iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** V **Month of publication:** May 2023

DOI: https://doi.org/10.22214/ijraset.2023.52327

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue V May 2023- Available at www.ijraset.com

Behaviour of Concrete by Partial Replacement of Fine Aggregate with Recycled Plastic Granules

Mohammed ShakeebUlla Khan[1], Abhijeet Wadkar[2], Vaibhav Karnik[3], Nikhil Beldare[4], Vaishali Sonawane[5]
[1]*Assistant Professor,* [2, 3, 4, 5]*Final Year students, Civil Department, Zeal Polytechnic, Pune*

Abstract: ***In this paper low density poly ethylene (LDPE) granules used as replacement for fine aggregate for producing concrete cubes has been investigated and reported. LDPE based concrete cubes were cast manually and the strength of the test concrete in terms of compression test experimentally evaluated. It is found that the strength of plastic replaced concrete in terms of compression can be comparable with the conventional concrete. The present study is aimed at concrete mix with partial replacement of fine aggregate by LDPE granules (0%, 10%, 20% and 30%) that will provide an advantage in reducing the dead weight of structure. This mix in the form of cubes and cylinders were subjected to compression to ascertain the strength parameter. Hence the use of plastic granules in concrete making is not only beneficial but disposal of plastic wastes.***

I. INTRODUCTION

The problem of disposing and managing solid waste materials in all countries has become one of the major environmental, economical, and social issues. A complete waste management system including source reduction, reuse, recycling, landfilling, and incineration needs to be implemented to control the increasing waste disposal problems. Typically, a plastic is not recycled into the same type of plastic products made from recycled plastics are often not recyclable. The use of biodegradable plastics is increasing. If some of these get mixed in the other plastics for recycling, the reclaimed plastic is not recyclable because the variance in properties and melt temperatures. The purpose of this project is to evaluate the possibility of using granulated plastic waste materials to partially substitute for the fine aggregate in concrete composites. Among different waste fractions, plastic waste deserves special attention on account no which is creating a lot of problems in the environment. In biodegradable property India approximately 40 million tons of solid waste is produced annually. This is increasing at a rate of 1.5 to 2% every year. Plastics constitute 12.3% of total waste produced most of which is from discarded water bottles. The plastic waste cannot be dis posed off by dumping or burning, as they produce uncontrolled fire or contaminate the soil and vegetation. Considerable researches and studies were carried out in some countries like USA and UK on this topic. However, there have been very limited studies in India on plastics in concrete. Hence an attempt on the utilization of waste Low Density Polyethylene (LD PE) granules as partial replacement of fine aggregate is done and its mechanical behaviors investigated.

II. METHEODOLOGY

A. Materials

In this chapter the properties of materials, such as cement, fine aggregate, LDPE natural granuels, coarse aggregate, admixture are described. The general information regarding the preparation and testing of concrete has been discussed.

1) *Cement:* There are 13 types of cement for which BIS has issued specifications and IS code numbers. Many of these cements are use specific. These include Rapid hardening cement, Portland slag cement, low heat Portland cement, Ordinary Portland Cement, Portland Pozzolana cement, High Alumina Cement, White Portland Cement and many others. Of these, only three types of cement are used by a house builder for his house. These are Ordinary Portland Cement, Portland Pozzolana Cement and White Portland cement.In project work we used Shree jungrodhak Portland Pozzolana Cement (PPC). The Portland Pozzolana Cement carries IS 1489 Part I mark.
2) *Fine Aggregate:* Fine aggregate (Sand) is a naturally occurring granular material composed of finely divided rock and mineral particles. It is defined by size, being finer than gravel and coarser than silt. Sand can also refer to a textural class of soil or soil type; i.e. a soil containing more than 85% sandsized particles (by mass).
3) *Coarse aggregate:* Construction aggregate (coarse aggregate), or simply “aggregate”, is a b road category of coarse particulate material used in construction, including sand, gravel, crushed stone, slag, recycled concrete and geosynthetic aggregates. Aggregates are the most mined materials in the world. Aggregates are a component of composite mat erials such as concrete and asphalt concrete; the aggregate serves as reinforcement to add strength to the overall composite material.

4) *Low density Polyethylene (LDPE):* Low-- density polyethylene (LDPE) is a thermoplastic made from the monomer ethylene. It was the first grade of pol yethylene, produced in 1933 by Imperial Chemical Industries (ICI) using a high pressure process via free radical polymerization. Its manufacture employs the same method today. The EPA estimates 3.3.7% of LDPE (recycling number 4) is recycled. Despite compe tition from more modern polymers, LDPE continues to be an important plastic grade. In 2013 the worldwide LDPE market reached a volume of about US$33 billi

Properties: LDPE is defined by a density range of 0.9100.940 g/cm3.1. It is not reactive at room temperatures, except by strong oxidizing agents, and some solvents cause swelling. It can withstand temperatures of 80 °C continuously and 95 °C for a short time. Made in translucent or opaque variations, it is quite flexible, and tough but breakab le. LDPE has more branching (on about 2% of the carbon atoms) than HDPE, so its intermolecular forces (instantaneousdipole induceddipole attraction) are weaker, its tensile strength is lower, and its resilience is higher. Also, since its molecules are l ess tightly packed and less crystalline because of the side branches, its density is lower. LDPE contains the chemical elements carbon and hydrogen.

Physical Properties: 1.Specific Gravity of LDPE Granules = 0.92 2. Tensile Strength of LDPE Granuels= >13mpa

LOW DENSITY POLYETHELENE BLACK NATURAL GRANUELS

5) *Admixture:* ALGISUPERPLAST -575 is a powerful super plasticizer without much set retardation (at age range) that gives a slump retention of 1.5 hours to 2.5 hours at normal dosage and is recommended for hot weather concreting. It also allows for reduction in the free water content of mix by 10-20% when concrete slumps is not increased

Properties: ALGISUPERPLAST-575 when concrete slumps is not increased when compared to575 should be added to concrete mix at ratio of 200control. 500 ml to 50 Kg of cement. Recommended to make field trial to determine optimum ratio.

Effects:-

a) Compatibility - Being a liquid, easily dispersible & compatible with concrete/mortar mixes.
b) Cohesiveness - Makes the concrete / mortar more cohesive, hence no bleeding & segregation.
c) Durability - Increases durability by improving water cement ratio without affecting workability
d) Permeability – It reduces the permeability of water into concrete.
e) Economy – It saves cement thus improving economy in mix designs.
f) Allows for early demolding thus speeds up construction and higher rotation of moulds.
g) Curing Time – High early strength gain and hence allows reduction in curing time

Procedure:-

- Aggregate sample was immersed in clean water for 20 hours and dry to saturated surface dry condition the sample was divided into approximate equal parts.
- One part was place in an oven dry to a constant temperature and dry mass was recorded.

- The jar was fill about in three equal fool of water of known temperature and saturated surface dry sample was added in it.
- Replaced the disc on the jar making sure that now void remains.
- A jar fill with water was weighted and mass was recorded.
- Remove the sample and cleaned the jar, refill the jar with water up to 1L and covered it with disc.
- Weighted the jar. Calculations of specific gravity(G):

$$\frac{W2-W1}{(W4-W1)-(W3-W2)}$$

(TABLE NO- 2.SPECIFIC GRAVITY OF FINE AGGREGATE)

Weight Of Sample	600 gm	W1
Weight Of Jar	99.7gm	W2
Weight Of Sample	600.9gm	W3
Jar + 900ml Of Water	956.8gm	W4
Jar+ Sample +water	1348.5gm	W5

(TABLE NO-3.SPECIFIC GRAVITY OF COARSE AGGREGATE)

Weight Of Sample	600 gm	W1
Weight Of Jar	99.7gm	W2
Weight Of Sample	600.9gm	W3
Jar + 900ml Of Water	952.8gm	W4
Jar+ Sample +water	1350.4gm	W5

Hence, specific gravity of coarse aggregate = 2.97 and that of fine aggregate = 2.88.

III. RESULTS

Compressive strength of plastic replaced concrete is compared with conventional concrete. From graph it is found that a compressive strength up to 80% is achieved for a mix of waste plastic up to 30% (as a replacement for coarse aggregate) in concrete. The reduction in compressive strength of plastic replaced concrete is due to deficient bonding of plastic granules in the matrix.

IV. CONCLUSIONS

The experimental results have shown the use of waste plastic material in making concrete/mortar can provide an alternative solution to minimize the environmental impact due to unscientific disposal of waste plastic. The following conclusions were drawn:

1) The properties of concrete containing various percentage of plastic (0%, 10%, 20%, and 30%) were tested for its physical properties and compressive strength.

2) The waste plastic used for experiments is of LDPE (Low Density Poly Ethylene), 57mm size and specific gravity of waste plastic is found to be 0.92.

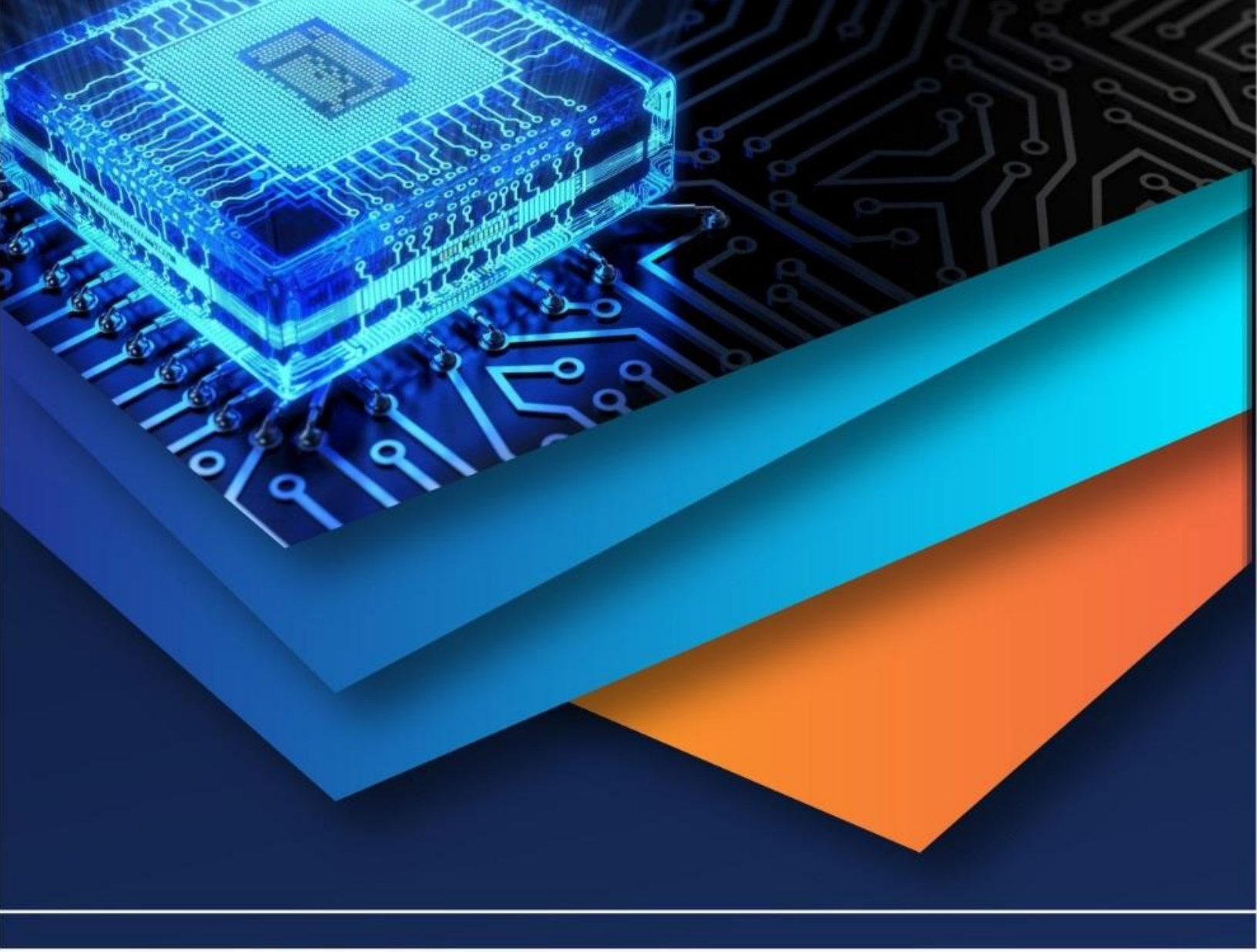
3) The compressive strength of test concrete is compared with plain concrete (fig 1.1) and it is found that the compressive strength up to 80% is achieved for a mix of waste plastic up to 30% (as a replacement for coarse aggregate) in concrete. Hence it is recommended for light weight concrete structures.

4) The mechanical properties of the test concrete did not display any notable differences depending on the color of the plastic waste.

5) This research also has potential application for the production of lightweight concrete, for minimizing the amount of polymer wastes in landfills, and the creation of decorative, attractive landscaping products.

REFERENCES

[1] Albano, C., Camacho, N., Hernandez, M., Matheus, A., and Gutierrez, A. (2009). "Influence of content and particle size of waste PET bottles on concrete behavior at different w/c ratios." Waste Manage. 29(10), 2707–2716.
[2] Al-Manaseer, A. A., and Dalal, T. R. (1997). "Concrete containing plastic aggregates." Concr. Int., 19(8), 47–52.
[3] Al-Salem, S. M., Lettieri, P., and Baeyens, J. (2009). "Recycling and recovery routes of plastic solid waste (PSW): A review." Waste Manage. 29(10), 2625–2643.
[4] By Karim S. Rebeiz, J Member, ASCE, Sleiman P. Serhal, 2 and David W. Fowler, 3 ASCE, Fellow (May 2015).
[5] Choi, Y. W., D. J. Moon, Y. J. Kim, and M. Lachemi. 2009. "Characteristics of mortar and concrete containing fine aggregate manufactured from recycled waste polyethylene Terephthalate bottles." Constr. Build. Mater. 23 (8): 28292835. https://doi.org/10.1016/j.conbuildmat.2009.02.036.
[6] Dunster, A. M., Moulinier, F., Abbott, B., Conroy, A., Adams, K., and 99999Widyatmoko, D. (2005). "Added value of using new industrial waste streams as secondary aggregates in both concrete and asphalt." R&D Rep., Banbury, Oxon, U.K., 1–13.
[7] European Plastics Industry Report. 2017. Plastics- the facts 2017: An analysis of European plastics production, demand and waste management, 1–41. Brussels, Belgium: PlasticsEurope.
[8] Fahad K. Alqahtani1; M. Iqbal Khan, M.ASCE2; Gurmel Ghataora3; and Samir Dirar4 (Dec. 2010).
[9] Feng Liu, Ph.D.1; Yong Yan2; Lijuan Li, Ph.D.3; Cheng Lan4; and Gongfa Chen, Ph.D. (Feb 2011).
[10] Fowler, D. W. (1989). "Future trends in polymer concrete." Special Publication 116- 8, Amer. Concrete Inst., Detroit, Mich., 129-143.
[11] Frigione. (2010). "Recycling of PET bottles as fine aggregate in concrete. "Waste Manage. 30(6), 1101–1106.
[12] Gurbir Kaur1 and Sara Pavia (June 2021).
[13] Hind M. AbdelMoti, Mustafa A. Mustafaa Materials and Nanotechnology Research Centre, Faculty of Engineering, University of Khartoum, Khartoum (Feb. 2019).
[14] M. Elzafraney1; P. Soroushian2; and M. Deru3 (April 2017).
[15] Md. Siddikur Rahman, Md. Bellal Hossain*, Reza Ruksana (May 2019).



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY