STRENGTHENING OF THE STRUCTURE USING WASTE PLASTIC TO PROMOTE SUSTAINABLE DEVELOPMENT

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Abstract - *Plastic waste granules were explored in this work as a replacement for coarse aggregates in the production of concrete cubes and cylinders. The strength of the test concrete in terms of compression and split tension was experimentally assessed using waste plastic granules-based concrete cubes and cylinders. In terms of compression and split tension, the strength of plastic granules that substituted concrete was determined to be comparable to ordinary concrete. The current study is based on a concrete mix using waste plastic granules (0, 10%, 20%, and 30%) as a partial replacement for coarse aggregate, which will result in a reduction in structural dead weight. Compression was applied to this mixture in the shape of cubes and cylinders. As a result, using plastic granules in concrete is not only useful, but it also aids in the disposal of plastic trash.*

1. INTRODUCTION

The challenge of discarding and managing solid waste products has become a serious environmental, economic, and social issue in all countries. To address the growing waste disposal issues, a comprehensive waste management system that includes source reduction, reuse, recycling, and incineration must be established. These plastics are not recycled into new plastic goods of the same sort. The use of biodegradable polymers has also risen. Because of the differences in characteristics and melt temperatures, if these plastics are mixed in recycling, the reclaimed plastic will not be recyclable. The goal of this experiment is to see if granulated waste plastic materials can be used to replace coarse aggregate in concrete composites in a proportional manner. Among the various waste components, waste plastic merits special attention due to its non-biodegradable characteristic, which is causing several environmental issues. Every year, India generates over 60 million tonnes of solid trash. This is increasing at a pace of 1.5 to 2% each year. Plastics account for 12.5% of total garbage, the majority of which comes from discarded water bottles. Dumping or burning discarded plastic is not an option since it causes uncontrolled fires and pollutes the land and vegetation. On this subject, extensive research and studies have been conducted in countries such as Japan, the United States, and the United Kingdom. However, there have been very few research on the use of plastics in concrete in India. As a result, an attempt is made to use plastic waste granules as a partial replacement for coarse aggregate, and the mechanical behaviour of these granules is explored.

2. METHODOLOGY

The most extensively utilised man-made construction material is concrete. The search for materials for construction and the disposal of waste plastic are also ongoing concerns. In the building business, sustainability has become a key issue. In this study, recycled waste plastics were used to make coarse aggregates, giving a long-term solution for dealing with plastic trash. There are many recycling operations around the world, but as plastics are recycled, their strength deteriorates. Instead of recycling plastic over and over, it might be used to prepare aggregates for concrete, which would be beneficial to the construction industry. The majority of concrete structure failures are caused by aggregate crushing, which causes the concrete to fail. Waste plastic aggregates with low crushing qualities are more difficult to crush than stone aggregates.

In comparison to stone aggregates, plastic aggregates are also lower in weight. Because a complete substitution for Normal Coarse Aggregate is not possible, a partial substitution using varying percentages of Waste Plastic Coarse Aggregate is attempted. As a result, the goal of this research is to use waste plastic granules to partially substitute coarse aggregate in concrete mixes (0 percent , 10 percent , 20 percent , and 30 percent). To determine the behaviour and strength parameter, this combination in the shape of cubes and cylinders was compressed and split tensioned.

Design stipulation for proportioning

i) Grade designation =M 20 .
ii) Type of cement =OPC 43 grade IS 8112 .
iii) Min cement content =320 kg/m3 .
iv) Max water cement ratio =0.55 .
v) Workability =75mm(slump) .
vi) Exposure condition = Mild .
vii) Degree of supervision = Good .
viii) Type of aggregate =Crushed angular aggregate
ix) Maximum cement content = 450 kg/m3

3. RESULTS AND DISCUSSION

• Test data for materials

a) Cement used =OPC 43 grade IS 8112 .

b) Specific gravity of cement = 3.15 .

c) Specific gravity of

Coarse aggregate =2.68 .

Fine aggregate =2.65 .

d) Water absorption

Coarse aggregate =0.6 percent

Fine aggregate =1.0 percente) Free (surface) moisture

Coarse aggregate = Nil (absorbed moisture full) .

Fine aggregate = Nil .

• Compressive strength test :

Testing hardened concrete is crucial for ensuring that the quality of cement concrete work is maintained. The compressive strength of concrete is the most important factor in its application in structures. The major attribute of hardened concrete is its strength, which demonstrates its ability to resist forces. The compressive strength of concrete is regarded as the most essential property, and it is frequently used as a gauge of the material's overall quality. The load that produces specimen failure per unit cross section on compression at a specific rate of loading is defined as the compressive strength of concrete. For the test, use a 150mm cube.

Compressive strength test:

% Granules added	Weight (kg)			Peak load (kN)			Compressive Strength (MPa)		
	7th days	14th days	28th days	7th days	14th days	28th Days	7th days	14th days	28th Days
0 %	8.22	8.21	8.26	419.52	504.22	637.18	18.48	22.50	28.22
	8.13	8.15	8.25	401.72	502.05	643.35	17.82	22.22	28.64
10 %	7.95	7.98	8.02	372.5	392.88	561.25	16.60	20.41	24.80
	8.05	7.92	7.85	323.2	501.90	545.70	16.30	22.32	24.31
20 %	7.82	7.92	7.65	308	454.20	501.63	15.71	20.12	22.35
	7.61	7.75	7.74	335.6	439.00	532.00	14.83	19.46	23.50
30 %	7.82	7.76	7.81	374.9	417.30	455.05	15.45	18.54	20.28
	7.86	7.55	7.86	386.6	381.70	461.83	15.22	16.92	20.67

• Split tensile test:

Due to its low tensile strength and brittle nature, concrete is not normally expected to withstand direct tension. However, to calculate the load at which concrete members may crack, tensile strength must be determined. Tensile failure is the cause of this cracking. For compression testing, cylindrical moulds with a height of 300mm and a diameter of 150mm are utilised.

Split tensile test:

% Granules added	Weight (kg)			Peak load (kN)			Tensile Strength (MPa)		
	7th days	14th days	28th days	7th days	14th days	28th days	7th days	14th days	28th days
0 %	12.55	12.59	12.60	166.87	184.80	225.99	3.62	4.01	4.95
	12.49	12.62	12.58	165.04	182.04	221.56	3.55	3.95	4.82
10 %	12.40	12.54	12.56	97.50	124.60	152.00	2.16	2.71	3.38
	12.30	12.40	12.48	105.90	136.10	153.40	2.35	3.03	3.43
20 %	12.11	12.21	12.20	162.30	181.30	207.60	3.58	4.05	4.55
	12.10	12.14	12.18	128.20	167.70	205.20	2.86	3.75	4.47
30 %	11.92	11.96	11.63	117.40	135.60	173.80	2.53	2.98	3.84
	11.86	11.82	11.57	125.60	151.80	178.70	2.71	3.36	3.92

Fig: Split tensilte strength test

Fig: Compressive strength test

4. CONCLUSION

The findings of the experiments suggest that using waste plastic material to make concrete or mortar can provide an alternate method to reducing the environmental impact of waste plastic disposal that is not scientific.

The following conclusions were reached:

• The compressive strength of concrete containing various percentages of plastic (0, 10%, 20%, and 30%) was tested.

• The waste plastic utilised in the research is WASTE PLASTIC (Plastic) with a size of 5-7mm and a specific gravity of 0.92.

• When the compressive strength of test concrete is compared to ordinary concrete, it is discovered that a mix of 30% waste plastic achieves a compressive strength of 80%. (as replacement for coarse aggregate). As a result, it might be used to build a light-weight concrete construction.

• The mechanical qualities of test concrete did not alter sign

ificantly depending on the colour of plastic trash; • This research could be used to make lightweight concrete and reduce the amount of polymer waste in landfills.

Advantages:

• When compared to traditional concrete, plastic reinforced concrete has a better workability.

• The development of light weight concrete is the consequence of a significant reduction in the weight of concrete.

• The use of recycled plastic in building can create a precedent by recycling non-biodegradable material and, as a result, reducing pollution.

Disadvantage:

• Strength decreases as we increase the amount of plastic replacement concrete; it is slightly less than traditional concrete, although it might be enhanced by adding admixtures to the mix.

• The cost of plastic is high when we have to buy it from a dealer, thus the cost of building may rise as well.

• There is less proper bonding of plastic materials with concrete, necessitating the use of admixtures to improve bonding.

Scope of future work-

the current study can be expanded upon.

• These tests can be carried out for different classes of mix design concrete, according to the current study.

• The use of admixtures in tests can be done to boost the strength.

• Experiments on different types of plastics, such as HDPE, PP, and PET, could be done.

• For beams and columns with varied quantities of waste plastic, the durability of such a concrete might be investigated.

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