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Partial Replacement of Low-Density Polyethylene by Fine Aggregate in Concrete

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Abstract - In India, Due to fast growing construction industry, the demand for sand has increased tremendously, causing deficiency of suitable river sand. Currently construction industry is finding cost effective material for increasing the strength of concrete and replacement of sand in concrete. This paper is an experimental investigation to study the characteristic of plain concrete using Low Density Polyethylene for the partial replacement of fine aggregates. The ldpe powder is mixed with natural aggregate to prepare concrete. The concrete mix of grade M20 (i.e. 1:1.6:2.9) was adopted with water cement ratio 0.5, 5%, 10%, 15% and 20% of fine aggregate is replaced by ldpe powder. Concrete cubes were casted with LDPE powder (fine aggregate). The test specimens were cured and tested for compressive strength as per IS specifications at 7 days and 28 days. When the LDPE powder is replaced up to definite percentage of fine aggregates.

Key Words: Low Density Polyethylene, Fine Aggregate, Partial replacement.

I. INTRODUCTION

India generates close to 26,000 tonnes of plastic a day, according to a CPCB estimate from 2012. Worse, a little over 10,000 tonnes a day of plastic waste remains uncollected. Uncollected plastic waste eventually ends up in the natural environment in our seas and oceans or piling up on our lands. CPCB data on plastic waste generation from a 2015 study showed that, in 2010-12, India generated 25,940 tonnes plastic per day. This would amount to 9.5 million tonnes per year. Humans have always produced trash and disposed of it in some way so solid waste management is not a new issue. The applications of plastic materials and their composites are still growing rapidly due to their low cost and ease of manufacture. Therefore, high amount of waste plastic being accumulated which create big challenges for their disposal. Recycling of this type of waste to produce new materials like concrete or mortar appears as one of the best solutions, due to its economic and ecological advantages. It was possible to use plastic waste in mortar. The different types of plastic materials are Polyethylene Terephthalate (PET or PETE), High Density Polyethylene (HDPE), Polyvinyl Chloride (PVC), Low Density Polyethylene (LDPE), Polypropylene (PP), Polystyrene (PS), Polycarbonate (PC), and Acrylonitrile Butadiene Styrene (ABS). In this work LDPE powder is used. Low-density polyethylene (LDPE) is a thermoplastic made from the monomer ethylene. LDPE is defined by a density range of 0.910–0.940 g/cm³. It is not reactive at room temperatures, except by strong oxidizing agents, and some solvents cause swelling. It can withstand temperatures of 80 °C continuously and 95°C for a short time. Made in translucent or opaque variations, it is quite flexible and tough.

II. OBJECTIVES

- To study the behavior of concrete in which fine aggregate is partially replaced by LDPE powder by 5, 10, 15 and 20%.
- To investigate the structural behaviour of such replaced concrete components.
- To investigate the mechanical behaviour of the components by using LDPE powder.
- Through this project, it is intended to arrive at a suitable mix proportions and percent replacement using locally available materials by partial replacement of the natural fine aggregate with LDPE powder.

III. MATERIALS

1. CEMENT

Cement is the most important ingredient in concrete. One of the important ingredients for the selection of cement is its ability to produce improved micro structure in concrete Conventional concrete FCC), the effect of characteristics of cement on water demand is more noticeable. The specific gravity of cement is 3.1, Normal consistency is 31%.

2. FINE AGGREGATE:

Fine aggregate used for Conventional Concrete (CC) should be properly graded 10 give minimum void ratio and be free from deleterious materials like clay, silt content and chloride contamination etc. The specific gravity of fine aggregate is 2.6, Fineness modulus is 2.52.

3. COARSE AGGREGATE

Aggregate are the important constituent in concrete. They give body to the Concrete reduce shrinkage and elect economy. The more fact that the aggregate Occupy 70-80 percent volume of concrete, their impact on various characteristics and properties is undoubtedly considered. The specific gravity of coarse aggregate is 2.7, Impact value is 13.5%.

4. WATER

Water is used for mixing and curing. Water free from impurities and salt used for casting and curing the concrete block as per IS: 456-2000.

5. LOW DENSITY POLYETHYLENE POWDER

LDPE powder is used to replace the fine aggregate and having the dimension about 0.3mm. Low-density polyethylene made from monomer ethylene.

Properties of ldpe powder

S.No	PROPERTY	RESULT
1	Specific gravity	0.92
2	Fineness modulus	2.8
3	Melting point (°C)	135



LDPE POWDER

IV. EXPERIMENTAL RESULTS

1. Mix proportions

The mix design was made confirming IS 10262:2009. Ratio for M20 Mix for Conventional Concrete is 1: 1.6: 2.9: 0.5

Mix designation	CC	RPRC 1	RPRC 2	RPRC 3	RPRC 4
Cement (kg)	1.36	1.36	1.36	1.36	1.36
Fine aggregate (kg)	2.04	1.938	1.836	1.736	1.632
Coarse aggregate (kg)	4.08	4.08	4.08	4.08	4.08
Water – cement ratio	0.5	0.5	0.5	0.5	0.5
LDPE (kg)	0	0.102	0.204	0.306	0.408

2. Workability test

Slump test is used to determine the workability of fresh concrete. The test was followed as per IS 1199-1959. The result of the slump test was represented in table.

SLUMP CONE TEST

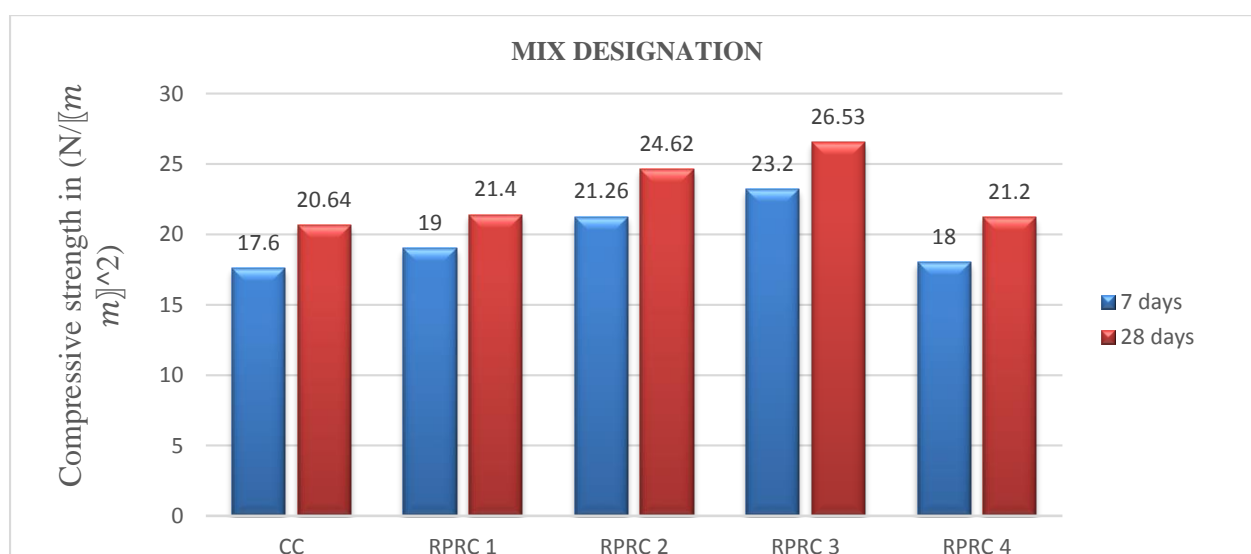
S.NO	Type of concrete	SLUMP VALUE (mm)
1.	CC	64
2.	RPRC 1	76
3.	RPRC 2	80
4.	RPRC 3	86
5.	RPRC 4	90

3. Compressive strength

The result of compressive strength for low density polyethylene powder mixes at 7 days and 28 days are shown in the table.

Compressive strength at 7 days and 28 days

S.NO	Type of concrete	Compressive strength at 7 days (N/mm ²)	Compressive strength at 28 days (N/mm ²)
1.	CC	17.95	20.64
2.	RPRC 1	19	21.4
3.	RPRC 2	21.26	24.62
4.	RPRC 3	23.20	26.53
5.	RPRC 4	18	21.2



IV. CONCLUSION

1. Higher content of LDPE powder replaced in concrete increases workability of concrete.
2. The compressive strength of concrete containing the low-density polyethylene powder show increase in strength.
3. Using LDPE powder with 15% of replacement of fine aggregate gives higher strength than normal concrete mix.
4. Mechanical performances of sand concrete seem to be positively influenced by the type of plastic waste added.
5. The use of ldpe powder induces a decrease of about 10-15% of density of sand in concrete.
6. Plastic has more water tightness capacity when compared to natural aggregate this can help in arresting micro cracks.

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