

Stabilized materials for civil engineering purposes —

**Part 1: General requirements, sampling,
sample preparation and tests on
materials before stabilization**

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Road Engineering Standards Policy Committee (RDB/-) to Technical Committee RDB/9, upon which the following bodies were represented:

- British Aggregate Construction Materials Industries
- British Cement Association
- British Civil Engineering Test Equipment Manufacturers' Association
- British Coal Corporation
- County Surveyors' Society
- Department of the Environment (Property Services Agency)
- Department of the Environment (Building Research Establishment)
- Department of Transport
- Federation of Civil Engineering Contractors
- Institution of Civil Engineers
- Institution of Highways and Transportation
- Institution of Structural Engineers
- Rothamsted Experimental Station
- Society of Chemical Industry

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

- Association of Consulting Engineers
- Refined Bitumen Association Ltd.
- Co-opted members

This British Standard, having been prepared under the direction of the Road Engineering Standards Policy Committee, was published under the authority of the Board of BSI and comes into effect on 31 October 1990

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Foreword

This Part of BS 1924 has been prepared under the direction of the Road Engineering Standards Policy Committee. It is Part 1 of a revision in two Parts of BS 1924:1975, which is now withdrawn.

The two Parts of BS 1924 are:

- *Part 1: General requirements, sampling, sample preparation and tests on materials before stabilization;*
- *Part 2: Methods of test for cement-stabilized and lime-stabilized materials.*

The tests for materials in the unstabilized state are given in Part 1 by reference to other British Standards. Except where they are seldom used or the test procedures are identical in all respects, the tests for materials in the stabilized condition included in Part 2 are given in full, although they may be similar to tests in other British Standards. This is to provide a complete and comprehensive document for use by testing laboratories, and because the tests themselves have to be modified to take account of the presence of the stabilizing agent. This particularly applies to sample preparation.

The title of the standard has been amended to reflect the wider scope of this revision, which is intended to cover, in addition to soils, materials which when stabilized with cement or lime may be used for civil engineering purposes. Although concerned principally with Portland cement, hydrated lime (calcium hydroxide) and quicklime (calcium oxide) it is also applicable to other cements and types of lime, including those in which pulverised fuel ash (pfa) or slag are the major components.

This revision includes all the tests, with minor exceptions, for materials stabilized with lime or cement that were included in the 1975 edition but does not include any tests for materials stabilized with bitumen. In deciding to exclude tests for bitumen-stabilized materials from the revision the Committee consulted extensively on the currency and use of the tests in the 1975 edition and on the existence of or need for other tests. Reader's comments are invited on the need for and contents of a further Part, (Part 3) of this British Standard for such tests¹⁾.

Lime, and to a lesser extent cement, may also be used to modify rather than to stabilize a material. Modified materials are usually natural soils and probably fine-grained but may be by-products of industrial processes, e.g. colliery spoil. The object of the modification process is to improve the properties of the soil such as shear strength, durability, etc. but the modified material retains many of the properties of soil. The process may, for example, be used to render an unsuitable material suitable by modifying the plasticity characteristics. In these cases the tests in this standard may be suitable but equally the soil tests in BS 1377 referred to in the text may be considered to be applicable to measure the change in properties caused by modifying the soil or other material.

It has been assumed in the drafting of this standard that the execution of its provisions is entrusted to appropriately experienced people, for whose guidance it has been prepared.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 14, 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⁾ Comments should be sent to the Secretary, Technical Committee RDB/9, BSI, 2 Park Street, London W1A 2BS.

1 Scope

This Part of BS 1924 deals with general requirements, sampling, sample preparation and preliminary tests carried out on materials in the unstabilized condition to assess their suitability for stabilization.

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

2 Definitions

For the purposes of this Part of BS 1924 the following definitions apply.

2.1

particle size distribution

the percentages of various grain sizes present in a material as determined by sieving and sedimentation

2.2

cobbles²⁾

rounded or sub-angular particles of sizes between 200 mm and 60 mm

2.3

gravel fraction²⁾

the fraction composed of particles between the sizes of 60 mm and 2 mm. See note to 2.5

2.4

sand fraction²⁾

the fraction composed of particles between the sizes of 2.0 mm and 0.06 mm. See note to 2.5

2.5

silt fraction²⁾

the fraction composed of particles between the sizes 0.06 mm and 0.002 mm

NOTE The gravel, sand and silt fractions may be subdivided as in Table 1.

2.6

clay fraction²⁾

the fraction composed of particles smaller in size than 0.002 mm

2.7

cohesive material

all material which by virtue of its clay content will form a coherent mass

2.8

non-cohesive material (granular material)

a material which will not form a coherent mass

2.9

sampling

the selection of a representative portion of material

2.10

representative sample

a sample taken to represent a body of material in order to study its average properties

2.11

spot sample

a sample taken from control tests carried out during construction work which represents only the material in that larger sample from which it was taken

2.12

batch (stockpile)

a definite quantity of material produced under conditions which are presumed uniform

NOTE With a continuous process such as is used in most work connected with cement and lime stabilization the quantity produced in a stated period should be treated as a batch.

2.13

sampling increment

a quantity of material taken at one time from a larger body of material

NOTE The material taken by a single operation of the scoop should be treated as a sampling increment.

2.14

bulk sample

an aggregation of the sampling increments

2.15

laboratory sample

a sample intended for laboratory inspection or testing

2.16

test portion

the material used as a whole in testing or inspection

2.17

quartering

the reduction in quantity of a large sample of material by dividing a circular heap into four approximately equal parts by diameters at right angles, removing two diagonally opposite quarters, and mixing the two remaining quarters intimately together so as to obtain a truly representative half of the original mass, then repeating the process until a representative sample of the appropriate size is obtained

²⁾ These classifications are based solely on particle size and give no indication of the mineralogy of the material.

Table 1 — Fraction particle size and test sieves

Fraction	Particle size	Sizes of test sieves to be used for separation ^{ab}
	mm	
a) Gravel fraction		
Coarse gravel	60 to 20	63 mm to 20 mm
Medium gravel	20 to 6	20 mm to 6.3 mm
Fine gravel	6 to 2	6.3 mm to 2.0 mm
b) Sand fraction		
Coarse sand	2.0 to 0.6	2.0 mm to 600 µm
Medium sand	0.6 to 0.2	600 µm to 212 µm
Fine sand	0.2 to 0.06	212 µm to 63 µm
c) Silt fraction		
Coarse silt	0.06 to 0.02	—
Medium silt	0.02 to 0.006	—
Fine silt	0.006 to 0.002	—

^a These are the test sieve sizes nearest to the theoretical sizes. When the 2.0 mm and 63 µm sieves are not available the 2.36 mm and 75 µm test sieves may be used in most cases without seriously affecting the result.

^b See 2.30.

2.18
riffing

the reduction in quantity of a large sample of material by dividing the mass into two approximately equal halves by passing the sample through an appropriately sized sample divider, e.g. a riffle box, then repeating the process until a sample of the required size is obtained

2.19
compaction

the process of packing stabilized particles more closely together by rolling or mechanical means, thus increasing the dry density of the stabilized material

NOTE This term should not be confused with consolidation, which is the process whereby soil particles are packed more closely together over a period of time by application of continued pressure.

2.20
bulk density

the mass of material (including solid particles, any contained water and any fluid stabilizer) per unit volume, including voids

2.21
dry density

the mass of material after drying to constant mass at 105 °C, and after removal of any fluid stabilizers, contained in unit volume of undried material (see note to 2.28)

2.22
moisture content

the mass of free water which can be removed from a material, usually by heating at 105 °C, expressed as a percentage of the dry mass (see note to 2.28)

NOTE Although the term moisture content has been used throughout this standard the term water content is also widely used and either may be employed.

2.23
optimum moisture content

the moisture content at which a specified amount of compaction will produce a maximum dry density (see note to 2.28)

2.24 maximum dry density

the dry density obtained using a specified amount of compaction at the optimum moisture content (see note to 2.28)

2.25
relative compaction

the percentage ratio of the dry density of the material to the maximum dry density of that material as determined by a specified laboratory compaction test

2.26
dry density/moisture content relationship

the relation between dry density and moisture content of a material when a given compactive effort is employed (see note to 2.28)

2.27
percentage air voids

the volume of air voids in the material expressed as a percentage of the total volume of the material

2.28
air voids line

a line showing the relation between the dry density and moisture content for a material containing a constant percentage of air voids

NOTE Figure 1 shows a method of deriving the optimum moisture content and maximum dry density from the dry density/moisture content relationship. The dry density/moisture content relationship does not always take the form shown in Figure 1, particularly with coarse-grained materials where the relation may not be well defined. Figure 1 also shows air voids lines. The line can be calculated from the equation:

$$\rho_d = \rho_w \left[\left(1 - \frac{v_a}{100} \right) / \left(\frac{1}{\rho_s} + \frac{w}{100} \right) \right]$$

where

ρ_d = the dry density of the material (in Mg/m³);

ρ_w = the density of water (in Mg/m³);

V_a = the volume of air voids in the material (as a percentage of the total volume of the material);

ρ_s = the particle density³⁾;

w = the moisture content, expressed as a percentage of dry material.