International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 03 | Mar-2018 www.irjet.net p-ISSN: 2395-0072

Experimental Study on Use of Waste Plastic as Coarse Aggregate in Concrete with Admixture Superplasticizer Polycarboxylate Ether.

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ABSTRACT: *The reused plastic lightweight coarse total is essential and flexible material which offers extensive variety of specialized, monetary and ecological improving and saving points of interest to wind up a prevailing material in the new thousand years. For structural application of lightweight concrete, the density is often more important than the strength. Thus, decreased density for the same level reduces self-weight, foundation size and construction costs. Structural lightweight concrete generally used to reduce dead weight of structure which reduces risk of earth quick.*

The strength of concrete in the current study was increased by using superplasticizer polycarboxylate ether in design mix M_{25} grade concrete. The current investigation carried out at 0%,5%,10%,15%,20% replacement of natural coarse aggregate by plastic aggregate. In the current investigation it was found that concrete properties got improved rather than previous work done on the use of waste plastic as coarse aggregate in addition with plastic coarse aggregate. The workability of concrete was insisted by slump cone showed increment. The compressive strength increases up to 15%, tensile and flexural shows increment up to 10%. The most important change brought about using plastics is that the thermal conductivity of concrete is reduced using waste plastic concrete. Therefore, it can be said use of plastic waste in concrete can reduce environmental concern and can save our land from becoming barren.

KEYWORDS: waste plastic as coarse aggregate, Light weight concrete, superplasticizer polycarboxylate ether, compressive strength, tensile strength, flexural strength.

1.INTRODUCTION

Research concerning the utilization of side-effects to enlarge the properties of cement has been continuing for a long time. In the current decades, the endeavors have been made to utilize industry side-effects, for example, fly fiery debris, silica seethe, ground granulated impact heater slag (GGBS), glass cullet, PET, LDPE and HDPE, in common developments. The potential uses of industry results in concrete are as fractional total substitution or as halfway bond substitution, contingent upon their concoction arrangement and grain estimate. The utilization of these materials in solid originates from the natural imperatives in the sheltered transfer of these items. Huge consideration is being centered around the earth and defending of characteristic assets furthermore, reusing of squanders materials. Numerous enterprises are creating a huge number of items which fuse scrap (buildups). Over the most recent 20 years, a ton of works concerning the utilization of a few sorts of urban squanders in building materials industrials process have been distributed. Many inquiries about have been reached out to ponder new sorts of squanders to examine profoundly specific perspectives. The expansion of squanders, aside from the ecological advantages, additionally delivers great consequences for the properties of conclusive items. One of the new waste materials utilized as a part of the solid business is reused plastic. For illuminating the transfer of substantial measure of reused plastic material, reuse of plastic in solid industry is considered as the most achievable application. Reused plastic can be utilized as coarse total in concrete. Be that as it may, underline that re-utilizing of squanders isn't yet financially invaluable, because of the high expenses of transport and its impact on the aggregate expenses of generation. In addition, it is imperative not to disregard different expenses, straightforwardly referable to the sort of squanders, because of the need of measuring gas discharge, amid terminating, and the nearness of harmful and contaminating components.

1.1 REGENERATION APPROACH AND CONSTRUCTION OPERATION.

The regeneration of plastic already we operate it in concrete encompass few changes and operation methods are given below: -

(a). chemical Change: -

Plastic can be regenerated by chemical conversion and depolymerization. The two methods to archive depolymerization are hydrolysis (chemical decay) and pyrolysis (thermal decay). i.e. PET polyethylene tetraphalate can be chemically changed to output non-soluble polyesters, thermoset polyesters adversely used in bathtubs, boat hulls and exterior automobile panels.

(b). Mechanical Regeneration: -

Mechanical regeneration of plastics bears to operation which includes melting, shredding, granulation of plastic waste. Plastics necessary to be segregated before mechanical regeneration. Presently innovation is utilizing to isolate plastic waste consequently, along these lines automated x-beam fluorescence, infrared and close infrared spectroscopy, electrostatics and floatation.

(c) Thermal Regeneration: -

Thermal regenerating conforms of melting a thermoplastic at extreme temperatures, thus plastic starts to flow. The plastic is thus modified into new product as it cools. The process is not changing chemical look of the plastics. Such as PET since thermoplastic polyester can be melted and into building panels, wall posts and fibers for flooring.

(d) Filling:

Plastic waste is used as filling material as maiden resin or other matters like concrete or as in bituminous road as admixture. Plastic waste may be molded as coarse aggregate to reduce dead weight of structures. As rubber can be used in asphalt concrete.

2. LITERATURE

MOHAMMAD HASMATH et. al. (2015): -The present study is to investigate use of waste plastic as coarse aggregate in concrete with the addition of plastics. From research, it is found compressive as well as tensile strength got reduced and thermal conductivity also reduced. The main aim of the experimental program is to compare the properties of concrete made with and without plastics used as coarse aggregate to check strength.

MOHAMMAD JAHID-UL ISLAM et. al. (2016): - The research study shows the effect of plastic as an alternative aggregate on various fresh and hardened properties of concrete. The plastic used is polyethylene terephthalate. The workability of plastic concrete does not defer more than 9% and W/C ratio 0.42%.PET is semi crystalline polymer with high mechanical strength and toughness as well as hydrolytic. The material strength for cement is 42.9 MPa, brick coarse aggregate with PET coarse aggregate were used. The water cement ratio was 0.42,0.48 and 0.57. The slump tests conducted for each category of the samples to measure workability. The six specimens were prepared of 300*150 mm dimensions.

NURSYAMSI et.al (2016): -The use of substitute materials of concrete aggregate such as industrial waste and other plastic materials are a serious concern. The purpose of this study is to determine the compressive strength of light concrete of (PET) plastic waste as coarse aggregate and influence of aggregate gradation towards the compressive strength of concrete that is produced. The material testing with various fines modulus

PANIMAYAN et. al. (2017): -The study expresses rapid industrialization and urbanization in the country, the problem leads to shortage of construction materials which leads to alternative solutions. Such as use of waste plastic as coarse aggregate in M20 concrete. Usually M20 is used in most constructional work. Waste plastic was incrementally added in 0%,2%,4%,6%,8%,10% to replace same amount of aggregate.

H. ALPEREN BULUT et al. (2017): - The aim of this paper is to find out the effects of electronic waste (e-plastic) on the mechanical properties of polymer concrete. Plastic was used as a part of the filling materials (Quartz Sand and gravel) to obtain polymer and used as binder in polymer cement is a generic term applied to all binders. There are wide variety of cements used in construction and building industry. The chemical composition of these cements can quite be diverse, but the far most and greatest portion used in construction industry is ordinary Portland cement. In the investigation 53 grade ordinary Portland cement were conforming IS 8112:1989 was used. The cement used in the investigation was supplied by the ultratech cement industries dealer. The specific gravity of cement is 3.

3. OBJECTIVE:

- To explore the possibility of using processed plastic aggregates in concrete as an alternative for natural coarse aggregate to reduce the weight of dead load in structure.
- To study the properties of plastic concrete mechanically and physically.
- To make plastic a resourceful material by using it in concrete, so that people cannot throw it as useless thing.

4. MATERIALS:

Natural Coarse Aggregates: Natural aggregates are those taken from the native deposits with no change in the natural state during production other than crushing, grading and washing. Coarse aggregate is the portion which retained on 4.75mm sieve. The natural coarse aggregate used for making concrete with maximum size 80mm,40mm,20mm,10mm,4. 75mm.The size between 80mm to 4.75 mm is known as coarse aggregate. The 4.75 is common in both coarse aggregate as well as fine aggregate.

4.1 Artificial Aggregates: The artificial aggregates are those materials which are obtained from industrial by products such as plastic waste by heat treatment. The aggregate used for

4.2 Plastic Coarse Aggregate: The artificial aggregate used in the investigation is plastic aggregate made from various type of plastics as follows HDPE, LDPE, PET by heating process. The plastic used for manufacturing of coarse aggregate was 80% PET and rest 20% was HDPE and LDPE, which got washed to remove foreign particles and then crushed before heating process. The size of aggregate used in investigation has been 10mm and 20 mm.

4.3 Fine Aggregate: concrete production. Resin/filling material ratio has been decided to be 0%,5%,15%and 25% for 7,28 days compressive, flexural and splitting, tensile strength values of test samples. The test method used to determine compressive strength for the axial compressive test on the hardened polymer concrete samples was utilized in this study. The samples were subjected to a compressive test with the loading speed 0.4 MPa/s.

4.4 Cement: The aggregate size ranges from 4.75 mm to 150 microns is known as fine aggregate. The aggregate used in the investigation is locally available river sand grading zone-I of IS:383-1970 clear and dry river sand got used. Sand passing through sieve 4.75 mm. Sand used casting all specimen.

4.5 Water: Water is the key ingredient in the manufacture of concrete. It is also material on its own right. Understanding its properties is helpful in gaining and understanding of its effects on concrete and other building material quality of Water. However mixing water can cause problems by introducing impurities that have detrimental effects concrete ter should be free from saline effects

4.6 ADMIXTURE: Admixture is used for increasing the workability and compressive. As the plastic content increases the workability and compressive strength decreases as well tensile and flexural strength. Thus, the requirement of admixture arises which maintain the workability and compressive strength of concrete.so the admixture used in the study is super plasticizer. In the present study superplasticizer polycarboxylate ether was used to improve the workability and compressive strength of waste plastic mix concrete. The specific gravity of Superplasticizer is 1.02.

5. METHODOLOGY.

In this investigation batching operation by weight got adopted. The design mix of M_{25}(1.77:2.78) has been investigated with water cement ratio 0.48. The natural aggregate replaced by plastic waste coarse aggregate has been 0%,5%,10%,15%,20%.

6. EXPERIMENTAL PROGRAMME

In the experimental study, the natural aggregate has been partially replaced by plastic waste aggregate to produce light weight concrete and reduce waste which is non-biodegradable and with the increase in cost of natural aggregate, it is an alternative to use waste plastic as a coarse aggregate by economical point of view. In present study design concrete mix M_{25} ratio is 1:1.77:2.78 (10262-2009) according water cement ratio of 0.48. The admixture Super Plasticizer (Polycarboxylate Ether) used in the investigation to maintain workability and it also increases compressive strength. The materials used for production of concrete, ultratech 53 grade cement, natural river sand as fine aggregate, crushed coarse aggregate and waste plastic aggregate with size 10 mm and 20 mm. The size of crushed coarse aggregate was 20 mm.

Table.1- Batching of Materials.

Super Plasticizer %	Plastic waste %age	Cement kg/m³	Fine aggregate . kg/m³	C.A. kg/m³	P.A kg/m³	w/c
0	0	1	1.77	2.78	0	0.48
.5	5	1	1.77	2.641	0.139	0.48
1	10	1	1.77	2.501	0.278	0.48
1.5	15	1	1.77	2.363	0.417	0.48
2	20	1	1.77	2.224	0.556	0.48

6.1 COMPRESSION TEST (IS 516-1959)

Compression test is conducted to check the load resistance of concrete against the compressive loads applied over it.

Strength usually gives an overall picture of the quality of concrete. Compressive strength test was done as per IS 516-1959.For acquisition of compressive strength, concrete cube was casted having size 150mmx150mmx150mm, after 24 hours these moulds were removed and cured in water for the rest of time. Six cubes were replaced for each replacement. The specimen was tested at age of 7 and 28 days. According to IS code the load is applied gradually at the rate of 140 kg/cm^2.

6.2 SPLIT TENSILE TEST

Split tensile strength test on concrete cylinder is a method to determine the tensile strength of concrete. For investigation of split tensile strength concrete cylinders having size150mm×300mm (diameter ×height) were cast, demoulded after 24 hours and cured for 28 days. Three cylinders were casted for each replacement. The split tensile strength conducted at age of 28 days. The split tensile test was done on compression testing machine(CTM).

Split tensile formula=2p/πdl

6.3 FLEXURAL TESTS

Flexural strength is one measure of tensile strength of concrete. It is a measure of unreinforced concrete beam or slab to resist failure in bending. The specimen casted having size 700mm×150mm×150mm concrete beam. The standard strength is expressed as modulus of rupture. The specimen casted were demoulded after 24 hours, kept for curing in water. Three specimens were casted for each replacement level. Total number of specimen casted were 15. The tested conducted at the age of 28 days according to IS code 516-1959.Therefore the reading were recorded at the point of failure. Flexural strength(MPa)=Pl/bd^2.

7. RESULTS AND DISSCUSSION.

The purpose of the exploratory program is to investigate the properties of concrete made with plastics used as coarse aggregates. The fundamental tests conducted to check the workability, compressive strength, Tensile strength and flexural strength during investigation. The main objective of investigation is to provide lightweight concrete which will reduce weight of concrete and economical in case of costs.

7.1 CEMENT: -Cement is a fine grey powder. It is blended with water and materials, for example sand, rock and squashed material to make concrete. Cement and water form a paste that binds other materials together as the concrete hardens. The standard concrete contains two fundamental fixings specifically argillaceous and calcareous

Table .2 -Properties of cement.

S.NO.	Characteristics	Values Obtained	Standard values
1.	Normal Consistency	33%	
2.	Initial Setting Time.	48 minutes	Not less than 30 minutes
3.	Final Setting Time	240 minutes	Not less than 600 minutes.
4	Fineness	4.8%	
5	Specific gravity	3.15	

7.2 WORKABILITY

Workability of fresh concrete can be insistent by using the slump cone and the results are presented in table. From the investigation it is found that workability of concrete increases with the addition of superplasticizer (polycarboxylate ether) at different level of replacement of natural aggregate by plastic aggregate. As we know from previous research workability decreases without superplasticizer by the addition of plastic percentage.

Table.3- slump value

%age of replacement	Slump value (mm)
0	48
5	56
10	63
15	70
20	78

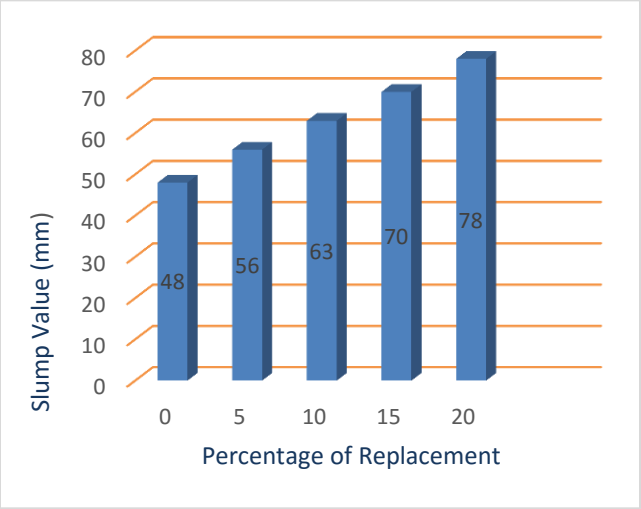

Figure.1 of slump values.

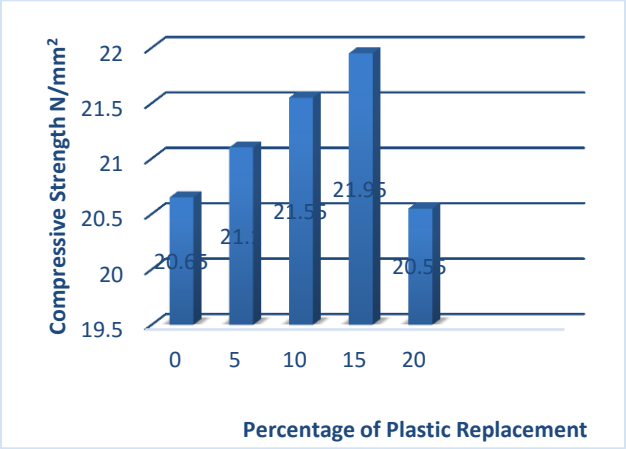

Figure .2-Compressive Strength of Cubes 150mm Size At 7 Days

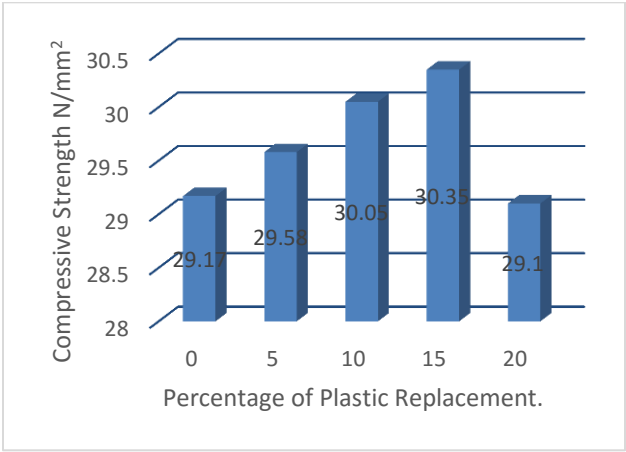

Figure .3 -Compressive Strength of Cubes 150mm. Size at 28 Days

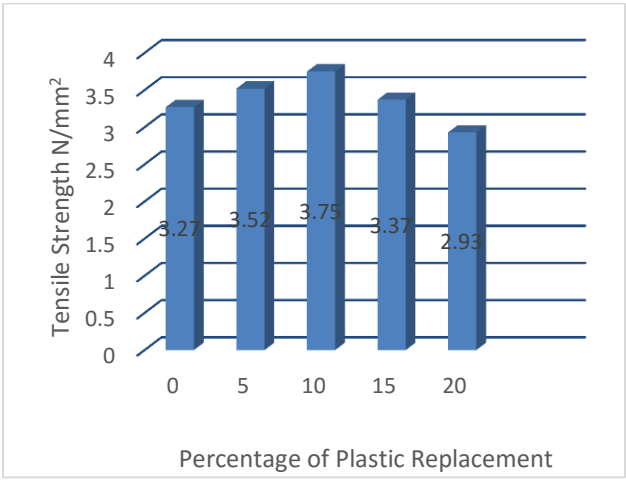

Figure. 4- Tensile Strength at 28 Days.

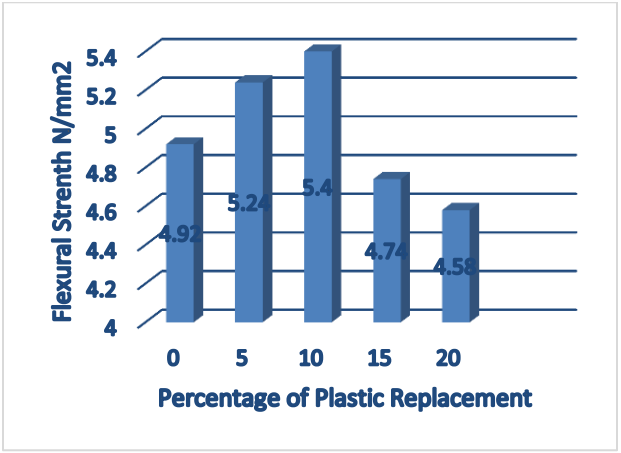

Figure .5-Flexural Strength at 28days.

8.CONCLUSIONS

Following conclusions can be made from current study.

1. 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.

2. For maintaining the workability, compressive strength and other factors, the use of admixture is necessary such as superplasticizer carboxylate ether used in this study.

3. The addition of plastic coarse aggregate make concrete ductile, hence develop the ability of ductility before failure. This main specific quality makes concrete useful where it will be taken to harsh weather expansion and contraction or freeze and thaw.

4. The introduction of plastic aggregate in concrete of the buildings made it advantageous from energy point of view. The use of plastic coarse aggregate makes the interior of building cooler and temperature of outer side got increased.

5. In general water cement ratio has much impact on the strength of concrete due to weak bond between plastic coarse aggregates and cement. Thus, with the addition of superplasticizer, the bond between cement and plastic coarse aggregate got increased.

ACKNOWLEDGEMENT

I am highly thankful to Mr. Tapeshwar Kalra (Assistant Professor Department of Civil Engineering who provided me full support during my research on current topic and

Fayaz Ahmad Laharwal, Lecturer Govt polytechnic college ganderbal for his primary guidance.

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