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A Review on Enforcement of Rigid Pavement by Using Waste Plastic Fibre

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ABSTRACT

Due to rapid industrialization and urbanization within the country lot of infrastructure developments are happening. This process has successively led inquiries to mankind to unravel the issues generated by this growth. The issues defined are acute shortage of constructional materials, increased productivity of wastes and other products. During this project, M30 and M40 concrete is taken and waste plastic is employed as modifier. Modifier was added in percentage like 0%, 0.5%, 1%, 1.5% and a couple of so as to exchange an equivalent amount of cement and sand. Tests were conducted on coarse aggregates, fine aggregates, cement and modifiers (Waste Plastics) to work out their physical properties. Cubes were casted and tested for 7 and 28 day's strength. These tests revealed that the optimum modifier content was found to be 1.5% by weight of cement and sand. The studies revealed that the optimum modifier content was 1.5% and therefore the strength was found to be greater than the plain cement concrete. The concrete works using modifier are often used for construction of Rigid Pavements which results in decrease within the overall thickness of the pavement can be used for construction of Rigid Pavements which leads to decrease in the overall thickness of the pavement.

Keywords: Rigid Pavement; Different curing condition; Fibre reinforced concrete; Mechanical properties of concrete; Waste Plastics.

1. INTRODUCTION

Civil structures made from steel ferroconcrete normally suffer from corrosion of the steel by the salt, which ends up within the failure of these structures. Constant maintenance and repairing is required to reinforce the life cycle of these civil structures. There are some ways to attenuate the failure of the concrete structures made from steel reinforce concrete. The custom approach is to adhesively bond fibre polymer composites into the structure. This also helps to extend the toughness and lastingness and improve the cracking and deformation characteristics of the resultant composite. But this method adds another layer, which is susceptible to degradation. These fibre polymer composites are shown to suffer from degradation when exposed to marine environment thanks to surface blistering. As a result, the adhesive bond strength is reduced, which ends up within the de-lamination of the composite. Basically this method of reinforcing the concrete substantially alters the properties of the non-reinforced cement-based matrix which is brittle in nature, possesses little lastingness compared to the inherent compressive strength. The principal reason for incorporating fibres into a cement matrix is to extend the toughness and lastingness , and improve the cracking deformation characteristics of the resultant composite. so as for fibre ferroconcrete (FRC) to be a viable construction material, it must be ready to compete economically with existing reinforcing systems.

2. LITERATURE REVIEW

2.1 Zhifeng Chen (Feb.2009): A parametric experimental study has been conducted to investigate the effect of polypropylene fibre on the shrinkage of cement-stabilized macadam. By means of the micrometer gauge method and the strain gauge method, the dry shrinkage coefficient and thermal shrinkage coefficient of cement-stabilized macadam were measured respectively. The results indicate that polypropylene fibre can effectively decrease the average dry shrinkage coefficient and average thermal shrinkage coefficient of cement-stabilized macadam. The average dry shrinkage coefficient of long curing period is smaller than that of short curing period, while the average thermal shrinkage coefficient of long curing period is much larger than that of shot curing period. When the fibre volume fraction is not beyond 0.1%, the average dry shrinkage coefficient and average thermal shrinkage coefficient are gradually decreasing with the increase in fibre volume fraction. Furthermore, polypropylene fibre appears to be highly effective in controlling dry and thermal shrinkage cracking of cement-stabilized macadam.

2.2 Parviz_Soroushian: He reported that, the effect of polypropylene fibres at 0.1% volume fraction as well as polyethylene fibres at 0.025 and 0.05% volume fractions had negligible effects on flexural strength of concrete, only 0.1% volume fraction of polyethylene fibres could improve flexural strength, and when used at 0.05% volume fraction, produced impact strength comparable to those obtained with polypropylene fibres used at 0.1% volume fraction.

2.3 Bhavesh Shah: He reported that, addition of polypropylene fibre increase the strength properties of concrete to an extent of 10-15%, Doubles the impact resistance of concrete and restrict the plastic shrinkage cracks.

2.4 Anbuvelan: He reported that, addition of 0.1% polypropylene fibres in concrete would increases the strength properties like compressive strength, flexural strength, abrasion resistance, impact resistance to an extent of 13%, 14%, 87%, 31% respectively and reduces the crack area of plain concrete in plastic shrinkage by 56.50 to 70.80%.

2.5 Rana A Mtasher, Dr. Abdulnasser M.Abbas & Najjat H. Ne'ma. : The main purpose of this investigation is to study the effect of polypropylene fibre on the compressive and flexural strength of normal weight concrete. Four mixes used polypropylene fibre weight with 0.4,0.8,1.0 and 1.5% of cement content. To provide a basis for comparison reference specimens of were cast without polypropylene fibre. The test result showed that the increase of mechanical properties [compressive and flexural strength] resulting from added of polypropylene fibre was relatively high. The increase was about 64% for compressive strength, while in flexural strength was about 55.5 percent.

3. MATERIALS AND METHODOLOGY

3.1. Cement Although the materials that enter cement concrete are essential, cement is extremely often the foremost important because it's usually the foremost delicate link within the chain. The function of cement isn't only to bind the sand but also to refill the voids in between sand and any coarse grained particles to make a compact mass. Although it constitutes only about 15 to 25 per cent of the quantity , it's the active portion of binding medium and is that the only scientifically controlled ingredient. Any variation in its quantity affects the compressive strength of the concrete mix also. Ordinary hydraulic cement (OPC) of 53 Grade (Ultratech) has been utilized in this work. The cement used was fresh and with none lumps. Tests were conducted for cement as per IS: 8112-1989. The physical properties of cement utilized in the study are given in following**:**

3.2.

Table 3.1 Physical properties of cement

Sr. No.	Names of Lab Test	Result	Sr. No.	Names of Lab Test	Result
1	Fineness	7%	5	28 days Compressive Strength	69.1 N/mm^2
2	Initial Setting Time	105 min	6	Standard consistency on cement paste	27%
3	Final Setting Time	230 mm	7	Specific Gravity	3.15
4	7 days Compressive Strength	51.8 N/mm^2	--	-------	---

3.2 Fine Aggregates: IS: 383 – 1970 defines the fine aggregate, because the one passing 4.75 mm IS sieve. The fine aggregate is usually termed as a sand size aggregate. Locally available river bed sand was utilized in this study. Percentage passing 600 micron sieve = 62.35%. The sand conforms to grading Zone – III as per IS: 383 – 1970. Sieve analysis was done to calculate the finesses modulus of sand. The results of an equivalent are given within the table and therefore the various other properties tested are tabulated in table below

Table 3.2 Properties of fine aggregates

Sr. No.	Name of Lab Test	Result
1	Specific gravity of fine aggregate	2.76
2	Water Absorption	0.9%
3	Silt content in fine aggregate.	3.30%
4	Fineness modulus of fine aggregate	3.06

3.3 Water: Generally, water that's suitable for drinking is satisfactory to be used in concrete. Water from lakes and streams that contain marine life also usually is suitable. When water is obtained from sources mentioned above, no sampling is important. When it's suspected that water may contain sewage, mine water, or wastes from industrial plants or canneries, it shouldn't be used unless tests indicate that it's satisfactory. Water from such sources should be avoided since the standard of the water could change thanks to intermittent discharge of harmful wastes into the stream.

3.4 Coarse Aggregates: Properties like crushing strength, durability, modulus of elasticity, maximum size, shape characteristic, flakiness index needs special consideration while selecting coarse aggregate for concrete. the mixture utilized in the project was crush stone black basalt available locally. the subsequent table shows properties of coarse aggregate use.

Table 3.3 Properties of coarse aggregate

Sr. No.	Name of Lab Test	Result
1	Sp. Gravity of Coarse aggregate	2.85
2	Flakiness index of Coarse aggregate	12.78%
3	Elongation Index of Coarse aggregate	34.68%
4	Water absorption	0.70
5	Fineness modulus of Coarse aggregate	7.55
6	Aggregate impact value	3.60%
7	Crushing value of Coarse aggregate	10.32%

3.5 Polypropylene Fibre: Polypropylene may be a synthetic hydrocarbon polymer material Polypropylene fibres are available in two different forms; Monofilaments and Multi-filaments. Monofilament fibres are produced by an extrusion process through the orifices during a spinneret then move the specified length. The newer film process is analogous except that the polypropylene is extruded through a die-that produces a tubular or flat film. This film is then slit into tapes and uniaxial stretched. These tapes are then stretched over carefully designed roller pin systems which generate longitudinal splits and these are often cut or twisted to make various sorts of fibrillated fibres. The fibrillated fibres have a net-like body. The lastingness of the fibres is developed by the molecular orientation obtained during the extrusion process. The draw ratio (final length/initial length), a measure of the extension applied to the fibre during fabrication, of polypropylene fibres is usually about eight.

Table 3.4 Properties of Polypropylene Fibre

Sr. No	Properties	Test Data
1.	Diameter(D) ,mm	0.0445
2.	Length (l),mm	6.20
3.	Aspect Ratio (l/D)	139.33
4.	Tensile strength Mpa	308
5.	Specific gravity	1.33

3.6 Mix Proportions: IS code method of mix design were used for mix design of M30 and M40 grade of concrete. Concrete specimens with various percentage of polypropylene fibre, were prepared.

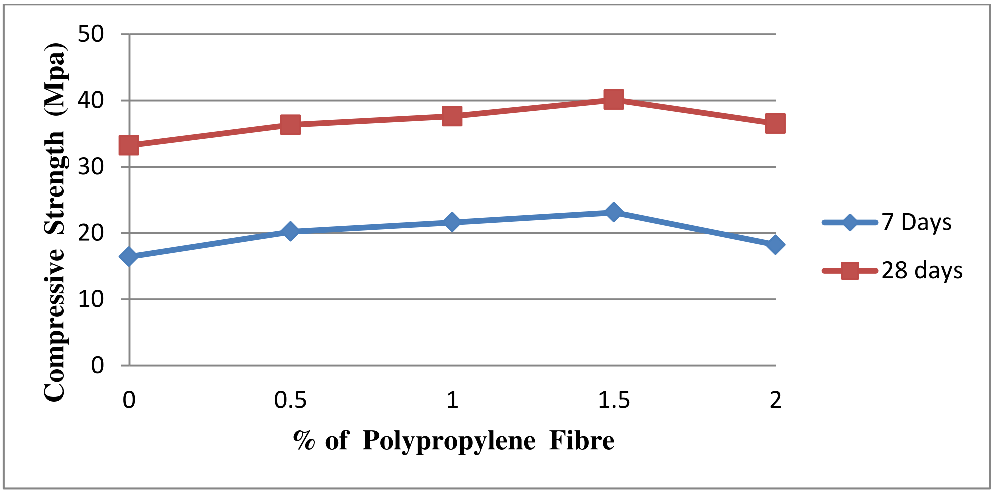
3.7 Casting of Concrete Specimens:

3.7.1. For all mix proportions, required quantities of materials were weighed to an accuracy of 0.5 grams.
3.7.2. Cement and fine aggregates were mixed dry to urge a consistent mixing.
3.7.3. The concrete were prepared by hand mixing in pan which was available our laboratory.
3.7.4. Water was added at the top and mixing was done till a consistent and homogeneous mix was achieved.
3.7.5. All the moulds were properly oiled before casting the specimens. To facilitate proper and uniform compaction, a vibration table with fixed revolutions per minute was used for the aim .
3.7.6. The cubes were filled in three layers. Vibrations were stopped as soon because the cement slurry appeared on the highest surface of the mould.
3.7.7. The specimens were far away from the moulds with care after 24 hours then cured during a curing tank for 7 and 28 days at the space temperature for curing.

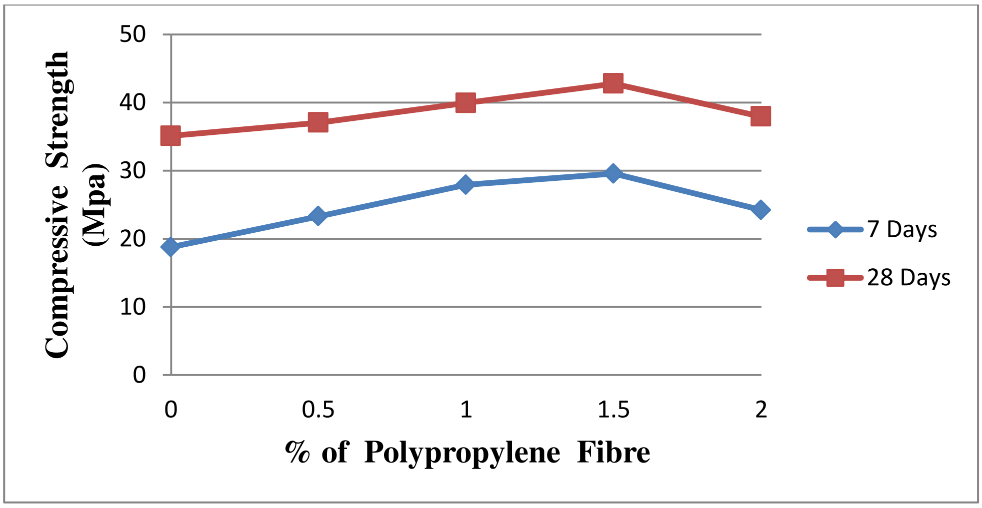
3.8 Testing of Specimens: The specimen cubes, beams and cylinder after the curing period of 7 and 28 days were tested for Compressive strength test, flexural strength test and Split tensile test and results have been obtained in next session.

4. RESULTS

4.1 Compressive Strength Test: The specimens cubes, after curing period of seven and 28 days were tested for compressive strength on an automatic compression testing machine (2000kN capacity). The compression test was administered on specimens cubical in shape both for polypropylene concrete also as conventional concrete. The cube specimen is of the dimensions 150 mm X150 mm X150 mm were wont to conducting the compressive testing. Standard proportions of concrete ingredients were mixed thoroughly to make the specimens of polypropylene concrete and traditional concrete for test. The specimens were made in 150 mm standard cube mould. The concrete was placed in three layers by manually and every layer was tamping 35 times with 16 mm diameter and 60 mm long of rod then mould was placed on the vibrator. The cubes are first cured under wet straw or gunny for first 24 hours. Then they were far away from mould and stored during a room at a temperature of 24 ºC to 30 ºC for 7 and 28 days till it's to be tested under wiped dry conditions. After 7 days and 28 days cubes were taken out from curing tank for testing. The cubes were tested on compression testing machine. The size of cubes was first measured and cubes also weighed and tested in compression testing machine. These data give us the density and compaction of concrete. The cubes were placed in CTM the load being applied to the edges of the specimen as cast. All specimens were tested at the speed of loading 14 N/mm2 per minute till failure of cube occur the sort of failure was also noted down. The load at failure per c/s area cube is taken as compressive strength of concrete. The typical strength of the set of two samples of every 7 days and 28 days is taken because the cube strength.

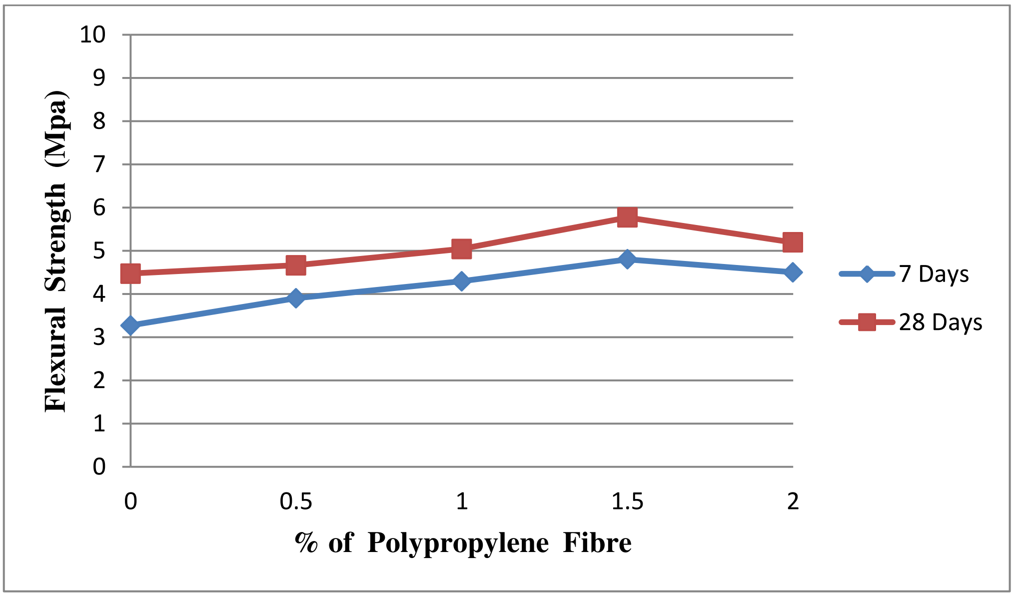


Graph 4.1 Variation in Compressive Strength with % of Polypropylene Fibre for M30 Grade

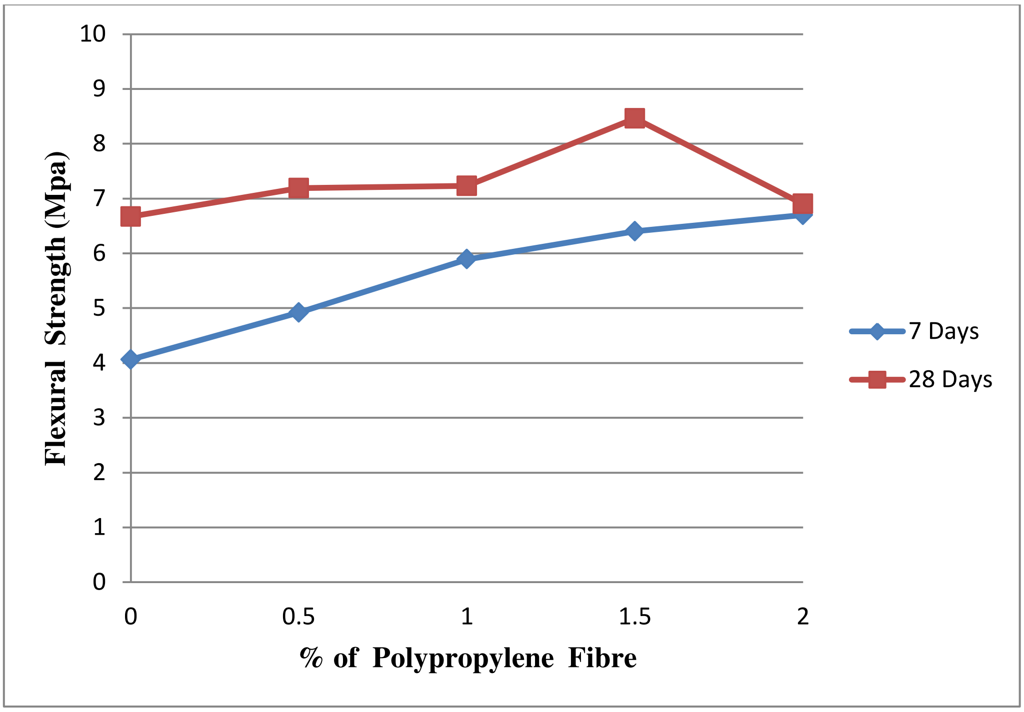


Graph 4.2 Variation in Compressive Strength with % of Polypropylene Fibre for M40 Grade

4.2 Flexure Strength test on Beam: Direct measurement of lastingness of concrete is difficult. Neither specimens nor testing apparatus are designed which assure uniform distribution of the "pull" applied to the concrete. While variety of investigations involving the direct measurement of lastingness are made, beam tests are found to be dependable to live flexural strength property of concrete. Flexural strength test is important to estimate the load at which the concrete members crack. the worth of the modulus of rupture (extreme fibre stress in bending) depends on the dimension of the beam and manner of loading. The systems of loading utilized in checking out the strain in flexure are central point loading and third point loading. within the central point loading, maximum fibre stress will come below the purpose of loading where the bending moment is maximum. just in case of symmetrical two point loading, the critical crack may appear at any section, not strong enough to resist the strain within the center third, where the bending moment is maximum. It are often expected that the 2 point loading will yield a lower value of the modulus of rupture than the centre point loading. In this investigation flexural strength of beams were acknowledged by two points loading on flexural testing machine. For determination of flexural strength of concrete with polypropylene and traditional concrete beam, specimens of ordinary size 100 x100 x 500 mm were cast. it had been kept for curing in cistern for 7 and 28 days at temperature at 27 ºC to 36 ºC. After 7 and 28 days the specimens were taken out from curing and surface is allowed to wiped dry for jiffy . Then the specimen was placed within the machine in such a fashion that the load was applied to the uppermost surface as cast in mould. The bed of testing machine was given two rollers mounted such the space between them is 400 mm.



Graph 4.3 Variation in Flexural Strength with % of Polypropylene Fibre for M30 Grade



Graph 4.4 Variation in Flexural Strength with % of Polypropylene Fibre for M40 Grade

4.3 Split Tensile Test: Due to difficulty involved in conducting direct tension, no of indirect method have been developed to determine the tensile strength of concrete. Cylinder Split tensile strength test is carried out by placing a cylinder specimen horizontally between two mild steel plates along diameter. Compressive force is applied on plates in compression testing machine till the cylinder fails.

The cylinder split tensile strength is calculated by following formula,

$$T = 2P / \pi L D$$

Where,

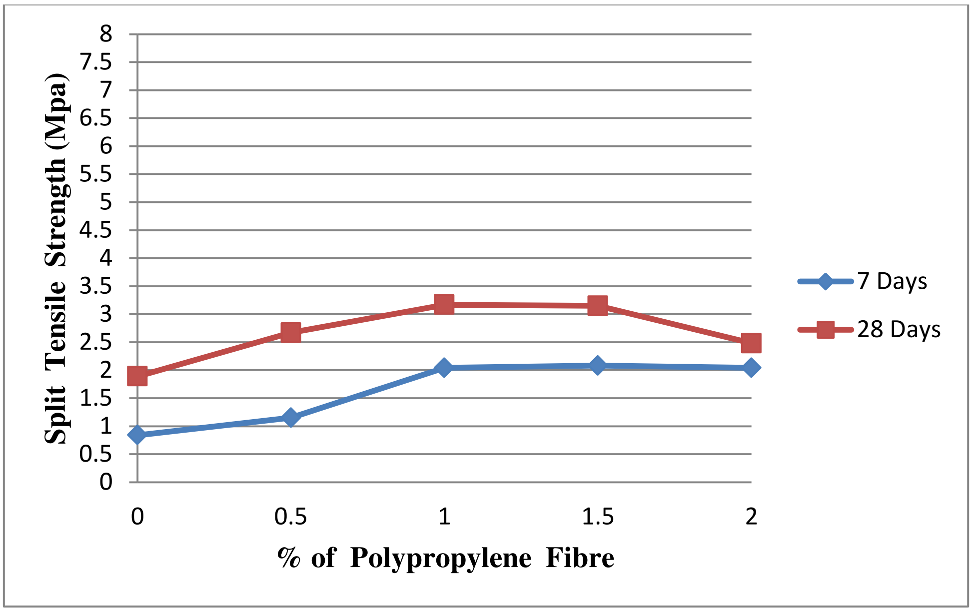
T = Split tensile strength in N/mm^2

P = Compressive force at failure on cylinder in N

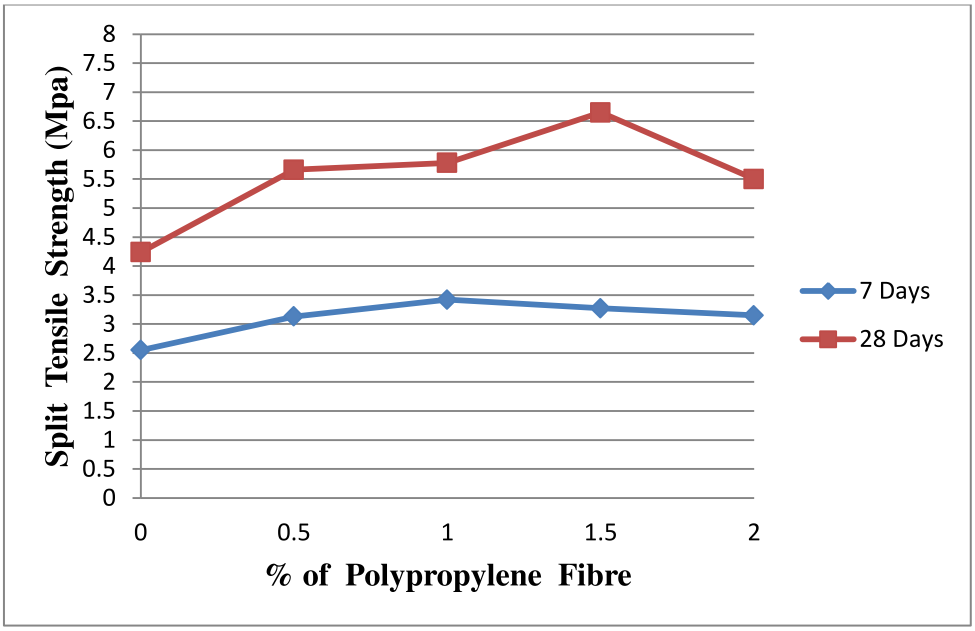
L = Length of cylinder in mm

D = Diameter of cylinder in mm

The loading condition produces a high compressive stress immediately below the 2 generators to which the load is applied. But the larger portion like depth is subjected to a consistent tensile stress acting horizontally. it's estimated that the compressive stress is acting for about 1/6 depth and therefore the remaining 5/6 depth is subjected to tension. the most advantage of this method is that an equivalent sort of specimen and therefore the same testing machine as are used for the compression test are often employed for this test. that's why this test is gaining popularity. The splitting test is straightforward to perform and provides more uniform results than other tension tests. Strength determined within the splitting test is believed to be closer to truth lastingness of concrete, than the modulus of rupture. Splitting strength gives about 5 to 12% higher value than the direct lastingness



Graph 4.5 Variation in Split Tensile Strength with % of Polypropylene Fibre for M30 Grade



Graph 4.6 Variation in Split Tensile Strength with % of Polypropylene Fibre for M40 Grade

5. CONCLUSIONS

From my experimental investigation, following points can be concluded:

5.1. From the result of this research, it was found that the use of fibre in concrete increases the compressive strength, split tensile strength and flexural strength up to 1.5 % of fibre content.

5.2. Mechanical properties of concrete were improved by use of polypropylene fibres.

5.3. If polypropylene fibre is used then reduction in shrinkage cracking were observed.

5.4. Use of polypropylene fibre decreases the workability to some extent, and compressive strength increases with the use of polypropylene fibre content 1% to 1.5%.

5.5. This research also help to avoid the general disposal techniques of waste plastic namely land filling, incineration each have certain burden on ecology.

5.6. The modified cement concrete mix can be used in construction of rigid pavement to reduce the thickness of pavement and also increases the durability of concrete and it can carry more load than plain cement concrete.

5.7. As per the current demand of construction industry, no type of concrete are to be invented which will satisfy the problems observed in the traditional concrete.

5.8. In this approach polypropylene fibre concrete will be a good substitute to meet the present demand of construction industry.

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