ECOMATERIAL TECHNOLOGIES
A CRH COMPANY

TECHNICAL BULLETIN

Fly Ash

Improves Workability

Blemishes in concrete, typically called rock pockets, are indicative of concrete without suitable workability, even though the slump may be judged to be acceptable. Rock pockets indicate a separation of the paste from the coarse aggregate in the concrete mix. Concrete must be cohesive even at high slumps to maintain its homogeneous character and avoid segregation and costly rock pockets. Fly ash offers this feature without extra cost.

Though it is never specified, workability is one of the most critical characteristics of concrete. Workability refers to the ease of handling, placing and finishing of fresh or "plastic" concrete. Use of fly ash can greatly enhance workability.

REDUCED WATER OF CONVENIENCE

Approximately 25 pounds (three gallons) of water are normally required to hydrate 100 pounds of cement[1]. A normal concrete mix will generally contain twice the required amount of water to hydrate the cement – enough to facilitate handling and placing of the concrete. This additional water, called "water of convenience", increases slump but at the cost of decreased cohesiveness. Water of convenience is reduced when fly ash is added to the mix because the plasticizing action results in a 2% to 10% water reduction in the plastic concrete to produce the same level of slump as plain concrete. Reduced water of convenience at the same level of slump makes for more cohesive concrete and decreases the occurrence of costly segregation.

GREATER CONSOLIDATION

Fly ash concrete is actually more workable than plain cement concrete at equivalent slump. The VEBE test measures the time and energy necessary for consolidation of concrete under vibration. Figure 1 shows the

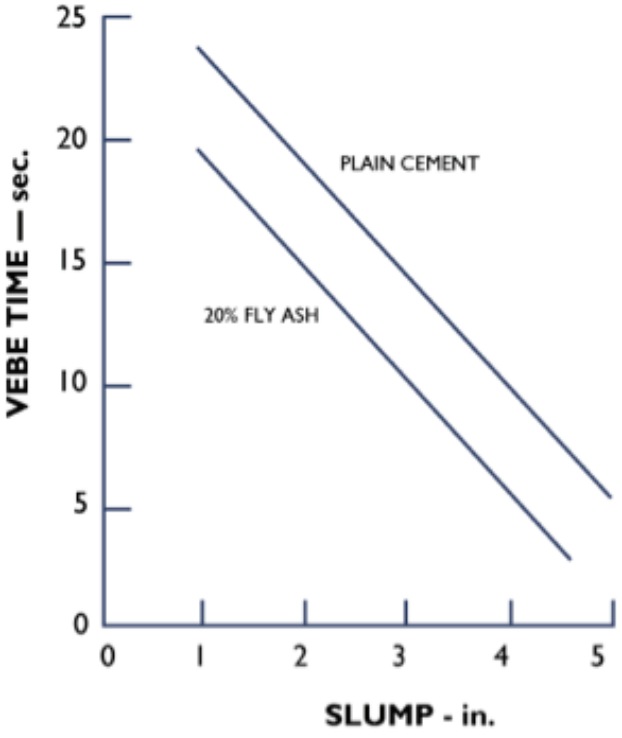

Figure 1: Typical VEBE Time vs Slump

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remarkable difference in time and energy required for consolidation of plain and fly ash concretes.

Great benefits can be obtained when using more completely consolidating fly ash concrete in areas of difficult placement where rock pockets and other placing defects often occur. Engineers understand the effectiveness of using fly ash concrete in tall thin walls, such as those used in water tanks. They know they have a better chance of getting the dense, void-free concrete they have specified when fly ash is included in the mix.

PASTE VOLUME INCREASES

The specific gravity of fly ash is lighter than cement. When replacing fly ash on a pound for pound basis, the result is a greater solid volume of cementitious fines. Proportioning concrete mixtures with only water-reducing admixtures results in a greatly diminished volume of cementitious fines. In effect, this amounts to taking cement out of the mix and replacing it with sand and gravel. The strengths may be acceptable, but the workability may not be. Proportioning performance concrete with fly ash virtually guarantees a greater solid volume of cementitious materials, which in itself helps promote cohesiveness and workability. Cementitious fines are very important to the contractor who finishes flatwork. These fines are necessary to allow proper leveling, sealing, and densification of the surface. Fly ash spheres help ease the contractor's job by lubricating the surface, making it much easier and faster to finish the job.

In lean mixes, or where aggregates are deficient in fines, an increase in the volume of paste and an improvement in consistency will be advantageous for workability and may also increase strength by allowing more complete compaction.[2]

ECONOMICAL MIXTURE

Pound for pound, no other solid material improves the workability, strength, and other properties of a concrete mix like fly ash can, resulting in the most economical of mixtures. Placing and finishing concrete becomes easier because of the improved workability from the spherically shaped fly ash particles. Lower slump concrete can be placed more easily (and at lower water content) because of the plasticity provided by fly ash spheres. Segregation and bleeding are reduced because of the increased cohesiveness of fly ash concrete, so form finish and sharpness of detail are enhanced. And coarse, clean sands can be used in concretes utilizing fly ash and still have good workability.

For more information or answers to questions about the use of fly ash in specific applications, contact your nearest Eco Material Technologies Technical Sales Representative or call 1-770-684-0102.

1 Highway Research Board, Bulletin 284, "Fly Ash in Concrete", January 1960, p. 27.
2 Central Electricity Generating Board, "Application of PFA in Concrete and Cement", RIBA Products Data, London, March 1982

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