DURABILITY STUDIES ON HIGH STRENGTH HYBRID FIBER REINFORCED SELF COMPACTING CONCRETE

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ABSTRACT
An Experimental study was conducted to investigate the behavior of High Strength Hybrid Fiber Reinforced Self Compacting Concrete (HSHFRSCC) using quartz sand and quartz powder. The Investigation is carried out to obtain the abrasion behavior, acid resistance and permeability of HSHFRSCC by using the partial pozzolanic admixture i.e. quartz powder in addition to use of hooked end steel fibers and glass fibers with complete replacement of river sand with quartz sand. Apart from achieving desired high strength it is also important for the structure to be more durable. Few of the methods which can help in determining the durability properties of concrete is the abrasion resistance, permeability and acid attack of concrete. The present Experimental investigation is carried out to determine the abrasion resistance, permeability and resistance to chemical attack of High Strength Hybrid Fibre Reinforced Self Compacting Concrete of M100 grade. The cylindrical specimen of 300mm diameter and 100mm height, cured for 28 days in water, was considered to determine the depth of wear using under water abrasion machine, which comprise seventy grade 1000 chrome steel grinding balls with nominal sizes, that are used to abrasive charges. Permeability of the specimen is determined using the permeability apparatus which meets the requirements of IS 3085-1965,in which specimen of size 100 mm diameter and 100 mm height are caste and cured fo1 28 days in water, then set into apparatus to determine the permeability. The cubes of size 150 mm X 150 mm are caste and cured for 28 days in water and then they are placed in the solutions of HCL and HzSO4with 5%and 10 % concentration to determine resistance to acid attack.

Keywords: *Concrete, hybrid fiber, Fiber Reinforced Self Compacting Concrete*

1.0 INTRODUCTION
The Importance and the application of concrete in the construction industry need not to be emphasized; research on normal and high strength concrete has been on the agenda for more than two decades. concrete is the most widely used material because it is said to possess very high strength and workability properties as per IS:456-2000(code of practice for plain and reinforced concrete) , concrete whose strength is ranging from 30 55 Mpa are called standard concrete. while those whose strength is above 55 Mpa are called high performance concrete and those which are above 100 Mpa are called ultra high strength concrete. Building which are made of high strength concrete need lots of reinforcement Usage of such heavy amounts of reinforcement may sometimes lead to congestion. Under such situation compaction of concrete after it is been placed becomes very difficult.

Therefore a special concrete is required which can be easily spread and placed in between the congested reinforced concrete elements. A highly homogeneous, well spread and dense concrete can be ensured using such a type of concrete. Self compacting concrete (SCC) is the concrete which gets compacted on its own due to its gravity. SCC prevents use of external vibrators there by makes the compaction easy in the places where it is difficult to compact. Usually SCC are of 60 N/mm^2 to 100 N/mm^2 strength .Lower grades SCC can also be used depending upon the requirement. SCC was developed in Japan in the University of Tokyo in 1980's for reinforced structures in seismic regions which are highly congested. Durability of concrete was important in Japan which is obtained by proper compaction, this requirement lead to the development of

SCC. The first SCC was reported in 1989 (Okamura and Ouchi, 1999). SCC is a new kind of High Performance Concrete (HPC) which has an excellent deformability and segregation resistance.

Obtaining high strength is not the only criterion for good performance of structure ,it should also have long serviceability. Life span of the structure is reduced try various actions such permeability through concrete, Acid attack and Abrasion effect the concrete and so durability studies on concrete is very much essential for any kind of, concrete. And since usage of quartz sand is invention to the concrete field, along with high strength achievement it is important to study the Durability properties of the high strength self compacting fiber reinforced concrete which includes Quartz sand. A detailed and a systematic experimental programmed is laid down as explained in the next paragraphs. The main objectives of the present investigation are:

Objective - I: To study the resistance to attack showed by cubes with mix proportion of size 150 mm X 150 mm and to compare the results between cast with fibers and without fibers.

Objective - II: To study the permeability through the specimen, by comparing the results between specimens caste with fibre and specimens cast without fibers

Objective - III: To study the Abrasion resistance of the concrete specimen caste with and without fibers.

With the above objectives in mind the experimental programmed is categorized into three phases as detailed below.

Phase 1: 48 Cubes are cast to study the resistance to Acid Attack. in which 24 cubes includes fibers and 24 cubes are cast without fibers. These Cubes are cured in water for 28 Days and then placed in Acid Solutions i.e. HCL and H_2SO_4 with 5% and 10% and concentration. The parameters which helps in determining the resistance to Acid Attack i.e. percentage of loss in compressive strength, percentage of loss in weight, Acid Attacking Factor (AAF),Acid Durability Factor(ADF) and ultrasonic Pulse Velocity values are noted

.2.0 LITERATURE REVIEW

Kuroiwa (9931), developed a type of concrete, which contained materials normally found in conventional concrete such as Portland cement aggregate, water mineral and chemical admixtures. The chemical admixtures were added in order to improve the deformability and the viscosity of the concrete. The newly developed type of was called was called super-workable concrete. It could also fill completely heavily reinforced formworks without any rise of vibrators After the laboratory tests it was found out that the super-workable concrete had superior properties in the fresh state and excellent durability after hardening ,Because of its properties, it was considered to suitable for projects involving heavily reinforced areas and was employed in the construction of a 20 story building.

Ozawa [1989], has done some research independently from Okamura, and he succeeded in developing self-compacting concrete for the first time in 1988. The year after that, an open experiment on the new type of concrete was held at the University of Tokyo, in front of more than 100 researchers and engineers. As a result , intensive research has begun in many places, especially in the research institutes of construction companies and at the University of Tokyo.

Ozawa [1989] completed the first prototype of self-compacting concrete using materials readily available in the market. By using different types of super plasticizers, he studied the workability of concrete and developed a concrete, workable. It was suitable for rapid placement and had a very good permeability" The viscosity of the concrete was measured using the v-funnel test.

P. Murthi and V. Sivakumar (2005)[.1]The investigation on the acid resistance of ternary blended concrete weeks in sulfuric acid (H2SOa) and hydrochloric acid (HCL)

Compared with blended concrete. ASTM class F fly ash was considered to develop the binary blended concrete at the replacement level of cement as 20Yo by weight. Then silica fume was considered to develop the ternary blended concrete and the replacement of cement in the ternary system by silica fume was suggested as powder content by weight. The variable factors considered in this study were concrete grades (M20, M30 and M40) and curing periods (28 days and 90 days) of the concrete specimens.

3.0 EXPERIMENTAL PROGRAMME

The present investigation is study of the durability properties of high performance self compacting concrete which includes the following studies

Study on resistance to acid attack when cubes are immersed in solutions of HCL and H_2SO_4.

Study of permeability to the specimen where the discharge is noted for 12,24,48 and hours

Aggregate is said to be fine if the size is less than 4.75mm. River sand can be used has fine aggregate. Both rounded and crushed sand can be used for production of SCC" Siliceous and calcareous sands can be used for production .To avoid segregation minimum amount of fines should be maintained. In this project we are using quartz sand has fine aggregate.

Hooked end steel bars

Microsilica

Chemical Admixtures:

1. The most commonly used chemical admixtures in SCC are Super plasticizers

2. Viscosity Modifying Ad mixture(Vlv1A)

Super plasticizers:

In the present investigations as super plasticizer namely Master Gienium ACE 30 and VMA namely Glenium stream 2 are used. The following information ,:btaincril from lWs Degussa Construction chemical (lndia) Pvt. Ltd., Mumbai, the manufacturer of these admixtures

Mineral admixtures:

Mineral admixtures are added to concrete as a part added to replace certain part of Portland cement in mineral, mixture usage improves properties of strength as a high performance Self Compacting Concrete is now get better strength properties and good performance of SCC, The durability and resistance to chemical attack can be improved thus reduces micro cracks in the transition zones. It can improve the workability.

Cement:

Cement which are conforming to the indian standards can be used for self compacting concrete. Depending on the overall requirements of SCC such as durability, strength the cement is selected. Quantity less than 350kg/m3 reduce the durability of concrete. , Ordinary Portland cement of 53 grade available in local market is used in the investigation. The cement used has been tested for various proportions as per IS 4031 -1988 and found to be confirming to various specifications of lS 1,2269-1987.

4.0 ANALYSIS AND DISCUSSIONS OF EXPERIMENTAL RESULTS

RESULTS OF THE HSHFRSCC:

Properties of HSHFRSCC concrete in fresh state:

In order to determine the self compatibility the following test were conclucded on fresh concrete

(i) FLOW TABLE
(ii) (ii) L-Box
(iii) (iii)v FLTNNEL

The result for fresh state of concrete

S.NO	FLOW TABLE	L-BOX	V FUNNEL
1.	Diameter=715mm As per EFNARC 650mmto800	H2/H1=0.87 as per EFNARC 0.8 to 1	T_f(seconds)=7 as per EFNARC 8 to 12sec
2.	T_{500}=5 seconds as per EFNARC 2 to 5 sec		T_5(min seconds)=9 as per EFNARC 0 to +3

Hardened properties of HSHFRSCC

Compressive strength(Mpa)	7 Days	96.3
	28 Days	123.8
	90 Days	132.7
Split tensile strength(Mpa)	7 Days	2.89
	28 Days	8.3
	90 Days	8.92
Flexural strength(Mpa)	7 Days	8.6
	28 Days	12.38
	90 Days	13.6

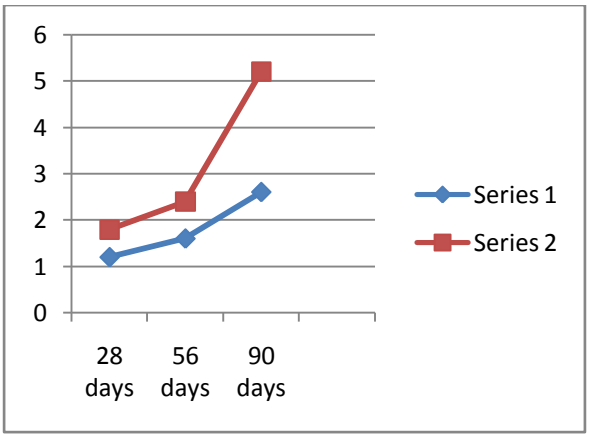
Cubes immersed in HCL for 28 days

Cubes immersed in HCL for 56 for 28 Days

Cubes immersed in HCL for 90 Days

IMMERSION OF CI]BES CASTE WITH FIBERS AND WITHOUT FIHERS IN H_2SO_4:

Cubes immersed in H_2SO_4 for 28 Days



percentage weight loss vs . age in days with HPSCHFRC immersed in 5 % and 10 % HCL solution at 28 days 90days 180 days.

X- axis- Duration of immersion in acids

Y-axis -%loss in weight when cubes are immersed in **H_2SO_4**

series -1=5% **H_2SO_4**

5.0 CONCLUSION

The Following Conclusions are drawn from the Experimental Investigation in presence.

Thesis:

1. Cubes immersed in the solution of HCL showed less percentage of loss weight than the cubes immersed in H_2SO_4 With the increase in percentage of acid there is increase in loss of weight of cubes
2. Percentage increase in Weight loss of Concrete Specimens with fibers immersed in 5%HCl Solution is varying from 1 .25% to 2.5%o from 28 to 90 days.
3. Percentage increase in Weight loss of Concrete Specimens with fibers immersed with 5 % H_2SO_4 Solution is varying from 3 .l8 % to 22.22% from 28 to 90 days.
4. Significant physical deterioration is more in cubes immersed in H_2SO_4 compared the cubes in HCL
5. The loss in weight off cubes in acids increases with increase in days of immersion for 28 days showed less loss in weight of cubes compared to 56 and 90 days , it is observed that the percentage of loss is more by almost 10% in HCL.
6. It is observed that cubes caste with fibers showed greater resistance in loss of weight when, immersed in acids compared to the cubes caste without fibers.
7. Both Acid durability factor and Acid attacking factor increases with increase in days of immersion of cubes in acids and also with increa.se in days of immersion of cubes in solutions the ultrasonic pulse velocity decreases.

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