The Effect of Mixing Randomly Shredded Plastics on The Technical Properties of M30 Concrete: A Review

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Abstract This project aims to investigate the use of waste plastic materials as a means of enhancing the strength of concrete. Plastic waste is a major environmental issue, and finding ways to repurpose it is an important goal. In this study, various types of waste plastic, such as polyethylene terephthalate (PET) and high-density polyethylene (HDPE), will be used as additives to concrete mixes. The impact of different plastic percentages on the mechanical properties of the resulting concrete, such as compressive strength, tensile strength, and flexural strength, will be evaluated through laboratory testing. The study will also assess the effect of waste plastic content on the durability and permeability of concrete. The results of this research will provide valuable insight into the potential of using waste plastic in the construction industry as a sustainable and effective means of improving concrete strength, while also reducing plastic waste.

INTRODUCTION

Concrete is the most commonly used construction material in the world, and its production accounts for a significant portion of global carbon emissions. Additionally, plastic waste is becoming an increasingly severe environmental problem, with much of it ending up in landfills or the ocean. Thus, finding ways to recycle and repurpose plastic waste has become a crucial task for the construction industry.

In recent years, researchers have explored the potential of using waste plastic materials as additives in concrete. The addition of plastic waste to concrete can provide several benefits, including an increase in the material's compressive strength, tensile strength, and flexural strength. Moreover, the use of waste plastic can help to reduce the carbon footprint of concrete production, and at the same time, address the issue of plastic waste disposal.

Several types of waste plastic have been investigated as additives in concrete, such as polyethylene terephthalate (PET), high-density polyethylene (HDPE), and polystyrene. The properties of the plastic waste and the processing method can significantly influence the impact of plastic on concrete properties. Therefore, the selection of plastic type and proper processing technique is critical.

However, the use of waste plastic in concrete is still a relatively new area of research, and further investigation is required to optimize the material properties of plastic-enhanced concrete. This project will contribute to the body of knowledge in this field by conducting laboratory tests to investigate the effects of different waste plastic types and percentages on the mechanical and durability properties of concrete. By understanding the optimal conditions for using waste plastic in concrete, this project could provide new sustainable solution for the construction industry while also tackling the issue of plastic waste disposal.

RELATED STUDIES

M. Zakwan Arab and Bahare Kaveh, in Annapolis, MD, USA. Conducting studies on the performance of concrete with recycled plastic waste: several studies have been conducted to investigate the performance of concrete with recycled plastic waste. M. Zakwan Arab and Bahareh Kaveh conducted one of the first experiments to study how recycled plastic debris in concrete affects compressive strength and water absorption. They found that incorporating recycled plastic waste into concrete increased compressive strength and reduced water absorption.

The literature concluded that the performance of concrete in terms of compressive strength, water absorption, and acid resistance could be improved by incorporating recycled plastic waste. However, both positive and negative effects on other parameters such as tensile strength, modulus of elasticity, sulfate resistance, and thermal properties have been documented. More research is needed to fully understand the potential of recycled plastic.

Fahad K. Bin Welah Algahtani has conducted extensive research on lightweight concrete, a low-density concrete commonly used in construction because of its insulating and acoustical properties. In recent years, the use of recycled plastic aggregate in concrete production has become popular as a way to reduce waste and improve the sustainability of buildings. Fahad K. Bin Welah and Algahtani's research focuses on the use of recycled plastic aggregates in the production of lightweight concrete.

A study on recycled plastic aggregates in lightweight concrete. Several studies have been conducted to investigate. Algahtani (2019) investigated the effect of recycled plastic aggregate on lightweight concrete parameters such as compressive strength, flexural strength, and density. Studies have shown that adding recycled plastic aggregate to lightweight concrete increases compressive and flexural strength while reducing density.

According to the literature, incorporating recycled plastic particles into lightweight concrete can improve mechanical performance and durability, such as compressive strength, flexural strength, freeze-thaw cycle, and resistance to fire. It can also lower the density and thermal conductivity of concrete, which can help in sustainable construction. However, more research is needed to fully understand the potential of recycled plastic aggregates.

Narmeel Boyong & Ismail Sayed's work is in the construction sector, and concrete paving blocks are often used for a variety of projects including patios, driveways, and sidewalks. The production of concrete blocks for paving creates waste and by-products that, if not properly disposed of, have an adverse impact on the environment. Researchers are exploring the possibility of using waste and by-products in the production of concrete blocks has been the subject of research by Narmeel Boyong and Ismail Sayed.

A study on the production of concrete blocks for paving using waste and by-products. The use of waste and by-products in the production of paving concrete blocks has been the subject of much research. Boyong and Sayed (2017) investigated how affects the compressive strength, flexural strength, and water absorption of concrete paving blocks. Studies have shown that adding waste and by-products to concrete paving blocks increases compressive and flexural strength and reduces water absorption.

This study demonstrates that by-products and waste components can improve mechanical and durability properties such as compressive strength, flexural strength, freeze-thaw cycles and resistance to fire of concrete blocks for paving. Additionally, the use of waste and by-products when making paving concrete blocks reduces the negative impact of construction on the environment and increases sustainability. More research is needed to fully understand the waste and by-product potential of concrete paving blocks and optimize their use in construction.

Habib Musa Bin Mohamad conducted the research. The compressive strength of concrete is a key factor in the design and construction of concrete structures. To maintain the integrity and safety of concrete structures, laboratory tests evaluate the compressive strength of concrete. In his research, Habib Musa Bin Mohamad explores the use of Pearson's correlation coefficients to evaluate the consistency of concrete compressive strength test results.

A study on the consistent compressive strength test of concrete using the Pearson correlation coefficient the uniformity of the compressive strength test results of concrete has been the subject of many studies. A study by Mohamad (2021) analyzed the use of Pearson's correlation coefficient to test the consistency of concrete compressive strength test results. As a result, it was shown that the use of Pearson's correlation coefficient is effective in verifying the consistency of concrete compressive strength test results and can be used as a tool to ensure the quality and safety of concrete structures.

The data show that using Pearson's correlation coefficient is an effective way to assess the consistency of compressive strength test results for concrete. In addition, since various variables such as curing conditions and types of aggregate affect the consistency of concrete compressive strength test results, it is important to manage these variables to secure the reliability and safety of concrete structures. More research is needed to fully understand the potential of Pearson's correlation coefficient to ensure the consistency of concrete compressive strength test results and maximize its application in construction.

Nisreen Alnimer's research is complete. The construction industry is paying more attention to using waste in concrete production as it can help reduce waste and improve sustainability. One such waste is PVC, which is often used in the construction industry for pipes and other purposes. The use of fine waste PVC aggregate and its effect on the structural performance of reinforced concrete slabs is a research subject of Nisreen Alnimer.

A study on the structural behavior of reinforced concrete slabs using PVC waste fine aggregate. The effect of the use of waste in concrete production on structural behavior has been the subject of numerous studies. A study by Alnimer (2021) used PVC waste fine aggregate in a reinforced concrete slab and evaluated its effect on structural behavior. Studies have shown that adding fine PVC waste aggregate to reinforced concrete slabs improves structural performance and provides a potential means to reduce waste and increase sustainability in the construction sector.

Therefore, studies have shown that adding small particles of PVC waste to reinforced concrete slabs can improve their structural performance. Additionally, the use of waste in concrete production can reduce waste and improve sustainability in the construction sector. More research is needed to fully understand the potential of micro waste PVC aggregates in reinforced concrete slabs and make the most of them in construction.

Nina Sirba & Md Jihad Miah can help minimize waste and increase sustainability. The use of waste in concrete production has recently attracted more and more attention. The work of Nina Sirba and Md Jihad Miah investigates the mechanical and durability properties of recycled plastic eco-aggregate concrete made from Resin8 and PET. Environmentally recycled plastic aggregate concrete: mechanical and durability studies there have been many studies on the effect of waste materials on the mechanical performance and durability of concrete. In a study published in 2021, Sirba and Mia evaluated the mechanical and durability properties of green aggregate

recycled plastic concrete made from PET and resins8. Studies have shown that the use of recycled plastic ecological aggregates in concrete improves its mechanical and strength properties and provides a potentially effective way to reduce waste and improve sustainability in the construction sector.

Therefore, studies have shown that using recycled plastic waste as green aggregate for concrete made from PET and resins8 can improve the concrete's mechanical performance and durability. Recycling for concrete production can also reduce waste and improve sustainability in the construction sector. More research is needed to make the most of it in construction and to fully understand the potential of green aggregate concrete made from recycled plastic waste, Resins8, and PET.

METHODOLOGY

The purpose of the investigation is to strengthen regular concrete using waste plastic. In the concrete mixture, 0.2, 0.4, 0.6, 0.8, 1% of the total mass of coarse aggregate is made of plastic which has been shred. Cast iron cubes 150 x 150 x 150 mm in size were used as compression test specimens. The bending part was cast using a typical mould that was 700 X 150 X 150 mm in size. Then the samples were carefully placed in curing tanks every 24 hours for 7 and 28 days, respectively. Each percentage of shredded plastic provides 9 cubes and 2 beams.

Objectives :

• Reducing the amount of plastic garbage.

• To determine the variation in mechanical properties (destructive tests) of concrete by adding shredded plastic..

• Manufacturing of lightweight concrete.

• Efficient use of shredded plastic waste.

• Investigate the effect of shredded plastic on the compressive strength of concrete.

• Examine the impact of plastic pieces on the concrete's flexural strength.

MATERIAL USED

Cement, Sand, Aggregates, PET Plastic Waste

Tests

Bulk Density

By dividing the object's total mass by its total volume, one can determine the density of any substance or object. Although it may be necessary to employ various techniques to determine the mass or volume of plastic, the density is found using the ASTM D792-98

ASTM D792-98

In accordance with ASTM D792 - 98, the specific gravity (relative density) and density of solid plastics in shapes like sheets, rods, tubes, or moulded products are determined. There are mostly two test methods:

Test method A : Testing the plastic in water.

Test method B : Testing the plastic in other liquids except water.

Slump Flow Test

One of the most crucial tests for self-compacting concrete is the slump flow test. This test is used to figure out how horizontally concrete flows. It is used to assess how well concrete will fill. An exterior inspection of this kind is possible.

Compressive Strength

Compressive strength testing, which is mechanical in nature, establishes the maximum compressive load that a material can sustain before failing. The test specimen, which frequently has the shape of a cube, prism, or cylinder, is compressed between the plates of a compression tester by a gradually applied load.

Flexural Strength

When a beam is put under a three-point stress, the bending test determines how much force is needed to bend it. When choosing materials for parts that do not bend under load, this information is frequently used. Concrete's tensile strength can be calculated using its flexural strength. evaluates the resistance to flexural failure of a slab or beam of unreinforced concrete. calculated by installing concrete beams measuring 6" x 6" (150 x 150 mm) with loads spanning at least three times their depth.

Splitting Tensile strength

The tensile strength of concrete is frequently assessed using a tensile split test. In this test, a biaxial stress field is produced by a compressive stress that is three times greater than the tensile stress.

CONCLUSIONS

- Use of Shredded plastic has been beneficial in increasing the compressive and tensile strength of the concrete.
- The compressive strength of the concrete has drastically improved from 30 N/mm^2 to 36 N/mm^2.
- The strength of the concrete in tensile has also been improved.
- Because plastics are less dense than the small particles that lower concrete's specific gravity, they can be used to substitute some aggregates in concrete. For lightweight, no-load concrete applications like concrete panels, this material is beneficial.

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