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Replacing GB 8076-1997

Concrete Admixtures

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Foreword

The compressive strength ratio, shrinkage ratio and relative durability listed in Table 1 of Chapter 5 are mandatory; while the rest are recommended.

This standard replaces GB 8076-1997 *Concrete Admixture* and it differs from GB 8076 - 1997 in the following aspects:

--- Add high performance water reducer and pumping admixture; formulate technical requirements and test methods;

--- Add Chapter “Codes of product”;

--- Classify high performance water reducer, high efficiency water reducer and ordinary water reducer; namely, a certain type of admixture may be divided into accelerating reducer, standard reducer and retarding reducer;

--- Delete “qualified product”, adjust the product technical index based on the performance index of former Class I product;

--- Adjust technical indexes (such as solid content, water content and density etc.) of uniformity items by referring to EN 934-2:2001 and JIS A 6204: 2006; Add concrete test items for some products (for instance: slump and air content change in one-hour duration);

--- Delete testing method on reinforcing steel rust in the former standard; establish test method – use chromatography of ions to measure chloride ion content in concrete admixture;

--- Improve the specific area of reference cement being that is specially used in concrete admixture performance inspection.

Appendix A and Appendix B in this Standard are normative; while Appendix C is informative.

This Standard was proposed by China Building Materials Federation.

This Standard shall be under the jurisdiction of National Technical Committee on Cement Products of Standardization Administration of China.

Drafting organization of this Standard: China Building Materials Academy.

Participating drafting organizations of this Standard: Jiangsu Research Institute of Building Science, Zhejiang Wulong Chemical Industrial Stock Co. Ltd, Tongji University, Shanghai Architectural Institute of Science and Technology, China Academy of Building Research, China Academy of Railway Sciences, Nanjing Hydraulic Research institute, China Building Material Test & Certification Center, Suzhou Concrete Cement

Concrete Admixtures

1 Scope

This Standard specifies the terms, definitions, requirements, test procedures, inspection rules, package, exit-factory, storage and return of admixtures used in concrete.

This Standard is applicable to high performance water reducer (accelerating, standard and retarding reducers), high efficiency water reducer (standard and retarding reducers), ordinary water reducer (accelerating, standard and retarding reducers), air-entraining water reducer, pumping admixture, early strength admixture, retarder and air-entraining admixture, eight in total.

2 Normative References

The following standard contains provisions which, through reference in the following text, constitute provisions of this standard. For dated reference, subsequent amendments (excluding correction) to, or revisions of, any of these publications do not apply. However, parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. For undated references, the latest edition of the normative document referred to applies.

GB/T176 Method for Chemical Analysis of Cement

GB/T 8074 Method for Cement Surface Area Testing Blaine Method

GB/T 8075 Definition, Classification, Nomenclature and Terms of Concrete Admixtures

GB/T 8077 Method for Concrete Admixture Uniformity Test

GB/T 8170 Rules of Rounding off for Numerical Values & Expression and Judgment of Limiting Values

GB/T 14684 Building Sand

GB/T 14685 Pebbles and Crackle for Construction

GB/T 50080 Standard for Test Method of Performance on Ordinary Fresh Concrete

GB/T 50081 Standard for Test Method of Mechanical Properties on Ordinary

crushed-stone result shall prevail.

6.1.4 Water

It shall meet the technical requirements for water consumption of concrete mixing specified in JGJ 63.

6.1.5 Admixtures

The admixtures that need to be inspected.

6.2 Mixing proportion

Reference concrete mixing proportion is designed according to JGJ 55. The proportion of test concrete added with non-air-entraining admixture shall be the same with that of cement, sand and crushed-stone of the corresponding reference concrete. Mixing proportion design shall meet the following provisions:

a) Cement consumption: per unit cement consumption of reference concrete and test concrete mixed with high performance water reducer or pumping admixture is 360 kg/m^3; and per unit cement consumption of reference concrete and test concrete mixed with other admixtures is 330 kg/m^3.

b) Sand ratio: sand ratio of both reference concrete and test concrete mixed with high performance water reducer or pumping admixture is 43% ~ 47%; sand ratio of reference concrete and test concrete mixed with other admixtures is 36% ~ 40%; but the sand ratio of test concrete added with air-entraining water reducer or air-entraining admixture shall be 1% ~ 3% less than that of reference concrete.

c) Admixture amount to be added: it is added according to manufacturer's instructions.

d) Water consumption: slump of reference concrete and test concrete added with high performance water reducer or pumping admixture is controlled to be (210±10)mm; the water consumption is minimum when slump is (210±10)mm; slump of reference concrete and test concrete mixed with other admixtures is controlled to be (80±10) mm.

Water consumption includes the water content contained in liquid admixture, sand and stone.

6.3 Concrete mixing

Adopt the single-lay-shaft forced blender with nominal capacity of 60L and that meets the requirements stipulated in JG 3036. The mixing amount of blender shall neither be less than 20L nor greater than 45L.

When admixture is in powder, then, put the cement, sand, crushed-stone and

6.5.1 Measurement of slump and slump change in one-hour duration

One sample is taken from each concrete lot. Both slump and slump change in one-hour duration are represented by the mean value of three test results. Among the three test results, if either the maximum value or minimum value exceeds 10mm from the medium value, then both the maximum and minimum values shall be abolished, and the medium value is taken as the test result of this lot; when both maximum value and minimum value exceeds 10mm from the medium value, then test shall be carried out again.

Measured value of slump and slump change in one-hour duration is represented by mm, and the result is rounded-off to 5mm.

6.5.1.1 Slump measurement

Concrete slump is measured in accordance with GB/T 50080; while for the concrete with slump of (210±10) mm, it is loaded in two layers and each layer is half cylinder height; then each layer is spaded by 15 times with spading rod.

6.5.1.2 Measurement of slump change in one-hour duration

If this item is needed to be measured, adequate concrete that is mixed in accordance with Article 6.3 shall be left for once slump test; then the concrete is placed into a sample cylinder cleaned with a damping cloth; cover the cylinder. After one-hour rest (from the time when water is added and the concrete is mixed), the concrete is poured out on iron-sheet and mixed evenly with a shovel. Then, slump is measured according to slump test method. Finally, the slump difference between discharging and after one-hour is figured out; that is the slump change in one-hour duration.

Slump change in one-hour duration is calculated according to Formula (1):

$$\Delta Sl = Sl_0 - Sl_{1h} \qquad \cdots\cdots(1)$$

Where:

ΔSl – slump change in one-hour duration (mm);

Sl_0 – discharging slump (mm);

Sl_{1h} – slump measured after one-hour (mm).

6.5.2 Water-reducing rate measurements

Water-reducing rate is, when slumps are basically the same, the ratio of the DIFFERENCE of per-unit water consumption between reference concrete and test concrete TO per-unit water consumption of reference concrete. Water-reducing rate is calculated according to Formula (2), accurate to 0.1%.

samples' measured-values.

6.7 Uniformity test methods

6.7.1 Chloride ion content measurement

Chloride ion content is measured according to GB/T 8077 or the method specified in Appendix B of this Standard. For arbitration, the methods stated in Appendix B are applied.

6.7.2 Measurement of solid content, total alkali amount, water content, density, fineness, pH value and sodium sulfate content

It shall be measured according to GB/T 8077.

7 Inspection Rules

7.1 Sampling and lot number

7.1.1 Spot-sample and mixing-sample

Spot-sample refers to a sample obtained from the product in one-time production. Mixing-sample refers to the sample that is obtained after three or more spot-samples are mixed equivalently and evenly.

7.1.2 Lot number

Manufacturer shall number the products by lot according to output and manufacturing equipment condition. Each lot number of admixture, with the same type and whose mixing proportion is greater than 1% (including 1%), is 100t; and each lot number of admixture, whose mixing proportion is less than 1%, is 50t. If the admixture is less than 100t or 50t, it shall also be regarded as a lot. products with same lot number must be mixed evenly.

7.1.3 Sampling amount

The sampling amount for each lot shall be no less than the admixture amount that is required by 0.2t of cement.

7.2 Samples and reserved-sample

Samples taken from each lot shall be thoroughly and evenly mixed, which shall be divided into two equal-portions. In which, one portion is tested according to the items listed in Table 1 and Table 2, and the other is sealed and conserved for half a year. If there is any question, it shall be submitted to the designated national inspection authorities for retest or arbitration.

a) Pilot production and finalized identification when new and old products are transferring the plant;

b) If material and process changes significantly and it may influence product performance after formal production;

c) Under normal production, at least one inspection is carried out every year;

d) After long-time shutdown, production is resumed;

e) When exit-factory inspection result differs significantly from the last type test result;

f) When national quality supervision agencies require for type test.

7.4 Judgment rules

7.4.1 Exit-factory inspection judgment

If type inspection report is within effective period and exit-factory inspection results meet the requirements in Table 2, then this lot of products may be determined to be qualified.

7.4.2 Type inspection judgment

After the product is inspected, if uniformity test-result meets the requirements listed in Table 2; and among the performance indexes of all admixture for test concretes -- the water-reducing rate and slump change in one-hour duration of high performance water reducer and pumping admixture, the water-reducing rate of other water reducers , the setting time difference requirements of retarding admixture, the air content and air content change in one-hour duration of air-entraining admixture and all performances of hardened concrete MEET the requirements of Table 1; then this lot of admixture is determined to be qualified. If the requirements are not met, then this lot of admixture is determined to be disqualified. Other items may be acted as the reference indexes.

7.5 Retest

Retest shall be carried out with sealed and reserved samples. If user-organization requires for on-site sampling, then the requirements shall be specified in procurement contract in advance, and mixing-sample shall be taken on-site when both personnel from the manufacturer and user-organization are present. Retest is inspected according to items of type inspection.

8 Instructions, Package, Storage and Return of

Appendix A

(Normative)

Technical Condition of Reference Cement Used for Inspecting Concrete Admixture Performance

Reference cement is the special-cement used to inspect concrete admixture performance. It is Type P.I Portland cement with 42.5 strength level that is grinded from Portland clinker and dihydrate gypsum which meet the following quality indexes. Reference cement must be supplied by those factories which are confirmed by Subcommittee of Concrete Admixture of China Building Materials Federation and the relevant organizations together.

A.1 Quality indexes (besides the technical requirements of meeting 42.5 strength level Portland cement)

A.1.1 Tricalcium aluminate (C_3A) content in Clinker is 6% ~ 8%.

A.1.2 Tricalcium silicate (C_3S) content in clinker is 55% ~ 60%.

A.1.3 Free calcium oxide (fCaO) content in clinker shall not be greater than 1.2 %.

A.1.4 Alkali content in cement ($Na_2O+0.658k_2O$) shall not be greater than 1.0%.

A.1.5 Cement specific area, (350±10) m^2/kg.

A.2 Test methods

A.2.1 Measurement of Free calcium oxide, potassium oxide and sodium oxide are carried out according to GB/T 176.

A.2.2 Cement specific area is measured according to GB/T 8074.

A.2.3 Content of tricalcium aluminate and tricalcium silicate is given by the following formula according to the content of calcium oxide, silica, aluminum oxide and ferric oxide in clinker:

$$C_3S = 3.80 \cdot SiO_2(3KH-2) \quad \cdots\cdots (A.1)$$

$$C_3A = 2.65 \cdot (Al_2O_3 - 0.64Fe_2O_3) \quad \cdots\cdots (A.2)$$

$$KH = \frac{CaO - fCaO - 1.65Al_2O_3 - 0.35Fe_2O_3}{2.80SiO_2} \times 100 \quad \cdots\cdots (A.3)$$

Where: C_3S, C_3A, SiO_2, Al_2O_3, Fe_2O_3 and fCaO represents these composition mass

Appendix B

(Normative)

Test Method of Chloride Ion Content in Concrete Admixture

(Chromatography of Ions)

B.1 Scope

This method is applicable to measure chloride ion content in concrete admixture.

B.2 Method summary

Chromatography of ions is a kind of analysis method of liquid chromatography; sample solution is separated by negative-ion chromatographic column; and the negative ions F^-, Cl^-, SO_4^{2-} and NO_3^- in solution are separated; and it is simultaneously inspected by conductivity cell. Chloride ion peak area or peak height in solution is measured.

B.3 Reagents and materials

a) Nitrogen: its purity is not less than 99.8 %;

b) Nitric acid: superior purity;

c) Water used in laboratory: Grade-1 water (specific conductivity is less than 18mΩ•cm and is filtered with 0.2μm hyper-filtration membrane);

d) Chloride ion standard solution (1mg/mL): Precisely weigh 1.648 g of sodium chloride (standard reagent) that has been pre-heated for (40 ~ 50) minutes at the temperature of (550 ~ 600) °C and cooled to ambient temperature in desiccator; use water to dissolve; transfer in a 1000mL volumetric flask; use water to dilute to scale.

e) Chloride ion standard solution (100μg/mL): 100mL of afore-mentioned standard solution is precisely shifted into a 1000mL volumetric flask; then it is diluted with water to the scale.

f) Chloride ion standard solution series: 1 mL,5 mL,10 mL,15 mL, 20 mL and 25 mL (100 μg/mL Chloride ion standard solution) are precisely shifted into 100mL volumetric flasks, and then diluted with water to the scale. The densities of these standard solutions are 1μg/mL, 5μg/mL, 10μg/mL, 15μg/mL, 20μg/mL and 25μg/mL respectively.

B.4 Instruments

Appendix C

(Informative)

Information on Concrete Admixture

C.1 Scope

This annex provides simple information such as kind of concrete admixtures, major functions, the adaptivity between cement, application precautions of admixture. It covers eight kinds of admixtures in total -- high performance water reducer (accelerating, standard and retarding types), high efficiency water reducer (standard and retarding types), ordinary water reducer (accelerating, standard and retarding types), air-entraining water reducer, pumping admixture, early strength admixture, retarder and air-entraining admixture.

C.2 Kind of admixture

Admixtures are classified according to their major functions. Each different admixture consists of a certain kind of major chemical constitution. All admixtures sold in market may be compounded with different constructional materials.

C.2.1 High performance water reducer

High performance water reducer, a new kind of admixture developed both at domestic and abroad in recent years, is poly carboxylic acid products at present. It is characterized by "pectination" structure and consists of main chain of anionic group with free carboxylic acid and polyoxyethylene-based side chain. It is used to change monomer variety. High performance water reducers with various performances and characteristics may be produced basing on different proportions and reaction conditions. Accelerating, standard and retarding high performance water reducers may be produced by bringing into different functional groups during molecular design; or they may be compounded by adding different components. They are mainly featured by:

a) Low admixture (calculated according to solid content, 0.15% ~ 0.25% of cementitious material mass in general); water-reducing rate is higher;

b) Operation-performance and operation-performance preservation of concrete mixture are better;

c) Chloride ion and alkali contents in admixture is lower;

d) The shrinkage of the prepared-concrete is lower; it may improve the concrete’s volume stability and durability;

d) To accelerate the early strength development of concrete or mortar;

e) To adjust the coagulation and setting rate of concrete or mortar;

f) To regulate air content of concrete or mortar;

g) To reduce cement early hydration heat or postpone hydration heat release;

h) To improve water bleeding performance of mixture;

i) To improve concrete or mortar resistance to corrosivity of various erosive salts;

j) To weaken alkali-aggregate reaction;

k) To improve the capillary porosity structure of concrete or mortar;

l) To improve concrete pumping performance;

m) To improve reinforcement capacity of rust resistance;

n) To improve aggregate and mortar interface cohesion and to improve the bondability of reinforcement and concrete;

o) To improve the cohesion of both new and old concrete interface etc.

C.4 Major factors to influence the adaptivity of cement and admixture

The adaptivity of cement and admixture is a very complicated subject; it is at least influenced by the following factors. If in-adaptation of cement and admixture is occurred, test must be carried out to find out the reasons and to eliminate each in-adaptation factor.

a) Cement: mineral composition, fineness, free calcium oxide content, added gypsum content and gypsum form, cement clinker alkali content, alkali sulfate saturation, composite material type & mixing amount and cement grinding aids etc.;

b) Kind and mixing amount of admixtures: for instance, the molecular constitution of naphthalene-based water reducer, including degree of sulphonation, mean molecular weight, molecular weight distribution, polymerization performance and kinds of counterion etc.;

c) Concrete mixing ratio: especially water paste ratio, the kind and mixing amount of mineral admixture;

d) Loading procedure when concrete is mixed, mixing temperature and blender type.

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