Study on the Partial Replacement of Pulverised Plastic as Fine Aggregate in Rigid Pavements

Vakkar[1] Er. Neeraj Kumar[2] Dr. R. K. Gupta[3]
[1]M. Tech Scholar [2]Head of the Dept. [3]Co- Guide
[1,2,3]Department of Civil Engineering
[1,2,3]SRMIET Ambala, India

Abstract— The Indian concrete industry is today consuming millions of tonnes of concrete every year and it is expected to increase further in upcoming years. All the materials required to produce such huge quantities of concrete come from the earth's crust, thus depleting its resources every year creating ecological strains. On the other hand, human activities on earth produce solid wastes in considerable quantities including industrial wastes, agricultural wastes and other wastes from rural and urban societies. Disposal of such solid wastes involves economic issues as well as ecological and environmental considerations. The plastic is one of the recent engineering materials which have appeared in the market all over the world. Some varieties of naturally occurring thermoplastics were known to Egyptians and Romans who extracted and used these plastics for various purposes. Plastics were used in bath and sink units, corrugated and plain sheets, floor tiles, joint less flooring, paints and varnishes and wall tiles. There has been a steep rise in the production of plastics in last 30 to 40 years. Major part of total waste is plastic products, which deserves special attention on account of non- biodegradable property which is creating a lot of problems in the environment. There is however now increase in awareness regarding the utilization of plastic as a useful building material in our country.

Keywords: Rigid Pavements, Fine Aggregate, Partial Replacement

I. INTRODUCTION

A rigid pavement is constructed from cement concrete or reinforced concrete slabs. The design of rigid pavements is based on providing a structural cement concrete slab of sufficient strength to resist the load from traffic. The main difference between a rigid pavement and flexible pavement is the strength and durability due to wearing course i.e. the top most layer of concrete. But the strength and durability of concrete can be changed by making appropriate changes in its ingredients like cementious material, aggregate and water and by adding some special ingredients. Hence concrete is very well suitable for a wide range of applications.

The use of concrete in road construction is increasing day by day due to high strength and long lasting life of rigid pavements. The most widely used fine aggregate for the making of concrete is the natural river sand mined from the riverbeds. Due to the depletion of river bed it has also become expensive. The high and increasing cost of these materials has forced us to identify any other cheaper and locally available substitute material for river bed sand.

In order to combat the scarcity of sand and the increase in cost of concrete under these circumstances the use of plastic wastes like plastic bottles, waste electrical and electronic equipments, plastic foams, rigid plastics, such as crates, pipes and mouldings came into use.

II. LITERATURE REVIEW

A number of research works have been attempted on the use of pulverized plastic in rigid pavements. The summary of few of them is as follows:

Lakshmipathy et. al. (2004) [1] have done experimental investigations to study the suitability of the use of re-engineered plastics as fibres for road pavements. The properties studied include compressive strength, tensile strength, flexural strength under reversed cyclic loading, impact resistance, plastic shrinkage and abrasion resistance etc. The results have shown that the improvement of concrete properties at lower cost is obtained with re-engineered plastic shred reinforced concrete.

M. Sivaraja et. al. (2010) [2] in his paper "Mechanical Strength of Fibrous Concrete with Waste Rural Materials" focuses on various mechanical properties of concrete specimens made by mixing the plastic fibers in concrete. The volume fraction of waste was varied from 0. 5% to 1.5%.

Venu Malagavelli, Rao. P. N. (2010) [3] in his paper "Effect of non bio degradable waste in Concrete slabs" describes about the polyethylene (PET) bottle which can easily be obtained from the environment with almost no cost is shredded and added into ordinary concrete to examine the strength behaviour of various specimens. Also the plastic waste is found to have no water absorption (based on literature) and hence corrosion control analysis was also done. It was observed that the compressive strength increased up to 2% replacement of the fine aggregate with PET bottle fibres and it gradually decreased for 4% and 6% replacements. Hence replacement of fine aggregate with 2% replacement will be reasonable.

R. N. Nibudey et. al. (2013) [4] in his paper "Strength And Fracture Properties of Post Consumed Waste Plastic Fibre Reinforced Concrete" seeks to optimize the benefits of using post consumed waste PET bottles in the fibre form in concrete (WPFRC).The post consumed waste mineral water plastic bottles are shredded into fibre of specific size and shape. Several design concrete mixes with different percentages (0 % to 3 %) of waste plastic fibres for two aspect ratios, are casted into desire shape and size as per requirement of the tests. Each specimen was cured for 28 days.

P. Suganthy et. al. (2013) [5] in his paper "Utilization of Pulverized Plastic in Cement Concrete as Fine Aggregate" focussed the use of HDPE (high density polyethylene) as it was easily available and had higher density than other types. The used plastics were collected, ground into smaller components, melted and pulverized in order to get granules of plastic of about 1mm size. The density of pulverized plastic was found to be 460 kg/m3 and its

specific gravity was 0.46. Sieve analyses were carried out and about 75% of the plastics were found to be in the range of 1-1.7mm. Cement concrete cubes of 1:1:2 mix were cast for 0%, 25%, 50%, 75%, and 100% sand being replaced with pulverized plastic material.

III. OBJECTIVES

1) Design mix for M40 follows IS - 10262 -2009.
2) As partial substitute for the fine aggregate (sand) in pavement quality concrete mixes.
3) To determine the percentage of plastic which gives more strength or comparatively equal strength to control concrete.
4) This study will help in the safeguarding of environment by reducing plastic waste.

IV. FUTURE SCOPE

The results of case study can be used for better assessment of plastic waste in road and building industry

1) Plastics can also be utilized in flexible pavements as additive in bitumen mix.
2) Other wastes generated from environment can also be used as additives.

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