

STANDARDS ASSOCIATION OF AUSTRALIA

Australian Standard
for
**METHODS OF SAMPLING AND TESTING MORTAR FOR
MASONRY CONSTRUCTION**

AS 2701.10
METHODS FOR CHEMICAL ANALYSIS
OF MORTARS

1 SCOPE. This standard sets out recommended procedures for methods of analysis and interpretation that may be used on fresh or hardened mortar to determine the nature and proportion of its original ingredients.

NOTES:

1. The range of situations leading to such investigations and the amount of available information vary so much that it is not possible to cover all cases, however, the methods given here are preferred.
2. Types of problem covered. The methods given here are applicable particularly to the following types of investigation:
 - (a) Assessment of the efficiency of mixing and the accuracy of batching.
 - (b) Analysis of mortar for compliance with specification.
 - (c) Investigation of failure.

The methods cannot be used without modification for mortars based on masonry cements because it is usually uncertain which of a wide range of possible ingredients have been used.

3. Limitations of chemical analysis of mortar. Proportions of mortar materials traditionally are specified by volume, and in the case of site-mixed mortars have also been measured by volume. In the analytical methods described below measurement is by mass, and the results are calculated as percentages by mass. To transform the analytical figures back to the original volume measure requires a knowledge of the bulk densities of the ingredients, and the errors inherent in this step are much greater than those inherent in the analytical procedures.

The bulk density of portland cement remains reasonably constant but the bulk densities of hydrated lime and lime putty depend upon the source of the material. The bulk density of sand depends not only on the source but also on the moisture content.

In certain parts of Australia, sand is known to contain significant amounts of acid-soluble calcium salts. When these sands are used in mortar, unless a sample of them is supplied for testing, only gross deviations from specification will be detected by chemical analysis. It will nearly always be possible to make comparisons of mortar from different parts of the same building with more certainty than on samples from different sources.

2 REFERENCED DOCUMENTS. The following standards are referred to in this standard:

- AS 1141 Methods of Sampling and Testing Aggregates
Section 11—Particle Size Distribution by Dry Sieving
- AS 1152 Test Sieves
- AS 1465 Dense Natural Aggregates for Concrete
- AS 2162 Code of Practice for the Use of Volumetric Glassware
- AS 2701 Methods of Sampling and Testing Mortar for Masonry Construction
Part 2—Methods of Sampling.

3 EXAMINATION OF MORTARS-GENERAL. The following points relating to the examination of mortars should be kept clearly in mind:

- (a) No problem should be investigated without full consideration being given to all information obtainable concerning the materials used, site conditions, adjacent materials, specification requirements, etc. In general the more information available the more definite can be the conclusions of an investigation.
- (b) Ideally, samples of all materials used in the preparation of a mortar should be used for the calculation of its composition. In their absence the results of previous examinations of the materials can sometimes be of great use.

In some instances, e.g. with defects arising some time after the placing of the mortar, such information may not be available. The analyst must then be very cautious in his interpretation of the analysis. In many of these instances, however useful information may be derived by analysis, despite the absence of background information, e.g. large variability in a given area of work can be proven.

Clauses 6.7 and 7.8 give methods of calculation of the proportions by weight and, from these, the proportions by volume.

- (c) The accuracy to which the analyst is justified in reporting mortar compositions is much less than the accuracy of the analytical methods used (given in Clauses 6 and 7).

Where appropriate an indication is given of the accuracy to which the analyst is justified in reporting. However, due to the wide variation of applications in practice, the analyst should make his own assessment.

4 REAGENTS. Unless otherwise stated, all reagents shall be of recognized analytical reagent quality and water shall be distilled or de-ionized water.

Reagents shall be prepared by the following methods, or proprietary reagents of proven quality may be used:

NOTE: Dilution of acids and other liquid reagents are given as (1 + *n*) which indicates that one volume of concentrated reagent is added to *n* volumes of water and mixed.

- (a) *Calcein (screened) indicator.* Mix by grinding together, 0.2 g of calcein, 0.12 g of thymolphthalein and 20 g of potassium chloride.
- (b) *Calcium standard solution* (2.8 mg/mL). Dissolve 5.005 g dried (150°C) calcium carbonate in a slight excess of hydrochloric acid (1 + 4), boil to expel carbon dioxide, cool and dilute to 1 L in a volumetric flask.
- (c) *EDTA solution* (0.05M). Dissolve 18.6 g of EDTA (diaminoethane tetra-acetic acid, disodium salt 2H₂O) in warm water, and filter, cool and dilute to 1 L. Store in a polyethylene bottle. Standardize against standard calcium solution as follows:
 - (i) Pipette 20.00 mL of standard calcium solution (2.8 mg CaO/mL) into a 400 mL perspex or polypropylene beaker, dilute to 50 mL with water, then add 5 mL of 10 percent (m/v) sugar solution followed by 10 mL of 10 percent (v/v) triethanolamine and 10 mL of 20 percent (m/v) potassium hydroxide solutions.
 - (ii) Stir and add approximately 0.01 g of screened calcein indicator and titrate with the EDTA solution and fluorescent green to pink-purple.
- (d) *Hydrochloric acid* (ρ 1160 kg/m³). Hydrochloric acid (approximately 0.5M). Dilute 50 mL of acid to 1 L. Standardize against sodium carbonate standard solution (0.25 M) using methyl orange as indicator.
- (e) *Hydrofluoric acid* (ρ 1120 kg/m³ to 1130 kg/m³). At least 40 percent m/m.
- (f) *Methyl orange indicator solution.* Dissolve 0.05 g of methyl orange in 100 mL of hot water, cool and filter.
- (g) *Potassium hydroxide solution* (200 g/L). Dissolve 200 g of potassium hydroxide in 1 L of water.
- (h) *Sodium carbonate solution* (100 g/L). Dissolve 100 g of anhydrous sodium carbonate in 1 L of water.
- (j) *Sodium carbonate standard solution* (0.25 M). Dissolve 6.25 g of anhydrous sodium carbonate, dried at 150°C, in water and dilute to 250 mL in a volumetric flask.
- (k) *Sugar*—granulated sugar solution (10 percent m/v). Dissolve 10 g sugar in 100 mL of water.

NOTE: Use fresh solutions daily.

- (l) *Thymolphthalein indicator.* Dissolve 0.1 g thymolphthalein in 50 mL of methanol.
- (m) *Hydrochloric acid* (1 + 9). Add 100 mL of concentrated hydrochloric acid to 900 mL of water.

5 APPARATUS. The following apparatus is required:

- (a) *Balance.* A balance of sufficient capacity and accurate to 0.05 g.
- (b) *Glassware.* Glassware shall be chemically resistant and shall comply with the appropriate requirements of the relevant Australian standard. See AS 2162 for recommendations covering the use of volumetric glassware. The following items are required:
 - (i) Conical flask, 500 mL.
 - (ii) Buchner funnel.
 - (iii) Pipette, 100 mL.
 - (iv) Tared dish.
 - (v) Watch glass.
- (c) *Muffle furnace.* Capable of maintaining a temperature of 1000°C.

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