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STUDY ON EFFECT OF POZZOLANAS ON FIBRE 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 products which simultaneously fulfill all of the properties. So the pozzolanic material silica fume with 10%,20%,30% which can be used in concrete as partial replacement of cement, which are very essential ingredients to produce high performance concrete M30 grade. 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.superplasticizer, which plays an important role for the production of high performance concrete. So in this project ihave tested on silica fume to obtain the desired needs. I used synthetic fiber (i.e. Recron fiber) in percentage of 0.2% to that of total weight of concrete and casting was done. In my study it was used two types of cement, Portland slag cement and ordinary Portland cement. I prepared cubes, cylinder, prism and finally compressive test, splitting tensile test, flexural test was conducted.

Index Terms-Silica fume, Recron fiber, Portland slag cement, Ordinary Portland cement.

I.INTRODUCTION

The Ordinary Portland Cement (OPC) is one of the main ingredients used for the production of concrete and has no alternative in the civil construction industry. Unfortunately, production of cement involves emission of large amounts of carbon-dioxide gas into the atmosphere, a major contributor for green house effect and the global warming, hence it is inevitable either to search for another material or partly replace it by some other material. Fly ash, Ground Granulated Blast furnace Slag, Rice husk ash, silica fume are some of the pozzolanic materials. Silica fume can be used in concrete as partial replacement of cement. A number of studies are going on in India as well as abroad to study the impact of use of these pozzolanic materials as cement replacements and the results are encouraging. The strength, durability and other characteristic of concrete depends on the properties of its ingredients, proportion of mix, method of compaction and other controls during placing and curing.

Considering the grade of cements high strength of cement of grades 43 are desirable for design of High strength concretes. To achieve the quest of high performance concrete we should accentuate on the replacement of OPC with industrial by-products. The utilization of pozzolanic materials in concrete as partial replacement of cement is gaining immense importance today, mainly on account of the improvements in the long-term durability of concrete combined with ecological benefits.Silica fumes (a waste by-product of the manufacture of Silicon or Ferro silicon alloys from high purity quartz and coal in a submerged-arc electric furnace), as partial replacement for cement which are largely available in India.

II.MATERIALS USED

Silica Fume: Silica fume 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. It also referred as micro silica or condensed silica fume is another material that is used as an artificial pozzolanic admixture. In the course of exit, oxidation takes place and the product is condensed in low temperature zones. In the course of exit, Silica fume rises as an oxidized vapour, oxidation takes place and the product is condensed in low temperature zones. When the silica is condensed, it attains non-crystalline state with ultra fine particle size. The super fine particles are collected through the filters. It cools, condenses and is collected in bags.Application of high performance concrete (HPC) has got momentum in various fields of construction globally in the near past. High performance concrete is being practiced in the fields like construction of nuclear reactors, runways at airport, railway sleepers, cooling towers, silos, chimneys and all kinds of bridges. Considerable amount of development has been made in the field of High performance concrete and high strength concrete can be obtained using silica fume as a mineral admixture.

Super plasticizing admixture: A substance which imparts very high workability with a large decrease in water content (at least 20%) for a given workability. A high range water reducing admixture (HRWRA) is also referred as Superplasticizer, which is capable of reducing water content by about 20 to 40 percent has been developed. These can be added to concrete mix having a low to- normal slump and water cement ratio to produce high slump flowing concrete. The effect of super plasticizers lasts only for 30 to 60 minutes, depending on composition and dosage and is followed by rapid loss in workability.

Although Superplasticizer are essential to produce a truly high performance concrete (HPC) characterized by low water-cement ratio and workability level without high cement content. Concrete are being produced with w/c ratio of as low as 0.25 or even 0.20 enabled the production of highly durable high performance concrete. The workability also increases with an increase in the maximum size of aggregate. But smaller size aggregate provides larger surface area for bonding with the mortar matrix, which increases the compressive strength. For concrete with higher w/c ratio use of larger size aggregate is beneficial. High range superplasticizer was used in all the concrete mixes to achieve good workability. Superplasticizers are added to reduce the water requirement by 15 to 20% without affecting the workability leading to a high strength and dense concrete. To achieve the uniform workability, the admixture dosage was adjusted without changing the unit water content. This ensured the identical W/C ratio for a particular cementitious content and the effect of pozzolanic material replacement can directly be studied on the various properties of concrete.

Recron fibre: Recron Fiberfill is India's only hollow Fibre specially designed for filling and insulation purpose. Made with technology from DuPont, USA, Recron Fiberfill adheres to world-class quality standards to provide maximum comfort, durability, and ease-of-use in a wide variety of applications like sleep products, garments and furniture. Reliance Industry Limited (RIL) has launched Recron 3s fibres with the objective of improving the quality of plaster and concrete. Application of RECRON 3s fibre reinforced concrete used in construction. The thinner and stronger elements spread across entire section, when used in low dosage arrests cracking. RECRON 3s prevents the shrinkage cracks developed during curing making the structure/plaster/component inherently stronger. Further when the loads imposed on concrete approach that for failure, cracks will propagate, sometimes rapidly. Addition of RECRON 3s in concrete and plaster prevents/arrests cracking caused by volume change (expansion & contraction).A cement structure free from such micro cracks prevents water or moisture from entering and migrating throughout the concrete. This in turn helps prevent the corrosion of steel used for primary reinforcement in the structure. This in turn improves longevity of the structure. The modulus of elasticity of RECRON 3s is high with respect to the modulus of elasticity of the concrete or mortar binder. The RECRON 3s fibres help increase flexural strength. RECRON 3s fibres are environmental friendly and non hazardous. They easily disperse and separate in the mix. Only 0.2-0.4% by cement RECRON 3s is sufficient for getting the above advantages.

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 grade, 43 grade, 53 grade. One of the important benefit 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 (I) Fine aggregate (II) 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.

According to IS 383:1970 the fine aggregate is being classified in to four different zone, that is Zone-I, Zone-II, Zone-III, Zone-IV. Also in case of 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.

III.TABULATION

Table 1.Properties of silica fume

Specific gravity	2.2
Particle size	< 1 micron
Bulk density (as produced) (as densified)	130 – 430 kg/m^3 480 – 720 kg/m^3

Table 2.Specification of Recron fibre

Denier	1.5d
Cut length	6mm,12mm,24mm
Dispersion	Excellent
Acid resistance	Excellent
Alkali resistance	Good

Table 3.Effect of silica fume on 7 days compressive strength with 0.2% Recron fibre using slag cement and OPC.

Silica fume %	**Portland slag cement N/mm^2**	**Ordinary Portland cement**	**Normal concrete N/mm^2**
		N/mm^2	
10	24.65	29.70	25.42
20	26.23	33.47	
30	22.34	35.26	

Table 4.Effect of silica fume on 7 days splitting tensile strength with 0.2% Recron fibre using slag cement and OPC.

Silica fume %	**Portland slag cement N/mm^2**	**Ordinary Portland cement N/mm^2**	**Normal concrete N/mm^2**
10	2.52	2.62	2.36
20	2.68	2.47	
30	2.10	2.21	

Table 5.Effect of silica fume on 7 days flexural strength with 0.2% Recron fibre using slag cement and OPC.

Silica fume %	**Portland slag cement N/mm^2**	**Ordinary Portland cement N/mm^2**	**Normal concrete N/mm^2**
10	6.42	7.92	8.25
20	6.65	6.83	
30	6.10	6.25	

Table 6.Effect of silica fume on 28 days compressive strength with 0.2% Recron fibre using slag cement and OPC.

Silica fume %	**Portland slag cement N/mm^2**	**Ordinary Portland cement N/mm^2**	**Normal concrete N/mm^2**

10	31.23	37.36	32.48
20	35.67	39.21	
30	30.48	43.04	

Table 7.Effect of silica fume on 28 days splitting tensile strength with 0.2% Recron fibre using slag cement and OPC.

Silica fume %	**Portland slag cement N/mm^2**	**Ordinary Portland cement N/mm^2**	**Normal concrete N/mm^2**
10	2.93	3.34	2.74
20	3.15	3.26	
30	2.84	3.07	

Table 8.Effect of silica fume on 28 days flexural strength with 0.2% Recron fibre using slag cement and OPC.

Silica fume %	**Portland slag cement N/mm^2**	**Ordinary Portland cement N/mm^2**	**Normal concrete N/mm^2**
10	8.13	9.25	10.25
20	8.46	8.57	
30	7.92	7.29	

IV.RESULTS AND DISCUSSION

Consistency of cement depends upon its fineness. Though silica fume having greaterfineness than cement and greater surface area so the consistency increases greatly, whensilica fume percentage increases compare to plain cement. It was observed that normalconsistency increases about 45% when silica fume percentage increases from 0% to 30%.

In compressive strength of Portland slag cement it was observed that using Recron fiber from 0.2% the compressive strength was increased and on further increament of fibrecontent the strength reduces. The differentpercentage of silica fume such as 10%, 20%, 30% replacement was used with 0.2% Recronfiber. The 20% replacement of slag cement with of silica fume gave maximum strengthcompared to other percentages of replacement, whereas the strength is higer with30%replacement of silica fume in case of ordinary Portland cement.

In splitting tensile strength of Portland slag cement it was observed that addition of Recron fiber from0.2% the 28 days splitting tensile strength is about 5% more than that ofconcrete without fiber. And with further addition of fiber the strength reduces. At 20% silicafume replacement to cement at 0.2% fiber content strength again increases about 12% morethan that of normal concrete and maximum to other percentage of replacement, where as incase of ordinary Portland cement the tensile strength at 28 days is 15% more than normalconcrete at 10% silica fume replacement and 0.2% fiber. The strength reduces gradually onother percentages of silica fume.

In Flexural strength using Recron fiber from 0.2% the flexural strength is increasing about 5% and asfurther increasing the fiber content the strength decreases. In case of silica fume replacementat 0.2% fiber content the flexural strength gives positive outcome. At 20% silica fume there ishiger strength about 10% more than normal concrete, which is the maximum strength thanother percentages of silica fume replacement. In case of ordinary Portland cement keeping0.2% fiber content and varying silica fume percent (10%, 20%, 30%) it was observed that the28 days flexural strength decreases as the of silica fume percentage increases. The strengthdecreases about 40% at 30% silica fume replacement than normal concrete.

V.CONCLUSION

In this paper I proposed that as the replacement of cement with different percentages with Silica fume increasesthe consistency increases.With the use of superplasticizer it possible to get a mix with low water to cement ratioto get the desired strength. With Portland slag cement keeping 0.2% Recron fiber constant and varying silicafume percentage the compressive, splitting tensile, flexural strength affected remarkably. Using 20% silica fume with 0.2% fiber percentage the 28 dayscompressive strength increases 7% more than concrete with 0.2% fiber only. 28dayssplit tensile and flexural strength increases further, about 12% and 10% that of normalconcrete So it is included that 0.2% Recron fiber and 20% SF is the optimum combination toachieve the desired need.In case of OPC the compressive strength is increasing as the percentage of silica fumeincreases from 0-30% and 0.2% Recron fiber and it is about 20% more than

strengthof normal concrete with OPC.The splitting tensile strength increases about 15% at 10% SF and constant 0.2%Recron fiber, then decreases with increasing the SF percentage.

Flexural strength isnot giving good indication and goes on decreasing and it is about 40% decrement asthe SF percentage increases to 30%.Ordinary Portland cement gives good compressive strength result as compared toPortland slag cement in case of mix with SF and 0.2% Recron.

REFERENCES

1.Alhozaimy.A.M, Soroushian.P & Mirza.F, "Mechanical Properties of Polypropylene Fiber Reinforced Concrete and the Effects of Pozzolanic Materials, Cement & Concrete Composite, Vol. 18, 1996, 85-92.

2.Al-Khalaf and Hana A Youssif, "Use of Rice husk ash in concrete", The International Journal of Cement Composites and Lightweight Concrete, Vol. 6, November 4 1984.

3.Andrzej Ajdukiewicz and Wojciech Radom ski, "Trends in the Polish research on high performance concrete", Cement and Concrete Composite, Vol. 24, 2002, 243-251.

4.Bhanja.S, Sengupta.B, "Modified water–cement ratio law for silica fume concretes", Cement and Concrete Research, Vol. 33, 2003, 447-450.

5. Bhanja.S, Sengupta.B, "Influence of silica fume on the tensile strength of concrete", Cement and Concrete Research, Vol. 35, 2005, 743-747.

6. Collepardi.M, "Admixtures used to enhance placing characteristics of concrete", Cement & Concrete Composite, Vol. 20, 1998, 103-112.

7.Ganesh Babu.K and Sree Rama Kumar.V, "Efficiency of GGBS in Concrete", Cement and Concrete Research, Vol. 30, 2000, 1031-1036.

8. Gemma Rodriguez de Sensale, "Strength development of concrete with rice-husk ash", Cement & Concrete Composite, Vol. 28, 2006, 158-160.

9.IS 456: 2000, "Indian Standard Code of Practice for Plain and Reinforced Concrete", Bureau of Indian Standard, New Delhi.

10.IS 10262: 2009, "Recommended Guidelines for Concrete Mix design", Bureau of Indian Standard, New Delhi.

11.IS 383: 1970, "Specification for Coarse aggregate and Fine aggregate from Natural Sources for Concrete", Bureau of Indian Standard, New Delhi.

12. IS 9103: 1999, "Indian Standard Concrete Admixture Specification", Bureau of Indian Standard, New Delhi.