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# Spectrophotometric Determination of Cobalt(II) after Separation by Adsorption of its 1-Diethylamino-2-Propanol Complex on Microcrystalline Naphthalene

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The spectrophotometric determination of trace amount of cobalt(II) with 1-diethylamino-2-propanol is described after the adsorption of cobalt(II) complex on microcrystalline naphthalene. This complex is stable in naphthalene dimethylformamide solution. The absorption obeyed Beer's law over the concentration range of 10–100 μg of cobalt(II). The molar absorptivity was $1.19 \times 10^4$ 1 $mol^{-1}$ $cm^{-1}$, the sensitivity being 0.007 μg $cm^{-2}$ for the absorbance of 0.001.

## INTRODUCTION

Survey of literature reveals that 1-diethylamino-2-propanol has not been investigated in detail as an analytical reagent. 1-Diethylamino-2-propanol is found to react with many metal ions to give the colour reactions of analytical importance. The present paper describes a sensitive and selective method for the photometric determination of cobalt(II) with 1-diethylamino-2-propanol. Various methods have been reported from the literature for the extraction and photometric determination of cobalt(II)[1–7]

In the present study, a new method called *Analysis of metals by solid-liquid separation after liquid-liquid extraction* developed by Fujinaga and co-workers[8], has been used for the photometric determination of cobalt(II). This method has many advantages over the usual liquid-liquid extraction[9, 10]. This method is very convenient and less time-consuming.

## EXPERIMENTAL

A standard solution of cobalt(II) (1000 ppm) was prepared by dissolving requisite amount of hydrated cobalt nitrate in 1000 ml of double distilled water. 0.2% Solution of 1-diethylamino-2-propanol and 20% naphthalene solution in acetone were used for the present investigation. Acetate buffer (pH 3–6) was used to adjust the pH of the solution. All the chemicals used were of analytical reagent grade.

### Apparatus

A.E.C. spectrophotometer model GS-5701 was used for absorbance measurements. Toshniwal digital pH meter model CL-46 equipped with combined electrode was used for pH measurements.

### Procedure

An aliquot of standard cobalt(II) solution containing 10–100 μg of cobalt(II) was taken in a clean, dry and tightly stoppered Erlenmeyer flask and diluted to 50 ml with ditilled water. pH of the solution was adjusted to 4.5 throughout by adding 3.5 mL of acetate buffer and 4.0 mL of 0.2% reagent solution. The contents were mixed and digested for 20 min on water bath at 55–60°C temperature. 3.5 mL of 20% naphthalene was added and shaken vigrously for 4.0 min. The complex adsorbed on microcrystalline naphthalene was filtered through Whatmann filter paper-42 and washed with water. The dried mixture of naphthalene and complex was dissolved in 10.0 mL of dimethylformamide. Absorbance of the solution was determined against reagent blank prepared similarly.

## RESULT AND DISCUSSION

### Absorption spectra

Absorption spectrum of cobalt(II) complex was taken in wave-length region 350–540 nm containing 60 μg of cobalt(II). The complex has a peak at 415 nm. At this wavelength reagent blank shows negligible absorbance. Therefore, 415 nm has been chosen as standard for all absorbance measurements.

### Effect of pH

The effect of variation of pH was studied in absorbance of cobalt(II) complex at 415 nm. The results show that pH 2.5–6.5 is suitable for complete extraction of cobalt(II).

### Effect of 1-diethyl-amino-2-propanol concentration

The effect of reagent concentration on absorbance of cobalt(II) complex was studied by the addition of various volumes of reagent solution to sample solution containing 60 μg of cobalt(II). The reagent solution 2–6 mL is sufficient for complete extraction of trace amount of cobalt(II).

### Effect on naphthalene concentration

The effect of naphthalene concentration on the absorbance of cobalt(II) complex was studied by adding different volumes of 20% naphthalene solution. The absorbance increased upto 2.0 mL and remained constant in the range of 2.0–5.0 mL of naphthalene solution. Therefore, 3.5 mL is suitable volume for determination of trace amount of cobalt(II)

### Effect of digestion time

The digestion time, over water bath at 55–60°C, 8–30 min had no effect on the absorbance of cobalt(II) complex. In this range the absorbance is maximum and

practically constant. Thus, 20 min digestion time was selected for absorbance measurements.

### Effect of diverse metal ions

Effect of diverse metal ions on the determination of cobalt(II) was studied by adding various amounts of metal ions to sample solution containing 60 μg of cobalt(II). The results are shown in Table 1.

TABLE 1
EFFECT OF DIVERSE METAL IONS

| Metal ions | Amount of ion added (μg) | Found (μg) |
|---|---|---|
| Ag(I) | 25 | 60.1 |
| | 50 | 60.3 |
| | 75 | 60.6 |
| Mg(II) | 40 | 60.4 |
| | 100 | 60.7 |
| Zn(II) | 30 | 60.2 |
| | 70 | 60.3 |
| | 120 | 60.5 |
| Ca(II) | 50 | 60.1 |
| | 100 | 60.3 |
| | 150 | 60.6 |
| Cu(II) | 25 | 60.2 |
| | 50 | 60.7 |
| | 100 | 61.0 |
| Ni(II) | 100 | 60.4 |
| | 200 | 60.9 |
| Al(III) | 10 | 59.9 |
| | 50 | 60.4 |
| | 100 | 60.7 |
| Fe(III) | 50 | 60.1 |
| | 100 | 60.2 |
| | 200 | 60.7 |
| Pb(IV) | 25 | 60.4 |
| | 50 | 60.6 |
| | 75 | 60.9 |
| V(V) | 20 | 60.2 |
| | 60 | 60.6 |
| | 100 | 60.9 |

Cobalt—60 μg; pH—4.5; Naphthalene solution—3.5 mL; Reagent solution—4.0 mL

### Calibration Curve for Cobalt(II)

The cobalt(II) complex in naphthalene dimethylformamide solution obeyed Beer's law over the range 10–100 μg cobalt(II) per 10.0 mL. The molar absorptivity was $1.19 \times 10^4$ l $mol^{-1}$ $cm^{-1}$, the senstivity being 0.007 μg $cm^{-2}$ for the absorbance of 0.001.

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