Experimental Investigation on the Behaviour of Concrete Brick Adding Glass and Plastic

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***Abstract*—Concrete bricks are used in large quantities. Waste plastic and glass disposal is a major concern, contributing to environmental degradation. This study aims to incorporate plastic (0.25–0.5%) and glass (12–18%) into concrete brick manufacturing. The bricks were tested for compressive strength, water absorption, and efflorescence. Experimental bricks showed improved compressive strength (up to 5.35 N/mm²), reduced water absorption (as low as 8%), and zero efflorescence. These bricks offer better performance and sustainability compared to conventional bricks.**

***Index Terms*—Bricks, Compressive Strength, Glass Waste, Plastic Waste, Sustainable Materials**

I. INTRODUCTION

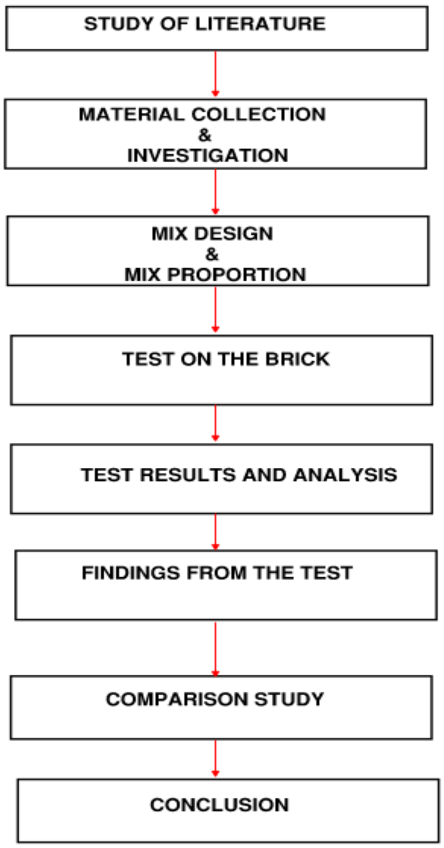
Plastic and glass waste present serious environmental challenges due to their non-biodegradable nature. As the construction industry seeks sustainable alternatives, the incorporation of waste materials in concrete bricks emerges as a practical and eco-friendly solution. This study explores the use of plastic (0.25–0.5%) and glass powder (12–18%) as partial replacement materials in brick manufacturing. The resulting bricks were evaluated for strength, durability, and water absorption, offering insight into their structural viability and environmental impact.

The increase in the popularity of using environmentally friendly, low cost and lightweight construction materials in building industry has brought about the need to investigate how this can be achieved by benefiting to the environment as well as maintaining the material requirements affirmed in the standards. To protect the environment as well as to take advantage of plastic and glass recycling procedure is used. The use of waste plastic and glass for the production of bricks is an optimal method to solve the problem of storing waste materials and to optimize the cost for the production of building materials. In this study, plastic and glass waste in bottle factory will be used to incorporate concrete with to produce concrete bricks. The bricks will then be tested to study the compressive strength, water absorption and efflorescence.

Problems like global warming, hazardous waste, loss of rain forests, endangered species, acid rain, the ozone layer, and the municipal waste crisis can feel out ofour control. At the very least, these problems require group and corporate actioner government intervention. But there are some things the individual can control Our waste reduction and use of waste material in precast blocks can make a difference.

II. METHODOLOGY

The experimental process involved two different mix designs using a ratio of 1:4:3 for cement, sand, and aggregates respectively. Waste plastic and glass powder were added at two levels: 0.25% plastic with 12% glass and 0.5% plastic with 18% glass. After mixing and casting in molds, bricks were cured and subjected to mechanical and physical tests including compressive strength, water absorption, and efflorescence evaluation.



III. MATERIALS

The key materials used in this project include Ordinary Portland Cement (OPC), M-sand as fine aggregate, coarse aggregates, crushed plastic pieces (10–15 mm), and finely ground waste glass (0.5–1 mm). Water conforming to IS standards was used for mixing.

Cement

Most commonly used binding material for concrete is Portland cement. Other binding materials used for this purpose, are lime, fly ash, silica fume etc. The selection of cement for concrete depends on the cement properties.we are used ordinary Portland cement.

Ordinary Portland Cement

Ordinary Portland cement (simply called ordinary cement) refers to the hydraulic binding material ground by mixing Portland cement clinker, 6% ~ 15% blended materials, and appropriate amount of gypsum, code named P•O. The maximum amount of active blended materials mixed in cement should not exceed 15% of the total mass. They are allowed to be replaced by kiln ash and inactive blended materials which should be no more than 5% and 10% of the cement mass respectively. The maximum amount of inactive blended materials mixed in cement should not exceed 10% of the total mass.

Fine Aggregate

The smaller size aggregates in concrete are Fine aggregates. The FM (Fineness Modulus) of fine aggregates can be between 1.2 to 2.5 depending on mix design. We use M sand as fine aggregate in concrete.

M Sand

M-Sand stands for Manufactured Sand. M-sand is crushed aggregates produced from hard granite stone which is cubically shaped with grounded edges, washed and graded with consistency to be used as a substitute of river sand. It is a fine aggregate that is produced by crushing stone, gravel, or slag.

Coarse Aggregate

Big sizes aggregates in concrete are coarse aggregates. The size of it varies between 1/2″ to 1.5″ depending on concrete mix design. Crushed stone or brick chips are used as coarse aggregate.

Crushed Stone

Crushed stone is the main sources of natural aggregate. These are granular materials composed of rock fragments that are mined or quarried and used in their natural state except for such operations as crushing, washing, and sizing

Water

The most important concrete ingredient is water. Water can decrease and increase the concrete strength. Water just starts and continues the chemical reaction of cement. The high-water content in the concrete mix increases the workability of concrete but decreases the strength. On the contrary, low water content increases the concrete strength but makes concrete less workable

Plastic

Plastics are commonly used substances which play an important role in almost every aspect of our lives. The widespread generation of plastics waste needs proper end- of-life management. The highest amount of plastics is found in containers and packaging's (i.e. bottles, packaging, cups etc.), but they also are found in durables (e.g. tires, building materials, furniture, etc.) and disposable goods (e.g. medical devices).). Post- production and post-consumer plastics are utilized in a wide range of applications. Crshed plastic is used for brick making.size of plastic piece 10-15 mm.

Glass Powder

Glass is an amorphous material with high silica content making it potentially pozzolanic when particle size is less than75µm. The main problem in using crushed glass as aggregate in Portland cement concrete are expansion and crackingcaused by the glass aggregate due to alkali silica reaction

IV. TESTS CONDUCTED

A series of tests were conducted to assess the properties of experimental bricks:

• Compressive Strength Test

Compressive strength test on bricks are carried out to determine the load carrying capacity of bricks under compression with the help of compression testing machine.

• Water Absorption Test

Bricks are dry and porous; therefore, it has the ability to release and absorb moisture inherently from the weather/mortar/Concrete. If the brick dry, absorbs moisture from water when laid, the mortar will become weak and poor. It fails to make the bond between bricks and mortar due to insufficient water for the hydraulic reaction of cement in the mortar and overall reduces the strength of construction

• Efflorescence Test

Efflorescence is a whitish crystalline deposit on surface of the bricks. Usually magnesium sulphate, calcium sulphate and carbonate of sodium and potassium are found in efflorescence. The movement of groundwater into the foundations of buildings and by capillary action into brickwork is very often the cause of Effloresence.

• Hardness Test

A good brick should resist scratches against sharp things. So, for this test a sharp tool or finger nail is used to make scratch on brick. If there is no scratch impression on brick then it is said to be hard brick.

• Soundness Test

In this test two bricks are held by both hands and struck with one another. If the bricks give clear metallic ringing sound and don't break then those are good quality bricks.

V. RESULTS AND DISCUSSION

The results indicate improved performance in bricks with added plastic and glass. The compressive strength increased from 4.25 N/mm² (control) to 5.35 N/mm² (0.5% plastic and 18% glass). Water absorption reduced from 16% to 8%, while efflorescence was found to be nil in all experimental samples. The bricks exhibited good hardness, soundness, and better surface finish than conventional bricks.

 COMPRESSIVE STRENGTH TEST

1. Brick in Locally available
Compressive strength = 8500/20000 = 4.25 N/ mm2

2. Brick ratio 0.25 % plastic and 12% glass powder Compressive strength = 97500/20000 = 4.875 N/ mm2

3. Brick ratio 0.5% plastic and 18% glass powder Compressive strength = 107000/20000 = 5.35 N/ mm2

 WATER ABSORPTION TEST

Water absorption,

1. brick in Locally available = (3.300-3.140) ×100 = 16 %

2. Experimental brick 0.25 % plastic and 12% glass powder added Water absorption = (3.020 - 2.910) ×100 = 11 %

3. Experimental brick 0.5 % plastic and 18% glass powder added Water absorption = (3.070 - 2.990) ×100 = 8 %

 EFFLORESENCE TEST

Results:

Results of efflorescence test shall nil If there is no noticeable deposit of efflorescence

 HARDNESS TEST

Result:

Not scratches visible the brick is hard.

 SOUNDNESS TEST

Result

The brick gives clear metallic sound and the brick is good quality.

VI. CONCLUSION

Incorporating plastic and glass waste into concrete bricks is a sustainable and practical approach to reduce environmental impact while enhancing structural properties. The experimental bricks showed superior compressive strength, reduced water absorption, and excellent durability, proving suitable for construction applications. This technique offers a cost-effective and eco-friendly solution to waste disposal and resource conservation.

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