



CEMENT ADMIXTURES ASSOCIATION

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the Sign of Quality

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Admixture Sheet – AS 15

Shrinkage reducing admixtures

1. Function

Shrinkage reducing admixtures when added to concrete during the batching stage, can significantly reduce both the early and long term drying shrinkage. This is achieved by treating the 'cause' of drying shrinkage within the capillaries and pores of the cement paste.

This type of admixture should not be confused with shrinkage compensating materials which are normally added at above 5% on cement and function by creating an expansive reaction within the cement paste to treating the 'effects' of drying shrinkage.

Shrinkage reducing admixtures can be used in situations where shrinkage cracking could lead to durability problems or where large numbers of shrinkage joints are undesirable for economic or technical reasons.

In floor slabs, the joint spacing can be increased from 5 - 6m. to 10 - 15m. due to the reduced movement of the concrete during drying. The risk of the slab curling at joints and/or edges is also significantly reduced.

Where new concrete is used to strengthen or repair existing structures, shrinkage reducing admixtures can reduce the risk of cracking in what can be a highly restrained environment.

2. Materials

Shrinkage reducing admixtures are mainly based on ethylene glycol derivatives.

These organic liquids are totally different to most other admixtures, which are water based solutions.

The admixtures are normally 100% active and are water soluble. They have a characteristic odour and a specific gravity of less than 1.00.

3. Mechanism

The mechanism by which shrinkage reducing admixtures operate is unique.

When excess water begins to evaporate from the concrete's surface after placing, compacting, finishing and curing, an air/water interface or "meniscus" is set up within the capillaries or pores of the cement paste of the concrete. Because water has a very high surface tension, this causes a stress to be exerted on the internal walls of the capillaries or pores where the meniscus has formed. This stress is in the form of an inward pulling force that tends to close up the capillary or pore. Thus the volume of the capillary is reduced leading to shrinkage of the cement paste around the aggregates, leading to an overall reduction in volume.

The shrinkage reducing admixtures operates by interfering with the surface chemistry of the air/water interface within the capillary or pore, reducing surface tension effects and consequently reducing the shrinkage as water evaporates from within the concrete.

4. Use

4.1 Dosage

The typical dosage range for a shrinkage reducing admixture is 5 – 7 litres/m³.

The dosage is largely independent of the cement content of the concrete because it does not function directly on the cement in the way that a dispersant such as a water reducing admixture works. However, some literature does give the dosage as a percentage based on volume for a weight of cement and this is typically 1 to 2%.

4.2 Cement type

Shrinkage reducing admixtures are compatible with all types of cement including those containing other binders such as PFA or GGBS.

4.3 Yield

Shrinkage reducing admixtures do not affect the yield.

4.4 Overdosing

Overdosing of a shrinkage reducing admixture will lead to extended setting times and potentially a significant reduction in compressive strength development. At dosages beyond 7 litres/m³, no significant extra reduction in drying shrinkage will be obtained.

5. Effects on properties of concrete

5.1 Strength

Shrinkage reducing admixtures can, in some cases, reduce strength development both at early and later ages. At recommended dosages, a maximum strength loss of 12 – 15% at 28 days could be expected.

5.2 Workability

The workability of concrete containing shrinkage reducing admixtures will not be adversely affected. The liquid volume of the admixture should, however, be included as part of the mixing water.

5.3 Slump loss

Shrinkage reducing admixtures will not lead to either an increase or a decrease in the rate of slump loss.

5.4 Setting time

At recommended dosages, shrinkage reducing admixtures will not significantly affect the setting time.

5.5 Air entrainment

Shrinkage reducing admixtures do not affect the air content of concrete and will not affect the way in which air is entrained into the concrete provided the sequence of addition, recommended by the admixture manufacturer, is followed.

5.6 Bleeding

Shrinkage reducing admixtures will not affect the rate at which concrete bleeds.

5.7 Heat of hydration

Shrinkage reducing admixtures will not affect the maximum rise in temperature of concrete.

5.8 Volume deformation

The function of shrinkage reducing admixtures is to reduce volume deformation by reducing the drying shrinkage of the concrete. The reduction is typically 30 – 70% depending on concrete type, admixture dosage and the time at which the shrinkage is measured.

5.9 Durability

Shrinkage reducing admixtures do not affect the long term durability and may improve it by reducing cracks and joints that can be the cause of failure in floors and other structures.