Utilization of E-Plastic Waste And Construction Demolished Waste In Concrete

Mr. Rahul Sen[1], prof. Rajesh Joshi [2]
[1, 2] Dept of Civil Engineering (construction technique & mgt)
[1, 2]Rajeev Gandhi Proudyogiki Mahavidyalya Bhopal

Abstract- *Concrete is most widely used man made construction material in the world. Concrete is a composite material that consists essentially of a binding medium within which are embedded particles or fragments of aggregate. In hydraulic- cement concrete, the binder is formed from a mixture of hydraulic cement and water (Mehta & Montario). Concrete in the broadest sense, is any product or mass made by the use of a cementing medium. Generally this medium is the product of reaction between hydraulic cement and water. But, these days, even such a definition would cover a wide range of products: concrete is made with several types of cement and also containing pozzolana, fly ash, blast-furnace slag, micro silica, additives, recycled concrete aggregate, admixtures, polymers, fibres, and so on, and these concretes can be heated, steam-cured, autoclaved, vacuum-treated, hydraulically pressured, shock-vibrated, extruded, and sprayed. The mixture when placed hardens into rock like mass known as concrete. The hardening is the result of the chemical reaction between cement and water which continues along with the time as a result concrete hardens with ages. The matrix of concrete is very simple the larger aggregates called as coarse aggregate (size range between 40mm to 4.75mm) have voids which are filled by sand or fine aggregate (size range between 4.75mm to 75μ), the voids of fine aggregates are been filled by cement and water paste. In addition to filling the voids the cement water paste also coats the surfaces of fine and coarse aggregate and binds them together in the compacted solid mass.*

The consumption of concrete is increasing day by day as a result of this natural aggregates are been depleted at a vast rate , to serve the growing demand the rocks are crushed and river beds are mined at a rapid rate for the supply. Moreover Natural or River sand are weathered and worn out particles of rocks and are of various grades or sizes depending upon the amount of wearing. Now-a-days good sand is not readily available; it is transported from a long distance. Those resources are also exhausting very rapidly. So it is a need of the time to find some substitute to natural river sand. On the other hand due to rapid industrialization and development many non-biodegradable wastes are been generated. Problem arises in treating them and if left or land filled can cause serious environmental issues. The alternate way is to use this industrial waste in concrete construction as per their suitability which will serve dual benefits; save pollution and exploitation of natural resources.India is a developing country and the need of infrastructure demand is increasing at a larger extent. This demand to be fulfilled requires a large quantity of resources as aggregate, sand, cement etc. As these materials which were at abundance at some time are going to be finish in near future due to increase in the intervention of mankind.

In addition to the global opportunities for advances in technology, India in particular, has a need for developing technologies in building construction that provide employment opportunities for local inhabitants in developing areas. Labour intensive construction requires technical soundness and economic competitiveness for these initiatives to be successful.

Against this backdrop of opportunity and challenge, research dissertations into utilization of waste materials in construction purposes have been structured. This chapter introduces the plastic and demolished waste material highlighting the advantages and disadvantages. In addition the chapter provides the background of mix design procedures for concrete mixes. Finally and most important, the objectives of the research dissertation are detailed.

I. INTRODUCTION

The construction industry in India is booming. Already at 10 per cent of the GDP, it has been growing at an annual rate of 10 per cent over the last 10 years as against the world average of 5.5 per cent per annum. Almost 70 per cent of the building stock in India is yet tocome up. The built-up area is expected to swell almost five times from 21 billion sq ft in 2005 to approximately 104 billion sq ft by 2030. This immense surge will have fallouts. Buildings are at the core of all our demands water, energy and material — but they also create waste. This waste, generated in the construction, maintenance and disposal phases of a building, is called construction and demolition (C&D) waste. This includes waste from demolished structures, renovations in the real estate sector and construction and repair of roads, flyovers,

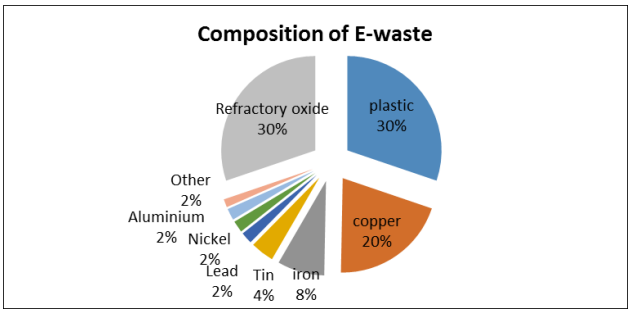
bridges, etc. To this is added the enormous debris that follows disasters such as during the Uttarakhand floods in 2013.

E-Plastic Waste

E-waste is one of the fastest growing waste streams today and is growing almost three times the rate of municipal waste. Electronic devices have their limited life period; they become waste. Globally E- waste is growing to 40 million tons every year. In developed countries the E-waste comprises of 1-2% of total municipal solid waste (MSW) generation. In India E-waste generation increases at a rapid growth of 15 % and was expected to cross 800,000 tons per year in 2012. E-waste consists of all waste from electronic and electrical appliances which have reached their end- of- life period or are no longer fit for their original intended use and are destined for recovery, recycling or disposal.

E-waste or electronic waste, therefore, broadly describes loosely discarded, surplus, obsolete, broken, electrical or electronic devices.

Composition of E-Plastic Waste



Objectives Of The Study

- Following are the objectives of the research work:
- To find an alternative for dumping of waste plastic.
- To protect environment from PCB's hazardous waste.
- To develop paving grade concrete using construction demolished waste.
- To increase the strength and durability properties of concrete using e-plastic waste. To save natural aggregates for future needs.

II. MATERIALS USED AND METHODOLOGY ADOPTED

Cement :

Ordinary Portland Cement (OPC) of 43 grade is taken for this project, which was manufactured in 2nd week of January 2015 as per Indian Standards of OPC 43 Grade cement i.e. IS: 8112-1989. Testing of cement as per Indian Standard codes of individual testing is shown in Table

Physical Properties of cement

S.No	Properties	Cement
1	Specific Gravity	3.16
2	Standard Consistency (%)	29%
3	Initial Setting Time (min)	117
4	Final Setting Time (min)	408
5	Compressive Strength (MPA)	44.16

Physical Properties of Sand

S.No	Properties	Result for sand
1	Water Absorption	1.21%
2	Specific Gravity	2.63
3	Apparent Specific Gravity	2.64
4	Bulk Density	1.512
5	Fineness Modulus	2.14

E-Plastic Waste Powder

E-Plastic waste or electronic plastic waste is collected from local waste area. This waste comprises of TV, radio, CD, mobile phones, chairs plastic, waste plastic toys etc. This waste is collected, segregated, dis-mantled and crushed to powder form. This E-Plastic waste is used in this project in replacement with fine aggregates.

Physical Properties of E-Plastic Waste Powder

S.No	Properties	E-Plastic Powder
1	Color	Light green
2	Specific Gravity	1.91
3	Water Absorption (%)	2.42%
4	Fineness Modulus	1.48
5	Bulk	0.76

Course aggrgate

The available coarse aggregate is of two types: a) on basis of size as 20mm and 10mm, b) on basis of source as natural and C & D waste. These two aggregates are tested to know there various physical properties such as size, toughness, hardness etc. these aggregates were tested as per their respective Indian Specifications to ensure the quality of the aggregate and their acceptance or rejection criteria for their use.

Water

Water used in concrete mix is potable water conforming the specification of IS 456:2000. Water used for mixing is free from injurious amount of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete.

Mix Design

In the view of mix design it is always a difficult task to address its performance. It is because of a number of diversities including:

- The variety of ways in which the performance of material can be calculated for example durability, fatigue life etc.
- Problems in finding the mode of failure of material and mechanism for it.
- The different types of mix properties and material properties that can affect performance e.g. binder content, material solidity, gradation of aggregate etc.
- External factors as climate, traffic frequencies, loading intensity etc.

More important the time and cost analysis modelling involved in long term planning.

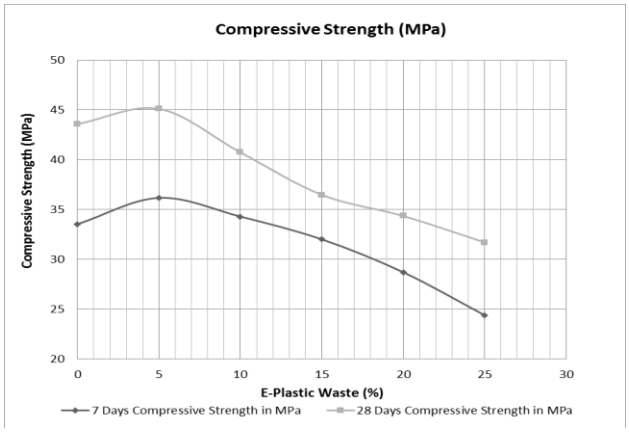
Principal of Concrete Mix Design

The concrete mix design is based on the principles of: Workability of fresh concrete.

- Desired strength and durability of hardened concrete which in turn is governed by water-cement ratio law.
- Conditions at the site, which helps in deciding workability, strength and durability requirements.

Experimental Work

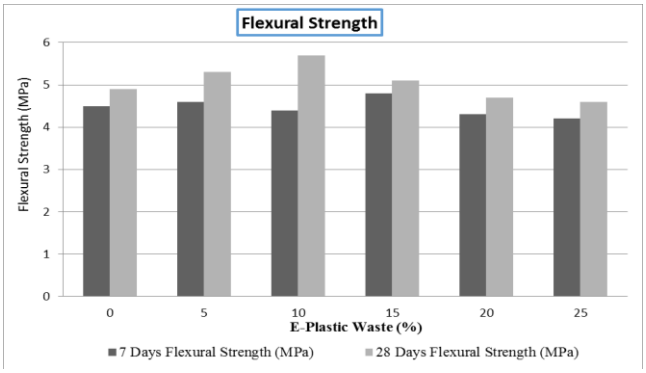
Compressive Strength Test



Tensile Strength Test

Concrete is known for its compressive strength and weak tensile strength but it's important to know the tensile strength as tensile stress are likely to develop in concrete due to drying shrinkage, rusting of reinforcement, temperature gradient and many such reasons, so it's important to have knowledge of tensile strength of concrete. In case of concrete slab the tensile stress are developed by two principle sources, load and volume change in concrete. Loads may cause high tensile stresses due to bending when inadequate support is there. Volume changes are due to changes in moisture and temperature generally called as warping stress.

Flexure Strength Test



Split Cylinder Test

It is the standard test, to determine the tensile strength of concrete in an indirect way.

This test could be performed in accordance with IS: 5816-1970. A standard test cylinder of concrete specimen (300 mm X 150mm diameter) is placed horizontally between the loading surfaces of Compression Testing Machine (Fig-4). The compression load is applied diametrically and uniformly along the length of cylinder until the failure of the cylinder

along the vertical diameter. To allow the uniform distribution of this applied load and to reduce the magnitude of the high compressive stresses near the points of application of this load, strips of plywood are placed between the specimen and loading platens of the testing machine. Concrete cylinders split into two halves along this vertical plane due to indirect tensile stress generated by poisson's effect.a uniform lateral tensile stress of **ft** acting along the vertical plane causes the failure of the specimen, which can be calculated from the formula as,

ft = 2P/πDL where,
ft = Lateral Tensile Stress,

P= Compressive Load at failure D= Diameter of Cylinder
L= Length of Cylinder

III. RESULTS AND DISCUSSIONS

The results of the study are discussed below:

- The crushing value, impact value and the abrasion value of the C & D waste aggregates is found to be more than the natural aggregate and for e-plastic waste it was less than the natural aggregate.
- The specific gravity of e-plastic waste is found to be less than the natural aggregate and highest for the C & D waste aggregates.
- Water absorption of the C & D waste aggregate is found to be higher than the natural aggregate but lower than the e-plastic waste powder.
- The physical properties of aggregates increased with the increase in percentage of the C & D waste in natural aggregate. The increase is found up to 30% replacement of natural aggregate with C & D waste aggregates.
- The workability of the concrete increases with the increase in the percentage of e-plastic waste and C & D waste aggregates.
- The compressive and tensile strength of the concrete increases with increase in the percentage of e-plastic up to 5% after which the strength decreases.
- In the tensile test the strength of the beam increases up to 10% e-plastic waste content and further decreases.
- Finally, the mix containing 30% C & D waste and 5% E-Plastic waste is found to be optimum with highest strength.

IV. CONCLUSIONS

Based on the study, following conclusions have been drawn:

- Physical properties of the C & D waste aggregates in combination with the natural aggregates show the suitability of these aggregates for construction and maintenance purposes.
- The workability of E-Plastic based concrete with mixed C & D and natural aggregate is observed to be less than control mix concrete. The reduction in workability was observed with increase in percentage of e-plastic waste.
- Compressive strength of concrete with 5% e-plastic waste powder with mixed C & D and natural aggregate is higher than control mix. On increasing e-plastic the strength reduces further.
- Flexural strength increases with increase in percentage of e-plastic powder up to 10%.
- Water absorption and percentage voids increases and density decreases with increase in e-plastic waste powder.
- The overall result states that on replacing coarse aggregate with 5% E-Plastic Waste Powder and 30% C & D waste aggregate the properties of concrete are enhanced so it can be used as additive to enhance the property of concrete.
- Introduction of plastics in concrete tends to make concrete ductile, hence increasing the ability of concrete to significantly deform before failure. This characteristic makes the concrete useful in situations where it will be subjected to harsh weather such as expansion and contraction, or freeze and thaw.
- The inclusion of recycled aggregates in the concrete of the buildings under investigation has been shown to be advantageous from an energy point of view. The use of plastic aggregates helped in keeping the interior cooler, when the outside temperature is raised, as compared to the corresponding control concrete.

V. FUTURE SCOPE

- In general, use of Construction and Demolition Waste and E-Plastic Waste in concrete is an environmental friendly approach which enhances the property of concrete mix up to certain level of replacement. Use of E-Plastic Waste is a solution for the global problem of recycling plastic waste. It is an approach to reduce pollution, carbon foot print and land filling of waste without compromising with the

properties of concrete. Some researchers have done research to utilize this waste in various fields.

- Researches related to utilization of C & D waste in combination with E-Plastic Waste are not much done till now and needs attention in this direction. There is a vast scope of this powder in the field of light weight non load bearing structures like false roofing, lintels, roofing and many such areas. Study related to effect of this waste on higher as well as low grade concrete also requires attention. Other than concrete application of this waste in soil stabilization, flexible pavement, sub base preparation etc. can be approached.

REFERENCES

[1] Indian Standard "SPECIFICATION FOR ORDINARY AND LOW HEAT PORTLAND CEMENT", IS 8112: 1989, Bureau of Indian Standards, New Delhi.

[2] Indian standard METHODS OF TESTS FOR AGGREGATES FOR CONCRETE, IS 2386(Part I,II,III, IV)-1963, Bureau of Indian Standards, New Delhi.

[3] Indian Standard Specification for "PLAIN AND REINFORCED CONCRETE", IS 456:2000, Bureau of Indian Standards, New Delhi.

[4] Indian standard "METHOD OF TEST FOR STRENGTH OF CONCRETE", IS: 516-1959, Bureau of Indian Standards, New Delhi.

[5] Indian standard "METHOD OF SAMPLING AND ANALYSIS OF CONCRETE", IS: 1199-1959, Bureau of Indian Standards, New Delhi.

[6] Indian standard "RECOMMENDED GUIDELINES FOR CONCRETE MIX DESIGN",IS: 10262-1982, Bureau of Indian Standards, New Delhi.

[7] Indian standard "CONCRETE MIX PROPORTIONING-GUIDELINES", IS: 10262-2009, Bureau of Indian Standards, New Delhi.

[8] Indian standard "STANDARD SAND FOR TESTING CEMENT", IS: 650-1991, Bureau of Indian Standards, New Delhi.

[9] Indian standard "METHOD OF TEST FOR ABRASION RESISTANCE OF CONCRETE", IS: 9284-1979, Bureau of Indian Standards, New Delhi.

[10] Indian standard "SPESIFICATION OF COARSE AND FINE AGGREGATES FROM NATURAL SOURCE FOR CONCRETE", IS 383-1970, Bureau of Indian Standards, New Delhi.

[11] Indian standard "METHOD OF TEST FOR SOILS PART VII DETERMINATION OF WATER CONTENT-DRY DENSITY RELATION USING LIGHT COMPACTION", IS: 2720-1959 (part VII), Bureau of Indian Standards, New Delhi.

[12] Indian standard "METHOD OF PHYSICAL TEST FOR HYDRAULIC CEMENT", IS: 516-1959 (part I,II,III,IV,V), Bureau of Indian Standards, New Delhi.

[13] "GUIDELINES FOR CEMENT CONCRETE MIX DESIGN FOR PAVEMENTS (SECOND REVISION)", IRC: 44-2008, Indian Road Congress, New Delhi.

[14] "GUIDELINES FOR THE DESIGN OF PLAIN JOINTED RIGID PAVEMENTS FOR HIGHWAYS (Third Revision)", IRC: 58-2011, Indian Road Congress, New Delhi.