Study of Conventional Concrete, Fiber Reinforced Concrete and self curing concrete

[1]S. J. Sonule, [2]G.P.Deshmukh

[1]ME student, [2]Assistant Professor
Civil engineering department
Pankaj Laddhad Institute Technology and Management Studies,
Buldana, District, Maharashtra, India

***Abstract*— Today concrete is most widely used construction material due to its good compressive strength and durability. Any laxity in curing will badly affect the strength and durability of concrete. Self-curing concrete is one of the special concretes in mitigating insufficient curing due to human negligence paucity of water in arid areas, inaccessibility of structures in difficult terrains and in areas where the presence of fluorides in water will badly affect the characteristics of concrete. The present study involves the use of shrinkage reducing admixture polyethylene glycol (PEG 400) in concrete which helps in self curing and help better hydration and hence strength. In conventional concrete, micro-cracks develop before structure is loaded because of drying shrinkage and other causes of volume change. In the FRC, a numbers of small fibers are dispersed and distributed randomly in the concrete at the time of mixing, and thus improve concrete properties in all directions. The present study, compare compressive strength of conventional concrete, fiber reinforced concrete (polypropylene fiber) and self curing concrete using PEG400 in different % for M20 and M25 grade of concrete . It is find through this experimental study the compressive strength of self curing concrete using PEG400 is stronger than that of conventional concrete and using polypropylene fiber in fiber reinforced concrete.**

***IndexTerms*— Polyethylene glycol PEG400, Polypropylene fiber, Workability, Compressive tests.**

I. INTRODUCTION

Concrete is the most widely used in construction material has several desirable properties like high compressive strength concrete, stiffness and durability under usual environmental factors. At the same time concrete is brittle and weak in tension. Plain concrete has two deficiencies, low tensile strength and a low strain at fracture. These shortcomings are generally overcome by reinforcing concrete. Normally reinforcement consists of continuous deformed steel bars or pre-stressing tendons. The advantage of reinforcing and pre-stressing technology utilizing steel reinforcement as high tensile steel wires have helped in overcoming the incapacity of concrete in tension but the ductility magnitude of compressive strength.

Fiber reinforced concrete (FRC) is a concrete made primarily of hydraulic cements, aggregates and discrete reinforcing fibres. FRC is a relatively new material. This is a composite material consisting of a matrix containing a random distribution or dispersion of small fibres, either natural or artificial, having a high tensile strength. Due to the presence of these uniformly dispersed fibres, the cracking strength of concrete is increased and the fibres acting as crack arresters. Fibres suitable of reinforcing concrete having been produced from steel, glass and organic polymers. Many of the current applications of FRC involve the use of fibres ranging around 1% by volume of concrete. Recent attempts made it possible to incorporate relatively large volumes of steel, glass and synthetic fibres in concrete. Results of tensile tests done on concretes with glass, polypropylene and steel fibers, indicate that with such large volume of aligned fibres in concrete, there is substantial enhancement of the tensile load carrying capacity of the matrix. This may be attributed to the fact fibre suppress the localization of micro-cracks into macro-cracks and consequently the apparent tensile strength of the matrix increases.

Concrete is the basic engineering material used in most of the civil engineering structures. Its popularity as basic building material in construction is because of its economy of use, good durability and ease with which it can be manufactured at site. Concrete like other engineering materials needs to be designed for properties like strength, durability, workability. With advent of new generation admixtures, it is possible to achieve higher grades of concrete with high workability levels economically. Curing is the maintaining of a satisfactory moisture content and temperature in concrete during its early stages so that desired properties (of concrete) may develop .The concept of self-curing agents is to reduce the water evaporation from concrete, and hence increase the water retention capacity of the concrete compared to conventional concrete. It was found that water soluble polymers can be used as self-curing agents in concrete. Polyethylene Glycol-400(PEG-400) (Used as an internal curing compound):- Polyethylene glycol is a condensation polymer of ethylene oxide and water with the general formula H(OCH2CH2)nOH, where n is the average number of repeating polyethylene groups typically from 4 to about 180. One common feature of PEG appears to be the water-soluble nature. Polyethylene glycol is non-toxic, odorless, neutral, lubricating, non-volatile and non-irritating and is used in a variety of pharmaceuticals. Thus, it is a shrinkage reducing admixture.

Conventional Concert

Concrete is prepared from a mixture of coarse and fine aggregates, Portland cement (PC), and water. Other additives such as fly ash and different types of admixtures such as air-entraining agents, accelerators, retarders, and plasticizers also may be used to improve the concrete's capabilities for workability and/or strength. Before concrete is produced, the components that make up concrete are tested for their qualitative performances. The aggregates for concrete are usually tested for gradation, hardness,

specific gravity, absorption, and organic material impurities. PC usually is tested for consistency, initial and final set, soundness, and strength (with mortar). Water is tested at the source of supply for its purity and portability. Admixtures usually are considered acceptable on certification from the supply after mixing the components, fresh concrete is produced and transported to the field to be poured into its final place for hardening. Subsequently, a test for consistency, named the "slump test", is carried out on concrete samples.

Self Curing Concrete

Excessive evaporation of water (internal or external) from fresh concrete should be avoided; otherwise, the degree of cement hydration would get lowered and thereby concrete may develop unsatisfactory properties. Curing operations should ensure that adequate amount of water is available for cement hydration to occur. This paper discusses different aspects of achieving optimum cure of concrete without the need for applying external curing methods.

Fiber-Reinforced Concrete

(FRC) is concrete containing fibrous material which increases its structural integrity. It contains short discrete fibres' that are uniformly distributed and randomly oriented. Fibres' include steel fibres, glass fibre, synthetic fibres and natural fibres – each of which lend varying properties to the concrete. In addition, the character of fibre-reinforced concrete changes with varying concretes, fibre materials, geometries, distribution, orientation, and densities. Fibre reinforced concrete (FRC) is a concrete made primarily of hydraulic cements, aggregates and discrete reinforcing fibres. FRC is a relatively new material. This is a composite material consisting of a matrix containing a random distribution or dispersion of small fibres, either natural or artificial, having a high tensile strength. Due to the presence of these uniformly dispersed fibres, the cracking strength of concrete is increased and the fibres acting as crack arresters. Fibres suitable of reinforcing concrete having been produced from steel, glass and organic polymers. Many of the current applications of FRC involve the use of fibres ranging around 1% by volume of concrete. Recent attempts made it possible to incorporate relatively large volumes of steel, glass and synthetic fibres in concrete. Results of tensile tests done on concretes with glass, polypropylene and steel fibres, indicate that with such large volume of aligned fibres in concrete, there is substantial enhancement of the tensile load carrying capacity of the matrix. This may be attributed to the fact fibres suppress the localization of micro-cracks into macro-cracks and consequently the apparent tensile strength of the matrix increases Concrete develops micro cracks with curing and these cracks propagate rapidly under applied stress resulting in low tensile strength of concrete. Hence addition of fibers improves the strength of concrete and these problems can be overcome by use of Polypropylene fibers in concrete. Application of polypropylene fibers provide strength to the concrete while the matrix protects the fibers.The primary role of fibres in a cementitious composite is to control cracks, increase the tensile strength, toughness and to improve the deformation characteristics of the composite.The performance of FRC depends on the type of the fibers used.Inclusion of polypropylene fibers reduces the water permeability, increases the flexural strength due to its high modulus of elasticity.In the post cracking stage, as the fibers are pulled out, energy is absorbed and cracking is reduced.

II OBJECTIVES

Following are the main objective of this study

1] To study the mechanical characteristics of concrete i.e compressive strength by varying the percentage of of polypropylene fiber from o.5%,1%,1.5% by weight of cement for both M20 and M25 grade on different properties and having different grade of concrete .

2] To study the effect of self curing concrete varying the percentage of PEG400 from 0% to 2% by weight of cement having for M20 and M25 grade of concrete and compare compressive strength with different % of PEG.

3] To study the compressive strength of conventional concrete with M20 and M25 grade of concrete

4] Finally compare the compressive strength of conventional concrete, polypropylene concrete and self curing concrete using PEG400

III EXPERIMENTAL PROGRAMME

1] **Materials**

Cement PPC- 53 grade available in local market is used in the investigation. The cement used has been tested for various proportions as per IS: 4031-1988 and found to be conforming to various specifications of IS: 12269-1987. The specific gravity was 3 and the fineness was 3200 cm2/gm

Coarse aggregate Crushed angular stone from was used as coarse aggregate.

Fine aggregate The specific gravity and fineness modulus was 2.93bulking of sand 20%and silt content in sand is 1%

Polypropylene fibers (PP) The fibers used were fine polypropylene monofilaments .The fibers were supplied by Reliance Industry by name RECRON 3s .It is available in 3 different sizes i.e. 6mm,12mm and 24 mm .In the present investigation 12mm fiber length is used specific gravity 0.91gr/cm^3 water absorption

Polyethylene glycol (PEG 400) –Polyethylene glycol is a condensation polymer of ethylene oxide and water with the general formula H (OCH2CH2) nOH, where n is the average number of repeating ox ethylene groups typically from 4 to about 180. The abbreviation (PEG) is termed in combination with a numeric suffix which indicates the average molecular weights. It is water-soluble in nature.

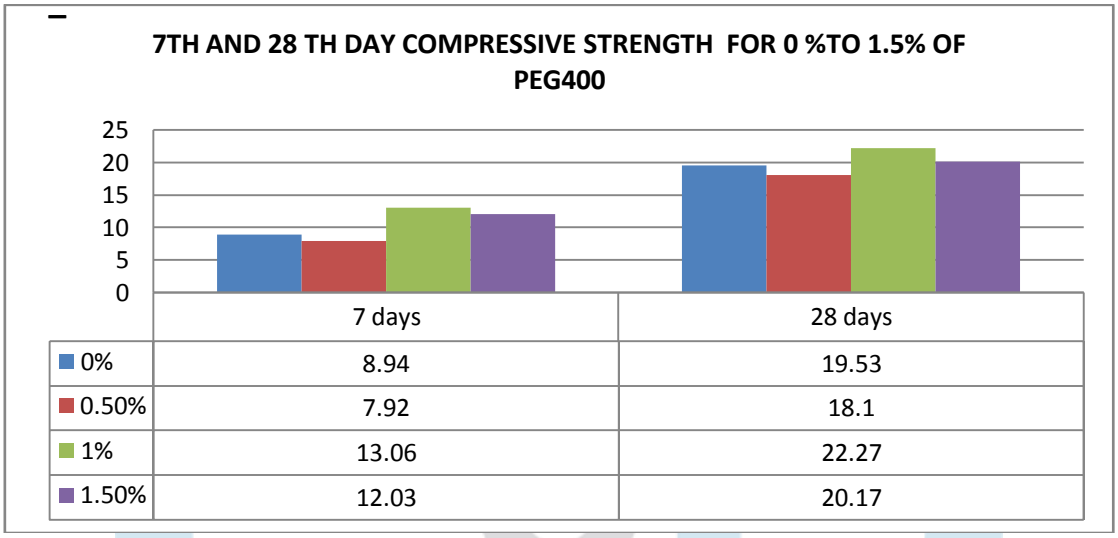
Experiment work

Preparations and casting of test specimen. The experimental program was aimed to study the compressive strength and compare

Test conducted* – 1) *Compressive test
2)Workability test

IV. THE TEST RESULT AND DISCUSSION

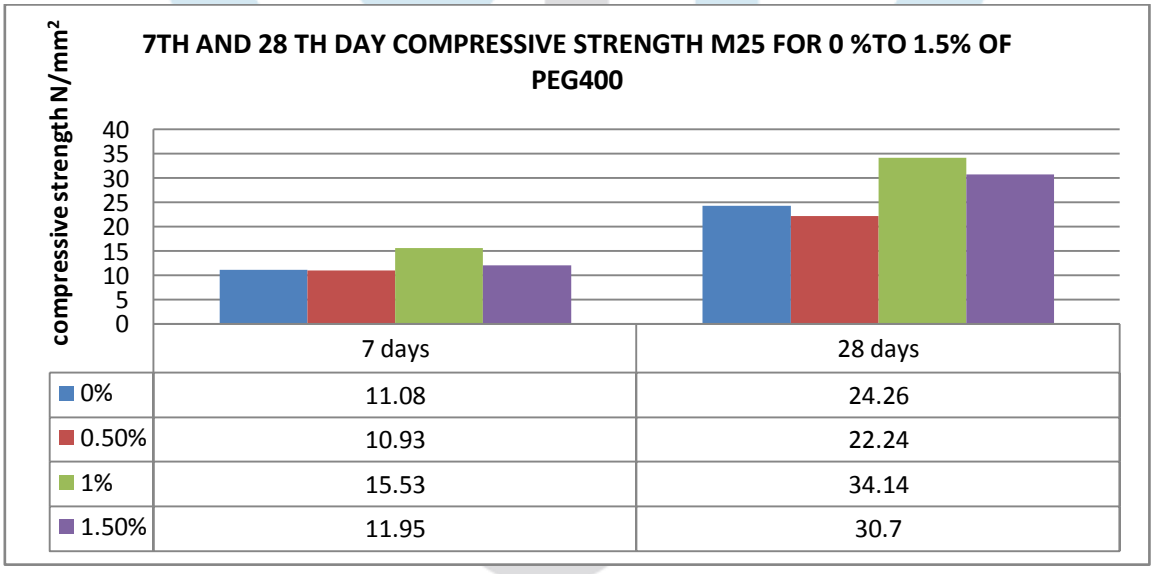
The compressive strength of concrete is one of the most important design parameters required for concrete. This series of tests determines the strength attained by concrete whose self curing concrete (PEG400), fiber reinforced concrete(PPF) and conventional concrete in varying percentage .The results plotted on the graphs below are the average values of three cubes tested at 7 and 28 day The results of the Slump & compressive test using M20 and M25 grade of concrete was represented in The graphical representation of the Compressive test is results are shown in figure respectively.



	7 days	28 days
0%	8.94	19.53
0.50%	7.92	18.1
1%	13.06	22.27
1.50%	12.03	20.17

Fig: 6.1 compressive test result using PEG400 for M20 grade of concrete.

It is observed that compressive strength of 7th and 28th day of M20 grade of concrete. Using 0.5% PEG400, the compressive strength compared to conventional concrete. Maximum compressive strength observed using 1% of PEG400. An increases the percentage PEG400 (1.5%) slightly decreases the compressive strength.



	7 days	28 days
0%	11.08	24.26
0.50%	10.93	22.24
1%	15.53	34.14
1.50%	11.95	30.7

Fig: 6.2 compressive test result using PEG 400 for M25grade of concrete

It is observed that compressive strength of 7th and 28th day of M25 grade of concrete. Using 0.5% PEG400, the compressive strength decreases compared to conventional concrete. Maximum compressive strength observed using 1% of PEG400. An increases the percentage PEG400 (1.5%) slightly decreases the compressive strength.

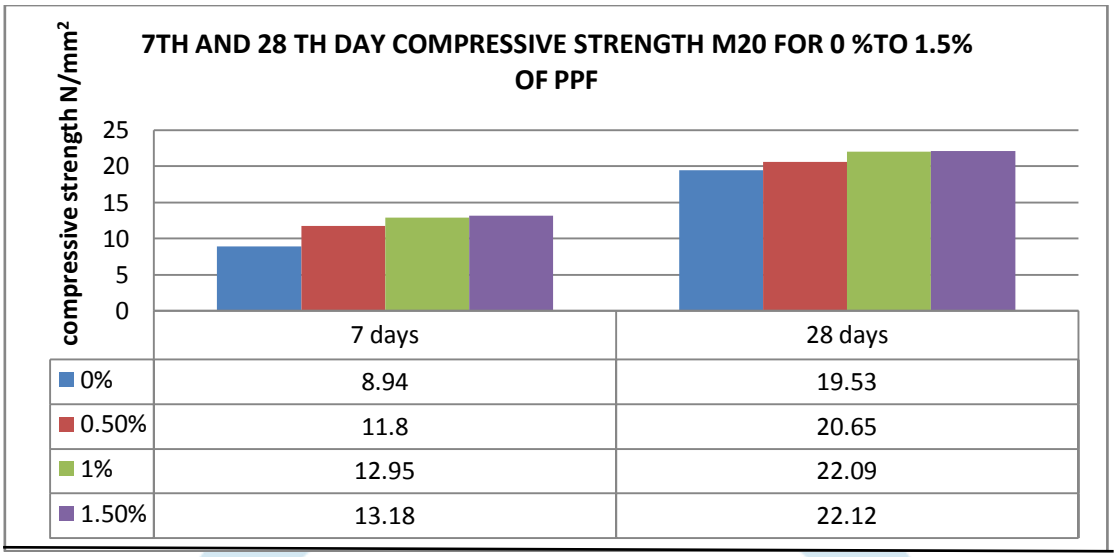


Fig: 6.3 compressive test result using (PPF) for M20 grade of concrete

It is observed that compressive strength of 7th and 28th day of M20 grade of concrete. Using 0.5% PEG400, the compressive strength compared to conventional concrete. Maximum compressive strength observed using 1% of PEG400. An increases the percentage PEG400 (1.5%) slightly decreases the compressive strength.

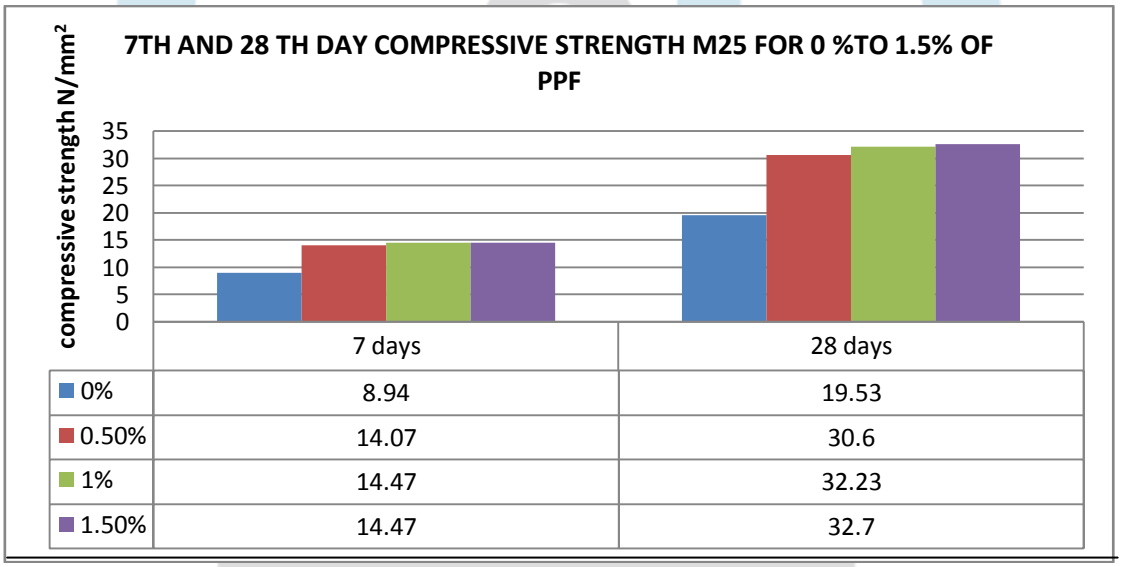


Figure: 6.4.compressive test result using PPF in M25grade of concrete

It is observed that compressive strength of 7th and 28th day of M20 grade of concrete. Using poly propylene fiber in concrete percentage increases the increases the Compressive strength of fiber reinforced concrete. Using 1.5% of polypropylene fiber maximum compressive strength.

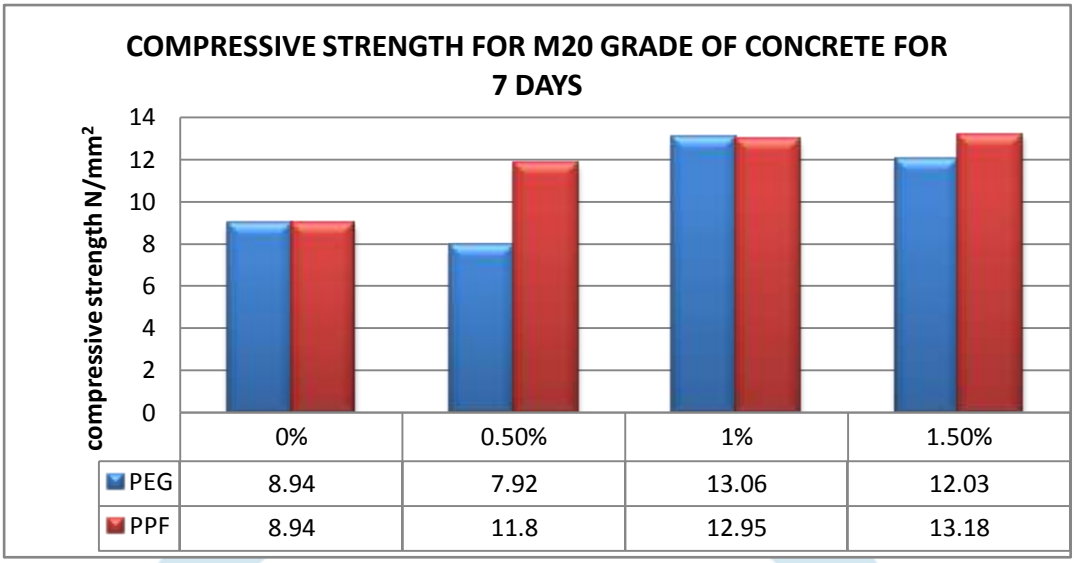


Fig: 6.5 compressive strength of M20 Grade of concrete with different %using PEG400 and PPF for 7 day

The M20 grade of concrete compare compressive strength of conventional concrete, self curing concrete using PEG400 0.5% and polypropylene fiber (PPF) 0.5% for 7 days as shown in figure 6.5 .from this figure, it is clear that self using PEG 400 increases 0% to 1.5% the maximum strength achieved in 1% of PEG400 as compare to conventional concrete and fiber reinforced concrete. And percentage of Polypropylene fiber (PPF) increases 0% to 1.5% the compressive strength increases the percentage of PPF increases and maximum strength achieved in 1.5% PPF.

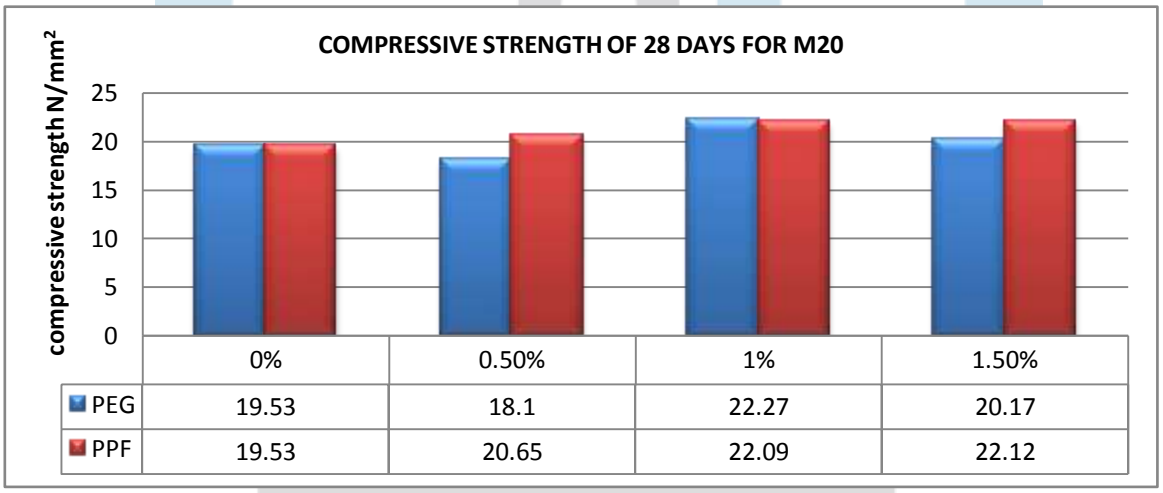


Figure 6.6: compressive strength of M20 grade of concrete with different %of PEG400 and PPF for 28 day

The M20 grade of concrete compare compressive strength of conventional concrete, self curing concrete using PEG400 0.5% and polypropylene fiber (PPF) 0.5% for 28 days as shown in figure 6.6 .from this figure, it is clear that self curing agent PEG 400 increases 0% to 1.5% the maximum strength achieved in 1% of PEG400 as compare to conventional concrete and fiber reinforced concrete. And percentage of Polypropylene fiber (PPF) increases 0% to 1.5% the compressive strength increases the percentage of PPF increases and maximum strength achieved in 1.5% PPF

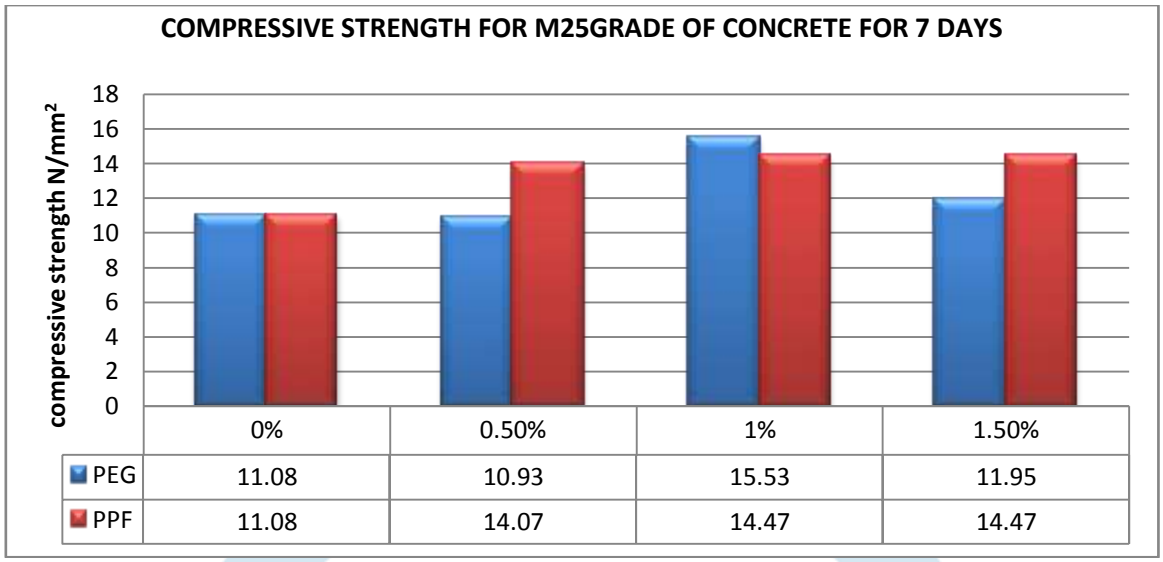


Figure 6.7: compressive strength of M25 grade of concrete with different %of PEG400 and PPF for 7 day.

The M25 grade of concrete compare compressive strength of conventional concrete, self curing concrete using PEG400 0.5% and polypropylene fiber (PPF) 0.5% for 28 days as shown in figure 6.7 .from this figure, it is clear that self curing agent PEG 400 increases 0% to 1.5% the maximum strength achieved in 1% of PEG400 as compare to conventional concrete and fiber reinforced concrete. And percentage of Polypropylene fiber (PPF) increases 0% to 1.5% the compressive strength increases the percentage of PPF increases and maximum strength achieved in 1.5% PPF.

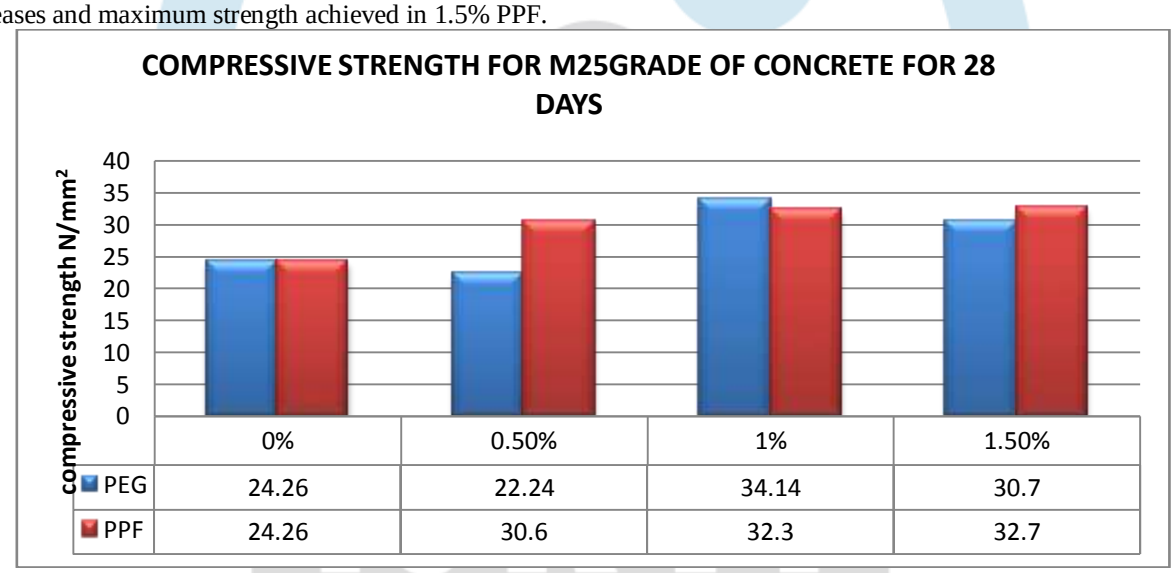


Figure 6.8: compressive strength of M20grade of concrete with different %of PEG400 and PPF

The M25 grade of concrete compare compressive strength of conventional concrete, self curing concrete using PEG400 0.5% and polypropylene fiber (PPF) 0.5% for 28 days as shown in figure 6.8 .from this figure, it is clear that self curing agent PEG 400 increases 0% to 1.5% the maximum strength achieved in 1% of PEG400 as compare to conventional concrete and fiber reinforced concrete. And percentage of (PPF) Polypropylene fiber increases 0% to 1.5% the compressive strength increases the maximum compressive strength achieved in 1.5% PPF.

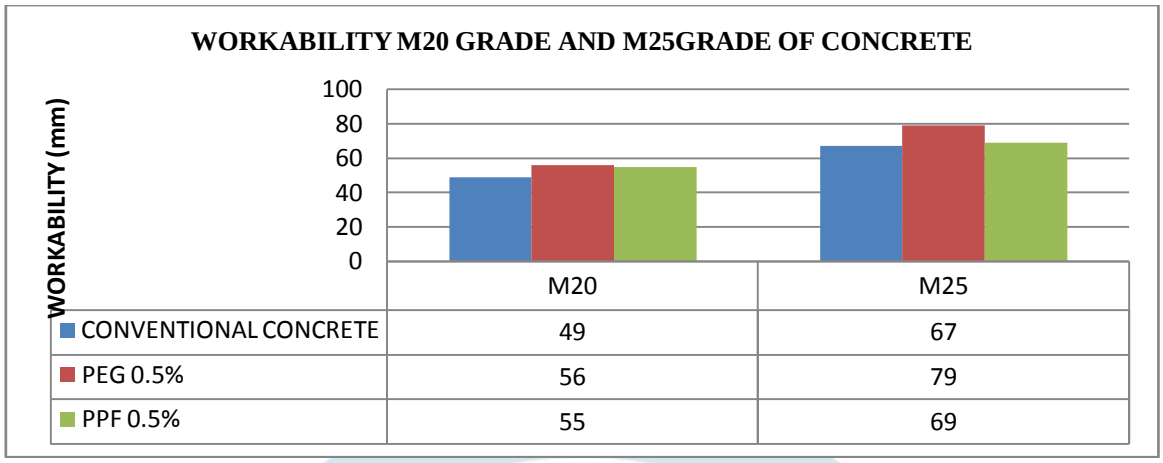


Figure 6.9: workability M20 grade and M25 grade of concrete using PPF and PEG400 0.5%

The workability test result of M20 and M25 grade of concrete as shown in fig 6.9 the result are found in self curing concrete using PEG 400 0.5% the workability increase as compare to conventional concert and polypropylene fiber. Using polypropylene fiber 0.5% the slump is increase as compare to conventional concrete.

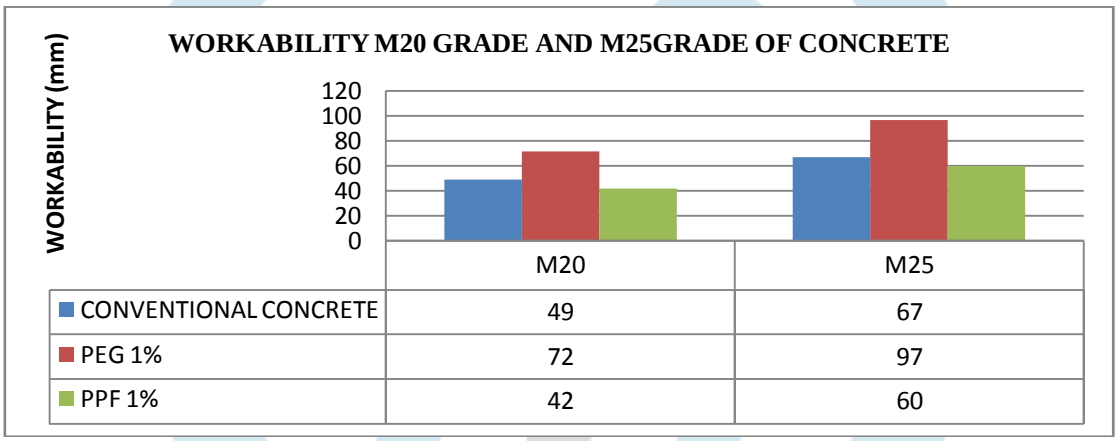


Figure 6.10: workability M20 grade and M25 grade of concrete using PPF and PEG400 1%

The workability test result of M20 and M25 grade of concrete as shown in fig6.10 the result are found in self curing concrete using PEG 400 1% the workability increase as compare to conventional concert and polypropylene fiber. Using polypropylene fiber 1% the slump is decreases as compare to conventional concrete and self curing concrete using PEG400.

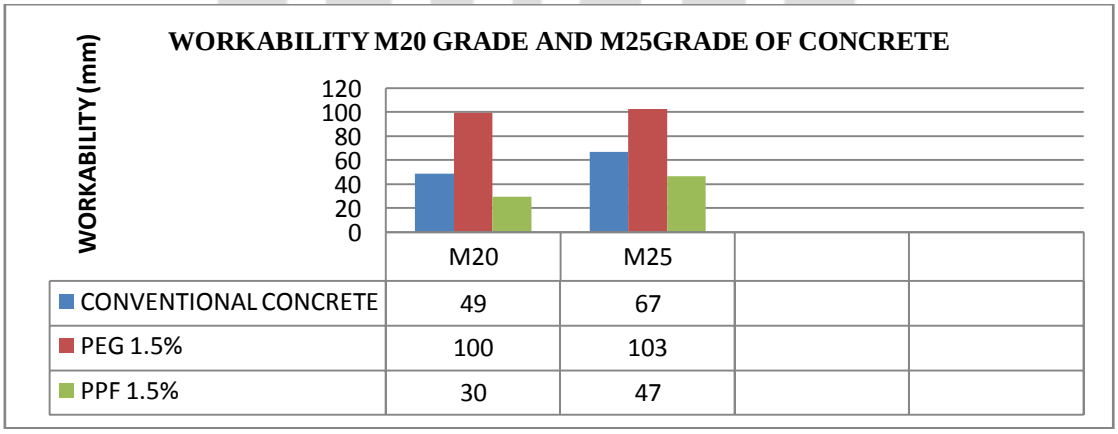


Figure 6.11: workability M20 grade and M25 grade of concrete using PPF and PEG400 1.5%

The workability test result of M20 and M25 grade of concrete as shown in fig 6.11.the result are found in self curing concrete using PEG 400 1.5% the workability increase as compare to conventional concrete and polypropylene fiber. Using polypropylene fiber 1.5% the slump is decreases as compare to conventional concrete and self curing concrete using PEG400

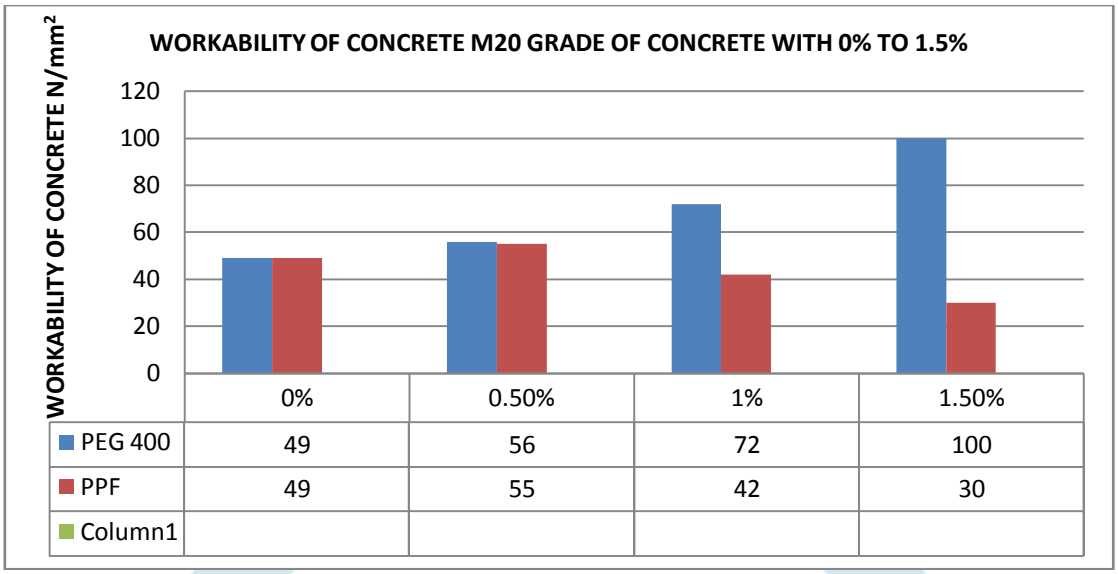


Figure 6.12: workability of concrete M20 grade of concrete using PPF and PEG400 using (0 to 1.5%)

In figure 6.12 shows workability of concrete with different percentage of PEG400 and PPF for M20 grade of concrete. Percentage of PEG 400 increases workability also increases maximum workability using PEG 400 1.5% and the percentage of polypropylene fiber increases the decreases slump. Lowest workability found in using PPF 1.5%.

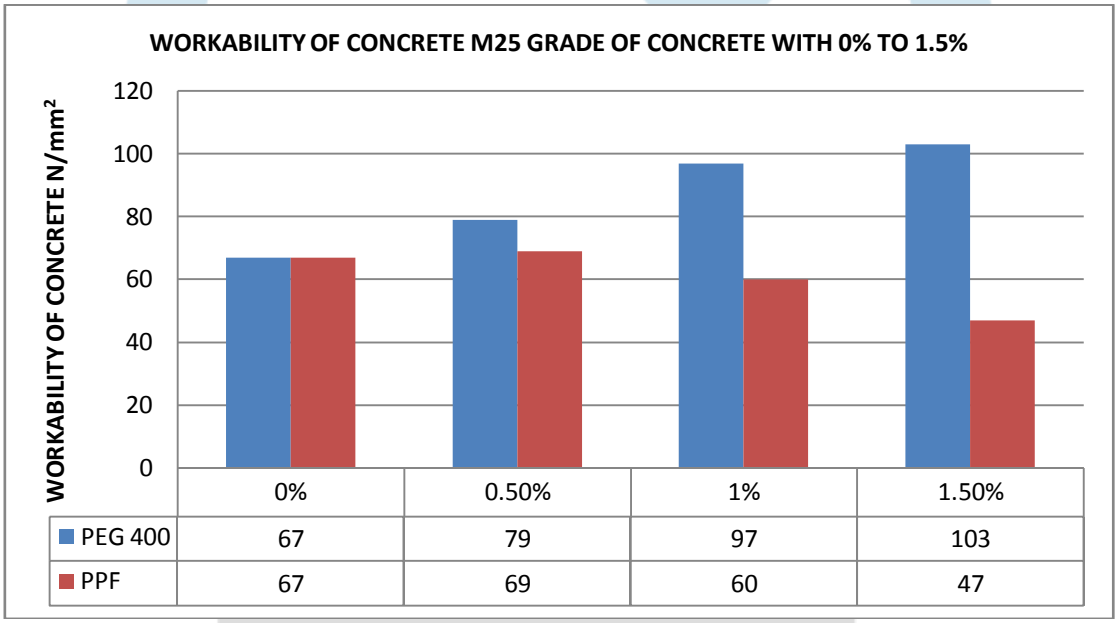


Figure 6.13: workability M25 grade and M25 grade of concrete using PPF and PEG400 (0% to 1.5%)

In figure 6.13 shows workability of concrete with different percentage of PEG400 and PPF for M20 grade of concrete. Percentage of PEG 400 increases workability also increases maximum workability using PEG 400 1.5% and the percentage of polypropylene fiber increases the decreases slump. Lowest workability found in using PPF 1.5%.

V. CONCLUSION

The following conclusion can be drawn from the work completed to date.

1. The optimum dosage of PEG 400 for maximum strength is found to be 1% for M20 and M25 grade as compare to conventional and fiber reinforced concrete using polypropylene fiber.
2. The sample with polypropylene fibers content of 1.5% shows maximum result in compression with other sample in this study.

3. As percentage of PPF increases, the slump goes on decreases for M20 and M25 grade of concrete.

4. As percentage of PEG400 increases, slump increases for M20 and M25 grade of concrete.

5. From the result of workability test, it was found that the self-curing agent improve workability.

6. Self curing concrete is the answer to many problems faced due to lack of proper curing.

7. Self curing concrete is an alternative to conventional concrete in desert regions where scarcity of water is a major problem.

Future Scope

The present research work leaves a wide scope for future investigators to explore many other aspects of this experimental work. Some recommendations for future research include:

1. The study can be done using different types of self curing agent such as PEG4000, and PEG200.

2. The other properties of fiber reinforced concrete such as split tensile strength, flexural strength, compaction factor may be determined using extensive experimentation.

3. The experiment can be extended by increasing grades of concrete such as M30 and M40.

REFERENCES

[1] Amit Rai1, Dr. Y.P Joshi, "Applications and Properties of Fiber Reinforced Concrete'', Int. Journal of Engineering Research and Applications, ISSN: 2248-9622, Vol. 4, Issue 5(Version 1), May 2014, pp.123-131.

[2] Shah Surendra and Rangan, "Effect of Fiber Addition on Concrete Strength", Indian Concrete Journal, Vol 5, Issue 2-6 pp. 13-21, 1994.

[3] Dr.T.Ch. Madhavi , L. Swamy Raju , Deepak Mathu,"Polypropylene Fiber Reinforced Concrete-A Review", International Conference on Advances in Civil Engineering and Chemistry of Innovative Materials (ACECIM 14).

[4]Mustapha abdulha, "Polypropylene Fibers Reinforced Concrete on Compressive and Tensile Behavior", International Journal of Engineering Trends and Technology (IJETT), Vol 9, Issue 6, March2014, ISSN: 2231.

[5] Mehul J. Patel, S. M. Kulkarni, "Effect of polypropylene fiber on the high strength concrete", Journal of information, knowledge and research : 0975 – 6744, Nov 12 to Oct 13, Vol 2, Issue 2 civil engineering.

[6] Pawan Kumar , Dr. A.K. Mishra, "Comparative Study of Polypropylene Fiber Reinforced Concrete with Conventional Concrete Pavement Design'', International Journal for Research in Applied Science & Engineering Technology (IJRASET), Vol 4, Issue 4, April 2016, IC Value: 13.98, ISSN: 2321-9653.

[7] Dr.T.Ch.Madhavi1, L. Swamy Raju, Deepak Mathur, "Polypropylene Fiber Reinforced Concrete-A Review", International Journal of Emerging Technology and Advanced Engineering, ISSN: 2250-2459, ISO 9001:2008 Certified Journal, Vol 4, Special Issue 4, June 2014.