ADDITIVES AND ADMIXTURES PART-2

AIR-ENTRAINING AGENTS

Air-entraining agents also known as pore-forming agents are compounds that entrain microscopic air bubbles in cement compositions, which then harden into concrete having microscopic air voids.

Air entrainment is the process of intentionally creating the tiny air bubbles in concrete. Minute spherical bubbles of size ranging from 5 microns to 80 microns distributed evenly in the entire mass of concrete. These incorporated millions of non-coalescing air bubbles, which will act as flexible ball bearings and will modify the properties of plastic concrete regarding workability, segregation, bleeding and finishing quality of concrete.

It also modifies the properties of hardened concrete regarding its resistance to frost action and permeability.

This is one of the important advancements made in concrete technology was the discovery of air entrained concrete

Where these air entraining agents are used?

The primary use of air-entraining concrete is for **freeze-thaw** resistance.

Freeze-thaw occurs when water continually seeps into cracks, freezes and expands, eventually breaking the rock apart.

Another related use is for deicer scaling resistance. Air-entraining admixtures cause small stable bubbles of air to form uniformly through a concrete mix. The benefits of entraining air in the concrete include increased resistance to freeze-thaw degradation, increased cohesion (resulting in less bleed and segregation) and improved compaction in low-workability mixes.

The following types of air entraining agents are used for making air entrained concrete.

1. Natural wood resins
2. Animal and vegetable fats and oils, such as tallow, olive oil and their fatty acids such as stearic and oleic acids.
3. Various wetting agents such as alkali salts or sulphated and sulphonated organic compounds.
4. Water soluble soaps of resin acids, and animal and vegetable fatty acids.
5. Miscellaneous materials such as the sodium salts of petroleum sulphonic acids, hydrogen peroxide and aluminium powder, etc.
6. Vinsol resin and Darex are the most important air-entraining agents.

The effects of Air entrainment agents on the properties of concrete are as given below:

1. It Increases the resistance to freezing and thawing.
2. It improves the workability.
3. Reduction in strength.
4. Reduces the tendencies of segregation.
5. Reduces the bleeding and laitance.
6. Decreases the permeability.
7. Increases the resistance to chemical attack.
8. Permits reduction in sand content.
9. Improves place ability, and early finishing.
10. Reduces the cement content, cost, and heat of hydration.
11. Reduces the unit weight.
12. Permits reduction in water content.
13. Reduces the alkali-aggregate reaction.
14. Reduces the modulus of elasticity.

HARDNERS

Concrete is hard, but not always hard enough. Some concrete floors wear out before their time. To make them last longer, there are wide range of products are available in the market like dry-shake hardeners, sealers, and concrete admixtures that can be mixed with concrete as Hardeners.

A hardener is a component of certain types of mixtures. In some mixtures a hardener is used simply to increase the resilience of the mixture once it sets. In other mixtures a hardener is used as a curing component. A hardener can be either a reactant or a catalyst in the chemical reaction that occurs during the mixing process.

A hardener may also be known as an accelerator. Hardeners are almost always necessary to make an epoxy resin useful for its intended purpose. Without a hardener, epoxies do not achieve anywhere near the impressive mechanical and chemical properties that they would with the hardener. The correct type of hardener must be selected to ensure the epoxy mixture will meet the requirements of the application. Research should always be done on both the resin and the hardener to make sure the final epoxy mixture will perform satisfactorily. Common examples of epoxy hardeners are anhydride-based, amine-based, polyamide, aliphatic and cycloaliphatic.

Hardeners are used to cure epoxy resins. However, simply adding a hardener to an epoxy resin may not cause the epoxy mixture to cure quickly enough. If this is the case a different hardener may be required. Also, hardeners with certain additives can be used. These hardener additives serve as catalysts that speed up the curing process.

What is workability and factors affecting workability?

Workability is a property of raw or fresh concrete mixture. In simple words, workability means the ease of placement and workable concrete means the concrete which can be placed

and can be compacted easily without any segregation. The desired workability is not same for all types of concrete.

The workability of concrete can be increased by the following ways:

1. Increase water/cement ratio.
2. Increase size of aggregate.
3. Use well-rounded and smooth aggregate instead of irregular shape.
4. Increase the mixing time.
5. Increase the mixing temperature.
6. Use non-porous and saturated aggregate.
7. With addition of air-entraining mixtures.

Factors affecting the workability of concrete are materials such as water content, cement concrete, sand and aggregate properties such as size, shape, grading, mix design ratio and use of admixtures. Each and every process and the materials used in concrete mixing affects the workability of concrete.

The various factors that affect the Workability of Concrete are as Given Below:

1. Water Content of the Concrete Mix
2. The Size of Aggregates
3. The shape of Aggregates
4. Surface Texture of Aggregates
5. The Porosity of Aggregates
6. Grading of Aggregates
7. Uses of Concrete Admixtures
8. Ambient Temperature

WORKABILITY AGENTS

Workability is one of the most important characteristics of concrete especially in the following cases:

1. If the concrete is to be placed around closely placed reinforcement or in difficulty accessible sections.
2. Where special means of placement are required such as tremie, chute or pumping methods.
3. If the concrete is harsh because of aggregate characteristics or grading

The various materials used as workability agents are:

1. Finely divided material
2. Water reducing agents
3. Air entraining agents
4. Common materials added as workability agents are bentonite clay, diatomaceous earth, fly ash, finely divided silica, hydrated lime and talc
5. When they are added and if the quantity of water is not reduced they greatly increase the workability.

FLY ASH

Fly ash is finely divided residue resulting from the combustion of powdered coal and transported by the flue gases and collected by the process of

- Electrostatic
- Precipitator

Fly ash is the most widely used pozzolanic material all over the world.

Class F

Fly ash normally produced by burning anthracite or bituminous coal, usually has less than 5% CaO. Class F fly ash has pozzolanic properties only.

Class C

Fly ash normally produced by burning lignite or sub-bituminous coal. Some class C fly ash may have CaO content in excess of 10%. In addition to pozzolanic properties, class C fly ash also possesses cementetous properties.

Effects of Fly Ash on Hardened Concrete

This Contributes to the strength of concrete due to its pozzolanic reactivity. Continued pozzolanic reactivity concrete develops greater strength at later age not at initial stage. It contributes to making the texture of concrete dense, resulting in decrease of water permeability and gas permeability.

Fly Ash is used in the concrete as admixtures in the following:

1. Many high-rise buildings
2. Industrial structures
3. Water front structures
4. Concrete roads
5. Roller compacted concrete dams.

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