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IS 4031-11 (1988): Methods of physical tests for hydraulic cement, Part 11: Determination of density [CED 2: Cement and Concrete]



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“Knowledge is such a treasure which cannot be stolen”



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*Indian Standard*

**METHODS OF PHYSICAL TESTS FOR  
HYDRAULIC CEMENT**

**PART II DETERMINATION OF DENSITY**

*( First Revision )*

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*Indian Standard***METHODS OF PHYSICAL TESTS FOR  
HYDRAULIC CEMENT****PART II DETERMINATION OF DENSITY***( First Revision )***0. FOREWORD**

**0.1** This Indian Standard ( Part 11 ) ( First Revision ) was adopted by the Bureau of Indian Standards on 22 April 1988, after the draft finalized by the Cement and Concrete Sectional Committee had been approved by the Civil Engineering Division Council.

**0.2** Standard methods of testing cement are essential adjunct to the cement specifications. This standard in different parts lays down the procedure for the tests to evaluate the physical properties of different types of hydraulic cements. The procedure for conducting chemical tests of hydraulic cement is covered in IS : 4032-1985\*.

**0.3** Originally all the tests to evaluate the physical properties of hydraulic cements were covered in one standard ; but for facilitating the use of this standard and future revisions, it has been decided to print the different tests as different parts of the standard and accordingly, this revised standard has been brought out in thirteen parts. This will also facilitate updating

of individual tests. Further, since publication of the original standard in 1968, a number of standards covering the requirements of different equipment used for testing of cement, a brief description of which was also covered in the standard, had been published. In this revision, therefore, reference is given to different instrument specifications deleting the description of the instruments, as it has been recognized that reproducible and repeatable test results can be obtained only with standard testing equipment capable of giving desired level of accuracy. This part ( Part 11 ) covers determination of density of hydraulic cement.

**0.4** 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\*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

\*Method of chemical analysis of hydraulic cement ( first revision ).

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

**1. SCOPE**

**1.1** This standard ( Part 11 ) covers the procedure for determining the density of hydraulic cement.

**2. SAMPLING AND SELECTION OF TEST SPECIMENS**

**2.1** The samples of the cement shall be taken in accordance with the requirements of IS : 3535-1986\* and the relevant standard specification for the type of cement being tested. The representative

\*Methods of sampling hydraulic cements.

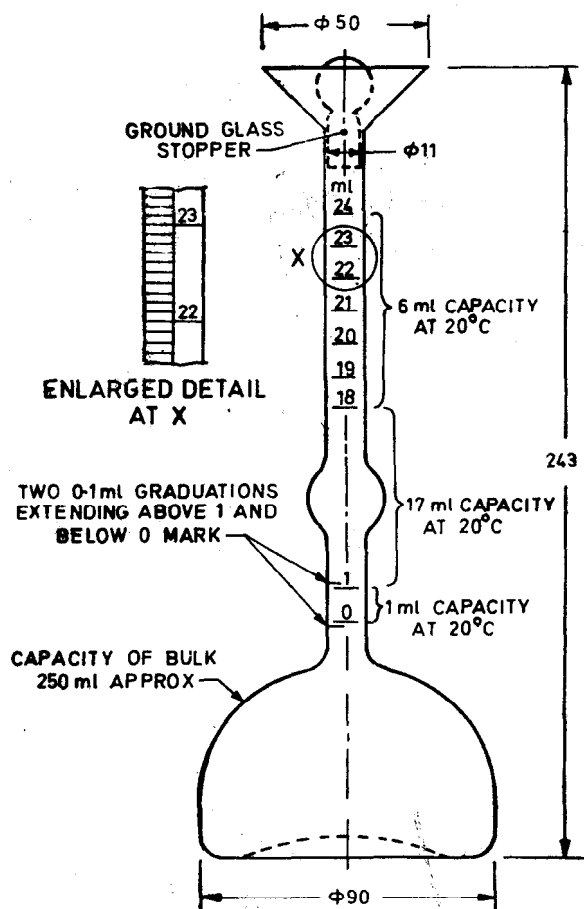
sample of the cement selected as above shall be thoroughly mixed before testing.

**3. TEMPERATURE**

**3.1** The temperature of the laboratory shall be maintained at  $27 \pm 2^\circ\text{C}$ .

**4. APPARATUS**

**4.1 Le Chatelier Flask** — Standard LeChatelier flask conforming to the dimensions shown in Fig. 1.



NOTE—Variations of a few millimetres in such dimensions as the height of flask, diameter of base, etc. are to be expected and will not be considered sufficient cause for rejection.

All dimensions in millimetres.

FIG. 1 LE CHATELIER FLASK FOR DENSITY TEST

**4.2 Analytical Balance** — Analytical balance capable of reproducing results within 0.000 2 g with an accuracy of  $\pm 0.000 2$  g.

NOTE — Self-indicating balance with equivalent accuracy may also be used.

**4.3 Standard Weights**

**4.4 Constant Temperature Water Bath** — The constant temperature water bath shall be capable of maintaining temperature within  $\pm 0.2^\circ\text{C}$ .

**5. MATERIAL**

**5.1** Kerosine free of water, or naphtha having a specific gravity not less than 0.731 3 shall be used in the density determination.

**6. PROCEDURE**

**6.1** Density of cement shall be determined on the material as received, unless otherwise specified. If the density determination on a loss-free sample is required, the sample shall first be ignited according to the test for loss on ignition.

**6.2** The flask shall be filled ( see Note 1 ) with

either of the liquids specified in 5.1 to a point on the stem between the zero and the 1-ml mark. The inside of the flask above the level of the liquid shall be dried, if necessary, after pouring. The first reading shall be recorded after the flask has been immersed in the water bath ( see Note 2 ) in accordance with 6.3. A weighed quantity of cement ( about 64 g for Portland cement ) shall then be introduced in small amounts at the same temperature as the liquid ( see Note 1 ). Care shall be taken to avoid splashing and to see that the cement does not adhere to the inside of the flask above the liquid. A vibrating apparatus may be used to accelerate the introduction of the cement into the flask and to prevent the cement from sticking to the neck. After all the cement has been introduced, the stopper shall be placed in the flask and the flask rolled in an inclined position ( see Note 1 ), or gently whirled in a horizontal circle, so as to free the cement from air until no further air bubbles rise to the surface of the liquid. If a proper amount of cement has been added, the level of the liquid will be in its final position at some point of the upper series of graduations. The final reading shall be taken after the flask has been immersed in the water bath in accordance with 6.3.

NOTE 1 — It is advisable to use a rubber pad on the table top when filling or rolling the flask.

NOTE 2 — Before the cement has been added to the flask, a loose-fitting lead-ring weight around the stem of the flask will be helpful in holding the flask in an upright position in the water bath or the flask may be held in the water bath by a burette clamp.

NOTE 3 — For cleaning of Le Chatelier flasks, acid cleaning will not be effective in removing any deposition of silicic acid gel. They may be satisfactorily cleaned by using warm sodium carbonate solution.

**6.3** The flask shall be immersed in a constant-temperature water bath, maintained at about room temperature, for a sufficient interval before making either of the readings so as to avoid variations greater than  $0.2^\circ\text{C}$  in the temperature of the liquid in the flask. All readings shall be checked until they are constant to ensure that the contents of the flask have reached the temperature of the water bath.

**7. CALCULATION**

**7.1** The difference between the first and the final readings represents the volume of liquid displaced by the mass of cement used in the test. The density shall be calculated as follows to the second place of decimal :

$$\text{Density} = \frac{\text{Mass of cement in g}}{\text{Displaced volume in cm}^3}$$

**7.2** Two tests shall be carried out and the average shall be reported.

**8. RETEST**

**8.1** If the difference between the two values differs by more than 0.03, the test shall be repeated.