International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 04 | April - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

USE OF PLASTICWASTE AS AN AGGREGATE IN CONCRETE

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ABSTRACT:
Significant growth in the consumption of plastic products is observed all over the world in recent years; this has contributed to increasing the production of plastic waste. Disposal of plastic is a challenging task. Because plastic waste can take anywhere from 20 to 500 years to decompose, and eventhen, it never fully disappears; it just get smaller and smaller. Hence it is necessary to reduce the amount of production of plastic as well as disposal and reuse of plastic is mandatory.

As decomposition of plastic is a serious problem as it takes very long time and adversely affection the environment in many ways so reuse of plastic waste in the production of concrete or mortar appears as an environmentally friendly solution for getting rid of plastic waste, due to its ecological and economic advantages and we can use it in construction, where we need life of structure to be improved. Furthermore, it leads to a decrease in plastic waste in landfills. Several studies presented the properties of cementitious composites (mortar and concrete) containing different types of (PWD)

Usage of these plastic waste materials helping in dual role by minimizing of concrete and by using the waste materials that are affecting the environment. The other advantage of using these waste materials is that they are helping improving the properties of concrete.This study summarizes the previous studies until 2019, discussing the use of recycled plastic aggregate as aggregates in cementation composites and its impact on the compressive strength.

In this study we are going to replace the fine aggregate and coarse aggregate by plastic aggregate with 2.5%, 10% and 25%, then specimens are tested and compared with a control specimen of 0% plastic in terms of compressive strength. We will also do the comparative study of replacement of fine and coarse aggregateand going to find that which replacement is better.

Keywords: plastic waste, plastic aggregate, environmentally friendly solution

1. INTRODUTION

Environmental issues that we are facing today. Plastic waste can take anywhere from 20 to 500 years to decompose. India is generating about 3.5 million tons of plastic waste annually and the per capita plastic waste generation has almost doubled over the last five yearsPlastic has become one of most pressing. The average plastic waste generation in the country is around 6.92 per cent of municipal solid waste (MSW). Extrapolation of plastic waste generation data from 60 major cities showed that around 25,940 tons of plastic waste per day (TPD) is generated. India. India recycles only 8 percentage of its plastic waste, reveals new study. And if the ”business as usual “ continues, the recycling capacity would only marginally go up to 11 percent by 2035, with India’s plastic use expect to rise to 70.5 million tons (MT) by then from the current production of 24.1 MT.

Plastic waste is a huge global problem .A study showed that 275 million tons of plastic waste were produced in 192 coastal countries among which 12.7 million tons of these disposed plastics were thrown in oceans resulting in detrimental effects on the environment. Developing countries are suffering from the negative effect of accumulating local wastes and garbage, in which it increases the level of pollution, affects the public health and increases the percentage of epidemic.

One of the least understood and most challenging aspects of plastics' negative environmental effects is their disposal. Ironically, one of plastic's most desired qualities—its longevity and resistance to decomposition—is also the cause of one of its biggest drawbacks in terms of disposal. The synthetic chemical bonds in plastic are extremely difficult for natural organisms to dissolve, which has a major impact on the durability of materials. Less than 10 percent of the total amount of plastic produced is efficiently recycled; the remainder is either burned in incinerators or dumped in landfills where it will rot for countless ages. "Plastic pollution adversely affects our ecosystem and is also linked to air pollution.

1.The production and burning of plastic will increase greenhousegas emissions.

2. Polluting the soil

3. Water contamination

4. Marine debris

5. Trash stains

6. Dangerous to living things.

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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. Plastic is helpful to improve the properties and hence can be used in construction industry due to some of its properties like inert behavior, resistance to degradation etc. Repurposing of plastic waste into the construction industry is a way to decrease the amount of plastic waste, while simultaneously, limiting the over-dredging of sand and other natural materials.

This research used experimental method to measure the effect of integrating plastic wastes in construction industry byreplacing cement with plasticat different percentages and turning itinto a useful cheap building material. In this study, plastic aggregates were used in place of natural coarse aggregates, and fine aggregate with 2.5%, 10% and 25%, then specimens are tested and compared with a control specimen of 0% plastic in terms of compressive strength. We will also do the comparative study of replacement of fine and coarse aggregate and going to find that which replacement is better.

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2. LITERATUREREVIEW.

1.ElangoAandAshok KumarAin 2018

Performed study concrete with plastic fine aggregates.They used OPC 53 grade, River sand and crushed aggregates.They used plastic in place of fine aggregates in proportion of 10%, 20% and 30%. They test mechanical and durability

properties on their concrete samples. They found the decrease in strength of concrete. But found that the concrete shows good results against acid attack sand increase in elasticity.So they concluded that the plastic aggregate concrete can be used in place where we need less compressive strength but more durability.

2.LhakpaWangmoThinghTamanget.al.in2017

Performed experiment on Plastics in Concrete as Coarse Aggregate. They performed the testing of mechanical properties of concrete containing Plastic aggregates They use plastic aggregates in proportion of 10%, 15%, and 20%.They found marginal reduction in strength and suggested the optimum result as 15% replacement.

3. BJaivignesh and A Safin2017.

Performed Study Properties of Concrete with Plastic Waste as Aggregate. They used the plastic place of fine aggregates as well as coarse aggregates in proportion of 10%, 15 % and 20%. They also added steel fiber to the concrete. Their research concludes to the reduction in strength but suggested its use in favor of reduction of waste material and ecofriendly materials.

4. MBHossain et.al.in 2016.

Performed work on Use of waste plastic in concrete as a constituent material .They replace coarse aggregates in proportion of 5%, 10% and 205.They found that the concrete was lighter in weight. But the compressive strength was lesser than that of conventional concrete. They also found that the concrete with 10% plastic aggregates shows strength nearly similar to the conventional concrete. So, the optimum result was 10% plastic aggregates.

5. Amalu.R.Get.al.in2016.

Performed the study the use of waste plastic as fine aggregate in concrete. They use plastic as substitute of fine aggregates in proportion of 10%, 15%, 20% and 25%. They found reduction in strength of concrete but support the use of plastic in nonstructural concrete for the reason it shows higher workability and reduce environmental waste.

6. S.Vanithaetal.in 2015

Performed studies on use of waste plastic in Concrete Blocks. Paver Blocks and Solid Blocks of size 200mm X 150mm X 60mm and 200mm X 100mm X 65mm were casted for M20 grade of concrete and tested for 7, 14 and 28 days strength. Plastic was added to a proportion of 2%, 4%, 6%, 8% and 10% in equal replacement of aggregates.

They found the optimum result for paver block at 4% replacement of aggregates with plastic aggregates. And 2% of plastic in case of solid blocks.

7. T. Subramanian and V.K.Pugal in 2015

Performed an experiments on plastic waste as coarse aggregates in concrete. They prepared the concrete with 5%, 10% and 15% replacement of aggregates in concrete with plastic. They found the optimum results at 10% replacement of aggregates with plastic. Further increase in plastic content decreases the strength of concrete.

8. Susanne Neha. Betel(2015)

“Application of waste plastic as an effective construction material in flexible pavement” polyethylene as one sort of polymers is used to investigate the potential prospects to enhance asphalt mixture properties.The objectives also include determining the best type of polyethylene to be used and its proportion.Two types of polyethylene were added to coat the aggregate High- Density Polyethylene (HDPE) and Low-Density Polyethylene (LDPE).The results indicated that grinded HDPE polyethylene modifier provides better engineering properties. The recommended proportion of the modifier is 12% by the weight of bitumen content. It is found to increase the stability, reduce the density and slightly increase the air void sand the void so mineral aggregate.

9. Daniel Yaw Osei in 2014.

Performed experiments on plastics aggregate in concrete. He replace the coarse aggregates in concrete of ratio 1:2:4 by 25%, 50%, 75% and

100% with plastic. He found that there was reduction in strength of concrete as well as density of concrete. They suggested that replacement of aggregates more than 36% is not suitable for structural concrete. They also suggested plastic as a medium for production of light weight concrete.

10. Praveen Mathew et. al. in2013

Study the use of Recycled Plastics as Coarse Aggregate for Structural Concrete. They performed test on concrete with various proportions of plastic aggregates in replacement of coarse aggregates and found the optimum result at 22% replacement of coarse aggregates with plastic aggregates. They further performed the test for other properties on concrete with 22% plastic aggregates and found that concrete with plastic aggregates was weaker in fire resistance.

11. RaghatateAtul M. Ain 2012

Performed study on use of plastic bags in form offiber in concrete and test it properties. He adds fiber in proportion of 0.2%, 0.4%, 0.6%, 0.8% and 1% by weight of concrete. [9] He found that there was reduction of compressive strength with increase in plastic content, but there was increase in tensile strength with optimum strength at 0.8% addition.

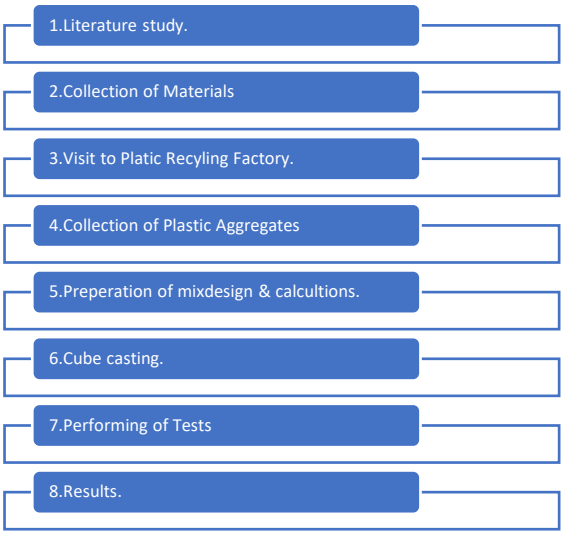
12.Shi-Cong Kou, Chi-sun Poona, Francisco Agrela [6]in2011

Performed study on the compressive strength of concrete containing recycled aggregateat1, 4,7, 28 and 90 days was lower than that of the control specimen, but could be compensated by the use of 10% SF or 15% MK. However, the use of 30% FAor 55% GGBS lowered the strength.

13. S. Rajasekaran et al (2009)

"Reuse of waste plastic coated aggregate" Marshall's mix design was carried out by changing the modified bitumen content at constant optimum rubber content and subsequent tests have been performed to determine the different mix design characteristics and for conventional bitumen (60/70) also.This has resulted in many improvedcharacteristics whencompared with straight run bitumen and that too at reduced optimum modified binder content

3. METHODOLOGY



3.1. Literaturestudy

- Literature study was done on the available data on useof plasticin concrete

3.2.Collection of materials

- **Cement:**-Confirming to IS12269:1987 Specification for53 grade ordinary Portland. OPC53 grade cement has better quality, strength, and less setting time compared to 33 and 43 grades of cement. Due to its high strength, we used this for making concrete of higher grade (M30).

- **Aggregates:** Confirming to IS 383:1970 – Specification for coarse and fine aggregates from natural sources for concrete.

- **FineAggregates:**

Sandissued as fine aggregate.

- **Coarse Aggregate:** coarse aggregate ofsize10mmand 20mm were used.

- **Water:** Potable water.

- **PlasticAggregates:**

- **Plastictype:**HDPE (Highimpact polystyrene)
- **Sizeof plastic:**75-120micron
- **sizeof aggregates :**2 to 5mm

3.4.PLASTICRECYLINGPROCESS:

Stagein plasticwaste recycling:

Recycling of plastic waste is consists of the following stages:

1. Collection: Plastic waste is collected from various collection sources like Rag Pickers, municipalities, Societies, Kabadiwalas, and Awareness Drives.

2. Sorting: Collected plastic waste needs to be sorted accordingly so it can be processed further in shredding machine.

3. Wasgung: Sorted plastic waste usually contains dust, adhesive and more impurities that need to be washed away. This is done in the washing line at the recycling facility.

4. Shredding: Once segregation and washed now plastic is shredded to smaller pieces by the process of shredding.

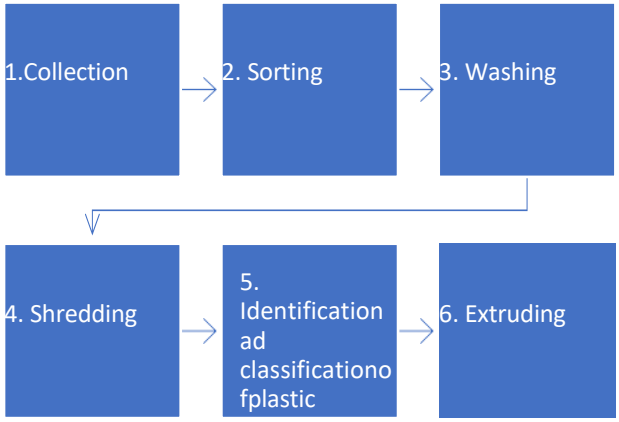
6. Identification and Classification of Plastic: After shredding proper testing of the plastic pellets are conducted in order to ascertain their quality and class.

Extruding: Running on the line next step is extruding, in this process, shredded plastic waste is melted and extruded, and converted to plastic granules. Also in order to enhance the properties of the material, even some extra filling is added tothe material.

3.5.Design Of Concrete Mix.

Concrete mix is the way by which we choose the different constituents used in the concrete and determining their amount and by taking care about the economy and various properties of the concrete like workability, slump value, strength criteria etc. For designing the concrete mix we followed IS: 10262-2009.Adesign mix for M30 grade concrete was prepared and trial mixes were prepared to check the mix design and to adjust amount of Water cement ratio. The following parameters were used for mix design

- Gradeofconcrete =M30
- TypeofCement=OPC-53Grade
- BrandofCement=ACC
- FineAggregates=ZoneIII
- SpecificGravity ofCement=3.16
- SpecificgravityofFA=2.61
- SpecificGravity of C.A10mm=2.6620mm=2.65



6. Specimens for Compressive Strength.

To check the compressive strength of concrete mix, specimens of cubical shape size 150mm x 150mm x 150mm were prepared. The required quantities of materials required quantities of materials required were weighed accrete the mix proportion. First we cast normal cube with 0% replacement of plastic aggregates and then cube casted by replacing fine aggregate in proportion of 2.5%, 10% and 20% then coast aggregates are replaced by plastic aggregate in proportion same ascine aggregates (2.5%, 10%, & 25%). Aggyand cement was firstly thoroughly mixed. Then water was then added to the drymi . Total 21 similar cubes were casted, each six cubes fir 7 days, 14 days and 28 days testing. After 24 hours of casting, the cubes were demolded then placed unto curing tank.

Table:

Sr. No.	Mix	Proportion
1	M1	0 % Replacement
2	M2	2.5% of Fine Aggregate
3	M3	10% of Fine Aggregate
4	M4	25% of Fine Aggregate
5	M5	2.5% of coarse Aggregate
6	M6	10% of coarse Aggregate
7	M7	25% of coarse Aggregate

7..Testing of Concrete.

After casting, specimens were tested after 7, 14 and 28 days of curing on CTM. In this article, the procedure adopted for testing of specimens for various properties like compressive strength is discussed below.

8. Compressive Strength.

To evaluate the compressive strength of concrete, cube specimens were used. The test were performed according to IS 516-1959. Specimens were then placed in curing tank for specified period. Specimens were then taken out of tank after 7, 14 and 28 days of curing and surface dried. They should be dried under shade not under direct sunlight or in oven. Specimens were then placed in Compression Testing Machine (CTM). The rate of loading was then set at 140Kg/m3 /minute or 5.2 KN per second. The load was applied and the peak load at which the specimen fails was noted. Compressive strength = P/A Where, P = load in KN and A = Area of cross section