Mechanical Behaviour of Concrete by using Waste Plastics

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Abstract— Rapid urbanization and industrialization cause a lot of infrastructure development is taking place in the last two decades. Due to this process, it leads a big problem. There are so many shortages of construction materials, increasing of wastes and other products. All the waste products have to be recycled in order to create a balance between production and disposal of wastes. The other alternative uses found are to use waste plastics in the Construction Industry. In this project we used the waste plastics in Cement Concrete construction. Standard Mix ratio for framed and unframed structure is M20, since it gives maximum strength to the structure to bear the Loads. Plastics are used in various ways for our project used as modifier. Plastics are added in the percentage of 2%, 4%, 6%, etc…, for the replacement of cement and sand. Many tests were conducted for the materials and determine their physical and mechanical properties. From those results Experimental investigations comprised of testing for physical requirements of Course Aggregates (CA), Fine Aggregates (FA), cement and the modifier. From that result the replacement content was 6% and the strength was found to be twice than plain cement concrete. While using modifier in rigid concrete pavement, it leads to decrease in size of the elements.

Key words: Concrete, Waste Plastics

I. INTRODUCTION

Research into new and innovative users of waste materials is continually advanced. Plastic is the important material as our daily usage in Human Life. Plastic material such as Polythene bags, tapes, water bottles, cups, and various other items have plays the major role in our day today our life. It is slowly replacing everything made of other material like pot, silver materials due to the advantages of plastic. It has high life, easy to manufacturing, less weight. But waste plastics cause the major environmental problems. Due to that, economic disposal of waste materials is going to consider carefully. In highway industries, there are so many large structures, pavements and filling activity is going on. So we are trying to use the waste plastics for better and more cost-effective construction materials.

II. PLASTICS

Definition of plastics: A material that contains one or more organic polymers of large molecular weight, is solid in its finished state and at some state in its manufacture or processing in to finished articles, can be shaped by flow is termed as "plastics".

A. Types of Plastics

- Thermosets.
- Elastomers.
- Thermoplastics.

B. Resins

Solid or semi-solid materials, light yellow to dark brown, composed of Carbon, Hydrogen and Oxygen. Resins occur naturally in plants and are common in pines and firs, often appearing as globules on the bark. Synthetic resins such as Polystyrene, Polyesters and Acrylics are derived primarily from petroleum. Resins are widely used in the manufacture of lacquers, varnishes, plastics, adhesives and rubber.

1) Sources of Generation of Waste Plastics

- Household: Carry bags, bottles, containers and trash bags.
- Health and Medicare: Disposable syringes, glucose bottles, blood, Intravenous
- Hotels: Packaging items, mineral water bottles, plates etc.

2) Necessity of Plastics

Polymers have a number of vital properties, which exploited alone or together make a significant and expanding contribution to constructional needs.

- Durable and corrosion resistant.
- Good Insulation material for cold, heat and sound saving energy
- Economical one and has a longer life.
- Maintenance free (such as painting is minimized)
- Clean & Ease of processing / installation
- Light weight
- Environmentally sound

3) Advantages of Using Waste Plastics as a Modifier

- It is easily bounded to coarse aggregates.
- It doesn't require any changes in road laying practice.
- The material is available locally in the form of shredded plastic, which is presently treated as a waste.

III. OBJECTIVES OF STUDY

1) Examine the properties of Coarse, Fine Aggregates and Cement.
2) Examine physical properties of Waste Plastics (Modifier)
3) To conduct mix design as per IS: SP 23-1982
4) To find out optimum modifier content.
5) To cast plain cement concrete and subject it to load application.

IV. LABORATORY TESTS

A. Aggregates (Coarse & Fine Aggregates)

Fine Aggregates and Coarse Aggregates are used in the present study were tested for their physical properties and the results have been tabulated below. The concrete mix was as per IS SP: 23-1982 i.e., Handbook.

Type of aggregate	Coarse	Fine
Specific gravity	2.60	2.70

Water absorption	0.50 %	1.0 %
Free (surface) moisture	Nil (absorbed moisture also nil)	2.0 %
Aggregate Impact Value	18.57 %	-----
Aggregate Crushing Value	17.88 %	-----
Los –Angeles Abrasion Value	23.60 %	-----

Table 1: Physical properties of Aggregate

B. Cement

Ordinary Portland cement of 43-grade was used as it satisfied the requirements of IS: 269-1969

Specific Gravity	3.15
Initial Setting time	40 minutes
Final Setting time	13 hours
Soundness	0.6

Table 2: Physical Properties of Cement

C. Mixing & Curing Water

IS: 456- 2000 (clause 2.20) covers various requirements for mixing and curing the concrete. In mixing water quality standards are not different. The maximum permissible limit of chloride content to 500 mg/liter in IS: 456-2000.

D. Plastics

A plastic that cannot be degraded further is been powdered into fine particles. These plastics consist mainly of High Density Polyethylene (HDPE). Some of the basic properties of these plastic is been tabulated as follows.

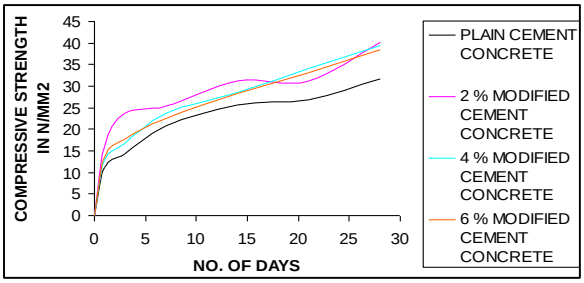
Type	High Density Polyethylene (HDPE)
Specific Gravity	1.04
Density (g/cc)	0.945 – 0.962
Melting Point (^{0}C)	75– 100
Softening Point (^{0}C)	110
Elongation at Break (%)	>500
Fineness	<2.36 mm

Table 3: Physical Properties of Plastics

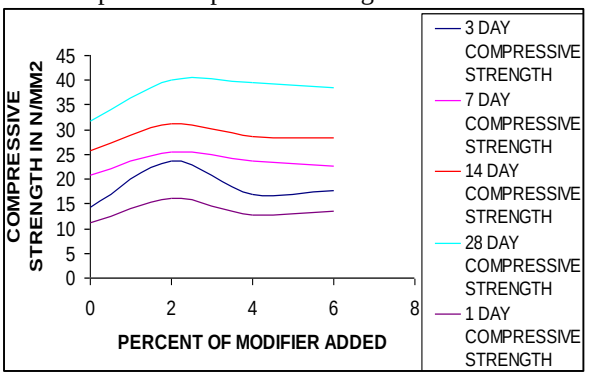
Coarse aggregates are heated to a temperature of 75^{0}C to 100^{0}C. The waste plastics, which are obtained in powdered form, are added throughout the heated aggregates and thoroughly mixed.

Now the other materials required to prepare a concrete mix, which is already mentioned above, are taken and a concrete mix is been prepared as per IS SP: 23-1982[(2)].Now, concrete cubes are casted, which are of standard dimension of 15 x 15 x 15cms. These specimens are allowed for curing and different day's compressive strengths (1, 3, 7, 14 & 28) have been calculated.

V. Analysis & Discussions



Graph 1: Compressive Strength of Concrete



Graph 2: Compressive Strength of Concrete % of Modifier Added

In the present investigation it was found that optimum plastic modifier content was 5% by weight of cement and sand.

From the test results it was observed that compressive strength value of the concrete mix increased with the addition of modifiers. Comparison of the compressive strength values of plain cement concrete and modified cement concrete are as shown in the above graphs.

A. Special Aspects

- The process is very simple
- In this project needs no new machinery
- Technology wise also very simple
- Waste plastics available in all places and used in effectively

VI. Conclusions

The use of waste plastics enables us to reduce the quantity of cement and sand; hence it reduces the cost of construction. The maintenance cost is reduced to a large extent. When plastics are used for road construction it can withstand higher temperatures hence it can be adopted in tropical regions also. The use of waste plastics on the road has helped to provide a better place for burying the plastic waste without causing disposal problem. At the same time, a better road is also constructed. It is the easiest method of disposal method of waste plastics to land filling. The hazards caused by the consumption of waste plastics by the animals are minimized.

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