Concrete Ready Mix Retarders & Accelerators

WATER: The primary function of water used in a concrete mix is to start the hardening process of the concrete through hydration of the cement. A secondary function is to make the mix workable enough to satisfy the requirements of the job. However, too much water will cause a loss of strength by upsetting the water-cement ratio. It will also cause “water gain” on the surface, a condition which leaves a surface layer of weak material called LAITANCE. Also, an excessive amount of water will impair the water tightness of the concrete. Water used in mixing concrete must be clean and free from oils, alkalis, acids, and organic materials. Most specifications recommend the mixing water be fit for drinking. This is because any water fit for drinking is usually satisfactory for use in mixing concrete. Seawater may be used for unreinforced concrete.

ADDITIVES USED IN CONCRETE: There are several additives or admixtures used to change the composition of concrete or to accelerate or retard its hardening. The three commonly used are air-entraining agents, retarders, and accelerators. Additives are not recommended if the end result can be reached more economically by altering the mix proportions. Air-entraining Portland cement is a special cement that can be used with good results for a variety of conditions. It was developed to produce concrete that has a resistance to freeze-thaw action and scaling caused by chemicals applied for severe frost and ice removal, Air-entraining agents are liquids derived from natural wood resins, animal fats, vegetable fats, or various wetting agents, such as alkali salts and water-soluble soaps. Agents are blended with the cement during manufacturing or added at the mixing site. If done at the site, the agent is added to the water used in the mix. Manufactured air-entraining cements are indicated by the letter A in the type number (Types IA, IIA, IIIA, etc.). Concrete made with this cement contains billions of extremely small, entirely separated air bubbles per cubic foot of concrete. These bubbles provide space for water to expand due to freezing without damage to the concrete. Retarders are used to slow down the rate of setting of a concrete. High temperatures of fresh concrete (85°F - 90°F and higher) are often the cause of an increased rate of hardening that makes placing and finishing difficult. One practical way to reduce the temperature of the concrete is by cooling the mixing water or the aggregates. Retarders do not decrease the initial temperature of the concrete. Retarders are sometimes used (o do the following: 1. Offset the accelerating effect of hot weather on the setting of concrete 2. Delay the initial set of concrete when difficult or unusual conditions of placement occur, such as placing concrete in large piers and foundations 3. Delay the set for a special finishing process, such as an exposed aggregate surface Some of the materials used to retard the set of a concrete mixture are lignin, borax, sugar, tartaric acid, and salt. These materials should be added to the mixing water. CAUTION If 20 percent by volume of retarding agent is added to the mix, the effect is reversed and it then acts as an accelerator. Accelerators are used to accelerate the strength development of concrete at an early age. Calcium chloride is the material most commonly used in accelerating admixtures; however, in addition to accelerating strength gain, calcium chloride causes an increase in drying shrinkage, potential reinforcement corrosion, discoloration, and scaling potential. Calcium chloride should be added to the concrete mix in solution form as part of the mixing water. If added to the concrete in dry form, all of the dry particles may not be completely dissolved during mixing. Un-dissolved lumps in the mix can cause pop-outs of dark spots in the hardened concrete. The amount of accelerator used should not exceed 2 percent by weight of cement.

COMPUTING CONCRETE VOLUME: To compute the volume of concrete required for a concrete pad, multiply the length of the pad by its width times its depth to get cubic feet (L x W x D); for example, a concrete pad is 20 feet in length by 30 feet in width and has a depth of 3 inches. First, convert the 3 inches into feet by dividing 3 by 12 to get 0.25 foot. Next, multiply the 20-foot length by the 30-foot width to get 600. Finally, multiply the 600 by 0.25 to determine the volume of concrete required for the pad which, in this case, is 150 cubic feet. Concrete is ordered and produced in quantities of cubic yards. To calculate the number of cubic yards required for the pad, divide the cubic feet of the pad by 27. This is required because there is 27 cubic feet in 1 cubic yard.

Therefore, the concrete pad described in the previous paragraph, which has a volume of 150 cubic feet, requires 5.56 cubic yards of concrete: 150 cubic feet divided by 27 = 5.56 cubic yards. Concrete projects often present varying degrees of difficulty; therefore, extra concrete is required to compensate for these difficulties. Once the total number of cubic yards of concrete is computed, add a little extra, normally 10 percent, to compensate for waste. To calculate the excess needed, multiply the cubic yards by .10 (10 percent). In the above case, multiply 5.56 cubic yards by .10 to get 0.556 cubic yards. Add the 0.556 cubic yards to the 5.56 cubic yards for a total of 6.116 or 6.12 cubic yards required for the concrete pad.

BATCHING CONCRETE: Batching is the process of weighing or volumetricall y measuring and introducing into a mixer the ingredients for a batch of concrete. To produce a uniform quality concrete mix, measure the ingredients accurately for each batch. Most concrete specifications require that the batching be performed by weight, rathcr than by volume, because of inaccuracies in measuring aggregate, especially damp aggregate. Water and liquid air-entraining admixtures can be measured accurate]y by either weight or volume. Batching by using weight provides greater accuracy and avoids problems created by bulking of damp sand. Volumetric batching is used for concrete mixed in a continuous mixer, and the mobile concrete mixer (crete mobile) where weighing facilities are not at hand. Specifications generally require that materials be measured in individual batches within the following percentages of accuracy: cement 1%, aggregate 2%, water 1%, and air-entraining admixtures 3%. Equipment within the plant should be capable of measuring quantities within these tolerances for the smallest to the largest batch of concrete produced. The accuracy of the batching equipment must be checked and adjusted when necessary.

MIXING CONCRETE: Concrete should be mixed until it is uniform in appearance and all the ingredients are evenly distributed. Mixers should not be loaded above their rated capacities and should be operated at approximately the speeds for which they were designed. If the blades of the mixer become worn or coated with hardened concrete, the mixing action will be less efficient. Worn blades should be replaced and the hardened concrete removed periodically, preferably after each production of concrete. When a transit mixer (TM) (fig. 7-1) is used for mixing concrete, 70 to 100 revolutions of the drum at the rate of rotation designated by the manufacturer as mixing speed are usually required to produce the specified uniformity. No more than 100 revolutions at mixing speed should be used. All revolutions after 100 should be at a rate of rotation designated by the manufacturer as agitating speed. Agitating speed is usually about 2 to 6 revolutions per minute, and mixing speed is generally about 6 to 18 revolutions per minute. Mixing for long periods of time at high speeds, about 1 or more hours, can result in concrete strength loss, temperature rise, excessive loss of entrained air, and accelerated slump loss. Concrete mixed in a transit mixer should be delivered and discharged within 1 1/2 hours or before the drum has revolved 300 times after the introduction of water to cement and aggregates or the cement to the aggregates. Mixers and agitators should always be operated within the limits of the volume and speed of rotation designated by the equipment manufacturer. Overmixing Concrete

OVERMIXING: Overmixing concrete damages the quality of the concrete, tends to grind the aggregate into smaller pieces, increases the temperature of the mix, lowers the slump, decreases air entrainment, and decreases the strength of the concrete. Also, overmixing puts needless wear on the drum and blades of the transit mixer. To select the best mixing speed for a load of concrete, estimate the travel time to the project (in minutes) and divide this into the minimum desired number of revolutions at mixing speed-70. The results will be the best drum speed; for instance, if the haul is 10 minutes, 70 divided by 10 equals 7. With this drum speed, the load will arrive on the jobsite with exactly 70 turns at mixing speed, with no overmixing of the concrete mix and no unnecessary wear on the equipment. If the concrete cannot be discharged immediately, the operator should turn the drum at the minimum agitating speed of 2 revolutions per minute.

When the transit mixer arrives at the project having used the minimum amount of mixing turns, the operator is able, if necessary, to delay discharging the concrete. Delay is limited by the maximum of 300 rotations allowed.