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Use of Aluminium foil and Glass powder waste in fly ash brick production

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ABSTRACT: In this paper, waste materials such as aluminium foil and glass powder waste are used in manufacturing fly ash bricks. Such wastes which cannot be recycled and takes longer time for breakdown can be considered as an alternative to raw materials. Recycling or reusing of such wastes is a very positive contribution in saving our natural environment. In order to utilize the waste material in an effective manner we have replaced sand by aluminium foil in range of 10-20% and cement by glass powder in the range of 10-30%. It is observed that bricks made using aluminium foil and glass powder waste can be used as an alternative to other bricks.

KEYWORDS: Fly ash, waste, aluminium foil, glass powder, cost

I. INTRODUCTION

The cost of construction materials is increasing day-by-day and also the cost of construction, so it is necessary to find alternatives to those costly materials which should not affect brick properties, waste material can be used as an alternative and various researches and experiments have been carried out and it was observed that using waste materials in bricks are more effective and obtained good results in every aspect as compared to conventional bricks. By using wastes in brick its effective properties can be useful to bricks. In this project we have used waste materials such as aluminium foil waste and waste glass powder. Aluminium foil is more harmful than plastic to environment. It's generally easy to recycle aluminium foil if it is clean but aluminium foil is usually contaminated by grease and oils from food or, in a lab setting, adhesives and tapes. Since contaminants can damage recycling equipment and create an inferior end product, countless tonnes of waste foil are landfilled or incinerated every year.

Glass is used in a variety of applications right from construction, automobiles, nosediving submarines, doors and windows, utensils, waste containers, windscreen, medicinal bottles, soft-drink bottles, tube lights, bulbs, electronic equipment, etc. Hence, the usage of glass has increased considerably, which has in essence, contributed to the increase of waste disposal. In addition, glass waste is considered as non-decaying material that pollutes the surrounding environment. Most of recovered waste glass is used by glass manufacturing company in the production of new glasses such as bottle and etc. But only a limited amount from the waste glass collect is that can be used toward the production of new glass.

The objective of this project is to use wastes in bricks to produce eco-friendly bricks. Beneficial properties of aluminium foil and glass powder waste will enhance properties when added in mixture of fly ash bricks, therefore manufacturing fly ash bricks using such wastes will be cost effective and will consist of more properties as compared to normal bricks.

II. MATERIALS

A) Aluminium foil waste:

Aluminium foil is light in weight, good in ductility, has a high barrier to water, steam, light and fragrance, and is not affected by the environment and temperature. The aluminium foil is stable at high and low temperature. It does not shrink at $-73 \sim 371$ °C, and has good thermal conductivity.



Fig.(a) Aluminium foil

B) Fly ash:

Fly ash is a residue resulting from combustion of pulverized coal or lignite in thermal power plants. About 80% of the total fly ash is in finely divided form which is carried away with flue gases and is collected by electrostatic precipitator or other suitable technology. The balance 20% of ash gets collected at the bottom of the boiler and is referred to as bottom ash. Fly ash goes into a fine powder in the comparable to cement.



Fig.(b) Fly ash powder

C) Sand:

The silica material was utilized as a fine aggregate in concrete and mortars. Natural river sand is the most preferred choice as a fine aggregate material. River silica sand is a product of natural weathering of rocks over a period of millions of years. It is mined from the river beds. River sand is far superior for construction purposes than any other sand used in construction.

D) Waste Glass powder

Glass is a transparent material produced by melting a mixture of materials such as silica, soda ash, and CaCO_3 at high temperature followed by cooling during which solidification occurs without crystallization. A glass powder is also used as a binder with partial replacement of cement which takes some part of reaction at the time of hydration; also it is act as a filler material. A denser (less porous) and more homogeneous structure is produced when milled waste glass is used as partial replacement for cement, which benefits the resistance to moisture sorption and the long-term durability of cementitious materials.

**Fig. (c) Glass powder****E) Cement:**

The manufacturing of Cement was conducted by heating limestone (calcium carbonate) with small quantities of other materials (such as clay). A cement is a binder, a substance used for construction that sets, hardens, and adheres to other materials to bind them together. Cement is seldom used on its own, but rather to bind sand and gravel (aggregate) together cement will act as a binding material.

Physical properties of cement

SR.NO.	TEST	STANDARDS
1	Initial setting time	30 MINUTES
2	Final setting time	600 minutes
3	Fineness	Not less than 90%
4	Sp. Gravity	3.10 to 3.15
5	Standard consistency	30 to 35%

III. METHODOLOGY**1. Collection of raw material& waste material:**

It includes collection of materials to be used in manufacturing brick such as fly ash, cement, sand, aluminium foil waste, glass powder waste. Aluminium foil waste can be collected from garbage collector and other materials from nearby dealers.

2. Mixing material in rotary mixer in proportion:

All collected materials are mixed by rotary mixer as per the mix proportion mentioned in below table.

NO.	MIX PROPORTION (in %)				
	FLY ASH	SAND	CEMENT	ALUMINIUM FOIL	GLASS POWDER
1)	50	40	10	-	-
2)	50	33	9	7	1
3)	50	30	8	10	2
4)	50	27	7	13	3

3. Moulding:

The mixed material is placed and compacted in mechanical compression machine to gain required shape and size.

4. Curing:

The prepared bricks are cured for 7days and 21days and dried in regular temperature. The curing of bricks is done by covering it with gunny bags and moisture is maintained regularly.

IV. RESULTS**1. COST ANALYSIS**

Let us consider the batching process is performed in a pan mixer of capacity of 500kg and find the cost for one brick. Calculation:

Calculating for 500kg total input material according to mix 2.

Materials	Proportion (%)	Weight (kg)	Rate (Rs./kg)	Amount (Rs.)
Fly ash	50	250	1	250
Sand	33	165	0.7	115.5
Cement	9	45	6	270
Aluminium foil	7	35	2	70
Glass Powder	1	5	5	25
Total Cost				730.5

Total expenditure for 500kg raw materials = Rs. 730.5

Avg. wt. of brick – 2.6kg

No. of bricks = $500/2.6 = 192.31$

Total input material – 500kg

Consider 190 bricks

Cost of one brick = $730.5/190 = \text{Rs. } 3.84/\text{brick}$

Other charges for one brick:

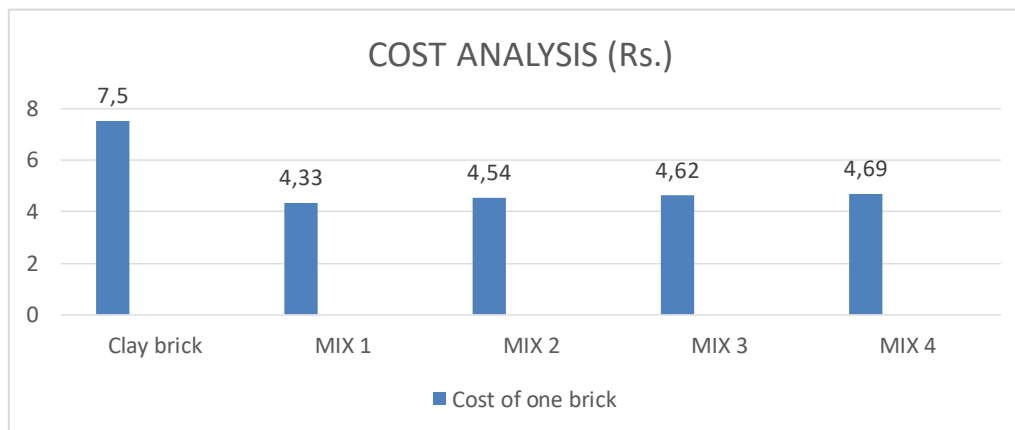
Electricity - Rs. 0.10

Labour - Rs. 0.50

Other - Rs. 0.10

Total cost of one brick = Rs. 4.54/brick

Similarly, calculating cost for other mix proportion,



2.COMPRESSIVE STRENGTH

The compression testing machine is used for testing the compressive strength of bricks. After the curing period of 7days and 21days gets over bricks are kept for testing. To test the specimens the bricks are placed in the calibrated Compression testing machine of capacity 2000 kN applied a load uniform at the rate of 2.0 kN/min. The load at failure is the maximum load at which specimen fails to produce any further increase in the indicator reading on the testing machine.

No.	Material proportion (in %)					Compressive strength (Mpa)
	Fly ash	Sand	Cement	Aluminium foil	Glass powder	
1)	50	40	10	-	-	7.5
2)	50	33	9	7	1	5.5
3)	50	30	8	10	2	5.6
4)	50	27	7	13	3	5.4

V. ENVIRONMENTAL IMPACT

- Aluminium foil is actually far worse for the environment than plastic wrap across the board, use of fossil fuels, water pollution, human health impacts, and greenhouse gas emissions. Mining bauxite (the raw material in aluminium) and processing it takes a lot of energy. To produce one ton of plastic wrap uses 83% less energy and 88% less greenhouse gas emissions than the same amount of aluminium foil. It is a material which takes around 400 years to breakdown and also makes the soil infertile during landfill. Recycling centers do not accept foil and trays due to the fact that they often contain food waste which can contaminate collection. So it is necessary to handle this aluminium foil waste properly.
- The waste glass is one of the issues of environmental problem. The usage of glass has increased considerably, which has in essence, contributed to the increase of waste disposal. In addition, glass waste is considered as non-decaying material that pollutes the surrounding environment. Manufacturers collect only a limited amount from the waste glass that can be used toward the production of new glass and exclude waste glass that mixed with colour. Such mixed coloured glass wastes are discarded can ends up causing pollution.
- Such rejected aluminium foil and mixed coloured glass waste can be used in fly ash brick and we can avoid such wastes from polluting the environment.

VI. CONCLUSION

From the above research it can be concluded that

- 1) This brick can be used as an alternative to clay bricks where it proves to be cost effective and provide better strength as compared to clay bricks.
- 2) Aluminium foil is lighter in weight this helps in reducing weight of brick and the glass powder helps in increasing the strength of brick.
- 3) Cost of brick using aluminium foil and glass powder material is slightly higher than normal fly ash brick but as this brick will be lighter in weight, more bricks can be transported during transportation as compared to other bricks at similar transportation cost.
- 4) As aluminium foil does not absorb water and glass powder absorbs less water, the water absorption of brick will be less.
- 5) Using aluminium foil waste and glass powder waste as brick material is a solution to the problem of waste disposal and land pollution.

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