International Journal on Recent Researches in Science, Engineering & Technology (IJRRSET)
A Journal Established in early 2000 as National journal and upgraded to International journal in 2013 and is in existence for the last 10 years. It is run by Retired Professors from NIT, Trichy. Journal Indexed in JIR, DIIF and SJIF.
Available online at: www.jrrset.com
ISSN (Print) : 2347-6729
ISSN (Online) : 2348-3105
JIR IF : 2.54
SJIF IF : 4.334
Cosmos: 5.395
Volume 8, Issue 4 - January 2021 - Pages 11-15

Partial Replacement of Fine Aggregate with PET Bottle Aggregate in Concrete

Gireesh Mailar[1], Manohar K Sankadal[2], Soumya Hiremath[3]
Assistant Professors
Dept. of Civil Engineering
RTE Society's Rural Engineering College Hulkoti
Gadag, Karnataka,India

ABSTRACT

Nowadays, there is a considerable shortage in the availability of river sand for the construction activities all around the globe and also enormous amount of waste (plastic) generating around the globe. In present study, to balance both, the shortage of natural sand re-using of waste, partial replacement of plastic bottles with fine aggregate has done to generate environment friendly concrete. The experimental program involved casting of six distinct mixes with 0%, 10%, 15%, 20%, 25% replacement of fine aggregate by crushed PET bottle particles. The mechanical and durability properties of the concrete were assessed for each of the five diverse blends. It was observed that the compressive strength increased up to 15% replacement of the fine aggregate with PET bottle aggregate and it gradually decreased for 20% and 25%replacements. Therefore, it can be concluded that replacement of fine aggregate with 15% replacement will be reasonable.

Keywords—PET bottles, environmental frirndly concrete

1. INTRODUCTION

The excessive raw materials consumption potentially release greenhouse gases leading to global warming. Therefore, the need to incorporate recycled materials as a substitution to construction materials are essential to reduce landfill space as well as a shortage of natural resources. Waste materials increase with increasing population and most of these materials are non-degradable. The excessive disposal of non-degradable materials can lead to environmental pollution. To overcome this serious issue the recycle of non-degradable materials is very substantial. Polyethylene Terepthalate (PET) bottles due to its lightweight properties have replaced the glass bottles and because of it is easy handling and storage .Over the past few year it is estimated that roughly 25 billion tons of concrete manufactured each year globally. Nearly 60 million tons of waste is disposed annually in developing nations like India which is growing 2.5 to 4% rapidly. Plastic is a synthetic, therefore it has many properties. The PET fibers addition and partial replacement of fine aggregate using PET bottle scrap in concrete is an innovative material that can be promote in construction field. PET bottles are also recycled as-is (re-used) for various purpose PET bottles are filled with and left in the sun to allow disinfection by ultraviolet radiation. To improve the weakness of the materials, number of studies on scrap concrete has increased in the last decades. Polyethylene terephthalate commonly abbreviated PET. It is the thermoplastic

International Journal on Recent Researches in Science, Engineering & Technology (IJRRSET)
A Journal Established in early 2000 as National journal and upgraded to International journal in 2013 and is in existence for the last 10 years. It is run by Retired Professors from NIT, Trichy. Journal Indexed in JIR, DIIF and SJIF.
Available online at: www.jrrset.com
ISSN (Print) : 2347-6729
ISSN (Online) : 2348-3105
JIR IF : 2.54
SJIF IF : 4.334
Cosmos: 5.395
Volume 8, Issue 4 - January 2021 - Pages 11-15

polymer resin of the polyester family and is used in scrap, PET is one of the important and extensively used plastics in the world. Concrete containing plastic aggregate can stop or divert the propagation of micro cracks and improve concrete toughness, which is of great practical significance.

The main objective of this investigation is to study strength properties after partially replacing fine aggregates with plastic. This project we made M-30 grade concrete with water cement ratio of 0.45 Workability.

Various physical and mechanical properties of cement have been evaluated incorporating different percentage of plastic aggregates by volume. The influences of plastic aggregates on concrete properties have also been analyzed and discussed. Plastic have become an inseparable and integral part of our lives. Its low density, strength, user-friendly design, fabrication capabilities, long life, light weight, and low cost are the factors behind such phenomenal growth.

Fig: 1.1 crushed PET bottles

2. OBJECTIVES

1. To determine the compressive strength by varying percentage of PET bottle aggregate in concrete.
2. To determine the optimum usage of PET bottle aggregates as partial substitute for the fine aggregate in concrete and to investigate the structural behavior of concrete.

3. MATERIALS

- Plastic: PET bottle waste granules.
- Fine aggregate: River sand. conforming to grading zone II and zone IV of IS: 383-1970 (1997)
- Cement: OPC53 grade. The physical properties of the cement confirm to the specifications of IS: 12269 – 1987 (1999).
- Coarse aggregate: 20 mm & 10 mm. conforming IS: 383-1970 was used for concreting.
-

International Journal on Recent Researches in Science, Engineering & Technology (IJRRSET)
A Journal Established in early 2000 as National journal and upgraded to International journal in 2013 and is in existence for the last 10 years. It is run by Retired Professors from NIT, Trichy. Journal Indexed in JIR, DIIF and SJIF.
Available online at: www.jrrset.com
ISSN (Print) : 2347-6729
ISSN (Online) : 2348-3105
JIR IF : 2.54
SJIF IF : 4.334
Cosmos: 5.395
Volume 8, Issue 4 - January 2021 - Pages 11-15

Optimal mix

The optimal values of the material composition as the standard guidelines are tabulated in Table.3.1 The blended mix for M30 brand accurate considered according to IS 456:2000, IS 10262:2009 in this paper.

Table: 3.1 optimal values of materials

	Quantity Kg/m^3	**Specific gravity**	**Water absorption (%)**
Cement	413	3.15	-
Fine aggregate	740	2.78	1
Coarse Aggregate	1092	2.89	.5
W/C ratio	0.45		

Table: 3.2 actual quantity of materials adopted for experiment

Replacement of PET Bottle Aggregate (%)	**0%**	**10%**	**15%**	**20%**	**25%**
Water (kg/ m^3)	197.16	197.16	197.16	197.16	197.16
Cement (kg/ m^3)	438.13	438.133	438.133	438.13	438.13
Fine Aggregate (kg/ m^3)	735.29	61.761	624.99	561.23	551.46
Coarse Aggregate (kg/ m^3)	1095.1	1095.12	1095.1	1095.1	1095.1
PET Aggregate (kg/ m^3)	0	73.529	110.29	147.05	183.82

International Journal on Recent Researches in Science, Engineering & Technology (IJRRSET)
A Journal Established in early 2000 as National journal and upgraded to International journal in 2013 and is in existence for the last 10 years. It is run by Retired Professors from NIT, Trichy. Journal Indexed in JIR, DIIF and SJIF.
Available online at: www.jrrset.com
ISSN (Print) : 2347-6729
ISSN (Online) : 2348-3105
JIR IF : 2.54
SJIF IF : 4.334
Cosmos: 5.395
Volume 8, Issue 4 - January 2021 - Pages 11-15

4. METHODOLOGY

In this project, river sand found in percentages 5%, 10%, 15% & 20% is substituted for 30 grade concrete. The amount of replacement percentage with respect to volume wise in comparison to the total volume is relative and it is blend proportioned. 150 mm x 150 mm × 150 mm cubical and cylinder of 300mm dia are chosen for the purpose of casting for altered accommodation with PET bottles (grounded) and ascendance mixture. Slump analysis was performed initially accurate to actuate the feasibility. The extensive performance evaluation tests performed on 3,7 and 28days

5. RESULTS AND DISCUSSION

Compressive test has been conducted on hardened concrete cube to analyse the use of PET bottle aggregate in concrete, the concrete cube samples are cured for 3, 7 and 28 days and tested. Three samples for each type of concrete are tested at each different curing period. The compressive strength of 3 specimens was taken as average compressive strength of the cube of a particular mix. The compressive testing and split tensile results are tabulated in below Table 5.1, 5.2 for 28 days curing respectively.

Table: 5.1 Compressive Strength result (N/mm^2) of Concrete Cube at 28 Days with Varying Percentage of PET Bottle Aggregate (Kg)

Results for28 Days Curing			
(%)	Weight of Cube (kg)	Load on Compression Testing Machine (KN)	P/A (N/mm^2)
10%	8.035	520KN	23.11
15%	7.579	560KN	24.88
20%	7.537	480KN	21.33
25%	7.391	400KN	17.77

Table: 5.2 Split Tensile Strength result (N/mm^2) of cylinder at 28 Days with Varying Percentage of PET Bottle Aggregate (Kg)

Results for28 Days Curing			
(%)	Weight of Cube (kg)	Load on Compression Testing Machine (KN)	P/A (N/mm^2)
10%	7.934	490	21.77
15%	7.491	570	25.33
20%	7.652	400	17.77
25%	7.372	430	19.11

The concrete with PET aggregates reduced the weight of concrete and thus if mortar with plastic aggregates can be made into light weight concrete based on unit weight

International Journal on Recent Researches in Science, Engineering & Technology (IJRRSET)
A Journal Established in early 2000 as National journal and upgraded to International journal in 2013 and is in existence for the last 10 years. It is run by Retired Professors from NIT, Trichy. Journal Indexed in JIR, DIIF and SJIF.
Available online at: www.jrrset.com
ISSN (Print) : 2347-6729
ISSN (Online) : 2348-3105
JIR IF : 2.54
SJIF IF : 4.334
Cosmos: 5.395
Volume 8, Issue 4 - January 2021 - Pages 11-15

It was observed that the compressive strength increased up to 15% replacement of the fine aggregate with PET bottle aggregate and it gradually decreased for 20% and 25%replacements. Therefore, it can be concluded that replacement of fine aggregate with 15% replacement will be reasonable.

CONCLUSION

- Recycled PET fine aggregate was considered as partial replacement of fine aggregate for concrete as means for studying an analyzing there by improving its performance.
- The ecological benefit of successfully using a waste material give added benefit and had been a prime motivation for the work.
- So, from the study it is concluded that PET aggregate concrete has less compression strength.
- There is a gradual increase in Compressive strength and Spit tensile strength of PET aggregates when replaced aggregate up to 15% then it is decrease from 20% to 25%.

Acknowledgement

The authors gratefully acknowledge Sri. S. D Patil Secretary, RTE Society's Rural Engineering College, Hulkoti-582205,Gadag, Karnataka, and Principal and all faculty of civil engineering department for their moral support during the research work.

REFERENCE

1. AltamashuddinkhanNadimalla, Siti Aliyyah Binti Masjuki, Asmahani Binti Saad, Kamsiah Binti Mohd Ismail, MaisarahBtAli,*"Polyethylene Terephthalate (PET) Bottles Waste as Fine Aggregate in Concrete"*, International Journal of Innovative Technology and Exploring Engineering (IJITEE), Volume 08, (2019), PP.(1177-1180)

2. Mastan Vali N and SS. ASADI, "*Pet Bottle Waste As A Supplement To Concrete Fine Aggregate*", International Journal of Civil Engineering and Technology (IJCIET), Volume 08, (2017),pp.(558-568)

3. L. R. Bandodkar, A. A. Gaonkar, N. D. Gaonkar, & Y. P. Gauns, S. S. Aldonkar, P. P. Savoikar,"*Pulverised PET Bottles as Partial Replacement for Sand*", International Journal of Earth Sciences and Engineering, Volume 04, (2011), pp.(1009-1012)

4. S. Janarthanan , S. Arun Sahayaraj, "*Partial Replacement of Low-Density Polyethylene by Fine Aggregate in Concrete*", International Conference on New Scientific Creations in Engineering and Technology, (2020), pp.(52-56)

5. A.Ananthakumar, Dr.K.Sasiekalaa, M.Deepika, "*Performance Of Concrete Using Pet Bottle Scrap Fines*", International Journal of Advance Research and Innovation, Volume 05, (2017), pp.(138-143)

6. M. Prakash, Dr. B.Hemalatha,"*Partial Replacement Of Fine Aggregate In Concrete Using Recycled Plastic*", International Journal Of Scientific & Technology Research, Volume 08, (2019),pp.(2089-2096)