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Indian Standard

SODIUM SILICATE FOR USE IN FOUNDRIES — SPECIFICATION
( Second Revision )

ICS 81.080

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

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Foundry and Steel Casting Sectional Committee, MTD 14

FOREWORD

This standard was first published in 1973 and subsequently revised in 1978. While reviewing the standard in the light of experiences gained during these years, the committee decided to revise this standard by merging with the requirements included in IS 8785 : 1978 ‘Specification for CO₂ core binder system (binder and break down agent) for use in foundries’.

Sodium silicate is extensively used in foundry industry as binder for producing moulds, cores, refractory, briquettes and for other purposes.

In this revision, the following changes have been made:

   a) Scope of the standard has been enlarged by including the requirements of CO₂ core binder system.
   b) Designation of grades has been made more rational.
   c) Three new grades of sodium silicate have been included.

Bureau of Indian Standards, has also published IS 381 : 1995 ‘Sodium silicate — Specification’. This prescribes requirements and method of sampling for sodium silicate, in solid and liquid forms, for use in various industries.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (revised)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.
Indian Standard
SODIUM SILICATE FOR USE IN FOUNDRIES —
SPECIFICATION
( Second Revision )

1 SCOPE
This standard covers the requirements of sodium silicate for use in foundry industry for the following purposes:
   a) CO2 core and mould binder;
   b) Refractory binder, adhesives, etc; and
   c) Binder for briquettes production of foundry raw-material and other purposes.

2 REFERENCES
The following standards 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 agreement based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

<table>
<thead>
<tr>
<th>IS No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>265 : 1993</td>
<td>Hydrochloric acid (fourth revision)</td>
</tr>
<tr>
<td>266 : 1993</td>
<td>Sulphuric acid (third revision)</td>
</tr>
<tr>
<td>323 : 1959</td>
<td>Rectified spirit (revised)</td>
</tr>
<tr>
<td>1070 : 1992</td>
<td>Reagent grade water (third revision)</td>
</tr>
<tr>
<td>1387 : 1993</td>
<td>General requirements for the supply of metallurgical materials (second revision)</td>
</tr>
<tr>
<td>1783 (Part 2) : 1988</td>
<td>Drum, large, fixed ends: Part 2 Grade B drums (third revision)</td>
</tr>
<tr>
<td>1918 : 1966</td>
<td>Methods of physical tests for foundry sands</td>
</tr>
<tr>
<td>3018 : 1977</td>
<td>Silica sand for raw material testing in foundries</td>
</tr>
<tr>
<td>4905 : 1968</td>
<td>Methods for random sampling</td>
</tr>
</tbody>
</table>

3 SUPPLY OF MATERIAL
General requirements relating to supply of sodium silicate for use in foundries shall be as laid down in IS 1387.

4 DESIGNATION AND GRADES
4.1 Designation
The grades of sodium silicate shall be designated as follows:
   a) By a letter F designating foundry. It means sodium silicate for foundry use.
   b) By a letter designating the use of sodium silicate as follows:
      1) C for CO2 Core and mould binder;
      2) B for briquetting of foundry material and other purposes; and
      3) R for refractory binder, adhesive, etc.
   The letter shall be followed by a hyphen (-)
   c) By three figures designating hundred times of average mass ratio of total soluble silica as SiO2 to total alkalinity as Na2O; for example, if the ratio of SiO2 to Na2O is 1.4, the designation would be 140. Then figures shall be followed by a stroke (/).
   d) By three figures designating ten times the minimum percentage by mass of Na2O, for example, if the minimum percent by mass of Na2O is 14, the designation would be 140.

Example of full designation:
The designation of sodium silicate for CO2 core and mould binder having an average mass ratio percent SiO2 to percent Na2O of 2.2 and minimum percent Na2O of 14 would be FC — 220/140.

4.2 Grades
Sodium silicate shall be of eight grades as given in Table 1. The grades are overlapping in use.

5 REQUIREMENTS
5.1 Description
The material shall be in the form of translucent clear syrupy liquid of watery white or slightly gray colour, free from dirt and other visible sediments and impurities and free sediment.

5.2 Chemical Requirements
When tested by the methods prescribed in Annex A the material shall comply with the requirements given in Table 2.
Table 1 Grades of Sodium Silicate

(Clause 4.2)

<table>
<thead>
<tr>
<th>Grade</th>
<th>Type</th>
<th>Use</th>
<th>Other Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>FC-200/155</td>
<td></td>
<td>CO₂ moulds</td>
<td>High mass ratio silicate has better collapsibility in comparison to low mass ratio silicate</td>
</tr>
<tr>
<td>FC-200/145</td>
<td>Alkaline</td>
<td>CO₂ cores</td>
<td></td>
</tr>
<tr>
<td>FC-220/140</td>
<td></td>
<td>Briquettes</td>
<td></td>
</tr>
<tr>
<td>FC-220/135</td>
<td></td>
<td></td>
<td>Low viscosity silicate hardness faster than the high viscosity silicate</td>
</tr>
<tr>
<td>FC-240/120</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FC-260/105</td>
<td></td>
<td></td>
<td>Proves to be friable cores and moulds, but collapsible</td>
</tr>
<tr>
<td>FC-330/85</td>
<td>Neutral</td>
<td></td>
<td>Refractory adhesives, gums and paste</td>
</tr>
<tr>
<td>FC-350/70</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.3 Sodium silicate for CO₂ cores and moulds binders shall be tested for the requirements as given in 5.1 and 5.2. It shall also be tested for the requirements as given in Annex B, if required by the purchaser.

5.4 Sodium silicate for refractory, briquetting and other purposes shall be tested for the requirements as given in 5.1 and 5.2. It shall also be tested for standard mix requirements as per mutual agreement between the purchaser and the supplier.

6 SAMPLING

Representative samples from each batch of the material manufactured shall be drawn as described in Annex C.

7 CRITERIA FOR CONFORMITY

7.1 If the tests results on individual as well as composite sample(s) satisfy the requirements given in 5, the lot shall be declared acceptable.

7.2 A test certificate shall be issued by the supplier giving details of the material and its corresponding test results.

8 PACKING

8.1 Sodium silicate shall be packed in 200 litre air tight steel drums conforming to IS 1783 (Part 2). The quantity may vary from 250 to 300 kg/drum.

8.2 Mode of packing other than that specified in 8.1 may be mutually agreed upon at the time of enquiry and order.

9 MARKING

9.1 Each container shall be marked with the following.

a) Indication of source of manufacture;

b) Production details number and/or date of manufacture;

c) Net and gross mass, in kg; and

d) Grade of the material.

9.2 BIS Certification Marking

The containers may also be marked with the Standard Mark, details for which may be obtained from the Bureau of Indian Standards.

9.2.1 The use of the Standard Mark is governed by the provision of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of the conditions under which the licence for use of the Standard Mark may be granted to manufacturer or producer may be obtained from Bureau of Indian Standards.
Table 2 Chemical Requirements for Sodium Silicate for Use in Foundries
(Clause 5.2)

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Characteristic</th>
<th>Requirements of Grades as given in Table 1</th>
<th>Method of Test, Ref to Cl No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>i)</td>
<td>Total soluble silica as $\text{SiO}_2$ percent, by mass</td>
<td>29.5-32.5 27.5-30.5 29.5-32.0 28.5-31.0 28.0-30.0 26.5-28.5 27.0-29.0 24.0-25.0</td>
<td>A-3</td>
</tr>
<tr>
<td>ii)</td>
<td>Total alkalinity as $\text{Na}_2\text{O}$ percent by mass, $\text{Min}$</td>
<td>15.5 14.5 14.0 13.5 12.0 10.5 8.5 7.0</td>
<td>A-4</td>
</tr>
<tr>
<td>iii)</td>
<td>Mass ratio of total soluble silica as $\text{SiO}_2$ to total alkalinity</td>
<td>2.0 $\pm$ 0.1 2.0 $\pm$ 0.1 2.2 $\pm$ 0.1 2.2 $\pm$ 0.1 2.4 $\pm$ 0.1 2.6 $\pm$ 0.1 3.3 $\pm$ 0.1 3.5 $\pm$ 0.1</td>
<td>A-5</td>
</tr>
<tr>
<td>iv)</td>
<td>Total soluble silicate (as percent $\text{SiO}_2 + \text{Na}_2\text{O}$)</td>
<td>45.0-48.5 42.0-45.5 43.5-46.5 42.0-45.0 40.0-42.5 37.0-39.5 35.5-38.0 31.0-33.0</td>
<td>A-5</td>
</tr>
<tr>
<td>v)</td>
<td>Solid content percent by mass, $\text{Max}$</td>
<td>$\text{Max}$</td>
<td>A-8</td>
</tr>
<tr>
<td>vi)</td>
<td>Specific gravity at 20 $^\circ$C</td>
<td>1.54-1.59 (51.0-54.0) 1.53-1.58 (50.0-53.0) 1.53-1.58 (50.0-53.0) 1.50-1.54 (48.0-51.0) 1.41-1.47 (42.0-46.0) 1.33-1.38 (36.0-40.0) 1.26-1.32 (30.0-35.0)</td>
<td>A-7</td>
</tr>
<tr>
<td>vii)</td>
<td>Viscosity at 27 $^\circ$C by Food B4 Cup in second, $\text{Min}$</td>
<td>220 180 170 160 140 110 90 70</td>
<td>–</td>
</tr>
<tr>
<td>viii)</td>
<td>Water in solubles percent by mass, $\text{Max}$</td>
<td>0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2</td>
<td>A-9</td>
</tr>
<tr>
<td>ix)</td>
<td>pH</td>
<td>12 12 11 11 10 10 9 9</td>
<td>–</td>
</tr>
</tbody>
</table>
ANNEX A

(Clause 5.2)

ANALYSIS OF SODIUM SILICATE FOR USE IN FOUNDRIES

A-1 QUALITY OF REAGENTS

A-1.1 Unless otherwise specified, analytical grade chemicals shall be employed in tests and distilled water (see IS 1070) shall be used where the use of water as a reagent is intended.

A-2 PREPARATION OF SAMPLE SOLUTION

A-2.1 Sodium Silicate, Liquid

Weigh accurately about 30 g of the material and dissolve it in fresh boiled distilled water. Filter and thoroughly wash the filter paper with freshly boiled distilled water. Transfer both the filtrate and the washing to a 500 ml volumetric flask and dilute up to the mark. Keep this prepared sample solution for test purpose.

A-3 DETERMINATION OF TOTAL SOLUBLE SILICA (as SiO₂)

Two methods, namely method A (Gravimetric) and method B (Titrimetric) have been prescribed for the determination of total soluble silica. If no specific option is mentioned by the customer method B (Titrimetric) shall be followed.

A-3.1 Method A — Gravimetric

A-3.1.1 Reagents

A-3.1.1.1 Concentrated hydrochloric acid — sp gr 1.16 (see IS 265).
A-3.1.1.2 Dilute hydrochloric acid — 1 : 1 (v/v).
A-3.1.1.3 Concentrated sulphuric acid — sp gr 1.84 (see IS 266).
A-3.1.1.4 Hydrofluoric acid — about 50 percent (m/v).

A-3.1.2 Procedure

Take 50 ml of the prepared sample solution in a 150 ml porcelain-evaporating dish, add 25 ml of concentrated hydrochloric acid and evaporate to dryness on a water bath. Moisten the residue with 10 ml of dilute hydrochloric acid and again evaporate to dryness on the water bath. Heat the dish for 1h on a suitable sand-bath or hot plate maintained at 100 ± 5°C. To dissolve the soluble salts add 10 ml of dilute hydrochloric acid and 20 ml of water to the residue and digest for 5 min on the water-bath. Filter the residue, which is mainly silica through a Whatman filter paper No. 40 (or equivalent) and wash the residue on the filter paper with hot water till it is free from chlorides test by dilute AgNO₃ solution. Keep the residue on the filter paper and collect the filtrate and washings in the original dish.

A-3.1.2.1 Evaporate to dryness the filtrate and washings on the water-bath. Moisten the residue with 10 ml of dilute hydrochloric acid and again evaporate to dryness. Heat at 110 ± 5°C for an hour. Add to the residue 10 ml of dilute hydrochloric acid and 20 ml of dilute of water and digest as before to dissolve the soluble salts. Filter any additional silica separated on a separate filter paper and wash it free from chlorides as before.

A-3.1.2.2 Transfer both the filter papers and residues to a platinum crucible previously ignited and weighed without cover. Ignite it in a muffle furnace, slowly raising its temperature until free from carbon. Cover the crucible with a platinum cover, heat to the highest temperature of blow lamp for 15 min. Cool in a desiccator and weigh without the crucible cover.

A-3.1.2.3 Moisten the contents of the crucible with about 5 ml of water and add 2 to 3 drops of concentrated sulphuric acid. Slowly add 10 ml of hydrofluoric acid. Evaporate to a small volume on the water-bath; add another portion of about 10 ml of hydrofluoric acid and evaporate to fumes the sulphuric acid. Heat the crucible gently at first over an open flame to drive off sulphuric acid and finally at a red heat. Cool in a desiccators and weigh. Repeat the heating, if necessary, till constant mass is obtained.

A-3.1.3 Calculation

From the loss in mass, calculate the percentage of total soluble silica (as SiO₂) as follows:

Total soluble silica = \[ \frac{A - B}{W} \times 100 \] percent, by mass silica (as SiO₂)

where

\[ A = \) mass of the residue and crucible as obtained under A-3.1.2.2, in g;\n
\[ B = \) mass of the residue and crucible after treatment with hydrofluoric acid (see A-3.1.2.3), in g; and\n
\[ W = \) mass of the material taken for the prepared sample solution, in g.
A-3.2 Method B — Titrimetric

Titrimetric method for determination of total soluble silica (as SiO₂) and total alkalinity (as Na₂O).

A-3.2.1 Principle

Both free alkalinity and soluble silica are determined simultaneously. First free alkalinity determined as described in A-4.2 using only methyl orange indicator. The same solution is used for determination of solution silica in the following manner. The alkali equivalent of sodium silicate is titrated with hydrochloric acid using methyl red indicator. Subsequently the sodium hydroxide released by treating the silica acid produced in the above titration with sodium fluoride can be found out by treatment with hydrochloric acid according to the following equations:

a) Na₂SiO₃ + 2HCl = H₂SiO₃ + 2NaCl — Titer 'a' using methyl red as indicator

b) H₂SiO₃ + 6NaF + H₂O = Na₂SiF₆ + 4NaOH

c) 4NaOH + 4HCl = 4NaCl + 4H₂O

NOTE — Use excess hydrochloric acid and back titrate excess hydrochloric acid with sodium hydroxide.

Thus, 1 more of Na₂SiO₃ = 1 mole of H₂SiO₃ = 4 moles of sodium hydroxide.

A-3.2.2 Procedure

Take 20 g of sample of sodium silicate, dilute it and make the volume to 1 000 ml. Take an aliquot so that titrate contains approximately 1 g of the material of 50 ml, add 0.5 ml of methyl red indicator and titrate with 1 N hydrochloric acid till the colour changes from yellow to red. Let this titer be 'a'. Now add 4 g of sodium fluoride, agitate to dissolve and then add 25 ml of methyl alcohol. Titrate with 1 N hydrochloric acid and note the volume of hydrochloric acid added as 'b' ml. Add 0.5 ml of methyl red and xylene cyanol FF indicator 25 g 100 ml. Titrate the excess hydrochloric acid with 1 N sodium hydroxide till the colour changes from violet passing grey to green. Note this titer as 'c'.

A-3.2.3 Calculations

Percent, SiO₂ = [(b) – (a + c)] (0.015 02 x 100)

Percent, Na₂O = (a) – (0.031 00 x 100)

A-4 DETERMINATION OF TOTAL ALKALINITY (as Na₂O) TITRIMETRIC METHOD

A-4.1 Two methods, namely, Method A and Method B, have been prescribed for this determination, Method B shall be followed only when xylene cyanol FF is not available.

A-4.2 Method A

A-4.2.1 Reagents

A-4.2.1.1 Standard hydrochloric acid — approximately 0.5 N.

A-4.2.1.2 Indicator — Dissolve 0.2 g of methyl orange powder in 100 ml of rectified spirit (see IS 323) 50 percent (v/v).

A-4.2.2 Procedure

Transfer 50 ml of the prepared sample solution by means of a pipette into a conical flask and titrate with standard hydrochloric acid, using the indicators specified in A-4.2.1.2, till the colour changes from green to grey.

A-4.2.3 Calculation

Calculate the total alkalinity (as Na₂O) on the basis that 1 ml of normal hydrochloric acid is equivalent to 0.031 g of sodium monoxide.

\[
\text{Total alkalinity (as Na}_2\text{O) = } \frac{31 \times A \times N}{W} \text{ percent by mass}
\]

where

\[A = \text{volume of standard hydrochloric acid required for the titration, in ml;}\]

\[N = \text{normality of hydrochloric acid; and}\]

\[W = \text{mass of the material taken for the prepared sample solution, in g.}\]

A-4.3 Method B

A-4.3.1 Reagents

A-4.3.1.1 Phenolphthalein indicator — Dissolve 0.5 g of phenolphthalein in 100 ml of rectified spirit (see IS 323) 50 percent (v/v), that has previously been neutralized to the indicator.

A-4.3.1.2 Standard sodium hydroxide solution — approximately 0.5 N.

A-4.3.2 Procedure

Transfer 50 ml of the prepared sample solution by means of a pipette into a conical flask and add a few drops of phenolphthalein indicator. Add in excess a known volume of standard sulphuric acid. Boil for some time taking care that no spurtng takes place and titrate the excess acid with standard sodium hydroxide solution until a delicate pink colour persists for 1 min.
A-4.3.3 Calculation

Calculate the total alkalinity (as Na₂O) on the basis that 1 ml of normal sulphuric acid is equivalent to 0.031 g of sodium monoxide.

Total alkalinity (as Na₂O) = \(3.1 \times \frac{AN - BM}{W}\)

\(\text{percent by mass}\)

where

- \(A\) = volume of standard sulphuric acid, in ml;
- \(N\) = normality of standard sulphuric acid;
- \(B\) = volume of standard sodium hydroxide solution required to neutralize the excess of acid, in ml;
- \(M\) = normality of standard sodium hydroxide solution; and
- \(W\) = mass of the material taken for the prepared sample, in g.

A-5 DETERMINATION OF RATIO OF TOTAL SOLUBLE SILICA (as SiO₂) TO TOTAL ALKALINITY (as Na₂O)

A-5.1 Mass Ratio

Determine total soluble silica and total alkalinity as under A-3 and A-4 and find out the ratio of these two components:

\[
\text{Mass ratio} = \frac{\text{Total mass of SiO}_2}{\text{Total mass Na}_2\text{O}}
\]

A-5.2 Total Soluble Silicates

Determine total soluble silicate by adding the total soluble silica and total alkalinity as under A-3 and A-4.

A-6 DETERMINATION OF TOTAL INVERT SUGAR CONTENTS

\[
\text{A-6.1.2 Pipette out 5 ml each of standard fehling solution A and B and pour into 500 ml conical flask, add 50 ml water and titrate the solution in hot conditions against the made up solution (S). The end point is detected by testing a drop from the conical flask with a drop from the conical flask with a drop of 1 percent sodium-diethyl-diphenyl carbonate solution on filter paper indicates incomplete titration and further addition of solution (S) required ( burette reading) by 'Y' ml to reach the end point.}
\]

A-6.1.3 Calculations

\[
\begin{align*}
5 \text{ ml each of Fehling solutions A and B} & = 0.05 \text{ sugar} \\
250 \text{ ml of made up solution (S)} & = \frac{0.05 \times 250}{Y} \text{ g sugar} \\
\text{Sugar in X g of binder} & = \frac{0.05 \times 250}{Y} \times \frac{2.5}{X} \text{ g} \\
\text{Percent sugar} & = \frac{0.05 \times 250 \times 2.5}{Y} \times \frac{100}{X} \times \frac{3125}{XY}
\end{align*}
\]

A-7 SPECIFIC GRAVITY

A-7.1 Specific gravity shall be measured by hydrometers at 20 ± 0.5°C. Measuring cylinders having an effective capacity of 500 ml and an outside diameter of approximately 50 mm shall be used.

A-7.2 Procedure

Adjust the temperature of approximately 500 ml of the test sample to 20 ± 0.5°C. Pour this sample into the measuring cylinder and then slowly insert the appropriate hydrometers. When hydrometer is reached the equilibrium position, depress it slightly, wait for its return to the equilibrium position and record the production mark.

The reading is the density of sample expressed gram per millimetre, result should be nearest to 0.001 g/ml experience has shown that accuracy of this method is within 0.02 g/ml.

A-8 DETERMINATION OF TOTAL SOLID CONTENTS

A-8.1 Principle

Drying of a test portion followed by heating to between 600 and 650°C. Weighing of the residue.

A-8.2 Procedure

A-8.2.1 Test Portion

Heat the platinum or silica dish which is having a
capacity of 30 to 35 ml and an upper diameter of approximately 75 mm, for a few minutes in the electric furnace controlled between 600 and 650°C allow to cool to ambient temperature in a desiccator and weigh to the nearest 0.001 g.

Weigh into the tared dish to the nearest 0.001 g, a test portion of 1 to 2 g of the test sample.

A-8.2.2 First gently heat the dish containing the test portion in order to remove most of the water, while avoiding losses of matter due to splashing. For this purpose use a device which heats the lower part of the vessel (heating plate) or the upper part (inferred radiation lamp or other source of heat not in contact with the dish).

Gradually increase the temperature to between 600 and 650°C and maintain for 10 min.

Allow to cool in a desiccators to ambient temperature and weigh to the nearest 0.001 g. Repeat the operation until the difference between the results of two successive weighing does not exceed 0.001 g.

A-8.3 Results

The dry matter content expressed as a percentage by mass is given by the formula:

\[ \text{Solid content, percent} = \frac{m_1 \times 100}{m_0} \]

where

- \( m_1 \) = mass of the weighed dry residue, in g; and
- \( m_0 \) = mass of the test portion, in g.

A-8.4 Accuracy

Practice has shown that the maximum deviation between results obtained using this method is 0.6 percent (m/m) in absolute value.

A-9 DETERMINATION OF MATTER INSOLUBLE IN WATER

A-9.1 Principle

A solution of the test sample in carbon dioxide free water is filtered through a tared filter crucible and the mass of the water insoluble residue is obtained.

A-9.2 Reagents

A-9.2.1 Distilled Water (Analytical Quality), freshly boiled to free in from carbon dioxide.

A-9.2.2 Phenolphthalein indicator 1 percent (m/v) solution in aqueous ethanol. Dissolve 1 g of phenolphthalein in 60 ml of 95 percent (v/v) ethanol and dilute to 10 ml with water.

A-9.3 Procedure

A-9.3.1 Weigh to the nearest 0.1 g about 25 g of the sample.

A-9.3.2 Transfer the weighed sample to a 400 ml beaker. Add 250 ml of water and warm, if necessary until dissolution of all soluble matter is complete. Allow standing for 1 h and filtering the solution through the sintered glass or porous porcelain crucible previously dried for 1 h in the oven controlled at 100°C to 105°C and weighed to the nearest milligram transferring any insoluble matter from the breaker to the crucible with a jet of water. Wash the filter with 5 ml of distilled water until the filtrate is no longer alkaline to the phenolphthalein indicator. Dry the crucible in the oven controlled at 100°C to 105°C for 1 h allow it to cool in a desiccator and weigh to the nearest milligram.

A-9.4 Results

The matter insoluble in water, expressed as a percentage by mass, is given by the formula:

\[ \text{Matter insoluble in water, percent} = \frac{m_1}{m_0} \times 100 \]

where

- \( m_0 \) = mass of the test sample, in g; and
- \( m_1 \) = mass of the matter insoluble in water, in g.
ANNEX B  
(Clause 5.3)  
REQUIREMENTS FOR SODIUM SILICATE FOR CO₂ CORES AND MOULD BINDER

B-1 Sodium silicate for CO₂ cores and mould binder shall be tested for the requirements given in Table 3, in addition to the requirements given in 4 of this standard. The test shall be carried out on the test pieces prepared from the standard sand mix.

B-2 PREPARATION OF STANDARD SAND MIX

B-2.1 Take 5 kg of the standard silica sand conforming to IS 3018 in a paddle type laboratory sand mixer. Add 100 g (2 percent by mass of sand) of coal dust, 50 to 100 g (1 to 2 percent by mass of sand) of the breakdown agent and water as per requirement. Mix it for 2 min and thereafter add 250 to 275 g sodium silicate (5 to 5.5 percent by mass of sand) mix it again for 3 min and discharge the mixed sand into a polythene bag, close it air tight and preserve the sand for testing.

NOTE — Breakdown agent could be bauxite powder; liquid sugar, a proprietary product or any other product which can increase the breakdown properties of the CO₂ hardened sodium silicate cores/moulds.

B-2.2 Prepare standard 50 × 50 mm long three ram cylindrical specimen in a split specimen tube (see 5 of IS 1918).

B-2.3 Gassing with CO₂ Gas

Carbon dioxide gas is passed through the specimen. Contained in the split specimen tube or a fixture (see Fig. 1). Pass CO₂ gas for 30 s with the specimen at the bottom and for another 30 s after inverting the specimen tube. The gas pressure is maintained at 0.035 MPa (0.35 kg/cm²) at the cylinder delivery.

B-2.4 Test for Gassed Strength

Test the strength of the gassed specimens after keeping them in open air (see Table 3). The test procedure shall be as given in IS 1918.

B-2.5 Test for Break-down Properties

Six specimens after gassing as given in A-2.3 are selected. Three of them are heated in a furnace at 1000°C for 3 min and other three for 10 min. Specimens are allowed to cool to room temperature and tested for compressive strength as specified in IS 1918. Cracks may appear on the specimen after firing. Retained strengths are given in Table 3.

B-2.6 Test for Gas Content

Dry to constant mass at 110°C ± 5°C, a give quantity of standard mixed sand (see B-2). Test the gas content in accordance with the procedure given in IS 1918.

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![Diagram of CO₂ Gassing Fixture](image-url)
Table 3 Gassed Strength and Breakdown Properties of Sodium Silicate for CO₂ Cores and Mould Binders

(Clause B-1, B-2.4 and B-2.5)

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Requirements</th>
<th>Minimum Gassed Strength in kg/cm² (Variation +2 kg/cm²)</th>
<th>Minimum Retained Strength After (Variation +2 kg/cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Immediate in 24 h 3 min 10 min</td>
<td></td>
</tr>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3) (4) (5) (6) (7)</td>
<td></td>
</tr>
<tr>
<td>i)</td>
<td>Compressive strength</td>
<td>14.0 18.0 24.0</td>
<td>8.0 6.0</td>
</tr>
<tr>
<td>ii)</td>
<td>Tensile strength</td>
<td>2.5 4.0 7.0</td>
<td></td>
</tr>
<tr>
<td>iii)</td>
<td>Gas content</td>
<td>9 to 30 ml/g</td>
<td></td>
</tr>
<tr>
<td>iv)</td>
<td>Friability</td>
<td>Gassed sample stored up to 48 h in an atmosphere of 40-60 percent relative humidity should not be friable</td>
<td></td>
</tr>
<tr>
<td>v)</td>
<td>Bench life</td>
<td>4h to 6 h. Bench life can be increased if it is covered with moist gunny bags</td>
<td></td>
</tr>
<tr>
<td>vi)</td>
<td>Flowability</td>
<td>Intricate cavities of cores and moulds should be compactly filled easily under normal shooting conditions. Core boxes and moulds should be properly vented to avoid air pockets</td>
<td></td>
</tr>
</tbody>
</table>

ANNEX C

(Clause 6)

C-1 SAMPLING OF SODIUM SILICATE

C-1.1 Representative samples from each batch of the material produced shall be drawn from drums after thoroughly mixing the material. Precautions shall be taken to protect the sample, sampling instruments and containers for samples from contamination.

C-1.2 Each sample container shall be closed air tight after filling and marked with details of sampling.

C-2 LOT SIZE

All the containers in a single consignment of the material of one grade, type and drum from a single lot shall be separated and grouped before drawing sample.

C-3 Vertical column by a burette or sampling tube of 30 mm internal diameter made of glass or metal shall be taken from each drum selected as per procedure given in C-4. Minimum 3 samples shall be taken from each drum.

C-4 The number (n) of drums to be chosen from a lot depend on the size (N) of the lot and shall be in accordance with col 2 and col 3 of Table 4. The drums to be selected for sampling shall be chosen as random in accordance with IS 4905.

C-5 From each drum 300 g sample shall be drained and stored in separate sample containers. These filled containers are termed as individual samples. Test sample of about 500 g shall be drain from the composite sample, prepared by thoroughly mixing the individual samples. However tests for the total soluble silicates and the ratio for total alkalinity shall be carried out on any three of the individual samples drawn as above. Same samples shall be used for both tests.

9
### Table 4 Number of Drums to be Selected

(Clause C-4)

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Lot Size</th>
<th>Number of Drums to be Selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>i)</td>
<td>Up to 10</td>
<td>3</td>
</tr>
<tr>
<td>ii)</td>
<td>11-20</td>
<td>5</td>
</tr>
<tr>
<td>iii)</td>
<td>21-30</td>
<td>7</td>
</tr>
<tr>
<td>iv)</td>
<td>31-50</td>
<td>10</td>
</tr>
<tr>
<td>v)</td>
<td>51 and above</td>
<td>15</td>
</tr>
</tbody>
</table>

**NOTE** — In the case of tankers, samples shall be drawn from each compartment and tested separately as well as after making it a composite sample.
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