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British Standard

Testing of resin compositions for use in construction

Part 5. Methods for determination of density of hardened resin compositions

Essais des compositions de résines à utiliser en construction
Partie 5. Méthodes de détermination des compositions de résines durcies

Prüfung von Kunstharzen im Bauwesen
Teil 5. Verfahren zur Bestimmung der Dichte von erhärteten Kunstharzverbindungen

Foreword

This Part of BS 6319 has been prepared under the direction of the Civil Engineering and Building Structures Standards Committee. This Part describes methods for measurement of density and is one of a series of Parts describing methods for measuring basic physical properties of resin-based materials.

The density of a hardened resin composition is an important factor since it is directly related to the degree of consolidation and the amount of air entrapped during mixing. Since most of the performance characteristics of a composition may be impaired by inadequate consolidation, it is desirable that density measurement should accompany all assessments of strength properties of hardened resin compositions.

This Part of this British Standard should be read in conjunction with BS 6319 : Part 1 which provides general information and describes a method for preparing test specimens.

Compliance with a British Standard does not of itself confer immunity from legal obligations. In particular, attention is drawn to the Health and Safety at Work etc. Act 1974.

1. Scope

This Part of BS 6319 describes two methods for the determination of the density of specimens of hardened resin-based mortars and concretes. The methods may be applied both in the laboratory under closely controlled conditions and on site for routine checks. Method A is a simple measurement method that can be applied only to regular-shaped specimens. Method B is a pyknometer method and is suitable for regular- or irregular-shaped specimens. It should be noted that the pyknometer method is only suitable for resin compositions that absorb less than 1 % (by mass) of water during the duration of the test. These methods may also be used to determine the relative density of the material.

NOTE. The titles of the publications referred to in this standard are listed on the inside back page.

2. Definitions

For the purposes of this Part of BS 6319 the definitions given in BS 6319 : Part 1 apply.

3. Principle

3.1 Method A. The density of a regular-shaped specimen is determined by measurement of its dimensions and relating the calculated volume to the mass of the specimen.

3.2 Method B. The density of a specimen is determined by measuring the volume of water displaced when it is introduced into a water-filled pyknometer and relating this to the mass of the specimen.

4. Apparatus

4.1 Method A

4.1.1 *Calipers*, complying with BS 3123.

4.1.2 *Balance*, capable of determining the mass of the specimen to the nearest 10 mg.

4.2 Method B

4.2.1 *Pyknometer*, comprising a cylindrical glass vessel with a flat glass plate lid. The vessel shall be of minimum volume able to contain the specimen. Its mouth shall be ground to form a watertight seal with the lid.

4.2.2 *Balance*, capable of determining the mass of the pyknometer filled with specimen and water to the nearest 50 mg.

4.2.3 *Thermometer*, graduated in divisions of 0.5 °C and having an accuracy of ± 0.5 °C.

5. Test specimens

5.1 General. Any conditioning or treatment of the specimens of the hardened resin composition prior to testing shall be declared in the test report. The volume of each specimen shall be not less than 62.5 cm^3.

NOTE. This requirement will be met by using the specimens described in BS 6319 : Parts 2 and 3. The actual size of the specimen is dependent upon the size of the aggregate used.

Each specimen shall be representative of the resin composition being assessed. Where more than one specimen is to be tested, the specimens shall be taken from the same batch of mixed materials.

5.2 Dimensions of specimens

5.2.1 *Method A.* Only regular-shaped specimens shall be measured for the calculation of volume.

5.2.2 *Method B.* Specimens may be of any shape and may comprise as many pieces as will conveniently fit into the pyknometer. Moulded cubes prepared for compressive strength determination and prisms for flexural strength determination are suitable.

NOTE. Pieces with concavities should not be used because of the risk of entrapping air.

6. Procedures

6.1 General

6.1.1 *Sample*

(a) *On-site tests.* For routine purposes, e.g. on-site tests, test one or more specimens.

(b) *Laboratory tests.* When the test is to be carried out under closely controlled conditions for the purpose of obtaining reference data, test a minimum of three specimens.

6.1.2 *Temperature.* Carry out the test at a temperature of 20 ± 1 °C. Maintain the specimen, and in method B the pyknometer, at this temperature for not less than 16 h before testing commences.

6.2 Method A. Weigh each specimen and record its mass, m (in g), to the nearest 10 mg.

Using calipers, measure the dimensions of each specimen between opposite vertical faces and the height as cast at four points across each pair of opposite faces. Calculate the mean of each set of four measurements and calculate the volume, V (in mm^3), of each specimen.

6.3 Method B

6.3.1 Weigh each specimen and record its mass, m_1 (in g), to the nearest 10 mg.

6.3.2 Fill the pyknometer with water at 20 °C and slide the lid into place, taking care that no air bubbles remain within the pyknometer. Wipe dry the outside of the pyknometer and its lid and determine the mass of the filled pyknometer, m_2 (in g), to the nearest 50 mg.

6.3.3 Remove the lid and introduce a specimen, taking great care to ensure that no air bubbles remain adhered to the specimen.

NOTE. In some cases it may be found advantageous to pre-wet the specimen with water containing a trace of a suitable wetting agent.

6.3.4 Completely fill the vessel with water and replace the lid as before. Wipe dry the outside of the vessel and lid and determine the mass of the pyknometer filled with specimen and water, m_3 (in g), to the nearest 50 mg.

6.3.5 Repeat the procedure given in **6.3.3** and **6.3.4** on each of the remaining specimens.

7. Calculations

7.1 General. Calculate the density, ρ, of each specimen using the equations in **7.2** or **7.3**, as appropriate. Where more than one specimen is tested calculate the mean density. Express the values to the nearest 0.01.

NOTE. The relative density of the specimen may, for all practical purposes, be calculated by multiplying the density by 1000. Relative density is a dimensionless quantity.

7.2 Method A. Calculate the density, ρ (in g/mm^3), from the following equation:

$$\rho = \frac{m}{V}$$

where

m is the mass of the specimen (in g);

V is the volume of the specimen (in mm^3).

7.3 Method B. Calculate the density, ρ (in g/mm^3), from the following equation:

$$\rho = \frac{m_1 \times D}{m_1 + m_2 - m_3}$$

where

m_1 is the mass of the specimen (in g);

m_2 is the mass of the pyknometer plus water (in g);

m_3 is the mass of the pyknometer plus water and specimen (in g).

D is the density of water (taken as 1×10^{-3} g/mm^3).

8. Test report

The following information shall be included in the test report:

(a) date and site of sample preparation;

(b) ambient conditions during the preparation and testing of each specimen, and the curing regime adopted;

(c) a complete identification of the material tested including type, source, manufacturer's code and history;

(d) the form (including number of pieces) of each specimen;

(e) the mass of each specimen;

(f) in the case of method A, the size and volume of each specimen;

(g) the density or relative density of each specimen.