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Experimental Investigations on Eco Friendly

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Abstract

The rapid Urbanization and Industrialization all over the world has resulted in large deposition of Plastic waste and Waste Tyre Rubber. This waste can be utilized under proper condition to reduce the Cement content in Concrete. M_{30} concrete is used for most of the constructional works. The strength of this concrete results has compared with concrete obtained of Plastic waste and Waste Tyre Rubber varying from 0% to 20% .Experimental investigations comprised of testing physical requirements of coarse aggregates, fine aggregates, cement and the modifier waste plastic and waste tyre rubber. M_{30} concrete design mix considered as per IS 10262-1982. The said percentage of modifier was blended with the cement concrete mix and the optimum modifier content was found. Cubes and cylinders were cast and tested for 28 days strength. These tests revealed that by adding Waste plastics and rubber as partial replacement in Fine Aggregate and Coarse aggregate by volume, the strength of concrete decreased. The cube strengths were decreased as the percentage replacement increased due to their poor bounding properties. By using Plastic waste and Waste Tyre Rubber as modifier, we can reduce the quantity of coarse aggregate and fine aggregate by their volume, hence decreasing the overall cost of construction .The Modified cement concrete can be used in the construction of small drainage works and rigid pavement. Effective utilization of waste plastics can be done for a good cause protecting global environment and effective solid waste management.

INTRODUCTION

The changed lifestyle and endlessly increasing population has resulted in a significant rise in the quantity of post-consumer Plastic waste and Waste Tyre Rubber. The world's annual consumption of plastic materials has increased from around 5 million tons and 20 million tonnes in the 1950s to nearly 100 million tons in recent times, resulting in a significant increase in the amount of Plastic waste and Waste Tyre Rubber generation. Out of this waste, a significant part is recycled but the majority of post-consumer Plastic waste and waste tyre rubbers, like shampoo sachets, carry-bags, nitro packs, milk and water pouches and rubbers in Waste tyres etc. though recyclable, remains comparatively untouched as they are difficult to separate from household garbage. In most of the cases, such post-consumer waste either litters all around or is disposed of by land filling. The disposal of post-consumer Plastic waste and Waste Tyre Rubber in this manner poses significant environmental hazards as it results in reduction in soil fertility, reduction in water percolation, emission of toxic gases, health hazard to animals and birds consuming the wastes, poor drainage due to landfill, pollution of ground water due to leaching of chemicals from these waste products etc.

Looking to the global issue of environmental pollution by post-consumer Plastic waste and Waste Tyre Rubber, research efforts have been focused on consuming this waste on massive scale in efficient and environmental friendly manner. Researchers planned to use Plastic waste and Waste Tyre Rubber in form of concrete ingredient as the concrete is second most sought material by human beings after water. The use of post-consumer Plastic waste and Waste Tyre Rubber in concrete will not only be its safe disposal method but may also improve the concrete properties like tensile strength, chemical resistance, drying shrinkage and creep on short and long term basis.

The Plastic waste and waste tyre rubbers which can be used as fine and coarse aggregate and their effect on properties of concrete. It also presents current trends and future needs of research in the area of use of post-consumer Plastic waste and Waste Tire Rubber in Concrete. The rapid Urbanization and Industrialization in India has Resulted in large deposition of Plastic waste. Plastic waste, consisting of carry bags, cups etc. Can be used as a coating over aggregate and this coated stone can be used for road.

This is a eco-friendly process. By using plastic waste as modifier, the quantity of cement and sand by their weight can be reduced, thereby decreasing the overall cost of construction. Discarded vehicle tires constitute an important part of waste material, which had historically been disposed of into landfills. The production of waste by the tire industry has been a growing problem, indicating the need for its reuse in the construction field. Rubber can be added to asphalt, which increases its durability and improve pavement quality and safety conditions by absorbing the rubber elastic properties. Rubber can also be used for concrete pavements for light traffic. Over the years, research is going on for the use of recycled tire rubber in PCC mixture as a possible alternative aggregate partially replacing some part of aggregate. Rubber aggregates from discarded tire rubber in sizes 20mm can be partially replaced natural aggregates in cement concrete construction.

Scrap tires of various automobiles are continuously accumulated in the landfills all over the world. After the service life of truck and car tires is over their storage and disposal becomes a challenging problem for the municipal authorities. The waste tires also pose a great health hand environmental threat due to increased breeding of mosquitoes and other insects or increase in fire hazards at their storage locations. The municipal authorities in many countries have already banned dumping of waste tires into the landfills due to the above-mentioned problems hence their disposal needs a viable and environmental friendly solution. Different methods have been adopted for the disposal of scrap tires. They include use of tires as fuel, ground rubber applications for play-ground or sports surfacing or use in new rubber products and use in asphalt rubber modified concrete. Some of the other civil engineering applications include road and landfill construction, septic tank construction etc. Remaining tires are disposed of into the landfills. The tire derives are accounted for 40.3%, ground rubber applications are accounted for about 26.2% and 5.5% accounted for various civil engineering applications of the total generation of scrap tires in the year 2009. However, at the end of 2010, about 112 million scrap tires still remained in the stock piles and this number is increasing every year. The statistics brings out the importance of the more widespread and durable application program for the reuse of the scrap tires.

Waste scrap tires can be used in different forms such as tire chips, ground rubber, or fibers for different applications. Tire chips and fibers can be produced by shredding. The ground rubber also called as crumb rubber is produced by reducing scrap tires to smaller sizes by grinding. However, the properties of eco friendly Concrete depend on whether the rubber is obtained from car or truck tires due to the different chemical composition in both types. The typical composition of rubber tire consists of natural rubber 14% for car tires, 27% for truck tires, synthetic rubber 27% for car tires and 14% for truck tires, carbon black 28%, steel 14-15% and fabric, fillers, anti-ozonants etc. 16-17% by total weight of a tire.

It is non degradable material. If not taken care, can effect human health and rein the peace of society. Many efforts have been made by construction industry to utilize these industrial wastes in construction and thus reducing the environmental pollution load. The main source of Plastic waste are shampoo packets, carry-bags, nitro packs, milk and water pouches and rubbers in Waste tires etc. Eco friendly concrete is not structural concrete. It is useful for surface pavements and small drainage works. This decreases the thickness of pavement. It is lightweight concrete compare to plain cement concrete. M_{30} grade concrete is useful for pavements. These are the disposals of waste plastic and rubber form house, hospital and industries. These have more elastic property then plain cement concrete.

TYPES OF WASTE PLASTICS

House Hold Plastics: These are the Domestic plastic wastes generally used in a house like plastic wraps, cups, poly ethylene covers, resins, polyester clothes etc, They are less toxic in nature and are of Food Grade material which can be recycled twice or thrice.

Eplastics: Waste describes loosely discarded, surplus, obsolete , broken, electrical or electronicevices. Rapid technology chan ge ,low initial cost have resulted in a fast growing surplus of e lectronic waste around the globe.

Industrial Plastics: For Eco Friendly concrete, here we are taking the round shape small particle for the replacement of sand. These are controlled by economically, physically, chemical limitations. We are considering waste plastic as fine aggregate.

USAGE OF PLASTIC WASTE AND WASTE TYRE RUBBERS IN CONCRETE

It is observed that plastic waste and waste tyre rubber is used as concrete ingredient in various forms. They are commonly used in the form of fine and coarse granular particles, powder and discrete fibers. This form of ingredient is mainly controlled by economical, physical and chemical limitations of converting the wastes in a particular shape or form. Few selective research efforts have been summarized here to present a general scenario of usage of post-consumer plastic waste and waste tyre rubber like carry bags, wrapping and packaging materials, left over or crushed bottles and small to medium containers etc in various forms. And waste and worn out tyres from the vehicles.

Advantages of waste plastic in concrete

- Concrete with waste plastics has more elastic property then P.C.C value of young's modulus of concrete with waste plastics is also found to be more than P.C.C
- Compressive strength increases substantially when compared to P.C.C
- Flexural strength increases by approximately 2 to 3 times Throughout the mix.
- Increase in cube strength of concrete.

Advantages of waste tyre rubber in concrete

Concretes with waste tyre rubber are found to be more tougher compared to concretes

Modulus of elasticity and Energy absorption capacity of concrete are increased slightly when waste tyre rubber are used in concrete

The durability of the concrete cast with waste tyre rubbers are bound to be more durable compared to conventional concretes

Problems associated with the use of plastic waste and waste tyre rubbers in concrete

As the surface of all the forms of plastic waste and waste tire rubber is smooth, their bond characteristics become a hindrance to use them as concrete ingredient. The major concern of using plastic waste and waste tire rubber in concrete is to produce roughness on the surface of the plastics used. Hence, when plastic waste and waste tire rubber is required to be used in concrete, they need surface roughening treatment for better bond properties. These treatments vary with the type of plastic waste and waste tire rubber. This aspect limits the full utilization of plastic waste and waste tire rubbers generated by consumers as concrete ingredient.

Though plastics and rubber had brought a rapid change in the life style, it had become a great problem to the mankind to dispose them.

Disposal method - Draw backs	
Land filling -	Decreeing soil fertility
Burning -	Releasing gases

The partial replacement of waste plastic in concrete has no draw backs. These have smooth surface. The special treatment is needed for better bonding. The present investigation deals with the effective utilization of those accumulated plastics and rubber as partial replacement in concrete. Till now the experimental investigations were done either by replacing partially the Fine or Coarse aggregate by either Plastics or Rubber but not both. In the present investigation we intend to partially replace Fine and Coarse Aggregates with both Waste Plastics and Waste tyre Rubber Respectively.

Future of plastic waste and waste tyre rubbers as concrete ingredient

The idea to use post-consumer plastic waste and waste tire rubber as concrete ingredient will result in its large volume disposal which is environmentally safe and does not pose any health hazard At present these trials are mostly limited to laboratory or research level. However, these investigations pose a big challenge to provide a bridge to gap the laboratory works and real applications. A need is also felt to accomplish the form plastic waste and waste tire rubbers apart from powder, grain and fibers, which can be used directly in concrete without any pre-treatment. The process of making plastic waste and waste tire rubbers suitable for concrete is energy intensive hence an energy efficient method is required to be developed. No clear-cut methodology is available for mix design using plastic waste and waste tyre rubbers; a significant experimentation is required for its formulation. Durability aspects of concrete using different types of plastic waste and waste tyre rubbers require thorough investigation. An in-depth experimental analysis of mechanical behavior of concrete containing plastic waste and waste tyre rubbers needs an urgent attention.

Usage of post-consumer Plastic waste and Waste Tire Rubber in concrete as ingredient can solve its disposal problems to significant extent. Improvement in the mechanical properties of concrete such as compressive strength, split tensile strength, thermal properties, energy absorption, flexural strength, crack arresting behavior etc. by adding post consumer Plastic waste and waste tyre rubbers may be found. However, a thorough investigation is required to be taken-up in this area. The plastic waste and waste tyre rubbers is mostly used in form of powder, aggregates and fibers as a concrete ingredient. All these forms have smooth surface and hence require surface roughening treatment for better bond characteristics. Use of plastic waste and waste tyre rubbers in concrete is quite a new research area hence presents a great research potential. The idea to use post-consumer Plastic waste and Waste Tyre Rubber as concrete ingredient will result in its large volume disposal which is environmentally safe and does not pose any health hazard At present these trials are mostly limited to laboratory or research level. Usage of post-consumer Plastic waste and Waste Tire Rubber in concrete as ingredient can solve its disposal problems to significant extent.

Mix proportioning concepts

Currently, there does not exist a standard or recommendation for mixture proportioning of plastic waste and waste tyre rubbers concrete. However different people have developed their own procedures, and in one-way or more, some have similarities with each other. plastic waste and waste tyre rubbers has been proportioned based on several concepts and considerations. There are three techniques of incorporating plastic waste and waste tyre rubbers relative to fine aggregate in the concrete mix

Addition to fine aggregate and coarse aggregate directly.

Partial replacement of fine aggregate by the equal volume of plastic waste and waste tyre rubbers(1:1 replacement)

Partial replacement of fine aggregate by the less volume of plastic waste and waste tyre rubbers (5%,10%, 15%, 20%)

In the third technique, it is possible to use plastic waste and waste tyre rubbers to reduce the cost for comparable quality by reducing the fine aggregate content and replacing it with a lesser amount of plastic waste and waste tyre rubbers.

Plastics and rubbers used for present investigation

The plastics used in the present investigation are domestic waste plastics which are processed in polyethene carry bag industry and are made into granules of variable sizes which in turn are graded according to the design requirements and are used as partial replacement for fine aggregate in concrete.

The plastics used in the present investigation taken from domestic waste plastics and considered for the replacement of fine aggregate. The waste tyre rubber from scrap and unused tyre and Considered waste tyre rubber as coarse aggregate

EXPERIMENTAL INVESTIGATION

The experimental investigation was taken up on M_{30} grade of concrete. The investigation was aimed at studying the effect of Plastic waste and waste tyre rubbers in concrete cubes cast with M_{30} grade concrete and tested under Compression testing Machine. To reach the purpose of this research, experimental laboratory study was developed using the materials-53 grade Portland cement, graded coarse aggregate, river sand, Plastic waste and waste tyre rubbers and bore well water.

Materials used

Concrete is an artificially engineered material made from a mixture of Portland cement, aggregates and water. It is most commonly used construction material in the world. It is strong, cheap and durable. Portland cement combines with water due to hydration to bond the aggregates together into a solid whole. The materials used in the present investigation are cement, fine aggregate, coarse aggregate, water, super plasticizer, plastic wastes and waste tyre rubbers.

Portland Cement

Portland cement is made from heating limestone and chalk, combined with silicates. Portland cement holds the aggregates together and is available in different grades and colors. The type of Portland cement generally available in hardware or lumber store is gray in colour. The cement used in this investigation is Orient Gold make, 53-grade Portland, for casting of the cubes, cylinders and prisms. The physical properties of the Portland cement used are given in the below table.

Table 1. Physical Properties of Cement

S.No	Property	Value
1	Grade	53
2	Specific Gravity	3.1
3	Standard Consistency	32%
4	Initial Setting Time	35 Minutes

Fine Aggregate

Sand is generally used as fine aggregate for production of the concrete. The sand should be sharp to grab the cement onto it. This sharp sand is also called as brick sand or mortar sand. The grains of sand from pit run sand are usually too round. Stone dust, a waste product from quarries or stone works can also be added to produce concrete, and usually for smooth mixtures for small scale concrete production. This stone dust adds strength, and reduces shrinkage on setting, and improves visual appearance of concrete. Limestone (dolomite) or marble dust is two types of dust. For the present experimental work river sand procured from Man air is used as Fine Aggregate. The physical properties of this Fine Aggregate are as shown in Table No 2.

Table 2. Physical Properties of Fine Aggregates

S.no	Property	Value
1	Specific Gravity	2.57
2	Fineness modulus	3.36
3	Zone of sand	II

Table No.3: Classification of Fine aggregate

RANGE	ZONE
4 – 2.71	ZONE I
3.37 – 2.10	ZONE II
2.78 – 1.71	ZONE III
2.25 – 1.35	ZONE IV

Coarse Aggregate

Crushed hard granite stone or gravel of size less than 20mm is used as coarse aggregate. Stone adds strength in larger work and also controls shrinkage. Stone is cheaper than cement. The coarse aggregate is procured from Jayagiri, Hanamkonda and used for investigation. The properties of coarse aggregate used are shown in Table 3.

Table 4: Physical Properties of Coarse Aggregate

S.No	Property	Value
1	Specific Gravity	2.79
2	Fineness Modulus	7.33

Waste plastic

The Word plastic means, the substances which have plasticity and accordingly anything that is performed in a soft state and used in a solid state can be called a plastic. These have two types, one is which can be melted for recycling in the plastic industry. Ex: Polyethylene, propylene, polymide, polyoxythylene. And Second type is Thermosetting plastic cannot be melted by heating because the Molecular chains are bounded firmly with meshed crosslink. Ex: Phenolic.

Waste tyre rubber

The rubber concrete reduces the concrete strength; however, this may be used where M_{10} and M_{15} grade concrete is needed. With proper mix design, about 20 percent density will be reduced in comparison to control mix when 30 percent rubber aggregate is replaced with coarse aggregate of control mix.

Water

It should be free from impurities and clean. The water is from bore well and is Potable. This water is used for both casting and curing. The temperature of the mixing water was maintained constant.

Mix design

In this study, the normal strength concrete of M30 grade is considered. BIS code procedure as per IS: 10262-1982 was followed for finding the mix proportions of all the concrete specimens. The mix proportions is as follows

Table No.5: Mix proportion

Water	Cement	Fine aggregate	Coarse aggregate
186 kg/m^3	404 kg/m^3	586 kg/m^3	1191kg/m^3
0.46	1	1.45	2.95

The replacement of waste plastic and waste tyre rubber in order to fine and coarse aggregate was done according to the volume replacement. For 10% of material replacement, considered 5% waste plastic in the replacement of fine aggregate and 5% waste tyre rubber in the replacement of coarse aggregate.

Scheme of project

For this present investigation at every replacement three no. of cubes and three no. of cylinders were need to cast. The scheme of project was as

S.NO	%OF WASTE PLASTIC REPLACEMENT	% OF WASTE TYRE RUBBER REPLACEMENT	NO. OF CUBES CASTED	NO. OF CYLINDERS CASTED	TOTAL
1	0	0	3	3	6
2	2.5	2.5	3	3	6
3	5	5	3	3	6
4	7.5	7.5	3	3	6
5	10	10	3	3	6

Mixing

The mixing process should be good for any concrete to get good results. The exact proportion of every material has to be considered according to the calculated quantity. For every mix weighing of material was needed. Waste Plastic, waste tyre rubber for mixing had to be taken as per the standard size of fine and coarse aggregate. The mixing for making concrete is done on the following steps

Nomenclature

Table No.6: Nomenclature

Cube
C_0 - Cube with replacement of 0% plastic and 0% rubber
$C_{2.5}$ - Cube with replacement of 2.5% plastic and 2.5%vrubber
C_5 - Cube with replacement of 5% plastic and 5% rubber
$C_{7.5}$ - Cube with replacement of 7.5% plastic and 7.5% rubber
C_{10} - Cube with replacement of 10% plastic and 10% rubber

Tests on fresh concrete

The following tests were conducted on fresh concrete for their slump and compaction factor valuesSlume test

Compaction factor test

SLUMP RESULTS

Table No.7: Slump values

PERCENTAGE OF WASTE PLASTIC AND WASTE TYRE RUBBER REPLACEMENT	SLUMP VALUE (cm)
0	2.5
5	2.7
10	3
15	3.2
20	3.8

Compaction factor test results

Table No.8: Compaction factor values

PERCENTAGE OF WASTE PLASTIC AND WASTE TYRE RUBBER REPLACEMNET	COMPACTION FACTOR VALUE
0	0.87
5	0.87
10	0.86
15	0.86
20	0.85

Casting of specimens

Standard cast iron moulds of (150x150x150) cube and (150diax300mm) cylinder are used for casting the specimens. All the moulds have been cleaned and oiled before every time. Moulds are being cast by placing them over neat surface. A mix generally requires much less vibrations to move the mix and consolidate it into the moulds. The compaction of the specimens have done on a tamping rad. The casting work was done in three batches for preparing three numbers of cubes of size 150mm x 150mm x 150mm. I.S Code method was used to obtain the mix proportions for M30 grade of concrete. The coarse aggregate used in the casting was of size 20 mm. The waste plastic and waste tyre rubber was incorporated in the above mix proportion 0, 5, 10, 15, 20 percentages of Fine aggregate and coarse aggregate by weight. The mixing of plastic waste and waste tyre rubber and Fine aggregate is shown in above figs. After obtaining the mix proportions with Fine aggregate+ coarse aggregate +plastic waste and waste tyre rubber for M_{30} grade of concrete, Details and placing the mould is shown in below fig. The cubes were cured in a pond for 28 days. The specimens were taken out curing pond and under shade for surface dry. Then the specimens were tested in the laboratory.

RESULTS

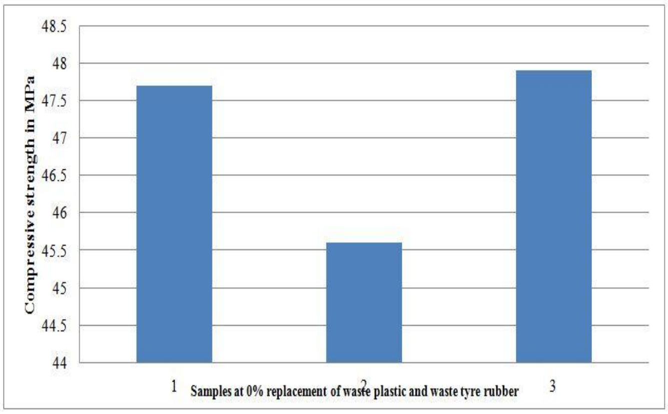
Compressive strength of cube specimens

The compressive strength of cubes are given below in N/mm^2

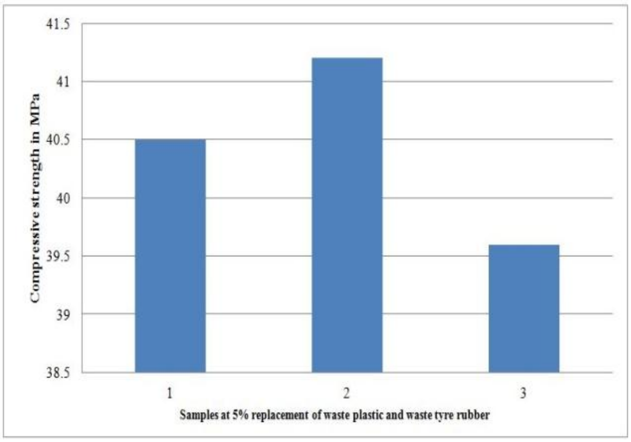
No. of samples	0% of waste material replacement	5% of waste material replacement	10% of waste material replacement	15%of waste material replacement	20% of waste material replacement
Sample 1	47.7	40.5	31.3	26.1	26.1
Sample 2	45.6	41.2	31.3	27.3	25.4
Sample 3	47.9	39.6	33.2	28.1	25.4
Avg	47.01	40.3	31.9	27.2	25.8

COMPARISON OF COMPRESSIVE STRENGTH OF CUBES VS PERCENTAGE REPLACEMENT OF WASTE PLASTIC AND WASTE TYRE RUBBER

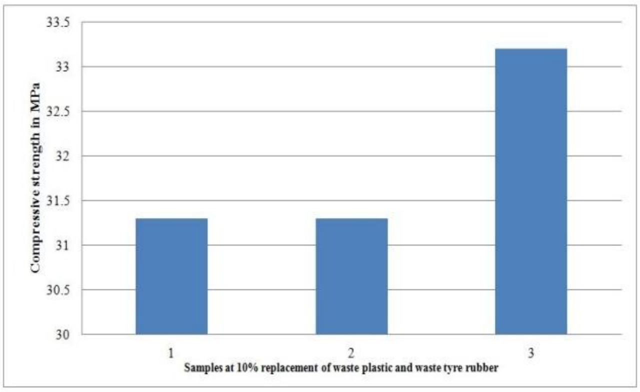
Graph No.1: Graph showing Compressive strength of cubes at the age of 28 days



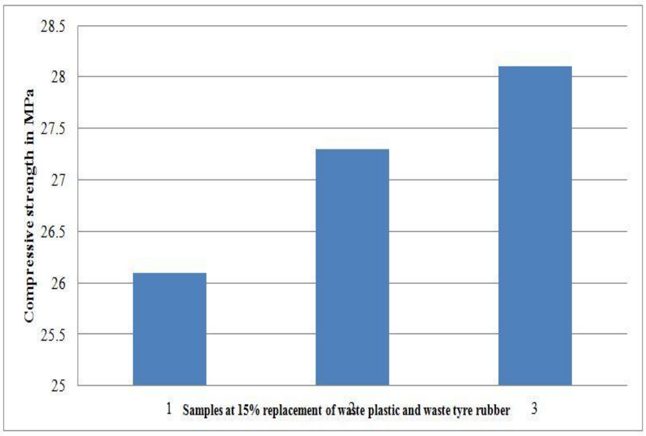
Graph No.2: Graph showing Compressive strength of cubes at the age of 28 days



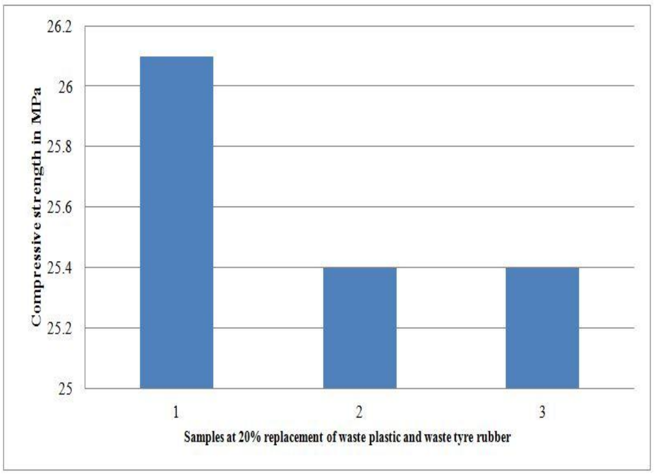
Graph No.3: Graph showing Compressive strength of cubes at the age of 28 days



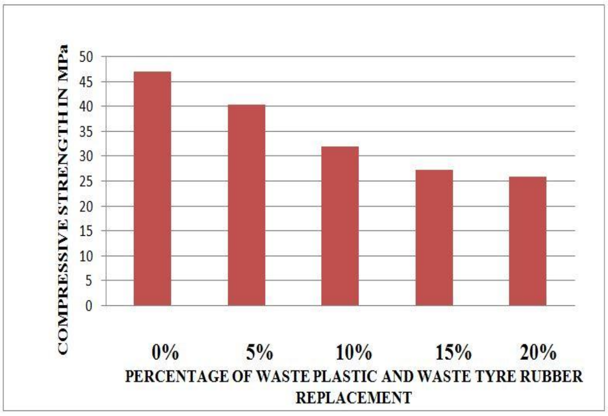
Graph No.4: Graph showing Compressive strength of cubes at the age of 28 days



Graph No.5: Graph showing Compressive strength of cubes at the age of 28 days



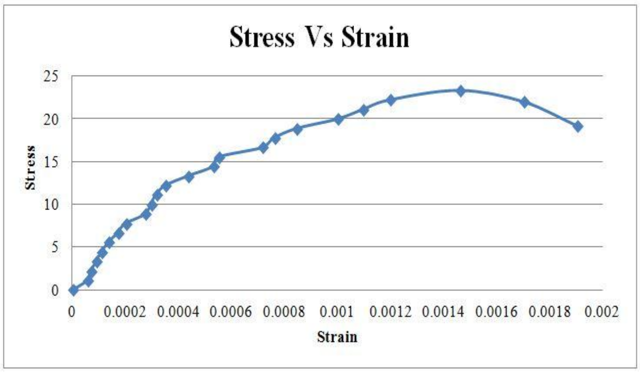
Graph No.6: Comparison of average compressive strength of cubes Vs percentage replacement of waste plastic and waste tyre rubber



THE FOLLOWING GRAPHS SHOWING STRESS VS STRAIN

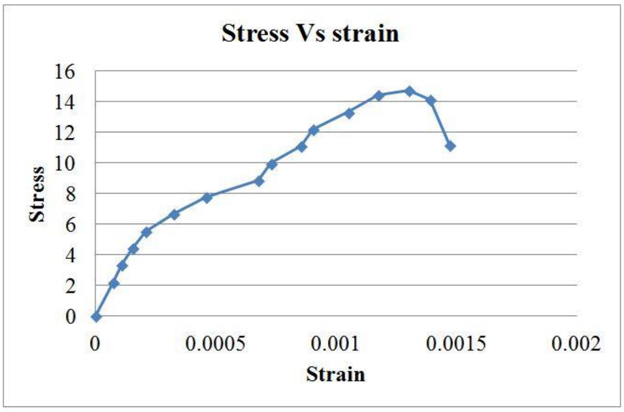
The graphs showing stress vs strain at 0% percentage replacement of waste plastic and waste tyre rubber: sample 1

Load	Extensometer reading		Mean	Area	Strain	Stress
KN	Left	Right		cm^2		N/mm^2
0	0	0	0	17671.45	0	0
2	4	7	5.5	17671.45	0.00005	1.11
4	5	9	7	17671.45	0.00007	2.22
6	7	11	9	17671.45	0.00009	3.33
8	9	13	11	17671.45	0.00011	4.441
10	10	17	13.5	17671.45	0.00013	5.551
12	13	21	17	17671.45	0.00017	6.661
14	14	26	20	17671.45	0.00021	7.771
16	19	36	27.5	17671.45	0.00027	8.882
18	20	39	29.5	17671.45	0.00029	9.992
20	22	41	31.5	17671.45	0.00031	11.102
22	23	47	35	17671.45	0.00035	12.212
24	33	54	43.5	17671.45	0.00043	13.323
26	47	59	53	17671.45	0.00053	14.433
28	50	60	55	17671.45	0.00071	15.543
30	73	70	71.5	17671.45	0.00076	16.653
32	80	72	76	17671.45	0.00084	17.764
34	86	83	84.5	17671.45	0.0009	18.874
36	110	90	100	17671.45	0.0011	19.984
38	125	94	109.5	17671.45	0.0013	18.987
40	142	97	119.5	17671.45	0.0014	17.987



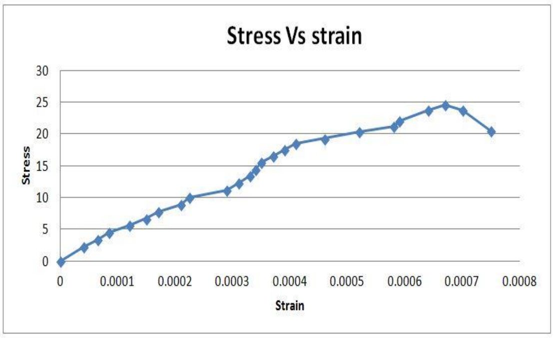
The graphs showing stress vs strain at 0% percentage replacement of waste plastic and waste tyre rubber: sample 2

Load	Extensometer reading		Mean	Area	Strain	Stress
KN	Left	Right		cm^2		N/mm^2
0	0	0	0	17671.45	0	0
2	5	10	7.5	17671.45	0.00007	1.11
4	7	15	11	17671.45	0.00011	2.22
6	11	20	15.5	17671.45	0.00015	3.33
8	17	25	21	17671.45	0.00021	4.441
10	30	35	32.5	17671.45	0.00032	5.551
12	47	45	46	17671.45	0.00046	6.661
14	80	55	67.5	17671.45	0.00067	7.771
16	85	61	73	17671.45	0.00073	8.882
18	97	74	85.5	17671.45	0.00085	9.992
20	100	81	90.5	17671.45	0.00090	11.102
22	120	90	105	17671.45	0.00105	12.212
24	140	95	117.5	17671.45	0.00117	13.323
26	120	97	108.5	17671.45	0.0013	14.433
28	110	93	125	17671.45	0.0013	13.543
30		93	93	17671.45	0.0014	12.425



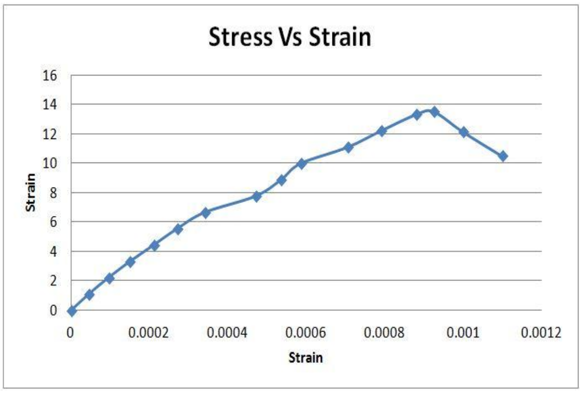
The graphs showing stress vs strain at 0% percentage replacement of waste plastic and waste tyre rubber: sample 3

Load	Extensometer reading		Mean	Area	Strain	Stress
KN	Left	Right		cm²		N/mm²
0	0	0	0	17671.45	0	0
2	3	5	4	17671.45	0.00004	1.11
4	6	7	6.5	17671.45	0.00006	2.22
6	8	9	8.5	17671.45	0.00008	3.33
8	13	11	12	17671.45	0.00012	4.441
10	21	21	21	17671.45	0.00015	5.551
12	32	30	31	17671.45	0.00017	6.661
14	39	35	37	17671.45	0.00021	7.771
16	41	44	42.5	17671.45	0.00022	8.882
18	45	47	46	17671.45	0.00029	9.992
20	47	48	47.5	17671.45	0.00031	11.102
22	49	50	49.5	17671.45	0.00033	12.212
24	50	51	50.5	17671.45	0.00034	13.323
26	60	459	259.5	17671.45	0.00035	14.433
28	72	71	125	17671.45	0.00037	16.444
30	81	80	80.5	17671.45	0.00039	17.456
32	90	90	90	17671.45	0.00041	18.424
34	92	92	92	17671.45	0.00046	19.254
36	76	82	79	17671.45	0.00052	20.354
38	53	60	56.5	17671.45	0.00058	21.113
40		115	115	17671.45	0.00059	22.046
42		148	148	17671.45	0.00064	23.671
44		151	151	17671.45	0.00067	24.568
46		140	140	17671.45	0.0007	23.751
48		110	110	17671.45	0.0007	20.475



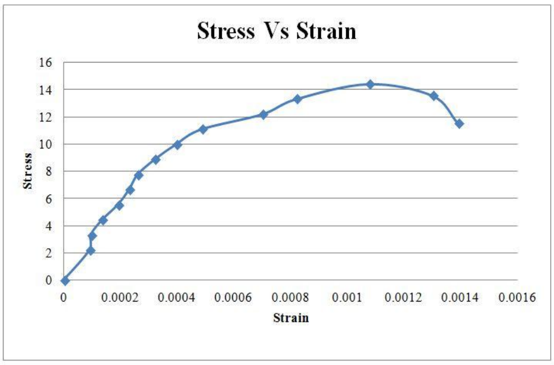
The graphs showing stress vs strain at 5% percentage replacement of waste plastic and waste tyre rubber: sample 1

Load	Extensometer reading		Mean	Area	Strain	Stress
KN	Left	Right		cm²		N/mm²
0	0	0	0	0	0	0
2	7	2	4.5	17671.45	0.00004	1.11
4	9	10	9.5	17671.45	0.00009	2.22
6	10	20	15	17671.45	0.00015	3.33
8	12	30	21	17671.45	0.00021	4.441
10	14	40	27	17671.45	0.00027	5.551
12	23	45	34	17671.45	0.00034	6.661
14	39	55	47	17671.45	0.00047	7.771
16	48	59	53.5	17671.45	0.00053	8.882
18	57	60	58.5	17671.45	0.00058	9.992
20	68	73	70.5	17671.45	0.00070	11.102
22	78	80	79	17671.45	0.00079	12.212
24	85	91	88	17671.45	0.00088	13.323
26	93	92	92.5	17671.45	0.00092	14.433
28	90	90	90	17671.45	0.001	13.543
30	89	98	93.5	17671.45	0.0011	12.653



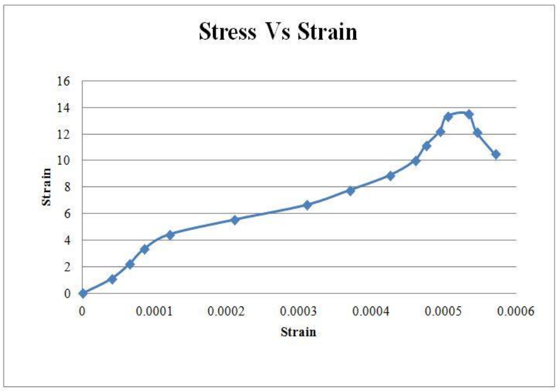
The graphs showing stress vs strain at 5% percentage replacement of waste plastic and waste tyre rubber: sample 2

Load	Extensometer reading		Mean	Area	Strain	Stress
KN	Left	Right		cm^2		N/mm^2
0	0	0	0	17671.45	0	0
2	8	10	9	17671.45	0.00009	1.11
4	9	10	9.5	17671.45	0.00009	2.22
6	17	10	13.5	17671.45	0.00013	3.33
8	43	10	26.5	17671.45	0.00019	4.441
10	35	11	23	17671.45	0.00023	5.551
12	40	12	26	17671.45	0.00026	6.661
14	51	13	32	17671.45	0.00032	7.771
16	64	15	39.5	17671.45	0.00039	8.882
18	72	25	48.5	17671.45	0.00048	9.992
20	95	50	72.5	17671.45	0.00075	11.102
22	110	54	82	17671.45	0.00082	12.212
24	145	70	107.5	17671.45	0.00107	13.323
26	130	55	130	17671.45	0.00131	12.452
28	122	43	120	17671.45	0.00139	11.457



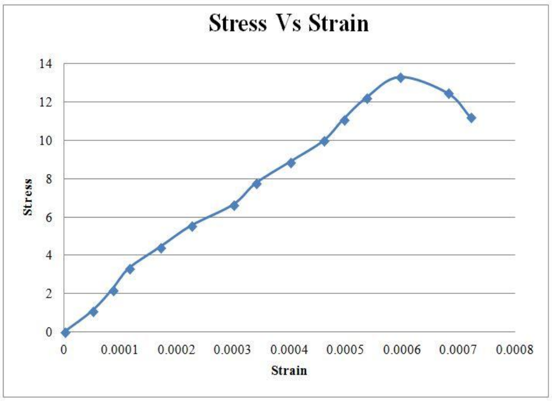
The graphs showing stress vs strain at 5% percentage replacement of waste plastic and waste tyre rubber: sample 3

Load	Extensometer reading		Mean	Area	Strain	Stress
KN	Left	Right		cm^2		N/mm^2
0	0	0	0	17671.45	0	0
2	3	5	4	17671.45	0.00004	1.11
4	6	7	6.5	17671.45	0.00006	2.22
6	8	9	8.5	17671.45	0.00008	3.33
8	13	11	12	17671.45	0.00012	4.441
10	21	21	21	17671.45	0.00021	5.551
12	32	30	31	17671.45	0.00031	6.661
14	39	35	37	17671.45	0.00037	7.771
16	41	44	42.5	17671.45	0.00042	8.882
18	45	47	46	17671.45	0.00046	9.992
20	47	48	47.5	17671.45	0.00047	11.102
22	49	50	49.5	17671.45	0.00049	12.212
24	50	51	50.5	17671.45	0.00050	13.323
26	60	57	58.5	17671.45	0.00053	14.433
28	57	52	54.5	17671.45	0.00054	13.543
30	51	51	80.5	17671.45	0.00057	12.759



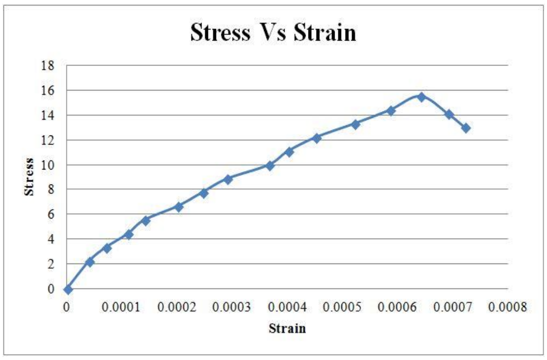
The graphs showing stress vs strain at 10% percentage replacement of waste plastic and waste tyre rubber: sample 1

Load	Extensometer reading		Mean	Area	Strain	Stress
KN	Left	Right		cm^2		N/mm^2
0	0	0	0	17671.45	0	0
2	10	0	5	17671.45	0.00005	1.11
4	17	0	8.5	17671.45	0.00008	2.22
6	23	0	11.5	17671.45	0.00011	3.33
8	34	0	17	17671.45	0.00019	4.441
10	40	5	22.5	17671.45	0.00022	5.551
12	50	10	30	17671.45	0.00033	6.661
14	55	13	34	17671.45	0.00034	7.771
16	60	20	40	17671.45	0.00044	8.882
18	65	27	46	17671.45	0.00046	9.992
20	67	32	49.5	17671.45	0.00049	11.102
22	70	37	53.5	17671.45	0.00053	12.212
24	77	42	59.5	17671.45	0.00059	11.451
28	60	40	50	17671.45	0.00068	10.462



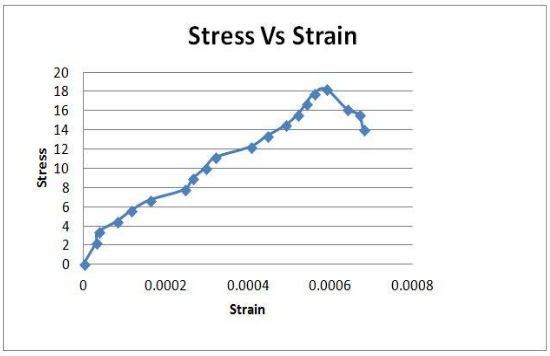
The graphs showing stress vs strain at 10% percentage replacement of waste plastic and waste tyre rubber: sample 2

Load	Extensometer reading		Mean	Area	Strain	Stress
KN	Left	Right		cm^2		N/mm^2
0	0	0	0	17671.45	0	0
2	1	7	4	17671.45	0.00004	1.11
4	2	12	7	17671.45	0.00007	2.22
6	5	17	11	17671.45	0.00011	3.33
8	7	21	14	17671.45	0.00014	4.441
10	10	30	20	17671.45	0.00022	5.551
12	12	37	24.5	17671.45	0.00024	6.661
14	17	41	29	17671.45	0.00029	7.771
16	23	50	36.5	17671.45	0.00036	8.882
18	25	55	40	17671.45	0.00041	9.992
20	27	63	45	17671.45	0.00045	11.102
22	29	75	52	17671.45	0.00052	12.212
24	32	85	58.5	17671.45	0.00058	13.323
26	33	95	64	17671.45	0.00064	14.433
28	32	90	61	17671.45	0.00069	13.459
30	29	87	58	17671.45	0.00072	12.783



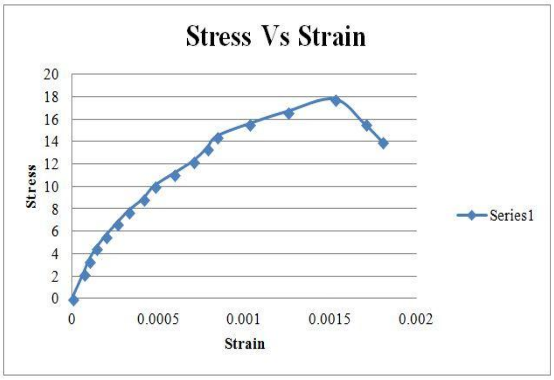
The graphs showing stress vs strain at 10% percentage replacement of waste plastic and waste tyre rubber: sample 3

Load	Extensometer reading		Mean	Area	Strain	Stress
KN	Left	Right		cm²		N/mm²
0	0	0	0	0.0565	0	0
2	3	3	3	0.0565	0.00003	2.220530856
4	4	3	3.5	0.0565	0.000035	3.330796284
6	6	10	8	0.0565	0.00008	4.441061713
8	8	15	11.5	0.0565	0.000115	5.551327141
10	12	20	16	0.0565	0.00016	6.661592569
12	16	30	23	0.0565	0.000245	7.771857997
14	18	35	26.5	0.0565	0.000265	8.882123425
16	20	39	29.5	0.0565	0.000295	9.992388853
18	24	40	32	0.0565	0.00032	11.10265428
20	34	47	40.5	0.0565	0.000405	12.21291971
22	40	49	44.5	0.0565	0.000445	13.32318514
24	55	51	53	0.0565	0.00049	14.43345057
26	62	53	57.5	0.0565	0.00052	15.54371599
28	67	54	125	0.0565	0.00054	16.65398142
30	70	58	70	0.0565	0.00056	17.76424685
32	80	60	70	0.0565	0.00059	18.217
34	83	65	74	0.0565	0.00064	16.152
36	81	70	75.5	0.0565	0.00067	15.5444444



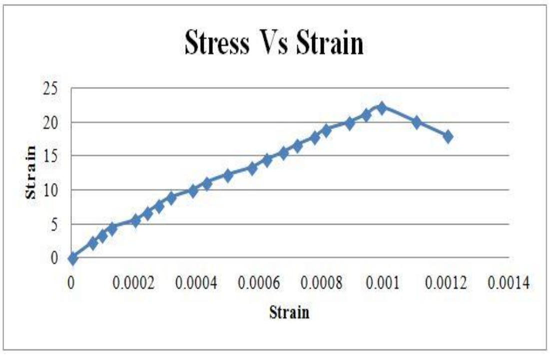
The graphs showing stress vs strain at 15% percentage replacement of waste plastic and waste tyre rubber: sample 1

Load	Extensometer reading		Mean	Area	Strain	Stress
KN	Left	Right		cm²		N/mm²
0	0	0	0	17671.45	0	0
2	3	10	6.5	17671.45	0.000065	1.11
4	4	15	9.5	17671.45	0.000095	2.22
6	5	22.5	13.75	17671.45	0.000138	3.33
8	11	27.5	19.25	17671.45	0.000193	4.441
10	14	37.5	25.75	17671.45	0.000258	5.551
12	15	50	32.5	17671.45	0.000325	6.661
14	17.5	65	41.25	17671.45	0.000413	7.771
16	20	75	47.5	17671.45	0.000475	8.882
18	30	87.5	58.75	17671.45	0.000588	9.992
20	40	100	70	17671.45	0.000721	11.102
22	46	110	78	17671.45	0.00078	12.212
24	53	115	84	17671.45	0.00084	13.323
26	65	140	102.5	17671.45	0.00102	14.433
28	90	160	125	17671.45	0.00125	15.543
30	115	190	152.5	17671.45	0.00152	16.653
32	110	170	140	17671.45	0.0017	15.764
34	105	165	135	17671.45	0.0018	14.874



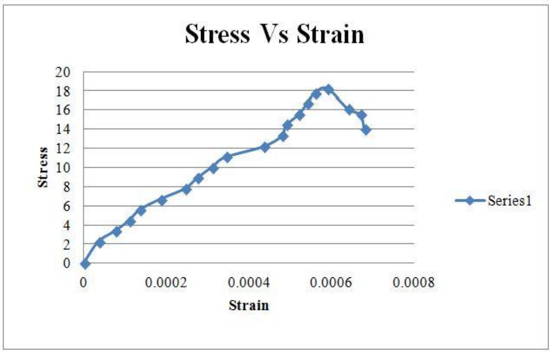
The graphs showing stress vs strain at 15% percentage replacement of waste plastic and waste tyre rubber: sample 2

Load	Extensometer reading		Mean	Area	Strain	Stress
KN	Left	Right		cm^2		N/mm^2
0	0	0	0	17671.45	0	0
2	13	0	6.5	17671.45	0.00006	1.11
4	18	1	9.5	17671.45	0.00009	2.22
6	20	5	12.5	17671.45	0.00012	3.33
8	32	8	20	17671.45	0.00021	4.441
10	38	10	24	17671.45	0.00024	5.551
12	42	13	27.5	17671.45	0.00027	6.661
14	48	15	31.5	17671.45	0.00031	7.771
16	57	20	38.5	17671.45	0.00038	8.882
18	61	25	43	17671.45	0.00042	9.992
20	69	30	49.5	17671.45	0.00049	11.102
22	73	42	57.5	17671.45	0.00057	12.212
24	79	45	62	17671.45	0.00062	13.323
26	80	55	67.5	17671.45	0.00067	14.433
28	84	60	72	17671.45	0.00071	15.543
30	90	65	77.5	17671.45	0.00077	16.653
32	92	70	81	17671.45	0.00081	17.764
34	97	80	88.5	17671.45	0.00088	18.874
36	98	90	94	17671.45	0.00094	19.984
38	102	95	98.5	17671.45	0.00099	20.987
40	100	91	95.5	17671.45	0.0011	19.987
42	92	90	91	17671.45	0.0012	18.315



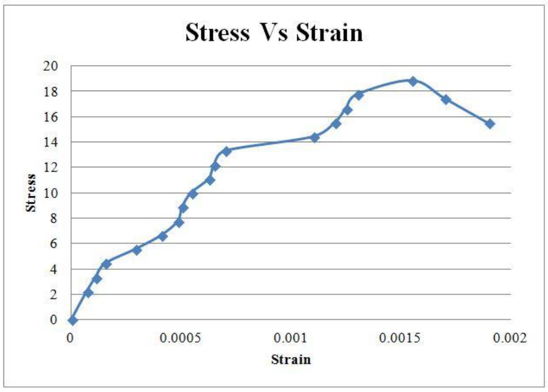
The graphs showing stress vs strain at 15% percentage replacement of waste plastic and waste tyre rubber: sample 3

Load	Extensometer reading		Mean	Area	Strain	Stress
KN	Left	Right		cm^2		N/mm^2
0	0	0	0	17671.45	0	0
2	4	3	3.5	17671.45	0.00003	1.11
4	5	10	7.5	17671.45	0.00007	2.22
6	7	15	11	17671.45	0.00011	3.33
8	10	17	13.5	17671.45	0.00013	4.441
10	15	22	18.5	17671.45	0.00018	5.551
12	18	52	35	17671.45	0.00024	6.661
14	20	35	27.5	17671.45	0.00027	7.771
16	22	40	31	17671.45	0.00031	8.882
18	26	43	34.5	17671.45	0.00034	9.992
20	37	50	43.5	17671.45	0.00043	11.102
22	45	51	48	17671.45	0.00048	12.212
24	60	54	57	17671.45	0.00049	13.323
26	667	55	361	17671.45	0.00052	14.433
28	70	57	125	17671.45	0.00054	15.543
30	80	60	70	17671.45	0.00056	16.653
32	82	70	76	17671.45	0.00059	16.964
34	85	75	80	17671.45	0.00064	16.874
36	82	73	77.5	17671.45	0.00067	15.984



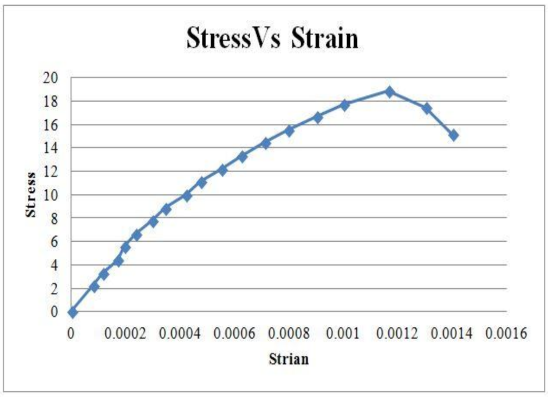
The graphs showing stress vs strain at 20% percentage replacement of waste plastic and waste tyre rubber: sample 1

Load	Extensometer reading		Mean	Area	Strain	Stress
KN	Left	Right		cm²		N/mm²
0	0	0	0	17671.45	0	0
2	7	7	7	17671.45	0.00007	1.11
4	13	9	11	17671.45	0.00011	2.22
6	21	10	15.5	17671.45	0.00015	3.33
8	43	15	29	17671.45	0.00029	4.441
10	61	21	41	17671.45	0.00041	5.551
12	70	27	48.5	17671.45	0.00048	6.661
14	74	27	50.5	17671.45	0.00050	7.771
16	81	28	54.5	17671.45	0.00054	8.882
18	95	30	62.5	17671.45	0.00062	9.992
20	100	25	62.5	17671.45	0.00066	11.102
22	100	40	70	17671.45	0.00071	12.212
24	140	80	110	17671.45	0.00111	13.323
26	170	95	132.5	17671.45	0.00122	14.433
28	140	110	125	17671.45	0.00127	15.543
30	120	140	130	17671.45	0.00131	16.653
32		155	155	17671.45	0.00155	17.764
34		130	130	17671.45	0.00174	16.874
36		120	120	17671.45	0.00197	15.984



The graphs showing stress vs strain at 20% percentage replacement of waste plastic and waste tyre rubber: sample 2

Load	Extensometer reading		Mean	Area	Strain	Stress
KN	Left	Right		cm²		N/mm²
0	0	0	0	`	0	0
2	8	8	8	17671.45	0.00008	1.11
4	13	10	11.5	17671.45	0.00011	2.22
6	14	20	17	17671.45	0.00017	3.33
8	15	24	19.5	17671.45	0.00019	4.441
10	20	27	23.5	17671.45	0.00023	5.551
12	24	35	29.5	17671.45	0.00029	6.661
14	27	42	34.5	17671.45	0.00034	7.771
16	34	50	42	17671.45	0.00041	8.882
18	37	58	47.5	17671.45	0.00047	9.992
20	43	67	55	17671.45	0.00055	11.102
22	55	70	62.5	17671.45	0.00062	12.212
24	64	78	71	17671.45	0.00072	13.323
26	77	82	79.5	17671.45	0.00079	14.433
28	85	91	125	17671.45	0.00094	15.543
30	110	95	102.5	17671.45	0.0013	16.653
32	120	113	116.5	17671.45	0.0011	17.764
34	90	80	85	17671.45	0.0013	16.874
36	85	70	77.5	17671.45	0.0014	15.984



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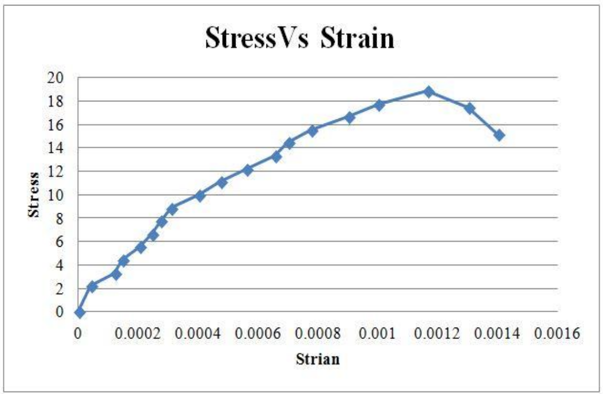
The graphs showing stress vs strain at 20% percentage replacement of waste plastic and waste tyre rubber: sample 3

Load	Extensometer reading		Mean	Area	Strain	Stress
KN	Left	Right		cm²		N/mm²
0	0	0	0	17671.45	0	0
2	3	5	4	17671.45	0.00004	1.11
4	16	8	12	17671.45	0.00012	2.22
6	15	14	14.5	17671.45	0.00014	3.33
8	22	19	20.5	17671.45	0.00020	4.441
10	27	22	24.5	17671.45	0.00024	5.551
12	31	24	27.5	17671.45	0.00027	6.661
14	34	28	31	17671.45	0.00031	7.771
16	50	30	40	17671.45	0.00042	8.882
18	60	35	47.5	17671.45	0.00047	9.992
20	75	37	56	17671.45	0.00056	11.102
22	87	44	65.5	17671.45	0.00065	12.212
24	90	50	70	17671.45	0.00074	13.323
26	95	60	77.5	17671.45	0.00077	14.433
28	96	70	125	17671.45	0.00093	15.543
30	100	78	89	17671.45	0.00144	16.653
32	120	113	116.5	17671.45	0.00116	17.764
34	114	90	102	17671.45	0.00131	16.874
36	107	80	93.5	17671.45	0.00144	15.984



CONCLUSIONS

Based on the above study following conclusions are presented.

- The cubes specimen cast with 0% replacement of waste plastic and waste tyre rubber have the maximum compressive strength of 47.9 MPa
- The cubes specimen cast with 5% replacement of waste plastic and waste tyre rubber have the maximum compressive strength of 41.2 MPa
- The cubes specimen cast with 10% replacement of waste plastic and waste tyre rubber have the maximum compressive strength of 33.2 MPa
- The cubes specimen cast with 15% replacement of waste plastic and waste tyre rubber have the maximum compressive strength of 28.1 MPa
- The cubes specimen cast with 20% replacement of waste plastic and waste tyre rubber have the maximum compressive strength of 26.1 MPa
- In the present investigation it was fond that at 0% replacement of waste plastic and waste tyre rubber the compressive strength is increased and at 20% replacement of waste plastic and waste tyre rubber the compressive strength is decreased
- As the percentage replacement of waste plastic and waste tyre rubber increased, it was found that the concrete has poor bonding properties and hence there is a decrease in compressive strength.
- This type of concrete is being used for non structural works such as pavements and drainages
- As the percentage of waste plastic and waste tyre rubber is being increased it is found that there is a decreasing in ultimate stress

FUTURE SCOPE

Further research can be carried out to study the different physical properties of plastic waste and waste tyre rubber which was used for this investigation

- Researchers planned to use Plastic waste and Waste Tyre Rubber in form of concrete ingredient as the concrete is second most sought material by human beings after water.
- The Plastic waste and waste tyre rubbers which can be used as fine and coarse aggregate and their effect on properties of concrete.
- It also presents current trends and future needs of research in the area of use of post-consumer Plastic waste and Waste Tire Rubber in Concrete.
- The rapid Urbanization and Industrialization in India has Resulted in large deposition of Plastic waste. Plastic waste, consisting of carry bags, cups etc. Can be used as a coating over aggregate and this coated stone can be used for road.

- Rubber aggregates from discarded tire rubber in sizes 20mm can be partially replaced natural aggregates in cement concrete construction.
- The idea to use post-consumer plastic waste and waste tire rubber as concrete ingredient will result in its large volume disposal which is environmentally safe and does not pose any health hazard
- Domestic waste plastics which are processed in polyethene carry bag industry and are made into granules of variable sizes which in turn are graded according to the design requirements and are used as partial replacement for fine aggregate in concrete.
- The waste tyre rubber from scrap and unused tyre and Considered waste tyre rubber as coarse aggregate
- Further research can be carried out to study the durability properties of concrete incorporating waste plastic sand as a partial replacement of fine aggregate.
- Further investigation is also possible by using waste plastic and waste tyre rubber and other waste materials in self compacting concrete.
- We can further study the materials which can be replaced in concrete instead of cement and aggregates and compare the different properties.

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