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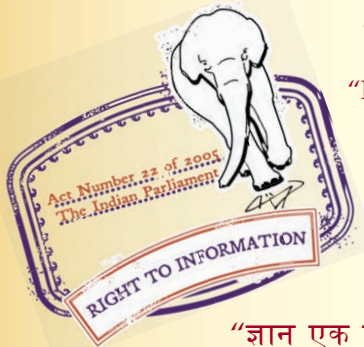
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IS 4456-2 (1967): Methods of test for chemical resistant mortars, Part II: Sulphur type [CED 5: Flooring, Wall Finishing and Roofing]



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IS : 4456 (Part II) - 1967

Indian Standard
METHODS OF TEST FOR
CHEMICAL RESISTANT MORTARS
PART II SULPHUR TYPE

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

Indian Standard

METHODS OF TEST FOR CHEMICAL RESISTANT MORTARS

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Indian Standard

METHODS OF TEST FOR CHEMICAL RESISTANT MORTARS

PART II SULPHUR TYPE

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 7 December 1967, after the draft finalized by the Non-cement Floor Coverings Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 This standard which covers the methods of test for the determination of various characteristics of sulphur type mortar is an essential adjunct to the ' Indian Standard specification for chemical resistant mortars : Part III Sulphur type ' (*under preparation*).

NOTE — Until this standard is published, the requirements of the material shall be as agreed to between the concerned parties.

0.3 In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country. This has been met by referring to the following publications:

C 267-1965 Test for chemical resistance of mortars. American Society for Testing and materials.

C 287-1962 Specification for sulphur mortar. American Society for Testing and Materials.

0.4 In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*

1. SCOPE

1.1 This standard covers the methods for carrying out the following tests on sulphur type chemical resistant mortar:

<i>Method of Test</i>	<i>Clause Number</i>
a) Compressive strength	2
b) Tensile strength	3

*Rules for rounding off numerical values (*revised*).

<i>Method of Test</i>	<i>Clause Number</i>
c) Flexural strength	4
d) Bond strength	5
e) Resistance to thermal shock	6
f) Moisture absorption	7
g) Sulphur content	8
h) Tendency of aggregate to settle	9
j) Chemical resistance	10

2. COMPRESSIVE STRENGTH

2.1 Object — To determine the compressive strength of sulphur type chemical resistant mortar.

2.2 Apparatus

2.2.1 Balance — of capacity 1 kg, sensitive to 0.1 g.

2.2.2 Moulds — The moulds shall be made of hard metal not attacked by the mortar and shall be of the type capable of making three 50-mm cubes at one time. These shall be tight fitting and shall be separable into not more than two parts. The parts of the moulds when assembled shall be positively held together. The sides of the moulds shall be sufficiently rigid to prevent spreading or warping. The interior faces of the moulds shall be plane surfaces. The angle between adjacent interior faces and between interior faces and top and bottom planes of the mould shall be $90^\circ \pm 0.5^\circ$ measured at points slightly removed from the intersection of the faces. A brass base plate and cover plate attached with studs and wingnuts shall be used. Two 10-mm holes shall be provided in the cover plate for pouring.

2.2.3 Compression Testing Machine

2.3 Preparation of Mortar — About 2.5 kg of the sample of sulphur mortar shall be melted in not more than one hour and held at a temperature of 130° to 140°C for at least 15 minutes while being stirred to lift the aggregates without beating air into the melt. All test specimens shall be cast from this sample.

2.4 Moulding Test Specimens

2.4.1 Cast six 50-mm cube specimens.

2.4.2 The mould and plates shall be greased before assembly. Melt the sample as described in 2.3. Fill the mould up to 5 mm from the top with sulphur mortar at 130° to 140°C . Fill in shrinkage hole as it forms.

Place the cover plate on top of the mould and fill the remainder of the mould with sulphur mortar through the 10-mm holes. Use a small funnel in the pouring so that shrinkage will take place in the funnel. Allow the specimen to remain in the mould until it is completely solidified. Upon removal, file or grind the surface flush removing the excess material remaining at the pouring gate.

2.5 Conditioning Test Specimens — Remove the specimens from the moulds as soon as the mortar has solidified. Age the specimens for 48 hours in air at $27^{\circ} \pm 2^{\circ}\text{C}$, the 48 hours to include the time in the mould.

2.6 Procedure — The cubes shall be tested on their sides without any packing between the cubes and the steel plattens of the testing machine. Place the test specimens in the testing machine in such a manner that the faces of the cube that were in contact with the two plain surfaces of the mould are placed in contact with the steel plattens of the testing machine. One of the plattens shall be carried on a base and shall be self-adjusting, and the load shall be steadily and uniformly applied, starting from zero at a rate of $200 \text{ kg/cm}^2/\text{min}$. Record the total maximum load indicated by the testing machine.

2.7 Calculation — Calculate the compressive strength from the crushing load and the average area over which the load is applied.

NOTE — Cubes that are manifestly faulty shall not be considered. If any of the individual strength values of the specimens made from the same sample and tested differ by more than 15 percent from the average strength or if fewer than four strength values were used in deriving the average strength, the test shall be repeated.

2.8 Report — The average compressive strength value shall be reported in kg/cm^2 .

3. TENSILE STRENGTH

3.1 Object — To determine the tensile strength of sulphur type chemical resistant mortar.

3.2 Apparatus

3.2.1 Balance — of capacity 1 kg, sensitive to 0.1 g.

3.2.2 Moulds — The moulds shall be capable of producing briquettes of the shape shown in Fig. 2 of IS : 4456 (Part I)-1967*.

3.2.3 Testing Machine — The universal type testing machine in which load is applied at constant but adjustable rate.

*Methods of test for chemical resistant mortars: Part I Silicate type and resin type.

3.3 Preparation of Mortar — Mortar shall be prepared as described in 2.3.

3.4 Moulding Test Specimens

3.4.1 Cover the waist of the mould with a small lubricated plate having the edges next to the mould rounded off to a radius of approximately 3 mm. Melt the sample in accordance with the procedure described in 2.3. Pour the molten sulphur mortar into both sides of the mould and puddle it to fill the space under the plate completely. Allow the plate across the centre of the mould to remain in place for at least 15 minutes after the briquette has been poured.

3.4.2 Cast six briquette test specimens.

3.5 Conditioning of Test Specimens — Conditioning shall be done as described in 2.5.

3.6 Procedure — Remove all rough edges from the surface of the briquette that has to come in contact with the tensile testing machine. The specimens shall be placed and carefully centered in strong metal jaws of the shape shown in Fig. 3 of IS : 4456 (Part I)-1967*.

NOTE — In order to distribute the stress set by the pressure of the jaws over as large a surface of the briquettes as possible, it is recommended that rubber or greased paper be inserted between the sides of the briquette and the jaws of the machine.

3.7 Faulty Briquettes and Retests

3.7.1 Briquettes which upon removal from the moulds at the end of the first 24 hour period after gauging do not conform to the requirements for width at the waist line and thickness, or which are manifestly faulty, shall be rejected. If, after such rejection, the number of briquettes left over is insufficient for four tests, fresh gauging shall be done.

3.7.2 In calculating the average value of the test results at any period, strength values differing by more than 15 percent from the average shall be discarded. After discarding such values, if less than four strength values are left for determining the tensile strength, the test shall be repeated.

3.8 Report — The tensile strength in kg/cm² shall be reported as the average of six test results.

4. FLEXURAL STRENGTH

4.1 The sulphur mortar shall be melted as given in 2.3 and the molten sulphur is poured into moulds permitting the moulding of bars of dimension 25 × 25 × 250 mm. The test specimens shall remain in their respective moulds for a period of 48 hours for aging. At least six test specimens shall be tested. The test shall be carried out and completed in accordance with the method laid down in 6.4, 6.5 and 6.6 of IS : 4456 (Part I)-1967*.

*Methods of test for chemical resistant mortars: Part I Silicate type and resin type.

5. BOND STRENGTH

5.1 The sulphur mortars shall be melted as given in 2.3. The tiles shall be mounted in a special jig as shown in Fig. 1. Molten mortar shall be poured into the joint cavity provided by the assembly. At least 15 minutes shall be allowed for the mortar to set before handling the specimen. The test shall be carried out in the same manner as described in 8 of IS : 4456 (Part I)-1967*.

6. RESISTANCE TO THERMAL SHOCK

6.1 Object — To determine the proportion of original strength retained by the sulphur mortar after thermal shock.

6.2 Apparatus

6.2.1 Balance — of capacity 1 kg, sensitive to 0.1 g.

6.2.2 Moulds — The moulds shall be of the form given in 3.2.2.

6.2.3 Testing Machine — The universal type testing machine in which the load is applied at constant but adjustable rate.

6.2.4 Two drums each of 50 litre capacity with suitable arrangements for heating to about 85°C.

6.3 Procedure — Cast at least 10 briquettes according to the method given at 3.4.1 and store them for 48 hours in air at $27^{\circ} \pm 2^{\circ}\text{C}$. Determine the tensile strength of 5 briquettes according to the procedure laid down in 3.6. Two drums shall be provided each containing 45 litres of water. Maintain the temperature in one drum between 80-85°C. Place the remaining five briquette specimens in a wire cage constructed so as to hold the briquettes spaced at least 25 mm from each other. Suspend the specimens in the middle of the hot bath for 5 min and immediately transfer to the cold bath for 5 min. After five cycles remove the 5 briquettes and determine their tensile strength as described in 3.6.

6.4 Calculation — Calculate percentage original strength retained from the following formula:

$$C = \frac{B}{A} \times 100$$

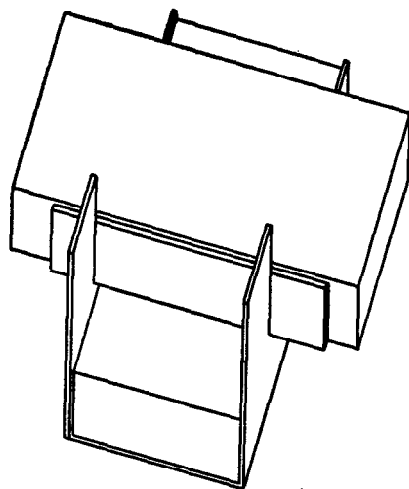
where

A = average tensile strength in kg/cm² before thermal shock treatment,

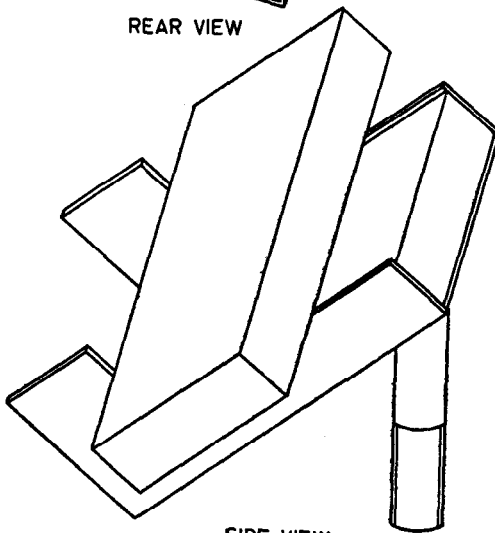
B = average tensile strength in kg/cm² after thermal shock treatment, and

C = percent strength retention after thermal shock treatment.

*Methods of test for chemical resistant mortars: Part I Silicate type and resin type.



REAR VIEW



SIDE VIEW

FIG. 1 APPARATUS FOR PREPARATION OF MORTAR
JOINT BY CASTING

6.5 Report — The resistance to thermal shock shall be reported as the percentage strength retained after the thermal shock treatment.

7. MOISTURE ABSORPTION

7.1 Object — To determine the percentage moisture absorption of sulphur type chemical resistant mortars.

7.2 Test Specimens — Cast three 50-mm cubes as described in 2.4.

7.3 Conditioning of Test Specimens — Age the specimens for 48 hours in air at $27^{\circ} \pm 2^{\circ}\text{C}$, the 48 hours to include the time in the mould.

7.4 Procedure — Immediately after conditioning weigh the specimens. Suspend the specimens in water at 85°C for five hours. Remove the specimens, wipe off the surface water with a damp cloth and weigh. Weighing shall be completed within five minutes after removal from the bath.

7.5 Calculation — Calculate the absorption of each of the specimens as follows:

$$\text{Percentage absorption} = \frac{W_2 - W_1}{W_1} \times 100$$

where

W_1 = dry weight of specimens, and

W_2 = saturated weight of specimens after five hours of submersion in water at 85°C .

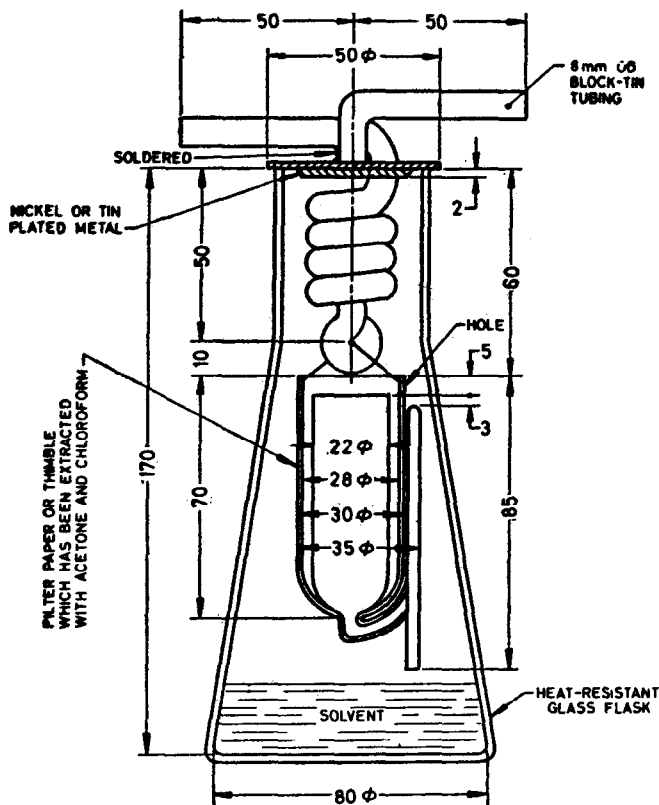
7.6 Report — The average percentage moisture absorption shall be reported.

8. SULPHUR CONTENT

8.1 Object — To determine the sulphur content in sulphur type chemical resistant mortars.

8.2 Apparatus — Extraction apparatus as shown in Fig. 2.

8.3 Procedure — Dry and weigh a Whatman filter thimble and place 10 to 15 g of the specimen in the thimble and pour 40 to 50 ml of carbon-disulphide over the specimen. Suspend the thimble containing specimen under the condenser by a fine wire bail as shown in Fig. 2. Carefully heat the flask in a water bath just enough to vaporise the solvent while circulating cold water through the condenser. Continue the extraction until the carbon-disulphide has filled the filter thimble and siphoned over 20 times. To determine whether the extraction is complete, remove the filter and wash



All dimensions in millimetres.

FIG. 2 EXTRACTION APPARATUS FOR DETERMINATION OF SULPHUR CONTENT

with a fine jet of carbondisulphide from a wash bottle. Collect the washings and evaporate to dryness on a water bath. If any residue remains, replace the filter and continue the extraction until the filtrate leaves no residue on evaporation.

8.3.1 Remove the filter. At first carefully dry at a low temperature to prevent ignition of carbondisulphide and next at 100°C to constant weight. Loss of weight represents the sulphur content of the specimen. Distil the carbondisulphide from the residue after extraction of the sulphur and weigh the residue as a check on the sulphur content.

NOTE — Carbondisulphide is toxic and has a flash point of 4°C.

8.4 Report — The percentage sulphur content of the mortar shall be reported.

9. TENDENCY OF AGGREGATE TO SETTLE

9.1 Object — To evaluate the tendency of the aggregate in the sulphur mortar to settle.

9.2 Apparatus

9.2.1 Glass Tube — heat resistant type, 25-mm diameter and 200-mm long.

9.3 Procedure — Fill the glass tube with molten sulphur mortar and hold it at a temperature of 140°C for 30 min. Carefully remove the test tube, hold under warm water until congealing begins and then immerse in ice water. When the sulphur mortar has solidified, break the tube, extract the top and bottom thirds of the contents separately by the method given in 8.3. Calculate the sulphur content and the aggregate content of each of the two portions. The aggregate content of the bottom portion divided by that of the top portion is an index of the tendency of the aggregate to settle.

NOTE — For a coarse silica aggregate that settles rapidly the index is greater than unity while for a coke aggregate that floats, it is less than unity.

9.4 Report — The index which gives the tendency of the aggregate to settle shall be reported.

10. CHEMICAL RESISTANCE

10.1 Object — To evaluate the chemical resistance of sulphur type chemical resistant mortars under anticipated service conditions.

10.2 Preparation of Specimens — Melt about 1 kg of the sulphur mortar in a suitable container in not over 1 hour and hold at a temperature of 130° to 140°C for at least 15 minutes with constant agitation. The stirring shall be such as to lift the aggregate without beating air into the melt. Place the piece of plastic sheet containing the rectangular hole, bevelled side down, over the open face of the mould with the hole centred on the face. On top of the piece of plastic sheet and surrounding the rectangular hole place a section of plastic tubing or pipe 25 mm in diameter by 25 mm high. Pour the melted mortar through the rectangular hole into the mould, and continue to pour until the section of tubing or pipe is completely filled. The excess of mortar contained in the section of tubing or pipe acts as a reservoir to compensate for shrinkage of the mortar during cooling. Allow the specimen to remain in the mould until it has

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completely solidified. Upon removal, file, grind or sand off the surface flush, removing the excess material remaining at the pouring gate.

10.3 Conditioning the Test Specimens — Age the specimens for 48 hours in air at $27^{\circ} \pm 2^{\circ}\text{C}$, the 48 hours to include the time in the mould.

10.4 Testing — The test shall be carried out and completed in accordance with the method described in 10.8, 10.9, 10.10, 10.11 and 10.12 of IS : 4456 (Part I)-1967*.

*Methods of test for chemical resistant mortars : Part I Silicate type and resin type.

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