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Experimental Studies on Waste Glass Powder in Manufacturing of Fly Ash Bricks

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Abstract:
Fly ash bricks have an important place in the modern building industry. They are cost effective and better alternative to burnt clay bricks by virtue of their good durability, fire resistance. In order to utilize the waste material in an effective manner used to add fine aggregate by glass powder in cement bricks up to 10% in the increment of 100 by the weight of fine aggregate. After casting 7^{th}& 14^{th} day compressive strength and Brick water absorption test will be determined for the various proportions. After that brick strength, cost, weights are compared to conventional fly ash brick & clay brick.

1. Introduction

Fly ash bricks have an important place in the modern building industry. They are cost effective and better alternative to burnt clay bricks by virtue of their good durability, fire resistance, partial resistance to sound, thermal insulation, small dead load and high speed of construction. A fly ash brick being usually smaller in size than the normal clay building bricks and less mortar is required, faster of construction is achieved.

Also building construction with Fly ash cement bricks provides facility for concealing electrical conduit, water and sewer pipes wherever so desired and requires less plastering.

At this time of days, buildings are constructed from clay & fly ash brick, consequently the clay brick manufacturing process to gain high quantity of natural clay and red soils day by day the land condition will be low and occurs poor earthquake resisting performance. Many previous researches undertaken, obtained valuable results to introduce new brick in construction, however, those people could not gain better results.

The medicine bottles and tube lights' waste glass is a major problem for municipalities worldwide due to high disposal cost and environmental concerns. Although the waste glasses have a low recycling rate have been dumped into landfills and day by day land will be polluted so in this project to gain a high amount of waste glasses are recycled to valuable process.

Along with this project can be introduced new brick its stronger, better than alternative brick. And brick can be manufactured on waste glass powders.

2. Material and Methods

2.1. Fly Ash

Fly ash is residue resulting from combustion of pulverized coal or lignite in thermal power plants. About 80% of total ash are in finely divided form, which is carried away with flue gases and is collected by electrostatic precipitator or other suitable technology. This ash is called as dry ash or chimney or hopper ash. The balance 20% of ash gets collected at the bottom of the boiler and is referred as bottom ash. Fly ash is very fine compared to cement, however, some particles have a size less than 1 micron in equivalent diameter. For this investigation fly ash was bought from commercial store.

- Glass Powder: Silica is the main constituent of glass. Medicine bottles contain high amount of silica presents. And tube lights are most commonly contained soda-lime-silicate glass material.
- Glass Powder Manufacturing: The following processes are involved in waste glass powder manufacturing.

2.2. Collection of Waste Glass

The useless tube light was collected directly from the municipal damping yard .For this project the useless tube light was collected from Karaikudi municipal dumping yard. And waste medicine bottles are collected from various hospitals and clinic. For this Project the waste medicine bottles were collected from Karaikudi and Devakottai area hospitals and Karaikudi municipal dumping yard.

Figure 1: Waste medicine bottles

Figure 2: Waste tube lights

2.3. Eradicate the Wrapper & Unnecessary Material

Medicine bottles are also manufactured from glass material and the bottles surface are finished labels. Waste medicine bottles are tamped in water into 24 hours. Finally labels are easy to remove by hand. For a time unnecessary materials are removed from tube lights.

2.4. Crushing Process

Medicine bottles and tube lights are crush into hammer and lastly broken glasses are grinding on machine finally to collect on glass powder. Glass powders are white yellowish colored, and sized maximum 4.25 mm. Fig 3 & 4 shows on broken tube lights & waste glass powder.

Figure 3: Busted tube lights

Figure 4: Waste glass powder

- SAND: Locally available river sand used in this brick manufacturing work, this is reacted by fine aggregates.
- WATER: Water fit for drinking is generally considered fit for making concrete. Water should be free from acids, oils, alkalis, vegetables or other organic impurities. Soft waters also produce weaker concrete. Water has two functions in concrete mix. Firstly, it reacts chemically, with cement from a cement paste in which the insert aggregates are held in suspension until the cement paste has hardened. Secondly, it serves as a vehicle or lubricant in the mixture of fine aggregates and cement.In this project we have used normal drinking water. It was collected from Ramanathapuram municipal. And it has pH value of 6.8
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2.6. Mix Proportions

S. No	Proportions	Fly ash in %	Waste glass powder in %	Sand in %
1	Mix- 1	100	10	90
2	Mix-2	100	20	80
3	Mix- 3	100	30	70
4	Mix- 4	100	40	60
5	Mix- 5	100	50	50
6	Mix- 6	100	60	40
7	Mix- 7	100	70	30
8	Mix- 8	100	80	20
9	Mix- 9	100	90	10
10	Mix- 10	100	100	0
TOTAL		1000	550	450

Table 1: Mix proportions

3. Results and Discussion

3.1. Compressive Strength

In this test the specimen brick is tested on the compression testing machine between the pressure plates on various days. Compression test decides the strength of the brick. This test was carried out by compression testing machine. The brick is loaded gradually increasing the pressure between the pressure plates of the machine. The brick is pressed till the breaks. This test was carried out on the three different age's 7^{th} & 14^{th} & 21^{th} day from the date of casting.

3.2. Compressive Strength@ 7, 14, 21days

SL.NO	TYPES OF SPECIMEN	COMPRESSIVE STRENGTH IN N / mm^2		
		7 days	14 days	21 days
1	Conventional Fly ash brick	7.890	8.530	13.47
2	Conventional Clay brick	6.630	10.86	8.93
3	Mix- 1	6.956	8.690	12.60
4	Mix-2	7.170	9.340	13.04
5	Mix- 3	7.608	9.780	13.26
6	Mix- 4	7.695	10.210	13.52
7	Mix- 5	7.820	11.950	14.02
8	Mix- 6	7.608	10.650	12.82
9	Mix- 7	7.391	9.780	12.60
10	Mix- 8	7.173	9.560	12.43
11	Mix- 9	7.065	9.130	12.39
12	Mix- 10	6.956	8.910	12.34

Table 2

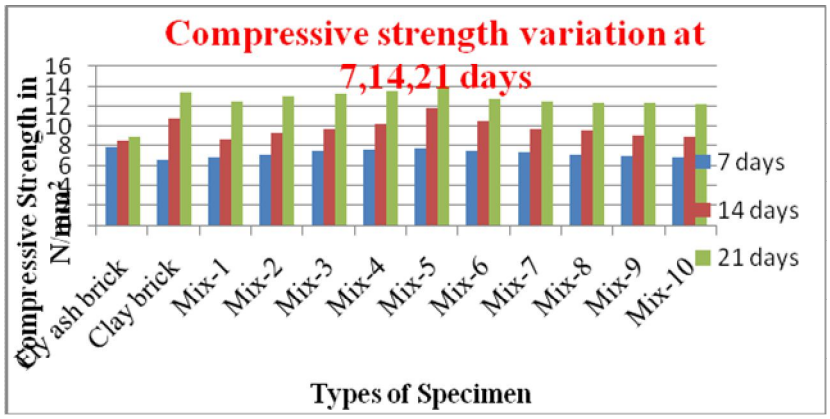

Figure 5: Compressive strength variation at 7,14,21 days

3.3. Water Absorption Test

Water adsorption test is used to find out the water absorption ratio. Because the brick, which are absorbing more water cannot be used in water logging area or exterior walls which is open to the sky.

As per IS standard, the brick should not absorb water more than 20% of its weight. Given mix-1 to mix-10 have a water absorption value less than 20% so its suitable for all type of walls .Fig 6 showed the water absorption value of manufactured bricks.

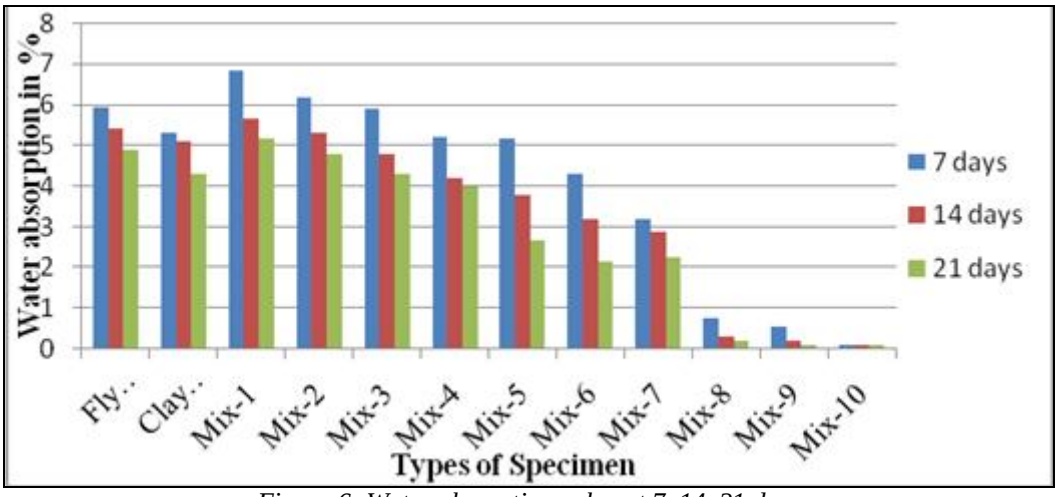

Figure 6: Water absorption value at 7, 14, 21 days

3.4. Weight Analysis

The manufacture of waste glass powder bricks was one of the major objectives of this project. All the bricks were tested for their weight after 21 days from the date of moulding. The ordinary conventional brick weight ranges from 3 kg to 4kg per brick. But manufactured waste glass powder, brick weight ranges from 2 kg to 2.8 kg per brick. The maximum weight is less than 2.8 kg. So this bricks were termed as lightweight and it will also reduce total cost of construction due to the reduction in dead load. Fig 7 showed the weight of the manufactured bricks

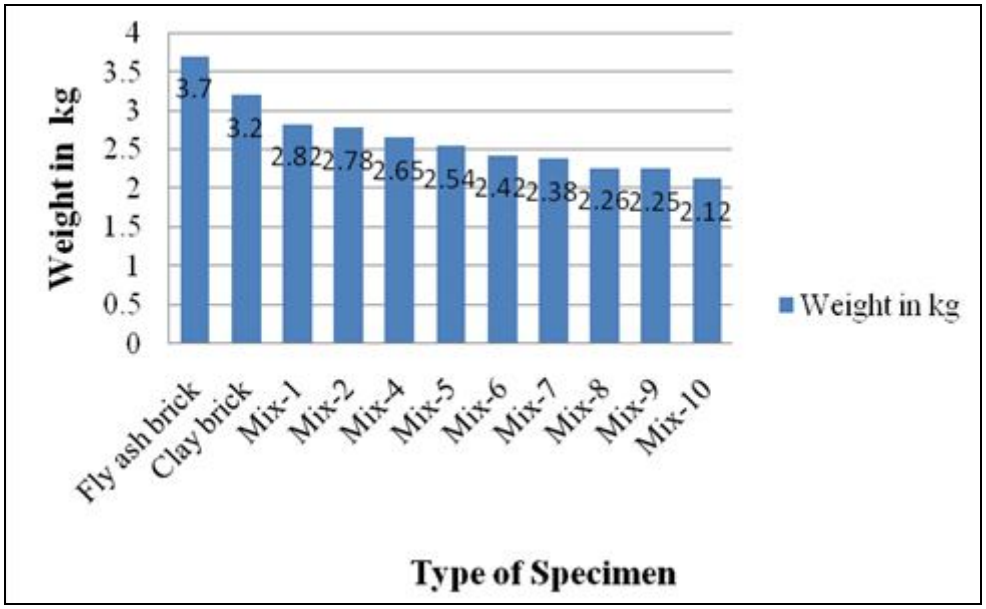

Figure 7: Weight in Kg

3.5. Cost Analysis

The waste glass powder bricks were subjected to cost analysis on the basis of 100 brick production. From that, the cost of one brick was calculated.

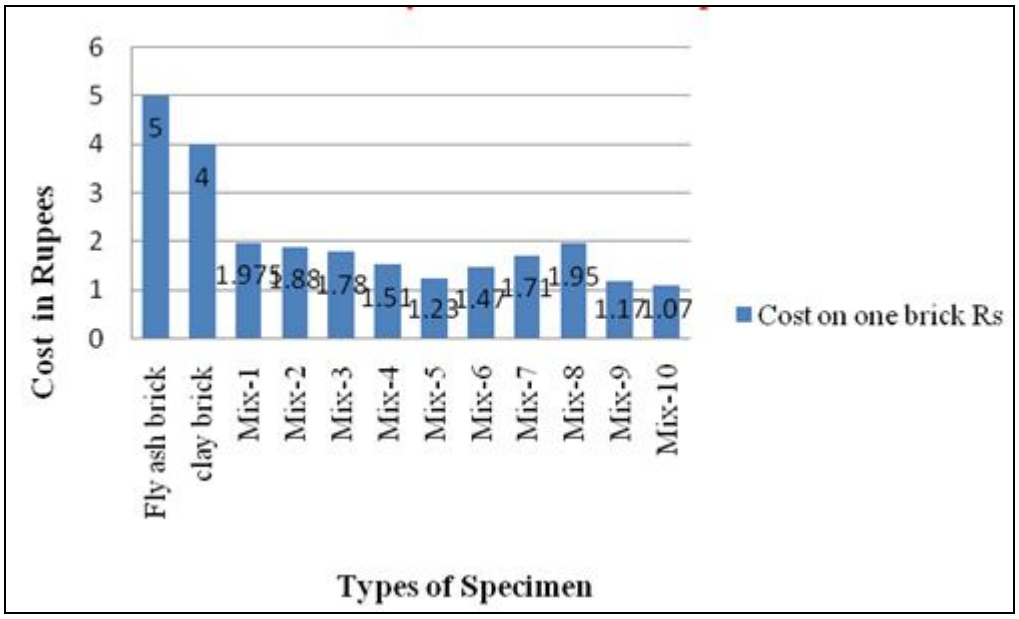

Figure 8: Cost analysis on one brick rupees

4. Conclusion

The following conclusions are drawn based on the experimental investigations and results obtained from those tests, which are follows:

1. The water absorption value of brick is lesser than the conventional fly ash& clay brick.
2. The weight of this brick is 30% to 50% lesser than the conventional fly ash& clay brick.
3. Due to less weight of these bricks, the total dead load of the building will be reduced. Since, the waste glass materials are used; it will reduce the landfills and pollution.
4. The cost of brick is 60% lesser than the conventional fly ash & clay brick.
5. Using this waste glass powder brick in a building construction cost will be lower than the conventional fly ash& clay brick.
6. The compressive strength of Mix-5 (50% glass +50% sand used) in 21 days is 14.02 N/mm^2
7. The compressive strength of brick is 30% higher than the conventional fly ash brick.
8. The compressive strength of brick is 50 % higher than the conventional clay brick.

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