

Admixtures

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Cement Admixtures Association

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Concrete Society

Glanville Consultants

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Quarry Products Association

Ready-mixed Concrete Bureau

RMC Readymix Ltd

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United Kingdom Quality Ash Association

A full list of the publications in this series is given on the back page.

INTRODUCTION

This publication provides information on the types and properties of admixtures that have been, or are being, standardized in Europe for implementation in national standards in CEN member countries. It also provides guidance on the circumstances when it may be necessary to specify an admixture to a concrete producer.

Admixtures for use in concrete are defined in BS EN 206–1 as “material added during the mixing process of concrete in small quantities related to the mass of cement to modify the properties in the fresh or hardened state”. This does not cover pigments or silica fume, which are additions. However, these two additions may be supplied as dispersions that also contain admixtures.

Admixtures are now widely accepted as materials that contribute to the production of durable and cost-effective concrete structures. The contributions include improving the handling properties of fresh concrete, making placing and compaction easier, reducing the permeability of hardened concrete, and providing freeze/thaw resistance.

Requirements for admixtures of all types are covered by European Standards in the BS EN 934 series, *Admixtures for concrete, mortars and grout*:

Part 2: *Concrete admixtures*;

Part 3: *Admixtures for mortar*;

Part 4: *Admixtures for grout*;

Part 5: *Admixtures for sprayed concrete*.

(There is no Part 1.)

This publication covers concrete admixtures only, i.e. Part 2.

The use of concrete admixtures is covered by BS EN 206–1 and BS 8500.

TYPES OF CONCRETE ADMIXTURE

BS EN 934–2: 1998 covers the following types of admixtures:

- water reducing/plasticizing;
- high-range water reducing/superplasticizing;
- water retaining (Note: this type is intended to reduce bleeding from concrete; it is little used in the UK);
- water resisting (Note: this type is frequently known as waterproofing admixture);
- air entraining;
- set accelerating;
- hardening accelerating;
- set retarding;
- *set retarding/water reducing/plasticizing;
- *set retarding/high-range water reducing/superplasticizing;
- *set accelerating/water reducing/plasticizing.

(*These dual function admixtures are included in an amendment to BS EN 934–2 currently in preparation.)

Other types of concrete admixtures in current use are not covered by BS EN 934–2, but their use is controlled by BS EN 206–1, which requires that they have “established suitability”.

Examples of other admixture types are:

- corrosion inhibiting;
- shrinkage reducing;
- for use in underwater concrete;
- for use in precast concrete.

Most admixtures are supplied as liquids as these are easier to dispense and disperse in the relatively small quantities used. However, BS EN 934–2 also covers concrete admixtures in powder form.

PROPERTIES OF CONCRETE ADMIXTURES

Except in special cases such as high-strength concrete, the maximum dosage of concrete admixtures is limited, by 5.2.6 of BS EN 206–1, to 50 g/kg cement. For low dosages of less than 2 g/kg cement, the admixture has to be dispersed in part of the mixing water.

The performance of concrete admixtures is controlled in BS EN 934–2 by requirements related to the main function for single-function admixtures and to the main function and secondary functions for dual- or multi-function admixtures. These performance requirements are shown in Table 1.

In addition there are general performance requirements applying to all admixtures; these include:

- effect on setting time;
- effect on compressive strength;
- effect on air content in fresh concrete;
- water soluble chloride content;
- alkali content as $\text{Na}_2\text{O}_{\text{eq}}$.

The performance of admixtures is determined by using reference concrete. The test mix (with admixture) is compared with the control mix (without admixture). The chloride and alkali contents also have to be measured and declared. Test procedures for admixtures are given in the BS EN 480 series, *Admixtures for concrete, mortar and grout – Test methods*.

The chloride content of all concrete is limited by Table 10 of BS EN 206–1 and the contribution of admixtures to the chloride content can be calculated. BS EN 934–2 limits admixture chloride content to a maximum of 0.10% or the manufacturer’s stated value.

Where the alkali content is limited in accordance with 5.2.2.2 of BS 8500–2, the contribution from admixtures can be calculated. BS EN 934–2 requires the manufacturer to state the maximum alkali content of each admixture.

Table 1: Principal performance requirements for admixtures given in BS EN 934–2

Type of admixture	Performance requirement	Value in BS EN 934–2
Water reducing/plasticizing	Water reduction at equal consistence	Reduction $\geq 5\%$
High-range water reducing/superplasticizing	Water reduction at equal consistence Increase in consistence at equal w/c ratio	Reduction $\geq 12\%$ Slump increase ≥ 120 mm
Water retaining	Reduction in bleeding	Reduction $\geq 50\%$
Water resisting	Reduction in capillary absorption	Reduction $\geq 50\%$ by mass
Air entraining	Air void characteristics in hardened concrete	Spacing factor $\leq 0.200 \mu\text{m}$
Set accelerating	Reduction in initial setting time	Reduction $\geq 40\%$ at 5°C
Hardening accelerating	Compressive strength at 1 day Compressive strength at 2 days	Increase $\geq 20\%$ at 20°C Increase $\geq 30\%$ at 5°C
Set retarding	Increase in initial and final setting times	Initial increase ≥ 90 min. Final increase ≤ 360 min.
Set retarding/water reducing/plasticizing	Water reduction at equal consistence Increase in initial and final setting times	Reduction $\geq 5\%$ Initial increase ≥ 90 min. Final increase ≤ 360 min.
Set retarding/high-range water reducing/superplasticizing	Water reduction at equal consistence Increase in consistence at equal w/c ratio Increase in initial and final setting times at equal consistence	Reduction $\geq 12\%$ Slump increase ≥ 120 mm Initial increase ≥ 90 min. Final increase ≤ 360 min.
Set accelerating/water reducing/plasticizing	Water reduction at equal consistence Reduction in initial setting time	Reduction $\geq 5\%$ Reduction ≥ 30 min. at 20°C and $\geq 40\%$ at 5°C

SPECIFYING CONCRETE ADMIXTURES

Designed and designated concrete

Admixtures will normally be used in designed and designated concrete. The concrete producer should be left to select the most appropriate admixture to contribute to achieving the specified concrete properties. For ready-mixed concrete, the type of admixture used is stated on the delivery ticket.

There is no reason to prohibit the use of admixtures.

For designed concrete, admixtures are frequently used to help achieve the following properties:

- compressive strength;
- consistence;
- density;
- air content;
- strength development;
- retarded stiffening;
- resistance to water penetration;
- other special properties (e.g. accelerated stiffening, high early strength development).

Prescribed concrete

Clause 3.1.3 of BS EN 934–2 advises that “trial tests should be carried out with the materials to be used on site to find the dosage necessary to achieve the desired result”. The concrete producer may well have the results of such tests, which should be obtained before specifying the type and dose of admixture for a specific concrete mix.

The specifier should take into account the following:

- admixtures of the same type from different manufacturers may well require different doses to achieve the desired effect;
- the effect of admixtures is dependent on the particular cement, additions and aggregates used in the concrete.

The specified dose should be within the recommended range of dosage for the particular type and brand of admixture. This information is provided by the manufacturer.

When a combination of admixtures is used it is important to obtain data for the performance of mixes incorporating the particular combination of admixtures.

FURTHER READING

The other publications from this series will be helpful. Visit www.cementindustry.co.uk and click ‘information’/‘library’/‘BCA publications’ to check availability and for free download.

Standards for fresh concrete – a composite of BS EN 206-1 and BS 8500

Specifying concrete to BS EN 206–1/BS 8500:

Concrete for normal uses

Concrete resistant to chemical attack

Guide to the selection of concrete quality and cover for reinforcement for normal concrete structures

Examples of the specification of designated concrete

Examples of the specification of designed concrete

Guidance on additional requirements for designed concrete

Lightweight concrete

Visual concrete

Coloured concrete

Concrete for industrial floors

Specifying constituent materials for concrete to BS EN 206-1/BS 8500:

Cements

Additions

Admixtures

European replacements for British Standards:

Concrete and its constituent materials

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