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UTILISATION OF PLASTIC AS AN AGGREGATE IN CONCRETE

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Abstract - *Modern activities in India leads to use of plastic bags in excess. Plastic being non-biodegradable material, it takes years to decompose. Plastic bags have main constituent as poly-ethylene. The poly-ethylene when combusted produces a by-product of Carbon dioxide which leads to global warming. In this, we study the efficiency of reusing plastic waste in concrete by comparing compressive strength of concrete whose fine aggregate is partially replaced by plastic(2%,4%,6%) with control concrete of M20 grade. To compensate for the strength lost due to replacement, iron fibres are used in fixed amount.*

Keywords **-** Plastic waste, Iron fibres, strength, cement, concrete (M20)

1 – INTRODUCTION

Concrete is a composite material composed of water, coarse granular material (the fine and coarse aggregate or filler) embedded in a hard matrix of material (the cement or binder) that fills the space among the aggregate particles and glues them together. Concrete is widely used for making architectural structures, foundations, brick or block walls, pavements, bridges or overpasses, highways, runways, parking structures, dams, pools/reservoirs, pipes, footings for gates, fences and poles and even boats. Concrete is used in large quantities almost everywhere mankind has a need for infrastructure

The amount of concrete used worldwide, ton for ton, is twice that of steel, wood, plastics, and aluminium combined. Concrete's use in the modern world is exceeded only by that of naturally occurring water. Concrete is also the basis of a large commercial industry. Globally, the ready-mix concrete industry, the largest segment of the concrete market, is projected to exceed $100 billion in revenue by 2015. Given the size of the concrete industry, and the fundamental way concrete is used to shape the infrastructure of the modern world, it is difficult to overstate the role this material plays today.

In India, 70 percent of total plastic consumption is discarded as waste. Around 5.6 million tonnes per annum (TPA) of plastic waste is generated in country, which is about 15,342 tonnes per day (TPD).

Government data shows that 17 states and union territories have imposed complete ban on manufacture, sale and use of plastic carry bags, but there is "no proposal to impose ban on the use of polythene bags completely throughout the country"

Main objective of this project is to determine "**Utilisation of plastic as an aggregate in concrete"** so that it can replace a significant amount of other environmentally sensitive materials. Iron fibres are also used along with the waste plastic to compensate for the reduction in strength due to replacement. This also helps us in managing our large plastic wastes and to save our environment from the emissions of the greenhouse gases due to burning of these plastics. In this study we will find the strength of the concrete mix at various replacement percentages and compare them. Also we will do curing for different number of days to check its impact on the strength.

2 – MATERIAL AND DESIGN METHODOLGY

2.1. Materials

The properties of material used for making concrete mix are determined in laboratory as per relevant codes of practice. Different materials used in present study were cement, coarse aggregates, and fine aggregates, in addition to plastic bags and iron slag.

Ordinary Portland Cement - Ordinary Portland cement of grade 43 was used in concrete. OP cement does not contain any pozzolanic material. Consistancy of Cement was found to be 29% and it was well sound with a tensile strength of 3.8 N/mm^2 after 7 days and compressive strength of 48 N/mm^2 after 28 days.

Aggregates -

- Fine aggregate: fine aggregate was used locally available. It was sieved through 2.36mm IS sieve. Fineness modulus was 2.59, and of zone - II
- Coarse aggregate: broken granite rocks of size 10mm and 20mm which were used, of abrasion value of 30%, crushing value of 24.3%

Plastic - Plastic as a Scrap of Waste polythene bags is used. The scraps were of size less than 2.36mm

Iron Fibre - Iron fibre of particle sizes vary anywhere from 20-200 µm. Iron fibre is used in concrete as fibre reinforcement.

Water - The potable water from the college was used for mixing and curing the concrete.

2.2. Methodology

In this study we follow the under mentioned model for the design, planning, implementation and achievement of the project:

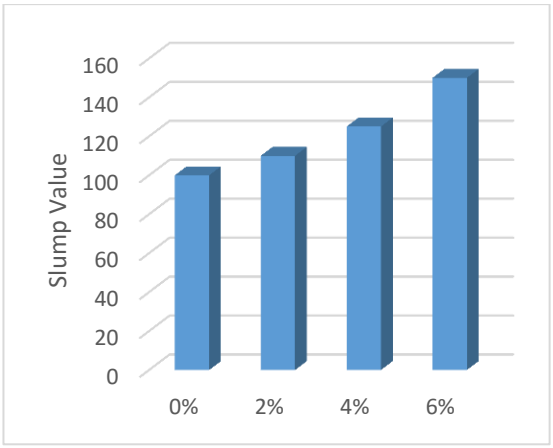
- The materials to be used will be collected.
- Various tests on the materials will be done to check quality standards.
- Mix design of the concrete will be done (M20). After that fine aggregates will be replaced in different percentages.
- Six cubes will be casted for every percentage of replacement. The dimension of test cube is 0.15m x 0.15m x 0.15m. According to the volume of material required for 6 cubes, materials are gathered and are mixed to prepare the concrete.
- The prepared concrete will then be casted in the form of test cubes. The cube while being filled is tamped by tamping rod to reduce the number of voids in concrete.
- The cube will be left for 24 hours to gain shape.
- After 24 hours, the cubes then will be taken off from the moulds.
- They will be left for curing then.
- Then their compressive strength will be checked from 7, 14 and 28 days from casting.
- Analysis of results will be done then.

3 - TEST RESULTS AND ANALYSIS

3.1. Slump test of concrete

Table 1: Slump Test

S.NO.	% Of Plastic Used	Slump Value (mm)
1.	0	100
2.	2	110
3.	4	125
4.	6	150

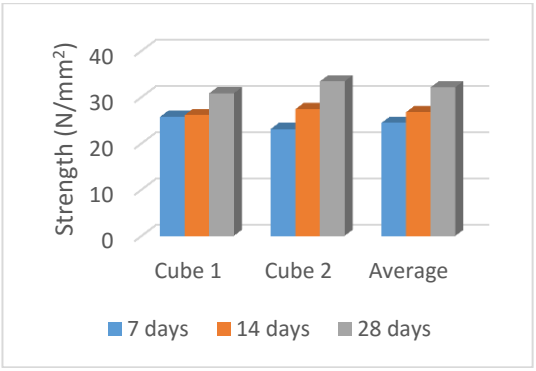


Graph 1 – Slump Value

3.2. Compressive strength testing of concrete cubes (.15x.15x.15 m).

Table 2: Compressive strength for 0% replacement

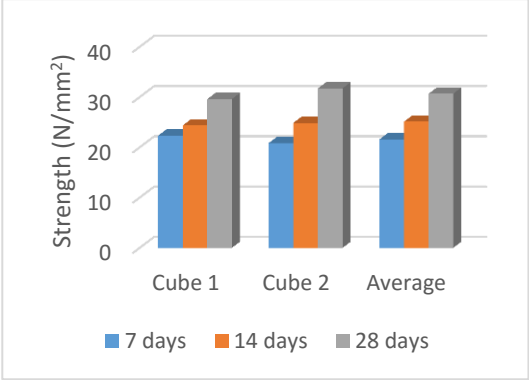
S.No.	No. of Days	Cube 1	Cube 2	Average
1.	7 days	25.73	23.11	24.42
2.	14 days	26.11	27.39	26.75
3.	28 days	30.83	33.4	32.115



Graph 2 – Compressive strength for 0% replacement

Table 3: Compressive strength for 2% replacement

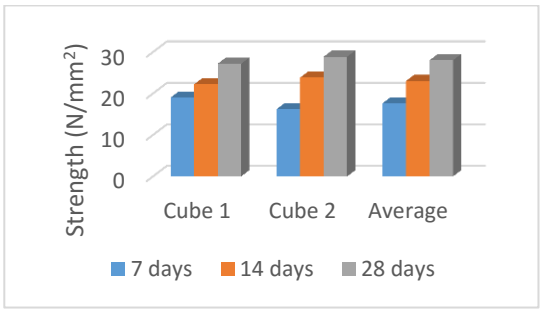
S.No.	No. of Days	Cube 1	Cube 2	Average
1.	7 days	22.33	20.87	21.6
2.	14 days	24.36	24.88	25.12
3.	28 days	29.61	31.75	30.68



Graph 3 – Compressive strength for 2% replacement

Table 4: Compressive strength for 4% replacement

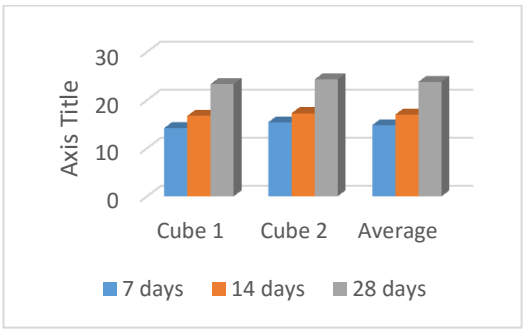
S.No.	No. of Days	Cube 1	Cube 2	Average
1.	7 days	19.03	16.21	17.62
2.	14 days	22.22	23.84	23.03
3.	28 days	27.19	28.87	28.03



Graph 4 – Compressive strength for 4% replacement

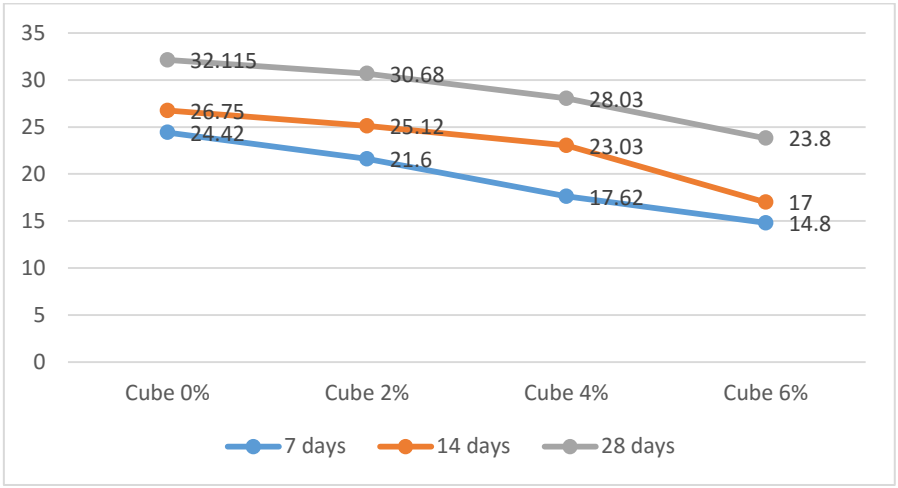
Table 5: compressive strength for 6% replacement

S.No.	No. of Days	Cube 1	Cube 2	Average
1.	7 days	14.21	15.39	14.8
2.	14 days	16.74	17.26	17.0
3.	28 days	23.32	24.28	23.8



Graph 5 – Compressive strength for 6% replacement

3.3. Comparison of strength with different plastic percentage at different days



***Graph 6** – comparison of strength*

4 - CONCLUSIONS

1. The compressive strength of concrete keeps on decreasing as the percentage of plastic is increased in concrete as a replacement of fine aggregate.
2. A concrete mixture made of 6% plastic waste had lowest compressive strength at 28 days curing age. The compressive strength will reaches below 20 MPa with further increase in plastic content.
3. There is visible effect on workability of concrete when fine aggregate is partially replaced by plastic.
4. Best compressive strength is obtained at 4% fine aggregate replacement with plastic waste and using steel fibre reinforcement.
5. As the strength of 4% replaced concrete is very close to the conventional cube strength hence it can be concluded that it is safe to use plastic as partial replacement of fine aggregate (4%) with 100 gm/(0.15m)3 of iron fibres in concrete.

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