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Chemical Admixtures for Concrete

1. WHAT are Admixtures?

Admixtures are natural or manufactured chemicals added to the concrete before or during mixing. The most often used chemical admixtures are air-entraining agents, water-reducers, retarders and accelerators

2. WHY Use Admixtures?

Admixtures are used to give special properties to fresh or hardened concrete. Admixtures may enhance the workability of fresh concrete and the durability and strength of hardened concrete. Admixtures are used to overcome difficult construction situations such as hot or cold weather placements, pumping requirements, early strength requirements or specifications that require low water-cementitious ratio. Admixtures can be used to optimize the cementitious composition of concrete mixtures for performance and sustainability.

3. HOWto Use Admixtures.

Chemical Admixtures

Consult your Ready Mixed Concrete Supplier about admixtures appropriate for your application. Admixtures are evaluated for compatibility with cementitious materials, construction practices, job specifications and economic benefits before being used. Purchasers of ready mixed concrete should avoid requiring the use of specific brands or using products of their own accord.

Follow this Guide to Use Admixtures:

a. AIR-ENTRAINING ADMIXTURES are liquid chemicals added when batching concrete to produce microscopic air bubbles, called entrained air, produced by the mixing action. These air bubbles improve the concrete's resistance to damage caused by exposure to cycles of freezing and thawing and deicing salt application. In fresh concrete, entrained air improves workability and reduces bleeding and segregation. For exterior flatwork (parking lots, driveways, sidewalks, pool decks, patios) subject to weather related freeze/thaw cycles, or in areas where deicer salts are used, specify an air content of 5 to 8%. Air-entrainment is not necessary for interior structural concrete since it is not subject to freezing and thawing. Entrained air should be avoided for concrete flatwork that will have a smooth troweled finish. In concretes with higher cementitious materials content, entrained air will reduce strength by about 5% for each 1 % of air added; but in low cement content concretes, adding air has less effect and can reduce segregation and result in a modest increase strength due to the reduced water needed for a required slump. Air entrainment admixtures for us in concrete should meet the requirements for ASTM C260.

b. WATER-REDUCERS are used for two different purposes: (1) to lower the water content in fresh concrete and to increase its strength; (2) to obtain higher slump without using additional water. Water-reducers reduce the required water content of a concrete mixture for a target slump. These admixtures disperse the cement particles in concrete and make more efficient use of cement. This increases strength or allows the use of less cement to achieve a similar strength. Water-reducers are useful for pumping concrete and in hot weather, to offset the increased water demand. Some water-reducers may cause an increased rate of slump loss with time. Water-reducers tend to retard concrete and sometimes have accelerators blended in to offset the retardation. Water-reducers should meet the requirements for Type A Chemical Admixtures in ASTM C 494. Mid-Range water reducers are now commonly used to achieve greater water reduction than typical water reducers. They are popular because they improve the finishability of concrete flatwork. Mid-Range water reducers must meet at minimum, the requirements for a Type A under ASTM C494. There is a separate classification for these admixtures under ASTM C494.

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c. RETARDERS are chemicals that delay the initial set of concrete by an hour or more. Retarders are often used in hot weather to counter the rapid setting caused by high temperatures. For large jobs, or in hot weather, concrete with a retarder allows more time for placing and finishing. Retarders are typically a component of water reducers. Retarders should meet the requirements for Type B or D under ASTM C494.

d. ACCELERATORS reduce the initial set time of concrete and produce higher strengths at early ages. Accelerators are recommended in cold weather to attain high -early strength. Accelerators do not prevent concrete from freezing; rather, they speed up the strength gain and make the concrete stronger to resist damage from freezing. Accelerators are also used in fast track construction requiring early form removal, opening to traffic, or load application on structures. Liquid accelerators should conform to ASTM C494 Type C and E. Accelerators come in two chemical based formats – chloride and non-chloride. Calcium chloride is the most commonly used, effective and economic accelerator, available in liquid or flake. Calcium chloride must conform to ASTM D98. For non-reinforced concrete, Calcium Chloride may be used to a limit of 2% by weight of cement. Because of concerns with corrosion of reinforcing steel induced by chloride, lower limits on chlorides apply to reinforced concrete. Prestressed concrete and concrete with embedded aluminum or galvanized metal should not contain chloride-based materials because of increased potential of corrosion of the embedded metal. Non-Chloride accelerators are used where there is a concern of corrosion of embedded metals or reinforcement in concrete.

e. HIGH RANGE WATER-REDUCERS (HRWR) are a special class of water reducers. Often called super-plasticizers, HRWRs reduce the water content of .a given concrete from 12 to 40%, to attain a targeted slump. HRWRs are therefore used to increase strength and to reduce permeability by reducing the water content of the concrete mixture. HRWRs can also greatly increase the slump to produce "flowing" concrete. These admixtures are essential for producing high strength and high performance concretes that contain high contents of cementitious materials and mixtures containing silica fume. Some HRWR's may cause an increase in slump loss rate over time. In some cases, HRWRs may be added on the job site in a controlled manner to provide the required slump for placement. HRWR's must meet the requirements for Types F and G under ASTM C494 or Types 1 and 2 under ASTM C 1017.

Apart from these 5 standard admixtures, there are products available for enhancing concrete properties for a wide variety of applications. Some of these products include: corrosion inhibitors, shrinkage reducing admixtures, anti-washout admixtures, hydration stabilizers or extended retarding admixtures, admixtures to reduce potential for alkali aggregate reactivity, pumping aids, permeability reducing admixtures, workability retaining admixtures, rheology and viscosity modifying admixtures as well as a variety of colours and products that enhance the esthetics of concrete. Consult your local ready mix supplier for more information on how chemical admixtures can add value to your project.

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