

Durability Study of Self Compacting Concrete Using Hybrid Glass Fibres

Saminathan.P¹, Jose Ravindra Raj.B²

Post Graduate Student (M.Tech-Structural Engineering), Department of Civil Engineering, PRIST University,
Trichy-Thanjavur highways, Vallam, Thanjavur, Tamilnadu, India. ¹

Assistant Professor, Department of Civil Engineering, PRIST University, Trichy-Thanjavur highways, Vallam,
Thanjavur, Tamilnadu, India. ²

ABSTRACT: Self Compacting Concrete is that concrete which is able to flow under its own weight and completely fill the formwork without segregation, even in the presence of dense reinforcement, without the need of any vibration whilst maintaining homogeneity. Self Compacting Concrete is Used in pre-cast industry, In complicated steel reinforcement area, Construction element in high rise building, Marine structures.

The construction of modern structures calls for the attention of the use of materials with improved properties in respect of strength, stiffness toughness and durability. The typical methods of compaction and vibration of normal concrete generates delays and additional costs in concrete. This has necessitated the research and development of self compacting concrete with better performance

The aim of this project is to study the durability of a self compacting concrete using hybrid glass fibres by preparing Self Compacting Concrete with addition of Glass fibre and Polypropylene. For this research work M-50 grade of concrete is used and the tests are conducted by casting cubes of size 150x150x150mm with the proportion of GF0.06%+0.1%PP and GF0.06% +0.2%PP. The tests are conducted for flow properties, mechanical properties and durability. The results were compared with the results of normal self compacting concrete and it is been tabulated.

I.INTRODUCTION

1.1. CURRENT DEVELOPMENT OF SELF COMPACTING CONCRETE

Self-compacting concrete (SCC) is a flowing concrete mixture that is able to consolidate under its own weight. The highly fluid nature of SCC makes it suitable for placing in difficult conditions and in sections with congested reinforcement. Use of SCC can also help minimize hearing-related damages on the worksite that are induced by vibration of concrete. Another advantage of SCC is that the time required to place large sections is considerably reduced.

When the construction industry in Japan experienced a decline in the availability of skilled labour in the 1980s, a need was felt for a concrete that could overcome the problems of defective workmanship. This led to the development of self-compacting concrete, primarily through the work by Okamura. A committee was formed to study the properties of self-compacting concrete, including a fundamental investigation on workability of concrete, which was carried out by Ozawa et al. at the University of Tokyo. The first usable version of self-compacting concrete was completed in 1988 and was named "High Performance Concrete", and later proposed as "Self Compacting High Performance Concrete".

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

In Japan, the volume of SCC in construction has risen steadily over the years. Data indicate that the share of application of SCC in precast concrete industry is more than three times higher than that in the ready-mixed concrete industry. This is attributable to the higher cost of SCC. The estimated average price of SCC supplied by the RMC industry in Japan was 1.5 times that of the conventional concrete in the year 2002. Research studies in Japan are also promoting new types of applications with SCC, such as in lattice type structures, casting without pump, and tunnel linings.

Since the development of SCC in Japan, many organizations across the world have carried out research on properties of SCC. The Brite-Euram SCC project was set up to promote the use of SCC in some of the European countries. A state-of-the-art report on SCC was compiled by Skarendahl and Petersson summarizing the conclusions from the research studies sponsored by the Brite-Euram project on SCC. A recent initiative in Europe is the formation of the project Testing SCC involving a number of institutes in research studies on various test methods for SCC. In addition, an organization with the participation from the specialty concrete product industry EFNARC has developed specifications and guidelines for the use of SCC that covers a number of topics, ranging from materials selection and mixture design to the significance of testing methods.

Current studies in SCC, which are being conducted in many countries, can be divided into the following categories: (i) use of rheometers to obtain data about flow behaviour of cement paste and concrete, (ii) mixture proportioning methods for SCC, (iii) characterization of SCC using laboratory test methods, (iv) durability and hardened properties of SCC and their comparison with normal concrete, and (v) construction issues related to SCC. These will be relevant to the immediate needs. In addition, the following questions also need particular attention, from a long-term perspective: (i) development of mixture design guideline tables similar to those for normal concrete, (ii) a shift to more 'normal' powder contents in SCC, from the existing high powder mixtures, (iii) better understanding of the problems of autogenous and plastic shrinkage in SCC, and (iv) development of site quality control parameters such as in 'all-in-one', acceptance tests.

ADVANTAGES OF SCC:

- a) Improved filling capacity of highly congested structural members.
- b) Improved health and safety of site.
- c) Allows lighter and more slender structures.
- d) Faster construction time.
- e) Reduced formwork and equipment cost.
- f) Less man power.
- g) Improved durability and good structural performance.
- h) Homogeneity of hardened SCC is better.
- i) SCC can be placed at a faster rate with no mechanical vibration and less screeding, resulting in savings in placement costs.
- j) Improved and more uniform architectural surface finish with little to know remedial surface work.
- k) Improved consolidation around reinforcement and bond with reinforcement.
- l) Improved pumpability.
- m) Resulting cost savings.

1.2 REQUIREMENTS OF SCC

The concrete mix can only be classified as Self Compacting Concrete if the following three characteristics are fulfilled as per EFNARC - 2002.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

1.3 FILLING ABILITY

The ability of SCC to flow into and fill completely all spaces within the formwork, under its own self-weight; Slump flow test was used to determine the filling ability of SCC. Normally the diameter of flow should be in the range of 650 to 800 mm.

1.4 PASSING ABILITY

The ability of SCC to flow through tight openings such as spaces between steel reinforcing bars without segregation. L box test was used to determine the passing ability of SCC. Normally the blocking ratio should be in the order of 0.8 to 1. But the minimum acceptable value is 0.8.

1.5 RESISTANCE TO SEGREGATION

The ability of SCC to remain homogeneous in composition during transport and placing; V-funnel test was used to determine the stability of SCC. Normally the flow time should be in the range of 8 to 12 seconds.

1.6 OBJECTIVE OF THIS WORK

Despite having numerous advantages, it does not reach the common man because of the high material cost. SCC is used only in major projects and it does not serve the whole society due to its high cost. To overcome this limitation, SCC should be made as a cost-effective material so that it could reach the common man also and serve the whole society. Replacing the cement (60 %) partially by local waste materials like fly ash (40 %) would reduce the cost of SCC. Moreover using these materials in construction process will reduce their disposal problems thereby reduce the environmental hazards. So this study includes dual purpose of making SCC a cost effective and proper utilization of waste material that would not affect the environment and also,

- a) To prepare SCC with addition of PFSSCC for M50 grade of concrete
- b) Testing the SCC & PFSSCC for flow properties.
- c) Testing the mechanical properties of SCC and PFSSCC
- d) Testing the durability of SCC & PFSSCC by various tests.

FLOW PROPERTIES

- a) Slump flow
- b) V-funnel
- c) L-box
- d) U-box

MECHANICAL PROPERTIES

- a) Compressive strength
- b) Tensile strength
- c) Flexural strength of concrete

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

DURABILITY STUDIES

- a) Acid tests – Sulphuric Acid, Hydrochloric Acid
- b) Sodium Sulphate
- c) Marine Environment

1.7 NEED FOR STUDY

- a) In recent decades many varieties of concrete is being developed due to various demands.
- b) Highly congested reinforcements in heavy structures demand several varieties of SCC.
- c) SCC is being used in wide variety of structures including marine structures where durability and strength are to be cared.

For new materials like SCC and PFSSCC studies on mechanical properties, durability are of paramount important for initializing confidence in engineers and builders. Hence considering the gap in existing literature an attempt has been made to study the mechanical properties, durability of both SCC and PFSSCC.

II. LITERATURE REVIEW

K.L.Radhika, P.Rathish Kumar (2012) made an attempt to study “The Performance Studies on Standard and High Strength Self Compacting Concretes” Acid durability factor and acid attacking factor highlighting the strength loss and mass loss in geometry were developed. The weight loss concrete cubes increased with the number of days immersion. Weight loss is more for the cube immersed in 5 % H₂SO₄ solution compared to other solutions. However the loss was more when compared normal concrete to self compacting concrete.

Rafat Siddique (2011) made an attempt to study “Properties of self-compacting concrete containing class F fly ash” The mixes were prepared with five percentages of class F fly ash ranging from 15% to 35%. Properties investigated were self- compactability parameters (slump flow, J-ring, V-funnel, L-box and U-box), mechanical and durability properties.

Her-Yung Wang, Wen-Liang Huang (2010) investigates “The properties of self-compacting glass concrete (SCGC)”, where liquid crystal glass sand (0%, 10%, 20%, and 30%) is used in place of aggregates. The results indicate that the slump flow of self-compacting glass concrete (SCGC) increases with higher glass sand content. Additionally, replacing 20% of the aggregates yields the highest compressive and flexural strengths. Self-compacting glass concrete has the highest ultrasonic pulse velocity. After 56 days, the electric resistivity is higher than 20 k Ωcm. Finally, when the volume of glass is increased to 30%, the amount of chloride ion penetration is reduced and the durability of the self-compacting glass concrete is improved.

V. Corinaldesi, G. Moriconi (2009) made an attempt to study “The Durable Fiber Reinforced Self-Compacting Concrete”. Precast elements, a self-compacting concrete was prepared. When manufacturing these elements, homogenously dispersed steel fibers instead of ordinary steel-reinforcing mesh were added to the concrete mixture at a dosage of 10% by mass of cement. An adequate concrete strength class was achieved with a water to cement ratio of 0.40. Compression and flexure tests were carried out to assess the safety of these thin concrete elements. Secondly, the resistance to freezing and thawing cycles was investigated on concrete specimens in some cases superficially treated with a hydrophobic agent. Lastly, both carbonation and chloride penetration tests were carried out to assess durability behavior of this concrete mixture. Concrete strength class was achieved with a water to cement ratio of 0.40. Compression and flexure tests were carried out to assess the safety of these thin concrete elements. Secondly, the resistance to freezing and thawing cycles was investigated on concrete specimens in some cases superficially treated

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

with a hydrophobic agent. Lastly, both carbonation and chloride penetration tests were carried out to assess durability behavior of this concrete mixture.

.P.Srinivasa Rao, Seshadri Sekhar (2009) made an attempt to study “Durability Studies On Glass Fibre SCC, addition Of Glass Fibres Improved Durability of Self Compacting Concrete”. The loss in weight and loss in compressive strength of the cube specimens improved with age. It was noted the durability factors of glass fibres self compacting concrete mixes are more than those of self-compacting concrete mixes. Higher the durability, higher will be the resistance to acid and sulphate attacks.

N.Ganesan, P.V.Indira (2006) made an attempt to study “The Durability Aspects of Steel Fiber - Reinforced Self Compacting Concrete”; it shows that the addition of steel fibres improved the durability aspects of the self compacting concrete. The loss in mass and the compressive strength of cubes were found to be negligible under marine and sulphate attack. It was observed that SFRSCC resists all the attacks within tolerable limits.

.Okumara and ouchi (2003) made investigation for establishing “A Rational Mix Design Method and Self Compactability Testing Methods” have been carried out from the viewpoint of making self- compacting concrete a standard concrete.

III.RESULTS AND DISCUSSION

3.1 MECHANICAL PROPERTY

3.1.1 Compressive strength test

Compressive strength tests were carried out on cubes of 150 mm size using a compression testing machine of 2000 KN capacity as per IS 516:1959.

Table 3.1 compressive strength test

| S.no. | CUBE | 7 DAYS (N/ MM ²) | 28 DAYS (N/ MM ²) |
|-------|---------------------------------|-------------------------------------|---|
| 1. | SCC | 13.00 | 47.96 |
| 2. | SCC with 0.06% GF +0.1%PP | 17.89 | 56.24 |
| 3. | SCC with 0.06%GF+0.2 PP | 17.88 | 53.83 |

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

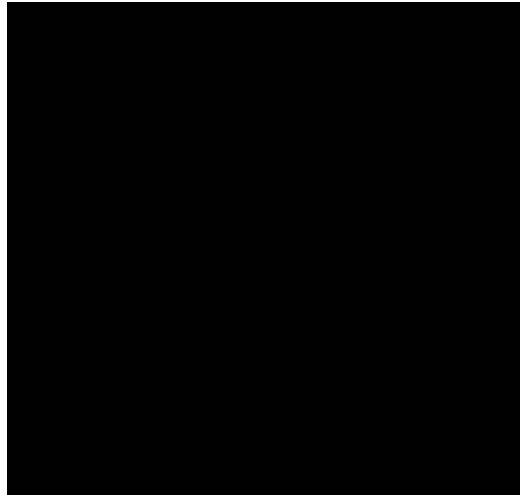


Fig 3.1 compressive strength (n/ mm²)

3.1.2. SPLIT TENSILE STRENGTH TEST

Split tensile strength tests were carried out on cylinders of 150 mm diameter and 300 mm height using a compression testing machine of 2000 KN capacity as per IS 516:1959.

Table 3.2 Split Tensile Strength Test

| 1S.no. | CYLINDER | 7 DAYS (N/ MM ²) | 28 DAYS (N/ MM ²) |
|--------|----------------------------------|---------------------------------------|--|
| 1. | SCC | 2.08 | 2.71 |
| 2. | SCC with 0.06%GF+0.1PP PFS | 2.50 | 3.19 |
| 3. | SCC with 0.06%GF+0.2PP PFS | 2.12 | 2.92 |

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

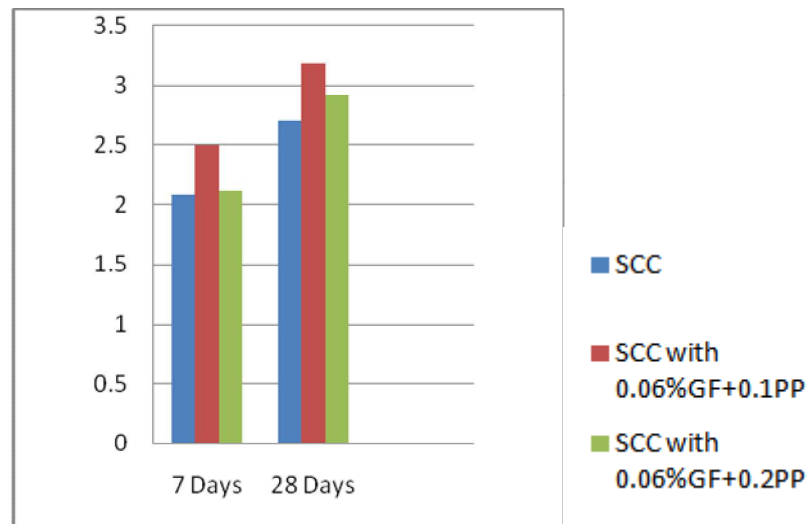


Fig 3.2 split tensile strength (n/mm²)

3.1.3 Flexural strength test

Flexural strength tests were carried out on prisms of size 100×100×500 mm on flexure testing machine of capacity 100 KN as per IS 516:1959.

Table 3.3 Flexural strength test

| S.no. | PRISM | 7 DAYS (N/ MM ²) | 28 DAYS (N/ MM ²) |
|-------|------------------------|------------------------------|-------------------------------|
| 1. | SCC | 6.25 | 7.38 |
| 2. | SCC with 0.06%GF+0.1PP | 7.75 | 7.88 |
| 3. | SCC with 0.06%GF+0.2PP | 8.00 | 8.78 |

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

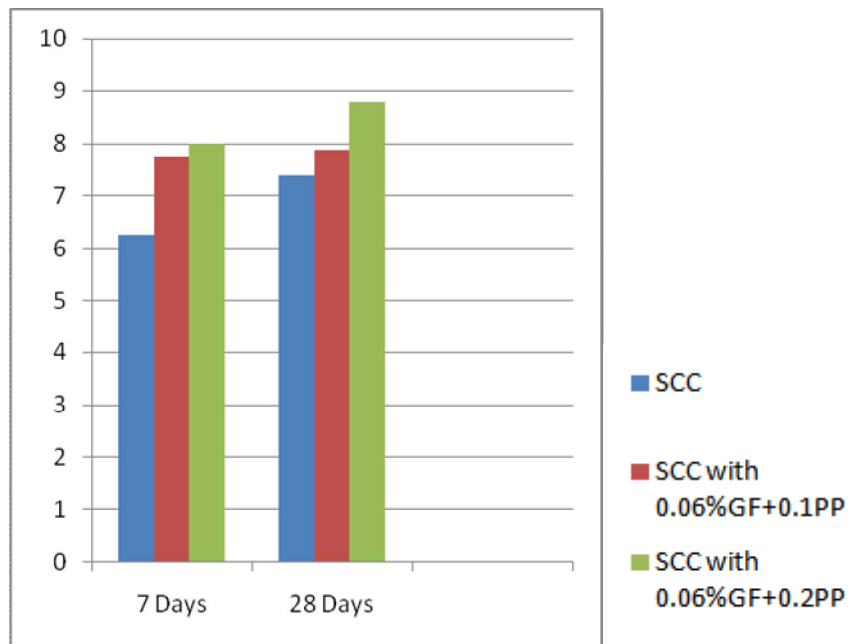


Fig 3.3 flexural strength (n/mm^2)

3.2 DURABILITY STUDIES

ACID ATTACK (H_2SO_4 AND HCL)

Acid attack was determined by immersing specimens of size 150 x 150 x 150 mm test cubes in Sulphuric acid H_2SO_4 (5%) solution and a Hydrochloric acid HCl (5%) solutions. The specimen is weighed and immersed immediately after curing in normal water after 28 days. The deterioration concrete specimens were measured as percentage reduction in weight 7, 28, 56 days, and compressive strength of concrete at 28, 56 days.

SULPHATE RESISTANCE (Na_2SO_4)

Sulphate resistance of concrete was determined by immersing 150 x 150 x 150 mm test cubes at 10% sodium sulphate solution (Na_2SO_4). The specimen is weighed and immersed immediately after curing in normal water after 28 days. The deterioration concrete specimens were measured as percentage reduction in weight 7, 28, 56 days, and compressive strength of concrete at 28, 56 days.

MARINE ENVIRONMENT

The test was carried to study the effect of sea water on the durability of concrete, the specimen includes the cubes size of 150x150mm. The specimens immediately after 28 days of curing were weighed and kept in the prepared Composition of Marine water. The composition of marine water prepared in the laboratory as per ASTM. The percentage of loss in mass determined for 7, 28 and 56 days. The Compressive strength of concrete 28 & 56 days were determined.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

PREPARATION OF SOLUTIONS

- a) 5% - hydrochloric acid
140 liters of water 7 liters of hydrochloric acid (hcl)
- b) 5%-sulphuric acid
130 liters of water 6.5 liters of (h₂so₄)
- c) 10%-sodium sulphate
90 liters of water 9 kg of (na₂s0₄)

3.2.1. HYDROCHLORIC ACID TEST

Table 3.4 weight of cubes measured at 7, 28, 56 days after immersion of hcl

| WEIGHT IN KG FOR 0.00% FIBRE | | | | |
|------------------------------|--------------------|-----------------|------------------|------------------|
| S.no. | ACTUAL CUBE WEIGHT | WEIGHT @ 7 DAYS | WEIGHT @ 28 DAYS | WEIGHT @ 56 DAYS |
| 1. | 7.922 | 7.846 | 7.800 | 7.628 |
| 2. | 7.892 | 7.742 | 7.640 | 7.441 |

Table 3.5 percentage of weight loss in cube (0.00 % FIBRE) at 7, 28, 56 days after immersion of hcl

| % OF WEIGHT LOSS - 0.00% FIBRE | | | |
|--------------------------------|-------|--------|--------|
| S.no. | Day 7 | Day 28 | Day 56 |
| 1. | 0.96 | 1.54 | 2.21 |
| 2. | 1.90 | 1.90 | 5.71 |

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

Table 3.6 weight of cubes measured at 7, 28, 56 days after immersion of hcl

| WEIGHT IN KG FOR 0.06%GF+0.1PP FIBRE | | | | |
|--------------------------------------|--------------------|-----------------|------------------|------------------|
| S.no. | ACTUAL CUBE WEIGHT | WEIGHT @ 7 DAYS | WEIGHT @ 28 DAYS | WEIGHT @ 56 DAYS |
| 1. | 7.893 | 7.839 | 7.820 | 7.654 |
| 2. | 7.840 | 7.736 | 7.713 | 7.524 |

Table 3.7 percentage of weight loss in cube (0.06%gf+0.1pp FIBRE) at 7, 28, 56 days after immersion of hcl

| % OF WEIGHT LOSS - 0.06%GF+0.1PP FIBRE | | | |
|--|-------|--------|--------|
| S.no. | Day 7 | Day 28 | Day 56 |
| 1. | 0.68 | 0.92 | 3.02 |
| 2. | 1.33 | 1.62 | 4.03 |

Table 3.8 weight of cubes measured at 7, 28, 56 days after immersion of hcl

| WEIGHT IN KG FOR 0.06%GF+0.2PP FIBRE | | | | |
|--------------------------------------|--------------------|-----------------|------------------|------------------|
| S.no. | ACTUAL CUBE WEIGHT | WEIGHT @ 7 DAYS | WEIGHT @ 28 DAYS | WEIGHT @ 56 DAYS |
| 1. | 7.889 | 7.848 | 7.837 | 7.437 |
| 2. | 7.972 | 7.880 | 7.694 | 7.332 |

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

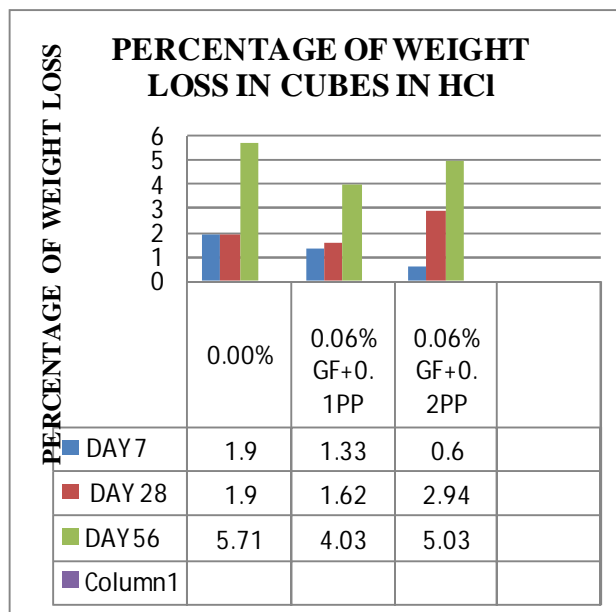
Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

Table 3.9 percentage of weight loss in cube 0.06%gf+0.2pp FIBRE) at 7, 28, 56 days after immersion of hcl

| % OF WEIGHT LOSS 0.06%GF+0.2PP FIBRE | | | |
|--------------------------------------|-------|--------|--------|
| S.no. | DAY 7 | DAY 28 | DAY 56 |
| 1. | 0.52 | 0.66 | 5.73 |
| 2. | 0.60 | 2.94 | 5.03 |

Figure 3.4 Percentage of Weight Loss in Cubes - HCl



3.2.2. SULPHURIC ACID TEST

Table 3.10 weight of cubes measured at 7, 28, 56 days after immersion of h₂so₄

| WEIGHT IN KG FOR 0.00% FIBRE | | | | |
|------------------------------|--------------------|-----------------|------------------|------------------|
| S.no. | ACTUAL CUBE WEIGHT | WEIGHT @ 7 DAYS | WEIGHT @ 28 DAYS | WEIGHT @ 56 DAYS |
| 1. | 7.956 | 7.639 | 7.350 | 7.226 |
| 2. | 7.997 | 7.619 | 7.449 | 7.388 |

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

Table 3.11 percentage of weight loss in cube (0.00 % FIBRE) at 7, 28, 56 days after immersion of h_2so_4

| % OF WEIGHT LOSS - 0.00% FIBRE | | | |
|--------------------------------|-------|--------|--------|
| S.no. | DAY 7 | DAY 28 | DAY 56 |
| 1. | 3.98 | 7.62 | 9.16 |
| 2. | 4.73 | 6.85 | 7.62 |

Table 3.12 weight of cubes measured at 7, 28, 56 days after immersion of h_2so_4

| WEIGHT IN KG FOR 0.06%GF+0.1PP FIBRE | | | | |
|--------------------------------------|--------------------|-----------------|------------------|------------------|
| S.no. | ACTUAL CUBE WEIGHT | WEIGHT @ 7 DAYS | WEIGHT @ 28 DAYS | WEIGHT @ 56 DAYS |
| 1. | 8.056 | 7.719 | 7.400 | 7.199 |
| 2. | 7.689 | 7.329 | 7.134 | 6.990 |

Table 3.13 percentage of weight loss in cube (0.06%gf+0.1pp FIBRE) at 7, 28, 56 days after immersion of h_2so_4

| % OF WEIGHT LOSS - 0.06%GF+0.1PP FIBRE | | | |
|--|-------|--------|--------|
| S.no. | DAY 7 | DAY 28 | DAY 56 |
| 1. | 4.18 | 8.14 | 10.63 |
| 2. | 4.68 | 7.22 | 9.09 |

Table 3.14 weight of cubes measured at 7, 28, 56 days after immersion of h_2so_4

| WEIGHT IN KG FOR 0.06%GF+0.2PP FIBRE | | | | |
|--------------------------------------|--------------------|-----------------|------------------|------------------|
| S.no. | ACTUAL CUBE WEIGHT | WEIGHT @ 7 DAYS | WEIGHT @ 28 DAYS | WEIGHT @ 56 DAYS |
| 1. | 7.928 | 7.556 | 7.264 | 7.034 |
| 2. | 8.018 | 7.606 | 7.335 | 6.872 |

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

Table 3.15 percentage of weight loss in cube (0.06%gf+0.2pp FIBRE) at 7, 2856 days after immersion of h_2so_4

| % OF WEIGHT LOSS - 0.06%GF+0.2PP FIBRE | | | |
|--|-------|--------|--------|
| S.no. | DAY 7 | DAY 28 | DAY 56 |
| 1. | 4.69 | 8.37 | 11.28 |
| 2. | 5.14 | 8.52 | 10.29 |

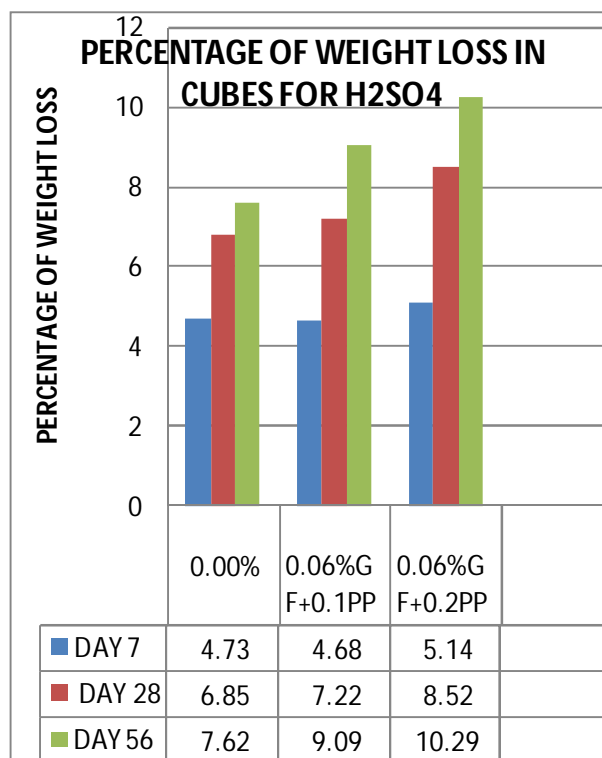


Fig 3.5 percentage of weight loss in cubes – h_2so_4

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

3.2.3. MARINE ENVIRONMENT TEST

Table 3.16 Weight of Cubes Measured At 7, 28, 56 Days after Immersion of Marine Water

| WEIGHT IN KG FOR 0.00% FIBRE | | | | |
|------------------------------|--------------------|-----------------|------------------|------------------|
| S.no. | ACTUAL CUBE WEIGHT | WEIGHT @ 7 DAYS | WEIGHT @ 28 DAYS | WEIGHT @ 56 DAYS |
| 1. | 7.887 | 7.883 | 7.839 | 7.801 |
| 2. | 8.095 | 8.093 | 8.050 | 7.906 |

Table 3.17 percentage of weight loss in cube (0.00 % FIBRE) at 7, 28, 56 days after immersion of marine water

| % OF WEIGHT LOSS - 0.00% FIBRE | | | |
|--------------------------------|-------|--------|--------|
| S.no. | DAY 7 | DAY 28 | DAY 56 |
| 1. | 0.05 | 0.61 | 1.09 |
| 2. | 0.02 | 0.56 | 2.33 |

Table 3.18 weight of cubes measured at 7, 28, 56 days after immersion of marine water

| WEIGHT IN KG FOR 0.06% GF+0.1PP FIBRE | | | | |
|---------------------------------------|--------------------|-----------------|------------------|------------------|
| S.no. | ACTUAL CUBE WEIGHT | WEIGHT @ 7 DAYS | WEIGHT @ 28 DAYS | WEIGHT @ 56 DAYS |
| 1. | 7.700 | 7.695 | 7.653 | 7.649 |
| 2. | 7.972 | 7.963 | 7.921 | 7.879 |

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

Table 3.19 percentage of weight loss in cube (0.06%gf+0.1pp FIBRE) at 7, 28, 56 days after immersion of marine water

| % OF WEIGHT LOSS - 0.06%GF+0.1PP FIBRE | | | |
|--|-------|--------|--------|
| S.no. | DAY 7 | DAY 28 | DAY 56 |
| 1. | 0.06 | 0.61 | 0.66 |
| 2. | 0.11 | 0.64 | 1.17 |

Table 3.20 weight of cubes measured at 7, 28, 56 days after immersion of marine water

| WEIGHT IN KG FOR 0.06%GF+0.2PP FIBRE | | | | |
|--------------------------------------|--------------------|-----------------|------------------|------------------|
| S.no. | ACTUAL CUBE WEIGHT | WEIGHT @ 7 DAYS | WEIGHT @ 28 DAYS | WEIGHT @ 56 DAYS |
| 1. | 7.959 | 7.956 | 7.926 | 7.869 |
| 2. | 8.171 | 8.164 | 8.136 | 8.074 |

Table 3.21 percentage of weight loss in cube (0.06%gf+0.2pp) at 7, 28, 56 days after immersion of marine water

| % OF WEIGHT LOSS - 0.06%GF+0.2PP FIBRE | | | |
|--|-------|--------|--------|
| S.NO. | DAY 7 | DAY 28 | DAY 56 |
| 1. | 0.03 | 0.41 | 1.13 |
| 2. | 0.09 | 0.43 | 1.19 |

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

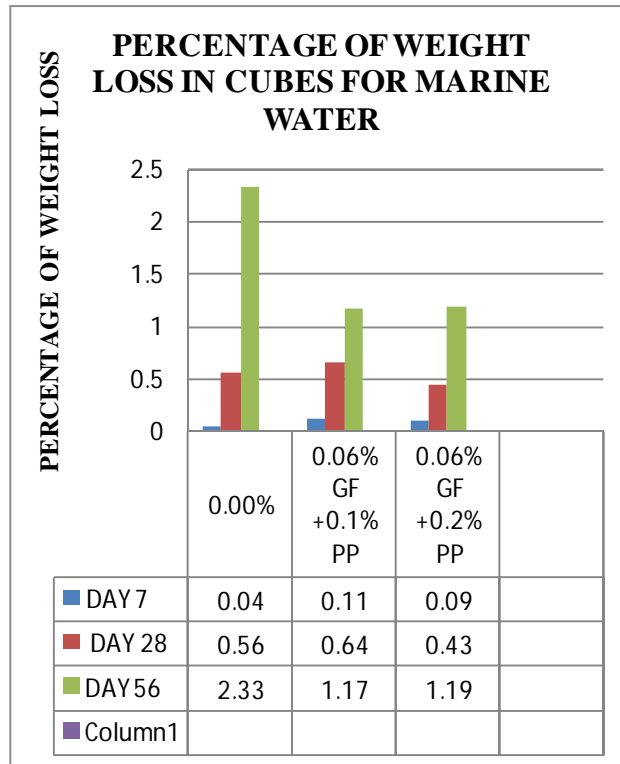


Fig 3.6 percentage of weight loss in cubes – Marine water

3.2.4. SODIUM SULPHATE TEST

Table 3.22 Weight of Cubes Measured At 7, 28, 56 Days after Immersion of Na₂SO₄

| WEIGHT IN KG FOR 0.00% FIBRE | | | | |
|------------------------------|--------------------|-----------------|------------------|------------------|
| S.no. | ACTUAL CUBE WEIGHT | WEIGHT @ 7 DAYS | WEIGHT @ 28 DAYS | WEIGHT @ 56 DAYS |
| 1. | 7.745 | 7.743 | 7.666 | 7.567 |
| 2. | 7.912 | 7.910 | 7.908 | 7.814 |

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

Table 3.23 Percentage of weight loss in cube (0.00 % FIBRE) at 7, 28, 56 Days after Immersion of Na₂SO₄

| % OF WEIGHT LOSS - 0.00% FIBRE | | | |
|-----------------------------------|----------|-----------|-----------|
| S.no.. | DAY 7 | DAY 28 | DAY 56 |
| 1. | 0.02 | 1.02 | 2.30 |
| 2. | 0.02 | 0.05 | 1.24 |

Table 3.24 weight of cubes measured at 7, 28, 56 days after immersion of na₂so₄

| WEIGHT IN KG FOR 0.06%GF+0.1PP FIBRE | | | | |
|--------------------------------------|--------------------------|-----------------------|---------------------------|---------------------------|
| S.no. | ACTUAL CUBE WEIGHT | WEIGHT @ 7 DAYS | WEIGHT @ 28 DAYS | WEIGHT @ 56 DAYS |
| 1. | 7.733 | 7.729 | 7.726 | 7.697 |
| 2. | 7.999 | 7.992 | 7.990 | 7.900 |

Table 3.25 Percentage of weight loss in cube (0.06%GF+0.1PP FIBRE) at 7, 28, 56 Days after Immersion of Na₂SO₄

| % OF WEIGHT LOSS - 0.06%GF+0.1PP FIBRE | | | |
|--|-------|--------|--------|
| S.no. | DAY 7 | DAY 28 | DAY 56 |
| 1. | 0.05 | 0.09 | 0.47 |
| 2. | 0.09 | 0.11 | 1.24 |

Table 3.26 weight of cubes measured at 7, 28, 56 days after immersion of na₂so₄

| WEIGHT IN KG FOR 0.06%GF+0.2PP FIBRE | | | | |
|--------------------------------------|--------------------------|-----------------------|------------------------|------------------------|
| S.no. | ACTUAL CUBE WEIGHT | WEIGHT @ 7 DAYS | WEIGHT @ 28 DAYS | WEIGHT @ 56 DAYS |
| 1. | 8.134 | 8.121 | 8.074 | 7.985 |
| 2. | 7.932 | 7.927 | 7.830 | 7.730 |

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

Table 3.27 Percentage of weight loss in cube (0.06%GF+0.2PP FIBRE) at 7, 28, 56 Days after Immersion of Na_2SO_4

| % OF WEIGHT LOSS - 0.06%GF+0.2PP FIBRE | | | |
|--|-------|--------|--------|
| S.no. | Day 7 | Day 28 | Day 56 |
| 1. | 0.16 | 0.74 | 1.83 |
| 2. | 0.06 | 0.29 | 1.34 |

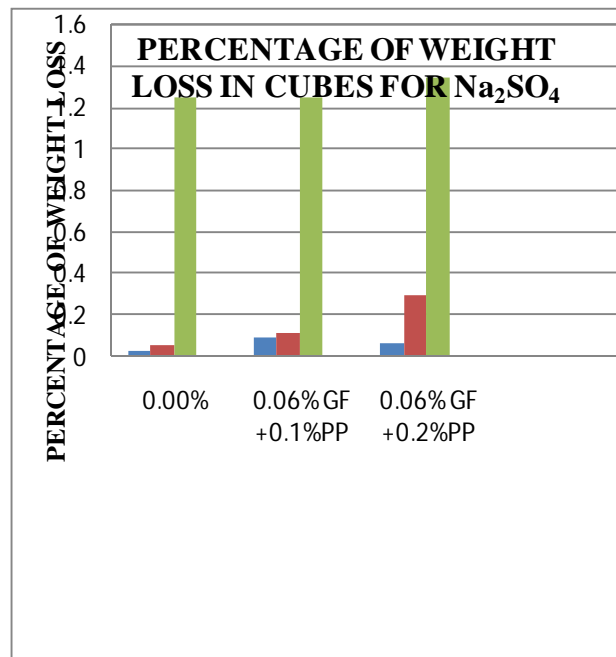


Fig 3.7 percentage of weight loss in cubes – na_2so_4

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

3.3 COMPRESSIVE STRENGTH OF CUBES AFTER IMMERSING IN RESPECTIVE SOLUTIONS

Table 3.28 compressive strength of cubes after immersing in respective solutions at 28 days

| S.no | S.C.C | HCL | H ₂ SO ₄ | MARINE | NA ₂ SO ₄ |
|------|---------------|-------|--------------------------------|--------|---------------------------------|
| 1 | 0 % | 42.79 | 25.29 | 35.80 | 40.55 |
| 2 | 0.06%GF+0.1PP | 21.80 | 27.47 | 21.80 | 35.75 |
| 3 | 0.06%GF+0.2PP | 27.47 | 24.85 | 43.16 | 43.60 |

Table 3.29 compressive strength of cubes after immersing in respective solutions at 56 days

| S.no | S.C.C | HCl | H ₂ SO ₄ | MARINE | Na ₂ SO ₄ |
|------|---------------|-------|--------------------------------|--------|---------------------------------|
| 1 | 0 % | 37.50 | 13.10 | 25.72 | 24.90 |
| 2 | 0.06%GF+0.1PP | 32.30 | 7.90 | 34.00 | 41.91 |
| 3 | 0.06%GF+0.2PP | 28.80 | 12.21 | 45.00 | 47.50 |

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

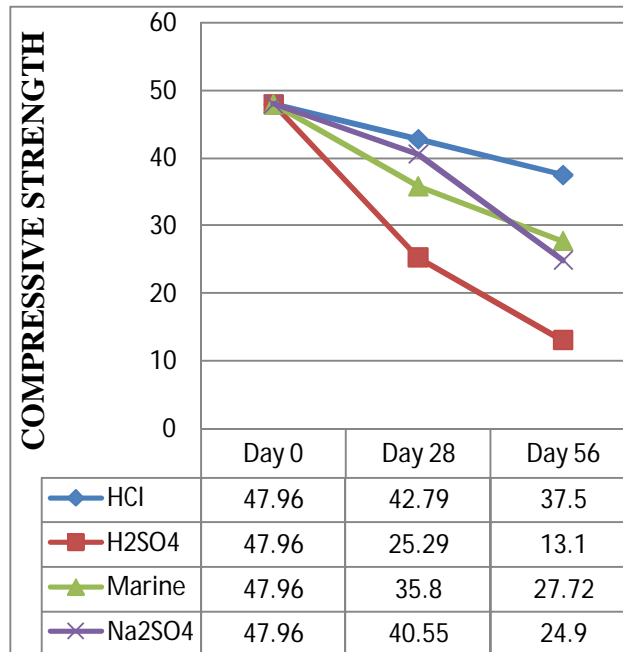


Fig 3.8 compressive strength comparison for 0.00 % of PFSSCC after immersion of test solutions

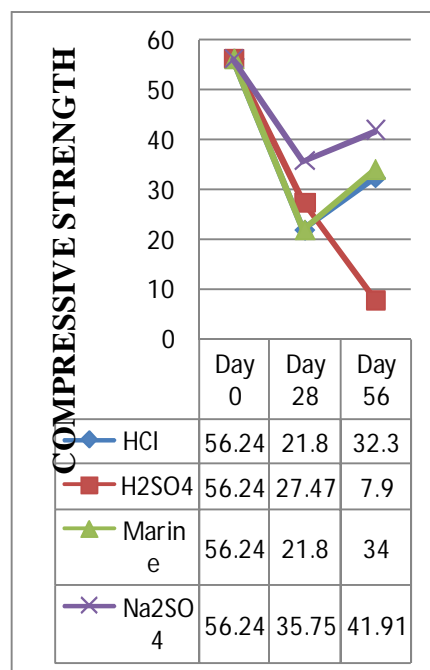


Fig 3.9 compressive strength comparison for 0.06%gf+0.1pp of pfsscc after immersion of test solutions

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

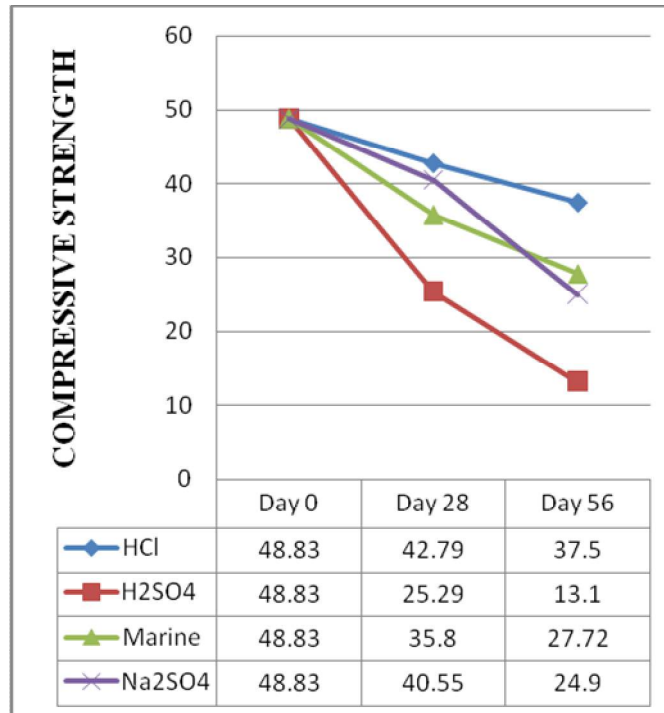


Fig 3.10 compressive strength comparison for 0.06%gf+0.2pp of pfsscc after immersion of test solutions



International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017



Fig 3.11 specimens

SPLIT TENSILE TEST



COMPRESSION TEST



FLEXURAL TEST

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

IV.SUMMARY AND CONCLUSION

CHARACTERISTICS OF SCC MIXES IN FRESH STATE

The filling ability, passing ability & segregation resistance values of PFSSCC mixes compared to Normal SCC mixes indicate that the presence of chopped FIBRE strands did not have any pronounced effect 0.06% GF+0.1%PP and 0.06% GF+0.2%PP. This may be due to the high dispersing nature of the Fibres strands.

COMPRESSIVE STRENGTH

The compressive strength values obtained by testing standard cubes made with different SCC and PFSSCC mixes. All the mixes have shown strength above 50 MPa, which is the required strength. The mix, without chopped FIBRE strands, containing the mineral admixture of FLY ASH (40%) has shown lower compressive strength compared to other PFSSCC mixes. The mix with 0.06%GF+0.1%PP&0.06% GF+0.1%PPFibres, containing the mineral admixture of FLY ASH (40%) has shows somewhat similar amount of compressive strength. Further, the PFSSCC mixes compared to normal SCC mixes have shown an improvement in compressive strength by 17%.

TENSILE STRENGTH & FLEXURAL STRENGTH

The Tensile strength of mixes is obtained (i) by conducting split tensile test on standard cylindrical specimens and also by (ii) by conducting two points bend test on standard prisms. The results indicated that the incorporation of PFS in to the SCC mixes increased the split tensile strength and flexural strengths by 18% and 21% respectively. The increase is significant and it may be due to high tensile strength of PFS

DURABILITY STRENGTH

Based on the experimental results it can be concluded that the self compaction concrete developed had good durability properties. The following conclusion can be drawn from the study.

The weight loss of concrete cubes increased with the number of days of immersion

However the weight loss is more for the cubes immersed in 5% H₂SO₄ solution compared to HCl & other solutions. Percentage of weight loss goes to the maximum of 10.3 %

When SCC was subjected to 10 % Sodium Sulphate the mass variation was not observed much, maximum of 2.5 % .It seems to be negligible.

It is found that the loss in mass in the marine solution is less than 2%, seems to be negligible.

All the SCC and PFSSCC mixes developed satisfied the requirements of self compacting concrete specified by EFNARC.

From above discussion of test results, it can be observed that addition of the PFS tested improves the compressive strength, tensile strength and Durability tests even with small dosage levels of 0.06%GF+0.1PP & 0.06%GF+0.2PP.From above results it is found that the cubes with 0.06%GF+0.1PP FIBRE strands are better durable as that are compared with the other specimens. Hence it is found to be optimum.

The optimum dosage of PFS is fixed to be 0.06%GF+0.1PP as there is no considerable amount of change in compressive, flexural and tensile strength in 0.06%GF+0.2PP of PFS as compared to 0.06%GF+0.1%PP of PFS. With the above discussion it is found out that the results obtained in 0.06%GF+0.1%PP is more when compared to the results obtained for 0.06%GF+0.2%PP

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

REFERENCES

1. **Antonios kanellopoulos, Michael F.Petrou, ioannis ioannou**,in 2012 “Durability performance of self-compacting concrete”, construction and building materials 37 (2012) 320–325,science direct.
2. **Bertil Persson in 2005**”On the internal frost resistance of self-compacting concrete, with and without polypropylene fibres”, 23 September 2005 / accepted: 16 February 2006.
3. **EFNARC in 2002** Specification and Guidelines for Self-Compacting Concrete February. 2002
4. **K.L. Radhika, P.Rathish Kumar and S.Venkateswara rao. in 2012** “The performance studies on standard and high strength Self Compacting Concretes”, ICI journal July to September 2012.
5. **P.Srinivasa rao ,Seshadri Sekhar.T and P Saravan in 2009** , “Durability studies on glass FIBRE SCC addition of glass Fibres improved durability of Self Compacting Concrete” the Indian concrete journal October 2009.
6. **M.S.Shetty**.Concrete Technology
7. **A.R.Santhakumar** Concrete Technology
8. **J Vengala , M S Sundarsan and RV Ranganath in 2003** “Experimental study for obtaining self-compacting concrete”. Indian concrete journal, vol 77, no.8 august 2003, pp.1261-1266.
9. **H.Okamura and M.Ouchi. In 2003** “Self compacting concrete. Journal of advanced concrete technology”, Japan concrete institute, vol 1, 2003, pp5-15.
10. **Ozawa K, Okamura H. in 1995** “Evaluation of self compactability of fresh concrete”, Japan society of civil engineers, 25 (1995) 59-75.