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STUDY ON RECRON3S FIBER REINFORCED CONCRETE WITH SILICA FUME AS A PARTIAL REPLACEMENT OF CEMENT

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Abstract - *Concrete is a versatile material of construction throughout the world for its inherent properties. It is well learnt that concrete is strong in compression and weak in tension. Development of crack in concrete is one of the major problems, which is due to brittleness of concrete and also heat of hydration. In order to improve the tensile property to the concrete, the use of fibers is recommended. In the present study, Recron3s fibers and silica fume are used in the conventional concrete and the compressive, tensile and flexural strengths obtained at 3 days,7 days,28 days, and 56 days are compared with conventional concrete. Silica fume is replaced at 5%, 10%, 15% and 20% of cement and the optimum is observed at 10% replacement. Then Recron3s fibers are added at 0.1%, 0.2%, 0.3% and 0.4% of cement. The test results had shown enhanced strengths at 10% silica fume and Recron3s fibers.*

Key Words: **Silica fume, Recron3s fiber, Cement, Strength Properties, Tensile Strength.**

1. INTRODUCTION

In construction industry, strength is a primary criterion in selecting a concrete for a particular application. The concrete used for gaining strength over a long period of time after casting. The characteristic strength of concrete is defined as the compressive strength of a sample that has been aged for 28 days. Neither waiting 28 days from such a test would not serve the rapidity of construction nor would neglecting it serve the quality control process on concrete in large construction sites. Therefore, rapid and reliable prediction of the strength of concrete would be of great significance. For example, it provides a chance to do the necessary adjustment on the mix proportion used to avoid the situation where concrete does not reach the required design strength or by avoiding concrete that is unnecessarily strong and also for more economic use of raw materials and fewer construction failures, hence reducing construction cost. Usage of Recron3s fiber is satisfying the flexural values and replacement of silica fumes with respect to cement is giving high early strength properties. Recron3s is proven performance in various experiments and comes in various lengths to suit applications. By usage of silica fume in practical experiments gives enhanced durability to whole structure and increases the bonding strength completely. By using these materials in practically results from flexural are completely satisfied. In construction of tanks and pavements gives best results in construction industry. Further the chemical reactions and elevated temperatures are studied like very low permeability to chloride and water intrusion to structures.

2.Materials used.

The details of the materials used with their properties are mentioned as follows

2.1 Cement

Ordinary Portland cement available in the local market of standard brand was used in the investigation. Care has been taken to see that the procurement made from a single batch is stored in airtight containers to prevent it from being affected by the humidity atmospheric and monsoon moisture.

2.2 Fine aggregate

The locally available river sand is used as fine aggregate in the present investigation. The sand is free from clay, silt and organic impurities. The fine aggregate used were should confirmed to the standard specifications as per IS: 2386-1963. The fine aggregate used is river sand confirming to zone –II. It is clean, free from organic matter, silt & clay. The specific gravity of fine aggregate is 2.67 and fineness modulus is 2.674.

2.3 Coarse aggregate

Machine crushed angular granite metal of 20mm nominal size from the local source is used as coarse aggregate. It is free from impurities such as dust, clay particles and organic matter etc... The coarse aggregate is also tested for its various properties. The coarse aggregate used was also confirmed to the standard specifications.

2.4 Water

The locally available potable water accepted for local construction is used in the experimental investigation after testing. The p^H value should not be less than 6.

2.5 Admixtures

High range water the reducing admixtures known as super plasticizers are used for improving or workability for decreased water-cement ratio without decreasing the compressive strength.

2.6 Micro silica

It is a very reactive and effective pozzoloanic material due to its fine particle size and high purity of sio2 (99.5 %) content. It enhances the mechanical properties, durability and constructability in concrete. It is used in the production of high early strength.

2.7 Recron 3s fiber

Recron-3s is a discrete, discontinuous short fiber that can be used in concrete to control and arrest cracks. It arrests shrinkage cracks in concrete and increases resistance to water penetration, abrasion and impact.

3 Mixing Proportions

At first a nominal mix for M25 grade concrete was prepared in the general procedure and three sets of each mould like cube, cylinder and prisms were casted and are tested for compressive strength, split tensile test and flexure test respectively. To the mix obtained above a replacement of Silica fume is done at 5%, 10%, 15%, and 20% and they are tested for the above said tests and the test results are tabulated below in table 1,2,3.

Table -1: Compressive Strength

Compressive Strength Values for Silica Fume Concrete					
S.no	**Silica fumes (%)**	**3 days Compressive strength(MPa)**	**7 days Compressive strength(MP)**	**28 days Compressive strength(MPa)**	**56 days Compressive strength(MPa)**
1	0	11.89	32.69	48.45	50.09
2	5	12.44	33.3	48.87	50.18
3	**10**	**13.53**	**36**	**51.25**	**53.01**
4	15	12.19	33.12	48.67	50.45
5	20	11.43	32.17	47.85	47.98

Table -2: Split Tensile Strength

Split Tensile Strength Values for Silica Fume Concrete					
S.no	**Silica fumes (%)**	**3 days Split tensile strength (MPa)**	**7days Split tensile strength(MPa)**	**28 days Split tensile strength(MPa)**	**56 days Split tensile strength(MPa)**
1	0	1.65	2.54	3.68	4.06
2	5	1.79	2.83	4.03	4.26
3	**10**	**1.98**	**2.96**	**4.24**	**5.19**
4	15	1.62	2.4	3.68	4.01
5	20	1.48	2.3	3.57	3.83

Table -3: Flexural Strength

Flexural Strength Values for Silica Fume Concrete					
S.no	**Silica fumes (%)**	**3 days Flexural strength (MPa)**	**7days Flexural strength(MPa)**	**28 days Flexural strength(MPa)**	**56 days Flexural strength(MPa)**
1	0	3.12	4.06	4.56	5.11
2	5	3.27	4.15	5.12	5.32
3	**10**	**3.34**	**4.51**	**5.53**	**5.86**
4	15	3.21	4.11	4.86	5.21
5	20	3.09	4.03	4.51	4.85

So the optimum percentage of silica fume is 10% for all strength parameters at all ages as shown above. Fixing the silica fume content as 10%, the optimum content of the Recron3s fibers is determined using various combinations like 0%, 0.1%, 0.2% and the test results are tabulated below in table 4,5,6.

Table -4: Compressive Strength

Compressive Strength Values for Recron3s fiber Based Concrete With 10%Silica Fume					
S.no	**Recron 3s fibers (%)**	**3 days Compressive strength(MPa)**	**7 days Compressive strength(MP)**	**28 days Compressive strength(MPa)**	**56 days Compressive strength(MPa)**
1	0.1	13.21	34.02	49.17	51.07
2	0.2	13.41	35.81	51.23	52.17
3	**0.3**	**14.62**	**37.23**	**59.81**	**54.09**
4	0.4	13.02	33.41	47.56	49.07

Table -5: Split Tensile Strength

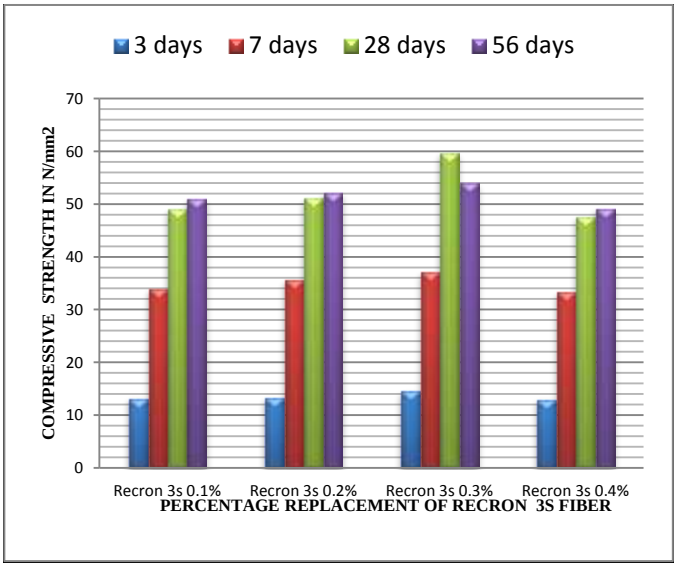
Split Tensile Strength Values for Recron3s fiber Based Concrete With 10%Silica Fume					
S.no	**Recron 3s fibers (%)**	**3 days Split tensile strength(MPa)**	**7days Split tensile strength(MPa)**	**28 days Split tensile strength(MPa)**	**56 days Split tensile strength(MPa)**
1	0.1	1.64	2.52	3.88	4.19
2	0.2	1.82	2.71	4.23	4.66
3	**0.3**	**2.01**	**3.21**	**4.34**	**5.26**
4	0.4	1.60	2.51	3.79	4.07

Table -6: Flexural Strength

Flexural Strength Values for Recron3s fiber Based Concrete With 10%Silica Fume					
S.no	Recron 3s fibers (%)	3 days Flexural strength(MPa)	7days Flexural strength(MPa)	28 days Flexural strength(MPa)	56 days Flexural strength(MPa)
1	0.1	3.41	4.11	5.26	6.12
2	0.2	3.46	4.26	5.41	6.75
3	**0.3**	**3.58**	**4.72**	**6.71**	**7.01**
4	0.4	3.36	4.18	5.57	6.79

3 Results and Discussions

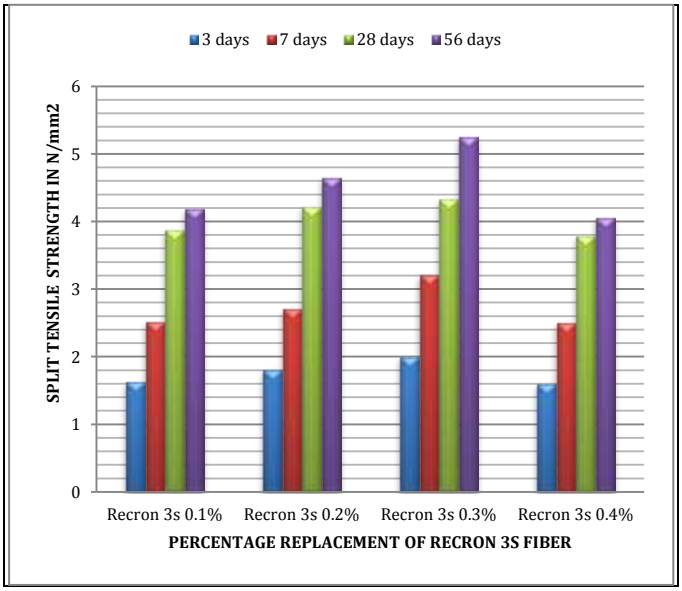
- From data of table.4, the Compressive strength of concrete at all ages is graphically represented in graph.1.



Graph -1: Compressive Strength

It is found that the compressive strength is increased at 0.3% of Recron3s fibers replacement to cement at all ages. The % increase of strength at 3 days is 10.673MPA, at 7 days is 9.435MPA, 28 days is 21.639MPA and 56 days is 5.913MPA.

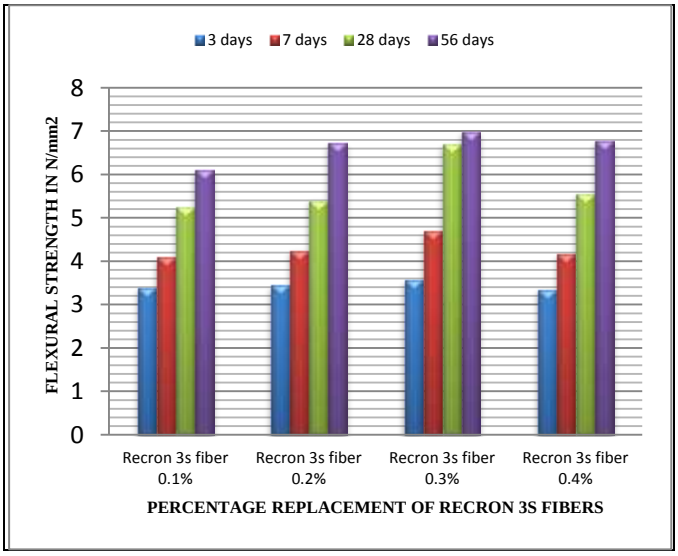
- From data of table.4, the split tensile strength of concrete at all ages is graphically represented in graph.2.



Graph -2: Split tensile Strength

It is found that the split tensile strength is increased at 0.3% of Recron3s fiber replacement to cement at all ages. The % increase of strength at 3 days is 22.560MPA at 7 days is 27.380MPA, 28 days is 11.855MPA and 56 days is25.536MPA.

- From data of table.6, the Flexural strength of concrete at all ages is graphically represented in graph.3.



It is found that the split tensile strength is increased at 0.3% of Recron3s fiber added to cement at all ages. The % increase of strength at 3 days is 4.985MPA, at 7 days is 14.841MPA,28 days is 27.566MPA and 56 days is 14.542MPA

Conclusions

An Observational study was conducted on cubes, cylinders, beams for Compressive Strength, Split tensile Strength and flexural Strength respectively by mixing of Recron3s fiber and Silica Fume.

Based on the investigation the following conclusions were drawn:

1.From the result, it is found that the optimum replacement percentage of cement with silica fume is found to be 10%. When Recron3s fibers are not added.

2.Usage of 0.3% Recron3s fiber and 5 to 10 % of silica fumes is the optimum combination to achieve the desired need.
3.Usage of Recron3s will reduce the cost of maintenance by reducing the micro cracks and permeability and hence the durability will increase. It is found that the use of Recron3s fiber reduce the segregation.

4.The compressive strength also shows an increment of 17.06 % silica fume to the conventional concrete.

5.The split tensile strength of Recron3s fiber with silica fume was increased at 10% silica fume and 0.3% Recron3s fiber.

6.The split tensile strength also shows an increment of 24 % silica fume to the conventional concrete.

7.The flexural strength of Recron3s fiber with silica fumes was increased at 10% replacement silica fume and 0.3 % Recron3s fiber.

8.The flexural strength also shows an increment of 28.83 % silica fume to the conventional concrete.

9.While testing the specimens, the plain cement concrete specimens have shown a typical crack propagation pattern which leaded into splitting of beam in two piece geometry. But due to addition of Recron3s fibers in concrete cracks gets ceased which results into the ductile behavior of fibered concrete.

Future scope study

Usage of Recron3s fiber is satisfying the flexural values and replacement of silica fumes with respect to cement is giving high early strength properties. Recron3s is proven performance in various experiments and comes in various lengths to suit applications. By usage of silica fume in practical experiments gives enhanced durability to whole structure and increases the bonding strength completely. By using these materials in practically results from flexural are completely satisfied. In construction of tanks and pavements gives best results in construction industry. Further the chemical reactions and elevated temperatures are studied like very low permeability to chloride and water intrusion to structures.

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