Comparative Study of Blended Concrete and Plastic Waste Concrete with Normal M20 Grade Concrete

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Abstract— The cement industry is the major contributor of CO2 emission, which could be curtailed by the use of supplementary cementitious materials. Fly ash, one of the supplementary cementitious materials, exhibits high pozzolanic characteristics when properly produced under controlled conditions. In this paper, three concrete mixtures were considered to identify the effect of fly ash (produced under controlled conditions) on performance characteristics of the concrete. Fly ash was added as partial replacement of ordinary portland cement for 20%. The properties investigated include compressive strength of blended concrete. Based on the results, it was found that fly ash addition up to 20% in partial replacement of ordinary portland cement lead to increased compressive strength of concrete compared with that of reference mixtures. This paper reports an experimental study on recycled plastic concrete (RPC) that uses recycled acrylonitrile-butadiene-styrene/polycarbonate copolymer (ABS/PC) plastic particles to replace 5%, 10%, 15% (in volume) of fine aggregate sand. The results showed that the compressive strength of RPC was higher than that of normal concrete by 12.47% and increased with the plastic content. The impact resistance performance of RPC materials was superior to that of normal concrete.

Keywords: Recycled Plastic Sand, Fly Ash, Natural Sand, Compressive Strength Test

I. INTRODUCTION

Cement-based substances have been the most essential construction materials for many decades now and they are likely to continue to enjoy this kind of an importance in the distant future too. Many waste materials like Fly Ash (FA), Ground Granulated Blast Furnace Slag (GGBS), Rice Husk Ash (RHA), Limestone Fines and Alccofine have been shown to exhibit pozzalonic properties; thus they have been used as alternative cementitious substances. They can be mixed either directly to cement or at the concrete mixer. Such cementitious substances for concrete should be fine mineral powders; further, when they are mixed with water, they should react chemically to shape as rigid mass to make concrete.

In civil engineering construction use of shredded plastics has increased drastically as a partial replacement of aggregates. As it is an added advantage in terms of environmental and potential economic consideration incorporation of waste in concrete increases. Plastic can be incinerated with energy recovery, if material recycling is not feasible. Air pollution may cause and results in acid rain because of waste incineration. Recycling waste solid materials is one of the most challenging problems worldwide with the unprecedented growth of the world population. Plastic constitutes a large portion of the solid waste that has turned into a worldwide environmental concern (McCarthy 1993; Al-Salem et al. 2009). In several countries, plastic is being burned and used as fuel, which may result in serious hazards. Plastic dumped in sanitary landfills is a significant environmental hazard and results in possible contamination. Only small quantities of scrap plastic are being recycled and used as construction materials.

With the scarcity of space for landfills and their ever-increasing cost, waste utilization has become an attractive alternative to disposal(Subramanian 2000; Patel et al. 2000; Welle 2011).

II. OBJECTIVES OF PROPOSED WORK

1) To find compressive strength of blended concrete, plastic waste concrete and normal concrete (M20).
2) To compare the compressive strength between blended concrete, plastic waste concrete and normal concrete.
3) To compare the water absorption capacity between blended concrete, plastic waste concrete and normal concrete.

III. METHODOLOGY ADOPTED FOR DISSERTATION

Experimental methodology is adopted for this dissertation work. The details of experimental work are as follows,

1) Testing of material like sand, aggregate, cement.
2) Preparation of Mix Design of waste plastic, blended concrete and M20 concrete.
3) Casting of cube specimen of area 22500 mm2 (150mm x 150mm x 150mm) with M20, plastic waste and Blended concrete.
4) Specimen is tested for Compressive Strength, under UTM machine.

M20 grade concrete was casted and Tested for 7, 14 and 28 days. Recycled Plastic concrete and PVC waste plastic concrete were cast for 5%, 10%, 15%.

Type of Concrete	Total no. of Cubes	Remark
Normal Concrete	9	– Grade of Concrete = M20 – % of Plastic Waste add for replacement of fine Aggregate = 5% – % of Blended concrete add for replacement of Cement = 20% – % of PVC Plastic Waste add for replacement of fine Aggregate = 5%
Blended Concrete for (20	27	
Recycled Plastic concrete	27	
PVC waste plastic concrete	27	

Table 3.1: Proposed works:

IV. PROCEDURE

1) Step 1. Batching:

Weight batching is used for preparing the concrete mix. The grade of concrete is used M20. The ratio of cement, sand and coarse aggregate is 1:1.84:3.3 by weight with water cement ratio 0.5.

2) Step 2. Mixing:

The mixing of ingredients of plain concrete is done in Pan mixing by taking required quantities of cement, sand, coarse aggregate. All these ingredients are first mixed in dry condition, then calculated amount of water is added and mixing is continued until uniform mix obtained.

3) Step 3. Placing:

Before placing concrete the mould is kept ready by applying oil inside it. After proper mixing of concrete, material is filled in mould, in three layers.

4) Step 4. Compaction:

Compaction of concrete is done by tamping the concrete by tamping rod. The compaction of concrete is required for expelling the entrapped air from the concrete and making dense concrete.

5) Step 5. Curing:

The concrete specimens are removed from the mould after 24 hrs. All the concrete specimens are kept in water for 28 days curing.

A. Strength Graph:

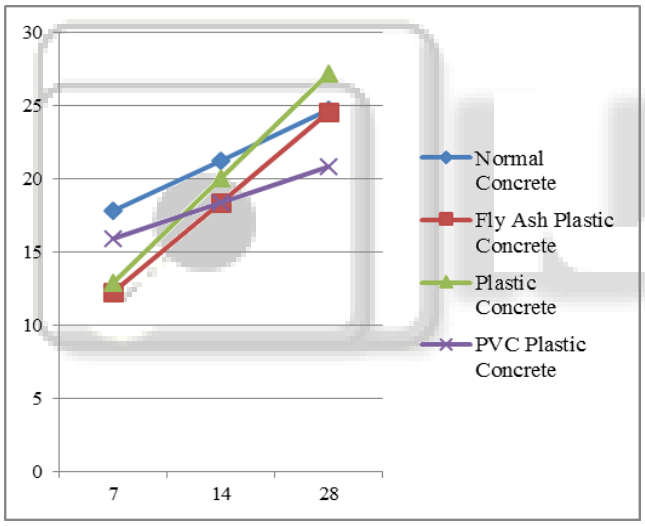

Fig. 4.2: Compressive Strength after 28 Days

V. COMPRESSION STRENGTH

A. Comparison between Compressive Strength of Blended Concrete with Plastic Sand and Normal M20 Concrete:-

Type of Concrete	7 days	14 days	28days
Normal concrete	17.80	21.27	24.74
Blended concrete (10%)	12.26	19.21	26.16

Table 5.1.1: Compressive strength results between NC and BC

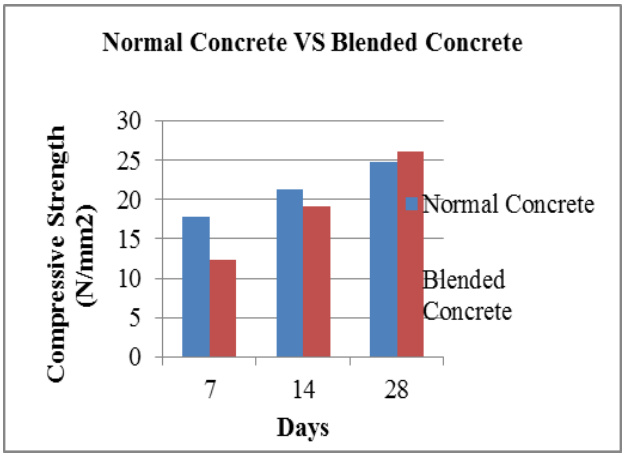

Fig. 5.1.1: Comparison between Compressive strength of Blended Concrete with Plastic Sand and Normal M20 Concrete

The compressive strength achieved is 26.16MPa, which is well above the target strength. The strength of the concrete depends on the water cement ratio and porosity. With the use of fly ash as mineral admixture the compressive strength was increased compared to normal concrete. As days increases the strength increases in 28 days blended concrete gains more strength as compare to normal concrete.

B. Comparison Between compressive Strength of Recycled Plastic Concrete and Normal M20 Concrete:

Type of Concrete	7 days	14 days	28days
Normal concrete (N/mm^2)	17.80	21.27	24.74
Recycled plastic Concrete (5%) (N/mm^2)	12.88	20.01	28.14

Table 5.1.2: Compressive strength results between RPC and NC

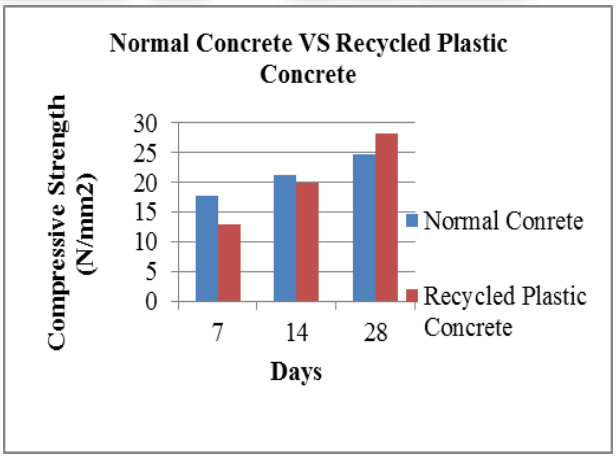

Fig. 5.1.2: Comparison between compressive Strength of Recycled Plastic Concrete and Normal M20 Concrete

The relationship of cube strength and plastic content is shown in Fig5.1.2. The compressive strength decreases with the increase of the plastic content after 5%. The compressive strength is 24.74 MPa for NC and 28.14 MPa for RPC-20, which is a 12.08% increase compared with NC. As days increases the strength increases in 28 days recycled plastic concrete gains more strength as compare to normal concrete.

C. Comparison Between compressive Strength of PVC Plastic Concrete and Normal M20 Concrete:

Type of Concrete	7 days	14 days	28days
Normal concrete (N/mm^2)	17.80	21.27	24.74
PVC plastic Concrete (5%) (N/mm^2)	15.93	18.39	20.85

Table 5.1.3: Compressive strength results between RPC and NC

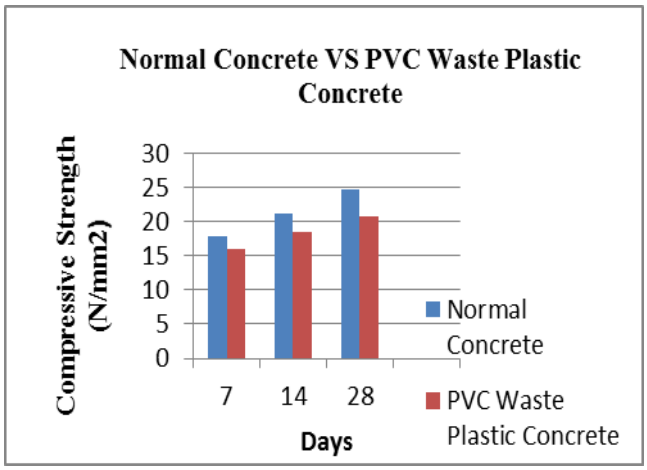

Fig. 5.1.3: Comparison between compressive Strength of PVC Plastic Concrete and Normal M20 Concrete

The 5% PVC waste plastic concrete give better result. As days increases the strength increases in 28 days Normal concrete gain more strength as compare to PVC waste concrete.

D. Comparison Between compressive Strength of Recycled Plastic Concrete and Blended Concrete:-

Type of Concrete	7 days	14 days	28days
Blended concrete (N/mm^2)	12.26	19.21	26.16
Recycled plastic Concrete (N/mm^2)	12.88	20.01	28.14

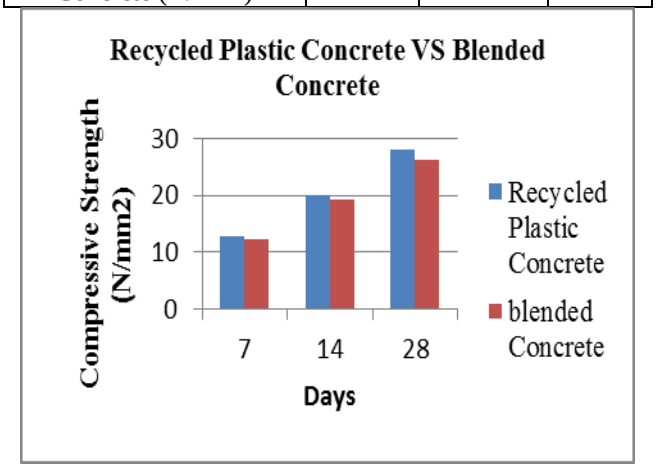

Fig. 5.1.4: Comparison between compressive Strength of Recycled Plastic Concrete and Blended Concrete

As days increases the strength increases in 28 days Recycled plastic concrete gains more strength as compare to blended concrete.

VI. Conclusion

1) The Fly ash and plastic sand used in this investigation has exhibited excellent pozzolanic characteristics and more durability and results in maximum compressive strength of approximately 92 MPa. The following conclusions can be drawn:

a) Fly ash with plastic sand addition has contributed to strength improvement of concrete at all ages.

b) Performance characteristics of BC -blended mixtures show significant improvement up to the 5.43% as compare to NC.

c) At the 5.43% BC level, the mixtures attained strength comparable to that of respective reference mixtures and showed improved resistance to performance characteristics. Hence, 10% of ordinary Portland concrete can be replaced with fly ash and plastic sand without affecting strength and durability properties

2) This paper has presented an experimental study on recycled plastic concrete (RPC) under compressive. Based on the test data, discussions, and analysis presented in this report, the following conclusions could be drawn:

a) In general, the compressive strength, are found to be increased with increasing the percentages of waste plastic. Furthermore, when percentages of waste plastic bottles are increased from zero to 5% of the sand in the mix, the compressive, strength of concrete are found to be decreased by the 10%,15% and are increased by 5% at 28 days age.

b) To add, the usage of waste plastic in concrete leads to a change in the modes of failure from brittle (rapid) failure to more ductile failure. It can be summed that one can use the waste plastic bottles and bags in nonstructural concrete members.

c) Recycled plastic concrete give more strength as compare to blended concrete normal M20 concrete and PVC plastic concrete.

VII. Future Scope

1) Availability of alternative materials and plastic to increase the strength of concrete block.
2) Suitable admixture to increase the strength of waste plastic paver block.
3) Use of suitable equipment and machinery for speed in production.

References

[1] Anand Kuber Parande, B. Ramesh Babu, M. Aswin Karthik, Deepak Kumaar K.K., Palaniswamy N. "Study on strength and corrosion performance for steel embedded in metakaolin blended concrete/mortar" Construction and Building Materials 22 (2008) 127–134 , page (1 to 8).

[2] Muthadhi and S. Kothandaraman "Experimental Investigations of Performance Characteristics of Rice Husk Ash–Blended Concrete" Technical Note DOI: 10.1061/(ASCE)MT.1943-5533.0000656. © 2013 American Society of Civil Engineers, pages (1 to 4).

[3] Narender Reddy, Prof. Meena. T, "Behavior Of Ternary Blended Concrete Under Compression" International Journal of Civil Engineering and Technology (IJCIET) Volume 8, Issue 4, April 2017, pp. 2089–2097 Article ID: IJCIET_08_04_238. Pages (1to 10).
[4] AvuthuNarender Reddy , Prof. T.Meena and K. VarunTeja, "International Journal of Engineering Technology Science and Research IJETSR www.ijetsr.com ISSN 2394 – 3386Volume 5, Issue 1 ,January 2018,pages (1 to 8).
[5] AvuthuNarender Reddy , Prof. T.Meena and K. VarunTeja, "International Journal of Engineering Technology Science and Research IJETSR www.ijetsr.com ISSN 2394 – 3386Volume 5, Issue 1 ,January 2018,pages (1 to 8).
[6] B Jaivignesh and A Sofi , "Study on Mechanical Properties of Concrete Using Plastic Waste as an Aggregat", IOP Conf. Series: Earth and Environmental Science 80 (2017) 012016 , page (1to7).
[7] Feng Liu, Ph.D.Yong Yan2, Lijuan Li, Ph.D. Cheng Lan4, and Gongfa Chen, Ph.D "Performance of Recycled Plastic-Based Concrete" DOI: 10.1061/(ASCE)MT.1943-5533.0000989. © American Society of Civil Engineers. Page (1 to 9).
[8] Kejin Wang and Zhi Ge "Evaluating Properties of Blended Cements for Concrete Pavements", Center for Portland Cement Concrete Pavement Technology Iowa State University, 21. No. of Pages, Final Report.
[9] Manhal A Jibrael1 and Farah Peter, "Strength and Behavior of Concrete Contains Waste Plastic" , Journal of Ecosystem & Ecography, J Ecosys Ecograph, an open access journal ISSN: 2157-7625 Volume 6 • Issue 2 • 100018,page (1 to 8).

