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Performance of concrete by using polyethylene plastic bags wastes as concrete ingredient

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Abstract-*The safe disposal of non-recyclable thin plastics bags is the most challenging issue for the solid waste management across the globe. Even today, at least 15% of total plastic waste remains untreated [1]. Concrete is the first choice for construction in many countries today. This has increased the fast vanishing of natural resources. It could be worth experimenting to use non recyclable plastic bags in concrete to overcome the dual issue of shortage of raw material and safe disposal of left over plastic to environment. This paper presents a study of various strength of concrete made by mixing of plastic bags as concrete ingredients. This study focuses on the use of polyethylene plastic bags of less than 20 micron thick use in M25 mix design concrete. Plastic was added 0%, 0.6%, 0.9%, and 1.2% by volume. The compressive strength, split tensile strength and flexure strength were measured.*

Keywords: *polyethylene plastic bags, workability, compressive strength, split tensile strength, flexure test.*

1. Introduction

The present Indian concrete industry is consuming about 370 million m^3 of concrete every year and it is expected, that it shall reach about 580 million m^3 by 2022[1][6].The re-formation of natural sources is beyond the proportion of mankind. Hence the increased demand of concrete has raised a serious question on the quickly vanishing valuable natural sources. It is therefore has become a necessity to find an alternate material could be used along with the conventional materials and try to reduce the quick and huge usage of valuable sources. A new term evolved called Green concrete – it is a concrete prepared by using the waste products of different industries with the conventional materials. Wide variety of such wastes are already being added and tested for various observations and their effects on different aspects of concrete properties.

One of the fastest growing industries is a plastic industry. Around the world almost one trillion bags per year are being used and it is just one example of a product of plastic. The plastic is one of the recent engineering materials which have appeared in the market all over the world. There has been a steep rise in the production of plastics from a mere 30 million KN in 1955; it has touched 1000 million KN at present.

Plastics are normally stable and not biodegradable. So, their disposal is a problem. Research works are going on in making use of plastics wastes effectively as additives in plain and reinforced concrete mixes for variety of purposes[2][3]. Different forms and types of wastes are utilised to check the feasibility of them in concrete [4][7][8]. This study attempts to give a contribution to the effective use of waste plastics in concrete in order to prevent the ecological and environmental strains caused by them, also to limit the high amount of environmental degradation.

2. Materials for tests

2.1 Cement: Ordinary Portland cement of 53 grades available in local market is used in the investigation. The cement used has been tested for various proportions as per IS 4031-1988 and found to be conforming to various specifications of IS 12269-1987. The specific gravity was 2.96.

2.2 Coarse aggregate: Crushed angular granite metal of 20 mm and 10 mm size from a local source was used as coarse aggregate. The specific gravity of 2.71 and fineness modulus 7.13 was used.

2.3 Fine aggregate: River sand was used as fine aggregate. The specific gravity of 2.60 and fineness modulus 3.25 was used in the investigation

2.4 Plastic fibres: The polythene plastic bags having thickness of less than 20 microns were collected and investigated for the plastic waste classification, category and density were checked before the use. The bags were shredded in form of fibres by manually cutting.

3. Mix Proportions for the test

The concrete mix is designed as per the guidelines given in the various Indian standards namely IS 10262 – 1982, IS 456-2000 and SP 23. Table no. 1 gives the materials required for the M25 grade concrete. The water cement ratio was maintained at 0.50 and mix proportions are 1: 1.69: 3.04.

Vol. of Concrete	Cement (OPC -53 G)	Water	Fine aggregate	Coarse aggregate	Grit
$1m^3$	383.16 kg	185.152 kg	649.256 kg	698.869 kg	465.913 kg

Table: 1 Requirement of material quantity as per the Mix design of M25 grade of concrete

4. Mixing and Casting

Mixing being an important aspect of any successful experiment and to avail the desired results, utmost care was taken in the mixing and casting process. All materials were mixed with the standard practice of mixing them in a mixer and the plastic fibres were added to the mix. Specimens were prepared by following the standard methods of mould preparation. Total 24 cubes of the size 150X150X150 mm were prepared for the compressive strength tests 8 nos cylinder of size 150 x 300 mm, 4 nos beam of size 100 x 100 x 500 mm.

5. Study of fibre form on strength of Concrete

Plastic bags were cut manually in the proportion of 60mm length x 3mm width fibres. The intentions were to study the effect of the aspect ratio of the form and size of the fibres to the strength and workability of the mix.

Fig.1: Hand cut fibres

6. Tests on Specimens

Total 24 cubes, 8 cylinders and 4 beams were prepared including controlled concrete and concrete mixed with polyethylene fibres in different proportions from 0.3%, 0.6%, and 0.9% to 1.2% of the volume of concrete. The tests were performed only with manually cut fibre samples, to notice the effect of size of fibres on strength and workability of concrete. The samples were tested with standard apparatus at two different curing intervals of 7 days and 28 days. The results were collected and presented with a graphical mode

7. Results and Discussions

All the samples specimens were tested for fresh and harden concrete conditions. The compaction factor test represents the indirect indication of the degree of workability of the mix. Similarly compressive strength tests were conducted on cubes split tensile test on cylinder and flexure test on beam specimens. Following are the results obtained,

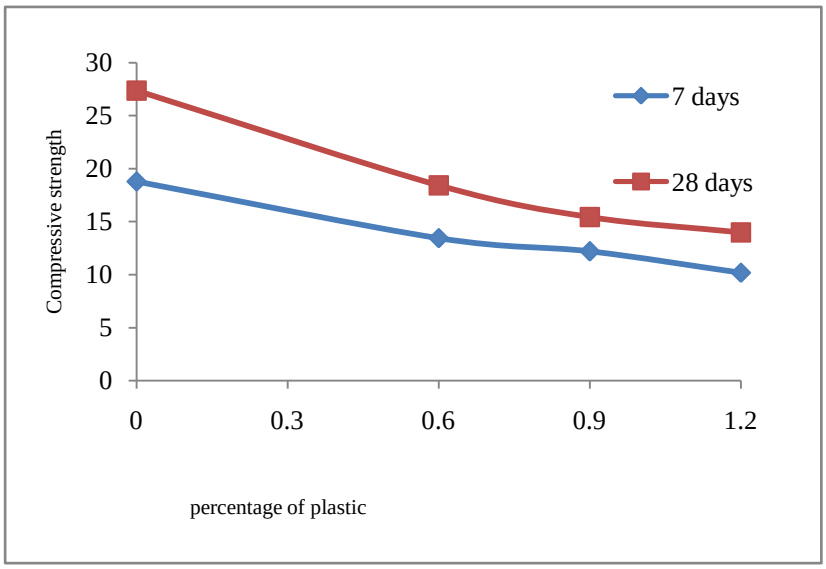

Fig.2: Compressive strength of concrete

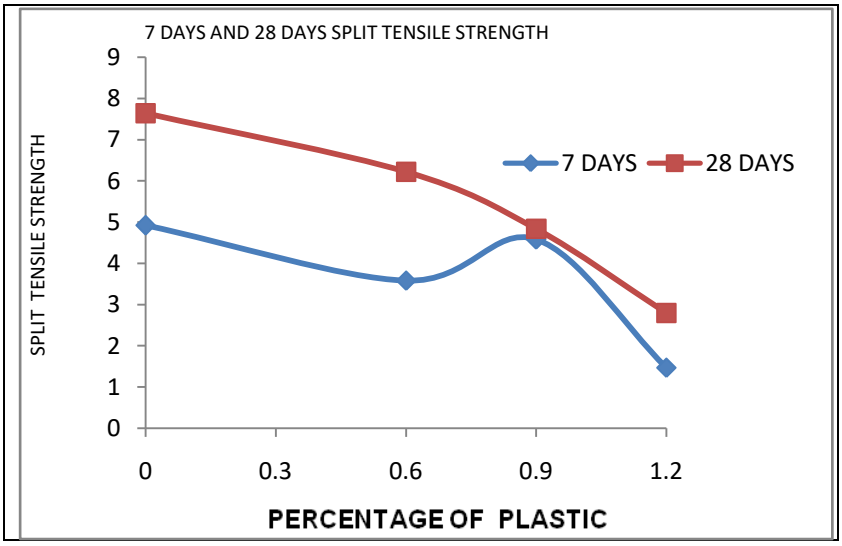

Fig.3: Split Tensile strength of concrete

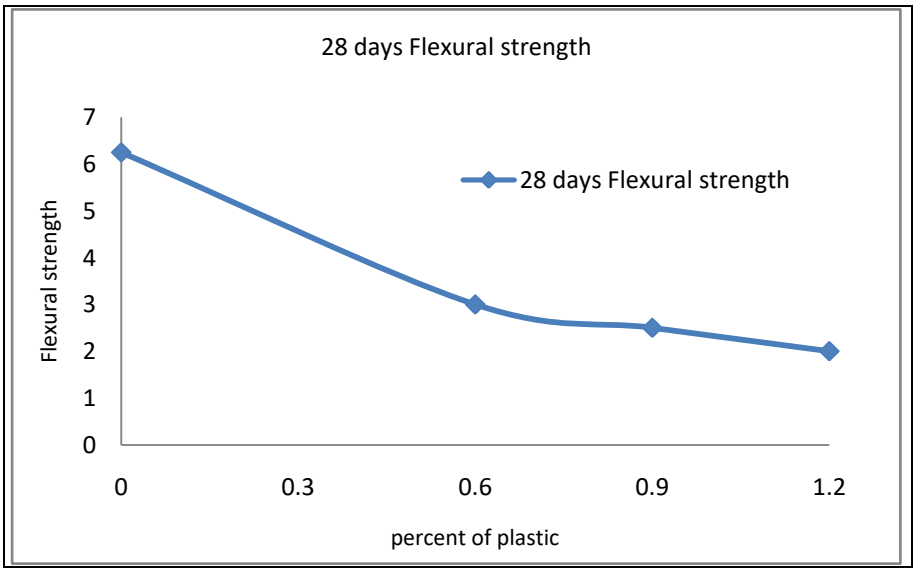

Fig.4: Flexure strength of concrete

8. Conclusions

Based on the experimental data received after a wide range of samples with different proportions of polyethylene fibres, following conclusions are made,

Compressive strength: - Addition of polyethylene plastic decreases the compressive strength of concrete. As the percentages of addition of polyethylene plastic increases from 0% to 1.2%, the compressive strength of concrete at 7 days decreases up to 54% and for 28 days decreases up to 51%.

Split Tensile strength: - Addition of polyethylene plastic decreases the split tensile strength of concrete. As the percentages of addition of polyethylene plastic increases from 0% to 1.2%, the split tensile strength of concrete at 7 days decreases up to 30% and for 28 days decreases up to 37%.

Flexural Strength: - Addition of polyethylene plastic decreases the split tensile strength of concrete. As the percentages of addition of polyethylene plastic increases from 0% to 1.2%, the split tensile strength of concrete at 28 days decreases up to 32%.

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