A STUDY ON EFFECTIVE USE OF WASTE PLASTICS IN CONCRETE BLOCKS

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ABSTRACT: *We have made an experiment by partially replacing fine aggregate and coarse aggregate with plastic powder and ceramic waste respectively. The strength properties of M20 grade concrete are studied with different plastic powder and ceramic waste percentage proportions. The proportions are 15% of plastic powder, 15% of ceramic waste and 20% of plastic powder,20% of ceramic waste are replaced with fine and coarse aggregate by volume.We studied strength properties of these mixes. There is increase in compressive strength when the ratio of plastic and ceramic to fine and coarse aggregate respectively was minimum. The workability of the concrete mixhas been increased. Based on the test results we can suggest that the plastic and ceramic can be used as alternative material within the small replacement proportions.*

1. INTRODUCTION

Concrete consists of cement, coarse and fine aggregates mixed with water. The cement and water form a paste or gel which coats the fine and coarse aggregate. When the cement has chemically reacted with the water, it hardens and binds the whole mix together. The worldwide production of concrete is 10 times that of steel by tonnage. These wastes (plastic) are almost nondegradable in the natural environment even after a long period of exposure. So, plastic waste is now a serious environmental threat to the modern way of living. It is not feasible to use waste plastic for land filling, which require huge land space area and as well land loses its fertility. It also causes serious problems such as clogging in drainage system, wastage of resources and environmental pollution. In this consequence, big attention is being focused worldwide on the environment and safeguarding the natural resources through recycling of waste plastic materials in the recent years.

AIM AND OBJECTIVES

AIM: The aim is to evaluate the use of waste plastics (plastic powder & ceramic waste) as partial replacement for fine aggregates and coarse aggregates in concrete

OBJECTIVES: The specific objectives are to:

- To analyze the properties of plastic powder as fine aggregate and ceramic waste as coarse aggregate.
- To test the properties of concrete using plastic powder as fine aggregate and ceramic waste as coarse aggregate.
- To prepare different mixes of concrete with replacement fine aggregate with plastic powder and ceramic waste as coarse aggregate.

2. LITERATURE REVIEW

Ramadevi [2012] conducted an experimental investigation on the propertiesof concrete with plastic PET (bottle) fibers as fine aggregate. Concrete with 2%, 4% and 6% PET bottle fibers replacement for fine aggregate wereproduced and compared against control mix with no replacement. Thecompressive and the tensile strength of the replaced concrete were higher when compared with the normal concrete.

Silva [2013] conducted experiment on the effect of curing conditions on the durability of concrete mixes containing plastic waste aggregates. Concrete mixes were prepared by replacing 0%, 7.5% and 15% of natural aggregates with plastic - polyethylene terephthalate (PET). Tests are done for shrinkage, water absorption by immersion, water absorption by capillarity action, carbonation and chloride penetration. The sensitivity analyses showed thatthe properties of concrete mixes containing

plastic aggregates generally deteriorate less than those of conventional concrete, when subjected to progressively drier curing regimes.

Guendouz [2016] conducted experiments on properties of the concrete by replacing fine Aggregate with plastic waste at different proportions 10%, 20%, 30%& 40% respectively. The results states that the replacement of sandcontributes to reduce the bulk density, decreases the air content causing an increase a compressive and flexural strength. In addition the reinforcement of the cementing matrix with plastic fibers induced a clear improvement of the tensile strength. The reusing waste plastic in sand concrete gives positive approach to reduce the cost of materials and solve some environmental problems.

3. MATERIALS AND METHODS

Materials

1.Cement (OPC53 grade conforming to IS 8112) 2.Coarse aggregates and fine aggregates
3. Plastic powder 4.Ceramic waste

ORDINARY PORTLAND CEMENT[OPC]: Ordinary Portland cement is the most common type of cement used in making concrete around the world for infrastructure development. It is a mixture of fine lime powder and clay minerals produced in a kiln to form ac linker which will be grinded to fine particles and finally added gypsum ofabout2- 3%. OPC will be grey in colour

COARSE AGGREGATE: The coarse aggregate is generally quarried rock from ground deposits. The size of coarse aggregate used in concrete generally is in the range of 4.75mm to 80 mm. The coarse aggregate is the reason beyond the strength of concrete. The coarse aggregate is different shapes generally like round, flaky, angular etc. The nominal size of aggregate used in this experiment is 20mm and angular shaped.

FINE AGGREGATE: Fine aggregate (sand) fills voids between aggregates. It forms the bulk and makes mortar or concrete economical. It provides resistance against shrinking and cracking. It is naturally available. The aggregates passing through 4.75mm sieve and retained on 0.15 mm sieve are called fine aggregates. Different size of sand is necessary for different works. For sand some terms like fine sand, medium sand, and coarse sand are used. It is difficult to distinguish one type of sand from others.

CERAMIC WASTE: After the demolition of the building the waste left out. The used in any building are made up of ceramic material. These tiles can be used as waste ceramic material replacement of coarse aggregate. The ceramic waste tiles have been collected from construction waste is taken then it is broken down into small pieces by hammering. These small ceramic waste pieces can be used for the replacement of coarse aggregate.

Fig 1: Ceramic waste

Fig 2: Plastic powder

PLASTIC POWDER: There is huge amount of plastic water bottles are disposed in different areas in our surroundings. The waste plastic bottles are converted into plastic powder. Initially the plastic water bottles will be cutting into small pieces then it is converted into powder form. This plastic powder is used as material for replacement of fine aggregate.

FOR M20 GRADE CONCRETE MIX PROPORTIONING

Cement = 345.45 kg/m^3 Water = 190 kg/ m^3 sand = 607.36 kg/m^3
Coarse aggregate = 792.82 kg/m^3 Plastic powder = 64.12 kg/m^3 Ceramic waste = 134.08 kg/m^3
Chemical admixture = 7.2 kg/m^3 Water cement ratio= 0.55

Final mix ratio: Cement: fine aggregate: coarse aggregate: water = 1:1.943:2.683:0.55

4. TESTS ON FRESH AND HARDENED CONCRETE

Workability tests like slump test, compaction factor test were administered for fresh concrete as per IS specifications. Compression strength test and split tensile strength on were administered at the age of 14 days, 28 days as per IS specifications.

SLUMP CONE TEST: Slump test is the most commonly used method of measuring consistency of concrete which can be employed either in laboratory. If the concrete slumps evenly it is called true slump. If one half of the cone slides down, it is called shear slump. In case of a shear slump, the slump value is measured as the difference in height between the height of the mould and the average value of the subsidence.

Fig 3: Slump Cone Test

COMPACTION FACTOR TEST: The compaction factor test is used for concrete which have low workability for which slump test is not suitable. The compacting factor test is performed to ascertain the workability of the concrete. The compaction factor is defined as the ratio of the weight of partially compacted concrete to the weight of fully compacted concrete.

Fig 4: Compaction Factor Test

COMPRESSIVE STRENGTH TEST: The compressive strength of the concrete cube test provides an idea about all the characteristics of concrete. By this single test one judge that whether Concreting has been done properly or not.

Fig 5: Compressive Testing Specimen size: Cubes (15cm X 15cm X 15cm).

Pouring concrete in moulds: Clean the moulds properly and finish it with oil so that concrete willnot stick into the mould and make latter cleaning difficult. Put concrete in the moulds layer by layer. Each layer is around 5 cmthick. Each layer is compacted with a tamping rod [35 strokes]. Level the top surface with a trowel.

Curing: Test specimens are kept in the moulds and stored in moist air for 24 hours and then, the

specimens are removed from the moulds and submerged infresh water for the specified curing period.

SPLIT TENSILE TEST: The tensile strength of concrete is one of the basic and important properties which greatly affect the extent and size of cracking in structures. Moreover, the concrete is very weak in tension due to its brittle nature. Hence. it is not expected to resist the direct tension. So, concrete develops cracks when tensile forces exceed its tensile strength.
Therefore, it is necessary to determine the tensile strength of concrete to determine the load at which the concrete members may crack. Furthermore, splitting tensile strength test on concrete cylinder is a method to determine the tensile strength of concrete.The procedure based on the ASTM C496 (Standard Test Method of Cylindrical Concrete Specimen) which similar to other codes like IS 5816 1999.

Fig 6: Split Tensile testing machine

5. DISCUSSIONS AND CONCLUSIONS

The present study aimed the use of two types of wastes (plastic powder and ceramic waste) as partial replacement of fine and coarse aggregate in concrete;

a. Plastics (plastic powder and ceramic waste) can be used to replace some of the aggregate in a concrete mixture as it contributes to reducing the unit weight of the concrete, due to low density of plastics as compared to the density of fine aggregates.

b. It was observed in the result that the slump decreases with increase in the percentage of plastic (plastic powder and ceramic waste), due to the fact that some particles are angular and others have non-uniform shapes resulting in less fluidity.

c. The recycled plastic (plastic powder and ceramic waste) aggregates can be used up to 15% replacement of fine aggregates in the concrete mixture.

d. The use of waste plastic (plastic powder and ceramic waste) in cement based composite can significantly reduced cost of construction through full or partial replacement of aggregates.

e. The used of waste plastics (plastic powder and ceramic waste) in constructions will grossly reduced rate of solid waste accumulation in the environment and income will be generated from its utilization.

6. REFERENCES

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