SRI LANKA STANDARD 923 : PART 2 : 1991

UDC 674. 04 : 621. 315. 66 : 66. 099. 4

SPECIFICATION FOR

COPPER/CHROME/ARSENIC PRESERVATIVE TREATMENT OF WOOD POLES FOR OVERHEAD POWDER AND TELECOMMUNICATION LINES

PART 2 - TEST METHODS

SRI LANKA STANDARDS INSTITUTION

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PART 2: TEST METHODS

SLS 923 : Part 2 : 1991

Gr. 12

SRI LANKA STANDARDS INSTITUTION
53, Dharmapala Mawatha,
Colombo 3,
Sri Lanka.

DRAFTING COMMITTEE ON WOOD POLES FOR OVERHEAD POWER AND TELECOMMUNICATION LINES

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SRI LANKA STANDARD

SPECIFICATION FOR PRESERVATIVE TREATMENT OF WOOD POLES FOR OVERHEAD POWER AND TELECOMMUNICATION LINES BY MEANS OF WATER-BORNE COPPER/CHROME/ARSENIC COMPOSITIONS

PART 2 : TEST METHODS

FOREWORD

This Sri Lanka Standard was authorized for adoption and publication by the Council of the Sri Lanka Standards Institution on 1991.04.02, after the draft, finalized by the Drafting Committee on Wood Poles for Overhead Power and Telecommunication Lines, had been approved by the Electrical Engineering Divisional Committee.

Copper/chrome/arsenic (CCA) preservative is the most widely used preservative for wood poles throughout the world. It has also proved effective for treating a wide range of species for a variety of applications from building timbers to marine piles due to the following advantages.

a) The solvent water is readily available.
b) Retentions can be easily adjusted by varying the concentration of the treating solution.
c) Evaporation is negligible;
d) The preservative is odourless and non-oily.
e) Economy in freight.

This part (Part 2) of the standard specifies the test methods.

Part 1 of the standard specifies the compositions of the preservative, the methods of application, the retentions and penetrations desired from the prescribed treatment and a method for assessing the effectiveness of treatment.

In reporting the results of a test or an observation made in accordance with this standard, if the value, observed or calculated, is to be rounded off, it shall be done in accordance with **CS 102**.

The Sri Lanka Standards Institution gratefully acknowledges the use of relevant publications of the British Standards Institution, Standards and Industrial Research Institute of Malaysia, and Bureau of Inadian Standards in the preparation of this standard.

1 SCOPE

This part of the standard specifies test methods related to the preservative treatment of wood poles for overhead power and telecommunication lines by means of water_borne copper/chrome/arsenic compositions.

2 REFERENCES

ISO 3696	Water for laboratory use
BS 410	Test sieves
BS 700	Graduated pipettes
BS 846	Burettes
BS 1792	Volumetric flasks
SLS 848	Wood poles for overhead power and telecommunication lines Part 2 : Selection and preparation for treatment
CS 102	Presentation of numerical values
SLS 923	Preservative treatment of wood poles for overhead power and telecommunication lines by means of water-borne copper/chrome/arsenic compositions. Part 1 Treatment processes

3 DEFINITIONS

3.1 **thief tube:** A device for the purpose of sampling the preservative in a drum.

4 METHODS OF SAMPLING

4.1 Selection of drums from a consignment

4.1.1 The least number of drums to be sampled out of any given consignment of preservative material, irrespective of whether it is composed of a solid or a paste, shall be the nearest whole number to the square root of half the total number of drums in the consignment (see Table 1). The drums to be sampled shall be taken at random.

Table 1 - Sampling of drums

Number of drums in consignment (x)	$\left[\frac{x}{2}\right]^{1/2}$	Number of drums to be sampled
10	2.24	2
20	3.16	3
50	5.0	5
100	7.07	7

4.2 Sampling the preservative

4.2.1 *Preservatives in dry powder form*

4.2.1.1 Apparatus

A standard "thief tube" of internal diameter 32 mm and probe length 900 mm is a suitable sampling device for the purpose of sampling the quality of the preservative in a drum.

4.2.1.2 Procedure

Take three "thief" samples by the triangular method from each drum selected for testing. Transfer the contents of the "thief" to an airtight sample container of about 2.25 kg capacity. Bulk the extracted samples and mix well. Transfer the entire sample to a clean dry surface and heap into a cone. Turn over to form a new cone carrying out this operation three times. From each conical heap by depositing material on the apex of the cone so that the portions which slide down the side are distributed as evenly as possible, and that the centre of the cone is not displaced. Some of the larger aggregates of the mixture may roll and scatter round the base, and these should be pushed back to the edge of the heap or broken and distributed evenly over the heap. Flatten the third cone from the mixed contents of the container by repeated vertical insertions of the edge of a board, commencing about the centre and working radially round the cone, lifting the board clear of the material after each insertion. Carry out this operation so that the flattened heap is of uniform thickness and diameter, and the centre coincides with the centre of the original cone.

Quarter the heap along two diameters which intersect at right angles, using a suitable divider. Shovel one pair of opposite quarters into a heap and reject the remainder. Mix and cone three times as described above, flatten the cone and quarter along two diameters. Repeat these operations until about 200 g gross sample remains. Take utmost care to reduce the moisture picked up during the sampling and mixing and reducing processes. If necessary, grind the whole of the gross sample to pass a No.8 mesh test sieve and well mix the ground sample. Immediately enclose the test sample in an airtight container until ready for analysis.

4.2.1.3 Preparation of solution (2.0 per cent m/v) for analysis
Dissolve 40.0 g of the ground sample in distilled water, in a beaker. Filter into a 2000 ml volumetric, wash the residue carefully and make up to volume.

4.2.2 *Preservatives in paste form*

4.2.2.1 Apparatus

A small weighted sampling can of 500 ml capacity is required. It should be of such weight as to sink readily in the material to be sampled. The can should be fitted with a handle to which is attached a chain and with a removable stopper or cap to which is attached a separate chain so that after lowering the can to the required depth in the paste, the stopper can be removed and the container allowed to fill. A stout steel stirring rod, suitable for stirring the contents of the drum is also required.

4.2.2.2 Procedure

Thorough mixing of the preservative in each drum is necessary before samples are taken. Any settled material should be displaced from the base of the drums using the stirring rod. The drum closures should then be re-attached and the drums shaken and rolled to effect complete homogenisation of the contents. Mechanical agitation should be used if available. The drums should then be reopened and examined for uniformity by probing with the steel rod. Alternate stirring, shaking and rolling should be continued until the contents are completely homogeneous.

Three samples are then taken from each drum with the sampling can, from just below the surface of the preservative, at a position about half-way between the surface and the base of the drum and from near the base. The three samples from each drum should be poured into a clean glass or plastic container and mixed together.

4.2.2.3 Preparation of solution (2.0 per cent m/v) for analysis
Dissolve 40.0 g of the mixed sample in distilled water in a beaker. Filter into a 2000 ml volumetric flask, wash the residue carefully and make up to volume.

4.3 Extraction of the preservative from treated poles

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.

Pulverize about 20 g of the dry sample until all the sample passes through 425 micron sieve. Collect the wood flour, mix well and dry to constant weight in an oven at 110 ^{0}C.

Weigh approximately 5.00 to 10.00 g of the prepared wood flour and transfer to a Kjeldahl flask. Add concentrated nitric acid to the sawdust 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 overnight under 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, the solution becomes clear green. 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.

5 DETERMINATION OF INSOLUBLE MATTER

Weigh to the nearest 0.1 g, about 10 g of the prepared sample preservative (see 4.3) into a beaker and dissolve in 500 ml of distilled water, stirring continuously, at a temperature not higher than 40^0 C. Cool the solution if necessary, and filter through a sintered glass filter of porosity 3. Wash the beaker and residue five times with 10 ml portions of hot water and finally with 10 ml of 10 per cent v/v ethanol. Dry the residue to constant mass at 100^0 C. Calculate the insoluble matter as a percentage by mass of the preservative.

6 DETERMINATION OF COPPER CONTENT

An alternative method for determination of copper content is given in 9.

6.1 Reagents

The reagents shall be as listed below. They shall be of a recognized analytical reagent quality.

Distilled water complying with ISO 3696 shall be used.

a) Ammonium hydrogen difluoride
b) Ammonium thiocyanate
c) Potassium iodide, iodate-free
d) Methanol, redistilled using calcium oxide
e) Hydrochloric acid, concentrated, sp gr 1.18
f) Sodium hydroxide, 10 per cent m/v solution
g) Standard copper sulphate solution, containing 10 mg of $CuSo_45H_2O$ per ml.
h) Sodium thiosulphate solution
Dissolve 9.4 g of sodium thiosulphate in a sufficient amount of water. Add 0.1 ml chloroform and dilute to 1000 ml. Store preferably in a dark bottle.
j) Starch solution
Mix 1.0 g of soluble starch with water to give a paste, pour the paste into boiling water, stir and make up to 100 ml and boil for 1 min. Sterilize by adding 3 mg of mercuric iodide.

6.2 Procedure

Use the preservative solution, prepared as described in 4 for analysis.

Transfer 25 ml of the solution into a 500 ml conical flask. Add 10 ml of concentrated hydrochloric acid and then, with care, add 15 ml of methanol down the side of the flask.

Warm to boiling and continue heating until all the hexavalent chromium is reduced, as evidenced by the absence of any yellowish-green colour (see Note 1).

Wash down the sides of the flask with water and boil for 1 min. Cool and dilute to approximately 100 ml and add, from a burette, 10 per cent sodium hydroxide solution with vigorous swirling until the first permanent precipitate forms.

Add concentrated hydrochloric acid dropwise until the solution becomes clear. Boil down to about 50 ml and cool to room temperature.

Add 2 g of ammonium hydrogen difluoride and shake well
(See Note 2).
The pH value of the solution before adding the potassium iodide should be 5.0 or slightly above if high results are to be avoided.
Add 3 g of potassium iodide, stopper and swirl until dissolve and store the solution for 5 min in the dark.The solution will then turn brown.

Titrate the liberated iodine with the sodium thiosulphate solution until the brownish colour of the iodine disappears. Then add 2 ml of starch solution, the colour will change to violet at this point. Continue the titration until violet becomes colourless.

Add 2 g of ammonium thiocyanate just before the end point to sharpen the colour change.

6.3 Calculation

Let the volume of the sodium thiosulphate solution used be V_1 ml.

Percentage of copper sulphate ($CuSo_45H_2O$) in the sample = $V_1 \text{ X } F \text{ x } 200$ m/m

where,

F is the mass of copper sulphate $CuSo_45H_2O$ equivalent to 1 ml of sodium thiosulphate solution

The determination of F, the copper sulphate equivalent of the sodium thiosulphate solution, is carried out as follows :

Pipette 25 ml of the standard copper sulphate solution into a 500 ml conical flask, dilute to approximately 100 ml and follow the procedure given above, from the addition of 10 per cent sodium hydroxide solution.

$$\text{Then, } F = \frac{0.25}{V_2}$$

where,

V_2 is the mean volume of sodium thiosulphate used in duplicate run; and
F is as defined above.

NOTES

1. The solution should not be evaporated to dryness, otherwise difficulty may be experienced in re-dissolving the trivalent chrominum salts, and the determination may be vitiated.

2. The conical flasks used in this determination should be rinsed out without delay after the completion of the titration as they are liable to become etched through the use of ammonium hydrogen difluoride.

7 DETERMINATION OF HEXAVALENT CHROMIUM CONTENT

An alternative method for determination of chromium content is given in 9.

7.1 Reagent

The reagents shall be as listed below. They shall be of a recognized analytical reagent quality.

a) Othophosphoric/sulphuric acid mixture
   Add 280 ml of othorphosphoric acid (sp gr 1.75) into a 2000 ml volumetric flask and make up to volume with 50 per cent v/v sulphuric acid.

b) Ammonium ferrous sulphate solution
   Dissolve 80 g of ammonium ferrous sulphate in water containing 50 ml sulphuric acid (50 per cent v/v) and dilute to 1000 ml with water.

c) Standard potassium dichromate solution
   Dissolve 10.0 g of potassium dichromate in water and dilute to 1000 ml.

d) Barium diphenylaminesulphonate solution. Dissolve 0.20 g in 100 ml of water.

Distilled water complying with ISO 3696 shall be used to make up solutions.

7.2 Procedure

Use the preservative solution, prepared as described in 4 for analysis.

Pipette 25 ml of the solution into a 500 ml titration flask, add 25 ml of the othophosphoric and sulphuric acid mixture and dilute to 200 ml with water.

Then add 25 ml of the ammonium ferrous sulphate solution and 1 ml of the barium diphenylaminesulphonate indicator solution using a pipette. Titrate the mixture against the standard potassium dichromate solution until the solution becomes deep purple. Let the volume of potassium dichromate solution used be V_1 ml.

Pipette 25 ml of the ammonium ferrous sulphate solution into another 500 ml titration flask. Add 25 ml of mixed acids and 1 ml of the barium diphenylaminesulphonate solution. Titrate with the standard potassium dichromate solution. Let the volume of potassium dichromate solution used be V_2 ml.

7.3 Calculation

The percentage of hexavalent chromium -in the sample = $F (V_2 - V_1)$ m/m

where,

F = 2.00 for $K_2Cr_2O_7$
2.026 for $Na_2Cr_2O_72H_2O$
1.781 for $Na_2Cr_2O_7$
1.358 for CrO_3

8 DETERMINATION OF ARSENIC CONTENT

An alternative method for determination for arsenic content is given in 9.

8.1 Reagents

The reagents shall be as listed below. They shall be of a recognized analytical reagent quality.

a) Hydrochloric acid, concentrated, sp gr 1.18
b) Sulphuric acid, concentrated, sp gr 1.84
c) Hypophosphorous acid, 30 per cent m/v solution
d) Potassium bromate, 0.1505 N solution
Dissolve 4.188 g of potassium bromate ($KBrO_3$) in 1000 ml of water (1 ml = 0.01 g $As_2O_55H_2O$).
e) Methyl orange indicator
Dissolve 0.01 g of methyl orange in 100 ml of water.

Distilled water complying with ISO 3696 shall be used.

8.2 Procedure

Use the preservative solution prepared as described in 4 for analysis.

Transfer 50 ml of the solution into a 300 ml beaker and add 50 ml of the concentrated hydrochloric acid and 30 ml of the hypophosphorous acid solution. Mix thoroughly.

Cover and heat slowly to boiling and continue boiling gently for 15 min.

Filter the precipitate using a, Gooch crucible with an asbestos pad. When using a Gooch crucible, care should be taken during the packing of the asbestos pad. Careless packing will result in loss of arsenic. Wash with water to remove all traces of hypophosphorous acid.

Dislodge the asbestos pad holding the precipitate and wash carefully into the original beaker (see Note 1).

Add 10 ml to 15 ml of the concentrated sulphuric acid and dissolve the precipitate by heating gently, over a naked flame, swirling the mixture, continue to heat until fumes are produced. Allow to fume strongly for 2 min to 3 min, then leave to cool.

Slowly, with continual swirling, add 50 ml of water. Remove the asbestoes pad or the Gooch crucible and wash well. Dilute the solution to about 100 ml.

Add 10 ml to 15 ml of the concentrated hydrochloric acid and two drops of the methyl orange indicator (see Note 2).

Titrate immediately with the potassium bromate solution, stirring continuously until the solution becomes colourless or possibly a pale yellow colour.

8.3 Calculation

Let the volume of potassium bromate solution required be V ml. The percentage (m/m) of arsenic pentoxide in the sample expressed as $As_2O_52H_2O$) = 0.01 X V X 100

NOTES

1. If the precipitate and pad are not completely removed from the crucible, transfer the crucible to the beaker also.

2. In order to produce a sharp end point and obtain an acurate titration, the acidity with respect to hydrochloric acid should be not less than 1.2 N and not more than 3.5 N.

9 ATOMIC-ABSORPTION SPECTROPHOTOMETRIC METHOD FOR THE ANALYSIS OF PRESERVATIVE IN SOLUTION

9.1 Apparatus

An atomic absorption spectrophotometer capable of operating under the conditions specified in Table 2 is required.

NOTE

For the determination of arsenic, a hollow cathode lamp of high spectral output should be used.

9.2 Reagents

All reagents shall be as listed below. They shall be of a recognised analytical reagent quality. Water complying with ISO 3696 shall be used.

9.2.1 *Sulphuric acid 2 M*

Cautiously add stirring and cooling, 224 ml of sulphuric acid (d_{20} 1.84 g/ml) to 1600 ml of water, cool, dilute to 2000 ml with water and mix.

9.2.2 *Sodium sulphate 30 g/l solution*

Dissolve 30 g of anhydrous sodium sulphate in water and dilute to 1000 ml with water.

9.2.3 *Sulphuric acid 0.5 M /Sodium sulphate 3 g/l solution*

Add 250 ml of 2M sulphuric acid to 100 ml of sodium sulphate (30 g/l) and dilute to 1000 ml with water and mix.

9.2.4 *Standard solution*

(1 ml = 2000 ug of $CuSo_4.5H_2O$, 3000 µg of $K_2Cr_2O_7$, and 300o ug of $As_2O_5.2H_2O$)
Dissolve 0.2000 g of copper sulphate pentahydrate ($CuSo_4.5H_2O$), in water and transfer the solution to a 100 ml one-mark volumetric flask (BS 1792). Dissolve 0.3000 g of potassium dichromate ($K_2Cr_2O_7$) in water, add 10 ml of 2M sulphuric acid and 2 ml of 30 per cent (100 volume) hydrogen peroxide solution, boil, cool and transfer to the volumetric flask containing the copper sulphate solution. Dissolve 0.2233 g of arsenic trioxide (As_2O_3) by boiling in a solution containing 15 ml of 2 M sulphuric acid, 2 ml of 30 per cent (100 volume) hydrogen peroxide solution and 10 ml of water, cool and transfer to the volumetric flask. Add 10 ml of 30 g/l sodium sulphate solution to the volumetric flask, dilute to the mark with water and mix.

9.3 Instrument setting and operation

The instrument settings and operating conditions for the determination of copper, chromium and arsenic shall be as described in Table 2.

9.3.1 Flame ignition procedure for operating the argon (entrained air)/hydrogen flame with a propane burner.
Connect the argon cylinder, via a reducing valve, to the air inlet. Similarly connect the hydrogen supply to the fuel inlet. Ensure that the gas lines (especially the hydrogen line) are free from leaks and that the spray chamber is flushed with hydrogen. Adjust the hydrogen flow to 1500 $cm^3 min^{-1}$ and ignite the flame. Turn on the argon and adjust the flow to 5000 $cm^3 min^{-1}$.

NOTE

Great difficulty will be experienced in igniting the mixture if the argon and hydrogen are introduced together.

TABLE 2 - Instrument setting and operating conditions for the detection of copper, chromium and arsenic

Instrument control	Copper	Chromium	Aresnic
Wavelength (nm)	324.8	357.9 or 429.0	193.7 or 197.2
Slit width (mm)	0.08	0.06 to 0.10	0.30
Lamp current (mA)	4	8	7
Scale expansion	up to X 10	up to X 10	up to X 10
Burner acetylene (cm)	10	10	10
Burner height (cm)	1.0	0.5	1.4
Acetylene flow rate (cm^3 min^{-1})at a pressure of 70 kPa	1 000	1 800	-
Air flow rate (cm^3 min^{-1})at a pressure of 210 kPa	5 000	5 800	5 000
Hydrogen flow rate (cm^3 min^{-1})at a pressure of 70 kPa	-	-	18 000
Argon flow rate (cm^3 min^{-1})at a pressure of 210 kPa	-	-	5 000

NOTE

Small differences in setting may be necessary with instruments of different manufacture.

9.4 Preparation of calibration solutions

From a burette, complying with the requirements specified in **BS 846**, or graduated pipette, complying with the requirements specified for Type 2 in **BS 700**, transfer aliquot portions of 0.5 ml, 1 ml, 2 ml, 3 ml, 4 ml, 5 ml, 6 ml and 7 ml, of the standard solution (9.2.4) to 100 ml one mark volumetric flasks, complying with the requirements specified in **BS 1792**, dilute to the marks with the 0.5 M sulphuric acid/3 grams per litre sodium sulphate (9.2.3) solution and mix.

9.5 Procedure for analysis of preservative solution prepared as described in 4

9.5.1 Transfer by pipette 2 ml of the 20 g/1 solution to a 200 ml one-mark volumetric flask. Add 50 ml of 2 M sulphuric acid and 20 ml of 30 g/1 sodium sulphate solution, dilute to the mark with water and mix.

9.5.2 Aspirate, using the operating conditions given in Table 2 the 0.5 M sulphuric acid 3 grams per litre sodium sulphate solution to obtain the blank absorbance, and a suitable range of calibration solutions followed by the sample solution. Check the calibration solutions after the last sample has been run. Plot calibration curves of g/ml of copper, chormium and arsenic, expressed as copper sulphate, potassium dichromate and arsenic pentoxide, against absorbance. Determine the contents of copper, chromium and arsenic in the test solutions by comparing the absorbance readings with the calibration curves and express the results as the percentages of copper sulphate, potassium dichromate and arsenic pentoxide in the solutions.

9.5.3 *Calculation*

The percentages, mass by volume, of either copper expressed as $CuSo_4.5H_2O$ or chromium expressed as $K_2Cr_2O_7$ or arsenic expressed as $As_2O_5.5H_2O$ are given by the formula :

$$\frac{C}{100}$$

where, C is the concentration of salt in the test solution in μg/ml.

9.6 Procedure for analysis of copper, chromium and arsenic in treated pole

9.6.1 Ensure that the sample of treated poles taken is representative of the poles concerned. Select a suitable area of the pole for sampling which is free from 'end penetration' ; if this precaution is not taken the results obtained will be too high. Avoid samples consisting entirely of heartwood otherwise the results obtained will be too low. Similarly avoid samples consisting entirely of sapwood otherwise the results obtained will be too high.

9.6.2 *Preparation of sample*

Pulverize about 20 g of dry sample, for example in a beater mill or hammer mill or in another hammer , until all the sample passes a 420 m test sieve, complying with BS 410. Collect the wood flour, mix well and dry to constant mass in an oven at 110°C.

9.6.3 *Digestion of wood flour*

Accurately weigh approximately 0.5 g of the dried wood flour and transfer to a micro-Kjeldahl flask. Add 4.5 ml of a cooled mixture of 2 parts by volume of 30 per cent (100 volume) hydrogen peroxide solution and 1 part by volume of concentrated sulphuric acid. Transfer the micro-Kjeldahl flask to a digestion stand and, without shaking, warm gently. A vigorous wet combustion reaction will commence.

Continue the reaction until a clear solution is obtained. Heat the solution until charring occurs. add a further two or three drops of hydrogen peroxide solution and continue heating until the solution is decolourized. If necessary, add further increments of hydrogen peroxide. Continue heating the decolourized solution until white fumes are evolved. Cool, wash the solution into a 50 ml one mark volumetric flask, add 10 ml of 2 M sulphuric acid solution and 5 ml of 3 per cent sodium sulphate solution, dilute to the mark with water and mix.

9.6.4 Aspirate, using the operating conditions given in Table 2, the 0.5 M sulphuric acid /3 grams per litre sodium sulphate solution to obtain the blank absorbance, and a suitable range of calibration solutions followed, by the sample solution. Check the calibration solutions after the last sample has been run. Plot calibration curves of g/ml of copper, chromium and arsenic, expressed as copper sulphate, potassium dichromate and arsenic pentoxide, against the absorbance. To determine the copper, chromium and arsenic, expressed as copper sulphate, potassium dichromate and arsenic pentoxide, contents of the test solutions, compare the absorbance readings with the calibration curves.

9.6.5 *Calculation of the percentage of metals*

The percentages by mass of copper (expressed as $CuSo_4 . 5H_2O$) chromium (expresed as $K_2Cr_2O_7$) and arsenic (expressed as $As_2O_5.2H_2O$) in the dry wood to given by the formula :

$$\frac{C}{200m}$$

where, C is the concentration of each salt in the tes solution in µg/ml)
m is the mass of wood flour taken in grams.

NOTE

The primary purpose of the method described is to provide a means of checking whether or not a given batch of poles has been significantly undertreated. For this purpose, expression of the results on a mass/mass basis is usually adequate.

9.6.6 *Calculation of the dry salt retentions*

The result may be expressed as kilograms per cubic metre if the density of the actual sample of timber is known; it is not satisfactory to take an average figure for the species of poles concerned. Adjustments for the moisture content of the pole are also necessary if the density figure does not apply to the dry material.

The retention of the toxic ingredient of the oven-dry wood expressed in kg/m^3 shall be calculated from the formula :

$$\frac{T \times D}{100}$$

where T is the percentage by mass of toxic ingredient
D is the oven-dry density of the wood in kg/m^3.

9.6.7 *Calculation of the density of oven-dry wood*

Dry a block of wood of dimensions 75 mm x 50 mm x 25 mm to constant mass in an oven maintained at 105 + 5 °C. Weigh the dried block and calculate the density.

10 DETERMINATION OF MOISTURE CONTENT OF POLES

10.1 Introduction

Two methods are available for the determination of moisture content, one by oven-drying the sample and the second by the distillation method using the Dean and Stark apparatus. These two methods will not necessarily give the same result, that by the first method tending to be higher than that by the second, owing to loss of other volatile products. Normally this difference is small and, as the determination is reguired in connection with the maximum moisture content specified in Clause 5 of **SLS 848 : Part 2 : 1989**, it is not usually significant.

However, with timbers having a high content of non-aqueous volatile substances it is preferable to use the Dean and Stark method. For the species of timber specified for poles in **SLS 848 : Part 2**, oven-drying method is adequate and hence only that method is given below.

10.2 Oven-drying method of test

10.2.1 *Selection of samples*

Samples of 75 mm or the full depth of the sapwood, whichever is the greater, shall be taken from the poles, at a point not less than 1.5 m from either end of the pole, by means of a test borer consisting of a hollow auger and extractor. The poles shall be carefully plugged, with durable or preservative treated plugs, as soon as the samples have been extracted.

10.2.2 *Procedure*

Weigh the sample (m_1) immediately after extraction. Dry the samples in an oven at a temperature of 103 + 2 °C until the mass is constant, and again weigh immediately after removal from the drying oven (m_2).

10.2.3 *Calculation*

The moisture content (ω) expressed as a percentage of the oven dry mass is calculated from the equation :

$$\omega = \frac{m_1 - m_2}{m_2} \times 100$$

10.2.4 *Expression of results*

When the sample has been selected according to the requirements of **10.2** (i.e. it is an average sample) or when the moisture content of a representative selection of samples has been determined and the average value has been calculated, the result may be reported as the average moisture content and as such may be used for assessing compliance with the moisture content requirement specified in 5 of **SLS 848 : Part 2 : 1989.**

11 DETERMINATION OF THE CONCENTRATION OF THE WORKING SOLUTION

11.1 Apparatus

The following apparatus is required :

a) Density hydrometer,graduated to an accuracy of 0.0002 for medium surface tension.

b) Glass cylinder of 500 ml nominal capacity and over all height not greater than 300 mm.

11.2 Procedure

Determine the density of the solution at 27°C and read the corresponding concentration from Table 2, or Figure 1.

Obtain a representative 500 ml sample of the working solution.

Transfer the solution to the glass cylinder and place it on a level surface.

Insert the thermometer into the solution, wait until the temperature has reached equilibrium with its surroundings and remains constant for 1 min and record the temperature before removing the thermometer.

Place the clean, dry hydrometer in the solution and when the hydrometer has settled to a constant level, record the height of the solution level against the graduated scale on the stem of the hydrometer, with the eye directly in line with the solution to the nearest 0.005.

Using a hydrometer calibration chart the accuracy of which has been verified by analysis (see Figure 1), place a straight edged ruler across the temperature and hydrometer reading scales at the points recorded for the solution sample.

The concentration of the solution (in g/l) of the preservative type under test is read at the point of intersection on the concentration scale.

NOTE

The densities given in Table 2 apply to preservatives of the nominal compositions given in Table 1 of SLS 923 : Part 1 : 1991. In practice, different tables will apply to concentrated or hydrated products.

Where the actual composition departs from the nominal composition, alternative density-concentration relationships are available from the manufactures.

TABEL 2 - Density at 27°C as a function of concentration

concentration of preservative	Density at 27°C	
	Type 1	Type 2
Kg/m^3 *	Mg/m^3**	Mg/m^3**
10	1.003	1.003
15	1.006	1.007
20	1.009	1.010
25	1.013	1.013
30	1.016	1.017
35	1.019	1.020
40	1.022	1.024
45	1.026	1.027
50	1.029	1.031
55	1.032	1.034
60	1.036	1.038
65	1.039	1.041
70	1.042	1.045
75	1.045	1.048
80	1.049	1.052

* 1 kg/m^3 = 1 g/l

** 1 Mg/m^3 = 1 g/ml

12 METHOD FOR THE DETERMINATION OF PENETRATION

12.1 Principle

A solution of a reagent which produces a characteristic colouration in the presence of copper salts is brushed or sprayed on to a cross section of the treated pole to be tested. It has been shown that there is no significant difference between the penetration of the active ingredients of the preservative and the extent of the colouration produced. The latter can therefore be taken as a measure of the penetration of the preservative as a whole.

12.2 Selection of sample

Cut a cross section at least 450 mm from the end of the pole or, if this is not practicable, from the centre, and free enough from holes or notches to avoid the effect of end penetration. Cross sections cut from timber that has been re-dried after treatment may be tested immediately, but it is necessary to dry cross sections taken from freshly treated poles. Plane the surface of the cross section smooth. If it is not possible to plane the surface, free it from adhering sawdust.
If it is not permissible to cross-cut the poles, a rough indication of the penetration may be obtained from a boring made with an increment borer.

12.3 Method

12.3.1 Reagent The reagents shall be of recognized analytical reagent quality.

a) 1.5-diphenylcarbazide solution
   Dissolve 0.5 g of 1,5-diphenylcarbazide in 15 ml of glacial acetic acid and add 125 ml of water.

Water complying with ISO 3696, shall be used.

NOTE

It is desirable that the solution should be freshly made up daily.

12.3.2 *Procedure*
Spray the reagent solution (12.3.1) evenly over the surface to be tested. After a minute or two a reddish purple colour will appear where the preservative has penetrated. Examine the surface within 15 min from applying the reagent.

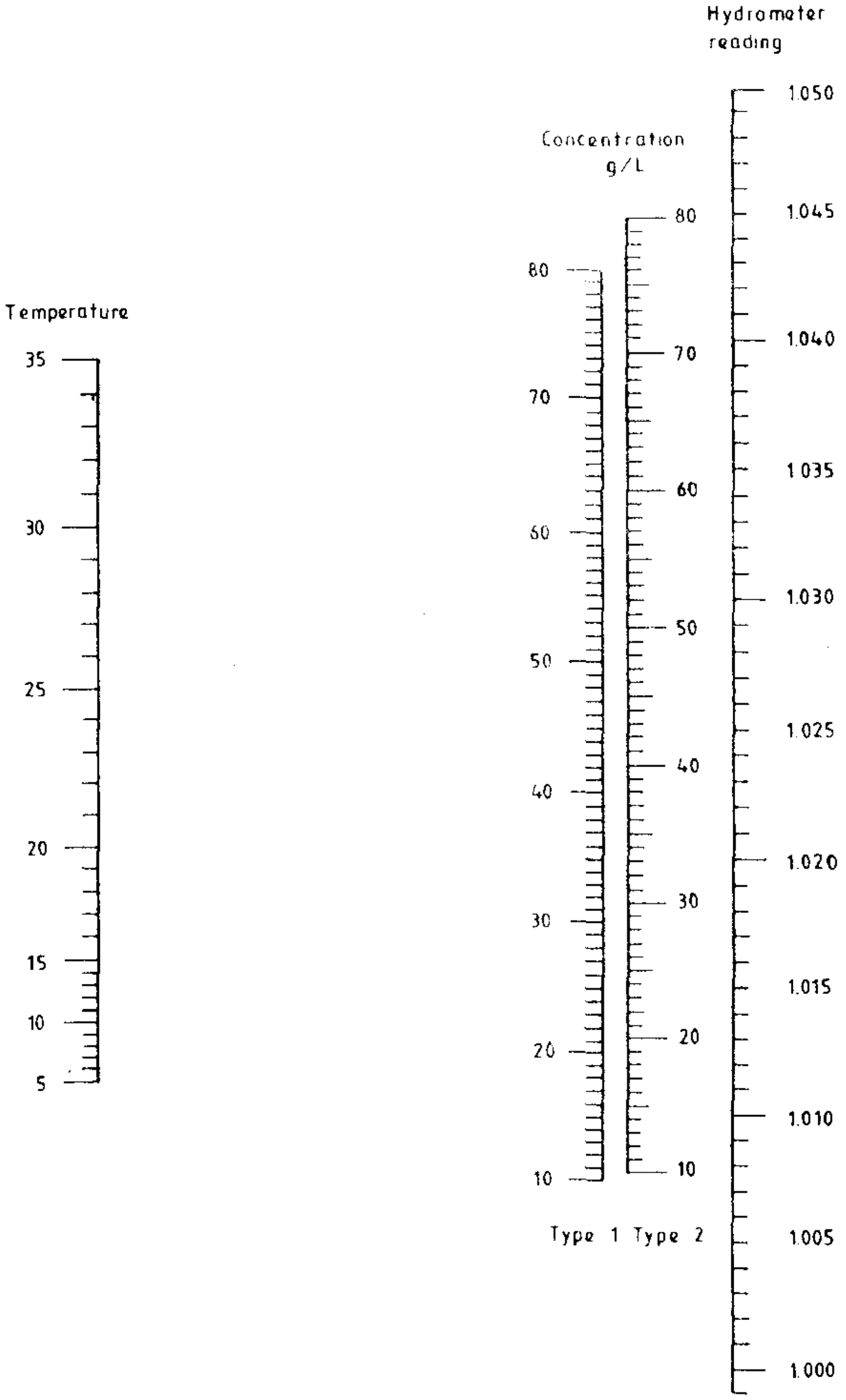

FIGURE 1-Hydrometer reading:concentration calibration chart for working solutions of type 1 and type 2 CCA preservatives

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