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Experimental Study on Self Curing Fibre Reinforced Concrete using Monofilament and Fibrillated Polypropylene Fibre

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ABSTRACT
Construction industry is one of the fastest emerging industries around the world. Self curing of concrete meet the demand of water by reducing the amount of water required for curing of concrete. Concrete attains its strength by proper curing if there is any negligence in curing it causes adverse effects in concrete strength and its durability. The proper curing is done by adding self curing agent PEG 400 which provides better curing and also enhances the strength of the concrete. Crack formation is one of the major problems in concrete structures which can be overcome by adding fibres. The detailed experimental work is carried out by varying the dosages of PEG 400 by 0.5%, 1.0% and 1.5% by weight of cement and thus by keeping the percentage of monofilament and fibrillated polypropylene fibre by 1% by weight of cement for M30 grade concrete in order to study its strength characteristics. The 1% PEG 400 is optimized for both monofilament and fibrillated polypropylene fibres.

***Keywords**:-Self curing, PEG 400, Monofilament polypropylene fibre, fibrillated polypropylene fibre.*

INTRODUCTION

Self-curing is one of the best method to control the evaporation of water in concrete and make the concrete structure for better in providing serviceability condition. The PEG 400 not only increases the water retention capacity but also reduces the shrinkage of concrete which reduces early age cracking. The formation of micro cracks can be arrested by adding monofilament and fibrillated polypropylene fibres thus by increasing the flexural toughness of the concrete.

The behaviour of self curing concrete using SAP and PEG as self curing agents. The optimum percentage of SAP is 0.3% and PEG is 1% provides considerable strength to concrete (M. Srihari, *et al*, 2016). The 1m^3 concrete requires 3m^3 of water for curing which can be replaced by self curing agents (Prema, *et al*, 2014). The experiment on self compacting concrete using steel fibre and polypropylene fibre then the compressive strength of hybrid fibre reinforcement shows higher strength then that of self compacting concrete with steel and polypropylene fibres (Aslani and Samali 2014). Two self curing agents such as sorbitol and PEG 400 were used in normal concrete and high strength concrete here the PEG 400 of 0.3% gives better strength when compared with sorbitol (K. Vedasakthi, *et al,* 2014).

The permeability of concrete decreases with increase in the replacement of fly ash with cement and in addition of PEG dosages. If PEG increases the penetration of chemicals gets reduced and it prevent the concrete from sulphate attack (A.Aielstein Rozario, *et al*, 2013). The study of fiber reinforced self compacting

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concrete using glass fibre increasing the fibre factor shrinkage is reduced and if the fibre factor less than the critical fibre factor during the time of loading it does not bridge the cracks (Mehdipour, *et al* 2013). Adding of polypropylene fibres of 6mm and 12mm to the light weight cement aggregates among those 12mm fibres with 0.35% gives satisfactory results (Roohollah Bagherzadeh, *et al*, 2012). The usage of self curing agents reduces shrinkage and permeability of the concrete and it improves compressive strength and split tensile strength (Selvamony, et al 2010).

OBJECTIVE

- To study the mechanical properties like compressive strength, split tensile strength and flexural strength of self curing fibre reinforced concrete using monofilament and fibrillated polypropylene fibre.
- To study the stiffness, ductility and energy absorption capacity of SCFRC beam using MFPPF and FPPF with conventional RCC beam.

MATERIALS

Cement

The PPC Cement with specific gravity of 2.90 is used confirming to IS 1489-1991.

Coarse Aggregate

The crushed aggregate of size 20mm with specific gravity of 2.86mm is used confirming to IS 393-1970.

Fine Aggregate

The fine aggregate used in this investigation M-Sand passing through 4.75mm sieve with specific gravity of 2.76 and fineness modulus of 2.63 is used confirming to Zone –II of IS 383.

Polyethylene Glycol 400

PEG 400 is a self curing agent but at the same time it also used as a shrinkage admixture. The hydrogen bond is formed with water molecules hereby increases the surface tension which does not allow water to evaporate out.

Table 1:*-Properties of PEG 400*

S.No	Parameter	Value
1	Appearance	Clear liquid
2	Colour	Colourless
3	Odour	Odourless
5	pH	5-7
6	Density	1.2 g/cc
7	Specific gravity	1.09

Monofilament Polypropylene Fibre

The MFPPF is a synthetic fibre which is smooth and circular in cross section it enhances the strength of concrete.

Table 2:*-Properties of MFPPF*

S.No	Parameter	Value
1	Melting point	162℃
2	Specific gravity	0.91
3	Length	12mm
5	Colour	White
6	Acid and alkali resistance	Nil
7	Water absorption	Nil

Fibrillated Polypropylene Fibre

The number of fibres firmly joins together to form a single strand of fibre which provide better anchorage properties.

Table 3:*-Properties of FPPF*

S.No	Parameter	Value
1	Melting point	165℃
2	Specific gravity	0.91
3	Length	12mm
4	Elongation	15%
5	Ignition point	600℃
6	Colour	White
7	Acid and alkali resistance	Nil
8	Water absorption	Nil

Water

The water used for the mixing of water should be free from sulphates and other harmful chemicals.

MIX PROPORTIONS

The concrete mixes were designed as per IS 10262-2019 for M30 grade of concrete is 1: 1.54: 2.6 for water cement ratio 0.45.

EXPERIMENTAL INVESTIGATIONS

The current experimental program includes seven specimens. The proportions of the specimens were namely S1, S2, S3, S4, S5, S6, and S7 were casted here S1 is control concrete with external curing and the remaining specimens were casted by varying PEG 400 by 0.5%, 1% and 1.5% with MFPPF as 1% and FPPF as 1% respectively.

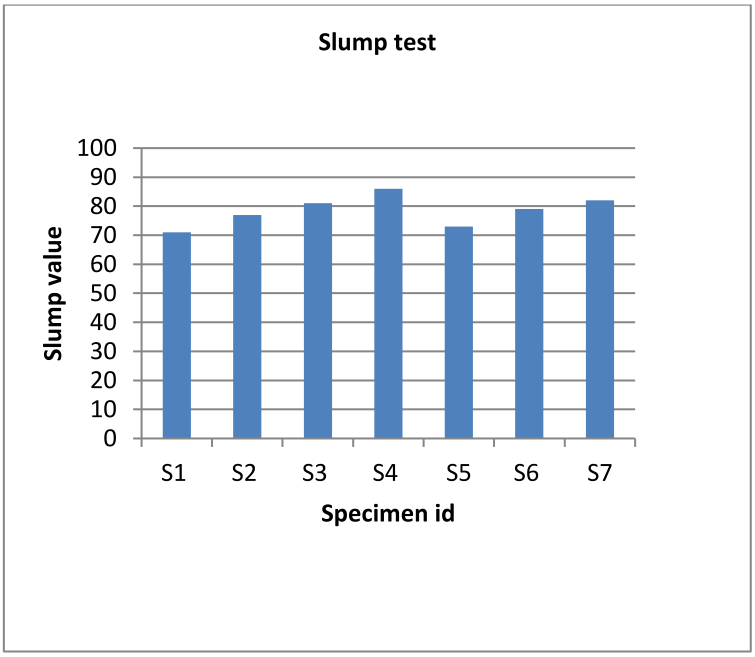

Fig.1:*-Slump Test*

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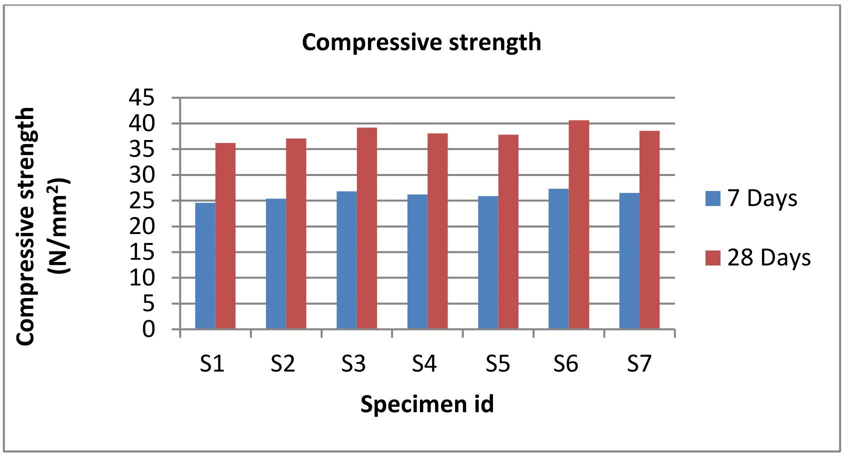

Fig.2:*-Compressive strength of SCFRC*

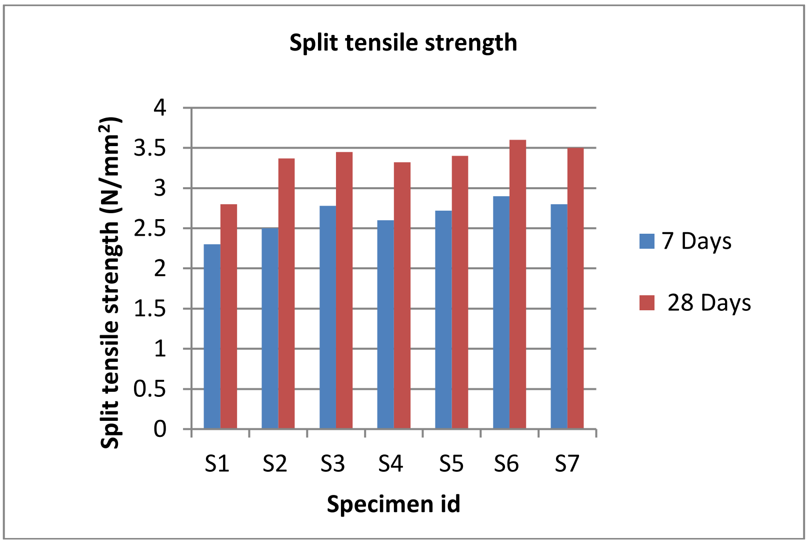

Fig.3:*-Split tensile strength of SCFRC*

FLEXURAL PERFORMANCE OF RC BEAMS

The concrete beams of suitable size 1700x150x100mm were cast. Two points loading was employed for determination of flexural strength under two point loading at the age of 28 days with simply supported end condition.

Table 5:*-Test results of beams*

S.No	Ultimate load (KN)	Mid-span deflection (mm)
S1	33.2	12.86
S2	38.02	16.72
S3	42.3	18.02
S4	34.4	24.02
S5	38.86	16.23
S6	44.8	17.72
S7	33.6	23.35

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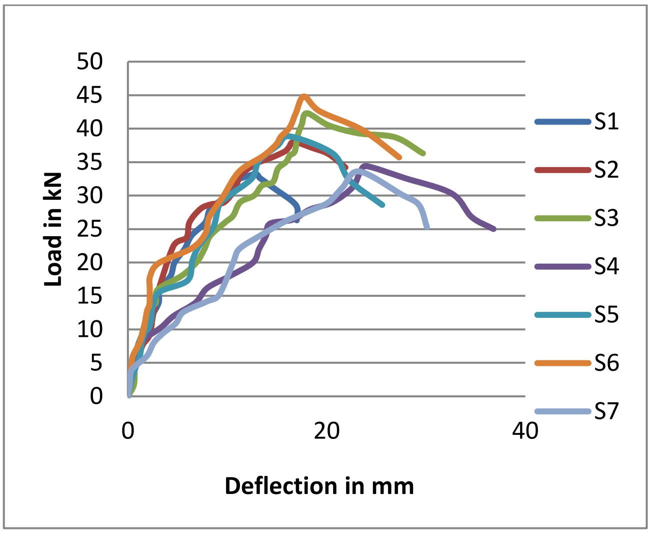

Fig.4:-Load – Deflection behaviour of beams

Displacement Ductility

Ductility is the important phenonmenenon of the materials which undergoes deflection. It is the ratio of yield load deflection to the ultimate load deflections

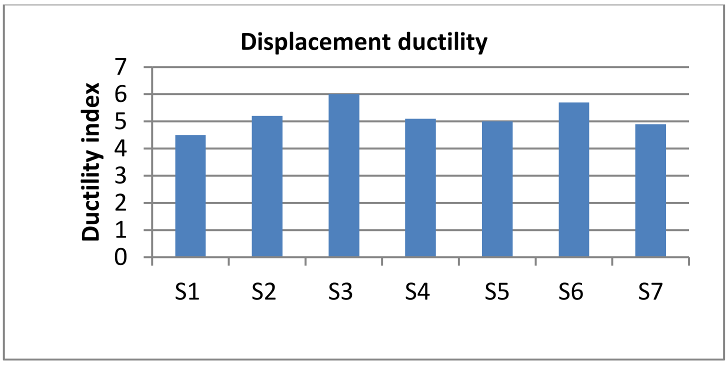

Fig.5:-Displacement Ductility

Stiffness

The stiffness of beams is calculated by the ratio of load to that of its deflection. The stiffness for first crack load is given by the ratio of first crack load to the first crack deflection.

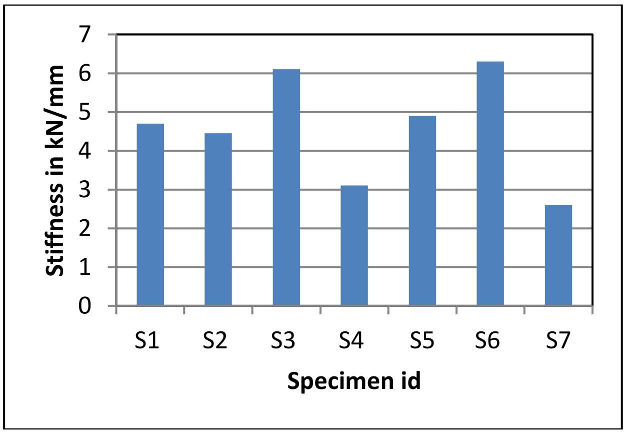

Fig.6:-Stiffness for first crack load

The stiffness for ultimate load is given by the ratio of ultimate load to the ultimate deflection.

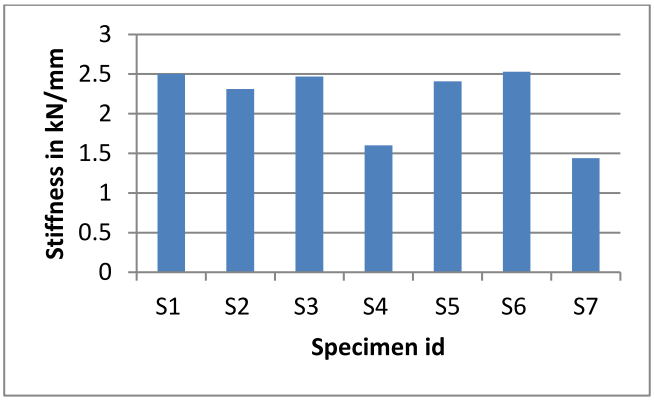

Fig.7:-*Stiffness at ultimate load*

Flexural Toughness

Flexural toughness is measured in terms of energy absorption capacity of the beams which is calculated by area under the curve of ultimate load with its mid span deflection.

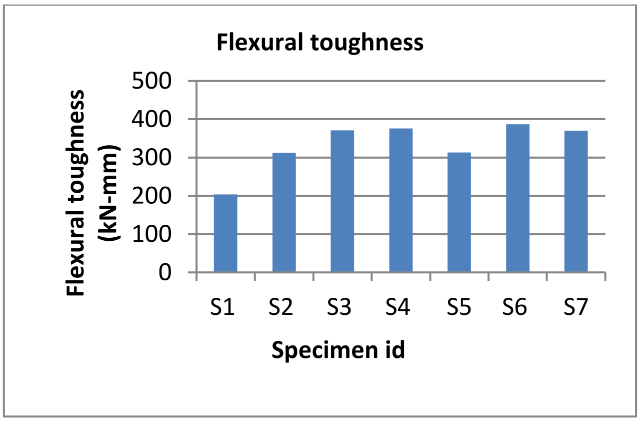

Fig.8:-*Flexural Toughness*

Energy Ductility

The energy ductility may be defined as the ratio of the energy absorbed up to first crack to energy absorbed up to ultimate load.

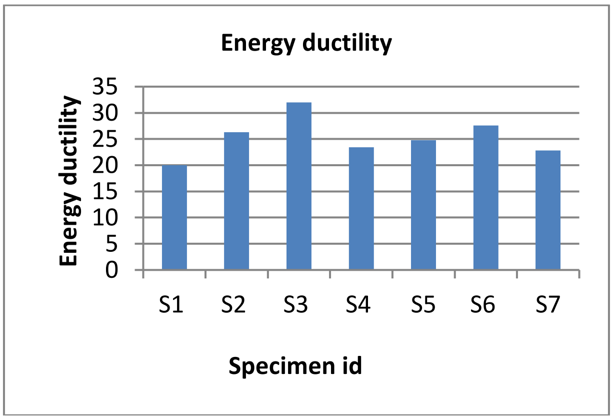

Fig.9:-*Energy Ductility Index*

CONCLUSIONS

The tests on the self-cured fibre reinforced concrete using monofilament and fibrillated polypropylene fibres with the self-curing agent polyethylene glycol 400 was successfully completed and the results were discussed below.

- The compressive strength of monofilament polypropylene fibres can be increased by 8.3% and fibrillated polypropylene fibre can be increased by 12.2% as compared to conventional concrete for optimum percentage 1% of PEG 400.
- The split tensile strength of monofilament polypropylene fibre can be increased by 23.2% and fibrillated polypropylene fibre can be increased by 28.6% as compared to conventional concrete for optimum percentage 1% of PEG 400.
- The flexural behaviour of self curing concrete of MFPPF and FPPF and conventional concrete were studied. The S6 shows higher flexural strength 44.8 KN with 17.72 mm mid span deflection which shows 35% as high as conventional concrete.
- The ductility index and ductility ratio shows that the monofilament and fibrillated polypropylene fibres are increased to that of conventional concrete. The ductility index can be increased by 15.6%**,** 33.3%, and 13.3%, for MFPPF of SCFRC among those 1 % of PEG 400 shows higher value of 33.3% to that of conventional concrete. Then the ductility index can be increased by 11.1%, 27%, and 9% for fibrillated can be among those 1% of PEG 400 shows higher value of 27 % to that of conventional concrete.
- The ductility improvement with addition of monofilament polypropylene fibre shows that 6.3% as higher ascompared to that with the addition of fibrillated polypropylene fibre. Then the ductility ratio for MFPPF is higher than the FPPF.
- In FPPF, the stiffness can be increased by 5.6% to that of conventional concrete for 1% of PEG 400. Then the addition of 1.5% of PEG 400 shows very less stiffness as compared to that of conventional concrete. In MFPPF, the stiffness can only improved by 3.0% to that of conventional concrete for 1% of PEG 400. Here the usage of FPPF shows higher stiffness as that of MFPPF of SCFRC.
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- The energy ductility of SCFRC is higher than that of CC. By using MFPPF the energy ductility can be increased 60% to that of CC for 1% of PEG 400. Using of FPPF, the energy ductility can be increased by 38% to that of CC for 1% of PEG 400. Here the MFPPF is higher than that of FPPF of SCFRC by 22 %.
- The self curing fibre reinforced concrete shows better performance when compared with conventional concrete. The overall strength is increased up to 1% of PEG addition and the strength is found to decrease when the proportion of PEG is increased beyond 1% therefore 1% is optimized.
- Though the optimum percentage of PEG 400 is same for both fibres, the fibres FPPF shows higher stiffness, energy absorption when compared with MFPPF due to its better anchorage properties. At the same time displacement ductility and energy ductility is higher for MFPPF than

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FPPF.

- The usage of self curing agent reduces the water consumption for curing and thereby reduces the cost of water for curing in drought regions.

REFERENCES

1. Geetha, M., & Malathy, R. Comparison of strength properties of concrete on addition of admixtures. *International Journal of computer Applications in Engineering, Technology and Science (IJ-CA-ETS), ISSN*, 0974-3596.
2. Bagherzadeh, R., Pakravan, H. R., Sadeghi, A. H., Latifi, M., & Merati, A. A. (2012). An investigation on adding polypropylene fibers to reinforce lightweight cement composites (LWC). *Journal of Engineered Fibers and Fabrics*, *7*(4), 155892501200700410.
3. Kumar, M. J., Srikanth, M., & Rao, K. J. (2012). Strength characteristics of self-curing concrete. *Nature*, *20*, M40.
4. Francis, A., & John, J. (2013). Experimental investigation on mechanical properties of self-curing concrete. *International Journal of Emerging*, *3*, 641-647p.
5. Kumar, M. M., & Maruthachalam, D. (2013). Experimental Investigation on Self-curing concrete. *International journal of advanced scientific and technical research*, *2*(3).
6. Rozario, A. A., Christy, D. C. F., & Angelin, M. H. (2013). Experimental studies on effects of sulphate resistance on self-curing concrete. *International Journal of Engineering Research & Technology (IJERT) Vol*, *2*.
7. Gifta, C. C., Prabavathy, S., & Kumar, G. Y. (2013). Study on internal curing of high performance concrete using super absorbent polymers and light weight aggregates.
8. Kholia, N. R., Vyas, B. A., & Tank, T. G. (2013). Effect on concrete by different curing method and efficiency of curing compounds-A Review. *International journal of advanced engineering technology*, *4*, 57-60.
9. Vijapur, V., & Tontanal, M. G. An Experimental Investigation On Behavior Of Self Cured Steel Fiber Reinforced Concrete.
10. Dahyabhai, P.,M., Pitroda, J.R. Self-curing concrete: new technique for concrete curing – a literature review. *Journal of International Academic research for Multidisciplinary, 1(9):539-544.*
11. Gambhir, M. L. (2013). *Concrete technology: theory and practice*. Tata McGraw-Hill Education.
12. Neville, A. M. (1995). *Properties of concrete* (Vol. 4). London: Longman."
13. IS 10262:2012 "*IS Recommended guidelines for concrete mix design"*