British Standard

BRITISH STANDARD

BS 3148:1980

Methods of test for

Water for making concrete (including notes on the suitability of the water)

UDC 666.972.17:691.32:628.1.03

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Association of Lightweight Aggregate Manufacturers
Electricity Supply Industry in England and Wales
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Contents

Foreword

This British Standard, prepared under the direction of the Cement, Gypsum, Aggregates and Quarry Products Standards Committee, is a revision of BS 3148:1959 which is now withdrawn.

In the light of present knowledge it is not possible to issue a specification for water for making concrete but only methods of testing such water. Guidance on the suitability of water for making concrete is given in appendix A which summarizes the present state of knowledge by which the results of chemical analysis of waters may be used to judge their suitability for this purpose.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 4, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This British Standard describes two methods by which water may be tested in respect of its suitability for making concrete. These tests do not give information regarding the long-term durability of the concrete and appendix A summarizes the present state of knowledge in the light of which waters may be judged as to their suitability for this purpose.

2 References

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

3 Definitions

For the purposes of this British Standard the definitions given in BS 2787 apply.

4 Sampling

A sample of water of not less than 5 litres shall be taken by a competent representative of the interested parties. The sample shall be typical of the water as it is to be used, due regard being paid to the effect of seasonal variation. The sample shall not receive any treatment before testing other than that envisaged for the bulk supply before the latter is used in concrete. The sample shall be stored in a clean container previously rinsed out with similar water.

NOTE Guidance on methods of sampling, with particular regard to the factors which may cause variation of composition, will be found in BS 1328 although the refinements necessary for obtaining accurate analytical figures will be out of place here. Elaborate sample collectors are not essential and may be replaced by any clean convenient container.

5 Materials for the test

5.1 Distilled water. Not less than 5 litres of distilled water shall be available for control tests and shall be stored in a clean container.

NOTE Deionized water is also suitable.

5.2 Test cement. Not less than 15 kg of cement shall be provided, of the same type, but not necessarily of the same batch or manufacture, as it is proposed to use for the concrete. It shall be thoroughly mixed, and stored in an airtight container. The cement shall comply with the requirements of the appropriate British Standard for its type and shall have an initial setting time of at least 30 min more than the minimum initial setting time specified in the standard, as shown in Table 1.

Table 1 — Test cement

Type of cement	British Standard number	Minimum initial setting time	
		In the BS	For this test
		minutes	minutes
Ordinary Portland cement	12	45	75
Rapid-hardening Portland cement	12	45	75
Portland-blastfurnace cement	146	45	75
Sulphate-resisting Portland cement	4027	45	75
Supersulphated cement	4248	45	75
Low heat Portland cement	1370	60	90
Low heat Portland-blastfurnace cement	4246	60	90
High alumina cement	915	120	150

6 Initial setting time test

A test block shall be made with the water and the appropriate test cement, and the initial setting time determined by the procedure described in BS 4550-3.5 and BS 4550-3.6. A control test block shall be made with the distilled water and the same cement, and the initial setting time shall be determined by the same procedure.

The initial setting times of the cement, determined from the test block and from the control test block, shall be reported. (Guidance on the suitability of the water, based on the initial setting time test, is given in **A.5**.)

NOTE It may also be useful to continue the test to determine the final setting time.

7 Compressive strength test

Concrete test cubes shall be made with the water and the appropriate test cement, and the compressive strength determined, by the method described in BS 4550-3.4. Control concrete test cubes shall be made with the distilled water and the same cement, and the compressive strength shall be determined by the same method.

Cubes shall be tested 28 days after preparation except in the case of concrete cubes made with high alumina cement which shall be tested 24 h after preparation.

The average strength of the test cubes and of the control test cubes shall be reported.

(Guidance on the suitability of the water, based on the compressive strength test, is given in **A.5**.)

NOTE It may also be useful to prepare, from the same concrete mixes, cubes for testing at other ages.

Appendix A Notes on the suitability of water for making concrete

A.1 General. As a general rule, water of chemical composition acceptable for drinking, whether treated for distribution through the public supply or untreated, is suitable for making concrete.

Where public supplies are not available, water for concreting may have to be drawn from natural sources, and may contain undesirable organic constituents or unacceptably high contents of inorganic salts. Surface waters in particular often carry suspended matter such as oil, clay, silt, leaves and other vegetable debris, and may be unsuitable for use without physical treatment, such as filtration or impounding to allow suspended matter to settle.

A.2 Organic impurities. The effect of organic substances in natural waters on the setting time of cement or the ultimate strength of the concrete, is a problem of considerable complexity. Highly coloured waters, waters with a pronounced odour, or those in which green or brown slime-forming algae are visible should be regarded with suspicion, and should be tested in accordance with this British Standard.

A.3 Inorganic impurities

A.3.1 *General.* The permissible limits for inorganic constituents are quite wide, but in some areas of the world these may be present in sufficient amounts to cause gradual deterioration of the concrete. The data available regarding the effect of dissolved solids on the strength and durability of the concrete are insufficient for a comprehensive system of numerical limits to be drawn up, but some guidance can be given on permissible levels of certain impurities.

The major ions usually present in natural waters are calcium, magnesium, sodium, potassium, bicarbonate, sulphate, chloride, nitrate and, less frequently, carbonate.[1)] Waters containing a combined total of not more than 2 000 mg per litre of these common ions are generally suitable as mix water.

A.3.2 *Chlorides.* The presence of chlorides in concrete, either from the mixing water, or from other sources, can present potential hazards with some cements or when metals are embedded in concrete. The amount of chloride that can be tolerated in the mixing water depends on the total amount of chloride in the concrete arising from all sources. Recommended limiting values for total chloride by weight of cement in different types of concrete are included in **6.3.8** of CP 110-1:1972. As a guide, the chloride content of the water should generally not exceed 500 mg of chloride per litre. It is however sometimes necessary to accept higher concentrations in certain arid regions of the world where natural waters can be highly saline.

Sea water has been used satisfactorily for making plain Portland cement concrete but there is a tendency for it to cause surface dampness and efflorescence. Its use may also cause a moderate reduction in strength.

Sea water should not be used in reinforced or prestressed concrete, nor in concrete made with high alumina cement.

A.3.3 *Sulphates.* A general guide to the acceptability of sulphates in mixing water is that the sulphate content should not exceed 1 000 mg of sulphur trioxide per litre. However, water with higher contents has been used satisfactorily. The amount of sulphate that can be tolerated in the mixing water depends on the sulphate contents of the aggregates and cement, since the critical factor is the total amount of sulphate in the concrete which generally should not exceed 4 % of sulphur trioxide by mass of cement, as stated in appendix A of BS 5328:1976.

A.3.4 *Alkali carbonates and bicarbonates.* Water that contains alkali carbonates and bicarbonates may affect the setting time of the cement and the strength of the concrete. Their presence may also be detrimental if there is a risk of alkali-aggregate reaction. In general, their combined total should not exceed 1 000 mg per litre.

A.4 Contamination from industrial wastes. Special attention is drawn to the need for extra caution when using waters that may be contaminated by industrial effluent or by drainage from mines, mineral dumps etc. and such waters should be tested in accordance with this British Standard.

[1)] For further information see BRE Current Paper CP 2/79 "Analysis of sulphate-bearing soils" M J Bowley, London, HMSO 1979.

A.5 Assessment of setting time and compressive strength tests. It is considered that water will have no significant effect on the setting and hardening characteristics of concrete if, when tested as specified,

a) the initial setting times of the cement, determined from the test block and from the control test block, do not differ by more than 30 min, and

b) the average compressive strength of the concrete test cubes is not less than 90 % of the average strength of the control test cubes.

Values that fall outside these limits imply that the water is causing an effect, therefore further consideration should be given to securing an alternative source of water, or, where the strength does not fall below 80 % of the average strength of the control test cubes, to modifying the mix proportions.

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Standards publications referred to

BS 12, *Specification for ordinary and rapid-hardening Portland cement.*
BS 146, *Portland-blastfurnace cement.*
BS 915, *High alumina cement.*
BS 1328, *Methods of sampling water used in industry.*
BS 1370, *Specification for low heat Portland cement.*
BS 2787, *Glossary of terms for concrete and reinforced concrete.*
BS 4027, *Sulphate-resisting Portland cement.*
BS 4246, *Low heat Portland-blastfurnace cment.*
BS 4248, *Supersulphated cement.*
BS 4550, *Methods of testing cement.*
BS 4550-3, *Physical tests.*
BS 4550-3.4, *Strength test.*
BS 4550-3.5, *Determination of standard consistence.*
BS 4550-3.6, *Test for setting times.*
BS 5328, *Methods for specifying concrete.*
CP 110, *The structural use of concrete.*
CP 110-1, *Design, materials and workmanship.*

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