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A Review paper on the Performance of Structural Concrete using Recycled Plastics as Course Aggregate

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Abstract: One of the main environmental problems today is the disposal of the waste plastics. The plastic waste is increasing day by day. On another side, the construction industry is facing problem due to the insufficient and unavailability of the construction materials. So we need to search new construction material as well as an efficient method for disposal of plastic waste. To find the solution of above two problems, one of them can be used to solve other. Hence the plastic waste was mixed with cement concrete in various proportions in between 0%-10% and the M20 grade test specimen were casted to study the behavior of plastic mixed concrete. The present topic covers the study of compressive strength, flexural strength of concrete.

Keywords: Compressive Strength, Flexural Strength, Plastic Waste.

1. INTRODUCTION

The Indian construction industry is today consuming about 400 million tons of concrete every year and it is expected, that this may reach a billion tones in less than a decade. All the materials required to produce such huge quantities of concrete, come from the earth's crust, thus depleting its resources every year creating ecological strains. On the other hand, human activities on earth produce solid wastes in Considerable quantities i.e., over 2500million tones per year, including industrial waste, agricultural waste, and other wastes from society. Disposal of such a solid wastes involves economic issues as well as ecological and environmental considerations. The major ecological strain in the disposal of solid waste may be due to the presence of waste plastics in it. The plastic is one of the recent engineering materials

Which have appeared in the market all over the world Plastics are used in the bath and sink units, corrugated and plain sheets, floor tiles, paints. Other than this domestically plastics were used in various forms as carrying bags, bottles, cans and also in

various medical utilities. Plastics are normally stable and non-biodegradable. So, their disposal poses problems. Research works are going on making use of plastics wastes effectively as additives in bitumen mixes for the road pavements. Reengineered plastics are used for solving the solid waste management problems a contribution to the effective use of domestic plastic waste in concrete to prevent environmental strains caused by them, also to limit the consumption of high amounts of natural resources.

2. LITERATURE REVIEW

Nithiya Kurup [2016][1]. This study presents the behavior of the concrete which made up of recycled plastic waste. In this study, the M20 grade concrete specimen casted by addition of 10% to 25% of plastic as a partial replacement of fine aggregate and tested for 28 days compressive as well as the flexural strength of concrete. From this study, it's concluded that the increase in the plastic percentage decrease in the compressive as well as the flexural strength of concrete. The main benefit of this study workability it will be increased because the plastic has been less absorbing water content, and reduce the pollution of the environment deficiency of fine aggregate and also reduce the cost of the materials.

Gaurav Verma [2016][2]. This paper represents a collection of waste plastics materials in concrete mixes. From this study, it's concluded that the fine aggregate can't be replaced by plastic materials so only the course aggregate is used. The strength decreases drastically after replacing more than 20% plastic waste.

T. Subramani [2015][3]. This study is intended to find the effective ways to reuse the hard plastic waste particles as course aggregate. From this study it has been concluded that the plastic waste is not suitable to use as a fine aggregate, it is used to replace as a course aggregate. However, the strength noticeably decreased when the plastic content was more than 20%.

Raghatate Atul M[4]. The paper is based on experimental results of concrete sample casted with use of plastic bags pieces to study the compressive and split tensile strength. He used concrete mix by using Ordinary Portland Cement, Natural River sand as fine aggregate and crushed granite stones as coarse aggregate, portable water free from impurities and containing a varying percentage of waste plastic bags (0%, 0.2%, 0.4%, 0.6% 0.8% and 1.0%). The compressive strength of concrete specimen is affected by the addition of plastic bags and with increasing percentage of plastic bag pieces, compressive strength goes on decreasing (20% decrease in compressive strength with 1% of addition of plastic bag pieces). On other hand increase in tensile strength of concrete was observed by adding up to 0.8% of plastic bag pieces in the concrete mix afterward it start decreasing when adding more than 0.8% of plastic bags pieces.

Praveen Mathew et al. [2013][5]. They have investigated the suitability of recycled plastic as a partial replacement to coarse aggregate in concrete mix to study the effect on compressive strength, modulus of elasticity, split tensile strength and flexural strength properties of concrete. Coarse aggregate from plastic was obtained by heating the plastic pieces at the required temperature and crushed to the required size of aggregate after cooling. Their test results were based on 20% substitution of natural coarse aggregate with plastic aggregate. Increase in workability was reported when slump test for the sample was carried out. Volumetric substitution of natural aggregate with plastic aggregate was selected best in comparison with grade substitution. An increase of 28% was observed in compressive strength but a decrease in split tensile strength and modulus of elasticity was observed. They recommended that with use of suitable admixture @0.4% by weight of cement will improve the bonding between matrix and plastic aggregate; however, they demand more research to address the tensile behavior of concrete prepared with 20% plastic aggregate.

Khilesh Sarwe. [2014][6]. This study presents the results of addition of waste plastics along with steel fibers with an objective to seek maximum use of waste plastic in concrete. Two different categories of mix were casted in cubes (150mm x 150mm x 150mm), one with varying percentages of plastic wastes (0.2%, 0.4%, 0.6%, 0.8% and 1% weight of cement) and another mix of plastics waste/steel fibers (0.2/0.1, 0.4/0.2, 0.6/0.3, 0.8/0.4 and 1/0.5 % by weight of cement) to study the compressive strength at 7 and 28 days strength. The combined mix of plastic waste and steel fibers has shown more strength as compare to concrete mix prep only with plastic waste. He has reached the conclusion that a plastic waste of 0.6% weight of cement when used with steel fiber of 0.3 % (weight of cement), has shown the maximum compressive strength. This study has really focused on addressing the issue of reduced compressive strength with the addition of plastic waste. Steel fibers, when used along with plastic wastes, will affect all the properties of concrete but the researcher only focused on compressive strength property which is insufficient to give a clear picture of concrete behavior.

Pramod S.Patil.et al.[7]. 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 a replacement of coarse aggregate in concrete mixes. They have conducted various tests and observed a decrease in density of concrete with increase percentage of replacement of aggregate with recycling plastic concrete. They also

reported a decrease in compressive strength for 7 and 28 days with the increase in the percentage of replacement of coarse aggregate with recycling plastic aggregate. They have recommended feasibility of replacing 20 % will satisfy the permissible limits of strength. Again these researchers limited their research to only compressive strength property and no work was carried out to study the other important properties of concrete. Their research also lacks the use of various admixtures in concrete to cater for the loss of strength.

3. MATERIALS

The materials used for making concrete specimens are Cement, Fine aggregate, coarse aggregate (waste plastic), water.

3.1 Aggregates: Course aggregates comprising a maximum size of 20mm having fineness modulus of 6.05, the bulk density of 1516 kg/m3 and specific gravity of 2.65 were used. Fine aggregates having a specific gravity of 2.65, the bulk density of 1672 kg/m3 and fineness modulus of 2.77, in saturated surface dry condition, were used.

3.2 Plastics used in investigation

The four types of plastics used in this experimental work were thermoplastic products. They are as follows:

3.2.1. Polythene sheet: The polythene sheets are organic polymers containing carbon in addition to hydrogen, nitrogen. The thickness of the polythene sheet used in the present investigation is 250microns.

3.2.2. Road Waste:-These are nothing but the plastics found on the road sides, which are collected and heated. After the product was cooled and the resultant product is shredded to mix along with concrete. This type of plastic is called as road waste.

3.2.3. Raw Plastics: the raw materials used for manufacturing the plastic straws were called as raw plastic. These were round shaped plastic granules which were white in color.

3.2.3. Plastic Straw: these are tabular plastic products used in day today life. These were mixed along with concrete after cutting them along its cross-section. Then the cast specimens were de-molded next day and subjected to curing.

TABLE: - I MATERIAL SPECIFICATION

Sr. No	Ingredient	Specifications.	Remark.
1	Cement.	Grade:-43ppc Sp.gravity:3.15 Fineness:4.0%	Is-4031-1988 Is-1489-1991.
2	Course aggregate.	20mm size Sp.gr.2.65 FM:6.05	Is-383-1970(9)
3	Fine aggregate.	River sand zone III Sp.gr.2.65 FM:2.77	Is-383-1970(9)
4	Low density polyethylene.	The density range of 0.910–0.940 g/cm^3. It is quite flexible and tough.	-
5	High density polyethylene.	Density 0.93 to 0.97 g/cm^3 or 970 kg/m^3. It is also harder and more opaque and can with stand some what higher	-

4. METHODOLOGY

The size of the polythene sheets, road waste, raw plastics, and plastic straws was cut in to the size of course aggregates. The percentage of addition of plastics was varied from 0%-10% by weight and the specimen was cast. The compression testing samples were cast in cubes of 150 X 150 X 150 mm cast iron mould. The flexural members were cast in the standard 700 X 150 X 150 mm mould. The specimens were systematically placed in curing tanks after 24 hours for 7 and 28 days respectively. For each given percentage of glass fibers, six cubes and six beams were cast. Similarly,

The workability for each of the given percentage of glass fiber is reported by taking the average of three slump test results. The Specimens were tested according to IS 516-1959 and are 1199-1959.

5. RESULTS & DISCUSSIONS

In order to compare the results obtained by adding varying amounts of plastic, plain cement concrete with 0% of the fiber is also prepared with the same material. The results of the compressive strength after 7 days and 28 days of curing are as presented in Table-II.

TABLE:-II COMPRESSIVE STRENGTH.

Sr. No.	% plastic used.	7 days (Mpa)	28 days (Mpa)
1	0%	15.3	23.3
2	2%	15.5	23
3	4%	14.5	19
4	6%	12	16
5	8%	9	14.5
6	10%	7	11

TABLE:-III FLEXURAL STRENGTH.

Sr. No.	% plastic used.	28 days (Mpa)
1	0%	4.15
2	2%	4.60
3	4%	5.10
4	6%	5.25
5	8%	5.40
6	10%	5.95

CONCLUSION

From the above experimental work, it's concluded that the plastic waste can be used as a partial replacement of natural aggregate.

From the results obtained from these studies the following conclusions can be drawn:

1. The compressive strength values of all waste plastic concrete mixture tend to decreases below the values for the references concrete mixtures with increasing the waste plastic ratio at all the curing ages.
2. The flexural strength at each curing age also decreases with the increase of the waste plastic and aggregate ratio.
3. The plastic aggregate reduced the density of resulting concrete, therefore, it used to the preparation of light weight concrete.

FUTURE SCOPE

Increasing the density of plastic waste is a burden to our environment. The plastic is the non degradable material its required huge or costly method to disposal. So we can use the plastic as a construction material and lower the burden on the environment effectively.

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