)

Metal ions	Uranium added (mg)	Uranium(VI) found (µg)
Pd(II)	40	94.7
	150	94.8
Cu(II)	50	95.3
	200	95.1
Mn(II)	60	95.0
	150	95.1
Ni(II)	40	96.5
	100	96.4
Co(II)	50	96.1
	110	95.9
Cr(III)	50	95.7
	150	95.6
Fe(III)	60	95.0
	100	95.3
Pt(IV)	30	94.5
	90	94.6
Ti(IV)	40	95.1
	80	95.5
V(V)	30	95.1
	100	95.0

added to 95 µg of uranium(VI) solution at pH 3.5. Maximum and almost constant absorbance value at 405 nm was obtained with 1.8-5.0 ml of reagent solution. Therefore, 3.0 ml of reagent solution was chosen as standard for the absorbance studies. Preliminary studies also showed that maximum and almost constant absorbance at 405 nm was observed when 3-7 foam pieces were added to a sample solution containing 95 µg of uranium(VI) and 3.0 ml of reagent solution at pH 3.5.

Hence, five foam pieces were used in all further studies.

#### Calibration curve for uranium(VI)

Under the optimum conditions as specified, calibration curve was obtained. Beer's law was obeyed over 10-170 µg of uranium(VI) per 10 ml chloroform. Molar absorptivity and sensitivity were found to be  $3.56 \times 10^4 \text{ l.mol}^{-1} \text{ cm}^{-1}$  and  $0.019 \text{ µg cm}^{-2}$  of U(VI) for 0.001 absorbance respectively.

#### Effect of diverse metal ions

Varying amounts of metal ions were added to a sample solution containing 95 µg of uranium(VI) and the effect of diverse metal ions was investigated. The results are shown in Table 1. Ten samples of solution containing 95 µg of uranium(VI) gave a mean absorbance of 0.502 with a standard deviation of 0.68%.

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