

Utilization of Glass Powder in Fly Ash Brick

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Abstract: Glass waste is the problematic threat to environment and also to the developing countries. In this study glass powder is used as a replacement material for stone dust. The stone dust was replaced by the glass powder in the various proportion. Million tons of waste glass is being generated annually all over the world. Once the glass becomes a waste it is disposed as landfills, which is unsustainable as this does not decompose in the environment. Two types of Fly ash bricks were casted. In first type ,only fly ash is used to prepare the brick and another type Soda lime glass replaced in stone dust bricks. The prepared bricks are cured for 7days and 14days dried in regular temperature. The tests results shows the compressive strength of the brick with 20% replacement of soda Lime glass powder revealed 3.08N/mm² , 4.43 N/mm² provokes the excellent performance. The water absorption, hardness are experimented.

Keywords: Fly Ash, Soda Lime Glass Powder, Cement, Stone Dust.

1. INTRODUCTION

Waste is the common environmental threat to India as well as to the developing countries. Most municipalities dumping 95% waste in the land and remaining 5% waste used for alternative method. Especially the glass wastes are increasing in terms of 2% to 4% tones per year. Glass is an amorphous (non- crystalline) solid material. Glass also a non degradable component in which provides the hazardous properties to the landfill. But those materials provide glass transformations states it helps the reversible transformation in amorphous materials from a hard and relatively brittle state into a molten state. Glass are in strong demand to utilize the waste glass to the alternative materials. The most familiar types of glass are based on the chemical compound of silica (silicon oxide) which is the primary constituent of sand. Glass waste are collected and disposed in the landfill.

This will create an environmental issues on global network. In today's environment the Main aim is to manufacture the building materials without any impact on environment. In this situation it is necessary to concentrate on recycle and reuse of waste materials. At the same time the waste material should not affect the strength and should have low cost.

However it's environmental footprint has raised concerns.

In response, researches have turned to incorporating glass powder, a recycled material, to enhance the sustainability of fly ash bricks.

The fusion of fly ash and glass powder offers a myriad of advantages, including reduced carbon emissions, enhanced durability, and decreased reliance on traditional clay bricks. Moreover, by diverting glass waste from landfills and incorporating it into construction

materials, this approach contributes to the circular economy paradigm, fostering resource efficiency and waste reduction.

Through meticulous research and experimentation, engineers and scientists have endeavoured to create a product that not only meets structural requirements but also always aligns with environmental stewardship principles. Through collaborative efforts between academia industries, potential to revolutionize the construction landscape, paving the way for a more sustainable future.

2. MATERIALS AND METHODS

2.1 Fly Ash

Fly ash is the fine powder formed from the mineral matter in coal, consisting of the noncombustible matter in coal and a small amount of carbon that remains from incomplete combustion. Fly ash is generally light tan in color and consists mostly of silt- sized and clay-sized glassy spheres.

The fly ash material under the category of Class F, containing SiO_2 , Al_2O_3 , Iron Oxide on total amount of 70% in composition. This Class F contains mostly pozzolonic materials with lower calcium oxide content. Meanwhile those materials are free from the power stations. They are remained to bury in to the ground. The available residual material FA is used in the brick.

Fly ash can vary in colour from light grey to dark grey, depending on its composition and source. Fly ash is generally porous, which can affect its water absorption and permeability characteristics when used in construction materials.

2.2 Glass Powder



Glass powder helps in reducing the thermal conductivity of bricks. This property is beneficial for insulation purposes providing better energy efficiency and reducing heat transfer.

Fineness Modulus: This test determines the particle size distribution of the glass powder. It involves determining the percentage of particles passing through various sieve sizes. The fineness modulus is calculated based on the results providing an indication of the grading of glass powder.

1. **Specific Gravity:** The specific gravity of glass powder is determined using a standard procedure. It helps evaluate the density of glass powder compared to water and provides insights into its porosity and compactness.

2.3 Cement

Cement is added to the mixture to provide binding properties to the bricks and improve their strength and durability. Water is added to the mixture to provide the necessary moisture content for manufacturing. It helps bind the raw materials together and allows for brick formation. Combining these raw materials produces high- quality, cost- efficient, and environmentally friendly fly ash bricks. Depending on the particulars of the production process, such as the required strength and texture of the bricks, the exact proportion of these elements will vary.

Field Tests of Cement

- 1. Date of Manufacturing:** As the strength of cement reduces with age, the date of manufacturing of cement bags should be checked.
- 2. Cement Color:** The color of cement should be uniform. It should be typical cement color i.e. gray color with a light greenish shade.
- 3. Whether Hard Lumps are Formed:** Cement should be free from hard lumps. Such lumps are formed by the absorption of moisture from the atmosphere.
- 4. Temperature Inside Cement Bag:** If the hand is plunged into a bag of cement, it should be cool inside the cement bag. If hydration reaction takes place inside the bag, it will become warm.

2.4 Stone Dust

Stone dust is a natural and renewable resource making it an environmentally friendly choice for brick production.

Additionally stone dust bricks can be recycled and reused in construction projects minimizing waste and promoting sustainability.

Stone dust has a high plasticity which means it can be easily molded and shaped when wet. This property allows it to be formed into various brick shapes and sizes giving flexibility in design and construction.



3. MIX PROPORTION

This study consists of five different mixtures for two types of bricks were prepared and casted .The dimension of the non-modular brick are chosen according to the Indian Standard

(IS12894:2002)- 230mmX110mmX70mm.

This study consists of five different mixtures for two types of bricks were prepared and casted .The dimension of the non-modular brick are chosen according to the Indian Standard.

In the first type only fly ash used to prepare the brick. In the second type, stone dust is partially replaced with Soda-Lime glass powder for the preparation of brick. Throughout the project, the glass powders (Soda lime glass powder) is replaced instead of stone dust with various percentages

i. e. 5%, 10%, 15%, 20%, and 25%.

4. BRICK PRODUCTION

Brick manufacturing involves the following steps:



1. **Mixing the Raw Materials:**

The raw materials, namely fly ash, cement, soda lime glass powder, stone dust and water are mixed in a pan mixer or a batching plant. The mixture is then transferred to a brick moulding machine.

2. **Moulding:**

The mixed material is moulded into bricks using a machine. The machine's hydraulic system compresses the material into the desired shape and size.

3. **Curing:**

The bricks are put on wooden pallets and cured for 7– 14 days. The bricks are kept wet during the curing process to prevent breaking and ensure they are sturdy and long-lasting.

4. **Drying:**

The bricks are air dried for 24 hours until they get hard.

5. RESULTS AND DISCUSSION

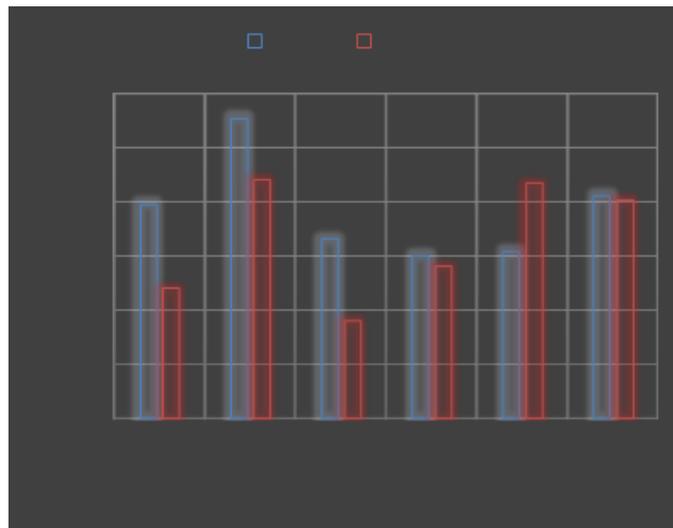
The tested results of the samples containing stone dust replaced Soda lime glass powders at the respective rate of 5%, 10%, 15%, 20%, 25% with the Dimension of brick-230x110x70mm.

6. COMPRESSIVE STRENGTH TEST

The compressive strength of the brick is done to find the amount of stress that the brick can withstand their respective area cross section by using the universal testing machine.

The result shows that the percentage of 20% replacement of soda lime glass powder samples

with 7th and 14th day curing, provokes the compressive strength of about 3.08,4.43N/mm² . The maximum compressive strength was attained in 20 % replacement of soda lime glass powder in fly ash bricks strength. Thus, the glass powder particles have the inherent capacity to increase the strength of the bricks.



7. SOUNDNESS TEST

The soundness test of bricks signifies the nature of bricks against the sudden impact. For a brick having good soundness should not break and give a clear ringing sound when suddenly struck with each other. A soundness test was performed for all the bricks prepared with the addition of waste glass powder. After striking 2 random bricks against their faces, a clear metallic sound was heard, which signifies that they are first class brick.

8. HARDNESS TEST

In the series of various physical tests, one such test is performed in which a scratch was tried to be made on a brick surface by using a hard material. In this work, no such scratch mark was observed even with the repeated trials. This ensured that the brick is sufficiently hard enough even with the addition of glass powder. This ensured that the brick is sufficiently hard enough even with the addition of glass powder. From this observation, it can easily be inferred that glass powder does not have any effect on the scratch-resistant characteristics of the brick, i.e. hardness characteristics of the fired brick.

9. CONCLUSION

Based on the experimental investigation, following are the conclusion can be concluded. When compared to the ordinary fly ash bricks the cost of bricks are reduced by 25%.The Compressive Strength of soda lime glass powder is 20% replaced by fly ash brick provide

optimum values 3.08 (N/mm²) and 4.43 (N/mm²).

By incorporating this waste material into the brick-making process, it not only reduces the environmental burden of glass disposal but also enhances the strength and durability of the bricks. Thus, Glass powder can inhibit the inherent capacity to relate with the fly ash properties and increase the strength of the bricks. Thus, fly ash-glass powder bricks can reduce the production cost as well as be feasible for the construction industry.

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