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BUREAU OF INDIAN STANDARDS

Draft Revision

TO

IS 3186 : METHODS OF CHEMICAL ANALYSIS OF CADMIUM COPPER

(First Revision)

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भारतीय मानक प्रारूप

कैडमियम ताँबा के रासायनिक विश्लेषण की पद्धतियाँ

(पहला पुनरीक्षण)

Draft Indian Standard

**METHODS OF
CHEMICAL ANALYSIS OF CADMIUM COPPER**

(First Revision)

ICS 77.120.30

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Price Group

Methods of Chemical Analysis of Metals Sectional Committee, MTD 34

FOREWORD

This draft Indian Standard (First Revision) subject to its finalization, is to be adopted by the Bureau of Indian Standards on recommendation of the Methods of Chemical analysis of Metals Sectional Committee and approval of the Metallurgical Engineering Division Council.

This standard was first published in 1965. Cadmium copper is used for making wire for telegraphic and telephone purposes. Suitable methods have been laid down in this standard to determine its chemical composition.

This revision has been brought out to bring the standard in the latest style and format of the Indian Standards.

In reporting the result of a test or analysis made in accordance with this standard, is to be rounded off, it shall be done in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be same as that of the specified value in this standard.

Draft Indian Standard

METHODS OF
CHEMICAL ANALYSIS OF CADMIUM COPPER

(*First Revision*)

1 SCOPE

This standard prescribes methods for determining copper and cadmium in the ranges as specified in IS 2665.

2 REFERENCES

The Indian Standards listed below contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<i>IS No.</i>	<i>Title</i>
IS 264 : 2005	Nitric acid – Specification (<i>third revision</i>)
IS 266 : 1993	Sulphuric acid – Specification (<i>third revision</i>)
IS 1070 : 1992	Reagent grade water – Specification (<i>third revision</i>)
IS 1817 : 1961	Methods of sampling non-ferrous metals for chemical analysis
IS 2665 : 1964	Specification for cadmium copper wire for telegraph and telephone purposes

3 SAMPLING

The sample shall be drawn and prepared in accordance with IS 1817 shall be employed in the tests.

4 QUALITY OF REAGENTS

Unless otherwise specified, pure chemicals and distilled water (*see* IS 1070) shall be employed in the tests.

NOTE – ‘Pure chemicals’ shall mean chemicals that do not contain impurities which affect the results of analysis.

5 DETERMINATION OF COPPER BY THE ELECTROLYTIC METHOD

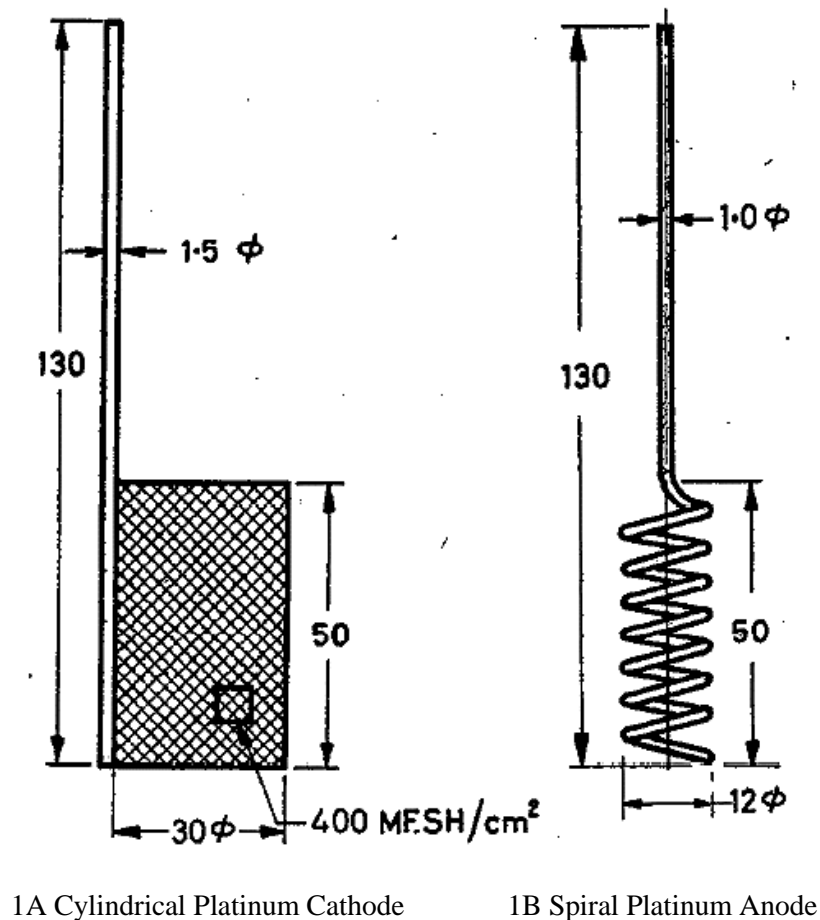
5.1 Outline of the Method

The sample is dissolved in sulphuric acid-nitric acid mixture. Copper is deposited electrolytically from the solution and weighed.

5.2 Apparatus

The following platinum electrodes (*see* Fig. 1) are recommended but strict adherence to the shape and size of the electrodes is not essential. In order to decrease the time of deposition, one of the

types of rotating forms of electrodes generally available for agitation of electrolyte may be employed.



1A Cylindrical Platinum Cathode

1B Spiral Platinum Anode

All dimensions in millimetres.

FIG. 1 CYLINDRICAL PLATINUM CATHODE AND SPIRAL PLATINUM ANODE

5.2.1 Cathode

It may be formed either from plain or perforated sheet or from wire gauze.

5.2.1.1 Gauze cathodes made preferably from gauze containing 400 mesh/cm² should be used. The wire used for making gauze should be approximately 0.20 mm in diameter. Cathodes should be stiffened by doubling the gauze for about 3 mm on the top and bottom or by reinforcing the gauze at the top and bottom with a platinum ring or band.

5.2.1.2 The diameter and height of the cylinder should be approximately 30 mm and 50 mm respectively. The stem should be made from platinum alloy wire such as platinum-iridium, platinum-rhodium or platinum-ruthenium having diameter of approximately 1.5 mm. It should be flattened and welded to the entire height of the gauze. The overall height of the cathode including the stem should approximately be 130 mm.

5.2.2 Anode

Either a spiral or a gauze anode should be used. The spiral anode should be made from 1.0 mm or larger platinum wire formed into a spiral of seven coils with a height of approximately 50 mm and

diameter of 12 mm, the overall height including the stem being 130 mm. The gauze anode should be made of the same material and of the same general design as platinum gauze cathode specified under 5.2.1.

5.3 Reagent

5.3.1 Sulphuric Acid-Nitric Acid Mixture

Add slowly, with constant stirring, 300 ml of concentrated sulphuric acid (sp gr 1.84; conforming to IS 266) to 750 ml of water, cool, add 210 ml of concentrated nitric acid (sp gr 1.42; conforming to IS 264) .

5.3.2 Ethanol or Methanol – 95 percent (v/v).

5.4 Procedure

5.4.1 Transfer 2 g of an accurately weighed sample into a 250-ml beaker provided with a cover glass and add 20 ml of sulphuric acid-nitric acid mixture. After the initial reaction is over, heat to 80° to 90°C until completely dissolved and brown fumes and expelled.

5.4.2 Wash down the cover and sides of the beaker and dilute the solution to 200 ml. Add 2 g of urea, insert the electrodes, the cathode having been accurately weighed; cover with a pair of split cover glass and electrolyze for 16 hours at a current density of 0.6 A/dm² (at this current density, the electrolysis is conveniently carried on overnight), or at a current density of 4 A/dm² for a short period (about 2.5 hours). In the latter case, one of the types of rotating forms of electrodes generally available may be used. When the solution becomes colourless reduce the current density to 0.3 A/dm² and continue electrolysis until the deposition of copper is complete as indicated ,by absence of plating on the new surface of the electrode obtained by raising the level of the solution.

5.4.3 Without interrupting the current, raise the electrode assembly. While raising, rinse thoroughly with water and collect the washings into the electrolyte. Remove the cathode quickly while washing further with water; rinse it with water in a beaker and then dip it in two successive baths of ethanol or methanol. Dry the cathode in an air oven at 110°C for three to five minutes, cool and weigh for copper. Preserve the electrolyte for the determination .of cadmium.

5.5 Calculation

$$\text{Copper, percent} = \frac{A}{B} \times 100$$

where

A = weight in g of copper, and

B = weight in g of the sample taken.

6 DETERMINATION OF CADMIUM BY EDTA (VOLUMETRIC)

6.1 Outline of the Method

Cadmium is precipitated from the electrolyte preserved under 5.4.3 by diethyldithiocarbamate; dissolved in hydrochloric acid and determined volumetrically by titration with EDTA.

6.2 Reagents

6.2.1 Tartaric Acid Solution (300 g/l)

Dissolve 300 g of tartaric acid in 700 ml of water with heat, cool to room temperature, and dilute to one litre.

6.2.2 Methyl Red Indicator Solution (0.4 g/l)

Dissolve 0.1 g of methyl red in 3.72 ml of 0.100 0 N Sodium hydroxide solution and dilute to 250 ml with water. Filter if necessary.

6.2.3 Sodium Hydroxide Solution (200 g/l)

Dissolve 200 g of sodium hydroxide in 800 ml of water, cool to room temperature, and dilute to one litre.

6.2.4 Potassium Cyanide (100 g/l)

Dissolve 100 g of potassium cyanide in 500 ml of water and dilute to one litre.

NOTE – The preparation, storage, and use of potassium cyanide solutions requires care and attention. Avoid inhalation of fumes and exposure of skin to the chemical or its solutions. Work in a well-ventilated room.

6.2.5 Sodium Diethyldithiocarbamate Solution (20 g/l)

Dissolve 20 g of the salt in 800 ml of water with heat; cool to room temperature, and dilute to one litre.

6.2.6 Wash Solution

To 20 ml of sodium hydroxide solution add 10 ml of potassium cyanide solution and 10 ml of sodium diethyldithiocarbamate solution and dilute to one litre.

6.2.7 Concentrated Hydrochloric Acid – sp gr 1.16 (conforming to IS 265).

6.2.8 Buffer Solution

Dissolve 54 g of ammonium chloride in 300 ml of water, add 350 ml of ammonium hydroxide and dilute to one litre. The pH value of this solution is 10.

6.2.9 Eriochrome Black-T Indicator Solution

Dissolve 0.4 g of Eriochrome black-T1- (1-hydroxy-2-naphtholazo) -5-nitro-2-naphthol-4-sulphonic acid, sodium salt in 20 ml of ethanol. Add 30 ml of triethanolamine and store in a polythene dropping bottle.

6.2.10 Formaldehyde (1:9)

Dilute 100 ml of formaldehyde (37 percent) with 900 ml of water.

6.2.11 Standard Disodium Ethylenediamine Tetra-acetate (EDTA) Solution (0.025 M)

Dissolve 9.6 g of the salt in 600 ml of water while heating. Cool to room temperature, add 0.1g of magnesium chloride ($\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$), and dilute to one litre with water. Standardize the solution as follows.

6.2.11.1 Transfer, to an 800-ml beaker, an aliquot of the standard zinc solution. Continue as directed in **6.3.5**. Calculate the equivalent of the EDTA solution in terms of grams of zinc per millilitre of solution. .

6.2.12 *Standard Zinc Solution* (1 ml = 0.001 0 g of Zn)

Dissolve 1.000 g of pure zinc in 50 ml of sulphuric acid (1:4), cool to room temperature, and dilute to one litre.

6.3 Procedure

6.3.1 Evaporate the electrolyte reserved under **5.4.3**. Cool to room temperature and dilute to 250 ml with water.

6.3.2 Add 15 ml of tartaric acid solution and 8 drops of methyl red indicator. Carefully neutralize the solution with sodium hydroxide solution avoiding excess. Add 10 ml of potassium cyanide solution and 75 ml of sodium diethyldithiocarbamate solution. Stir thoroughly and allow to stand for about 30 minutes.

6.3.3 Filter the solution with suction through the fritted glass crucible. Wash the precipitate twice by decantation with the wash solution (*see 6.2.6*). Transfer the crucible and the precipitate to a 250-ml beaker and add 25 ml of concentrated hydrochloric acid and 30 ml of water to completely cover the precipitate and the crucible. Heat until the precipitate is completely dissolved. Cool to room temperature and dilute to 200 ml.

6.3.4 Neutralize the solution with sodium hydroxide solution using methyl red indicator. Add 30 ml of buffer solution, 10 ml of potassium cyanide solution, 5 drops of eriochrome black-T indicator and sufficient formaldehyde to just give a red colour.

6.3.5 Titrate slowly with standard EDTA solution to a bluish-green end point. Add 5 ml of formaldehyde solution and if the colour changes to red, titrate again with EDTA solution to a bluish-green end point. Continue the formaldehyde addition, and if necessary, the EDTA titrations, until the bluish-green end point is stable for at least two minutes for the last formaldehyde addition.

6.4 Calculation

$$\text{Cadmium, percent} = \frac{A \times B}{C} \times 100$$

where

A = volume in ml of EDTA solution required for titration of the solution,

B = cadmium equivalent in g/ml of EDTA solution, and

C = weight in g of the sample taken,