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ADVANCES IN CONCRETE TECHNOLOGY

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ABSTRACT:

Concrete is the only binding material which is used from ages till now. But we did not find any kind of material which replaces it. Since it is a mixture of Cement, Aggregates and Water in a required or calculated ratio. But advances in concrete technology includes the properties of concrete such as Workability, Strength, and Durability and so on. But this present scenario describes about Advances in Concrete Technology such as Admixtures, Plasticizers, Super plasticizers, Retarders. The usage of these materials has become a lift for Structural Engineers to bring down big constructions in usage in a smaller time. But in general, Advances in Concrete Technology deals with increase in Strength and Durability of Concrete and increasing Workability to required time. So, the present paper deals with Advances in Concrete Technology and their impacts on structures building by using them.

Introduction:

Concrete is a mixture of Cement, Aggregates and Water. Cement is most important material in Concrete. An aggregate consumes about 70% - 80% of volume of Concrete. Water is used to bind the above materials and to give some Workability. Cement is main and most important material in Concrete. It is a mixture of Calcareous Materials and Argillaceous Materials. These materials can be mixed in presence of water and also in absence of water. Wet Process means mixing of raw materials used for cement in presence of Water and Dry Process means mixing them even in presence of water but not as much as Wet Process. After completion of all above processes, we get Cement in a bag of 50 kgs.

An aggregate includes Fine Aggregates and Coarsed Aggregates. Fine Aggregates includes Sand and Coarsed Aggregates includes Gravels. The above diagram shows different types of Aggregates such as Rounded, Flaky and Irregular Shapes of Aggregates. Aggregates also have some strength.

Properties:

The main properties of Concrete are Workability, Strength, Durability, Elasticity, Creep and Shrinkage. The advances in Concrete Technology mean increase in Strength, Workability and Durability of Concrete.

Types of Concrete:

There are different types of Concrete. Some of them are:

- Fresh Concrete
- Hardened Concrete
- Special Concrete
- Light – Weight Concrete
- Fiber Reinforced Concrete

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- Reinforced Cement Concrete
- High Density Concrete
- Self Compacting Concrete(SCC)

Fresh Concrete is such concrete in which Concrete is in plastic state. Hardened Concrete is next to Fresh type of Concrete means it gains 90% more strength than Fresh Concrete. Each of the above concrete's has their own uses and their own applications and their properties unique to them.

Advances in CT:

The main advances in CT deals with action of:

- Plasticizers,
- Super plasticizers,
- Retarders,
- Accelerators,
- Air – entraining admixtures,
- Puzzolanic Admixtures,
- Damp – proofing Admixtures,
- Gas forming Admixtures,
- Workability Admixtures,
- Bonding Admixtures,
- Colouring Admixtures and
- Corrosion Inhibiting Admixtures.

Not only these, but these also includes Construction Chemicals such as:

- Concrete Curing Compounds,
- Mould Releasing Agents,
- Non – shrink high Strength Grout,
- Surface Retarders,
- Ready to use Plaster,
- Guniting Aid and
- Protective Coatings.

The above mentioned Compounds are useful in not only increasing Strength, Durability and Workability of Concrete but they are also useful in giving protection to concrete, creates bonds between the materials of concrete, and gives attractive colours to concrete and also they reduce water to a great extent which is a severe crisis in now – a – days.

In past times, while construction of bridges, they construct piers to support bridges which are to be constructed in a deep way below the water level in Sea or River. That was a serious problem at those times. Since, some of problems such as:

- At such great depths, temperature will be high and concrete can loose moisture at those depths, and it sets from that point.
- Transportation of Concrete to such great depths is also a problem with help of pulleys etc…
- Not only in depths, but when tallest buildings are constructed concrete is to be transported to top most floor of building which has to take place with in 5 minutes, since the initial setting time of OPC is 5 min.

From that point of view, some of experts observed the properties of Concrete, and they gave some formulae for initial and final setting time of concrete, from which concrete can be made to gain early strength and also at the same time to gain strength even after 30 min. So, this can be said as ADVANCES IN CONCRETE TECHNOLOGY.

Explanation of Compounds:

Action of Plasticizers:

1. These are Water Reducers.
2. In general, the water – cement ratio of concrete is 0.40, but when these are used they reduce w/c ratio to 5% to 15%.
3. The reduction of w/c ratio naturally increases Strength of Concrete.
4. These are composition of lignosulphonates, salts of sulphonates hydrocarbons.

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5. They contain nonionic surfactants such as polyglycol esters, acid of hydroxylated carboxylic acids.
6. Efficient Plasticizer is one which does not cause air – entrainment in concrete more than 1% - 2%.
7. Dispersion Effect and Retarding Effects are main actions of Plasticizers.

Action of Super plasticizers:

1) These are High Range Water Reducers.
2) Their use was developed in Japan and Germany in 1960 and 1970.
3) Usage of Super plasticizers reduces the w/c ratio unto 30% without reducing workability.
4) They reduce w/c ratio to 0.25 or even more.
5) They can produce more workable concrete at same w/c ratio.
6) For same workability, they produce usage of lower w/c ratio.
7) It also permits reduction on Cement Content too…

Action of Retarders:

a) They are also called as Retarding Plasticizers.
b) Retarders are mixed with plasticizers to form Retarding Plasticizers for commercial purposes.
c) These are used in RMC for retaining the slump loss during high temperature, long transportation, to avoid construction or cold joints.

Action of Accelerators:

a. Accelerators are also mixed with plasticizers.
b. They are added to concrete to increase the rate of early strength development.
c. They permit early removal of formwork.
d. They reduce required period of curing.
e. They advance the time that a structure can be placed in service.
f. They are used in emergency repair work.

Action of Air – entraining Admixtures:

I. One of the most important advancements made in concrete technology was the discovery of air entrained concrete.
II. Air entraining agents are considered as FIFTH INGREDIENT in concrete making.
III. They occupy 85% of concrete manufactured in America contains one or other type of air entraining agent.
IV. Entrained air and Entrapped air are different groups in Air entraining admixtures.
V. Natural wood resins, animal and vegetable oils, alkali salts, resin acids, sodium salts of petroleum sulphonic acids are types of air entraining admixtures.

Action of Mineral Admixtures:

i. These are also called as Puzzolanic materials.
ii. Puzzolona addition in concrete improves increases the water tightness, reduce the alkali aggregate reaction, and improves extensibility, workability and lower costs.
iii. Puzzolanic materials are siliceous or siliceous and aluminous materials with out cementitious values.
iv. Clay and Shales, Opalinc Cherts are Natural Puzzolonas.
v. Fly ashes, Rice Husk ash, Surkhi are Artificial Puzzolonas.

Action of DP and WP Admixtures:

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A. Important requirement of concrete is that it should be impervious to water when subjected to pressure of water on one side and
B. Absorption of surface water by capillary action.
C. Vegetable oils, fats, waxes are some kind of water proofing admixtures.
D. Calcium or Ammonium stearate or oleate will mainly act as water repelling materials.
E. Butyl Stearate is superior to soap as water repellent material in concrete.

Action of Gas Forming Agents:

a. A gas forming agent is a chemical admixture such as aluminium powder.
b. It reacts with the hydroxide produced in hydration of cement to produce minute bubbles of hydrogen gas.
c. Action of Aluminium powder causes a slight expansion in plastic concrete or mortar and this reduces settlement.

Action of Workability Agents:

1. Workability is most important characteristic of concrete.
2. Finely divided materials, plasticizers, super plasticizers, air entraining agents are used as workability agents.
3. The property of concrete which is placed and compacted 100% without air voids is called Workability.

Action of Bonding Agents:

1. These are water emulsions of several organic materials that are used to grout for application to an old concrete surface just prior to patching.
2. Natural Rubber, Synthetic Rubber, Poly vinyl Chloride are Bonding Agents.
3. They are added to 5 to 20% of weight of cement.

Action of Colouring Admixtures:

The requirements of suitable admixtures include:

Colour fastness when exposed to sunlight,
Chemical stability in presence of alkalinity produced in set cement,
No adverse effect on setting time and strength.

They are used to give attractive colours and even pleasant colours.
They are used in RMC to arrest possible cracks and craziness in floor.

Action of Corrosion Inhibiting Agents:

1. The problem of corrosion of reinforcement is universal problem.
2. Sodium Benzoate was used as Corrosion Inhibiting Agents.
3. 2% of Sodium Benzoate is used in water.
4. Calcium Lignosulphate decreased rate of corrosion of steel in concrete.

Effect of Compounds on Properties of Concrete:

Workability:

- Generally, concrete is to have more workability, if water content in concrete is reduced, usually its workability is lost which is not good
- So, in such cases, we use plasticizer which not only reduces water content in w/c ratio up to 15% of original content but also increases workability even with that less quantity of water.
- Super plasticizers, they even reduce water content up to 30%, which is double of plasticizers. So, it is mostly

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used in many constructions where water scarcity is a big problem.

- OPC sets at a time of even 5 minutes, which is not wanted in many number of constructions. So to retard the initial setting time, some of compounds such as Retarders are used. The main use of them is to retard the Initial Setting Time of concrete.
- Accelerators are also used to accelerate Initial and also Final Setting Time of Concrete.
- Air entraining admixtures are very important in concrete, so, they are considered as Fifth Ingredient in Concrete
- Workability agents are mainly useful to give better workability for concretes.
- Bonding agents are mainly used to bring a good bond between components of concrete.
- Colouring and Corrosion Inhibiting Admixtures are mainly useful to give pleasant colours and also to reduce corrosion effects on Reinforcements in Concrete.

On Strength:

- Plasticizers not only reduces w/c ratio but also gives good strength.
- Super plasticizers are not only high range water reducers they also give more strength than general w/c ratio concrete.
- Accelerators are mainly used to get Early Strength of Concrete.
- Retarders are also useful to gain strength but in late time.
- Air entraining admixtures are mainly considered as Fifth Ingredient in Concrete, so it also gives good strength to concrete.
- Mineral admixtures are Puzzolanic materials which includes Fly ash, Rice Husk which are presently used in Constructions as they give good strength.
- The better the workability of concrete, the better the strength of concrete, so workability agents play role in improving strength of concrete.
- Without proper bond between the components of concrete, the concrete cannot with stand loads, to give more strength Bonding Agents are necessary to be used.
- Colouring admixtures does not give any strength to concrete but they can give pleasant colours to concrete.
- Corrosion inhibiting agents are useful in preventing corrosion to reinforcements in concrete.
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On Durability:

- As strength increases, durability also increases. So all the above discussed compounds have good durability as far as they are used in a limited and in calculated manner.
- Though, plasticizers affect PVC coatings, but not so much, but these play a vital role in improving strength, durability and workability of concrete.

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Uses:

- While constructing bridges, piers supporting bridges must be strong enough to support and carry loads coming on to it**.**
- So, to have better workability and strength, we use some of compounds such as Plasticizers, Super plasticizers, Accelerators, Retarders.
- Piers are to constructed inside water. If any concrete structure is placed in water, it collapses.
- To prevent such collapses, we use ACCELERATORS, which are wonderful invention in Civil Engineering.
- Accelerators, they accelerate the initial setting time of concrete to 1 to 1.5 minutes. So, as if pour concrete inside piers, the concrete starts to set inside the hollow columns and pier is constructed inside water.
- If the construction is done at a business site, it is almost impossible to mix concrete at site itself.
- So, we have to transport concrete from manufacturing industries.
- As they travel from industries to site, the concrete may set. So to retard the setting time of concrete, Retarders are used.
- Not only in such cases, when concrete is to be sent at very lower depths, at about, 600 – 700 feet below, they due to heat evolving there, concrete may loose water and they may set.
- To prevent Initial Setting time, we use Retarders.
- To have a good bond between components of concrete, we use Bonding Agents.
- To give pleasant Colour to concrete, we add colouring agents.
- To give good strength, reinforcements should not be corroded. To prevent that, we use corrosion inhibiting agents.
- To have better workability, we use workability agents which are used in many cases such as construction of underground works, piers.
- Concrete Curing Compounds,

Mould Releasing Agents, Non – shrink high Strength Grout, Surface Retarders,

Ready to use Plaster, Guniting Aid are Protective Coatings are many types of construction chemicals which are used at construction site which give better workability and also prevent cracks and problems coming in future.

These are some of constructions built by using above mentioned compound

Conclusion:

There is no particular conclusion for Advances in Concrete Technology, since technology is increasing day by day.

But as Civil Engineers we have to concentrate on Economy and Durability of Structures.

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