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IS 2753-1 (1991): Methods for estimation of preservatives in treated timber and in treating solutions, Part 1: Determination of copper, arsenic, chromium, zinc, boron, creosote and fuel oil [CED 9: Timber and Timber Stores]



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भारतीय मानक

उपचारित लकड़ी और उपचार करने वाले घोल में
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भाग 1 तांबा, आर्सेनिक, क्रोमियम, जस्ता, बोरान, क्रीओसोट तथा
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(पहला पुनरीक्षण)

Indian Standard

**METHODS FOR ESTIMATION OF
PRESERVATIVES IN TREATED TIMBER AND
IN TREATING SOLUTIONS**

**PART 1 DETERMINATION OF COPPER, ARSENIC, CHROMIUM
ZINC, BORON, CREOSOTE AND FUEL OIL**

(First Revision)

UDC 674.048 : 543

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**BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002**

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FOREWORD

This Indian Standard (Part 1) (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Timber Sectional Committee had been approved by the Civil Engineering Division Council.

IS 401 : 1982 'Code of practice for preservation of timber (*third revision*)' covers details of preservatives, methods of preservative treatment of timber, etc. The standard (Parts 1 and 2) details the methods of detection and estimation of the preservatives in such treated timber and treating solutions. While Part 1 covers determination of copper, arsenic, chromium, zinc, boron, creosote and fuel oil, Part 2 of the standard covers the determination of copper (in copper organic preservative salts) and pentachlorophenol.

This standard (Part 1) was first published in 1964. In this revision, modifications have been made in Method I and Method II for digestion of wood flour and in the procedure for determination of copper as $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ on the basis of experience gained. Part 2 of this standard deals with the determination of copper (in copper organic preservative salts) and pentachlorophenol.

In preparation of this standard considerable assistance has been rendered by the Forest Research Institute, Dehra Dun.

In reporting the results of a test or analysis made in accordance with the standard, if the final value observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

Indian Standard

METHODS FOR ESTIMATION OF PRESERVATIVES IN TREATED TIMBER AND IN TREATING SOLUTIONS

PART 1 DETERMINATION OF COPPER, ARSENIC, CHROMIUM, ZINC, BORON, CREOSOTE AND FUEL OIL

(First Revision)

1 SCOPE

1.1 This standard (Part 1) lays down methods for the quantitative and qualitative estimation of the following in treated timber and in treating solutions:

- a) Copper, arsenic and chromium in timber treated with copper-chrome-arsenic or copper-chrome preservatives;
- b) Chromium and zinc in timber treated with chromated zinc chloride;
- c) Boron; and
- d) Creosote and fuel oil in timbers treated with creosote-fuel-oil mixtures.

2 REFERENCES

2.1 Indian Standard IS 1070 : 1977 'Water for general laboratory use (*second revision*)' is necessary adjunct to this standard.

3 QUALITY OF REAGENTS

3.1 Unless specified otherwise, pure chemicals and distilled water (*see* IS 1070 : 1977) shall be employed in the tests.

NOTE — 'Pure chemicals' shall mean chemicals that do not contain impurities which affect the results of analysis.

4 QUANTITATIVE DETERMINATION OF COPPER, ARSENIC AND CHROMIUM IN TIMBER TREATED WITH COPPER- CHROME-ARSENIC OR COPPER-CHROME PRESERVATIVES

4.1 Selection of Sample

Ensure that the sample of treated timber taken is as representative as possible of the timber or timbers concerned. The area of the timber selected shall be free from end penetration; if this precaution is not taken, the results obtained will be too high.

4.2 Preparation of Sample

Pulverize about 20 g of the dry sample until all the sample passes 425 microns IS Sieve. Collect the wood flour, mix well and dry to constant weight in an oven at 110°C.

4.3 Digestion of Wood Flour

4.3.1 Method I

Weigh approximately 5.00 to 10.00 g of the prepared wood flour and transfer to a Kjeldahl flask. Add concentrated nitric acid at the rate of about 8 ml per gram of the sawdust and 5 ml of sulphuric acid for the entire mass and allow the contents to stand over night in a hood. Gently heat for one hour and increase the temperature slowly. When charring begins add successive portions of 5 ml of concentrated nitric acid until, on slight fuming, the solution become pale yellow. Allow to cool. Make it to a known volume with distilled water in a graduated flask. This solution should be used for the determination of arsenate, copper and chromate.

For the determination of chromate, add to the solution, one millilitre of phosphoric acid (sp-gr 1.75), 5 ml of 0.1 N silver nitrate and 0.2 ml of 0.1 N potassium permanganate. Bring the solution to the boil and sprinkle a few milligrams of potassium persulphate into the boiling solution until the solution remains a permanent pink. Boil for 10 minutes. Allow to cool. Add 20 ml of sodium chloride solution (10 percent w/v) and reboil for 8 minutes. Periodically wash down the sides of the flask. Cool and dilute with water to prevent reduction of hexavalent chromium due to high acidity. Add about 10 ml of sulphuric acid (1:1 by volume) and proceed for the analysis of chromium.

4.3.2 Method II (For Timber Treated with Copper, Chromium, Arsenic and Zinc)

Weigh the wood flour into an Erlenmeyer flask. Add 40 (80) ml of concentrated nitric acid and preferably allow to stand overnight. Add 5 (10) ml of 70 percent perchloric acid and 10 (20) ml of sulphuric acid in the order given. Digest at low heat on a hot-plate/indane gas burner for about one hour or until the wood is dissolved or brown fumes cease to evolve. Now heat the contents over naked flame of the burner at high temperature until the solution becomes pale yellow in colour. If the solution remains dark in colour then add 5 (10) ml of conc nitric acid and reheat to fumes. If charring again occurs, add more nitric acid and heat. Cool and add 5 (10) ml of perchloric acid and heat to fumes of perchloric acid. The solution should become pale yellow in colour.

NOTE — The figure outside the brackets apply to quantities of wood flour up to 5 g and the figures within the brackets apply to quantities of 5 to 15 g.

4.3.2.1 Precautions

The improper and careless use of perchloric acid may lead to violent and dangerous explosions. Digestions once started should be kept away from any possible contact with other organic matter. The digestions should not be allowed to boil dry. Perchloric acid digestions should preferably be carried out in special hoods reserved for this purpose only. Large volumes of water should immediately be applied to all spills of perchloric acid. Saw-dust rags or other organic material should never be used.

4.4 Methods of Estimation

The methods given in 4.4.1 to 4.4.3 are intended for analysis of solutions containing up to 7.2 percent of salt. Concentrations higher than this necessitate either an increase in the amounts of some of the reagents used or a decrease in the size of the sample analyzed. The treating solution or digested solution should be made thoroughly homogeneous by agitating before a sample is taken for analysis. A portion of the sample is then filtered and analysis carried out in duplicate on 10-ml portions of the clear filtrate.

4.4.1 Determination of Arsenic as $As_2O_5 \cdot 2H_2O$

4.4.1.1 General

Arsenic is determined by titration with potassium bromate solution of known strength after separating the arsenic from the other components of the treating solution with hypophosphorous acid.

4.4.1.2 Reagents

- Concentrated hydrochloric acid (HCl) — sp-gr 1.19.
- Hypophosphorous acid (H_3PO_2) — 50 percent.
- Concentrated sulphuric acid (H_2SO_4) — sp-gr 1.84.
- Solution of potassium bromate ($KBrO_3$) — containing 2.093 g of reagent grade potassium bromate per one litre of solution.
- Methyl orange indicator solution — containing 0.1 g of methyl orange per 100 ml.

4.4.1.3 Procedure

Pipette 10 ml of the filtered treating solution into a 250-ml wide-mouthed Erlenmeyer flask and to this add 10 ml of distilled water, 25 ml of concentrated hydrochloric acid and 10 ml of 50 percent hypophosphorous acid. Heat the solution carefully to 70° to $80^\circ C$, but avoid boiling until all the arsenic has been precipitated. After 10 minutes boil the solution gently until the precipitate has coagulated. With the aid of suction, filter the hot solution through a 10-ml porcelain Gooch crucible containing a mat of medium-fibre acid-washed asbestos. Rinse the flask several times with small portions of distilled water, and pour all

rinsings through the filter. Wash the precipitate in the crucible three or four times.

Put the crucible containing the precipitate into the original wide-mouthed Erlenmeyer flask. Add 10 ml of concentrated sulphuric acid and heat the flask while swirling over an open flame until dense fumes evolved gradually rise to the neck of the flask. Cool the solution thoroughly and carefully dilute to about 100 ml with distilled water and add 5 ml of concentrated hydrochloric acid and two drops of methyl orange indicator. Subject the mixture to preliminary warming on a steam-bath and undertake the final titration at room temperature running in the 0.209 3 percent potassium bromate solution until the pink colour is destroyed leaving a colourless solution. Approach the end-point of this titration very carefully to avoid over-running.

4.4.1.4 Calculation

The percentage of arsenic pentoxide in the treating solution is found by dividing the titre by 20.

Example:

Ten millimeters of treating solution requires the addition of 15.0 ml of 0.209 3 percent potassium bromate solution. Therefore, the percentage of arsenic pentoxide is:

$$15.0/20 = 0.75$$

The treating solution, therefore, contains 0.75 g of $As_2O_5 \cdot 2H_2O$ per 100 ml or 0.75 percent.

4.4.2 Determination of Copper as $CuSO_4 \cdot 5H_2O$

4.4.2.1 General

Copper is determined iodometrically after first destroying the chromate with hydrogen peroxide methanol or ethanol in acid solution. Excess of hydrogen peroxide methanol or ethanol is removed by boiling. After adjusting the acid concentration, potassium iodide is added and the solution is titrated immediately with a sodium thiosulphate solution of known strength.

4.4.2.2 Reagents

- Concentrated hydrochloric acid (HCl) — sp-gr 1.19.
- Hydrogen peroxide (H_2O_2) — 30 percent solution.
- Sodium hydroxide (NaOH) — 20 percent solution.
- Potassium iodide (KI) — 20 percent solution.
- Starch indicator solution — 0.5 percent.
- Standard sodium thiosulphate solution — containing 9.950 g of sodium thiosulphate ($Na_2S_2O_3 \cdot 5H_2O$) per litre.

4.4.2.3 Procedure

Pipette 10 ml of the filtered treating solution into a 300-ml Erlenmeyer flask and add 10 ml of distilled water and 5 ml of concentrated hydrochloric acid, after

which pour 5 ml of 30 percent hydrogen peroxide carefully down the side of the flask while gently swirling the contents. Now heat the solution gently until all oxygen evolution ceases and then boil for 2 to 3 minutes. Rinse the sides of the flask with a small amount of water and resume boiling only when the volume has been reduced to about 10 ml of yellowish-green solution smelling strongly of hydrochloric acid. Adjust the acidity of the solution by adding 20 percent sodium hydroxide solution slowly with constant stirring until a permanent precipitate just forms. Then add concentrated hydrochloric acid drop by drop until the precipitate just dissolves, after which add one or two drops more.

Cool the solution, add 10 ml of 20 percent KI and carry out the titration with 0.995 percent sodium thiosulphate immediately. When the end point is approached and the colour resulting from the liberated iodine has become barely perceptible add 5 ml of the starch solution. Continue the titration until the blue colour fades and the addition of any drop produces no further colour change.

If the end point is not sharp then add in the beginning 3 g of ammonium hydrogen difluoride followed by 2 g of ammonium thiocyanate prior to adding KI solution.

4.4.2.4 Calculation

If the thiosulphate used was exactly 0.995 percent, the titration in millimetres divided by 10 will correspond to the concentration of copper sulphate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) per 100 ml or 2.25 percent.

Example :

Ten millimetres of treating solution requires the addition of 22.50 ml of 0.995 percent thiosulphate. The copper in the treating solution is, therefore, equivalent to $22.5/10 = 2.25$ g of copper sulphate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) per 100 ml or 2.25 percent.

4.4.3 Determination of Hexavalent Chromium as $\text{K}_2\text{Cr}_2\text{O}_7$

4.4.3.1 General

Hexavalent chromium is determined by reduction with an excess of ferrous ammonium sulphate solution and subsequent titration of the excess ferrous salt with one percent potassium dichromate solution, using barium diphenylamine sulphonate as an internal indicator.

4.4.3.2 Reagents

- Phosphoric acid (H_3PO_4) — 85 percent; sp-gr 1.71.
- Ferrous ammonium sulphate solution — containing 140 g of ferrous ammonium sulphate $[\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}]$ and 25 ml of concentrated sulphuric acid per litre.
- Potassium dichromate solution — containing 10 ± 0.001 g of potassium dichromate ($\text{K}_2\text{Cr}_2\text{O}_7$) per litre.
- Barium diphenylamine sulphonate solution — containing 0.2 g of the salt in 100 ml of solution.

4.4.3.3 Procedure

Pipette exactly 10 ml of filtered treating solution into a 500 ml Erlenmeyer flask and dilute with about 200 ml of distilled water. Then add 3 ml of 85 percent phosphoric acid after which pipette exactly 25 ml of the ferrous ammonium sulphate solution into the flask. This will cause a colour change from orange to clear green; no trace of yellow should remain. Add ten drops of the indicator and titrate the solution with the one percent potassium dichromate. The end point is reached when the colour changes from clear bright green to musky dark green or purple.

At the time of carrying out the foregoing titrations, pipette another 25 ml portion of the same ferrous ammonium sulphate solution into a 500 ml flask, dilute to about 200 ml with distilled water and add 3 ml of phosphoric acid and 10 drops of indicator; carry out the titration with the one percent dichromate solution to the same end-point as above.

4.4.3.4 Calculation

Determine the concentration of hexavalent chromium in the treating solution by subtracting the titration of the solution containing the treating solution from that of the ferrous solution alone and dividing this difference by 10.

Example :

Twenty-five millilitres of ferrous ammonium sulphate solution plus 10 ml of the treating solution require 3.20 ml of one percent potassium dichromate.

Twenty-five millilitres of the same ferrous ammonium sulphate solution alone require 40.70 ml of one percent potassium dichromate.

Therefore, volume of one percent potassium dichromate in 10 ml of treating solution = $40.70 - 3.20 = 37.50$ ml.

Hence, concentration of chromium

$$\text{as potassium dichromate} = \frac{37.50}{10} = 3.75$$

5 QUANTITATIVE ESTIMATION OF CHROMIUM AND ZINC IN TIMBER TREATED WITH CHROMATED ZINC CHLORIDE

5.1 The sample shall be prepared and digested as in 4.1, 4.2 and 4.3.1.

5.2 Methods of Determination

5.2.1 Determination of Chromate

This shall be determined by the same procedure as given in 4.4.3.

5.2.2 Determination of Zinc

5.2.2.1 General

The sample in filtered solution should contain zinc equivalent to approximately 0.25 g of zinc chloride.

5.2.2.2 Reagents

- Dilute sulphuric acid (H_2SO_4) — 1 : 1 dilution.
- Sodium bisulphate solution (NaHSO_3) — 5 percent in distilled water.
- Ammonium hydroxide — 1 : 1 dilution.
- Ammonium sulphate [$(\text{NH}_4)_2\text{SO}_4$] — solid.
- Diphenylamine indicator — Dissolve one gram of diphenylamine in 100 ml of concentrated sulphuric acid.
- Potassium ferricyanide solution [$\text{K}_3\text{Fe}(\text{CN})_6$] — one percent in distilled water.
- Standard potassium ferrocyanide solution [$\text{K}_4\text{Fe}(\text{CN})_6 \cdot 3\text{H}_2\text{O}$] — Prepare by weighing accurately 20.67 g of potassium ferrocyanide [$\text{K}_4\text{Fe}(\text{CN})_6 \cdot 3\text{H}_2\text{O}$] and dissolving it in distilled water, adding 0.2 g of sodium carbonate to stabilize the solution and making the volume up to one litre. The solution should be kept in a dark bottle.

5.2.2.3 Procedure

- Place the sample in a 500-ml Erlenmeyer flask and add sufficient water to make a total volume of about 50 ml. Add 8 ml of dilute sulphuric acid to the solution and mix well. While gently agitating, add dropwise from a pipette sodium bisulphite solution until the solution changes from its original orange to a green colour. Continue addition until an excess of approximately 10 drops of the bisulphite solution has been added after the final colour change. Boil the solution down to a volume of 20 to 25 ml to expel all sulphur dioxide.
- Cool to about room temperature, add 50 ml of distilled water and neutralize to litmus paper with 1 : 1 ammonium hydroxide. Add 25 ml of 1 : 1 sulphuric acid and enough distilled water to bring the volume of the solution up to 150 ml. Add approximately 10 g of ammonium sulphate and stir until dissolved. Add 6 drops of diphenylamine indicator and 3 drops of potassium ferricyanide solution.
- Titrate with standard potassium ferrocyanide solution by adding it rapidly at first and then dropwise with thorough agitation after each drop as the end-point is approached. Near the end-point, add 2 more drops of potassium ferricyanide solution. The original blue colour of the solution turns to violet as the end-point is approached. At the end-point it becomes creamy white or very pale green.

For the standardization of the potassium ferrocyanide solution used, weigh a portion of pure zinc between 0.15 and 0.20 g to the nearest 0.1 mg. Place the zinc in a 500-ml Erlenmeyer flask and add 10 ml of concentrated hydrochloric acid to dissolve it. After the initial rapid reaction, the rate of solution may be hastened by heating and agitation.

When the zinc has completely dissolved, proceed further as specified in (b) and (c).

5.2.2.4 Calculation**a) Percentage of zinc chloride**

1.0 ml of standard potassium ferrocyanide containing 0.020 67 g of [$\text{K}_4\text{Fe}(\text{CN})_6 \cdot 3\text{H}_2\text{O}$] is equivalent to 0.01 g of zinc chloride.

Therefore,

$$\text{ZnCl}_2, \text{ percent} = a/b$$

where

a = volume in ml of $\text{K}_4\text{Fe}(\text{CN})_6$, and

b = weight in g of sample.

If the potassium ferrocyanide solution does not contain exactly 20.67 g of [$\text{K}_4\text{Fe}(\text{CN})_6 \cdot 3\text{H}_2\text{O}$] per litre, apply a correction factor obtained by the standardization procedure for potassium ferrocyanide.

b) Correction factor

1.0 g of zinc is equivalent to 4.308 g of $\text{K}_4\text{Fe}(\text{CN})_6 \cdot 3\text{H}_2\text{O}$.

Therefore,

$$\text{Weight in g of } \text{K}_4\text{Fe}(\text{CN})_6 \cdot 3\text{H}_2\text{O} = \frac{x \times 4.308 \times 1.000}{y}$$

per litre of solution

where

x = weight in g of zinc, and

y = titration in ml.

This value divided by 20.67 gives the correction factor for the standard potassium ferrocyanide solution.

6 QUANTITATIVE DETERMINATION OF BORON**6.1 Reagents**

6.1.1 Dilute Sodium Hydroxide Solution — 10 percent (w/v).

6.1.2 Phenolphthalein Indicator — 0.1 g in 100 ml of 60 percent rectified spirit.

6.1.3 Concentrated Hydrochloric Acid — sp-gr 1.19.

6.1.4 Methly Orange

6.1.5 Glycerol

6.2 Digestion of Wood Flour

Mix about 2.5 to 5 g of finely ground wood to a paste with saturated barium hydroxide in a platinum crucible. Dry on a water-bath, ash slowly in muffle furnace first at low temperature and then gradually raise the temperature to dull red heat (about 500° to 600°C). Ashing should be completed in about 1 1/2 hours. When no trace of carbon remains, half fill the crucible with distilled water. Add dilute HCl to dissolve the ash. Keep the crucible covered during this

operation. Make the solution to a known volume in a graduated flask. This solution should be used for the determination of boron.

6.3 Procedure

Take 10 ml aliquots of about 1 to 1.25 percent boric acid solution in nickel or platinum evaporating basin, add 2 to 3 ml of 10 percent (w/v) sodium hydroxide and evaporate to nearly dryness over a water-bath. Ignite the residue for about 5 minutes at a dull red heat.

Dissolve the residue in about 10 ml of warm distilled water into an Erlenmeyer flask. Add 2 drops of phenolphthalein and then concentrated hydrochloric acid dropwise till colour fades. Add 2 drops of methyl orange and few drops of concentrated hydrochloric acid till the solution is acidic to this indicator.

By means of dilute sodium hydroxide adjust the solution to methyl orange end-point and boil gently for 15 minutes under air reflux condenser, making sure that steam does not issue from the top of the condenser (this step is to remove carbon dioxide from the solution). Cool the solution and readjust to methyl orange end-point. Add a measured amount (approximately equal to one-and-a-half times the volume of the solution) of glycerol to the solution 0.5 ml of phenolphthalein and titrate with N/10 standard, carbonate free sodium hydroxide to the phenolphthalein end-point.

6.4 Calculation

Calculation on the basis that one millilitre of N/10 NaOH = 0.006 19 g of boric acid. Glycerol is often acidic in reaction, hence corrections should be applied by taking measured quantity of glycerol diluted by equal volume of distilled water and titrating with 0.1N sodium hydroxide solution.

7 QUANTITATIVE DETERMINATION OF CREOSOTE AND FUEL OIL IN TIMBERS TREATED WITH CREOSOTE FUEL OIL MIXTURES

7.1 Selection of Sample

Ensure that the sample of treated timber taken is as representative as possible of the timber or timbers concerned.

7.2 Preparation of Sample

Powder about 200 g of the sample to pass through 425-micron IS Sieve and mix well (the moisture content may be separately determined by the Dean and Stark Method).

7.3 Procedure

Weigh approximately 50 to 100 g of the prepared sawdust and transfer it to a Soxhlet extraction apparatus. Pour down ether till two successive complete runs take place into the flask. Heat the flask (preferably at 60°C) on a water-bath or carbon filament bulbs. Stop heating when the extractions from the dust are colourless. Cool and carefully remove the extracted dust. Again heat the flask till all the ether is separated from the

creosote-fuel oil mixture. Heat the flask containing creosote-fuel oil mixture over a water-bath for about 5 minutes to remove final traces of ether (Some resin is also extracted by the ether along with the creosote and may be removed by washing with a 5 percent solution of potassium carbonate.) Weigh the flask. The difference in weight of the flask containing creosote-fuel oil mixture and the empty flask is the weight of the creosote-fuel oil extracted.

For the determination of the amounts of creosote and fuel oil, distil the mixture up to 350°C in a distillation flask. Take 4 ml of the distillate in a graduated cylinder and add dimethyl sulphate to make the volume to 10 ml. Carefully shake the cylinder and allow to stand for some time. The volume of the upper layer in the cylinder represents fuel oil in the mixtures.

8 QUANTITATIVE TEST FOR THE PRESENCE OF PRESERVATIVES IN TREATED TIMBER BY COLOUR REACTION

8.1 Copper-Chrome-Arsenic Composition and Copper-Chrome Preservatives

8.1.1 Method I

8.1.1.1 Preparation of reagent

Dissolve 0.5 g of diphenyl carbazide in 50 ml of isopropyl alcohol and 50 ml of distilled water. Syndiphenyl carbazide, so obtained, shall be freshly prepared if there are intervals of more than a day between tests.

8.1.1.2 Test

A reasonably dry boring or cross-section of the timber to be tested shall be dipped into or sprayed with the solution obtained in 8.1.1.1. The reagent-treated surface shall be examined within 15 minutes from applying the reagent.

8.1.1.3 Reaction

The material treated with the preservative quickly turns purple while the untreated material or part retains nearly its original colour.

8.1.2 Method II

8.1.2.1 Preparation of reagent

Dissolve 0.5 g of chrome azurol S and 5.0 g of sodium acetate in distilled water and dilute to 100 ml.

8.1.2.2 Test

Apply the reagent mixture obtained in 8.1.2.1, in the form of mist, evenly over the surface to be tested. If too much reagent is sprayed on to the surface, the reaction will be masked and the results will be unreliable.

8.1.2.3 Reaction

Immediately after spraying, the parts of the surface-treated with the preservative change to blue colour, while the untreated parts will remain red.

8.2 Zinc Chloride

8.2.1 Preparation of Reagents

Prepare about 200 ml of each of the following stock solutions and keep them separate until use :

- a) Potassium ferricyanide solution — one percent (w/v).
- b) Potassium iodide solution — two percent (w/v).
- c) Soluble starch solution — five percent; boil until starch is in solution. Freshly prepared solution shall be used each time.

8.2.2 Test

Mix 10 ml each of the three stock solutions and pour into an atomizer. Spray the solution on the reasonably dry boring or cross-section of the timber to be tested.

8.2.3 Reaction

The material treated with the preservative turns deep blue instantly while the untreated material or part retains the original colour.

8.3 Boric Acid and Borax

8.3.1 Preparation of the Reagents

- a) *Alcoholic extract of the turmeric powder* — Reflux 2 g of turmeric powder with 100 ml of 95 percent alcohol for one hour, cool and filter.
- b) *Extract of salicylic acid and hydrochloric acid* — Saturate with salicylic acid and a mixture of 80 ml of distilled water and 20 ml of 30 percent hydrochloric acid.

8.3.2 Test

Apply the alcoholic extract of turmeric powder obtained in 8.3.1(a) on a reasonably dry surface of the material to be tested. Allow the surface to dry for a few minutes and apply the extract obtained in 8.3.1(b).

8.3.3 Reaction

The treated surface develops red colour.

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BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 331 01 31, 331 13 75

Telegrams : Manaksanstha
(Common to all Offices)

Regional Offices:

	Telephone
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	{ 331 01 31 331 13 75
Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola CALCUTTA 700054	37 86 62
Northern : SCO 445-446, Sector 35-C, CHANDIGARH 160036	53 38 43
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