INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X

Impact factor: 4.295

(Volume 4, Issue 3)

Available online at: www.ijariit.com

Replacement of fine aggregate with plastic in concrete

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ABSTRACT

Recycled plastic aggregate used in a various proportion in the concrete mix and check their suitability. This study investigates the effects of using plastic waste as an alternative of Fine Aggregate. Disposal of plastic waste in the environment is considered to be a big problem due to the rapid growth of population in countries like India the disposing of solid waste is a major problem in our daily life. Solid waste management is one of the major environmental concerns. Among the waste material, plastic is the material that is the major concern to most of the environmental effects. There are different types of plastic which are classified on the basis of the physical property. As the plastic waste is nondegradable, it must be recycled or reused. The objective of the study is to study the behavior of the concrete which is made of the recycled plastic materials along with the study of the some of the physical properties that are related. In this study, M40 cement concrete is considered in which the recycled plastic waste is used as the replacement of fine aggregate in the concrete. Concrete cubes were cast taking 10%, 20%, 30 %, 40% & 50% of plastic as partial replacement of fine aggregate and tested for 7 & 28 days of compressive strength of concrete.

Keywords: *Waste plastic, Compressive strength, Workability.*

1. INTRODUCTION

Due to an increase of day to day disposal goods, waste disposal management has become a major environmental issue in the World. The use of plastic is consistently growing because of its versatility. The total plastic produced worldwide in 2014 was estimated at 313 million tones in 2015 it increased to 322 Mt, which is about 3% rise in 2 years. India consumption of Plastics will grow 15 million tons by 2015 and is set to be the third largest consumer of plastics in the world.

One of the new waste materials used in concrete industry is the recycled E-Plastic. For solving the disposal of large amount Recycled Plastic Material, the reuse of plastic in the Concrete industry is considered as the most feasible application. Recycled plastic can be used as coarse aggregate in concrete. Choi et al. studied the use of plastic waste PET bottles as aggregates on some properties of concrete. Their Results showed that decrease in weight using plastic waste was about 2-6% of the normal weight concrete while compressive strength reduced up to 33% compared with the compressive strength of normal Concrete.

This research aims to investigate the use of recycled plastic components of E-waste in construction applications. This is an alternative solution to administer the growing quantity of the E-waste. The properties of concretes containing various waste E-plastic particle contents were investigated in this study. Waste E plastic particles were derived from obsolete electrical and electronic equipment's, The strength properties of specimens were observed with the use of waste E-plastic in various percentages (0%, 10%, 20%, 30%, 40% and 50%).

Plastic Granules

The word "plastic" means substances which have plasticity, and accordingly, anything that is formed in a soft state and used in a solid state can be called a plastic. Therefore the origin of plastic forming can be traced back to the processing methods of natural high polymers such as lacquer, shellac, amber, horns, tusks, tortoiseshell. As well as inorganic substances such as clay, glass, and metals. Because the natural high polymer materials are not uniform in quality and lack mass productivity in many cases, from early times it has been demanded in particular to process them easily and into

better quality and to substitute artificial materials for natural high polymers. Celluloid, synthetic rubber, ebonite, and rayon are these artificial materials. Presently, it is defined that the plastic is synthesized in high polymers which have plasticity, and consequently, substances made of these natural materials are precluded.

2. LITERATURE REVIEW

Amula R.G, Azeef Ashraf,et al[1] In this study the behavior of the concrete which is made of the recycled plastic materials along with the study of the some of the physical properties that are related In concrete mix they replaced the fine aggregate by plastic in the ranges 0%, 10%,15%,20% & 25% and give the compressive strength of at each replacement level. And they concluded that compressive strength values of all waste plastic concrete mixture tend to decrease below the values for the reference plastic ratio at all curing ages.

Mastan Vali N, SS. ASADIet al[2] The goal of this paper to decide ideal quality and impact of utilization of reused PET as fractional substitution of the fine total in common Portland bond. In this study Concrete with 0%, 5%.10%, 15% and 20% PET containers waste for fine total were delivered and contrasted against blend and no substitution or 0% substitution. The 3D square examples and shaft examples of 45 no of each were thrown, cured and tried for 7days and 28days quality. The pressure and flexural quality were done and results were contrasted and control example. In light of the examination a relationship for the forecast of compressive quality and flexural quality of cement containing waste PET as a fine total substitution. The consequences of this examination merge the possibility of the utilization of pet container waste in the field of development particularly in the plan of cement. The utilization of PET containers waste due to reduced and light weight and in turn lessens the unit cement weight. The auxiliary solid individual weight from a building diminishment will lead to a reduction in building weight and reduce the seismic danger due to the earth shake drives directly reliant on the earth shudder strengths.

Zainab Z. Ismail, Enas A. AL-Hashmi et al[3] It Investigated the industrial activities in Iraq which are associated with significant amounts of non-biodegradable solid waste, waste plastic being among the most prominent. This study involved 86 experiments and 254 tests to determine the efficiency of reusing waste plastic in the production of concrete. Thirty kilograms of waste plastic of fibriform shapes was used as a partial replacement for sand by 0%, 10%, 15%, and 20% with 800 kg of concrete mixtures. All of the concrete mixtures were tested at room temperature. These tests include performing slump, fresh density, dry density, compressive strength, flexural strength, and toughness indices. Seventy cubes were molded for compressive strength and dry density tests, and 54 prisms were cast for flexural strength and toughness indices tests. Curing ages of 3, 7, 14, and 28 days for the concrete mixtures were applied in this work. The results proved the arrest of the propagation of micro cracks by introducing waste plastic of fabriform shapes to concrete mixtures. This study insures that reusing waste plastic as a sand-substitution aggregate in concrete gives a good approach to reduce the cost of materials and solve some of the solid waste problems posed by plastics.

Fahad K. Alqahtani , Gurmel Ghataora , M. Iqbal Khan, Samir Dirar et al[4] investigated Plastic waste and its low recycling rate make a significant contribution towards the pollution of the environment. It is therefore essential that plastic waste is utilized in different applications, such as aggregates in concrete. In this paper, an investigation of a manufactured plastic aggregate as a replacement for volcanic lightweight aggregate and Lytag aggregate in concrete is presented. The influence of replacement level on the fresh, hardened and microstructure properties of concrete was investigated. The slump, compressive strength, flexural strength, splitting tensile strength and elastic modulus decreased with the increase in replacement level. Neither the fresh density nor the hardened density was significantly affected by replacement level. The Lytag and conventional lightweight concrete mixes had a brittle failure; whereas the concrete mixes incorporating the manufactured plastic aggregate had a ductile post-peak behavior. The results suggest that the concrete mix containing the manufactured plastic aggregate at a replacement level of 25% can be used in structural and non-structural applications requiring moderate strength and ductility. Predictive models were proposed and demonstrated to be in good agreement with the experimental results for the mechanical properties of the concrete mixes incorporating the manufactured plastic aggregate.

Rafat Siddique, Jamal Khatib, Inderpreet Kaur et al [5] It found that This paper presents a detailed review about waste and recycled plastics, waste management options, and research published on the effect of recycled plastic on the fresh and hardened properties of concrete. The effect of recycled and waste plastic on bulk density, air content, workability, and compressive strength, splitting tensile strength, modulus of elasticity, impact resistance, permeability, and abrasion resistance is discussed in this paper. The use of waste products in concrete not only makes it economical but also helps in reducing disposal problems. Reuse of bulky wastes is considered the best environmental alternative for solving the problem of disposal. One such waste is plastic, which could be used in various applications. However, efforts have also been made to explore its use in concrete/asphalt concrete. The development of new construction materials using recycled plastics is important to both the construction and the plastic recycling industries.

Nabajyoti Saikia, Jorge de Brito, et al[6] have studied substantial growth in the consumption of plastic is observed all over the world in recent years, which has led to huge quantities of plastic-related waste. Recycling of plastic waste to produce new materials like concrete or mortar appears as one of the best solutions for disposing of plastic waste, due to its economic and ecological advantages. Several works have been performed or are under way to evaluate the properties of cement-composites containing various types of plastic waste as aggregate, filler or fiber. This paper presents a review on the recycling plastic waste as aggregate in cement mortar and concrete productions. For better presentation, the paper is divided into four different sections along with introduction and conclusion sections. In the first section, types of plastics and types of methods used to prepare plastic aggregate as well as the methods of evaluation of various properties of aggregate and concrete were briefly discussed. In the next two sections, the properties of plastic aggregates and the various fresh and hardened concrete properties of cement mortar and concrete in presence of plastic aggregate

are discussed. The fourth section focus on the practical implications of the use of plastic waste in concrete production and future research needs.

Nursyamsi, Syukur Berkat Zebua et al[7] investigated the details studies carried out on The use of substitute materials of concrete aggregates such as Industrial wastes and other aggregates, which are light, is being a concern. It is due to these materials can be a solution in order to manage wastes from industries and also to reduce the weight of building structures. This study utilizes Polyethylene Tetraphlate (PET) plastic waste ehich is light as coarse aggregate. The Coarse aggregate from PET plastic waste is the result of the PET heated to produce agglomeration, and then it is cooled and crushed into aggregates that have a variety of sizes with certain gradations. The purpose of this Study is to determine the Compressive strength of light concrete of PET plastic waste as Coarse aggregate and the influence of aggregate gradations towards the compressive strength of maximum compressive strength is achieved on the sample using the maximum fineness modulus of PET plastic waste aggregate. According to SNI 03-3994-2002, the weight and compressive strength of the Material should fit the standard. As the result, the gradation of a coarse aggregate of PET plastic waste can affect the compressive strength of light concrete.

3. OBJECTIVES

- To identify that plastic waste can be disposed of by using them as construction material.
- Replacement of plastic waste as fine aggregate.
- To limit the number of toxic substances in the certain plastic product.
- To determine the compressive strength of concrete containing a plastic aggregate.
- To reduce the overall weight of the structure.

4. METHODOLOGY

The main purpose of this project is to utilize recycled materials for the production of concrete. As disposal of plastic waste is not possible easily, they create an adverse impact on the environment. Reuse of plastic waste in concrete industry is considered as the most feasible application. It decreases the pollution of the environment and reduces the cost of materials.

Materials

- Cement
- Aggregates (coarse & fine)
- Water
- Plastic granules

1) Mix Proportion & Material Properties:

Reference concrete mixtures: Each mixture consisted of 695 kg/m3 sand, 1133 kg/m3 coarse aggregate, 465 kg/m3 cement and a W/C ratio of 0.4. These mixtures were of 0% waste plastic and were cured for 7 and 28 days. The plastic granule has 0.7826 specific gravity.

2) Preparation of Test Specimen:

The concrete specimen will be prepared in proper proportion and w/c ratio of 0.4. Twelve cubes specimens having dimensions (150 X 150 X 150) mm will be casted. The total cube specimens will be kept for curing period of 7 and 28 days before testing.

5. COMPARISON OF RESULTS

1) Results analysed by Amalu.R.G

Percentage Of Plastic	Compressive Strength (N/mm^2)
0%	24.44
10%	22.22
15%	21.11
20%	19.55
25%	17.55

2) Results analysed by Mastan Vali & SS Asadi

Percentage Of Plastic	Compressive Strength (N/mm^2)
0%	26.8
5%	29
10%	30
15%	28.5
20%	27

From the above results we can conclude that plastic can be use to replace some of aggregate in concrete mixture reduces the unit weight of concrete can be used as concrete panels in facades..

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