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Fiber Reinforced Eco Concrete

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Abstract: ***This paper presents the results of an experimental investigation on the mechanical properties of 16M (molar) and 14M (molar) Concentrations of different binder composition of Ecopolymer concrete (EPC) and also we make study on analysis and design of Recorn-3s polypropylene fibers in 16M, 14M. By conducting test on mechanical properties of concrete such as Compressive, Split tensile and Flexural strength on hardened Eco Polymer Concrete. Binder composition can be prepared with the Alkaline liquid to Fly ash ratio by Mass Ratio as 0.30 for different mix ids of M1, M2, M3, M4, M5, and M6. We added The Recorn-3s polypropylene fiber to these Mix ids in various proportions of 0.03% and 0.06% based on volume of concrete. In this EPC consisting of total replacement of Cement with Fly ash. We tested the Structural properties of the specimens after exposing of Hot Air Oven curing temperature at 60^{o}c for 24 hours after completion of Gestation period of five days. Finally Obtained Values are compared with the Normal Portland Cement Concrete.***

Keywords: Fly ash, alkaline liquids, Recorn-3s, polypropelinefiber, Compressive strength, Split Strength, Flexural Strength.

1. Introduction

Now a Days there is enormous increase in the infrastructure development it shows the development of Country, It increases the demand for Cement as a construction material. In which it increases demand for Ordinary Portland cement (OPC).Cement is main Constituent in the preparation of ordinary Portland cement Concrete (OPCC). Production of cement involves in the high energy consumption of Coal, Natural Gas...Etc .Production of Cement involves in the significant amount of nonrenewable natural resources of limestone. For 1ton production of OPC liberate 1 ton of carbon dioxide into the atmosphere it also the one of reason for air pollution. To decrease the energy consumption of natural resource we choose for alternate binder to make concrete as same as that of normal concrete. By waste utilization of Fly ash which avoids pollution in Atmosphere. There are larger amounts of fly ash availability of all over the world which is the by product from thermal power plants. So it is the Best choice to utilization of Fly Ash mixed with the Alkaline Solutions which produce Concrete. Davidovits (1988) proposed that an alkaline liquid could be used to react with the Silicon &Aluminum as a source materials which are liberated as by products in Industries like Iron ore Processing units, Thermal Power plants ,materials like fly ash, Metacoline, Ground granulated blast furnace slag, Rice husk ash which are used in Ecopolymer Concrete.

B.Vijaya Rangan Proposed the mix design of Polymer concrete in this he stated that polymer binds the loose course and fine aggregate and other un reacted materials together to form EPC.EPC can be prepared with usual methods of concrete technology. Davidovits (1990)proposed that binders can be prepared with the polymeric reaction of alkaline liquids of sodium hydroxide and sodium silicate It Forms PolySilites type (-SI-O-AL-O) poly(sialate-siloxo) type (-SI-O-AL-O-SI-O) Poly (sialate – Disiloxo) type (-Si-O-Al-O-Si-O-) long chains will form in the Polymerization process. EPC attains high early strength, it is resistance to freeze &thaw resistance, it is also sulphate resistance and corrosion resistance..EPC possess strength and durability characteristics as same as that of normal portlandcement.EPC with reinforcement has high strength to that of Ordinary Portland cement. In EPC the Impact of stem curing on the strength properties for attaining of Strength Early days We use Steam Curing temperature as similar to Hot air Oven Temperature .For EPC we take fly ash which contain low calcium amount so that it possess excellent compressive strength and having low drying shrinkage and also low creep and more resistance to acid attacks form toxic gases .We Follow Current standards of code used for casting and testing .Ratios between Gel space ratio and solid ratios are influenced on densities ,if low voids are there strength improves. In Fiber Reinforced concrete is the new material improved to arrest micro cracks. Additions of Recorn -3s polypropylene fiber in Ecopolymer concrete in 0.03%and0.06% based on Volume of concrete. We absorbed there is a change in structural properties EPC. In Polymer Concrete there is less Water Consumption while in preparation and Curing.

2. Experimental Investigation

Materials: Materials used for Fiber Reinforce Eco concrete are ASTM low calcium class F fly ash, Alkaline Liquids, Coarse Aggregate, Fine Aggregate, Recorn-3SPolypropeline Fiber and Water.

Flyash: Fly ash is the By Product coming from the burning of coal it is collected on electro static precipitators from Thermal power stations.fly ash particles are spherical and in shape due this it absorbed less water. For this Experimental investigation we collected low calcium fly ash from RAICHUR thermal power Plant at Karnataka. Specific gravity of fly ash is 2.3.

Alkaline Liquids: A Mixture of Sodium hydroxide and sodium Silicate on ratio proportions we called it as Alkaline Activators. For Polymerization Process Sodium Hydroxide was taken commercially available in Pellets Form its purity is 99%. Sodium hydroxide solution can be prepared based

on Molarity. Sodium silicate is commercially available in the viscous liquid form its chemical composition it is Na_20-16%, Sio_2-30%and water -54%.

Aggregates: Aggregates taken are saturated surface dry condition. Maximum size of coarse aggregate are passed through 20mm sieve and retained on 12.5mm sieve and also retained on 10mm sieve. Coarse Aggregate having density 1450kg/mm3 and specific gravity of aggregate is 2.9.were used. Fine aggregate is clean river sand which is having no inorganic material, clay particles and dust in it .Fine aggregate passed through to 4.75mm sieve it is conforming to the Zone –II having the specific gravity of 2.6.

Polypropeline Fiber: Recorn -3s Polypropylene fibers spherical in shape which combines with the micro cracks developed in the concrete at hydration process. Due this it binds the concrete hardly and improves the strength.

Cement: Ordinary Portland cement of JSW43Grade were used having normal consistency of 27% and initial setting time of 21min and final setting time of 132 min is for the preparation of normal concrete.

2.1Mix Design of Ordinary Port Land Cement Concrete

Opc concrete can be Designed for M30 Grade Concrete as per ISCODE of IS 456-2000.Concrete can be prepared with the mixing of the water to the pan mixer and coarse, fine aggregate and cement of half off quantities mixed for one minute t and remaining quintiles mixed thoroughly for 2-minutes.check the workable properties of fresh concrete by using of slump test the slump values obtained are 168mm.After that concrete be placed in Moulds of 150x150x150mmand cylinders of 150x300mm,beam of 100x100x500mmprisms.placethem for one day and demould after that placed in water curing for 28days.

2.2 Mix Design of Polyropeline Fiber Reinforced Concrete

EPC can be designed for the ratio between fly ash to alkaline liquid was taken as 0.30.the ratio between the sodium hydroxide to sodium silicate was taken as 2.5.Following Design principles mix proportions and quantities obtained as follows.

Table1: Mix Proportions For Normal concrete.

Material Name	*Quantities For Kg/M^3.*
Cement	395
Water	158
Fine Aggregate	709
Coarse Aggregate	1195
Water/Cement Ratio	0.4
Super Plasticizer	4.0

Table 2: Mix Proportions for 16M& 14M Concrete

Material Name	*Quantities For Kg/M^3.*
Fly Ash	461
Fine Aggregate	540
Coarse Aggregate	1260
Sodium Hydroxide (Naoh)	40
Sodium Silicate (Na_2Sio_3)	100
Super plasticizer	4.61
Mix proportion	1:1.17:2.73

Table 3: Mix Portions for Recorn-3s Fiber for 16M and 16M.

Mix ID	*Mix Proportion*	*Quantities For Kg/M^3.*
M1	16M	--
M2	16M-0.03%	0.721
M3	16M-0.06%	1.443
M4	14M	--
M5	14M-0.03%	0.721
M6	14M-0.06%	1.443

2.3 Preparations of I6m And 14mgeopolymer Concrete

To prepare 16Mand 14M Concentration of sodium hydroxide solution we require640gm (16x40) (Molarity X molecular weight) and 560 gm of sodium Hydroxide required It is Exothermic reaction heat should be liberated when mixed with water. Then sodium silicate was added to the Naoh solution the total composition is called as alkaline liquid. It can be prepared one day prior to the mixing. Naphthalene based super plasticizer of Conplast Sp-430 is used. After that 0.03% and0.06%of Obtained Calculated Quantity of polypropylene fiber mixed into the mixer.

Figure 1: Eco Polymer concrete Mixing

2.4 Curing of Geopolymer Concrete

EPC industry it is suitable for Precast Members like Box culverts, Railway sleepers, Precast Slabs….etc. We casted 24cubes of (150x150x150) mm size, 24 cylinders of (150x300) mm size and 24 prisms of (100x100x500) mm size for Ordinary Portland Cement Concrete. We also casted 24cubes, 24 cylinders and 24 prisms for ECO concrete. After placing of concrete in the cubes leave alone for a period of five days we have to call it as “Gestation Period”. These specimens were exposed to Heat curing for 24hours for 60^0c. For Compressive strength test were performed under compressive testing machine of 2000KN Capacity and Split tensile strength test also. Flexural test has been performed under universal testing machine of 60 tone capacity. These testing were performed as per Indian standard specifications.

3. Results and Discussions

As for that of conventional concrete slump value can be find out for EPC. The Obtained slump values of are as follows;

Mix Id	Type of Mix
M1	16M
M2	16M-0.03%
M3	16M-0.06%
M4	14M
M5	14M-0.03%
M6	14M-0.06%

Mix Id	Obtained Slump (mm)
M1	157
M2	173
M3	180
M4	163
M5	175
M6	183

Figure 2: Slump Checking for Eco Concrete

Results Obtained for Ordinary Port land Cement concrete for 28 Days are as Follows of M30 Grade Concrete:

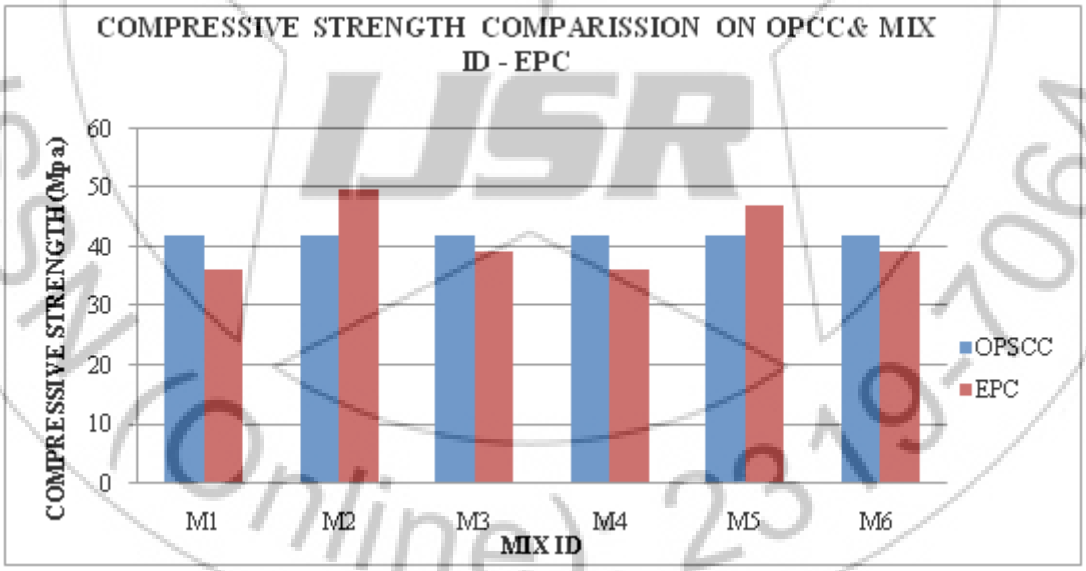
Grade of Concrete	Strength Parameter	Obtained Results (mpa)
M30	Compressive Strength	42
	Split Tensile Strength	2.92
	Flexural Strength	1.50

3.1 Compressive Strength

The Compressive strength values of different Mixes of different molarities as shown in table. Comparisons of different mixes are shown by plotting of graphs.

MIX ID	Compressive for OPCC(Mpa)	Compressive Strength (Mpa)
M1	42	36.35
M2	42	49.96
M3	42	39.25
M4	42	36.34
M5	42	46.96
M6	42	39.22

In 16M,16M-0.03%,16M-0.06% polypropylene Fiber reinforced Concrete composite mixes resulted in increasing compressive strength .there is increasing of strength in 16M-0.03%and decrease in strength in 16M-0.06% 16M.Where as in the case of 14M,14M-0.03%,14M-0.06% we also seen that there is increase in strength in the 14M-0.03% and there is decrease in strength in 14M-0.06%,14M.EPC Posses high Compressive strength that of OPCC in 16M-0.03% and 14M-0.03%.



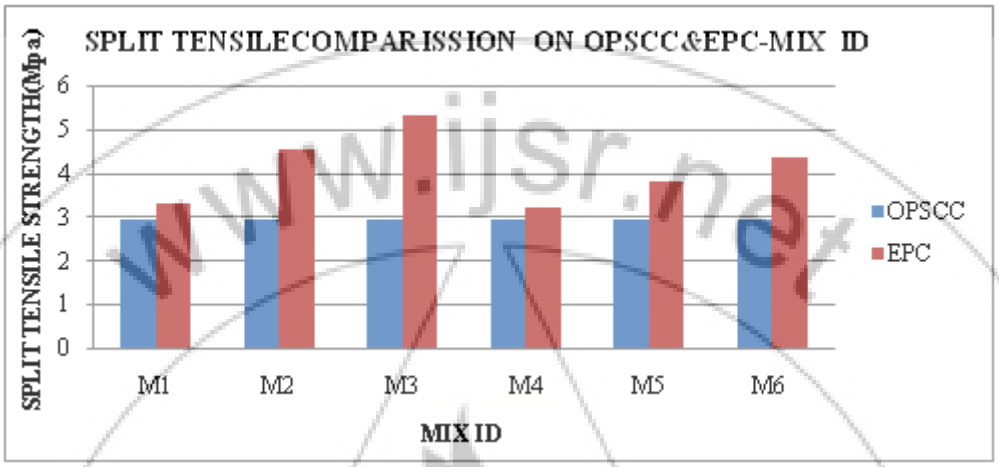
Graph 1: Showing Comparison between Opscc and 16M&14M MIX IDS.

3.2 Split Tensile Strength

The Split strength values of different Mixes of different molarities as shown in table. Comparisons of different mixes are shown by plotting of graphs.

Mix ID	*Split Tensile Strength OPCC(Mpa)*	*Split Tensile Strength (Mpa)*
M1	2.92	3.32
M2	2.92	4.54
M3	2.92	5.33
M4	2.92	3.22
M5	2.92	3.82
M6	2.92	4.34

In 16M,16M-0.03%,16M-0.06% polypropylene Fiber reinforced Concrete composite mixes resulted in increasing Split tensile strength .there is increasing of strength at 16M-0.06%and decrease in strength in 16M-0.03% 16M.in the case of 14M,14M-0.03%,14M-0.06% we also seen that there is increase in strength in the 14M-0.06% and there is decrease in strength in 14M-0.03%,14M.EPC Posses high Split tensile strength that of OPCC.



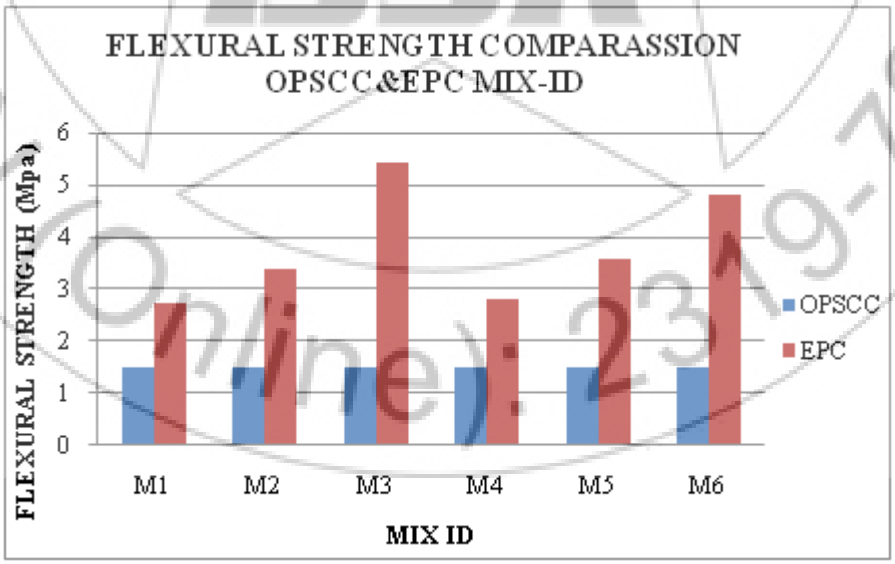
Graph 2: Showing Comparison between Opscc and 16M&14M MIX IDS

3.3 Flexural Strength

The Flexural strength values of different Mixes of different molarities as shown in table. Comparisons of different mixes are shown by plotting of graphs.

Mix ID	Flexural Strength OPCC (Mpa)	Flexural Strength (Mpa)
M1	1.50	2.73
M2	1.50	3.38
M3	1.50	5.42
M4	1.50	2.82
M5	1.50	3.57
M6	1.50	4.82

In 16M,16M-0.03%,16M-0.06% polypropylene Fiber reinforced Concrete composite mixes resulted in increasing Flexural strength .there is increasing of strength at 16M-0.06%and decrease in strength in 16M-0.03%,16M.in the case of 14M,14M-0.03%,14M-0.06% we also seen that there is increase in strength in the 14M -0.06%,14Mand there is decrease in strength in 14M-0.03%.EPC possess higher values than that of OPCC.



Graph 3: Showing Comparison Graph between Opscc and 16M&14M MIX ID

4. Conclusions

1) For Eco polymer Concrete there is less Water Absorption < 5% when compare to ordinary Port land Concrete.
2) EPC can be use full in the preparation of precast Reinforced Concrete Blocks of Railway Sleepers, Box Culvert, and slab panels of walls …etc Completion Job work in less time.
3) The Price of fly ash based EPC is estimated to be about 10to 30 percentages cheaper than that of Portland cement concrete.
4) We won't absorb the Bleeding and segregation problems in the Ecopolymer concrete, because of viscous nature of alkaline liquid and cohesion and adhesion properties of materials.
5) EPC Possess less Shrinkage property than that ordinary Port land Concrete. Due to the Fiber Content in Concrete and it expands chemical molecular Structure.
6) EPC has similar Density that of normal concrete. Epc attains early strength with in a period of one day with the help of Steam Curing. Ecopolymer concrete we can decrease the fly ash Environmental pollution problem to maximum Extent.
7) 7.EPC possess the similar compressive strength as that of Opc, Fiber Reinforced Ecopolymer concrete posses Higher strength of normal concrete at 0.03% of Recorn-3s Polypropylene Fiber.
8) Split tensile strength of Eco polymer concrete is gradually increases from 16M, 16M-0.03%, 16M-0.06%.Its Value is higher than Normal concrete.
9) Split tensile strength of Eco polymer concrete is gradually increases from 14M, 14M-0.03%, 14M-0.06%.Its Value is higher than Normal concrete.
10) Flexural strength of Eco polymer concrete is gradually increases from 16M, 16M-0.03%, 16M-0.06%.Its Value is higher than Normal concrete.
11) Flexural strength of Geo polymer concrete is gradually increases from 14M, 14M-0.03%, 14M-0.06%.Its Value is higher than Normal concrete.

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