मानकः पथप्रदर्शकः

COMPENDIUM OF INDIAN STANDARDS

CEMENT SPECIFICATIONS

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INTRODUCTION

Cement is one of the most widely used building material in the world. It is used in various applications such as building construction, cement matrix products, infrastructure projects, pavement construction, and many more. It is one of the most important constituents of concrete, the second most consumed material in the world. The quality of cement used in concrete is critical in ensuring the durability and strength of concrete structures. Bureau of Indian Standards (BIS) had formulated various standards on cement in order to establish uniform quality, composition, safety, and performance for different types of cement. These Indian Standards provide specifications related to raw materials used, manufacturing, physical and chemical requirements, storage, packaging and marking.

This compendium aims at providing an overview of Indian Standards on different varieties of cement, offering insights into their specifications, physical and chemical requirements, and their applications. It is intended for use by cement manufacturers, construction professionals, engineers, quality control personnel, academic professionals, and regulatory authorities to enhance understanding and compliance with industry standards.

By compiling relevant standards on cement in a single document, this compendium serves as a ready reference for professionals involved in cement production, quality assessment, and application, contributing to improved construction quality and safety.

1 ORDINARY PORTLAND CEMENT (OPC) [IS 269: 2015, REAFFIRMED IN 2020]

This standard covers the manufacture and chemical and physical requirements of ordinary Portland cement. This standard specifies five grades of OPC namely OPC 33, OPC 43, OPC 53, OPC 43S and OPC 53S. This standard also permits different types of performance improvers such as limestone, fly ash, slag, etc which may be added at grinding stage to enhance the properties of cement.

Applications and Uses: It is used in all types of general construction work such as building construction, concrete pavements, flooring, plastering, etc.

2 PORTLAND POZZOLANA CEMENT (PPC) FLY ASH BASED [IS 1489 (PART 1): 2015, REAFFIRMED IN 2020]

This standard covers the manufacture and chemical and physical requirements of Portland pozzolana cement using fly ash as pozzolana. The fly ash used in the manufacturing of PPC shall conform to IS 3812 (Part 1). It can be manufactured either by intimately intergrinding or by uniformly blending. **The fly ash constituent in the cement shall not be less than 15 percent and not more than 35 percent by mass of Portland pozzolana cement.**

Applications and uses: It is used in hydraulic structures, mass concrete structures such as dams, bridge piers, foundations, etc, marine structures, and all other situations where OPC is used except where high early strength is of special requirement.

3 PORTLAND POZZOLANA CEMENT CALCINED CLAY BASED [IS 1489 (Part 2): 2015, REAFFIRMED IN 2020]

This standard covers the manufacture and chemical and physical requirements of Portland pozzolana cement using calcined clay as pozzolana. Calcined clay which is used as pozzolana in the cement shall conform to IS 1344 or a mixture of calcined clay pozzolana conforming to IS 1344 and fly ash conforming to IS 3812 (Part 1) can also be used. **The total pozzolana constituent in the cement shall not be less than 10 percent and not more than 25 percent by mass of Portland pozzolana cement.**

Applications and Uses: It is suitable for use in the building construction, marine and coastal structures, mass concrete structures such as dams, bridge piers, foundations, etc, highway and other infrastructure projects.

4 PORTLAND SLAG CEMENT (IS 455: 2015, REAFFIRMED IN 2020)

This standard covers the manufacture and chemical and physical requirements of Portland slag cement. The raw materials used in the manufacturing of PSC are granulated slag conforming to IS 12089 (Part 1), ground granulated blast furnace slag for blending with Portland cement conforming to IS 16714. Portland cement clinker conforming to IS 16353, or ordinary Portland cement conforming to IS 269. **The granulated slag constituent in the cement shall not be less than 25 percent and not more than 70 percent by mass of Portland slag cement.**

Applications and Uses: Portland slag cement offers high resistance to chloride and sulphate attacks and hence highly suitable for marine structures, ports and harbours, sewage treatment plants, canal lining, tunnels, piling works, basement of buildings, etc.

5 WHITE PORTLAND CEMENT (IS 8042: 2015, REAFFIRMED IN 2020)

This standard covers the manufacture and chemical and physical requirements of white Portland cement. It shall be manufactured by intimately grinding the Portland cement clinker with appropriate proportion of natural or chemical gypsum so as to produce a cement capable of complying with this standard. **Limestone, dolomite and marble may be added as performance improver either individually or in combination, and the total limit of their addition shall not be more than 10 percent.** The standard also provides the test method for estimation of whiteness of the cement.

Applications and Uses:

1. Aesthetic applications such as interior and exterior wall finishes, architectural panels, etc.
2. Used as a base in tile filler gaps (grouts) and tile adhesives (in kitchens and bathrooms).
3. Suitable for construction and restoration of historical monuments, statues and heritage structures.
4. Used as a binder in terrazzo flooring and mosaic tiles.

6 COMPOSITE CEMENT (IS 16415: 2015, REAFFIRMED IN 2020)

This standard covers the manufacture and chemical and physical requirements of composite cement using fly ash [as per IS 3812 (Part 1)] and granulated slag (as per IS 12089). **The constituent of fly ash shall be in between 10 - 25 percent and granulated slag shall be in between 25 - 40 percent by mass of composite cement.**

Applications and Uses:

1. As it uses industrial by-products (fly ash and slag), results in less CO_2 emissions.
2. It can be used in reinforced concrete construction only when containing a declared clinker content not less than 45 percent, fly ash content not more than 25 percent and a minimum 28-day compressive strength of 43 MPa.

7 MASONRY CEMENT (IS 3466: 1988, REAFFIRMED IN 2023)

This standard lays down the requirement for masonry cement to be used for all general purposes where mortar·for masonry is required. It also provides the staining requirement which shall apply only when a purchaser specifically states that cement shall be non-staining to limestone.

Applications and uses: Masonry cement is chiefly intended for use in masonry mortars for brick, stone and concrete block masonry, and for rendering and plastering work. Because of its property of producing a smooth, plastic, cohesive and strong, yet workable, mortar when mixed with fine aggregates, masonry cement is considered superior to lime mortar, lime-cement mortar or cement mortar.

Caution: Masonry cement is not intended for use in structural concrete for flooring and foundation work or for reinforced and prestressed concrete works.

8 HIGH ALUMINA CEMENT FOR STRUCTURAL USE (IS 6452: 1989, REAFFIRMED IN 2024)

This standard covers the manufacture and chemical and physical requirements of high alumina cement. It shall be manufactured from aluminous and calcareous materials either by fusion or by sintering, and grinding the resulting clinker so as to produce a cement complying with this specification. The total alumina content (Al_2O_3) determined in accordance with the method specified in IS 4032 shall not be less than 32 percent by mass.

Applications and Uses: High alumina cement is mainly a refractory cement but in some cold regions this cement may find use as a structural material taking advantage of high heat of hydration and high early strength development. The use of this cement is restricted to areas of continuously low temperature where highest summer temperatures do not exceed 18°C.

Caution

1) In view of the restrogression in strength and reduced durability, high alumina cement shall not be used in locations where the ambient temperatures are likely to exceed 18°C even for short periods. It shall not be used in mass concrete in view of the high heat of hydration inducing conversion of the hydrated compounds;
2) Accelerators like calcium chloride shall not be used with this cement;
3) Steam curing or elevated temperature of curing shall be avoided; and
4) It shall not be mixed with any other type of cement.

9 SUPERSULPHATED CEMENT (IS 6909: 1990, REAFFIRMED IN 2021)

This standard covers the requirements for composition, manufacture and testing of supersulphated cement. Calcium sulphate shall be obtained by calcining high purity gypsum to convert it to anhydrite; calcination temperature may range from 500°C to 700°C. Naturally occurring anhydrite ($CaSO_4$) or industrial by-product anhydrite may also be used.

Applications and Uses: 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 of weak solutions of mineral acids. It can be 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. Although its use as a general purpose cement can be made with adequate precautions, it is not recommended for producing steam-cured products.

10 RAPID HARDENING PORTLAND CEMENT (IS 8041: 1990, REAFFIRMED IN 2024)

This standard covers the manufacture and chemical and physical requirements of rapid hardening Portland cement.

Applications and Uses:

1. Prefabricated concrete construction
2. Where formwork is required to be removed early for re-use
3. Road repair works

11 HYDROPHOBIC CEMENT (IS 8043: 1991, REAFFIRMED IN 2024)

This standard covers the manufacture and chemical and physical requirements of hydrophobic Portland cement. It is obtained by grinding ordinary Portland cement clinker with an additive which will impart to ground cement, a water repelling property which shall be destroyed only by wet attrition, such as in concrete mixer. The hydrophobic quality of cement would facilitate its storage for longer periods in extremely wet climatic conditions. Some of the hydrophobic agents used in the manufacture of hydrophobic cement are oleic acid, naphthenic acid, stearic acid, pentachlorophenol, etc.

Applications and Uses:

1. Construction in high humid regions such as coastal areas and tropical climatic regions.
2. Damp basements and water prone substructures

12 OIL WELL CEMENT (IS 8229: 1986, REAFFIRMED IN 2023)

This standard covers the physical and chemical requirements of oil-well cement required for the Indian Oil Industry which is expanding at a rapid pace, and is intended to provide guidance to the cement producers for the manufacture of this cement. It covers oil-well cement of classes A, B, C, D, E, F, C and H

Applications and Uses:

Oil-well cement is used by the petroleum industry for cementing gas and oil-wells at high temperatures and pressures. Slurries of such cement have to remain pumpable at these elevated temperatures and pressures for a sufficient length of time and then harden fairly rapidly. The two principal uses of oil-well cement are to cement the steel casing to the walls of the well and to seal the porous formations which contain either gas or water that is flowing into oil-bearing formations.

13 SULPHATE RESISTING CEMENT (IS 12330: 1988, REAFFIRMED IN 2024)

This standard covers the manufacture and chemical and physical requirements of sulphate resisting cement. It is a type of Portland cement in which the amount of tricalcium aluminate is restricted to an acceptably low value. This cement should not be mistaken for supersulphated cement, which is produced by intergrinding or intimately blending a mixture of granulated blast furnace slag, calcium sulphate and a small amount of Portland cement or Portland cement clinker or any other source of lime.

Applications and Uses:

1. It can be used for structural concrete wherever OPC/PPC/PSC are useable under normal conditions. Use of supersulphated cement is, however, generally restricted where the prevailing temperature is below 40°C. The later is not recommended for producing steam-cured products.

2. Use of sulphate resisting Portland cement is particularly beneficial in such conditions where the concrete is exposed to the risk of deterioration due to sulphate attack, for example, in contact with soils and ground waters containing excessive amounts of sulphates as well as for concrete in sea water or exposed directly to sea coast.

14 LOW HEAT PORTLAND CEMENT (IS 12600: 1989, REAFFIRMED IN 2024)

This standard covers the manufacture and chemical and physical requirements for low heat Portland cement.

Applications and Uses

Low heat cement is particularly suited for making concrete for dams and many other types of water retaining structures, bridge abutments, massive retaining walls, piers and slabs, etc.

15 MICROFINE ORDINARY PORTLAND CEMENT OPC (IS 16993: 2018, REAFFIRMED IN 2023)

This standard covers the manufacture and chemical and physical requirements for microfine ordinary Portland cement. It also cover requirements for microfine sulphate resisting Portland cement.

Applications and Uses

It is used for special applications like rock grouting, grouting concrete structures and underground construction for leak prevention, soil stabilization, etc.

16 PORTLAND LIMESTONE CALCINED CLAY CEMENT (IS 18189: 2022)

This standard covers the manufacture and chemical and physical requirements for Portland limestone calcined clay cement. It is an intimately interground mixture of Portland cement clinker, calcined clay, and limestone with addition of gypsum or an intimate and uniform blending of ordinary Portland cement, finely ground limestone and fine calcined clay with addition of ground gypsum, if required as per the proportions given in the standard.

Applications and Uses: It is suitable for all types of structural/non-structural works, preferably in marine and coastal structures due to its high resistance towards chlorides and sulphates.

17 HIGH ALUMINA REFRACTORY CEMENT (IS 15895: 2018, REAFFIRMED IN 2023)

This standard specifies the classification, evaluation procedure and properties of high alumina refractory cement. These cements are produced either by fusion or by sintering process using a mix of calcareous material like limestone / hydrated lime / dolomitic lime stone and argillaceous material like bauxite / brown or white fused alumina / calcined alumina.

Applications and Uses: It is specifically used for refractory purposes such as lining of furnaces, kilns, etc.

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