RECYCLED PLASTIC WASTE AS PARTIAL REPLACEMENT OF FINE AGGREGATE

B. SAICHARAN[1], M. KARTHIK[1*], B. KALPANA[2], H. ARUN2[1*], G. ANUSHA[2**], S. SHIVA SAI[2***],

L. HEMANTH[2****], T. PAVAN[2*****]

[1, 1*]ASSISTANT PROFESSOR DEPARTMENT OF CIVIL ENGINEERING IN JAYAMUKHI INSTITUTE OF TECHNOLOGICAL SCENCES NARSAMPET, WARANGAL DIST, TELANGANA, INDIA

[2, 2*, 2**, 2***, 2****, 2*****]SCHOLAR, DEPARTMENT OF CIVIL ENGINEERING IN JAYAMUKHI INSTITUTE OF TECHNOLOGICAL SCENCES NARSAMPET, WARANGAL DIST, TELANGANA, INDIA

Abstract *As the world population grows, wastes of various types are being generated. The creation of non–decaying and low biodegradable waste materials, combined with a growing consumer population has resulted in waste disposal crisis. One solution to this crisis is recycling wastes into useful products. Many Government agencies, private organizations and individuals have completed or in the process of completing a wide variety of studies and research projects concerning the feasibility, environmental suitability and performance of using waste plastics in construction field which needs better and cost effective construction material and reuse of waste plastics and save our world from environmental Pollution. With the increase in development, there is an increase in cost of construction and the maintenance of pavements. So, the Engineers and Designers have been looking for new concept of using waste plastics in cement concrete Paver Blocks and Solid Blocks. This pavement are less susceptible to rutting, minimum fatigue or thermal cracking, low stripping due to moisture and offers great durability, little or no impact on processing and also produces eco friendly construction and costs less.*

With the drastic increase in the population, the use of plastics have also increased drastically. For years, researchers and environmentalists are looking for a solution to manage the plastic wastes disposal. Many ways of reusing plastics for were implemented, yet those ways were not enough to manage the amount of plastic wastes being generated. So incorporating plastic wastes in concrete can be another way to reduce the disposal problem of plastic wastes. It can not only reduce the waste disposal problem but also reduce the excessive extraction of natural aggregates. Excessive extraction of natural aggregates can cause silting and sedimentation in rivers and can also change river courses, causes death of aquatic life and expose land to agents of degradation. Since waste is abundantly available, concrete with plastic aggregates can be cheaper compared to conventional concrete.

1. INTRODUCTION

As the world population grows, wastes of various types are being generated. The creation of non–decaying and low biodegradable waste materials, combined with a growing consumer population has resulted in waste disposal crisis. One solution to this crisis is recycling wastes into useful products. Many Government agencies, private organizations and individuals have completed or in the process of completing a wide variety of studies and research projects concerning the feasibility, environmental suitability and performance of using waste plastics in construction field which needs better and cost effective construction material and reuse of waste plastics and save our world from environmental Pollution. With the increase in development, there is an increase in cost of construction and the maintenance of pavements. So, the Engineers and Designers have been looking for new concept of using waste plastics in cement concrete Paver Blocks and Solid Blocks. This pavement are less susceptible to rutting, minimum fatigue or thermal cracking, low stripping due to moisture and offers great durability, little or no impact on processing and also produces eco friendly construction and costs less.

1.1 Plastic as aggregates

Plastic needs no introduction as it is the widely used material now a days on our Earth. Due to its properties like strength, durability and easy processing it can be used for many purposes. Studies shows that plastic is nearly inert that is it get very less affected by the chemicals and have higher durability. Disposal of plastic waste is a huge problem as due to absence of organic compounds, it is non decomposable material and proves to be a threat to our environment as it has many health hazards. As decomposition of plastic is a serious problem as it takes very long time and adversely affection the environment in many ways. So we can use it in construction, where we need life of structure to be improved and use of waste plastic after small processing can help us to reduce the waste in the environment which is new motto of civil engineering.

1.2 Objectives of the research

The main objective of this research is to explore the possibility of using waste plastics in concrete as concrete aggregate and reduce the problems associated to plastic wastes disposal as well as the extraction of natural aggregates from the environment. Other objectives of the research are as follows:

1. To compare the compressive strength and Density of Recycled Plastics used as Coarse Aggregate for Constructional Concrete with the Conventional concrete.
2. To know its applications in construction industry.
3. To reduce the pressure on naturally availability materials by replacing it with Recycled plastic aggregate.
4. To compare the physical characteristics of natural aggregate with Plastic recycled aggregate.
5. To study the behavior of fresh and hardened concrete with polymer waste coarse aggregate and compare its properties to those of conventional concrete.
6. To produce lightweight polymer concrete for multi-purpose use It represents an environmental friendly and economical viable solution, for utilization of waste plastic.

2. LITERATURE REVIEWS

Rafiq Ahmad Pirzada, Tapeshwar Kalra et al.,(2018) The current investigation carried out at 0%,5%,10%,15%,20% replacement of natural coarse aggregate by plastic aggregate in M25 grade concrete. From this paper which was concluded Plastics can be used to replace some of coarse aggregate in concrete mixture. This contributes reducing total weight of concrete. The application is advantageous for non - bearing of lightweight concrete i.e. concrete panels.

Lhakpa Wangmo Thingh Tamang, Tshering Wangmo et al., (2017) plastic due to its properties such as durability, light weight and its ability to be moulded into any desired shape has enhanced its popularity. It aims on finding the optimum percentage replacement of natural coarse aggregate with plastic coarse aggregate, which can give the same or more strength compared to nominal concrete. From this study it was concluded that the following conclusions are drawn from this experiment: According to the results obtained from this experiment 15% replacement can be concluded as the optimum replacement percentage to achieve the maximum tensile and flexural strength of a plastic aggregate concrete.

3. Materials used in the study

3.1 OPC 53 Grade cement

In this examination Ordinary Portland concrete of 53 review (ACC bond) has been obtained and has been utilized.

Fig 1: OPC 53 grade cement

3.2 Coarse aggregates

Coarse aggregates are particles more prominent that 4.75mm yet by and large range between 9.5mm to 37.5mm in distance across. In this study coarse aggregate of nominal sizes of 20mm, 12mm are used.

3.3 Plastic aggregates

The plastic aggregates were produced mainly from waste PET bottles. The plastic bottles were crushed and cut into small pieces using a crushing machine. The plastic aggregates were washed properly to make them clean and to ensure that no other dust particles were present there. Polyethylene terephthalate (PET) is thermoplastic polyester with tensile and flexural modulus of elasticity of about 2.9 and 2.4GPa, respectively, tensile strength up to 60 MPa and excellent chemical resistance.

Fig 2: Waste plastic aggregates

3.4 Water

Water is a critical element of concrete as it effectively takes part in the synthetic response with bond. Since it shapes the quality giving concrete gel, in the amount and nature of water is required to be investigated deliberately. C3S requires 24% of water by weight and C2S requires 21%.

3.5 Concrete Mix proportions for M20 grade

Cement = 358.47kg/m3

Water = 197.16 lit

Fine aggregates = 736.533 kg/m3

Coarse aggregate = 987.84 kg/m3

Water-cement ratio = 0.55

Final trial mix for M20 grade concrete is 1:2.055:2.75 at w/c of 0.55

4. EXPERIMENTAL STUDY

4.1 Workability

Workability of concrete Workability is a property of raw or fresh concrete mixture. In simple words, workability means the ease of placement and workable concrete means the concrete which can be placed and can be compacted easily without any segregation. Workability is a vital property of concrete and related with compaction as well as strength. The desired workability is not same for all types of concrete. More workability is required for a thin inaccessible section or heavily reinforced section rather than a mass concrete body. Hence, we can't set a standard workability for all casting works. Compaction and workability are very close to each other. Workability can also be defined as the amount of useful internal work necessary to produce full compaction.

4.1.1 Slump cone test

Concrete slump test or slump cone test is to determine the workability or consistency of concrete mix prepared at the laboratory or the construction site during the progress of the work. Concrete slump test is carried out from batch to batch to check the uniform quality of concrete during construction. Generally concrete slump value is used to find the workability, which indicates water-cement ratio, but there are various factors including properties of materials, mixing methods, dosage, admixtures etc. also affect the concrete slump value.

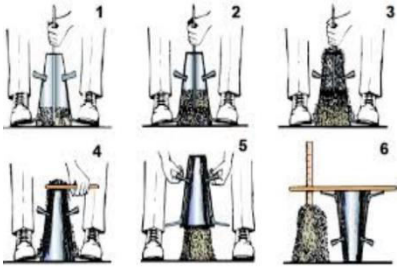
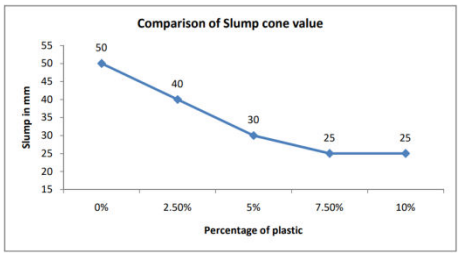


Fig 3: Slump cone test



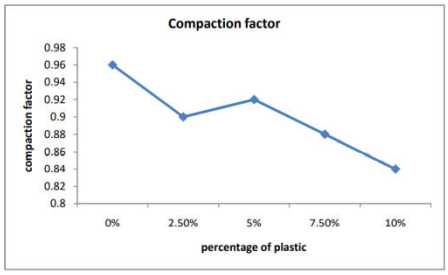
Graph 1: Comparison of slump cone value

From the above graph it was observed that the value of slump cone is decreases with increase of the plastic waste from 0 to 10% (50 -25mm).

4.1.2 Compaction factor test

Compaction factor test is the workability test for concrete conducted in laboratory. The compaction

factor is the ratio of weights of partially compacted to fully compacted concrete. It was developed by Road Research Laboratory in United Kingdom and is used to determine the workability of concrete. The compaction factor test is used for concrete which have low workability for which slump test is not suitable.



Graph 2: Compaction factor

From the above graph it was observed that the value of compaction factor is decreases with increase of the plastic waste from 0 to 10% (0.96-0.84mm).

4.2 Casting of specimens

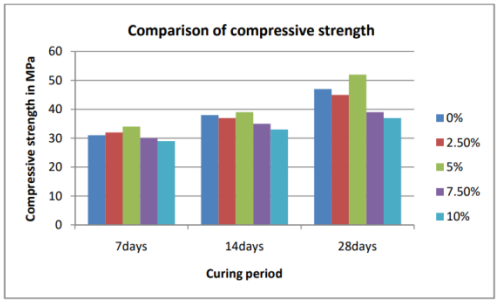
Casting of cube specimens of 100mmX100mmX100mm and cylinder of 150mm diameter and 300mmlength dimensions were carried out for different types of trial mixes from 0% to 10% of plastic aggregates. The casting of cubes was done in 3 layers in each layer we have to give 25 blows with tampering rod.

Fig 4: Casting of cube specimens

4.3 Compressive strength

Compressive strength is the ability of material or structure to carry the loads on its surface without any crack or deflection. A material under compression tends to reduce the size, while in tension, size elongates. 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. Compressive strength of concrete depends on many factors such as watercement ratio, cement strength, quality of concrete material, quality control during the production of concrete, etc

Fig 5: Compressive strength testing machine



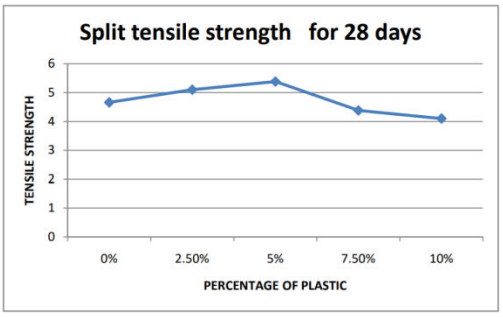
Graph 3: Compressive strength of concrete

From the above graph it was observed that the value of compressive strength is decreases with increase of plastic waste from 0 to 10%.

4.4 Split tensile strength

The splitting tensile strength test consists of applying a diametric compressive load along the entire length until failure occurs. This loading induces tensile stresses on the plane containing the applied load and compressive stresses in the area around the applied load.

Fig 6: Tensile strength testing



Graph 4: Split tensile strength for 28 days

From the above graph it was observed that the value of split tensile strength is decreases with increase of the plastic waste from 0 to 10% (33-29mm).

5. CONCLUSIONS

From this study the following conclusions were made

1. Plastic needs no introduction as it is the widely used material now days on our Earth. Due to its properties like strength, durability and easy processing it can be used for many purposes.
2. The value of slump cone will be decreases with increasing the percentage of plastic aggregates from 0% to 10%.
3. The value of compaction factor will be decreases with increasing the percentage of plastic aggregates from 0% to 10%.
4. The maximum value of compressive strength was observed at 5% of plastic aggregates for 7, 14 and 28 days curing period. Initially the value of compressive strength increases from 0% to 5% after 5% of plastic aggregates replacement the value of compressive strength decreases.

REFERENCES

[1]. Adewumi John Babafemi,Branko Šavija et al.,(2018) " Engineering Properties of Concrete with Waste Recycled Plastic" Sustainability 2018, 10, 3875

[2]. T.Subramani , V.K.Pugal et al.,(2015) "Experimental Study On PlasticWaste As A Coarse Aggregate For Structural Concrete" ISSN 2319 4847 Web Site: www.ijaiem.org Email: editor@ijaiem.org

[3]. Rafiq Ahmad Pirzada, Tapeshwar Kalra et al.,(2018) " Experimental Study on Use of Waste Plastic as Coarse Aggregate in Concrete with Admixture Superplasticizer Polycarboxylate Ether". www.irjet.net

[4]. Anandhu mohan,anandhu P Haridas "Methods To Improve Properties of Concrete while Using Plastic as Partially Replaced Coarse Aggregate". 2017 http://www.ijert.org

[5]. Lhakpa Wangmo Thingh Tamang, Tshering Wangmo et al., (2017) "Use of Plastics in Concrete as Coarse Aggregate". www.ijear.org

[6]. Anju Ramesan,Shemy S. Babu et al.,(2015) "performance of Light Weight Concrete Plastic Aggregate". www.ijera.com