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TO STUDY THE EFFECT ON MECHANICAL BEHAVIOUR OF FIBER REINFORCED CONCRETE USING POLYETHYLENE TEREPHTHALATE FIBERS AND EGG SHELL POWDER IN CONCRETE

Nahan[1], Sourabh Lalotra[2]

[1] *PG Scholar, Sri Sai College of Engineering and Technology, Pathankot, India*
[2] *Assistant Professor, Sri Sai College of Engineering and Technology, Pathankot, India*

Abstract - This research has been done to find out the maximum percentage of PET fibers as additive and Egg shell powder as partial cement Replacement. The construction industries are in the search to find alternative products that can reduce the cost of construction. Demand for cement has been growing every day. In this Research, different PET fibers and ESP concretes were developed by replacing with cement. Concrete plays an important role and a large quantity of concrete is being utilized in every construction. The eggshell which usually disposes of is used as an alternate for the cement because the shell of an egg is made up of calcium. An eggshell is used in different combinations to find the practicability of using the eggshells as an alternative to cement. PET fibers the mechanical features of polystyrene, strong electric insulating properties, low elongation at break and heat resistance, high centrifugal forces are not appropriate. The glasses have a maximum use temperature of 75-80 degree Celsius and its 1.05gms/cm3 range of density. The more ductile behavior and longer strips of concrete reinforced with circular PET fibers have high adherence of concrete of PET fibers. Polystyrene disposal is pure hydrocarbon compound and thus environmental neutral during disposal. No harmful substance are produced by incineration. It has strong mechanical features that make it acceptable for structural uses, such as concrete 0.000138g/cm2 specific gravity. A important advantage in the use of PET is given by its toughness, which is one of the key concrete concern steel erosion is the main cause of concrete bar degradation; so PET fibers may be important to address this issue and to increase the longevity of reinforced structural concrete and structural elements in concrete. The aim of this project is to halt the pollution of the environment by the improper disposal of the Eggshell waste, a remain from eggshells domestic waste such as schools, restaurant, bakeries, homes, and fast food hotels, by using it as an additive material in form of ash & powder in conventional concrete with grade M25, as it is normally used in construction sites. Eggshell is one of the waste materials which can be a promising future in the construction industry as a partial or full substitute of either cement just because of its physical similarity to the fine Cement.. The PET fibers 2.4% and ESP9% is replaced with Cement show positive results. Workability reduces with increasing % age of PET fibers. The maximum proportion of replacement has been found by conducting the following strength tests: Compressive strength test, Flexural strength test and Split Tensile Strength Test.

Keywords: Polyethylene terephthalate fibers, (EPS) Egg shell powder, Compressive Strength, Split Tensile Strength, Flexural Strength, Concrete.

***Key Words*: PET (POLYETHYLENE TEREPHTHALATE FIBERS), ESP (EGG SHELL POWDER, Compressive Strength, Split Tensile Strength, Flexural Strength, Concrete.**

1. INTRODUCTION

In ancient times, the idea of using fibers as reinforcement was implemented. In the 1950s, it introduced the idea of composite material and fiber reinforced concrete. Reinforced with fiber concrete is the concrete containing fibrous material with increase the integrity of the structure. It comprise small uniformly distributed and randomly oriented discrete fibers. Fibers are used for the prevention of cracking shrinkage in concrete. They also decrease the permeability of the concrete, thus reducing water bleeding. The additions of fibers greatly enhance the efficiency of concrete. The main cause of environment pollution has been plastic waste. An effort was therefore made to use plastic plastic waste in concrete. The bottles were randomly cut into bits and applied and applied to the weight of the cement. The tensile strength and crack resistance of concrete is less. As found in other samples, longer fibers performed better than shorter fibers. The overall crack width were found to experience an increase in fiber volume fraction, reduction of control mix from 3mm to hairline crack of less than 0.5mm deep for the panel cast with mortar reinforced with by 50mm long deformed fibers.

1.1 POLYETHYLENE TEREPHTHALATE FIBERS

It is a material that is hard, stiff, heavy, and dimensionally stable and which absorb very less water. Its got good material, gas barrier properties and strong chemical resistance expect to alkalis. Terephthalate polyethylene can be very extremely translucent and transparent. Parts that colorless but thicker are typically opaque and off white. The reaction to strain hardening is often connected with high

performance fiber reinforced composite in which coarse aggregates are fully excluded. It was discovered that concrete was achieved in the presence of PVA fibers strain hardening reaction with a load drop up to 50% of the peak load and the strain, under direct strain, potential of about 2 percent. The performance test closely matches the direct tension test result. The mechanical features of polystyrene, strong electric insulating properties, low elongation at break and heat resistance, high centrifugal forces are not appropriate. The glasses have a maximum use temperature of 75-80 degree Celsius and its 1.05gms/cm3 range of density. The more ductile behavior and longer strips of concrete reinforced with circular PET fibers have high adherence of concrete of PET. Polystyrene disposal is pure hydrocarbon compound and thus environmental neutral during disposal. No harmful substance are produced by incineration. It has strong mechanical features that make it acceptable for structural uses, such as concrete, 0.000138g/cm2 specific gravity. An important advantage in the use of PET is given by its toughness, which is one of the key concrete concern: steel erosion is the main cause of concrete bar degradation; so PET may be important to address this issue and to increase the longevity of reinforced structural concrete and structural elements in concrete. Differences in PET aggregates size, shape and texture affect the ratio of water to cement as well the slump in fresh concrete mixes, which ultimately alters the mechanical behavior . It is found that specimen with fiber reinforced are much more ductile than in reinforced specimens, which are extremely ductile, and are desirable in many applications of backfill.

1.2 EGG SHELL POWDER

Eggshells are the organically decomposable waste obtained from chick hatcheries, bakeries, and fast-food restaurants. Among other biodegradable wastes, this can affect the surroundings and thus can lead to ecological issues/contamination which would need appropriate solutions. Scientists have been investigating the beneficial use of Egg shells in construction purposes or other related purposes and it is known that the eggshell is mainly has the composition of compounds of calcium. Okonkwo et al (2012) presented eggshells are composed of 93.70% calcium carbonate (in calcium), 4.20% of it is organic matter, 1.30% is magnesium carbonate, and 0.8% of it is calcium phosphate.

2. LITERATURE REVIEW

R.N.Nibudey, Dr.P.B.Nagarnaik (2013) : In this study, This paper outlines the performance of plastic fiber reinforced concrete (M30). The experimental work was performed on the sample such as cubes and cylinders that have been casted in the laboratory and behavior were observed. Plastic fibers were added from 0.0% to 3.0%. After 28 days of curing time, tensile strength and compressive strength were measured. The test results were compared and the relationships between the observed and predicted strengths were given.

Rathbet (2015) This research is done to investigate the The mechanical characteristics of polystyrene are low break elongation and heat resistance. Nice electrical insulating characteristics, not ideal for high centrifugal forces. These glasses have a maximum working temperature of 75-80 degree and density range of 1.05gms/cm3. The glasses are inflammable and the general chemical resistance are solution of salt, non-iodizing agent as well as alcohols and alkaline fuel, etheric oil and due to aromatic substance cracks are occur. Reinforced concrete with circular PET fibers having long strips are more ductile behavior and high concrete - PET adherence..

Prabagar Subramaniam, Kalya et al (2015) This research is done to investigate the Usage of EGG SHELL Powders a partial substitute for cement is one of the most promising strategies for rising cement strength and thermal insulation for cement block. The present study based on the partial replacement of cement material with EGG SHELL POWDER during sand cement block production. The mixture of concrete is mixed with 10%, 15%, 20%, 25%, of EGG SHELL Powders a partial sand cement replacement and then tested for compressive strength, absorption of water and heat release. The higher compressive force was obtained in the sample of having 15 %EGG SHELL POWDER material. Lower heat absorption was shown in the sample having other than 25% EGG SHELL POWDER replacement and the maximum was obtained in 15 % ash content from wood. In 15% and 20% sample of EGG SHELL POWDER replacements lower heat release was observed after 21 days of curing period. 15 % EGG SHELL POWDER addition for production of concrete block was developed and these blocks comply with the standard limits.

Mehnaza Akhter (2017) the present thesis deals with the findings of experimental studies on effects of EGG SHELL POWDER on compressive strength and setting time of cement and concrete. Influence of EGG SHELL POWDER on cement and concrete compressive strength by varying percentage of EGG SHELL POWDER0% 10%, 20%, 30%, and 40% by weight of cement. The EGG SHELL Powder this paper as partial replacement of cement in concrete is used and its effects on concrete properties was achieved. For the compressive strength test, specimens of size 150 mm X 150 mm X 150 mm for compressive strength test of concrete. Water cured all the specimens and processing is performed for 7 days and 28 days. The result of compressive strength of cement and concrete with EGG SHELL POWDER were observed and compared with the results of normal concrete and concrete showed the significant improvements in the results of compressive strength. The optimum percentage of various agro waste replacement is obtained.

Harsha Bhaskaran et.al 2016 this paper presents the partial replacement of cement by egg shell powder. In present world, increased accumulation of carbon dioxide content in atmosphere is creating environmental pollution and global warming. In every tons of cement manufacturing produces equal amount of carbon dioxide. In order to reduce the impact of carbon dioxide emission and to protect the environment, cement is been replaced by egg shell powder. This study represents the influence in properties of concrete when cement is replaced by 5%, 10% and 15% of egg shell powder. Properties are experimentally investigated based on compressive strength, split tensile strength and flexural strength of concrete. Compressive, tensile and flexural strength up to 7 days of age were compared with conventional concrete; from the results obtained, it is found that egg shell powder can be used as cement replacement material.

3. MATERIALS

3.1 CEMENT Ordinary Portland cement is the world's most prevalent form of cement in general use as basic material include concrete, mortar, stucco, and no specialist grout at most. It developed from other types of hydraulic lime in England in mid-19th century and usually originates from limestone. It is a fine powder developed for the forming of clinker by heating material. Small amount of remaining material will be added after grinding of clinker. There are several types of cement available in the market. If we talk about different grades of cement, the 53 Grade OPC Cement provides better performance as compared to other grades. According to the Bureau of Indian Standards (BIS), the cement grade number indicates the minimum compressive strength that the cement is expected to attain within 28 days. The minimum compressive strength for 53 Grade OPC cement at the end of 28 days, should not be less than 53 Mpa or 530 kg/ cm2.The color of OPC is grey color and ferrous oxide is removed during the manufacturing process of cement we will get white cement as well.

3.2 FINE AGGREGATES Sand is a natural granular material which is mainly composed of finely divided rocky material and mineral particles. The most common constituent of sand is silica (silicon dioxide, or SiO2), usually in the form of quartz, because of its chemical inertness and considerable hardness, is the most common weathering resistant mineral

3.3 COARSE AGGREGATES The coarse aggregate used were a mixture of two locally available crushed stone of 10 mm and 20 mm size in 50:50 proportion. The aggregates were washed to remove dirt, dust and then dried to surface dry condition.

3.4 POLYETHYLENE TEREPHATHALATE FIBERS

COMPONENT	VALUE
Color	White
Lusture	Bright
Elastic modulus	90
Specific gravity	1.38
Solubility in Water	Insoluble

Table -1: Physical properties of PET FIBERS

3.5 EGG SHELL POWDER

S.No	Composition	Percentage(%)
1.	CaO	53%
2.	MgO	1%
3.	SiO_2	1.5%
4.	Al_2O_3	0.28%
5.	Fe_2O_3	0.36%
6.	Cl	0.011%

Table -2: Chemical composition of EGG SHELL POWDER

4. METHODOLOGY

4.1 CASTING A careful procedure was adopted in the batching, mixing and casting operations. The fine aggregates were weighed first with an accuracy of 0.5 grams. The mixture was prepared by hand mixing on a watertight platform. The proportions of Cement is replaced with Egg shell powder with addition of PET fibers in specified proportions are mixed and thoroughly mixed. Then water was added carefully so that no water was lost during mixing. Fifteen clean and oiled moulds for each category were then placed on the vibrating table respectively for the cubical and cylindrical samples for compression strength testing and for splitting tensile strength. Vibrations were stopped as soon as the cement slurry appeared on the top surface of the mould. Cubical mould of size 150 mm ×150 mm x 150mm and cylindrical mould of 150mm diameter and 300mm in length were used to prepare the specimens and the test is made on the beam of size 700 mm× 150mm × 150mm Care was taken during casting and vibrator was used for proper compaction.

4.2 CURING all the moulds were cleaned and oiled properly. These were securely tightened to correct dimensions before casting. Care was taken that there is no gaps left from where there is any possibility of leakage out of slurry. The specimens were allowed to remain in the steel mould for the first 24 hours at ambient condition. After that these were de-

moulded with care so that no edges were broken and were placed in the curing tank at the ambient temperature for curing. The ambient temperature for curing was 27 ± 20OC.

4.2 SLUMP CONE TEST It can be used in site as well as in lab. This test is not applicable for very low and very high workability concrete. It consists of a mould that is in the form of frustum having top diameter of 10cm, bottom diameter of 20cm and height of 30cm. The concrete to be tested if fitted in the mould in four layers. The each is compacted 25 times with the help of tamping rod. After the mould is completely filled it is lifted immediately in the vertically upward direction which causes the concrete to subside

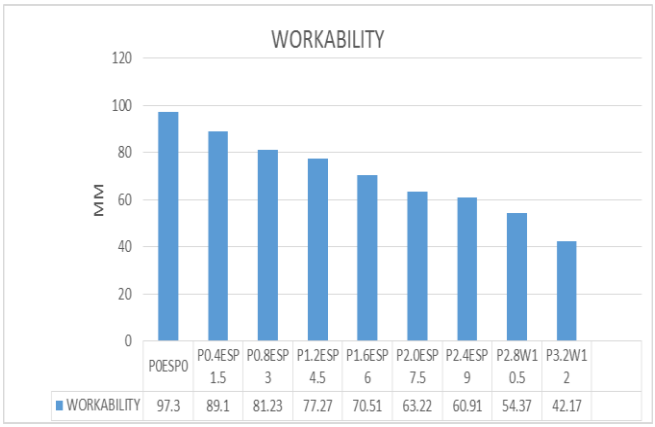


Fig -1: **SLUMP CONE TEST**

4.3 COMPRESSIVE STRENGTH TEST

Then fresh concrete is filled in mould in 4 layers and after filling each layer tamping should be done 35 times in case of cube and 25 times in case of cylinder by using standard tamping rod. Once the mould is filled then leveled top surface of concrete with trowel. After the day the mould will removed and specimen are dropped in the curing tank under standard temperature of 27±2° c. After 3days, 7 days and 28 days in this research.

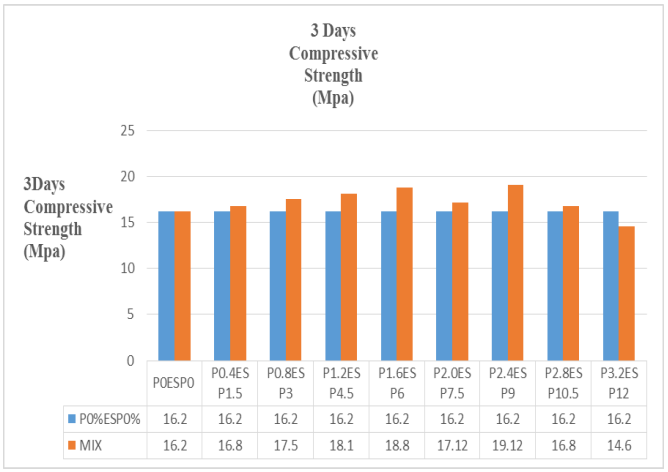


Fig -2: **COMPRESSIVE STRENGTH TEST 3 days**

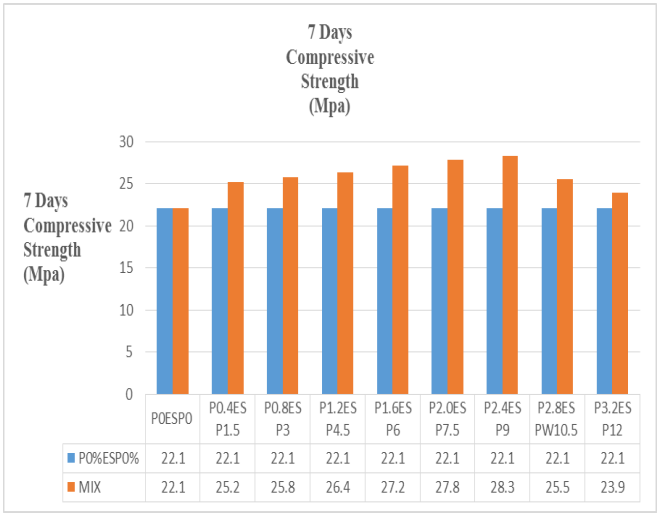


Fig -3: **COMPRESSIVE STRENGTH TEST 7 days**

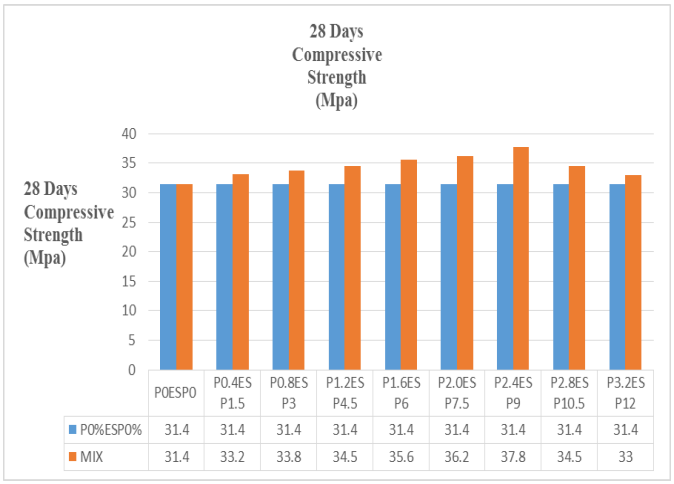
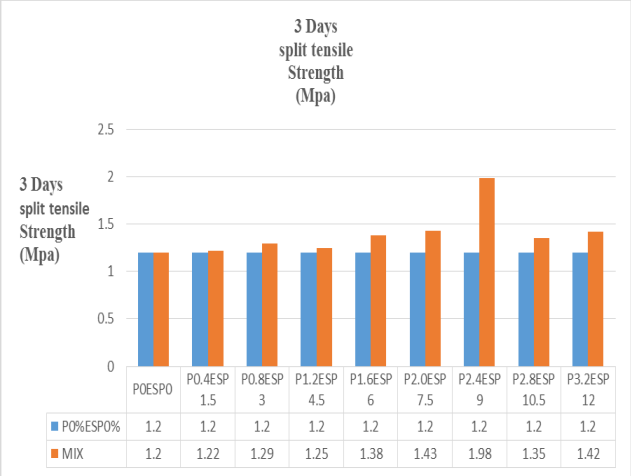


Fig -4: **COMPRESSIVE STRENGTH TEST 28 days**

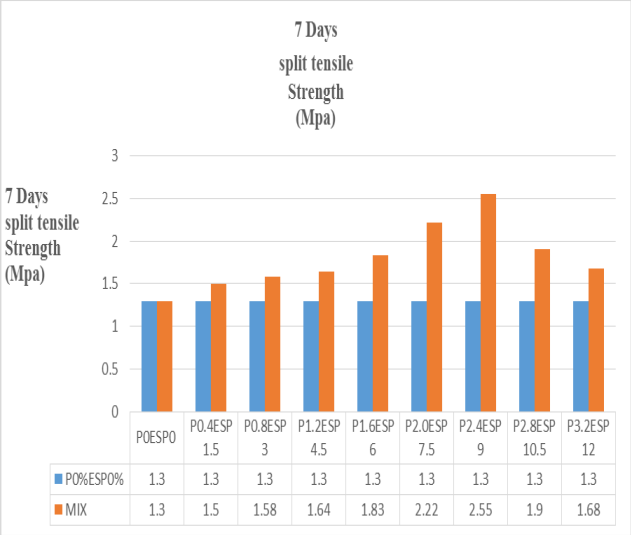
4.4 SPLIT TENSILE STRENGTH

The specimen used for this test is cylindrical and its dimension is 150mm in diameter and 300mm in length. The instrument used for this testing is universal testing machine. The fresh concrete is prepared in according to the required grades and respective mix proportion. The fresh concrete is filled in mould in layers and each layer is tamping with standard tamping rod with 25 blows for each layer. After the day the mould is removed and specimen is placed in the curing tank for 3days, 7 days and 28 days in this research at the temperature 27+ 2°c. Then draw the line on the specimen



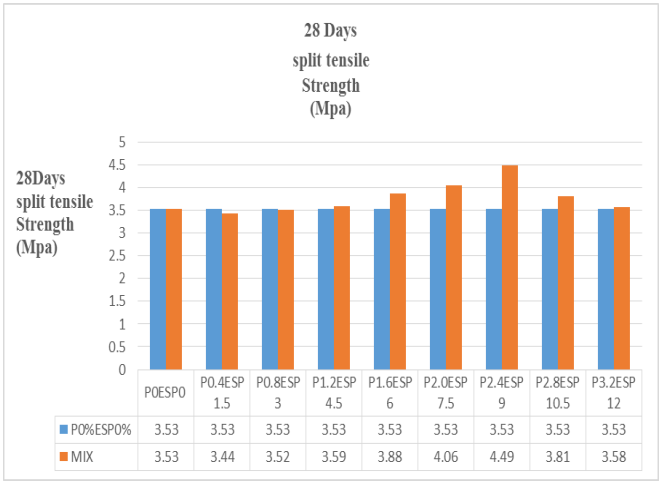
	P0ESP0	P0.4ESP 1.5	P0.8ESP 3	P1.2ESP 4.5	P1.6ESP 6	P2.0ESP 7.5	P2.4ESP 9	P2.8ESP 10.5	P3.2ESP 12
P0%ESP0%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
MIX	1.2	1.22	1.29	1.25	1.38	1.43	1.98	1.35	1.42

Fig -5 SPLIT TENSILE STRENGTH 3 days



	P0ESP0	P0.4ESP 1.5	P0.8ESP 3	P1.2ESP 4.5	P1.6ESP 6	P2.0ESP 7.5	P2.4ESP 9	P2.8ESP 10.5	P3.2ESP 12
P0%ESP0%	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
MIX	1.3	1.5	1.58	1.64	1.83	2.22	2.55	1.9	1.68

Fig -6 SPLIT TENSILE STRENGTH 7 days

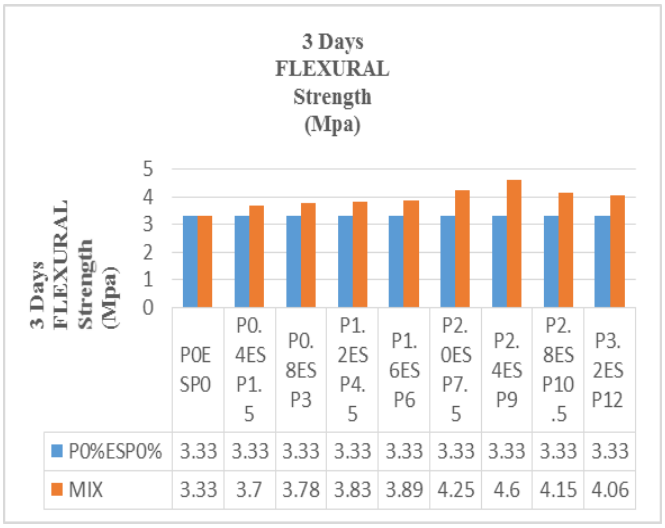


	P0ESP0	P0.4ESP 1.5	P0.8ESP 3	P1.2ESP 4.5	P1.6ESP 6	P2.0ESP 7.5	P2.4ESP 9	P2.8ESP 10.5	P3.2ESP 12
P0%ESP0%	3.53	3.53	3.53	3.53	3.53	3.53	3.53	3.53	3.53
MIX	3.53	3.44	3.52	3.59	3.88	4.06	4.49	3.81	3.58

Fig -7 SPLIT TENSILE STRENGTH 28 days

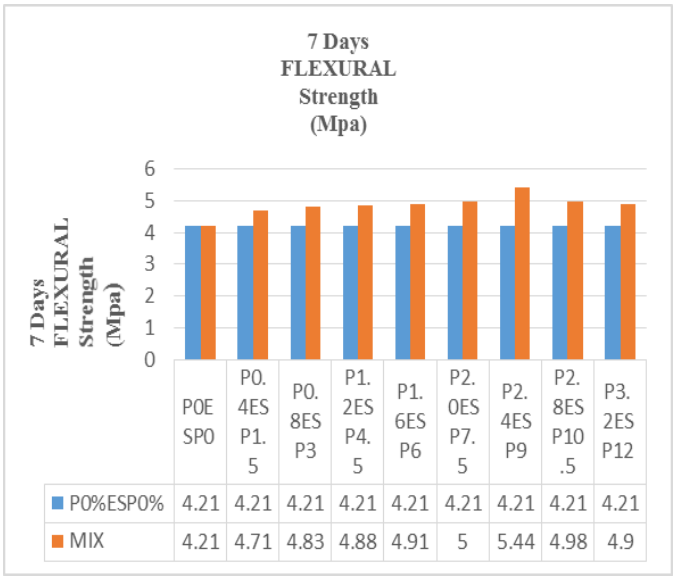
4.5 FLEXURAL STRENGTH TEST

The concrete is prepared at required rate of mass element the mould is filled with concrete in layers and blows 25 times with standard tamping rod. After the day or we can say 24 hours the mould is removed and specimen placed in the water tank for curing at a temperature of 27 + 2 C. Depending upon the requirement the test specimen is removed from the water tank and wipe it properly for 3days, 7 days and 28 days for testing.



	POESP0	P0.4ESP1.5	P0.8ESP3	P1.2ESP4.5	P1.6ESP6	P2.0ESP7.5	P2.4ESP9	P2.8ESP10.5	P3.2ESP12
P0%ESP0%	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33
MIX	3.33	3.7	3.78	3.83	3.89	4.25	4.6	4.15	4.06

Fig -8 FLEXURAL STRENGTH 3 days



	POESP0	P0.4ESP1.5	P0.8ESP3	P1.2ESP4.5	P1.6ESP6	P2.0ESP7.5	P2.4ESP9	P2.8ESP10.5	P3.2ESP12
P0%ESP0%	4.21	4.21	4.21	4.21	4.21	4.21	4.21	4.21	4.21
MIX	4.21	4.71	4.83	4.88	4.91	5	5.44	4.98	4.9

Fig -9 FLEXURAL STRENGTH 7 days

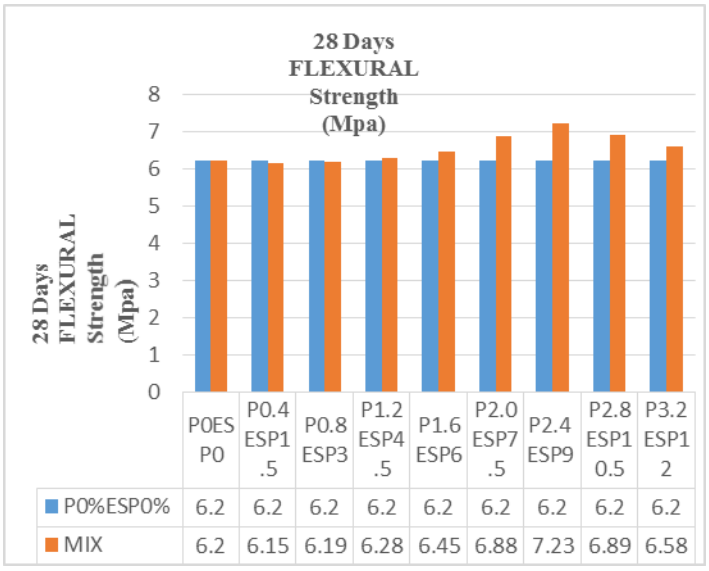


Fig -10 FLEXURAL STRENGTH 28 days

5. CONCLUSIONS

1. By adding Polyethylene therepathelte fibers and Egg shell powder, there is not such large amount of increase in percentage after 3, 7 and 28 respectively. The variation of percentage increase in compressive strength with replacement percentage of Egg shell powder with addition of pet fibers (0.4%-3.2%) and partial replacement Egg shell powder (1.5%-12%).

2. The compressive strength results concluded that with increasing percentage of Egg shell powder the strength of concrete increases. This may be due to finer particle size of Egg shell powder.

3.The result also concluded that with increasing percentage of Egg shell powder the strength increases up to 9% replacement and there is marginal decline in strength above 9% replacement of Egg shell powder.

4.The maximum value of compressive strength at 28 days obtained at 9% Egg shell powder and 2.4 % of PET bottles which is 18.49% higher that control mix.

5.The split tensile result shows similar result as that of compressive strength. The maximum value of split tensile strength for concrete containing 9% Egg shell powder and 2.4% PET bottles which is 23.94% higher that control mix.

6.The result of flexural strength concluded that the maximum value of flexural strength at 28 days was obtained at containing 9% Egg shell powder and 2.4 % Polyethylene therepathelte fibers which is 15.33% higher that control mix.

7.Based on mechanical strength result the partial replacement of Egg shell powder with 9% and Polyethylene therepathelte fibers with 2.4 % which clear evident from 28 days strength.

8.Fine aggregate having very low fineness modulus is also fit for producing standard concrete.

9.Egg shell powder and Polyethylene therepathelte fibers can be used satisfactorily to produce M25 concrete keeping water cement ratio in the range of 0.45.

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