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EXPERIMENTAL INVESTIGATION ON UTILIZATION OF POLYESTER FIBRES FOR ENHANCED PROPERTIES OF CONCRETE

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Abstract - *In this project an experimental investigation of concrete was done by utilizing polyester fibers of various percentages (0.20%, 0.40%, 0.60%). A total of 36 concrete cubes, concrete cylinders and concrete beams were casted for compression test, split tensile test and flexural test. Compression test was done for the casted concrete cubes using a "Universal testing machine" (UTM) and the strength of the cubes casted was determined for 7, 14 and 28 days. Similarly the flexural strength of the casted concrete beams and also the tensile strength of the casted concrete cylinders was determined using a "Universal testing machine" (UTM) for 7, 14 and 28 days.*

Polyester fibers were used as a replacement of cement. The replacement of the cement was done as 0.20%, 0.40% and 0.60% of fiber. The comparison was made with 0% replacement of fiber with 0.20% replacement, 0% replacement of fiber with 0.40% replacement, 0% replacement of fiber with 0.60% replacement. The highest compressive strength was observed when the cement was replaced with 0.40% of fiber with a value of 17.87 N/mm² after 7 days, 21.86 N/mm² after 14 days and 25.49 N/mm² after 28 days. The highest flexural strength was observed when cement was replaced with 0.40% of fiber with a value of 4.397 N/mm² after 7 days, 6.68 N/mm² after 14 days and 10.98 N/mm² after 28 days. The highest tensile strength was observed when the cement was replaced with 0.40% of fiber with a value of 1.407 N/mm² after 7 days, 2.465 N/mm² after 14 days and 2.846 N/mm² after 28 days. The graphs for compression strength, flexural strength and split tensile strength were plotted accordingly.

***Key Words*: Fibre, Compressive Strength, Flexural Strength, Split tensile Strength, Polyester Fibre.**

1. INTRODUCTION

With a yearly manufacture of above 7 billion tons to being most broadly used structural material. In this world, concrete plays the main part in construction field. But this concrete cracks because of numerous reasons. The reasons adding to the crack formation in concrete could be structural, environmental, economic factors however utmost cracks happen because of characteristic weakness in material to repel tensile forces. Likewise in specific conditions, concrete may shrink and it cracks when it is retained. The fiber reinforcement suggests an answer to cracking, by creating concrete extra ductile and tougher. The field trials completed and by wide research in past 3 decades infer that, the adding of fiber within conventional plain or pre-stressed concrete members or reinforced, during the period of mixing and generation confers upgrades to a few properties of concrete, particularly related to strength durability and performance. At the point when the fragile matrix in concrete shall be reinforced with fibers, evenly distributed in the whole mass, gets strengthened extremely, thereby tending matrix to carry on as an composite substantial with the properties essentially different kind of conventional concrete.

Fiber is known to be utilized since olden times to strengthen brittle materials. Horse hair was utilized for reinforcing masonry mortar and plaster as well as straw was utilized for reinforcing sun baked blocks.

2. FIBRE REINFORCED CONCRETE (FRC)

Concrete comprising hydraulic cement, water and aggregates as also discontinuous discrete fibre is said as fibre reinforced cement. It might contain pozzolonas and different admixtures generally utilized with concrete. Fibres of unlike shapes and also sizes developed from the steel, plastic, glass and also natural materials are utilized. However for structural and also for non-structural purposes steel fibre was most regularly used of all fibers. But studies shows that polyester fibres also incorporate well with concrete and gives improve mental results in contrast to conventional concrete.

3. TOUGHENING MECHANISM

Load deflection curve for FRC and plain concrete is as in the figure. FRC continues to withstand certain loads, also at deflections substantially in addition of fracture deflection on the plain concrete; then again, plain concrete fails all of a sudden once the deflection in approving to the ultimate flexural strength surpasses. Experimentation on fractured specimens on FRC demonstrates that failure occurs mostly due to bonding of fibres and matrix or fibre pull out this proves that a FRC sample do not break rapidly after appearance of first crack not like plain concrete. Henceforth we can state, it has the benefit of increasing the work of fracture, which is mentioned to as toughness and is indicated by area underneath load deflection curve. From the structural and material opinion, it has a minute balance in optimising the bond among matrix and fibres. The fibres can slide out at lesser loads and shall add less to crack bridging if at all fibres have weak bonds with the matrix. In such circumstance the fibres don't have a capability to rise toughness of system. Likewise, if the bonding amongst fibre and matrix is too big in order to strong, huge quantity of fibres may break before they dissipate energy by sliding out. It is imperative to underscore the part of fibre size on mechanical conduct of composite. It is obligatory to have a high amount of short fibres to link the high amount of micro cracks in composite underneath the load to avoid huge strain localisation. It is easy to optimise mixture proportions to incorporate short fibres and obtain high workability. The strength and also ductility of composite is expanded by the even distribution of short fibres. The bridge discrete macro-cracks at higher loads, long fibres will be required, anyways, volume fraction for long fibres could be two minor than volume fraction for short fibres. Workability of mix lessens altogether due to the presence of long fibres and also its volume fraction should to be properly decided. In specific applications like slurry in filtered fibred concrete (SIFCON) workability is certainly not a major deal and consequently a huge level of long fibre shall be utilized.

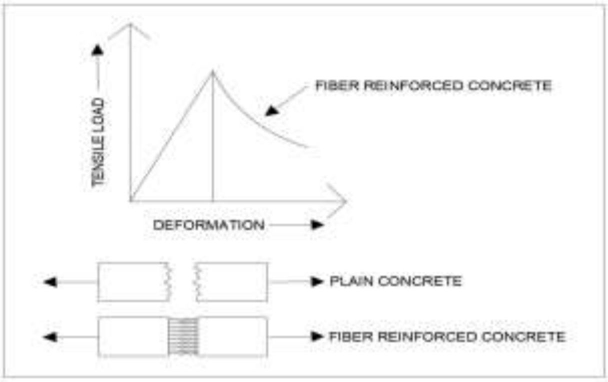


Fig. 1 Toughness mechanism

4. STRUCTURE OF POLYESTER FIBRE

It is a triangular synthetic fibre called polyester fibre. The fibre adopted is 12 mm long virgin triangular monofilament polyester. Its aspect ratio is smaller than 360. This 12 mm fibre length is satisfactory for mean sized aggregate of 20 mm. Young's modulus is larger than 6500 MPa.

5. ENGINEERING PROPERTIES OF RECRON 3S.

1. Rise in compressive strength by 12 to 16% for normal mix is needed.
2. Rise in flexural strength by 7 to 20%for normal mix is desirable.
3. Rise in split tensile strength by 7 to 22% for normal mix is desirable.
4. Reduction in water percolation is desired for normal mix.
5. Below 5 bar pressure the permeability is reduced to nil.
6. For normal mix, energy absorption is desired to be increased by 50%.
7. Residual strength is 2 to 15 times of plain concrete and toughness being 6 to 12 times.

6. AIM OF THE EXPERIMENT

1. In the area of special concrete, FRC constitutes the most appropriate innovations.

2. Ordinary concrete has a tendency to become brittle and develop cracks because weak tensile strength by facing frequent stress, corrosion and temperature variation.

3. The capability to with stand frequently applied shock or impact loading and also energy absorption property is considerably increased since the adding of fibre gives the alteration from a brittle to ductile kind of material.

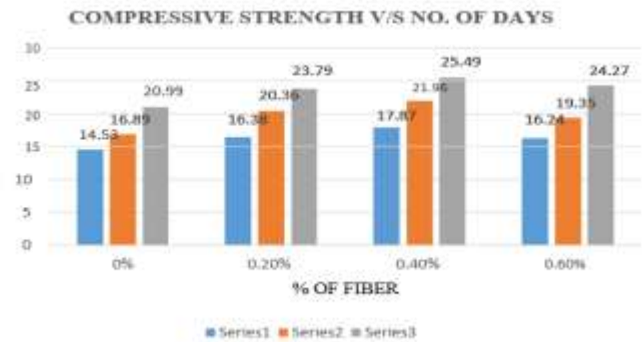
4. Static and also dynamic properties are developed since fibres in concrete perform as crack arrestors.

7. TESTS CONDUCTED

1. Compressive strength test.
2. Split tensile strength of concrete.
3. Flexural strength of the concrete.

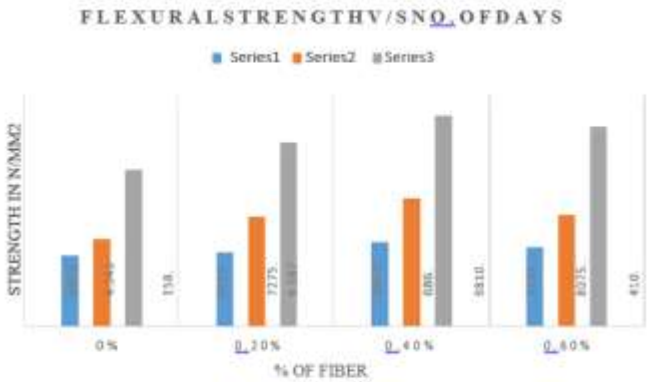
8. RESULTS

8.1. COMPRESSION TEST



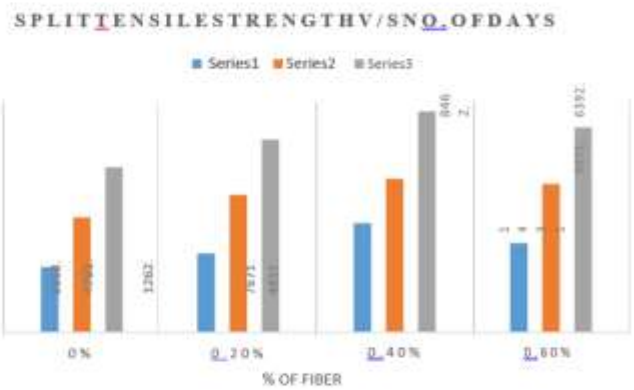
Graph 1 Compressive strength V/S no. of days for all % of fiber

8.2. FLEXURAL TEST



Graph 2 Flexural strength V/S no. of days

8.3 SPLIT TENSILE TEST



Graph 3 Split tensile strength V/S no. of days

9. CONCLUSIONS

1. The maximum compressive strength is obtained when the percentage of fiber added is 0.40%, the maximum compressive strength being 25.49 N/mm^2.

2. The maximum flexural strength is obtained when the percentage of fiber added is 0.40%, the maximum flexural strength being 10.98 N/mm^2.

3. The maximum split tensile strength is obtained when the percentage of fiber added is 0.40%, the maximum flexural strength being 2.846 N/mm^2.

4. It is found that the compressive strength, flexural strength and split tensile strength is the highest at 0.40% addition of fibers and reduces when the percentage of fiber added exceeds 0.40%.

5. Since the 28 days split tensile strength is found to be increased, these fibers can be used as secondary replacement with steel.

6. These fibers when used as secondary reinforcements can lead to considerable cost savings.

7. At higher percentage of addition of fibers, due to less bonding of the fibers with the concrete mix results in over strength.

10. FUTURE SCOPE

1. These fibers can be used as secondary reinforcements with steel due to its ductile properties.

2. This can have considerable saving in cost of steel.

3. This fiber reinforced concrete can be studied and tested for marine condition for construction of hydraulic structures.

4. The behavior of these concrete for pavement surfaces can be tested. The fibers can be tested for secondary reinforcement with steel which could well reduce the quantity of steel used.

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