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EXPERIMENTAL INVESTIGATION ON CONCRETE USING WASTE MATERIALS AS FLYASH, GGBS, PET FLAKES AND FIBRES

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ABSTRACT

Concrete is a composite material created from Cement, fine aggregate, coarse aggregate, admixture. Nowadays the requirement of materials for concrete is high but the availability is less. Therefore the replacement for cement and sand are being done by fly ash, GGBS, and PET plastic pieces which in-turn will help both environment and construction industry.

As we know, Fly ash is a by-product of coal combustion and causes harm to both environment and society. The disposal of fly ash is costlier when compared to replace it in construction activities. Therefore 30% of Fly ash is replaced with cement in this experiment and study the properties of concrete.

GGBS is obtained by quenching of molten slag, which is in powdered form, In concrete, it helps to decrease the damages caused by an alkali-silica chemical attack and also gives higher attrition to chloride. Therefore 20% of GGBS is replaced with cement along with Flyash.

Plastic as a material is a major challenge to the environmental pollution in which PET plastic is also a part. Therefore to use PET plastic in concrete could be a solution in solving an environmental problem. In this experiment 10%, 12%, 14% and 16% of PET Plastic are replaced to fine sand as an alternative source.

To help gain the tensile strength of concrete Recron 3s fibres are added at 0.25% of the volume of cement. .It is expected to show sufficient deflection before failure of concrete.

The concrete with all the additives and proper design mix .will be tested for compressive, Split tensile and flexural strength is tested for 3,7 and 28 days.

Keywords:

PET-FLAKES;
FLY ASH;
GGBS;
RECRON 3S FIBRES;
ECONOMICAL.

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1. INTRODUCTION

Plastic is one of the easily available material and which shows high potential in our daily routines and it also has low density, high strength and flexible to use for any work, The cost of the plastic is very less and it also requires low maintenance. Hence these properties of plastics contribute to extraordinary growth in the market. Plastic gives more merits than other material but it also causes environmental problems by increasing the solid waste stream.

Nowadays recycling of PET bottle is very less than compared to the production of a bottle, It is dramatically Increases the solid waste and it pushes for finding the solution to recycle at a higher rate. We have to give special attention towards plastic because it has non-biodegradable property and is increasing yearly up to 1.5%-2%.[10]

PET bottles pieces cannot a dumped and burnt as these are chances of fire which may contaminate the soil and vegetation.

Currently, Cities are now being transformed into smart cities around the world, therefore the main emphasis is of making the concrete green and sustainable, by using the smart materials, Flyash is one such material which adds to the concept of green concrete. It is a residual material which is produced by combustion of coal and it gives significant advantages by using in concrete, It enhances the workability, reduces the permeability, increases the strength, minimizes the bleeding, better surface finishing, reduces The heat of hydration and The particles of flyash are very small in size hardand round in shape. Therefore it minimizes the voids by filling themselves between the free spaces in concrete. It is also having "ball bearing "effect in the concrete and hence using less amount of water quantity. Fly ash is collected in electro-static precipitators and stored in power plant or in landfills. The overall 43% of fly ash collected is often used to supplement the production of cement.

GGBS is the by-product from Iron manufacturing industry along with iron coke, limestone in the furnaces and its physical appearance is in glassy and non-metallic granular. This component establishes the pozzolanic properties.

In the manufacturing of Iron at 1500^0C to 1600^0C, the hot molten slag is floated above the furnace,It's the composition is 30 to 40 % of $SiO_2$and 40% of CaOwhich are also the requirement for chemical composition in cement. [27]

Recron Polypropylene fibres are stereo-regular polymer it is having a high significance in industries as it is 100% synthetic fiber and formed by 80% of monomer propylene,

It is the by-product of petroleum product. Thesefibres were mainly introduced in textile industries in 1970 's, Now it is the 4^{th} most important fibre class after polyester, Nylon,and acrylic.

When these fibres are mixed with concrete it increases the homogeneity in mix and achieves in stabilizing the movement of solid particles and reduces blocking the bleeding action in concrete due to which the surface abrasion and enhancing the strength andfrostresistance, It also reduces the spalling of concrete in fibre, These are an increase which avoids the sudden failure action.

LITERATURE REVIEW

"Use of plastic fibre in concrete" in this topic,Concrete is filled with different percentage of plastic by partial replacing of sand by 0.5 % 1% 1.5% 2%,and tested for 3,7 and 28 days which gives high compression, flexural for 1.5% replacement and it achieves in increases 5% compared to conventional.[1]

"Experimental investigation on the properties of concrete with plastic PET (bottle) fibres as fine aggregates" in this project partially replaced traditional sand by 0.5% 1% 2% 4% 6% with PET bottle fibres for M25 ,test conducted for 3 7 ,28 days which it gives results high for 2 % replacement of PET.[2]

"Concrete incorporated with optimum percentages of recycled polyethylene terephthalate (PET) bottle fiber" in this project replacement of sand is done by 0.5% 1% 1.5% and 2% of PET for 1 % of replacement helps to increases the strength of compression about 10% compared to normal concrete.[3]

"Re-UseOf Poly-ethylene Plastic Waste In C0ncrete" this research shows increasing percentage of PET decreases the Compressive strength, the partial replacement of sand by 2% 4% 6% of PETwhen 2 % of PET gives increasing compressive strength,[4]

"experimental investigation on the properties of concrete with carbon black and PET" in this project utilization of PET and carbon black,PETis varied with percentages of 10 and 20 %, carbon black varies with 10% 20% and 30% in that when replaced with 10% of PET and 30 5 carbon black gives the high strength.[5].

"Use Of Recycled Plastic Waste As Partial Replacement For Fine Agg In Concrete" in this project they are partial replacing the sand by PET waste as 5% 6% 8%10%15% and 20% in that considering the which gives lower compression strength mix then they partially replacing cement by silica fume 5% 10%and 15% to the least compression PET mix and increasing compression strength to 15% replacement cement with 20% of

PET about 22.5% compared to 0%silica fume and 20% PET in concrete.[6]

"Hardened properties of polyethylene terephthalate based concrete" in this project addition of PET waste flakes 1% 2% 3% 4% 5% to the weight of cement it gives optimum results to 2% of PET addition.[7]

"An experimental study on the properties of PET fibre reinforced concrete" in this adding the PET fibres to concrete 2% 4% and 6% in that compression and flexural is increased for 4% of PET.[8]
"Effect of partial replacement of fine aggregate in concrete with low-density polypropylene" in this topic natural sand is partially replaced with plastic polypropylene about 5%,10%,15% and 20%.In that 10 % of replacement reaches the optimum strength of concrete. [29]
"Strength and behavior of concrete contain waste plastic"In this paper, they investigated results by addition of plastic waste polyethylene about 1 %, 3% and 5% to the volume of sand. The strength of concrete increased 4.1% for 1% of PET mix. [17]
"Experimental Investigation on partial replacement of waste plastic in concrete "they are researched as partial replacement of sand by PET plastic by 5%,10%,15% and 20%.In that 5% of replacement gives the higher strength and 10% gives strength within permissible limit.[18]
"Use of plastic waste in sand concrete" in this research it concluded as replacement of sand is done by plastic fibres powder content about 10% 20%, 30%, and 40%.and also plastic fibre also used about 0.5%,1%,1.5% and 2%.in that concrete gain strength optimum at 20% of fibre and 1.5% of fibre when it replaced with sand.[20].

2. RESEARCH METHOD

MATERIALS ARE USED:
CEMENT:We have used 53 grade of OPC MAHA CEMENT according to the requirement as per IS 1489 PART I, 1991.
FINEAGGREGATES:It is filler material in the concrete, which is formed by the river or crushed stones etc. In this project, we have used river sand Zone II grade. As per IS:383-1970. [20].
COARSEAGGREGATES: Coarse aggregate is the inert material in concrete.Wehave used the crushed stone aggregates which are 20 mm downsize,aBasic test of aggregate is calculated as per code IS 2386-1963.[24].
WATER: Using the Water which is portable, drinkable and contains the less impurities, It is confirming the requirement for concreting and Curing as per IS: 456-2000.[23].
ADMIXTURE: It is a chemical agent which helps to reduce the water content in the concrete and it is also increases the workability of concrete, In this project, we have used the admixture as Complast SP 430.[15].
PET (**POLY-ETHYLENETEREPHTHALATE**) **Flakes**:Poly-Ethylene Terephthalate is plastic which is used for the manufacture of plastic bags, Bottles, and many other materials and it causes the wastages or waste plastic in the environment.PET flakes having the size less than 4.75mm, specific gravity 1.32 and texture of the plastic is uniform.[13].
FLYASH: Fly ash is in the form of powder, it isthe by-product of pulverized coal. Which wascombustion in the electric power plant, In this project, We have used 30% of class F type of fly-ash in concrete with the specific gravity of 2.02 (IS 3812).[26].
GROUND-GRANULATED BLAST FURNACE SLAG:It is the co-product which is produced with iron. Slag in the furnace is cooled instantly by quenching in a large quantity of cold water and it is called as granulation, to produce granulated blast furnace slag.

In this project, we used 20% of GGBS with partial replacement of cement to enhance the compressive strength.[28].

RECRON3SPOLYPROPYLENEFIBRES: It is a reinforcing fibre that improves properties such as abrasion, tensile, burst,and bulk. About 0.25% volume of fibre is used in this project.

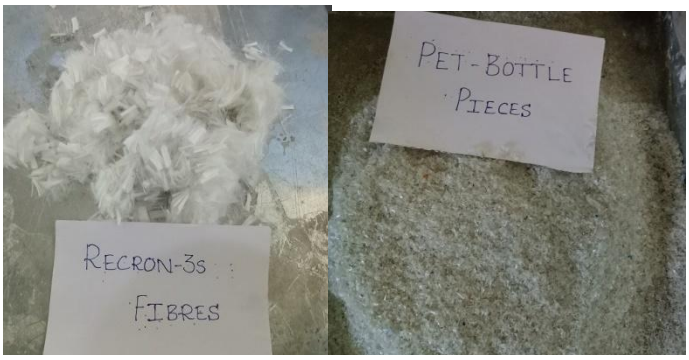

Figure 1: RECRON 3S FIBRES AND PET FLAKES

3. RESULT AND ANALYSIS :

MIX DESIGN:The mix is designed for M_{40} grade of concrete, Calculation is done with reference of IS 456-2000 and IS 10262-2009.

Table 1: Proportion for 1 meter-cube, M_{40} grade

CEMENT kg/m^3	FLYASH (30%) kg/m^3	GGBS (20%) kg/m^3	SAND kg/m^3	COARSE AGG kg/m^3	W/C RATIO l/m^3
221.8	118.8	55.44	942.71	1311.66	0.4
1			2.38	3.31	0.4

Table 2: ProportionFor Mixing

Specimens	% FLY-ASH	% GGBS	Percentage of PET fibers	% RECRON 3S FIBRE	Specimens for compressive strength3, 7 and 28 days	Specimens for Flexural strength3, 7 and 28 days	Specimens for Split tensile strength3, 7 and 28 days
A1	30%	20%	10 %	0.25%	3	3	3
A2	30%	20%	12 %	0.25%	3	3	3
A3	30%	20%	14 %	0.25%	3	3	3
A4	30%	20%	16 %	0.25%	3	3	3

Table **Error! No text of specified style in document.**: Partial replacement of sand by various % of the PET by their volume for the requirement of concrete for one specimen

10 % PET	CEMENT	SAND	CA	FLYASH	GGBS	PET	W/C
CUBE	0.890	3.430	5.31	0.480	0.220	0.187	0.636
CYLINDER	1.410	5.430	8.40	0.760	0.355	0.295	1.000
PRISM	4.192	16.030	24.80	2.240	1.047	0.873	3.000
12 % PET							
CUBE	0.890	3.350	5.310	0.480	0.220	0.220	0.636
CYLINDER	1.410	5.300	8.400	0.760	0.355	0.355	1.000
PRISM	4.192	15.670	24.800	2.240	1.047	1.048	3.000
14 % PET							
CUBE	0.890	3.280	5.310	0.480	0.220	2.620	0.636
CYLINDER	1.410	5.190	8.400	0.760	0.355	0.414	1.000
PRISM	4.192	15.320	24.800	2.240	1.047	1.220	3.00
16 % PET							
CUBE	0.890	3.200	5.310	0.480	0.220	0.300	0.636
CYLINDER	1.410	5.060	8.400	0.760	0.355	0.473	1.00
PRISM	4.192	14.960	24.800	2.240	1.047	1.400	3.00

TESTING PROCEDURE:

Compression test, Split tensile test and the Flexural test is conducted according to as per Is 516: 1959 methods of tests for strength of concrete.

Figure 2: Testing methods for the strength of concrete

Table 4: Compression Results

Sample No	% Of Mixing	Compression Strength In (N/mm^2) 3 days	Compression Strength In (N/mm^2) 7 days	Compression Strength In (N/mm^2) 28 days
Conventional	0%	18.14	27.02	47.42
A1	10%	19.28	27.73	46.48
A2	12%	16.35	24.00	41.79
A3	14%	15.65	19.54	37.25
A4	16%	14.88	19.24	35.21

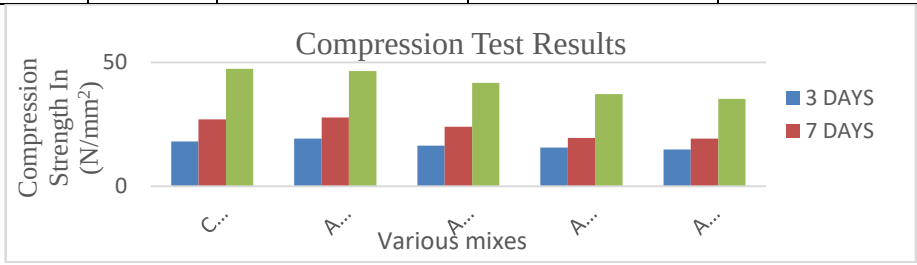

Figure 3: Compression Test Results

Table 5: Split Tensile TestResults

Sample No	% Of Mixing	Split Strength In (N/mm^2) 3 days	Split Strength In (N/mm^2) 7 days	Split Strength In (N/mm^2) 28 days
Conventional	0%	2.00	2.84	4.95
A1	10%	2.01	2.98	4.99
A2	12%	1.66	2.57	4.59
A3	14%	1.26	2.37	4.27
A4	16%	1.15	2.13	3.88

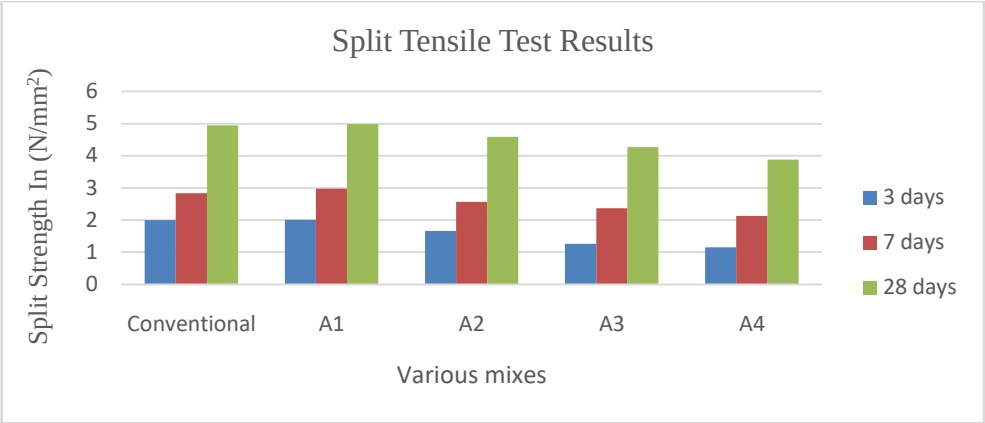

Figure 4 : Split Tensile Test Results

Table 6:Flexural Test Results

Sample No	% Of Mixing	Flexural Strength In (N/mm^2) 3 days	Flexural Strength In (N/mm^2) 7 days	Flexural Strength In (N/mm^2) 28 days
Conventional	0%	2.84	3.46	4.60
A1	10%	3.11	3.64	4.80
A2	12%	2.66	3.20	4.35
A3	14%	2.40	2.93	4.17
A4	16%	2.31	2.75	3.91

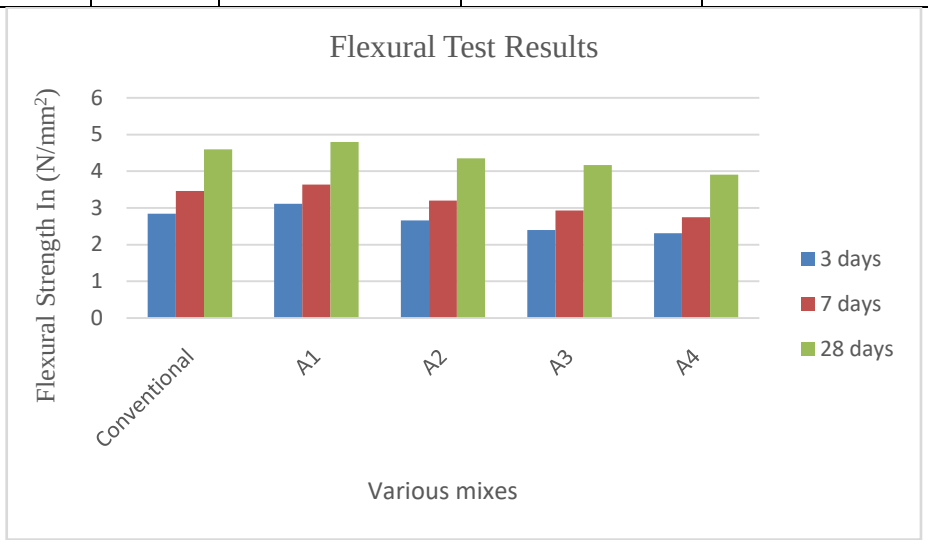

Figure 4: Flexural Test Results

DURABILITYTEST:

In this test taking the specimen which is cured for 28 days and weighing accurately Then it is subjected to Sulfuric acid (H_2SO_4) which having pH=2.5 and pH=3 for 7 days,after the seven days, wiping the specimen with cloth and allow to dry and weighing the weight of the specimen.[24].

Table 7:Results of Sulfuric Acid-Attack

Designation of mix	The weight of specimen before testing	The weight of specimen after testing	Loss in percentage
Normal	8.50	8.47	0.353
A1	8.48	8.46	0.236
A2	8.44	8.41	0.355
A3	8.43	8.40	0.356
A4	8.02	7.98	0.490

4. CONCLUSION

1. The compressive strength of the mix A1 shows higher strength for 3 days and 7 days compared to conventional mix. After 28 days, the strength is satisfactory and equivalent to conventional concrete.
2. The split tensile strength of mix A1 also shows the higher strength compared to conventional mix.
3. The flexural strength of mix A1 is more compared to other mixes and conventional mix.
4. The test results of durability for A1 mix concrete indicates it can resist the acid attack when compared to other mixes.
5. The overall results indicate that the properties of concrete of mix A1 which contains 10% of PET flakes, Fly ash replacement of 30%, GGBS replacement of 20% and recronfibre of 0.25% showed promising results compared to other mixes.
6. If can also be noted that the strength in tension has increased which is also an important factor for the concretes.
7. As the by-products and waste materials have been added to the concrete, the waste material management environmental issues can also be served.
8. It can be concluded that the PET flakes at maximum 10% can be added beyond which the strength decreases. Further experiments can be performed by varying the mixes and studying the properties of the concrete.

REFERENCES

[1] "Use Of Plastic FibreIn Concrete" BalteSanjaykumar, Prof S.N.Dalue, SSRG-IJCE –Volume 4 Issue 11-Nov 2017.

[2] "Experimental Investigation on The Properties Of Concrete With Plastic PET-Bottle Fibres As Fine Aggregates" Ms. K Ramadevi, Ms. R Manju, ISSN 2250-2459,Volume 2,Issue 6, June 2014.

[3] "Concrete Incorporated With Optimum Percentages Of Recycled Polyethylene Terephthalate Bottle Fibre",S.Shahidan,N.A.Ranle Et All, International Journal Of Integrated Engineering,Vol.10 N0.1 2018 Page 1-8.

[4] "Re-Use Of Polyethylene Plastic Waste In Concrete" M Mahesh, B VenkatNarsimhaRao Et All, 2016IJERD,Volume 4,Issue 4,Issn:2321-9939.

[5] "Experimental Investigation On The Properties Of Concrete With Carbon Black And PET" B PadmaPriya,Mrs. K Pandeeswari M. E,International Journal Of Advanced Research -2016,Volume 4,ISSUE 4,1082-1088.

[6] "Use Of Recycled Plastic Waste As Partial Replacement For Fine Aggregate In Concrete" B.Harini And K V Ramana, International Journal Of Innovative Research In Science,Vol.04, ISSUE 9,September 2015.

[7] "Hardened Properties Of Polyethylene Terephthalate Based Concrete" Aneesa Mushtaq,Juned Ahmad And SamanKhan,IJCSEIERD,Volume 7,ISSUE 6,Dec 2017,21-28.

[8] "An Experimental Study On The Properties Of Pet Fibre reinforced concrete" T Subramani, A.Fizoor Rahman.IJAIEM,Volume 6,ISSUE 3,March 2017 ISSN 2319-4847.

[9] W. Romão; M. A. S. Spinacé, M. A. De Paoli. "Poli (Tereftalato De Etileno), Pet: Uma RevisãoSobreOsProcessos De Síntese, Mecanismos De Degradação E SuaReciclagem", Polímeros: Ciência Tecnologia,V.19, N.2, Pp. 121-132.

[10] Mohammed Jalaluddin. "Use Of Plastic Waste In Civil Construction And Innovative Decorative Material (Eco-Friendly)",MOJ Civil Engineering,2017.

[11] Sulyman M., Haponiuk J., and Formela K., 2016, "Utilization of Recycled Polyethylene Terephthalate (PET) Engineering Materials: A Review", International Journal of Environmental Science and Development, 7(2): p.p. 100-108.

[12] Arivalagan.S et al 5(11): "Experimental Investigation On Partial Replacement Of Waste Plastic In Concrete" Volume 3. ISSN: 2277-9655, International Journal Of Research In Engineering And Technology,2016.

[13] Recycled PET Bottles.A Journey From Outerwear To Fashionwear,ApparelOnline,May18,2010 Issue.

[14] PurnandSavoikar October 2011 "Pulverized PET Bottles As Partial Replacement For Sand", International Journal Of Earths Sciences And Engineering, Vol 4.No 06 SPL, October 2011, PP.1009-1012.

[15] IS 9103:1999 Specification For Admixtures For Concrete.
[16] IS 516: 1959 Methods Of Tests For Strength Of Concrete.
[17] Manhal A Jibrael and Farah Peter "Strength And Behavior Of Concrete Contain Waste Plastic"Jibrael And Peter,JEcosysEcograph 2016,6:2.
[18] Arivalagan.S: "Experimental Investigation on partial replacement of waste plastic in concrete"ISSN: 2277-9655,Impact Factor:4.116,CODEN:IJESS7.
[19] M Guendouz,F.Debieb,OBoukendakdji "Use Of Plastic Waste In Sand Concrete" J Mater.Environ.Sci.7(2) (2016) 382-389 ISSN : 2028-2508. CODEN:JMESCN.
[20] IS:383-1970,"SPECIFICATIONFOR COARSE AND FINE AGGREGATE", Bureau of Indian Standards,New Delhi.1970.
[21] IS:10262-2009 Recommended Guidelines For Concrete Mix Design.
[22] IS 456-2000:Plain And Reinforced Concrete-Code Of Practice.
[23] IS 2386-1963, "Methods Of Test For Aggregates Of Concrete, Part I, III & IV", Bureau Of Indian Standards, New Delhi, 1963.
[24] ASTM C1247-14, Standard Test Method for Durability.
[25] Swapnil Samrit, PiyushShrikhande "USE Of Fly Ash As Partial Replacement Of Cement In Concrete "ICSTSD ISSN 2348-8352 Page no 60.
[26] Vinod Goud ,NirajSoni "Partial Replacement of Cement with Fly Ash in Concrete and Its Effect" IOSR Journal ISSN 2250-3021 vol 06, issue 10, PP 69-75.
[27] ChalamcharlaVenu Gopal, Suresh A "Partial Replacement of Cement With GGBS In Concrete" IJARIIT,ISSN 2454-132X VOL 3,ISSUE 5.
[28] ReshmaRughooputh And Jaylina Rana "Partial Replacement Of Cement By Ground Granulated Blast Furnace Slag In Concrete Journal Of Emerging Trends In Engineering And Applied Sciences (JETEAS) 5(5):340-343 (ISSN: 2141-7016).
[29] S SreenathAnd S Harishankar "Effect Of Partial Replacement Of Fine Aggregate In Concrete With Low-Density Polypropylene"IJCIET, VOLUME-7, ISSUE 6, November –December 2016.
[30] Maneeth P D, Lokesh G, Subhash C Yaragal, K S Babu Narayan, "Usage Potential Of Melt Processed Plastic Pellets As A Substitute To Fine Aggregate In Porous Concrete", International Journal Of Earth Science And Engineering (IJESE), Volume 05, Issue No. 2, 327-334, April 2012
[31] Maneeth P D, Pramod K, Kishor Kumar, Shanmukha Shetty,"Utilization Of Waste Plastic In Manufacturing Of Plastic Soil Bricks", International Journal Of Engineering Research And Technology (IJERT), Volume 3, Issue 8, Aug-2014, Pp.529-536.
[32] Nadeem M A, Rohan S Gaurav, Brijibhushan S, Maneeth P D, "Experimental Investigation On Partial Replacement Of Natural Fine Aggregate By HD-PET Thermoplastics And Cement By Glass Fibres In Cement Concrete",IJSRD, VOL 3, Issue 10, Pp.294-300,2015.
[33] Poornima M Reddy, Dr. Shreenivas Reddy Shahapur, Maneeth P D, Brijbhushan S," Analysis Of Action Of Polypropylene Fiber On M- 30 Concrete By Supplementing Cement With Fly Ash And GGBS", International Journal For Innovative Research In Science &Technology (IJIRST)- Volume 4, Issue 3, August 2017, Pp. 99-103.