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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 2938-2008

Replacing GB 2938-1997

Low heat micro-expansion cement

低热微膨胀水泥

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Foreword

SAC/TC 184 is in charge of this English translation. In case of any doubt about the contents of English translation, the Chinese original shall be considered authoritative.

This standard replaces GB 2938-1997 Low heat micro-expansion cement in whole.

Compared with GB 2938-1997, there have been some changes in this standard over its previous edition in the following technical aspects: the cement grade has been changed to strength grade (Clause 5 of 1997 edition, Clause 5 of this edition); the requirement of control limit on chloride ion has been added, with the chloride ion content in cement not more than 0.06 % (6.8 of this edition).

The test standard for cement strength has been replaced by GB/T 17671 Test method for cement mortar strength (ISO method) from that in previous edition GB/T 177-1985 Test method for cement mortar strength (6.4 of 1997 edition, 7.6 of this edition).

For the test method of heat of hydration of cement, the standard GB/T 12959-1991 Method for determination of heat of hydration of cement (heat of solution method) has been added, in addition to the standard GB/T 2022-1980 Method for determination of heat of hydration of cement (direct method); between the both standards, the direct method is taken for arbitration (6.5 of 1997 edition, 7.4 of this edition).

This standard was proposed by China Building Materials Federation. This standard was prepared by SAC/TC 184 Technical Committee on Cement of Standardization Committee of China.

The previous editions of this standard are as follows: GB 2938-1982, GB 2938-1997.

1 Scope

China's national standard for low heat micro-expansion cement, the slag-based binder that Chinese dam and mass-concrete practice reaches for when a pour is too thick to shed its own heat. Ordinary portland cement releases most of its hydration heat in the first days, and in a large section that heat cannot escape: the core expands, the cooling skin restrains it, and the block cracks before it has ever carried a load. This cement answers the problem twice over. Granulated blast-furnace slag is the main constituent, ground with portland cement clinker and gypsum, so the heat of hydration is capped at 185 kJ/kg at 3 days and 220 kJ/kg at 7 days; and the binder is formulated to expand slightly rather than shrink, at least 0.05 % at 1 day and at least 0.10 % at 7 days but not more than 0.60 % at 28 days, so the restrained expansion works against the tensile stresses instead of adding to them. The standard fixes the definition, the material requirements for slag, gypsum, clinker, grinding aids and admixtures, the single strength grade 32.5, the technical requirements for sulfur trioxide, fineness, setting time, soundness, strength, heat of hydration, linear expansion, chloride ion and alkali content, and then the test methods, inspection rules and the rules for packaging, marking, transport and storage. It applies to the production, inspection and acceptance of low heat micro-expansion cement, code-named LHEC. The 2008 edition replaced the 1997 one, moved from cement grade to strength grade, added the chloride ion limit of 0.06 %, and switched the strength test to the ISO method of GB/T 17671.

This standard specifies the definition, material requirements, strength grade, technical requirements, test methods, inspection rules, packaging, marking, transportation and storage of low heat micro-expansion cement.

This standard is applicable to the production, inspection and acceptance of low heat micro-expansion cement.

2 Normative references

The following referenced 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 Method for chemical analysis of cement; GB/T 203 Granulated blast-furnace slag used in cement; GB/T 1346 Test method for water requirement of normal consistency, setting time and soundness of cement.

GB/T 2022 Determination of heat of hydration of cement (direct method); GB/T 5483 Gypsum and anhydrite; GB/T 8074 Determination of specific surface area of cement (Blaine method); GB/T 9774 Sacks for packing cement.

GB/T 12573 Sampling method for cement; GB/T 12959 Determination of heat of hydration of cement (heat of solution method); GB/T 17671 Test method for strength of cement (ISO

method).

JC/T 313 Test method for expansion rate of expansion cement; JC/T 420 Chemical analysis method of chloride ion in cement raw materials; JC/T 667 Cement grinding aids.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 low heat micro-expansion cement: low heat micro-expansion cement, code-named as LHEC, is a kind of hydraulic cementitious material with the features of low heat of hydration and micro expansion, which is the finely ground powder made by grinding the mixture of granulated blast-furnace slag as its main composition together with portland cement clinker and gypsum in proper proportions.

4 Materials requirement

4.1 Granulated blast furnace slag. The granulated blast-furnace slag shall be in high grade and conform to the provisions specified in GB/T 203.

4.2 Gypsum. Natural gypsum: the grade of natural gypsum shall meet the requirement of Grade II (or above) as specified in GB/T 5483, either Type A or Type G can be used. Industrial by-product gypsum: it is the by-product from industrial production with its main content of calcium sulfate. Before an industrial by-product gypsum is used, it shall have passed the necessary tests to prove its harmless to cement performance.

4.3 Portland cement clinker. Portland cement clinker is a hydraulic cementitious material with calcium silicate as the main mineral composition, which is manufactured by grinding the mixture of raw materials in a proper proportioning ratio and mainly containing CaO, SiO₂, Al₂O₃ and Fe₂O₃ into fine powder, and burning it up to partial melting. In Portland cement clinker, the content of calcium silicate shall not be less than 66 %, and the mass ratio of calcium oxide to silicon oxide shall not be less than 2.0. The clinker strength shall reach 42.5 or above; the content of free lime must not exceed 1.5 %; and the content of magnesium oxide must not exceed 6.0 %.

4.4 Grinding aids. Grinding aid is allowed to be used in cement grinding process by no more than 0.5 % of the cement by mass. It shall also meet the requirements as specified in JC/T 667.

4.5 Admixtures. It is allowed to add a small amount of admixture to improve the expansion performance of the cement through consultation between the supplier and the buyer.

5 Strength grade

The strength grade of low heat micro-expansion cement is 32.5.

6 Technical requirements

- 6.1 Sulfur trioxide. The content of sulfur trioxide shall be 4.0 % to 7.0 % by mass.
- 6.2 Specific surface area. The specific surface area shall not be more than 300 m²/kg.
- 6.3 Setting time. The initial setting time shall not be shorter than 45 min, and the final setting time not longer than 12 h. It can also be determined by the cement manufacturer and the end user.
- 6.4 Soundness. The cement shall pass the soundness test by method of boiling process.
- 6.5 Strength. The strength of low heat expansion cement at different ages shall conform to the requirements in Table 1. Table 1 gives, for strength grade 32.5, a flexural strength of at least 5.0 MPa at 7 days and 7.0 MPa at 28 days, and a compressive strength of at least 18.0 MPa at 7 days and 32.5 MPa at 28 days.
- 6.6 Heat of hydration. The heat hydration of the cement at each age shall not be greater than the value in Table 2. Table 2 gives, for strength grade 32.5, a heat of hydration of not more than 185 kJ/kg at 3 days and not more than 220 kJ/kg at 7 days.
- 6.7 Linear expansion rate. The linear expansion rate shall meet the following requirements: the 1 d linear expansion rate must not be less than 0.05 %; the 7 d linear expansion rate must not be less than 0.10 %; the 28 d linear expansion rate must not be more than 0.60 %.
- 6.8 Chloride ion. The chloride ion content of the cement shall not exceed 0.06 %.
- 6.9 Alkali content. It shall be decided by the cement manufacturer and end user. The alkali content is obtained by the calculated value of Na₂O + 0.658 K₂O.

7 Test methods

- 7.1 Sulfur trioxide (SO₃), sodium oxide (Na₂O) and potassium oxide (K₂O). The test shall be carried out in accordance with GB/T 176.
- 7.2 Specific surface area. The test shall be carried out in accordance with GB/T 8074.
- 7.3 Setting time and soundness. The test shall be carried out in accordance with GB/T 1346.
- 7.4 Heat of hydration. The test shall be conducted in accordance with GB/T 2022 or GB/T 12959; and the "Direct method" shall be taken for determination of heat of hydration in arbitration.
- 7.5 Linear expansion rate. The test shall be conducted in accordance with both JC/T 313, and the following supplementary provisions: a) the specimen shall be measured for its initial length after a moisture curing for 24 h and demould, and measured respectively after curing in water for 1 d, 7 d and 28 d; b) if the final setting time is more than 12 h, the specimen