UTILIZATION OF SHREDDED PLASTIC IN CONCRETE FOR OPTIMIZATION OF DURABILITY PROPERTIES

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Abstract. Today, the proper disposal of waste plastics is one of the major environmental issues. The amount of plastic waste is growing daily. The shortage and unavailability of construction supplies is another issue the construction sector is now dealing with. Therefore, we need to look for alternative building materials as well as an effective way to get rid of plastic garbage. One of the two problems mentioned above can be used to solve the other in order to obtain their answer. In order to research the behaviour of plastic mixed concrete, plastic waste was mixed with cement concrete in various quantities ranging from 0% to 10%, and M20 grade test specimens were cast. The study of concrete's compressive and flexural strengths is the subject of the current topic.

Manufacturing activities, service sectors, and municipal solid wastes all produce a variety of waste products. Concerns over the disposal of created garbage have been greatly exacerbated by people's growing environmental awareness.One of the world's top environmental challenges is the handling of solid waste. Waste utilisation has emerged as a desirable substitute for disposal due to the lack of landfill space and the rising expense of disposal. On the use of waste materials in concrete, research is being done. Tires, plastic, glass, steel, charred foundry sand, and coal combustion byproducts are a few examples of such waste materials (CCBs). Each of these waste materials had a unique impact on the characteristics of newly-poured and fully-cured concrete.

Concrete is made more affordable by using waste materials, and it also helps with disposal issues. Bulky garbage reuse is thought to be the most environmentally friendly solution to the disposal issue. Plastic is one such waste that has a variety of potential uses. But there have also been attempts to investigate its application in concrete/asphalt concrete. The development of new construction materials using recycled plastics is important to both the construction and the plastic recycling industries.

Keywords: Plastic waste,PET,recycle,concrete.

INTRODUCTION

Currently, the Indian building industry uses roughly 400 million tonnes of concrete annually, and it's predicted that number might rise to a billion tonnes in less than ten years. The earth's crust provides all the elements needed to manufacture such massive amounts of concrete, depleting its resources every year and straining the environment. On the other hand, human activity on earth generates significant amounts of solid trash, or more than 2500 million tonnes annually, comprising industrial waste, agricultural waste, and other types of societal garbage. Such solid waste disposal entails both economic and ecological and environmental concerns. The presence of waste plastics in solid trash may be the main ecological stressor in its disposal.

One of the more recent engineering materials to enter the market on a global scale is plastic. The bathtub and sink units, corrugated and plain sheets, floor tiles, and paints are all made of plastic. Other than this, plastics were employed domestically in a variety of ways, including carrying bags, bottles, cans, and numerous medical tools. Typically, plastics are stable and non-biodegradable. Therefore, their disposal presents issues. The successful use of plastic trash as an ingredient in bitumen mixtures for paving roads is the subject of ongoing research. In order to effectively use domestic plastic trash in concrete and minimise the environmental pressures created by it, solid waste management issues are solved using reengineered polymers. This also helps to reduce the consumption of large amounts of natural resources.

The annual global consumption of plastic has been phenomenally increasing. Its incredibly user-friendly attributes and capabilities, special adaptability,The primary causes of this phenomenal rise are the products' incredible cost-effectiveness, fabricatability, and processability in addition to their enormous durability. Plastics are widely utilised in packaging, automotive, industrial, and healthcare applications in addition to water desalination and bacteria removal, food preservation and distribution, housing appliances, communication, the electronics industry, and other medical delivery systems.

LITERATURE REVIEW

Vikas Khandelwa, Assistant Professor,Chandigarh University, Mohali,Punjab (India) performed some investigation on Replacement of Sand with Shredded Plastic in Cement Concrete.The objective of their research was Utilizing shredded waste plastic well.to research how shredded plastic affects concrete's compressive strength.to research how shredded plastic affects concrete's flexural strength. Different test were performed for fresh concrete. And for hard concrete.The tests performed were Compressive strength and flexural strength.Materials used such as Ordinary Portland cement grade – 43 , sand: is 2386, course aggregates: is 2386.,Water, Concrete mix,Waste Plastic (PET).

They concluded that waste plastic that has been cut into smaller pieces can be utilised in concrete without sacrificing strength. When concrete is added with 4% of shredded plastic, the most compressive strength is seen. After 28 days of adequate curing, adding will also cause a drop in compressive strength. It has been found that the 28-day compressive strength of concrete does not significantly vary with the addition of 0 to 2% shredded plastic. When 4% of shredded plastic is added to concrete, the maximum flexural strength is also noted. After 28 days of adequate curing, adding will also cause a drop in flexural strength.

Pramod S. Patil, J.R.Mali, Ganesh V.Tapkire did detailed study on Innovative techniques of waste plastic used in concrete mixture.During the study they used Cement, Sand,Conventional aggregates,Waste plastic.They performed different test such as Specific Gravity, Bulk Density, Fineness Modulus, Water Absorption, Free Moisture, Compressive Strength, Flexural Strength.

In that project, the primary area of investigation is the use of recycled concrete as a coarse aggregate in the manufacturing of concrete. Determine specific gravity, water absorption, abrasion value, crushing strength, and impact test of two replacement levels, 0%, 10%, 20% and 30%, 40%, 50% by volume of aggregates used for the preparation of the concretes, are the main goals of this study.

The modified concrete mix delivers strength within the permitted range by replacing conventional material with plastic aggregate up to a set proportion (20%). 10% of modified and cast concrete that uses plastic aggregate as a partial replacement for coarse aggregate shows that it might meet IS regulations. The density of the concrete begins to decline once 20% of the coarse particles are changed.

J. Thorneycroft, J. Orr, P. Savoikar researched on the Performance of structural concrete with recycled plastic waste as a partial replacement for sand. Research.They used Cement, Sand,Conventional aggregates,PET Plastic Waste.

They performed several test Bulk Density, Fineness Modulus, Water Absorption, Compressive Strength, Flexural Strength,Tensile Strength.for the time period of 28 days.

They concluded that by replacing 10% of the sand in structural concrete mixes with recovered plastic waste, 820 million tonnes of sand per year can be diverted from being used in concrete and put to better use. The most effective plastic aggregate for use in concrete mixes should have a rough surface, be irregular in shape, be tiny enough to not cause a substantial failure surface, and be graded similarly to the sand it replaces, according to testing of various types of plastic. The findings demonstrate that strength losses can be held to reasonable limits by employing an appropriate mix design.

Bahareh Kaveh , Hynda Klalib Aoun, Zakwan Arab, Thomas Kemp did a research.They researched on the performance of concrete with recycled plastic waste.The goal of the experimental research is to determine the mechanical and durability properties of the developed patented material known as 'Plasmega' in order to avoid degradation issues and defects during the fabrication process.

Materials such as Cement, Pulverized fuel ash, waste plastics were used during the research.They performed several Absorption test, Permeability test, Rebound hammer test, Ultrasonic Pulse Velocity (UPV) test, Compression and tensile-splitting tests, Sulphate and Chloride Attacks.

Findings from the project will increase our knowledge of how waste plastic may be utilised in concrete in place of natural aggregate and assist in the development of new sustainable materials. The information shows that using plastic waste in place of aggregate decreases density, hardly changes compressive strength, and has higher chemical resistance. Further research on the amount and kind of recycled plastic in the concrete is also required to guarantee that its mechanical properties and durability are not compromised. The Plasmega material may be made stronger and more durable by using different additional cementitious ingredients.

An experimental study of utilization of plastic wastes in concrete was carried out by Mohd Aamir Gour, Shivam Kumar Sharma, Shreya Khaudiyal, Nikhil Garg at International Journal of Advanced Research in Engineering and Technology (IJARET) .The material used during the reseach were Cement, Sand,Conventional aggregates,Different plastic wastes(PET,PE-HD,PVC,PE-LD).

Several tests such Bulk Density, Air Content, Slump Test, Compressive Strength, Flexural Strength,Splitting, Tensile strength. Are conducted during the research.

They found that the amount of recycled plastic aggregate directly relates to the density of partially replaced concrete. The mix's density starts to decline as the proportion of recycled plastic aggregate rises. The amount of recycled plastic replacement and aggregate particle form both directly and inversely affect the workability of freshly prepared concrete that contains recycled plastic aggregates. The study found that as the amount of coarse aggregate replacement increases, the compressive and flexural strength of concrete that has had various polymers added to it diminishes.

The authors Jibrin Sule, Sule Emmanuel, Ismaila Joseph, Osagie Ibhadobe, Buba Y. Alfred researched on Use of Waste Plastics in Cement-Based Composite for Lightweight Concrete Production.During the experiment materials such as Cement, Aggregates and Waste plastics.The purpose of this research is to find a waste product that is suitable for manufacturing lightweight concrete and is affordable. comparing the density and strength of lightweight and conventional concrete. Think about the functions and applications of lightweight concrete in building. The goal is to determine whether waste plastics may partially replace fine concrete particles to generate lightweight concrete (LWC).Different test were performed on the fresh and hardened concrete. Specific Gravity, Bulk Density, Fineness Modulus, Water Absorption, Free Moisture, Compressive Strength, Flexural Strength.

At the end it was concluded that the Plastics can be used to substitute some aggregate in a concrete mixture since they have a lower density than small particles, which lowers the unit weight of the concrete. The material is beneficial for lightweight non-bearing concrete applications like concrete panels. The results show that the slump decreases as the proportion of plastic increases because some particles are angular and others have non-uniform shapes, which impair fluidity. It is possible to substitute up to 15% of the fine aggregate in concrete mix with recycled plastic components. The use of scrap plastic in cement-based composites can significantly lower construction costs.

Experimental study on utilization of Waste Plastic in Concrete was carried out by Karthikeyan Muniraj Balamurali Kanagaraj, Janarthanan Rameshkumar.Materials such as Ordinary Portland Cement (43 Grade), sand, Crushed stone, Water,Waste Plastics such as Thermoset & Polypropylene.The objective of the research was to to lessen plastic waste, as it is challenging to dispose of plastics. Plastic is an inorganic substance, hence it has no impact on the chemical composition of concrete. in order to save money and sand tonnes.

Test such as Water absorbility,Compressive Strength, Flexural Strength,Split Tensile test.The test results show that, with 10% replacement, the compressive strength is attained at 9.5 N/mm2, 15 N/mm2, 21 N/mm2, and 26 N/mm2 after 3, 7, 14, and 28 days, respectively. At 3, 7, 14, and 28 days with 10% replacement, the split tensile is raised by 1.07 N/mm2, 1.5 N/mm2, 2 N/mm2, and 2.5 N/mm. After 28 days of 10% replacement, flexural strength increases by 2.5 N/mm2, 3.5 N/mm2, 4.2 N/mm2, and 4.5 N/mm2. As the amount of plastic increases, discernible drops in compressive strengths are seen.

METHODOLOGY

Different methods such in which plastic straws, road debris, raw plastics, and polythene sheets were all chopped to the same size as coarse aggregates. The inclusion of plastics ranged from 0% to 10% of the total weight, and the specimen was cast. The samples for the compression tests were cast in 150 x 150 x 150 mm cast iron cubes. The typical 700 X 150 X 150 mm mould was used for the casting of the flexural components. After every 24 hours, the samples were methodically placed in curing tanks for 7 and 28 days, respectively. Six cubes and six beams were manufactured for each % of glass fibres. The workability for each % of glass fibre is calculated similarly by averaging the results of three slump tests.

OBJECTIVE AND USES

- To reduce the plastic waste as it is difficult to dump plastics.
- As plastic is inorganic in nature it does not effect the chemical properties of concrete.
- To cut the cost and save the tones of sand.
- One of the key objectives of this study was to determine the mechanical characteristics of the Plasmega material by conducting both destructive and non-destructive tests.
- To utilize the plastic waste in an effective manner.
- To cut the cost of concrete.
- To produce light weight concrete.
- To replicate structural concrete, a compressive strength of 54 MPa is desired.
- Effective use of shredded waste plastic.
- To study the effect of shredded plastic on compressive strength of concrete.
- To study the effect of shredded plastic on flexural strength of concrete.

MATERIALS USED

Cement, Sand,Conventional aggregates,PET Plastic Waste

Tests

Bulk Density

The bulk density of a powder is the ratio of the mass of an untapped powder sample and its volume including the contribution of the interparticulate void volume.

Slump Flow Test

One of the most crucial tests for self-compacting concrete is the slump flow test. This test is used to determine the concrete's horizontal flow. It is used to determine the concrete's capacity for filling. This kind of examination can be carried out outside.

Compressive Strength

The mechanical test known as the compressive strength test determines the maximum compressive load that a material can withstand before breaking. A gradually applied load compresses the test item, which often takes the shape of a cube, prism, or cylinder, between the platens of a compression-testing machine.

Flexural Strength

The force necessary to bend a beam under three-point loading circumstances is measured by the flexural test. The information is frequently used to choose materials for sections that won't bend while supporting loads. One way to gauge the tensile strength of concrete is by its flexural strength. It measures how well an unreinforced concrete beam or slab can withstand bending failure. It is determined by loading concrete beams of 6 x 6 inches (150 x 150 mm) with a span length that is at least three times the depth.

Splitting Tensile strength

To determine the tensile strength of concrete, splitting tensile tests are typically used. In these tests, the stress field is really a biaxial stress field, with the compressive stress being three times larger than the tensile stress.

CONCLUSIONS

- The density of partially replaced concrete is directly proportional to the percentage of recycled plastic aggregate. As the percentage of recycled plastic aggregate increases, the density of the mix begins to fall.
- The workability of freshly made concrete containing recycled plastic aggregates is inversely proportional to the percentage plastic replacement and directly proportional to aggregate particle shape.
- According to the study, the compressive and flexural strength of concrete that has been replaced with different plastics decreases as the percentage of partial replacement of coarse aggregate increases.
- Due to the low density of plastics compared to the density of fine particles, some of the aggregate in a concrete mixture can be replaced with plastics, which helps to reduce the unit weight of the concrete. The substance is useful for non-bearing lightweight concrete applications like concrete panels.
- Due to the fact that certain particles are angular and others have non-uniform forms, which reduce fluidity, it was found in the results that the slump diminishes as the percentage of plastic increases.
- Up to 15% of the fine aggregate in the concrete mix can be replaced with recycled plastic materials.
- The cost of building can be greatly decreased by using waste plastic in cement-based composite.

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