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Study on the Performance of Plastics as Replacement for Aggregates

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***Abstract*— Solid waste management is of the major environmental concern in our country now a days. The use of plastics is increasing day by day, although steps were taken to reduce its consumption. Dumping or disposal of these waste products causes environmental and health issues. This creates substantial garbage every day which is much unhealthy. A healthy and sustainable reuse offers a host of advantages. This project is to be considered as an approach to a more extensive investigation on the use of plastic aggregate as replacement for coarse aggregates in concrete. In the present work studies were conducted by adding different percentages of plastic aggregates (0%, 10%, 15%, 20%, 25%) to find the optimum percentage and also to determine the performance of plastic aggregates on concrete. Studies are done on to determine mechanical and durability properties of concrete containing plastic aggregates and its suitability as a construction material. Also properties of concrete mix with plastic aggregates was studied and compared with control mix with normal aggregates.**

Keywords- Plastic Aggregates, Superplasticizer, Concrete, Optimum Percentage, Compressive Strength, Flexural Strength, Split Tensile Strength

I. INTRODUCTION

A 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. Plastic is an organic hydrocarbon-based material, its high calorific value can be used for incineration or in other high temperature processes. But, burning of plastics releases a variety of poisonous chemicals into the air, including dioxins, one of the most toxic substances. Plastic waste can also be used to produce new plastic based products after processing.

A new revolution, a new movement, a new awareness is spreading across the world. Governments and organizations are working together to find solutions for a greener future, while prospective zero – carbon sustainable cities are already underway. Recycling of plastic waste in concrete appears as one of the best solution for disposing of plastic waste, due to its economic and ecological advantages.

Fig 1: Accumulation of plastics

Rapid industrialization and large scale infrastructural development results in the huge scarcity of construction materials.Thus addition of waste apart from the environmental benefits, also provides an alternative for the use of aggregates in concrete mix. Several works have been performed to evaluate the properties of cement-composites containing plastic waste as aggregate. This paper presents a review on the recycling plastic waste as aggregate in concrete productions.

Plastics are polymers having a number of vital properties, which makes a significant and expanding contribution to constructional needs.

- Durable and corrosion resistant.
- Good Insulation for cold, heat and sound saving energy.
- It is economical and has a longer life.
- Maintenance free (such as painting is minimized)
- Hygienic and clean
- Ease of processing / installation
- Light weight

II. EXPERIMENTAL INVESTIGATION

A. Material properties

i) Cement: Portland slag cement to determine the properties. Laboratory test were conducted to determine the properties of cement.

ii) Fine Aggregate: Locally available river sand passing through 4.75 mm IS sieve was used for the experiments. Laboratory tests were conducted to determine different physical properties as per IS 383 (Part III)-1970. Sieve analysis was done to determine the grain size distribution of river sand. Specific gravity of fine aggregate is 2.7 and grading zone is I.

iii) Coarse Aggregate: For proper gradation, combination of 12.5 mm and 20 mm aggregates are used. Laboratory tests were conducted to determine the different physical properties as per IS 383 (part III)-1970.specific gravity of coarse aggregate is 2.8.

iv) Plastic Aggregates: Plastic aggregates represent the discarded waste from plastic covers that were collected from the disposal area and it was then melted and shredded into specific sizes using shredding machines.

Fig 2: Plastic aggregates

Table 1: Properties of plastic aggregates

Specific gravity	2.1

v) Mixing water: Clean drinking water available was used for casting as well as curing of the test specimens.

vi) Super plasticizer: Super plasticizer used was MasterGlenium sky 8233. This increases the workability of concrete drastically and also facilitates excellent retention of workability.

Table 2: Properties of Superplasticizer

Supply form	Liquid
Colour	Brown
pH	≥6
Chloride iron content	< 0.2%

B. Mix Proportion

The final proportion was 1:1.5:3 (cement: fine aggregate: coarse aggregate) with w/c of 0.5.

III. PROPERTIES OF CONCRETE

A. Fresh Properties of Concrete

i) Workability of concrete

Slump test was done to measure the workability of concrete. Based on IS: 1199 – 1959.

B. Mechanical properties of hardened concrete

i) Compressive strength of hardened concrete

The compressive test is carried out on specimens cubical in shape having a size 15x15x15cm. The compression tests were conducted after 7 days, 28 days. The test was conducted according to IS specifications.

Fig 3: Compression test of concrete cube

ii) Flexural strength of hardened concrete

The flexural strength was conducted with optimum percentage of plastic aggregate on the universal testing machine using beams of 15x15x70cm. The test was conducted according to IS 516-1989.

Fig 4: Determination of flexural strength of beam

iii) Split tensile strength

For finding split tensile strength of concrete three cylinders of size 150x300mm were made and stored in the curing tank for specified time period.

Fig 5: Determination of split tensile strength of cylinder

IV. RESULTS AND DISCUSSION

A. *Optimum percentage of plastic aggregates*

Determined the 7th and 28th day compressive strength of concrete with 0 to 25% of plastic aggregates.

Optimum percentage of plastic aggregates in concrete is obtained as 15%.

B. *Workability of concrete*

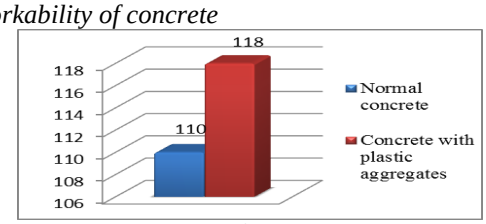

Fig 6: Slump value for concrete mix

C. *Compressive strength of hardened concrete*

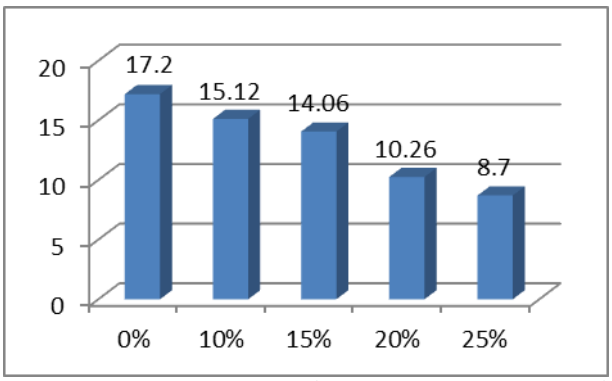

Fig 7: 7 day compressive strength of concrete containing various % of plastic aggregates

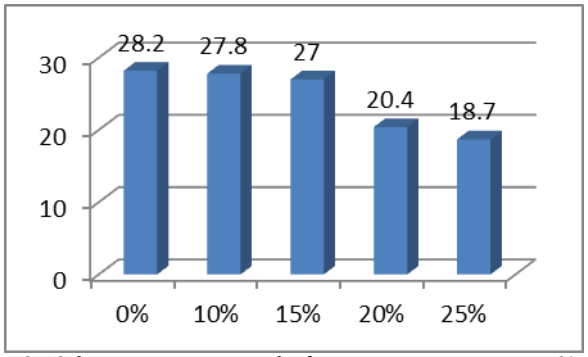

Fig 8: 28 day compressive strength of concrete containing various % of plastic aggregates

On comparing the normal concrete with concrete containing plastic aggregates showed 4.3% decrease in compressive strength.

D. *Flexural strength of hardened concrete*

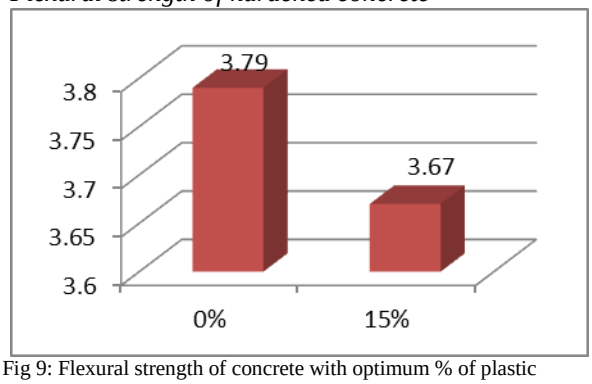

Fig 9: Flexural strength of concrete with optimum % of plastic aggregates

On comparing the normal concrete with concrete containing plastic aggregates showed 3.2% decrease in tensile strength.

E. *Split tensile strength of concrete*

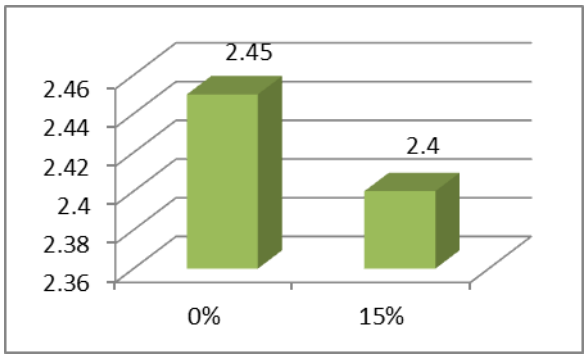

Fig 9: Split tensile strength of concrete with optimum % of plastic aggregates

Comparing the split tensile strength of normal concrete with concrete containing plastic aggregates showed 2% decrease.

V CONCLUSION

The strength values of plastic concrete mixer tend to decrease with the addition of greater percentages of plastic aggregates. This may be attributed to the decrease in the adhesive strength between the surface of plastic aggregates and cement paste. In addition plastic is hydrophobic material which does not take part in hydration.

On comparing normal concrete mix with concrete containing optimum percentage of plastic aggregates showed better strength characteristics. Thus aggregates in concrete can be effectively replaced using plastic aggregates.

REFERENCES

[1] Nabajyoti Saikia , Jorge de Brito, Use of plastic waste as aggregate in cement mortar and concrete preparation, 2012.

[2] Zainab Z. Ismail , Enas A. AL-Hashmi, Use of waste plastic in concrete mixture as aggregate replacement, 2007.

[3] Rahmania E, Dehestani M, BeygiM.H.A ,Allahyari H,Nikbin I.M, On the mechanical properties of concrete containing waste PET particles, 2008.

[4] Tomas U. Ganiron, Effect of Thermoplastic as Fine Aggregate to Concrete Mixture,2014.

[5] Raghatate Atul M, Use of plastics in concrete to improve its properties, 2012.

[6] Praveen Mathew, Shibi Varghese, Thomas Paul, Eldho Varghese, Recycled plastics as coarse aggregate in structural concrete,2013.

[7] Dora Foti, Use of recycled waste pet bottles fibers for the reinforcement of concrete, 2013.

[8] Gavela S, Karakosta C, Nydriotis C, Kaselouri V, Astudy of concretes containing thermoplastic wastes as aggregates,2004.

[9] Ganesh Tapkire, Satish parihar, Pramod Patil, Hemraj R Kumavat, Recycled plastic used in concrete paver block,2014.