

An Experimental Study on Properties of Concrete by the Addition of Grinded Plastic Waste

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Abstract- Due to rapid construction of industries in the country lot of infrastructure developments are required. Therefore developing infrastructure has in turn led questions to mankind to overcome the problems generated by this growth. The problems are shortage of constructional materials, increased productivity of wastes and other products. Usually M20 grade of concrete is used for most of the construction works, hence in the present study M20 concrete is taken and waste plastics is being added as a modifier. Modifier was taken in percentage of 5%, 10%, 15%... in order to replace the same amount of sand according to code IS 383:1970. Tests were conducted on materials used in concrete such as coarse aggregates, fine aggregates, cement and modifiers such as plastic waste to determine their physical characteristics. Cubes were casted and tested the concrete for 7 day's compressive strength. These tests revealed that the optimum modifier content was found to be 15% by weight of sand. The present studies revealed that the optimum modifier content of 5%, the strength was greater than the plain cement concrete. Therefore the concrete with modifier can be used for construction of Rigid Pavements which decreases the overall thickness of the pavement.

Keywords – Grinded Plastic Waste, M20 Plain Cement Concrete.

I. INTRODUCTION

As the world population grows, the amount of wastes being generated. Plastic is everywhere in today's lifestyle. It is used for packaging, serving, and even disposing of all the necessary kinds of consumer goods. With the industrial revolution, production of goods and plastic seemed to be a cheaper and effective raw material. Today, the sector of the economy being from agriculture, building construction, automobile, communication has been virtually reformed by the use of plastics. Usage of this non-biodegradable (according to recent studies, plastics is unchanged for 4500 years on earth) product is growing according to the usage. Recent Studies have linked the improper disposal of plastic to problems as breast cancer, genital abnormalities, reproductive problems in humans and animals, and even a decline in human sperm count. If a ban is put on the use of plastics on grounds, the real cost would be much higher, and the chances of damage or contamination is much greater in the world. The risks to the family health and safety would increase, but it is more concerned with the judicious use and re-use of plastic-waste.

The presence of non-decaying waste materials, with a growing consumer population, has resulted in a waste disposal crisis. Solution to this crisis is based on recycling waste materials into useful products.

Research of innovative use of waste materials being adopted world and innovatively ideas are expressed which is worthy in present study. Many highway agencies, private enterprises and individuals have presented the process of completing a wide variety of studies and research papers concerning the availability, environmental suitability and performance of using waste plastics in highway construction. These studies are needed for safe and economic disposal of waste materials with the help of eco friendly industries, which require better and effective price of construction materials.

A. General

Definition of plastics: A material which contains one or more organic polymers of large molecular weight, which shows solid form in its finished state and while manufacturing or processing into finished articles, can be shaped by its flow, is termed as "Plastics".

1)Types of plastics:

- Thermosets.
- Elastomers.
- Thermoplastics.

2)Resins:

Resins are solid or semi-solid materials, the colour is light yellow to dark brown, and it is mainly composed of Carbon, Oxygen and Hydrogen. In plants Resins occurs naturally and are common in pines and firs, often appearing as globules on the bark. Synthetic resins are:

- Polystyrene,
- Polyesters
- Acrylics are derived primarily from petroleum. Resins are mostly used in the manufacture of lacquers, plastics, varnishes and adhesives.

3) Types of Plastics (Resins):

- (PET, PETE) - Polyethylene Terephthalate
- (HDPE) - Density Polyethylene
- (Poly Vinyl Chloride or PVC) - Vinyl
- (LDPE) - Low Density Polyethylene
- (PP) - Polypropylene

4) Sources of Generation of Waste Plastics

Household: Carry bags, bottles, plastic box, containers and trash bags.

Health and Medicare: Disposable syringes, catheters, glucose bottles, blood and surgical gloves.

Hotel and Catering: Mineral water bottles, Packaging items, Plastic plates, etc.

B. Why Use Plastics?

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

- It is Durable and corrosive resistant.
- Good Insulation property for cold, heat and sound saving energy then reducing noise pollution.
- It is more economical and has a longer life.
- free Maintenance (such as painting is minimized)
- very Hygienic and clean
- Ease processing / installation
- Light weight material

C. Sources of Plastic Waste

Plastic recycling plays a important role in India and about 60% of plastic waste is recycled. In India People have realised that recycling of plastic waste have huge economic value and provides employment opportunities which results in economic growth of the country. Indian construction industry provides plenty of employment opportunities and accounts for major portion of the capital outlay in consecutive 5-year plan. The massive projected investment in this industrial sector continues to show a growing trend.

Plastic waste is bulk in volume and unsuitable for disposal by incineration or composting which result in polluting the environment badly, so the people are facing number of problems which results in hazardous diseases.

Apart from mounting problems, other reasons to recycle the waste are:

1. To reduce the extraction of raw materials.
2. To reduce the transportation cost.
3. To reduce the environmental impact and improved profits.

D. Advantages of Using Plastic Waste

- The material is easily available in the form of shredded plastic, which is now treated as a waste.
- The process makes use of plastic bags in shredded form. The disposal of plastics is an environmental problem, is thereby eliminated.

E. Objective of Study

- To find the properties of Coarse Aggregate, Fine Aggregates and Cement.
- To find the physical properties of Waste Plastics
- To conduct mix design as per IS: SP 23-1982⁽¹⁾.
- To find out the Optimum Modifier Content (OMC).
- To cast both the plain and modified cement concrete cubes, Cylinders, Prisms and subjected to fatigue loading.
- To study the effect of temperature on both the plain and modified cement concrete.

II. LABORATORY INVESTIGATIONS

A. Aggregates (Coarse & Fine)

Selection of aggregates for normal conventional concrete is very important because, various aggregates properties can influence the performance of the concrete. while selecting the materials, various considerations have to be kept in mind. Aggregates used in this study, were tested for finding specific gravity, water absorption and other physical properties and results have been tabulated in table 1. The grade adopted for the mix as per IS SP: 23-1982(1) Handbook on Concrete Mixes.

TABLE I

Type of aggregate	Coarse	Fine
Specific gravity	2.55	2.6
Water absorption	0.35%	1.5%
Aggregate Impact Value	15.57%	----
Aggregate Crushing Value	16.88%	----
Los-Angeles Abrasion Value	18.60%	----

B. Cement

Ordinary Portland Cement of 43-grade was used and the requirements are satisfied based on IS: 269-1969.

C. Curing Water

IS: 456-2000 (Cl. 2.20) satisfied the requirements for water used for mixing and curing of concrete.

III. GRINDED PLASTIC WASTE AND PROCESS

Plastic waste are mostly collected are

1. Carry Bags, bottle Covers, Water bottles except waste which is reusable.
2. Waste pipes- PVC

Above collected wastes are washed in water and the following process has been carried out

- Step 1 - Collection of all type of plastic waste like - PVC pipes, Plastic bottles and all kind of plastic wastes.
- Step 2 - Crushing the collected plastic waste by heavy hammer.
- Step 3 - Crushed plastic wastes are put into grinding machine to make as powder form.
- Step 4 - Unwanted dust removal from grinded plastic waste.



Fig(1) Step 1 - Collection of Plastic waste



Fig(4) Step 4 – Dust removal from grinded plastics



Fig(2) Step 2 – Crushed plastics



Fig(3) Step 3 – Crushed plastics-putting into grindingM/C

IV. MIX PROPOTION AND TRIAL CUBES CASTING

A. Mix proportion

The reference mix design and mix proportion for trial cubes are listed in below table II.

TABLE II

REFERENCE MIX DESIGN FOR M20 GRADE CONCRETE							
S.No	VOLUME	CEMENT	COARSE AGGREGATE	FINE AGGREGATE	PVC WASTE	WATER	W/C RATIO
1	1.0 m ³	383 kg/m ³	1103 kg/m ³	727 kg/m ³	0 kg/m ³	191.6 kg/m ³	0.5
MIX PROPOTION FOR TRIAL CUBES							
TRIAL No.	TOTAL VOLUME OF EACH TRIAL (2 CUBES)	CEMENT	COARSE AGGREGATE	FINE AGGREGATE	PVC WASTE	WATER	W/C RATIO
1	0.00675 m ³	2.58 kg	7.78 kg	4.91 kg	0.00 kg (0%)	1.29 kg	0.5
2				4.66 kg	0.25 kg (5%)		
3				4.42 kg	0.49 kg (10%)		
4				4.17 kg	0.74 kg (15%)		
5				3.93 kg	0.98 kg (20%)		

B. Preparation of concrete trial cubes

For the Various Mix Proportion of Plastic waste the Concrete cube have been prepared for 7 and 28 days of curing. Now, the standard dimension for concrete cubes are 15 x 15 x 15cms. The compressive strength of the specimens of tested for 7& 28 days.

Here, the waste plastics is added in varying percentages such as, 5, 10, 15, 20 by weight of Sand. The process of preparation of trial cubes is shown in figure 5 - 8.

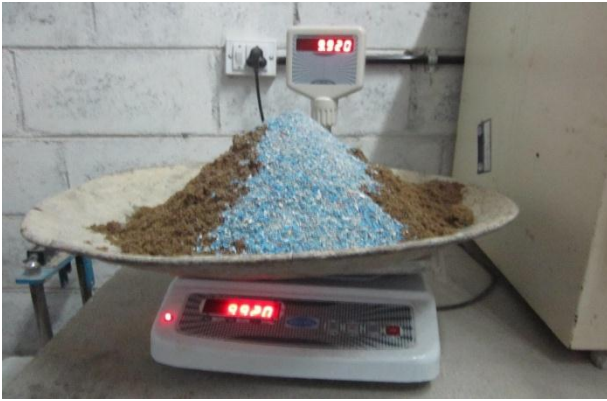


Fig (5) Cement, Sand and PVC waste mix weighing



Fig (8) Test result observation in CTM machine



Fig (6) Deshuttering and numbering of cubes

V. TEST RESULTS AND DISCUSSION

Concrete specimens of Cubes are casted using plastic for the various percentages of the weight of sand. Similarly, plain cement concrete also casted. Then the specimens are subjected to loading and various test results are shown in the fig.(7), fig(8) and table III.

TRIAL III

7 DAYS CUBE STRENGTH					
TRIAL No.	PVC WASTE (kg)	WEIGHT (kg)	LOAD (KN)	COMPRESSIVE STRENGTH (Mpa)	REMARKS
1	0.00 kg (0%)	7.2	399.1	17.73	
2	0.25 kg (5%)	8.6	444.0	19.73	OPTIMUM STRENGTH
3	0.49 kg (10%)	7.9	386.6	17.18	
4	0.74 kg (15%)	7.7	342.6	15.22	
5	0.98 kg (20%)	7.7	402.7	17.89	

In the present analysis it is found that optimum plastic content was found that 5% of weight of sand on 7 days cube strength. 28 days strength test have to be conducted to estimate optimum plastic content, which will be studied further.



Fig (7) Weighing of cubes

V. CONCLUSION

From the above aspects we come to the conclusions that the waste plastics can be used as a fine aggregates in the cement concrete mix for certain percentage. This modified concrete mix is applicable in the construction of rigid pavements to reduce the thickness of the pavement and to increase the durability of the pavement.

- From experimental analysis, we came to conclusion that the compressive strengths of modified cement concrete increases by 11% more than that of plain cement concrete on 7 days strength test.
- The optimum modifier content is found to be 5% by weight of sand for the 7 days strength.
- It also helps to avoid the general disposal technique of waste plastics such as land filling and incineration which are burden on ecology.
- However, percentage of optimum plastic content will be arrived only after the study of 28 days compressive strength which will be a future scope.

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