

IS : 1344 - 1981
(Reaffirmed 1999)
Edition 3.1
(1992-02)

Indian Standard
**SPECIFICATION FOR
CALCINED CLAY POZZOLANA**
(Second Revision)

(Incorporating Amendment No. 1)

UDC 666.952.4

© BIS 2003

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Price Group 3

Indian Standard
**SPECIFICATION FOR
 CALCINED CLAY POZZOLANA**
(Second Revision)

Pozzolana Sectional Committee, BDC 16

Chairman

SHRI B. T. UNWALLA
 15/9, Rustom Baug, Victoria Road, Bombay

Members

Representing

SHRI P. D. AGARWAL

Public Works Department, Government of Uttar Pradesh, Lucknow

DR B. L. DHAWAN (*Alternate*)

National Test House, Calcutta

SHRI S. K. BANERJEE

SHRI P. R. DAS (*Alternate*)

Housing & Urban Development Corporation Ltd, New Delhi

SHRI H. U. BIJLANI

SHRI SURAJ S. J. BAHADUR (*Alternate*)

Federation of Electricity Undertaking of India, Bombay

SHRI K. V. CHAUBAL

CHIEF ENGINEER

Irrigation Department, Government of Punjab, Chandigarh

DIRECTOR (IPRI) (*Alternate*)

SHRI K. DEVARAJAN

Engineer-in-Chief's Branch, Army Headquarters, New Delhi

SHRI S. K. GUPTA (*Alternate*)

DIRECTOR

Gujarat Engineering Research Institute, Vadodara

RESEARCH OFFICER (MTD) (*Alternate*)

DIRECTOR (CSMRS)

Central Water Commission, New Delhi

DEPUTY DIRECTOR (CSMRS) (*Alternate*)

DIRECTOR

Maharashtra Engineering Research Institute, Nasik

RESEARCH OFFICER (MT DIVISION)

(*Alternate*)

SHRI T. A. E. D'SA

The Concrete Association of India, Bombay

SHRI N. C. DUGGAL (*Alternate*)

(*Continued on page 2*)

© BIS 2003

BUREAU OF INDIAN STANDARDS

This publication is protected under the *Indian Copyright Act* (XIV of 1957) and reproduction in whole or in part by any means except with written permission of the publisher shall be deemed to be an infringement of copyright under the said Act.

IS : 1344 - 1981

(Continued from page 1)

<i>Members</i>	<i>Representing</i>
SHRI S. K. GHOSH	Directorate General of Technical Development, New Delhi
DR IQBAL ALI	Engineering Research Laboratories, Hyderabad
SHRI P. J. JAGUS	The Associated Cement Companies Ltd, Bombay
SHRI M. R. VINAYAKA (<i>Alternate</i>)	
JOINT DIRECTOR, RESEARCH (B & S)	Research, Designs & Standards Organization, Lucknow
DEPUTY DIRECTOR, RESEARCH (B&S)-I (<i>Alternate</i>)	
SHRI B. MAHAPATRA	Steel Authority of India Ltd, Rourkela
SHRI E. G. D. MELLO	Kandla Port Project, Ministry of Shipping and Transport
SHRI K. K. NAMBIAR	In personal capacity (' <i>Ramanalaya</i> , ' II First <i>Crescent Park Road, Gandhinagar, Adyar,</i> <i>Madras</i>)
SHRI J. R. K. PRASAD	Ministry of Shipping and Transport
SHRI A. D. NARAIN (<i>Alternate</i>)	
SHRI V. RAMALINGAM	Neyveli Lignite Corporation Ltd, Neyveli
SHRI K. A. RAMABHADRAN (<i>Alternate</i>)	
DR A. V. R. RAO	National Buildings Organization, New Delhi
SHRI J. SEN GUPTA (<i>Alternate</i>)	
DR S. S. REHSI	Central Building Research Institute (CSIR), Roorkee
DR R. K. DATTA (<i>Alternate</i>)	
SHRI R. SAMPATKUMARAN	Delhi Electric Supply Undertaking, New Delhi
SHRI RAMESH CHANDER (<i>Alternate</i>)	
SHRI K. L. SETHI	Central Road Research Institute (CSIR), New Delhi
SHRI J. P. SRIVASTAVA	Geological Survey of India, Calcutta
SHRI R. S. SHENOI (<i>Alternate</i>)	
SUPERINTENDING ENGINEER (P & S)	Tamilnadu Housing Board, Madras
PROJECT OFFICER (CCP) (<i>Alternate</i>)	
SUPERINTENDING ENGINEER (DESIGNS)	Public Works Department, Government of Tamilnadu, Madras
EXECUTIVE ENGINEER (S M & R Division) (<i>Alternate</i>)	
SUPERINTENDING SURVEYOR OF WORKS (DAZ)	Central Public Works Department, New Delhi
SURVEYOR OF WORKS II (DAZ) (<i>Alternate</i>)	
DR H. C. VISVESVARAYA	Cement Research Institute of India, New Delhi
DR S. K. CHOPRA (<i>Alternate</i>)	
SHRI G. RAMAN, Director (Civ Engg)	Director General, ISI (<i>Ex-officio Member</i>)

Secretary

SHRI M. N. NEELAKANDHAN
Assistant Director (Civ Engg), ISI

Indian Standard
 SPECIFICATION FOR
 CALCINED CLAY POZZOLANA
 (*Second Revision*)

0. FOREWORD

0.1 This Indian Standard (Second Revision) was adopted by the Indian Standards Institution on 30 December 1981, after the draft finalized by the Pozzolana Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 The calcined clay pozzolana covered in this standard is a reactive pozzolanic material manufactured under controlled conditions by calcination of clay at suitable temperature and grinding the resulting product to the required fineness. This material can be used for manufacture of Portland pozzolana cement for blending with hydrated lime to produce ready to use lime pozzolana mixture, and for part replacement of cement in unblended cement mortar and concrete and for use as an admixture. The various test procedures for the requirements of calcined clay pozzolana are covered in IS : 1727-1967*.

0.3 This standard was first published in 1959 under the title 'Specification for *SURKHI* for use in mortar and concrete'. In its first revision published in 1968, title of the standard was modified as 'Specification for burnt clay pozzolana' to bring out the difference between *SURKHI* as commonly known and burnt clay pozzolana as covered by the standard. In this revision, the title of the standard has further been modified as 'Specification for calcined clay pozzolana', the term 'calcined clay' being technically more expressive as far as the requirements of pozzolanic materials are concerned.

0.3.1 This revision incorporates a number of changes. The scope of the standard has now been revised to specifically bring out the use of calcined clay pozzolana for manufacture of Portland pozzolana cement conforming to IS : 1489-1976†. Two grades of Pozzolana have been introduced on the basis of end use and physical requirements have been specified accordingly. The requirement of fineness by sieving has been deleted in this revision and lime reactivity requirement for the 2 grades has been specified as 4 N/mm^2 and 3 N/mm^2 respectively in place of 4.9 N/mm^2 . The requirement of drying shrinkage has been

*Methods of tests for pozzolanic materials (*first revision*).

†Specification for Portland pozzolana cement (*second revision*).

IS : 1344 - 1981

introduced in this revision and requirement of compressive strength at 90 days and uniformity requirements have been deleted. Further, in this revision, references to latest Indian Standards on terminology, tests, sampling and storage have been made and the corresponding clauses have been modified accordingly. SI units have also been introduced in this revision.

0.4 Use of calcined clay pozzolana as part replacement of unblended cements and as an admixture has been covered in IS : 456-1978* and IS : 4098-1967† covers the requirements of lime-pozzolana mixture manufactured by intergrinding or blending lime and calcined clay pozzolana conforming to this standard. IS : 1489-1976‡ covers the requirements of Portland pozzolana cement manufactured either by intergrinding Portland cement clinker and calcined clay pozzolana with addition of gypsum, or by blending Portland cement and calcined clay pozzolana.

0.5 This edition 3.1 incorporates Amendment No. 1 (February 1992). Side bar indicates modification of the text as the result of incorporation of the amendment.

0.6 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§. The number of significant places retained in the rounded off value shall be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers the requirements of calcined clay pozzolana for part replacement of unblended cements, for use with lime, for use as an admixture and for the manufacture of Portland pozzolana cement conforming to IS : 1489-1976‡ and gives guidelines for the manufacture of calcined clay pozzolana.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 4305-1967¶ shall apply.

3. DESIGNATION

3.1 Calcined clay pozzolana shall be supplied in the following grades corresponding to the properties specified in 4.1.

*Code of practice for plain and reinforced concrete (*third revision*).

†Specification for lime-pozzolana mixture.

‡Specification for Portland pozzolana cement (*second revision*).

§Rules for rounding off numerical values (*revised*).

¶Glossary of terms relating to pozzolana.

*Grade Designation**General Use*

Grade I	For incorporation in unblended cement mortar and concrete and in lime-pozzolana mixture, and for manufacture of Portland pozzolana cement
Grade II	For incorporation in unblended cement mortar and concrete and in lime-pozzolana mixture

NOTE — Calcined clay pozzolana of Grade II may also be used for manufacture of Portland pozzolana cement by intergrinding method subject to the requirements of IS : 1489-1976*.

4. RAW MATERIALS

4.1 In selecting a clay for the manufacture of calcined clay pozzolana, past experience of the use of the particular clay under service conditions and any experimental investigations are good guides.

4.2 A number of clays, which have been investigated in India and have given satisfactory results, conform generally to the following chemical requirements on an oven dry basis (at 105°C):

<i>Constituents</i>	<i>Contents</i>
Silica+Alumina+Iron oxide ($\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3$)	Not less than 70 percent
Silica (SiO_2)	Not less than 40 percent
Calcium oxide (CaO)	Not more than 10 percent
Magnesium oxide (MgO)	Not more than 3 percent
Sulphuric anhydride (SO_3)	Not more than 3 percent
Soda and potash ($\text{Na}_2\text{O}+\text{K}_2\text{O}$)	Not more than 3 percent
Water-soluble alkali	Not more than 0.1 percent
Water-soluble material	Not more than 1 percent
Loss on ignition	Not more than 10 percent

NOTE — For chemical analysis of clays, reference shall be made to IS : 1727-1967†.

*Specification for Portland pozzolana cement (*second revision*).

†Methods of test for pozzolanic materials (*first revision*).

5. MANUFACTURE

5.1 Calcined clay pozzolana shall be obtained by calcining processed clay at suitable temperature and grinding the resulting product to required fineness.

5.2 Preparation of Raw Material — The clay may be prepared with suitable additions of water into a plastic mass, weeding out gritty material, pebbles, sticks, etc.

NOTE — The method of manufacture of calcined clay pozzolana, currently practised in India, is to calcine clay after moulding it into bricks, tiles or balls as is the general practice adopted by the brick and tile industry; the calcined material is later pulverized.

5.3 Calcination — The clay prepared as in **5.2** shall be calcined at a temperature suitable to the type of clay used in the manufacture.

5.3.1 The exact degree of calcination for each clay shall be determined after making necessary experiments with samples prepared at different temperatures and ground to specified fineness and testing for strength and other properties with lime and cement.

NOTE — The optimum temperature of burning is presumed to be that at which the crystal structure of the clay mineral just collapses and the oxides of silicon, aluminium and iron are in fine active form. Generally, the optimum temperatures of burning of different clays at which maximum reactivity is produced have been found to be the following:

For montmorillonite type of clay	600 to 800°C
For kaolinite type of clay	700 to 800°C
For illite type of clay	900 to 1 000°C

5.3.2 Differential thermal analysis technique may also be used for determination of calcination temperature at which the clay becomes reactive. In this technique the calcination temperature is determined from the completion of the endothermic peak which indicates loss of structural water (activation of clay).

5.4 Grinding — The calcined clay shall be pulverized to the fineness specified in **6.1**.

6. PHYSICAL REQUIREMENTS

6.1 Calcined clay pozzolana shall conform to the physical requirements given in Table 1, when tested in accordance with IS : 1727-1967*.

6.2 Notwithstanding the strength requirements specified in Table 1, mixes in which calcined clay is incorporated shall show a progressive increase in strength.

*Methods of test for pozzolanic materials (*first revision*).

TABLE 1 PHYSICAL REQUIREMENTS

(Clauses 6.1 and 6.2)

CHARACTERISTIC (1)	REQUIREMENT	
	Grade I (2)	Grade II (3)
i) Fineness — Specific surface in m ² /kg by Blaine's permeability method, <i>Min</i>	320	250
ii) Lime reactivity — Average compressive strength in N/mm ² , <i>Min</i>	4.0	3.0
iii) Compressive strength* at 28 days, <i>Min</i>	Not less than 80 percent of the strength of corresponding plain cement mortar cubes	
iv) Drying shrinkage, <i>Max</i>	0.15	0.10

*Applicable in case of pozzolana to be used for manufacture of Portland pozzolana cement only.

7. STORAGE

7.1 The calcined clay pozzolana shall be protected from rain and dampness and shall be stored in such a manner as to permit easy access for proper inspection and identification of each consignment.

NOTE — For guidance on storage at site, IS : 4082-1977* may be referred to.

8. MANUFACTURER'S CERTIFICATE

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

9. DELIVERY

9.1 The calcined clay pozzolana may be supplied in bags (jute, jute-laminated, multi-ply paper or polyethylene lined) bearing the manufacturer's name or registered trade marks, and the net mass of each bag shall be 50 kg.

*Recommendations on stacking and storage of construction materials at site (*first revision*).

IS : 1344 - 1981

9.1.1 The bags may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

9.2 The permissible tolerance on the mass of calcined clay pozzolana supplied in bags shall be ± 2.5 percent per bag with an overall tolerance of ± 0.5 percent per wagon load of 20 to 25 tonnes.

9.3 Supplies of calcined clay pozzolana in bulk may be made by arrangement between the purchaser and the supplier (manufacturer or stockist).

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 authorized representative, or by any person appointed to superintend the works for the purpose of which the calcined clay pozzolana is required.

10.2 Procedure for Sampling — Each sample for testing shall consist of a mixture of approximately equal portions selected from at least 12 different positions in the heap, when the calcined clay pozzolana is loose, or from not less than 12 different bags or other packages, when the calcined clay pozzolana is not loose; or where there is a lesser number than 12 different bags or other packages, then from each bag or package. Every care shall be taken in the selection to obtain a fair average sample. The final sample shall weigh at least 5 kg for every 100 tonnes of material. The sample, thus collected, shall be stored in a suitable container for being forwarded to an approved testing laboratory.

10.2.1 Alternatively, the procedure for sampling may be in accordance with the procedure for sampling fly ash laid down in IS : 6491-1972*.

10.3 Facilities for Sampling and Identifying — The manufacturer or supplier shall afford every facility, and provide all labour and materials, for taking and packing the samples for testing the calcined clay pozzolana and for subsequently identifying the calcined clay pozzolana sampled.

*Methods of sampling fly ash.

11. TESTS

11.1 The sample or samples of calcined clay pozzolana for tests shall be taken as described in **10** and shall be tested in accordance with IS : 1727-1967*.

11.2 All tests shall be carried out at the fineness at which it is supplied for use by the purchaser.

11.3 Independent Testing

11.3.1 If the purchaser or his authorized 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.

11.3.2 *Cost of Testing* — The manufacturer shall supply, free of charge, the calcined clay pozzolana required for testing. Unless otherwise specified in the enquiry or order, the cost of the tests shall be borne as follows:

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

11.3.3 After a representative sample is drawn, tests on the sample shall be carried out as expeditiously as possible.

*Methods of test for pozzolanic materials (*first revision*).

