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AN EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF COARSE AGGREGATE WITH WASTE PLASTIC AND CRUMB RUBBER IN CONCRETE

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***Abstract*—Plastic waste is silent threat to the environment and their disposal is a serious issue for waste management. Now a day society does not have any alternative to plastic products like plastic bags, plastic bottles, and plastic sheets etc. Polyethylene Terephthalate (PET) obtained from various industries were used. We are using various grade of cements, waste plastics and crumb rubber in our project. We are testing mechanical strength by using compressive, split tensile strength.**

***Keywords*—concrete, Waste plastic, crumb rubber, cube, cylinder, compressive strength, split tensile strength.**

I. INTRODUCTION

The rapid industrial growth and urbanization there has been an unprecedented increase in amount of waste plastics produced every year. This plastic waste has far reaching impact on environment. Recycling is an option however there is only a small fraction that is recycled, rest ends up in landfills and poses serious environmental threats. So, coming up with an alternative approach can be quite beneficial in present condition.

In construction industry concrete is major input which is made from cement, fine aggregates and coarse aggregates. These raw materials are becoming difficult to procure due to high demand and less availability. Thus, use of waste plastics and crumb rubber(tyre) in concrete as raw material can solve both problems to an extent. PET is one of major plastic among waste produced by single use plastic bottles used for beverages and packaged drinking water.

II. MATERIALS USED

The different materials used in this work are as follows;

- Ordinary Portland cement
- M-sand
- Coarse aggregate
- waste plastics
- Crumb rubber
- water

A. cement

In this experimental investigation ordinary portland cement of 43 grade is used. Cement is one of the most important among the ingredients of concrete. In this work, Ordinary

Portland Cement of grade 43 is used. Test for cement such as consistency tests, setting time test, specific gravity were done to study the properties of the cement as per IS specifications.

B. M-sand

Full form of M Sand is Manufactured sand also known crushed sand or manufactured fine aggregate. It is manufactured by crushing rocks, quarry stone or larger aggregate pieces into sand size particle in a factory or query. M-sand is obtained by washing and screening of stone dust obtained during quarrying operation. It satisfies the criteria of well graded or uniformly graded material. Extracting river sand from the river is harmful to the environment it reduces the groundwater level and river water gets dried up.

C. Coarse aggregate

The coarse aggregate used here is 20mm in size, crushed angular shape and free from dust. The specific gravity and fineness modulus of this fine aggregate where found to be 2.6 and 2.98 respectively.

D. Waste plastic

A recycled plastic was used to replace coarse aggregates for making concrete specimen. Plastics are never decayed at the level on dense particles and it will be dissipated at level of fine particles. Polyethylene terephthalate (PET) is mainly consist in this plastic. The industrial byproducts are to be used in concrete by the partial replacement of Coarse aggregate. The Plastic Waste available in the plastic bottles and cans. Which is in the form of loosely discarded, surplus, obsolete, Broken. These materials are collected and crushed into different particle sizes.

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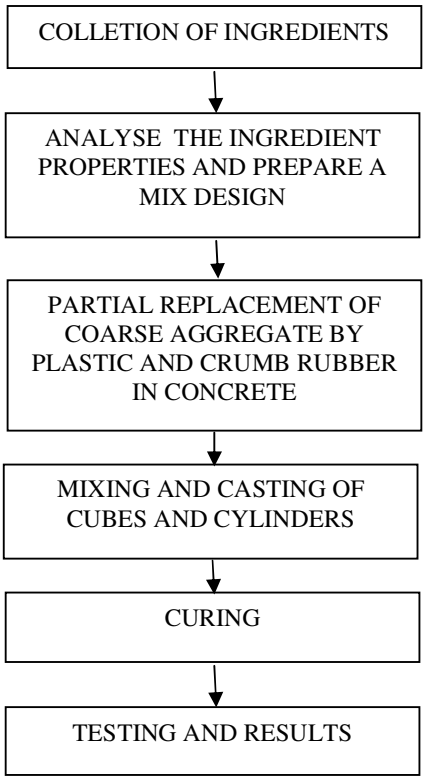
E. Crumb rubber

Crumb rubber is one of the waste material, which is collected from various industries. It gives good elasticity to the concrete.

F. Water

Water is the key ingredient, which when mixed with cement, forms a paste that binds the aggregate together. The water causes the hardening of concrete through a process called hydration.

III. METHODOLOGY



IV. LITERATURE REVIEW

1. PULIKONDA SUMAN AND SARATH CHANDRA KUMAR.2019 Investigation on partial replacement of coarse aggregate with plastic waste in concrete. This paper refers to the study of using the grinded plastic wastes as a moderate replacement of coarse aggregate in concrete and to find the ideal fraction of plastic waste that can be used in concrete without the reduction of concrete strength or with a slight amount of strength reduction which are considered as negligible.
2. SINA SAFINA 2016Use of recycled plastic water bottles in concrete blocks. 500ml plastic bottles used and the strength was compared by normal concrete
3. A.ANANTHI 2017 Utilization of waste plastic as a fiber in concrete. The plastic cups used as a fiber and its increases the compressive and split tensile strength.
4. T.SUBRAMANI 2017 Experimental investigation of waste plastic fiber in reinforced cement concrete using recycled coarse aggregate. It is investigating the shear strength and workability characteristic of FRHSC by adding different mixes.
5. ESHMAIEL GANJIAN 2009 Scrap-tyre-rubber replacement for aggregate and filler in concrete. Concrete mixture incorporating 5,7.5,10 % of discarded tyre rubber as aggregate and cement replacement was investigated.
6. BALTE SANJAYKUMAR 2017 Use of plastic fiber in the Concrete The tensile strength as well as ductile property of concrete could be improved by addition of fibers.
7. BOUZIYANI TAYEB Properties of flowable sand concretes reinforced by polypropylene fibers Research on fresh and hardened properties of flowable sand concrete reinforced by polypropylene. the test were conducted on both plain and fiber reinforced FSC.
8. PRAMOD S. PATIL. 2010 This study presents the use of plastic recycled aggregate as replacement of coarse aggregate for production of concrete. They used forty eight specimen and six beams/cylinders casted from variable plastic percentages (0, 10, 20, 30, 40 and 50%) used as replacement of coarse aggregate in concrete mixes. They have conducted various tests and observed decrease in density of concrete with increase percentage of replacement of aggregate with recycle plastic concrete.

V. MIX PROPORTION

The material properties are analyzed, then we are using M_{25} grade of concrete and it's ratio is 1:1:2. The various proportion will give a good strength to the structure. In our project, we are partially replaced the coarse aggregate by using recycled waste plastic and crumb rubber in our project. This replacement method is reducing the demand of coarse aggregates. Mix design is carried out as per Indian Standard Code Method (IS 10262 – 2009) for concreting the test specimen. The grade of concrete which we adopted is M_{25} with the water cement ratio of 0.47.

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Proportion mix	Normal aggregate in %	Waste plastic in %	Crumb rubber in %
MIX I	100	-	-
MIX II	50	50	-
MIX III	50	-	50
MIX IV	50	30	20
MIX V	50	20	30

Table 1 Mix Proportion

Fig.1 Mixing

VI. RESULTS

A. INTRODUCTION

The following test done by the concrete compressive strength of cube, split tensile strength for cylinder

B. COMPRESSIVE STRENGTH TEST

At the time of testing, each specimen must keep in compressive testing machine. The maximum load at the breakage of concrete block will be noted. Size of the test specimen=150mm x 150mm x 150mm.

Proportion	Compression Strength (N/mm^2)		
	7 days	14 days	28 days
MIX I	15.55	20.47	24.68
MIX II	17.77	23.65	27.36
MIX III	17.24	23.74	26.92
MIX IV	16.55	22.67	26.37
MIX V	17.02	22.75	25.98

Table 2 Compressive Strength

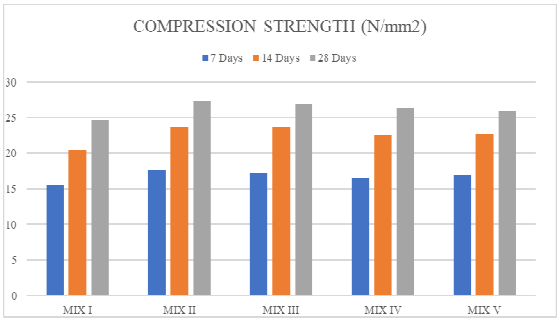

Fig.2 Compressive Strength

C. SPLIT TENSILE STRENGTH

The size of cylinders 300 mm length and 150 mm diameter are placed in the machine such that load is applied on the opposite side of the cubes are casted. Align carefully and load is applied, till the specimen breaks.

Proportion	Split tensile Strength (N/mm^2)		
	7 days	14 days	28 days
MIX I	15.55	20.47	24.68
MIX II	17.77	23.65	27.36
MIX III	17.24	23.74	26.92
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Table 3 Split Tensile Strength

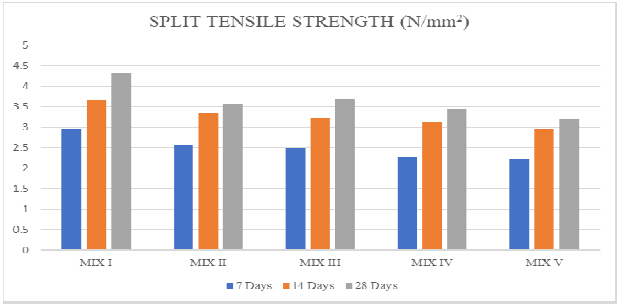

Fig 3 Split Tensile Strength

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VII. CONCLUSION

Utilization of waste plastic in various proportions to improve the strength. Waste Plastic along with crumb rubber can be used to improve the strength of concrete. The relationship between cube and cylinder compressive strength is linear. Better split tensile strength was achieved with the addition of the recycled plastic and crumb rubber in concrete. The strength has increased when compared to that of normal concrete specimen. Plastics can be used to replace some of the aggregates in a concrete mixture. This contributes to reducing the unit weight of the concrete. This is useful in applications requiring non-bearing lightweight concrete.

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