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EXPERIMENTAL STUDY ON RECYCLED PLASTIC AS COARSE AGGREGATE FOR CONCRETE

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Abstract: This study has been undertaken to Plastic waste is silent threat to the environment and their disposal is a serious issue for waste managers. Now a day society does not have any alternative to plastic products like plastic bags, plastic bottles, and plastic sheets etc. In spite of all efforts made to limit its use but unfortunately its utility is increasing day by day. To circumvent this issue many efforts were made in the past to reuse the plastic waste but no significant results were achieved. On contrary concrete being the widely used construction material is facing problem due to unavailability of construction material (Cement, sand and coarse aggregate). Various attempts were made through experimentation to check the feasibility of plastic waste to be use partially in concrete with respect to various properties of strength, workability, durability and ductility of concrete. This paper includes review of various studies conducted on utility of waste plastic material used in the concrete. Moreover this paper will draw our focus toward the impingement on the various properties of concrete when partially replacing with waste plastic.

Keywords - Plastic waste, concrete, replace, testing, properties

I. INTRODUCTION

Plastic plays a vital role in developing the economy of the world. Plastics have many uses in human life and many fields such as Health & Safety, Automobiles, Furniture, Toys, Construction, Electronics, Sports, Agriculture, especially packing industry, etc. The majority of plastics are excellent in thermal, electrical insulation and non-degradable. Plastic materials are used for recycling and it generates a circular economy.

Present days expanding the interest for plastic in view of Technological advancements in a wide scope of Consumer and Industrial applications. “Some of the quantity is recycling; remaining is incorporated in landfills, seas, oceans, burnt in municipal dump yards etc., Plastic waste creates air pollution, land pollution, water pollution”. “Due to lack of proper waste management for plastic materials, kills numerous animals, Aquatic species etc., And, due to the low degradation rate, it becomes a problem to the environment”. Concrete is one of the building materials which have high demand due to rapid urbanization. “Concrete is made up of natural resource materials such as Sand, Aggregate, Cement”. Because of the huge demand for concrete, there is an impact on the depletion of natural resources. “For the Sustainability of natural resources, we want to use alternate materials without affecting the properties of concrete” Electricity, compost and bio-fuels.

II. OBJECTIVE

Following are the objectives of our proposed work

- To study the possibility of using shredded plastic waste material as partial replacement for the coarse aggregate in concrete.
- To determine the different test on plastic waste coarse aggregate.
- To determine the compressive strength of concrete with different proportion of plastic waste coarse aggregate with replacements of 10%,20% & 30%

III. LITERATURE REVIEW

I)Azad Khajuria, Puneet Sharma (2019) in his paper he found that, plastic coarse aggregates were used in place of natural coarse aggregates. Plastic aggregates were produced by little processing of waste plastic. Plastic is the biggest threat to the environment, and it is affecting the environment rapidly. Some recent studies show that it can be used construction industry due to some of its properties like inert behaviour, resistance to degradation etc. Also, use of waste plastic can help in reducing plastic waste. Various experiments were performed to test the mechanical properties of the concrete with plastic coarse aggregates. Concrete was prepared using plastic coarse aggregates in varying proportions of 0, 2.5, 5, 7.5 and 10%

II) Sk. Md. Imdadul Islam and Habibur Rahman Khan (2021) in his paper he concluded that, abundant quantities of polymeric materials are generated by manufacturing process from different industries which produce huge amount of municipal solid wastes. Among these broken plastic bottle, bucket, basket and thin container made by High Density Polyethylene (HDPE) are a large part of these wastes. These plastic wastes can be utilized under proper condition as an ingredient of concrete. This study was carried out to determine the compressive strength, split tensile strength, flexural strength and dry density of recycled plastic concrete. In this study, total 15 cylinders and 5 beams were prepared with stone aggregate and 5%, 10%, 15% and 20% replacement of stone by recycled plastic aggregate at w/c ratio of 0.50.

III) K. Sai Gopi1Dr. T. Srinivas (2020) in his paper he found that Utilization of recycled plastic waste in the production of sustainable concrete by partial replacement of fine aggregate. This study has been investigated the utilization of two types of recycled plastic waste Polyethylene Terephthalate (PET) and Polypropylene (PP) as fine aggregate in concrete. M30 grade of concrete has been used by partial Experimental Study on Recycled Plastic as a Coarse Aggregate for Concrete Dept. Of Civil Engg. Adarsh Institute of Technology & Research Centre, Vita. 5 replacements of fine aggregate (River Sand) with recycled plastic waste in the percentage of 5, 10, 15, 20, and 25. The workability and compressive strength results are checked to find the acceptable percentage of incorporation of PET and PP in concrete. From the results, it is observed that the workability is decreased as the percentage of recycled plastic waste is increased. The Optimum Percentage of replacement of PET is 10%. PP has shown a marginal reduction in compressive strength for 5% replacement.

IV) Dr. Kiran Tajine and Mrs. Pranita Bhandari1(2016) in his paper he found that, the suitability of recycled plastics as coarse aggregate in concrete and its advantages are discussed here. The initial questions arising of the bond strength and the heat of hydration regarding plastic Aggregate was solved. Tests were conducted to determine the properties of plastic aggregate such as density, specific gravity and aggregate crushing value. Partial replacement at various percentages. The percentage substitution that gave higher compressive strength and flexural strength, higher compressive strength was found with 10% &15% NCA replaced concrete.

V) Jouontso Tene Yves Constantine al. (2019) in his paper he found that urbanization, changes in life style and development of many activities are leading to a widespread pollution of landscape by plastic bags. Waste plastic bags have been used for totally replacing the conventional cement in concrete paving blocks to improve desired engineering properties of paving blocks for road pavement. This paper aims at evaluating the influence of coarse aggregate on the mechanical and physical properties of paving blocks made using melted Low-Density Polyethylene (LDPE). Melted LDPE are mixed as binder with sand and coarse aggregate to make paving blocks for road pavement purposes. In conventional paving blocks making process, cement paste is used as binder. Paving blocks made using waste LDPE plastic and sand, with addition of 5% of coarse aggregate show better mechanical properties, flexibility, and more resistant to water absorption.

IV. EXPERIMENTAL WORK

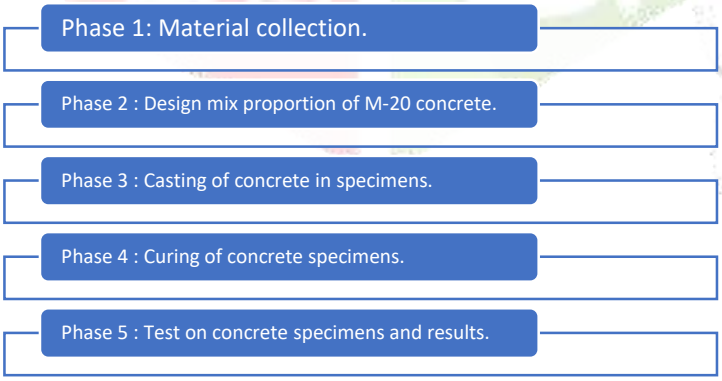
4.1. Materials used

- Cement
- Fine Aggregate
- Coarse Aggregate
- Plastics Aggregate
- Water

Fig. Plastic Aggregate

Material Tests are performed o know the strength and characteristics properties of material. Various tests on material are known now days to check the quality of material. To know the properties of material such as specific gravity, fineness, strength, consistency, etc. various testing methods are used. Construction work testing of material is essential before use.

4.2 Methodology of concrete



4.3 Following tests are carried out on the material:

A) Cement: -

Sr. No.	Property of Cement	Actual Result
1	Fineness	93%
2	Initial Setting Time	31 Min.
3	Final Setting Time	560 Min.
4	Specific Gravity	3.12

B) Aggregate: -

Sr. No.	Property of Cement	Actual Result
1	Specific Gravity	2.62

C) Plastic Aggregate: -

Sr. No.	Property of Cement	Actual Result
1	Specific Gravity	1.074
2	Impact Test	2%

4.4 Mix Proportion of M-20 Grade Concrete

Unit of batch	**Cement**	**Fine aggregate**	**Coarse aggregate**	**Water**
Cubic meter content	358.18	661.69	1148.55	197
Ratio	1	1.847	3.2066	0.55

4.5 Test and Procedure

After casting, specimens were tested after 14 and 28 days of curing. In this article, the procedure adopted for testing of specimens for various properties like compressive strength, split tensile strength and flexure strength have been discussed. Compressive Strength Three (3) specimens of each mix design were taken to the lab for testing. The test was carried out as per the standard for compressive strength test on paving blocks. illustrates the test setup in the compressive testing machine.

4.5.1 Specimens for Compressive Strength

To check the compressive strength of concrete mix, specimens of cubical shape size 150mmX150mmX150mm were prepared. The required quantities of materials required were weighed according to the mix proportion. Aggregates and cement was firstly thoroughly mixed. Admixture was added to the water. Water was then added to the dry mix. Total 9 similar cubes were casted, each three cubes for 14 days and 28 days testing. After 24 hours of casting, the cubes were demolded then placed into curing tank.

Fig. Compressive testing machine

V. RESULTS AND DISCUSSION

5.1 Compressive strength test

This test is performed on hardened concrete, to check the strength of concrete. The concrete specimens were put under the load per unit area of cross section in uniaxial compression under a fixed rate of loading. The compressive strength of concrete is expressed in N/mm2. We performed this test on standard cubes of size 150mmX150mmX150mm. Concrete mix with different proportions was prepared and filled into cube mould. It was then left for 24 hours for initial setting. For every mix proportion 9 specimens were prepared, 3 specimens for each 14 days and 28 days testing. After completion of curing period the specimens were tested using Compression testing machine (CTM). Surface dried specimens were placed in CTM. A fixed rate of loading of 140Kg/m2/minute or 5.2 KN was applied.

The maximum value of load (P) under which the specimen fails was noted down.

Compressive strength =P/A

Here,

P = load on the cube

A= cross-sectional area of cube

1. Compressive Test Result After 14 Days of Curing

A) Compressive Strength Result of 10% Replacement Cubes -

Sample	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
I	14.31	
II	13.73	**14.02**
III	14.04	

B) Compressive Strength Result of 20% Replacement Cubes -

Sample	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
I	11.51	
II	11.86	**11.53**
III	11.24	

C) Compressive Strength Result of 30% Replacement Cubes -

Sample	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
I	9.6	
II	10.13	**10.01**
III	10.31	

2. Compressive Test Result After 28 Days of Curing

A) Compressive Strength Result of 10% Replacement Cubes -

Sample	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
I	20.81	
II	20.66	**20.39**
III	19.70	

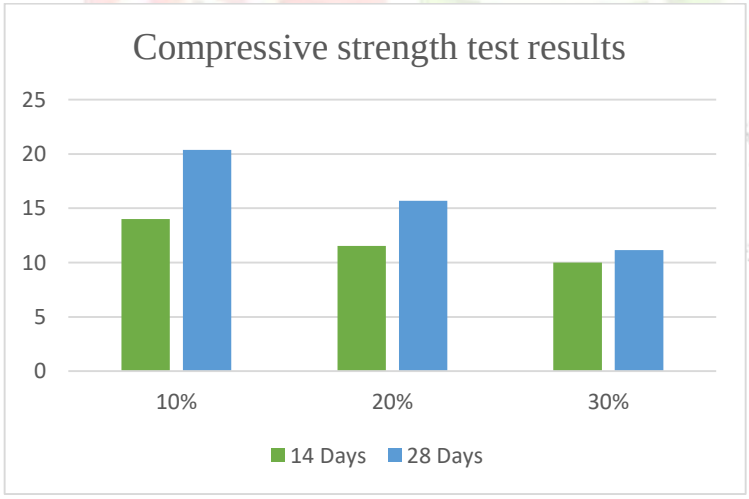
B) Compressive Strength Result of 20% Replacement Cubes -

Sample	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
I	16.10	
II	15.85	**15.68**
III	15.10	

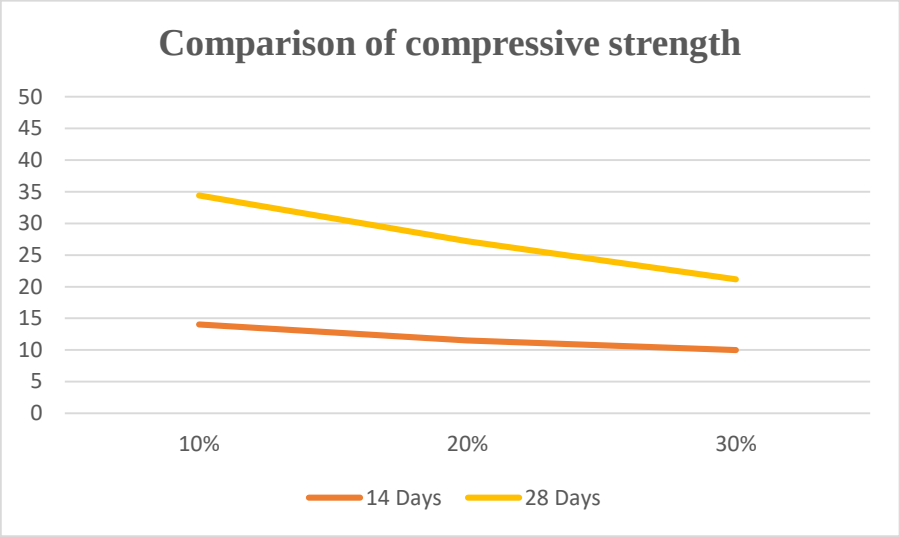
C) Compressive Strength Result of 30% Replacement Cubes -

Sample	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
I	12.44	
II	11.10	**11.14**
III	9.88	

5.2 Graphical Analysis



Graph 1 - Comparison of compressive strength



Graph 2 - Variation of Compressive strength of concrete at 14 days and 28 days

5.3 Discussion

As compared to conventional concrete cubes, there is reduction in weight of concrete cubes containing plastic waste.

1. For 10% partial replacement, there is reduction of 6%.
2. For 20% partial replacement, there is reduction of 14%
3. For 30% partial replacement, there is reduction of 18%

VI. CONCLUSION

The study was conducted to find an effective solution to reduce the environmental pollution due to rapid increase of plastic waste by recycling as coarse aggregate for concrete.

1. Recycling waste plastic in concrete as coarse aggregate can be an effective solution to dispose large amount of plastic which can reduce environmental pollution to a large extent and produce green concrete. But for that assurance of strength is also a major concern.
2. This study experimentally tries to find the applicability of waste plastics as partial replacement of coarse aggregate.
3. From the above results it is found that there is a rise in compressive strength for 10% replacement of coarse aggregate. The rise in compressive strength for 10% replacement mix is found to be usable.
4. There will be an also decline in stone quarrying which can be carried out for making stone Aggregates.

VII. FUTURE SCOPE

We get most of the aggregates by quarrying the stones and then crushing. As quarrying of stones cause change in geological aspects of the area, crushing causes the entry of dust particles in the environment. So, causing bad impact to the environment in dual manner. To minimize these researchers focused on the usage of waste materials that were also adversely affecting the environment. Some of these are already in use such as Iron slag, Crusher Dust, etc. and many others are under research. So, usage of these waste materials helping in dual role by minimizing the usage of raw material of concrete and by using the waste materials that are affecting the environment.

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