CEMENT ADMIXTURES ASSOCIATION

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the Sign of Quality

Admixture Sheet – ATS 14
Semi-dry, Precast concrete admixtures

1 Function

Admixtures are used in the manufacture of "dry" or "semi-dry" vibrated and pressed concrete products such as paving and masonry blocks, bricks, flags and architectural masonry to assist compaction, disperse cement, colour and fine aggregate particles, and help control primary and secondary lime staining (efflorescence). Admixtures can be specific to only one of these functions or can be multi-purpose.

2 Materials

The principal chemical types are:

a) compaction/dispersion - salts of lignosulphonic acids
- salts of hydroxycarboxylic acids
- combinations of surface active agents.

b) efflorescence control - soluble and insoluble salts of specific chain length fatty acids.

3 Mechanism

Concrete mixes with very low water contents (typically 6-9%) are made easier to compact by reducing particle attraction and surface tension, making the mix more susceptible to vibration and pressure, thereby increasing density. The reduced particle attraction prevents agglomeration and disperses cement and colour particles.

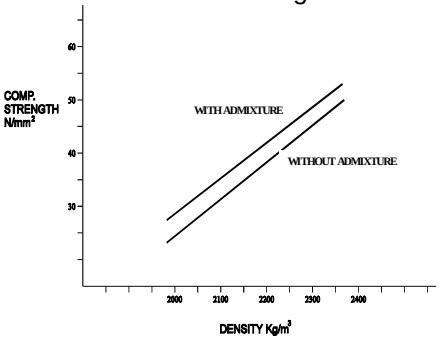
The plasticising action does not normally lead to an increase in workability, as this would cause product shape deformation.
The occurrence of efflorescence is reduced by either blocking the capillaries in the concrete matrix or making them hydrophobic, slowing down the passage of water and dissolved calcium hydroxide to the surface.

4 Effect on Concrete Properties.

4.1 Strength

Increasing the density and reducing the amount of unhydrated or partly hydrated cement particles raises the strength of semi-dry concrete. An admixture that affects compaction and improves cement hydration therefore changes the relationship between density and strength of semi-dry concrete.

Compressive and tensile/flexural strengths are directly related to density. An increase in density of 50-70 kg/m can result in a compressive strength gain of 5-8N/mm (12-18%), with similar improvements in tensile and flexural strengths.

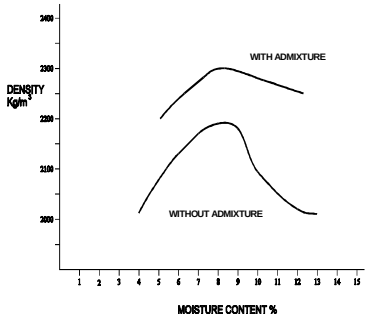


4.2 Density and Compaction

Admixtures which cause a reduction in particle attraction increase the response to vibration and pressure which increases compaction and density.
Using Admixtures, the normal moisture content/density relationship is affected by maintaining a similar Optimum Moisture Content (OMC) whilst achieving a higher mix density.
Mixes on the lower water content/dry side of the OMC have improved compaction.
Mixes on the higher water content/wet side of the OMC are less liable to deformation or collapse.
This raises the tolerance to variations in water content.

4.3 Moisture content and compaction

The relationship between moisture content, green strength and density is illistrated below. The use of a properly designed admixture has the effect of flattening the curve, increasing water tolerance and reducing batch-to-batch variation.



4.4 Production Cycle Time

The improvement on the compactibility can also be used to reduce compaction time, reducing machine cycle times to allow increased output. A typical cycle time reduction from 14 to 13 seconds results in 7% product output increase.

4.5 Coloured Concrete

Admixtures can improve dispersion of colour particles increasing the efficiency and effect of colour pigments.

4.6 Efflorescence

The use of an integral water repellent or dual-purpose admixture maintains the colour by reducing efflorescence.

Primary efflorescence, often termed lime bloom, is a very fine surface film of white calcium carbonate originating as calcium hydroxide, produced by cement hydration, which then reacts with carbon dioxide in the air. This generally occurs as the concrete dries for the first time and has the effect of dulling or lightening the colour. Secondary efflorescence, also white calcium carbonate, occurs when further drying takes place or when water from rain or condensation passes through or over the surface of the concrete product, depositing dissolved calcium hydroxide or calcium carbonate on the surface.

An integral water repellent discourages the passage of hydroxide bearing water through the concrete, reducing porosity, so water is less likely to evaporate from the surface and leave the white lime salts there. The reduced absorbency can also reduce rain and water penetration, the adherence of air borne dirt and algal growth which mar the appearance.

4.7 Appearance

Admixtures that improve the compaction of semi-dry concrete mixes reduce the occurrence of segregation of fine and coarse aggregates, thus making the appearance more consistent. Some admixtures specially designed for the purpose can also produce a finer textured finish and are used in fair-faced or paint-grade masonry blocks, or to close up the surface of paving blocks and flags.

4.8 Other Properties

Other properties of the concrete product are affected by the improved compaction and hydration.
Damage by handling, strapping and palleting is reduced, and the resistance to abrasion and freeze/thaw cycles is significantly enhanced.