ICS 91.100.10
CCS Q 11

NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 31545-2015

Portland cement for nuclear power engineering

核电工程用硅酸盐水泥

Issued on: May 15, 2015 **Implemented on: February 1, 2016**

Issued by: General Administration of Quality Supervision, Inspection and Quarantine;
Standardization Administration of the PRC

Table of Contents

Foreword

GB/T 31545-2015 was issued on 15 May 2015 by the General Administration of Quality Supervision, Inspection and Quarantine and the Standardization Administration of the People's Republic of China, and has been in force since 1 February 2016.

The document is a recommended national standard: the /T in the designation marks it as recommended rather than compulsory, which in the Chinese system means it is the method the reviewer applies.

1 Scope

China's national standard for Portland cement used in nuclear power construction. Nuclear concrete differs from ordinary structural concrete in requirements that come from the plant's

hazards rather than from its loads. The containment and shielding structures are enormous continuous pours, so the heat the cement generates as it hydrates cannot escape: the interior reaches a high temperature while the surface cools, and the differential cracks a structure whose whole function is to be impermeable. The second constraint is neutron activation - trace elements in the cement become radioactive under long exposure, which turns the shielding itself into radioactive waste at decommissioning - and the third is chloride, which must be held very low to protect the reinforcement over a design life of sixty years. The standard specifies the definition, the material requirements, the strength grade, the technical requirements, the test methods, the inspection rules, and the packaging, marking, transport and storage of nuclear power cement.

This standard specifies the definition, the material requirements, the strength grade, the technical requirements, the test methods, the inspection rules, and the packaging, marking, transport and storage of Portland cement for nuclear power engineering.

This standard applies to Portland cement for nuclear power engineering.

2 Normative references

The following documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 176 Methods for chemical analysis of cement

GB/T 1346 Test methods for water requirement of normal consistency, setting time and soundness of the portland cement

GB/T 5483 Natural gypsum

GB/T 8074 Testing method for specific surface of cement - Blaine method

GB 9774 Sack for portland cement

GB/T 12573 Method for cement sampling

GB/T 12959 Test methods for heat of hydration of cement

GB/T 17671 Method of testing cements - Determination of strength (ISO method)

GB/T 26748 Cement grinding aids

JC/T 603 Standard test method for drying shrinkage of mortar

3 Terms and definitions

For the purposes of this document, the following term and definition apply.

3.1 Portland cement for nuclear power engineering, P.N - a hydraulic cementitious material

suitable for nuclear power engineering, made by finely grinding Portland cement clinker of suitable composition together with an appropriate quantity of natural dihydrate gypsum.

4.1 Nuclear power cement clinker

The content of tricalcium silicate (C3S) shall not exceed 57 % by mass; the content of tricalcium aluminate (C3A) shall not exceed 7 % by mass; and the content of free calcium oxide (f-CaO) shall not exceed 1.0 % by mass.

The contents of the several mineral constituents are calculated from the chemical composition and are only the theoretically possible contents of those constituents.

Where the ratio of the mass of Al2O3 to the mass of Fe2O3 is greater than 0.64, the mineral composition is calculated by formulae (1) and (2): w(C3A) = 2.65 x w(Al2O3) - 1.69 x w(Fe2O3); and w(C3S) = 4.07 x w(CaO) - 7.60 x w(SiO2) - 6.72 x w(Al2O3) - 1.43 x w(Fe2O3) - 2.85 x w(SO3).

Where that ratio is 0.64 or less, the C3A content is taken as zero and the C3S content is calculated by formula (3): w(C3S) = 4.07 x w(CaO) - 7.60 x w(SiO2) - 4.48 x w(Al2O3) - 2.86 x w(Fe2O3) - 2.85 x w(SO3).

4.2 Natural gypsum

Natural dihydrate gypsum of class G, grade two or better, as specified in GB/T 5483.

4.3 Grinding aid

A grinding aid may be added when the cement is ground. The quantity added shall not exceed 0.5 % of the mass of the cement, and the grinding aid shall comply with GB/T 26748.

5 Strength grade

The strength grade of nuclear power cement is 42.5.

6.1 Magnesium oxide (MgO)

The magnesium oxide content shall not be greater than 5.0 % by mass.

6.2 Insoluble residue (IR)

The insoluble residue content shall not be greater than 0.75 % by mass.

6.3 Sulfur trioxide (SO3)

The sulfur trioxide content shall not be greater than 3.0 % by mass.

6.4 Loss on ignition

The loss on ignition shall not be greater than 3.0 % by mass.

6.5 Chloride ion (Cl-)

The chloride ion content shall not be greater than 0.06 % by mass.

6.6 Alkali content (R2O)

The alkali content shall not be greater than 0.60 % by mass. The alkali content is expressed as the value calculated from 0.658 x w(K2O) + w(Na2O).

6.7 Specific surface area

The specific surface area shall be not less than 280 m2/kg and not greater than 400 m2/kg.

6.8 Setting time

The initial setting time shall be not less than 45 min and the final setting time not greater than 390 min.