Durability Of Fiber Reinforced Concrete With Artificial Sand

Mahesh Indorey [1], Dharmendra Kurmi[2]
[1] Dept of CE
[2]Assistant Professor, Dept of CE
[1, 2] VITM Indore (M.P.)

Abstract- *Concrete is the combination of cement, natural sand or artificial sand and aggregate which are used in civil engineering works such as township project and infrastructure work . The present research work shows the study of cement concrete with varying percentage of fibers which are namely 0.10%, 0.20%, 0.30%, 0.40% & 0.50%. M20 grade concrete was adopted. Sizes of cube (15*15*15 cm) were used for testing. Compressive test of cubes was carried out with various types of fibers namely AFRC and NFRC with N.S and A.S. The aim of this experiment is to use of different fiber as reinforcement in concrete for a greater durability, workability and reduction in crack. The present work is concerned with the compressive strength of FRC specimens (132 cubes) with 90 days of normal W.C and 90 days curing in sulphate & chloride.*

The methods of mixing play a major character in FRC in which stress is determined by the fiber orientation. FRC controls micro cracking and deformation under load much superior than plain concrete. About 43.8 N/mm^2 extreme compressive strength found with N.S at 0.4% fiber concentration when cubes samples were cured in plain water (AFRC) & about 44.1 N/mm^2 extreme compressive strength found with natural sand at 0.4% fiber concentration when cube samples were cured in NaCl & $MgSO_4$ mixed water (AFRC) and about 35.8 N/mm^2 compressive strength found with artificial sand at 0.4% fiber concentration when cubes samples were cured in plain water (AFRC) & about 39.9 N/mm^2 compressive strength found with artificial sand at 0.4% fiber concentration when cube samples were cured in NaCl & $MgSO_4$ mixed water (AFRC).

I. INTRODUCTION

The method of using fibers to enhance the strength of concrete is very aged process and its early applications such as addition of horse hair, etc for the reinforcement of plaster. Use of fiber reinforcement in concrete mixes which enhance strength and ductility but requires proper placement of fiber with proper skill. Fibers addition to concrete mix makes it a more uniform and close to isotropic material. When concrete cracks, then fiber orientation play an major role to arrest crack formation and propagation, and thus improve strength and ductility. N.S and coarse aggregate are near about 75% of total quantity of concrete. Therefore, we have to select right type and good quality aggregate for concrete, as the aggregate is the major ingredient of the concrete or mortar and provide strength to the concrete mix. Concrete is a construction material made-up of cement, sand (i.e. N.S or A.S), aggregate, water and admixtures.

The addition of these fibers into concrete which help to enhance the compressive strength of concrete and also improve tensile strength, and impact strength of concrete. FRC has found many applications in civil engineering. In the present work, the two verities of fiber have been used that is jute fiber (natural fiber) and plastic pipe chips fiber (artificial fiber) in a concrete along with various percentage of fiber varies from 0.1 to 0.5 % along with 100% N.S and also with artificial sand. Total 132 cubes were casted in which 66 cubes were placed in normal W.C and remaining 66 placed in mixed NACL and $MgSO_4$ solution for 90 days. After normal curing and chemical curing we had compared the compressive strength and durability of these cubes.

II. SCOPE OF WORK

- To overcome or minimize the hair cracking, micro cracks & chemical effect of concrete by addition of small quantity of fibers.
- To provide applications, use of various types of fibers on a single place and also their comparison between them, so that the best one can be chosen which fulfills the requirement of work.
- To minimize the cost of materials such as reinforcement.
- To enhance the compressive strength, low post cracking capacity, & toughness of the concrete.

III. METHODOLOGY

Concrete is poor or weak in tension and due to which it characterized by brittle failure and concrete also suffer high shrinkage, cracking, low durability etc. This properties, which limits the application of the material, can be solve by addition of small quantity of distributed fibers in concrete mix (artificial and natural) and due to which fiber properly bonded

with concrete and overcome the drawback of cracking and durability.

There are many types of fibers with different properties and that type of fibers are use in concrete such as artificial fiber, natural fiber like, bamboo, Jute, Sisal, etc Fibers are used in concrete to reduces micro crack due to plastic shrinkage of concrete and also drying shrinkage of concrete. They also control the permeability of concrete and due to which its control the concrete bleeding and Some fibers produce heavy impact–, abrasion–, and shatter–resistance in concrete The durability and strength of concrete can be improved by making changes in its material like cement, sand such as natural sand or artificial sand, aggregate and water and by adding some special admixtures.

Aspect Ratio:

Aspect Ratio is the ratio of length of the fiber to the diameter of its cross- section. Standard aspect ratio ranged between 20to150:

Aspect Ratio = Length (L) / Diameter (D)

Types of Artificial Fiber:

There is various type of fiber available in market to use in a concrete which helps to improve its compressive strength In this project we used rigid PVC fiber as artificial fiber There are also some Synthetic Fibers in which primary types of synthetic fibers commercially available are polypropylene, polyester and nylon. The fiber are of different length ,size and thicknesses, synthetic fibers provide same advantages when used as secondary form of concrete reinforcement And many types of fiber based on synthetic fiber polymer have been evaluated as important commercial material, two of them are more commonly in use in concrete namely, Polypropylene and Nylon. In present experiment we have to use PVC conduct pipe chips as an artificial fiber to use in concrete to improve its compressive strength. The river sand used in this experiment having silt content is 5 % and in artificial sand it is 7 % silt content.

Durability of Fiber Reinforced Concrete

Nowadays required the durability of fibers in concrete generally, the durability of concrete is carried out by the concrete cube sample is placed in chemical solution for one or long duration .The concrete cube is tested for durability and also check the compressive strength and finally the durability of concrete is carried out .The required service life of concrete structure is usually of the order of 60 to 100 years.

Many researcher works on durability test in field along with different fiber to check which give higher durability. Due to this new material to be approved by the construction industry having a good durability .Therefore a big challenge for researchers in durability to determine its deterioration rate of concrete, and thereby the service life of fibers in concrete. On the basis of experience able to choose proper safety factors, taking account of the deterioration due to environmental influence. Compared to other building materials such as metals, concrete is under goes bleeding, plastic settlement, and thermal and shrinkage strains and is subjected to stress concentrations imposed by external restraints. The construction sites today demands for high strength, long lasting durability and low cost. Chloride penetration and sulphate attacks are the primary reasons for such deterioration. The chemicals used in experiment are NaCl and MgSO4 which generally cause the extreme deterioration. Generally the amount of chemical added is 2 – 8%. In the present work 2.5% of each chemical is used with respect to the quantity of water so as to make the studies more realistic.

Experimental Results

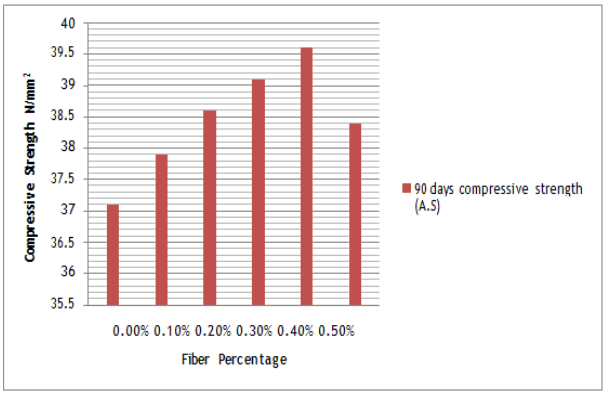

Fig 1: 90 days chemical cured compressive strength of NFRC with artificial sand (bar chart)

On the basis of the experimental study it was observed that in case of Artificial fiber (plastic pipe chips) with natural sand the Compressive strength of M20 grade concrete using varying percentage of Artificial fibers are observed to be increasing from 41.1 to 43.8 N/mm2 and after that it decreases up to 42.9 N/mm2 in 90 days potable water curing and 41.9 to 44.1 N/mm2 and after that decreases up to 43.4 N/mm2 in 90 days chloride & sulphate mixed water.

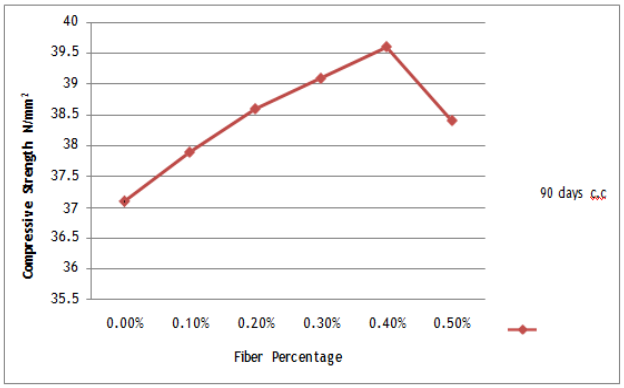

Fig 2: 90 days chemical cured compressive strength of NFRC with artificial sand (scattered chat)

The Compressive strength of M20 grade concrete using varying percentage of Natural fiber (jute) with natural sand are observed to be increasing from 41.1 to 43.2 N/mm2 and after that it decreases up to 42.4 N/mm2 in 90 days potable water curing and 41.9 to 44.0 N/mm2 and after that decreases up to 43.2 in 90 days chloride & sulphate mixed water.

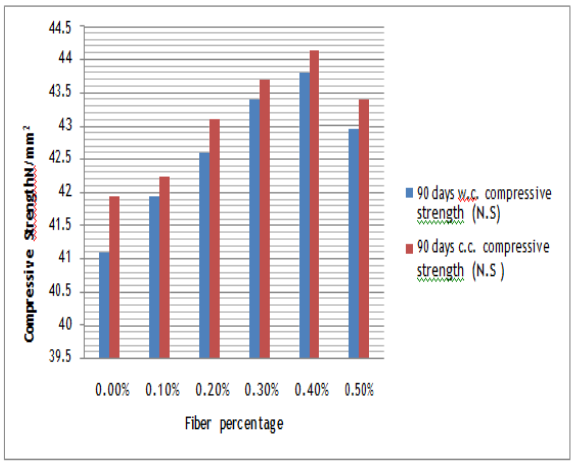

Fig 3: 90 days water cured & 90 days chemical cured compressive strength of AFRC with natural sand (barchart)

Compressive strength of M20 grade concrete using varying percentage of Artificial fiber (plastic pipe chips) with Artificial sand are observed to be increasing from 33.3 to 35.8 N/mm2 and after that it decreases up to 34.8 N/mm2 in 90 days potable water curing and 37.1 to 39.9 N/mm2 and after that decreases up to 38.6 in 90 days chloride & sulphate mixed water.

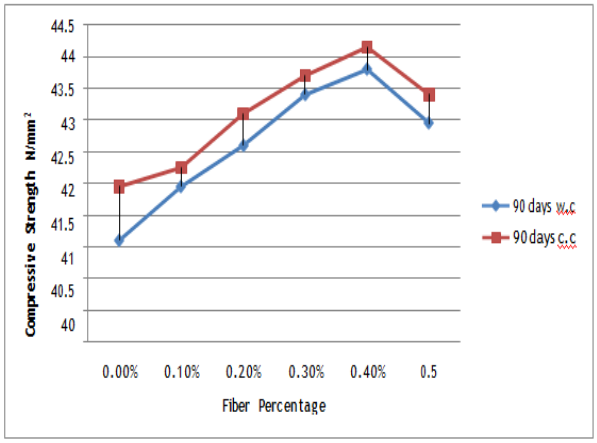

Fig 4: 90 days water cured & 90 days chemical cured compressive strength of AFRC with natural sand (scatteredchat)

The Compressive strength of M20 grade concrete using varying percentage of Natural fiber (jute) with Artificial sand are observed to be increasing from 33.3 to 35.5 N/mm2 and after that it decreases up to 34.7 N/mm2 in 90 days potable water curing and 37.1 to 39.6 N/mm2 and after that decreases up to 38.4 in 90 days chloride & sulphate mixed water.

- The compressive strength of artificial fiber (plastic pipe chips) reinforced concrete (AFRC) cubes with natural sand cured for 90 days in plain water for the proportion 1 : 1.5 : 3 (by weight) improves from 41.1 to 43.8 N/m2 with increase in fiber percentage from 0.1%, 0.2%, 0.3% and 0.4% and after that it decrease to 42.9 N/mm2 at 0.5% (Fig 1)
- The compressive strength of artificial fiber (plastic pipe chips) reinforced concrete cubes with natural sand cured for 90 days in NaCl+MgSO4 water for proportion 1 : 1.5 : 3 (by weight) improves from 41.9 to 44.1 N/mm2 with increase in fiber percentage from 0.1%, 0.2%, 0.3% and 0.4% in chloride & sulphate mixed water and after that it decrease to 43.4 N/mm2 at 0.5%.(Fig 3)

IV. CONCLUSIONS

The fiber orientation plays an important role to determine the compressive strength, which depends on the mixing. FRC controls the micro cracking, shrinkage and deformation under load much better than plain concrete. About 43.8 N/mm^2 compressive strength found with natural sand at 0.4% fiber concentration when cubes samples were cured in plain water (AFRC) & about 44.1 N/mm^2 compressive strength found with natural sand at 0.4% fiber concentration when cube samples were cured in NaCl & $MgSO_4$ mixed water AFRC and On the other hand 35.8

N/mm^2 compressive strength found with artificial sand at 0.4% fiber concentration when cubes samples were cured in plain water (AFRC) & about 39.9 N/mm^2 compressive strength found with artificial sand at 0.4% fiber concentration when cube samples were cured in NaCl & $MgSO_4$ mixed water.(AFRC)

1. The extreme compressive strength of AFRC with natural sand on comparing with NFRC with natural sand, it is observed that if compressive strength of AFRC is (42.9 N/mm2) considered 100% then compressive strength of NFRC reduced to 98.83%, for 0.5% addition of fiber cured in plain water.
2. The extreme compressive strength of AFRC with natural sand on comparing with NFRC with natural sand, it is observed that if compressive strength of AFRC is (43.8 N/mm2) considered 100% then compressive strength of NFRC reduced to 98.7%, for 0.4% addition of fiber cured in plain-water.
3. The extreme compressive strength of AFRC with natural sand on comparing with NFRC with natural sand, it is observed that if compressive strength of AFRC is (43.8 N/mm2) considered 100% then compressive strength of NFRC reduced to 98.84%, for 0.3% addition of fiber cured in plain water.
4. The extreme compressive strength of AFRC with natural sand on comparing with NFRC with natural sand, it is observed that if compressive strength of AFRC is (42.6 N/mm2) considered 100% then compressive strength of NFRC reduced to 98.82% for 0.2% addition of fiber cured in plain water.
5. The extreme strength of AFRC with river or natural sand on comparing with NFRC with natural sand, it is observed that if compressive strength of AFRC is (41.9 N/mm2) considered 100% then compressive strength of NFRC reduced to 99.0%, for 0.1% addition of fiber cured in plain water.
6. The extreme compressive strength of AFRC with natural sand on comparing with NFRC with natural sand, it is observed that if compressive strength of AFRC is (43.4 N/mm2) considered 100% then compressive strength of NFRC reduced to 99.5%, for 0.5% addition of fiber cured in chemical water.
7. The extreme higher strength of AFRC with natural sand on comparing with NFRC with natural sand, it is observed that if compressive strength of AFRC is (44.1 N/mm2) considered 100% then compressive strength of NFRC reduced to 99.7%, for 0.4% addition of fiber cured in chemical water.
8. The high compressive strength of AFRC with natural sand on comparing with NFRC with natural sand, it is noticed that if compressive strength of AFRC is (43.7 N/mm2) considered 100% then compressive strength of NFRC reduced to 99.0%, for 0.3% addition of fiber cured in chemical water.
9. The extreme compressive strength of AFRC with natural sand on comparing with NFRC with natural sand, it is observed that if compressive strength of AFRC is (43.1 N/mm2) considered 100% then compressive strength of NFRC reduced to 99.3%, for 0.2% addition of fiber cured in chemical water.
10. The topmost compressive strength of AFRC with natural sand on comparing with NFRC with natural sand, it is observed that if compressive strength of AFRC is (42.2 N/mm2) considered 100% then compressive strength of NFRC reduced to 99.7%, for 0.1% addition of fiber cured in chemical water.

REFERENCES

[1] S. P. Shah and P. N. Balaguru, “Fiber Reinforced Cement Composites", McGraw-Hill Inc; 1992.

[2] R. Ilangovana, N. Mahendrana ,K. Nagamanib,” Strength And Durability Properties Of Concrete Containing Quarry Rock Dust As Fine Aggregate ,” Arpn Journal Of Engineering And Applied Sciences , Vol. 3, No. 5, October 2008.

[3] Shama Parveen, Sohel Rana, Raul Fangueiro, ” Natural Fiber Composites For Structural Applications,” Mechanics Of Nano, Micro And Macro Composite Structures politecnico Di Torino, 18-20 June 2012a. J. M. Ferreira.

[4] A.L.Ardeshana*, Dr Atul K Desai, Durability Of Fiber Reinforced Concrete Of Marine Structures ,” International Journal Of Engineering Research And Applications (Ijera) Issn: 2248-9622 Vol. 2, Issue 4, July- August 2012, Pp.215-219.

[5] Rajendra P. Mogre1, Dr. Dhananjay K. Parbat ,” Behaviour Of Polypropylene Fiber Reinforced Concrete With Artificial Sand ,” International Refereed Journal Of Engineering And Science (Irjes) Issn (Online) 2319-183x, (Print) 2319-1821 Volume 1, Issue 2 (October 2012), Pp.37-40.

[6] Vinayak R. Supekar, Popat D.Kumbhar," Properties Of Concrete By Replacement Of Natural Sand With Artificial Sand,” International Journal of Engineering Research & Technology (IJERT) Vol. 1 Issue 7, September- 2012

[7] Amit Rai, Dr. Y.P Joshi ,”Applications And Properties Of Fiber Reinforced Concrete, Amit Rai Et Al Int. Journal Of Engineering Research And Applications Www.Ijera.Com Issn : 2248-9622, Vol. 4, Issue 5(Version 1), May 2014, Pp.123-131.