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अतिसल्फेट कृत सीमेंट — विशिष्टि
(पहला पुनरीक्षण)

Indian Standard
SUPERSULPHATED CEMENT —
SPECIFICATION
(First Revision)

(Incorporating Amendment Nos. 1, 2, 3 & 4)

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BUREAU OF INDIAN STANDARDS
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Price Group 3

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Cement and Concrete Sectional Committee had been approved by the Civil Engineering Division Council.

This standard was first published in 1973 and since then large number of amendments have been issued from time to time in order to modify various provisions based on the requirements of the users and also keeping in view the raw materials and fuel available in the country for manufacture of cement. The important amendments include incorporating a clause on false set of cement, permitting packaging of cement in 25 kg bags, making compulsory provision for issuing a certificate indicating the total chloride content in percent by mass of cement, modification in the tolerance requirements for the mass of cement packed in bags, etc. In view of these large number of amendments, the Sectional Committee decided to bring out the first revision of the standard incorporating all these amendments so as to make it convenient for the users.

Supersulphated cement has been successfully used in a variety of aggressive conditions, for example, for marine works, mass concrete jobs to resist the attack by aggressive water, reinforced concrete pipes in ground water, concrete construction in sulphate bearing soils, and in chemical works under conditions involving exposure to high concentrations of sulphates or weak solutions of mineral acids. It has been used for the underside of bridges over railways and for concrete sewers carrying industrial effluents. Its use under tropical conditions has also been recommended, provided the prevailing temperature is below 40°C (*see Note*). Although its use as a general purpose cement can be made with adequate precautions, it is not recommended for producing steam-cured products. Production of this cement will also result in greater utilization of blastfurnace slag, an industrial by-product of steel in the country.

NOTE — The limit of 40°C for use of this cement in tropical conditions is on the basis of available literature and this limit will be reviewed when more experience will be gained with the use of this cement in this country.

Mass of cement packed in bags and the tolerance requirements for the mass of cement packed in bags shall be in accordance with the relevant provisions of the *Standards of Weights and Measures (Packaged Commodities) Rules, 1977* and **B-1.2** (*see Annex B for information*). Any modification in these rules in respect of tolerance on mass of cement would apply automatically to this standard.

The composition of the committee responsible for the formulation of this standard is given in Annex C.

This edition 2.4 incorporates Amendment No. 1 (June 1991), Amendment No. 2 (November 1991), Amendment No. 3 (November 1993) and Amendment No. 4 (April 2000). Side bar indicates modification of the text as the result of incorporation of the amendments.

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 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

SUPERSULPHATED CEMENT — SPECIFICATION

(*First Revision*)

1 SCOPE

1.1 This standard covers the requirements for composition, manufacture and testing of supersulphated cement.

2 REFERENCES

2.1 The Indian Standards listed in Annex A are necessary adjuncts to this standard.

3 TERMINOLOGY

3.1 For the purpose of this standard, the definitions given in IS 4845 : 1968 shall apply, in addition to the following.

3.2 Supersulphated Cement

A hydraulic cement produced by intergrinding or intimately blending a mixture of granulated blastfurnace slag, calcium sulphate and a small amount of Portland cement, Portland cement clinker or any other source of lime. The abbreviation 'SSC' shall be used for 'supersulphated cement'.

3.3 Calcium Sulphate

Calcium sulphate obtained by calcining high purity gypsum to convert it to anhydrite; calcination temperature may range from 500 to 700°C. Naturally occurring anhydrite (CaSO₄) or industrial by-product anhydrite may also be used.

4 COMPOSITION AND MANUFACTURE

4.1 Supersulphated cement shall be manufactured by intergrinding or intimately blending a mixture of granulated blastfurnace slag, calcium sulphate and a small amount of 33 grade ordinary Portland cement, Portland clinker or any other source of lime (*see Note*). The dry granulated blastfurnace slag component of the mixture shall not be less than 70 percent by mass. The cement shall be ground finer than 33 grade ordinary Portland cement and the technology of production shall ensure most intimate blending of its constituents.

NOTE — When produced by intimate blending, the various ingredients sought to be blended shall also have prior grinding to the fineness required.

4.2 An approved or established grinding aid may be used provided it is used in very small amounts in a manner similar to the grinding of clinker.

5 CHEMICAL REQUIREMENTS

5.1 The supersulphated cement shall comply with the following chemical requirements when tested in accordance with the methods given in IS 4032 : 1985.

Insoluble residue	4 percent, <i>Max</i>
Magnesium oxide	10 percent, <i>Max</i>
Sulphuric anhydride	6 percent, <i>Min</i>
Sulphide sulphur	1.5 percent, <i>Max</i>

NOTES

1 The limit of total chloride content in cement for use in plain and other reinforced concrete structures is being reviewed. Till that time, the limit may be mutually agreed to between the purchaser and the manufacturer. (Method of test for determination of chloride content in cement is given in IS 12423 : 1988).

2 Granulated slag conforming to IS 12089 : 1987 has been found suitable for manufacture of supersulphated cement.

6 PHYSICAL REQUIREMENTS**6.1 Fineness**

When tested by Blaine's air permeability method given in IS 4031 (Part 2) : 1988, the supersulphated cement shall have a fineness (specific surface) of not less than 400 m²/kg;

6.2 Soundness (Cold-Expansion)

The cement when tested for soundness by the Le-Chatelier method described in IS 4031 (Part 3) : 1988 (modified to omit the boiling test so that the initial reading is taken immediately after moulding and the final reading after immersion in water at 27 ± 2°C for 24 hours) shall not have an expansion of more than 5 mm.

NOTE — The Le-Chatelier boiling test procedure and autoclave expansion are omitted since excessive unhydrated calcium oxide and periclase content are not envisaged.

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6.3 Setting Time

The setting time of the supersulphated cement when tested by the Vicat apparatus method described in IS 4031 (Part 5) : 1988 shall be as follows:

- | | |
|-------------------------|---------------------------|
| a) Initial setting time | Not less than 30 minutes |
| b) Final setting time | Not more than 600 minutes |

6.3.1 If cement exhibits false set, the ratio of final penetration measured after 5 minutes of completion of mixing period to the initial penetration measured exactly after 20 seconds of completion of mixing period, expressed as percent, shall be not less than 50 when tested according to the method described in IS 4031 (Part 14) : 1989. In the event of cement exhibiting false set, the initial and final setting time of cement when tested by the method described in IS 4031 (Part 5) : 1988 after breaking the false set, shall conform to **6.3**.

6.4 Compressive Strength

The average compressive strength of at least three mortar cubes (area of face 50 cm²) composed of one part of supersulphated cement, three parts of standard sand by mass and $p/4 + 3.0$ percent (of combined mass of cement plus sand) water, and prepared, stored and tested in the manner described in IS 4031 (Part 6) : 1988 shall be as follows:

- | | |
|--------------------------------|--------|
| a) 72 ± 1 hour not less than | 15 MPa |
| b) 168 ± 2 hours not less than | 22 MPa |
| c) 672 ± 4 hours not less than | 30 MPa |

NOTES

1 Standard sand shall conform to IS 650 : 1966.

2 P is the percentage of water required to produce a paste of standard consistency (see 11.3).

6.5 By agreement between the purchaser and the manufacturer, transverse strength test of plastic mortar in accordance with the method described in IS 4031 (Part 8) : 1988 may be specified in addition to the test specified in **6.4**. The permissible values of the transverse strength for supersulphated cement shall be mutually agreed to between the purchaser and supplier at the time of placing order.

6.6 Notwithstanding the strength requirements in **6.4** and **6.5**, supersulphated cement shall show at 168 hours and 672 hours a progressive increase in strength from the strength at 72 hours.

7 STORAGE

7.1 The supersulphated cement shall be stored in such a manner as to permit easy access for

inspection and in a suitable weather-tight building to protect the cement and clinker component from hydration and to minimize warehouse deterioration.

8 MARKING AND DELIVERY

8.1 The cement shall be packed in bags [jute sacking bag conforming to IS 2580 : 1982, double hessian bituminized (CRI type), multiwall paper conforming to IS 11761 : 1986, polyethylene lined (CRI type), jute, light weight jute conforming to IS 12154 : 1987, woven HDPE conforming to IS 11652 : 1986, woven polypropylene conforming to IS 11653 : 1986, jute synthetic union conforming to IS 12174 : 1987, or any other approved composite bags] bearing the manufacturer's name or his registered trade-mark, if any. The words 'Supersulphated Cement' and a suitable mark to distinguish supersulphated cement from other cements shall be clearly and indelibly made on each bag. The number of bags (net mass) to the tonne or the net mass of the cement shall be legibly and indelibly marked on each bag. The bags shall be in good condition at the time of inspection.

8.1.1 Similar information shall be provided in the delivery advices accompanying the shipment of packed or bulk cement (see **8.3**).

8.2 The net mass of cement per bag shall be 50 kg (see Annex B).

NOTE — Since the specific gravity (2.80 to 2.90) and the bulk density (1.3 kg/l) of supersulphated cement are lower than those of ordinary Portland cement, the size of the bag for 50 kg supersulphated cement will be somewhat larger compared to the size of conventional bag for ordinary Portland cement.

8.2.1 The net mass of cement per bag may also be 25 kg subject to tolerances as given in **8.2.1.1** and packed in suitable bags as agreed to between the purchaser and the manufacturer.

8.2.1.1 The number of bags in a sample taken for weightment showing a minus error greater than 2 percent of the specified net mass shall be not more than 5 percent of the bags in the sample. Also the minus error in none of such bags in the sample shall exceed 4 percent of the specified net mass of cement in the bag. However, the net mass of cement in a sample shall be equal to or more than 25 kg.

8.2.2 When cement is intended for export and if the purchaser so requires, packing of cement may be done in bags or in drums with a net mass of cement per bag or drum as agreed to between the purchaser and the manufacturer.

8.2.2.1 For this purpose the permission of the certifying authority shall be obtained in advance for each export order.

8.2.2.2 The words 'FOR EXPORT' and the net mass of cement per bag/drum shall be clearly marked in indelible ink on each bag/drum.

8.2.2.3 The packing material shall be as agreed to between the manufacturer and the purchaser.

8.2.2.4 The tolerance requirements for the mass of cement packed in bags/drum shall be as given in **8.2.1.1** except the net mass which shall be equal to or more than the quantity in **8.2.2**.

8.3 Supplies of cement in bulk may be made by agreement between the purchaser and the supplier (manufacturer or stockist).

NOTE — A single bag or container containing 1 000 kg or more net mass of cement shall be considered as bulk supply of cement. Supplies of cement may also be made in intermediate containers, for example, drums of 200 kg, by agreement between the purchaser and the manufacturer.

9 MANUFACTURER'S CERTIFICATE

9.1 The manufacturer shall satisfy himself that the cement conforms to the requirements of this standard, and if requested, shall furnish a certificate to this effect to the purchaser or his representative.

9.2 The manufacturer shall furnish a certificate, within ten days of despatch of cement, indicating the total chloride content in percent by mass of cement.

10 SAMPLING

10.1 Samples for Testing and by Whom to be Taken

A sample or samples for testing may be taken by the purchaser or his representative, or by any person appointed to superintend the work for the purpose for which the supersulphated cement is required, or by the later's representative. The samples shall be taken within three weeks of delivery and the tests shall be commenced within four weeks of delivery.

10.2 Notwithstanding the requirements of **10.1** the methods and procedure of sampling shall be in accordance with IS 3535 : 1986.

10.3 Facilities for Sampling and Identifying

The manufacturer or supplier shall afford every facility, and shall provide all labour and materials for taking and packing the samples for testing the supersulphated cement and for subsequent identification of the cement samples.

11 TESTS

11.1 The sample or samples of cement for tests shall be taken as described in **10.1** and **10.2** and shall be tested in the manner prescribed in the relevant clauses.

11.2 Temperature for Testing

The temperature at which physical tests are carried out should, as far as possible, be $27 \pm 2^\circ \text{C}$.

11.3 Consistency of Standard Cement Paste

The quantity of water required to produce a paste of standard consistency, to be used for the determination of the water content of mortar for the compressive strength tests and for the determination of soundness and setting time, shall be obtained by the method described in IS 4031 (Part 4) : 1988.

11.4 Non-compliance with Test

Any cement which does not comply with any of the tests and analysis specified in this standard or which has not been stored in the manner provided under **7.1** may be rejected as not complying with this standard.

11.5 Independent Testing

11.5.1 If the purchaser or his representative requires independent tests, the samples shall be taken before or immediately after delivery at the option of the purchaser or his representative, and the tests shall be carried out in accordance with this standard on the written instructions of the purchaser or his representative.

11.5.2 Cost of Testing

The manufacturer shall supply, free of charge, the supersulphated cement required for testing. Unless otherwise specified in the enquiry and order, the cost of the tests shall be borne as follows:

- a) By the manufacturer in the event of the results showing that the cement does not comply with this standard, and
- b) By the purchaser in the event of the results showing that the cement complies with this standard.

11.5.3 After a representative sample has been drawn and hermetically sealed, tests on the sample shall be carried out as expeditiously as possible.

ANNEX A

(Clause 2.1)

LIST OF REFERRED INDIAN STANDARDS

<i>IS No.</i>	<i>Title</i>	<i>IS No.</i>	<i>Title</i>
650 : 1966	Standard sand for testing of cement (<i>first revision</i>)	11652 : 1986	High density polyethylene (HDPE) woven sacks for packing cement
2580 : 1982	Jute sacking bags for packing cement (<i>second revision</i>)	11653 : 1986	Polypropylene (PP) woven sacks for packing cement
3535 : 1986	Methods of sampling hydraulic cement (<i>first revision</i>)	11761 : 1986	Specification for multiwall paper sacks for cement, valved-sewn-gusseted type
4031 (Parts 1 to Part 13) : 1988	Methods of physical tests for hydraulic cement (<i>first revision</i>)	12089 : 1987	Granulated slag for the manufacture of Portland slag cement
4031 (Part 14) : 1989	Methods of physical tests for hydraulic cement: Part 14 Determination of false set	12154 : 1987	Light weight jute bags for packing cement
4032 : 1985	Method of chemical analysis of hydraulic cement (<i>first revision</i>)	12174 : 1987	Jute synthetic union bags for packing cement
4845 : 1968	Definitions and terminology relating to hydraulic cement	12423 : 1988	Method for colorimetric analysis of hydraulic cement
4905 : 1968	Methods for random sampling		

ANNEX B

(Clause 8.2)

TOLERANCE REQUIREMENTS FOR THE MASS OF CEMENT PACKED IN BAGS

B-1 The net mass of cement packed in bags at the plant in a sample shall be equal to or more than 50 kg. The number of bags in a sample shall be as given below:

<i>Batch Size</i>	<i>Sample Size</i>
100 to 150	20
151 to 280	32
281 to 500	50
501 to 1 200	80
1 201 to 3 200	125
3 201 and over	200

The bags in a sample shall be selected at random (*see* IS 4905 : 1968).

B-1.1 The number of bags in a sample showing a minus error greater than 2 percent of the

specified net mass (50 kg) shall be not more than 5 percent of the bags in the sample. Also the minus error in none of such bags in the sample shall exceed 4 percent of the specified net mass of cement in the bag.

NOTE — The matter given in **B-1** and **B-1.1** are extracts based on the *Standards of Weights and Measures (Packaged Commodities) Rules, 1977* to which reference shall be made for full details. Any modification made in these Rules and other related Acts and Rules would apply automatically.

B-1.2 In case of a wagon/truck load up to 25 tonnes, the overall tolerance on net mass of cement shall be 0 to + 0.5 percent.

NOTE — The mass of a jute sacking bag conforming to IS 2580 : 1982 to hold 50 kg of cement is 531 g, the mass of a double hessian bituminized (CRI type) bag to hold 50 kg of cement is 630 g, the mass of a 6-ply paper bag to hold 50 kg of cement is approximately 400 g and the mass of a polyethylene lined (CRI type) jute bag to hold 50 kg of cement is approximately 480 g.

ANNEX C

(Foreword)

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