

Effect of pozzolanas on fiber Reinforced concrete

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Abstract: High-performance concrete is defined as concrete that meets special combinations of performance and uniformity requirements that cannot always be achieved routinely using conventional constituents and normal mixing, placing, and curing practices. Ever since the term high-performance concrete was introduced into the industry, it had widely used in large-scale concrete construction that demands high strength, high flow ability, and high durability. A high-strength concrete is always a high-performance concrete, but a high-performance concrete is not always a high-strength concrete. Durable concrete Specifying a high-strength concrete does not ensure that a durable concrete will be achieved. It is very difficult to get a product which simultaneously fulfils all of the properties. So the different pozzolanic materials like Ground Granulated Blast furnace Slag (GGBS), silica fume, Rice husk ash, Fly ash, High Reactive Metakaolin, are some of the pozzolanic materials which can be used in concrete as partial replacement of cement, which are very essential ingredients to produce high performance concrete. So we have performed XRD tests of these above mentioned materials to know the variation of different constituent within it. Also it is very important to maintain the water cement ratio within the minimal range, for that we have to use the water reducing admixture i.e super plasticizer, which plays an important role for the production of high performance concrete. So we herein the project has tested on different materials like rice husk ash, Ground granulated blast furnace slag, silica fume to obtain the desired needs. Also X-ray diffraction test was conducted on different pozzolanic material used to analyse their content ingredients. We used synthetic fiber (i.e Recron fibre) in different percentage i.e 0.0%, 0.1%, 0.2%, 0.3% to that of total weight of concrete and casting was done. Finally we used different percentage of silica fume with the replacement of cement keeping constant fiber content and concrete was casted. In our study it was used two types of cement, Portland slag cement and ordinary Portland cement. We prepared mortar, cubes, cylinder, prism and finally compressive test, splitting test, flexural test are conducted. Finally porosity and permeability test conducted. Also to obtain such performances that cannot be obtained from conventional concrete and by the current method, a large number of trial mixes are required to select the desired combination of materials that meets special performance.

I. HIGH PERFORMANCE CONCRETE

"High-Performance Concrete" has been introduced into the construction industry. The American Concrete Institute (ACI) defines high-performance concrete as concrete meeting special combinations of performance and uniformity requirements that cannot always be achieved routinely when using conventional constituents and normal mixing, placing and curing practices. The specification of high-strength concrete generally results in a true performance specification

in which the performance is specified for the intended application, and the performance can be measured using a well-accepted standard test procedure. The same is not always true for a concrete whose primary requirement is durability.

Salient Features of HPC:

- High Compressive strength
- Low water-binder ratio
- Reduced flocculation of cement grains
- Wide range of grain sizes
- Densified cement paste
- No bleeding homogeneous mix
- Less capillary porosity

II. High Strength Concrete: High-strength concrete

Columns can hold more weight and therefore be made slimmer than regular strength concrete columns, which allows for more useable space, especially in the lower floors of buildings. High-strength concrete is specified where reduced weight is important or where architectural considerations call for small support elements. By carrying loads more efficiently than normal-strength concrete, high-strength concrete also reduces the total amount of material placed and lower the overall cost of the structure.

There is special method of making high strength concrete such that:

- Seeding
- Revibration
- High speed slurry mixing
- Use of admixtures
- Inhibition of cracks
- Sulphur impregnation
- Use of cementitious aggregate

III. REVIEW OF LITERATURE:

As our aim is to develop concrete which does not only concern on the strength of concrete, it also having many other aspects to be satisfied like less porous, capillary absorption, durability. So for this we need to go for the addition of pozzolanic materials along with superplasticizer with having low water cement ratio

Earlier researches: Ismail and waliuddin[5] (1996) had worked on effect of rice husk ash on high strength concrete. They studied the effect of rice husk ash (RHA) passing 200 and 325 micron sieves with 10-30% replacement of cement on the strength of HSC. The RHA was obtained by burning rice husk, an agro-waste material which is abundantly available in

the developing countries. A total of 200 test specimens casted and tested at 3,7,28 and 150 days. Compressive and split tensile strengths of the test specimens. Cube strength over 70 MPa was obtained without any replacement of cement by RHA. Test results indicated that strength of HSC decreased when cement was partially replaced by RHA for maintaining same level of workability. They observed that optimum replacement of cement by RHA was 10-20%, and even from crystalline form of RHA good result may be obtained by fine grinding. De Sensale[6] (2006) studied on strength development of concrete using rice husk ash. This paper presents a study on the development of compressive strength up to 91 days of concretes with rice-husk ash (RHA), in which residual RHA from a rice paddy milling industry in Uruguay and RHA produced by controlled incineration from the USA were used for comparison. Two different replacement percentages of cement by RHA, 10% and 20%, and three different water/cementitious material ratios (0.50, 0.40 and 0.32), were used. The results are compared with those of the concrete without RHA, with splitting tensile strength and air permeability. It is concluded that residual RHA provides a positive effect on the compressive strength at early ages, but the long term behavior of the concretes with RHA produced by controlled incineration was more significant. Results of splitting tensile and air permeability reveal the significance of the filler and pozzolanic effect for the concretes with residual RHA and RHA produced by controlled incineration. Oner A and Akyuz S [7] (2007) studied on optimum level of ground granulated blast furnace slag (GGBS) on compressive strength of concrete. In their study GGBS was added according to the partial replacement method in all mixtures. A total of 32 mixtures were prepared in four groups according to their binder content. Eight mixes were prepared as control mixtures with 175, 210, 245 and 280 kg/m³ cement content in order to calculate the Bolomey and Feret coefficients (KB, KF). For each group 175, 210, 245 and 280 kg/m³ dosages.

III RICE HUSK ASH:

Rice husk ash is obtained by burning rice husk in a controlled manner without causing environmental pollution. When it is properly burnt it has high SiO₂ content and can be used as a concrete admixture. Rice husk ash exhibits high pozzolanic characteristics and contributes to high strength and high impermeability of concrete. Rice husk ash essentially consists of amorphous or non crystalline silica with about 85- 90% cellular particle, 5% carbon and 2% K₂O. The specific surface of RHA is between 40000-100000 m²/kg. India produces about 122 million ton of paddy every day. Each ton of paddy produces about 40 kg of RHA. There is a good potential to make use of RHA as a valuable pozzolanic material to give almost the same properties as that of microsilica. In USA highly pozzolanic rice husk ash is patented under the trade name of Agrosilica and is marketed. It is having superpozzolanic property when used in small quantity i.e. 10% by weight of cement and it greatly enhances the workability and impermeability of concrete.

Advantage of Rice husk ash: Even with small dosages, for instance 10 percent by weight of cement rice husk ash can produce a very strong transition zone and very low permeability rating in concrete mixtures. In the cement having large size particles introduction of rice husk ash particles, which are micro porous blocks the channels of flow and internal pore of concrete improves. The major advantage of rice husk ash and silica fume is that they are very strong absorbents of sodium, potassium and other ions which are good conductors of electricity. A highly durable concrete with little or no corrosion in a server environment can be obtained by improving the electrical resistivity of concrete by adding rice husk ash or silica fume.

SILICA FUME: Silica fume also referred as microsilica or condensed silica fume is another material that is used as an artificial pozzolanic admixture. It is a product resulting from reduction of high purity quartz with coal in an electric arc furnace in the manufacture of silicon or ferrosilicon alloy. The use of silica fume in conjunction with superplasticizer has been back bone of modern high performance concrete.

- Ground granulated blast furnace slag
- Rice husk ash
- Fly ash

2) Chemical admixture:

- Accelerating admixture
- Retarding admixture
- Water-reducing admixture

CEMENT: Cement is a material that has cohesive and adhesive properties in the presence of water. Such cements are called hydraulic cements. These consist primarily of silicates and aluminates of lime obtained from limestone and clay. There are different types of cement; out of that I have used two types i.e,

- Ordinary Portland cement
- Portland slag cement

Ordinary port land cement (OPC) is the basic Portland cement and is best suited for use in general concrete construction. It is of three types, 33 grades, 43 grades, 53 grades. One of the important benefits is the faster rate of development of strength. **Portland slag cement** is obtained by mixing Portland cement clinker, gypsum and granulated blast furnace slag in suitable proportion and grinding the mixture to get a thorough and intimate mixture between the constituents. This type of cement can be used for all purposes just like OPC. It has lower heat of evolution and is more durable and can be used in mass concrete production. **AGGREGATE:** Aggregate properties greatly influence the behaviour of concrete, since they occupy about 80% of the total volume of concrete. The aggregate are classified as

- Fine aggregate
- Coarse aggregate

Fine aggregate are material passing through an IS sieve that is less than 4.75mm gauge beyond which they are known as

coarse aggregate. Coarse aggregate form the main matrix of the concrete, where as fine aggregate form the filler matrix between the coarse aggregate. The most important function of the fine aggregate is to provide workability and uniformity in the mixture. The fine aggregate also helps the cement paste to hold the coarse aggregate particle in suspension. coarse aggregate maximum 20 mm coarse aggregate is suitable for concrete work. But where there is no restriction 40 mm or large size may be permitted. In case of close reinforcement 10mm size also used.

FIBER: In recent years, several studies have been conducted to investigate the flexural strengthening of reinforced concrete (RC) members with fiber reinforced composite fabrics. Recently, the use of high strength fiber-reinforced polymer (FRP) materials has gained acceptance as structural reinforcement for concrete. In this composite material, short discrete fibers are randomly distributed throughout the concrete mass. The behavioral efficiency of this composite material is far superior to that of plain concrete and many other construction materials of same cost. Due to this benefit, the use of FRC has steadily increased during last two decades and its current field of application includes airport and highway pavements, earthquake resistant and explosive resistant structures, mines and tunnel linings, bridge deck overlays, hydraulic structures, rock slope stabilization. Extensive research work on FRC has established that the addition of various types of fibers such as steel, glass, synthetic and carbon, in plain concrete improves strength, toughness, ductility, and post cracking resistance etc.

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