

# Use of Glass-Fibre and Textile Waste for the Manufacturing of Fly-Ash Bricks

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**ABSTRACT:** As there is a humongous increase in population, there is abundant waste, which is, being generated that causes adverse effect on the environment. Therefore, the need of the hour is to re-cycle the industrial waste for optimum disposal of waste and to conserve and replace the fast depleting current resources and materials. One of the way of doing so is by the use of fly ash, textile waste and glass fibres in manufacturing of bricks by replacing the parent material i.e., clay (a natural resource). These fly-ash bricks are almost two-third in weight of conventional burnt clay bricks and the compressive strength is quite high. Water absorption and efflorescence is quite low and other field test also indicate that fly-ash bricks are better alternative of burnt clay bricks. This paper represents the pioneering use solid waste in different proportions such as fly ash, glass-fibres and textile waste to increase the strength of the bricks. This paper also represents the test which are performed on the said bricks and also its results.

**KEYWORDS:** Burnt clay, Fly-ash, Bricks, Textile waste, Glass-fibres, Recycling.

## I. INTRODUCTION

I Conventional bricks are being used extensively in India. But this level of usage is harmful for the environment as the clay is obtained from agricultural fields by excavating it. This excavation causes erosion of land. At present, India has production capabilities of over 10,000 Crore bricks through around 45,000 local kilns (bhattas), in the unorganized sector. Assuming a weight of 3 kg. Per brick, the total clay taken out from the agricultural fields per day was over 300 million tonnes for 10,000 Crore bricks.

Energy requirements for many countries get energy from coal which produces a large amount of thermal waste mainly fly-ash. The proper disposal of this is need of the hour for these areas. Fly ash is composed of the non-combustible mineral portion of coal which is used. Fly ash is a powdered substance obtained from dust collectors of the chimneys of the power plants that use coal as fuel. There are two major types of fly-ash Class F and Class C.

Glass fibre is a material consisting of numerous extremely fibres of glass. Glass is mainly made from silicon (SiO<sub>2</sub>) with a tetrahedral structure (SiO<sub>4</sub>). Some aluminium oxides and other metallic ions are then added in various proportions to either ease the working operations or modify some properties Fibre glass is a light weight, extremely strong material. These fibres are commonly used in the construction industries for high performance. Their particular characteristic is their high strength.

The textile industry is one of the oldest, largest and important sectors in India. It generates liquid and solid waste from its different processes. Government has allotted specific location for its removal. Generated sludge is mostly disposed in landfill and dumping in the specified areas by Government. The transportation and disposal process is very

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costly. The textile waste composition falls within the range of 0.5-1% from the total Composition of municipal solid waste collection. However, the garment industry may generate humongous amount of waste ranging from 19,000 to 38,000 tons annually, as the garment cutting waste is approximately 10 - 20% of the total fabric consumption. Considerable amount of textile waste is dumped in open areas and incinerated after removing small percentage for recycling and reuse. This accumulation of textile waste from all over the country is one of the major cause of severe environmental and health hazards.

Thus lack of strength in burnt clay brick, it's cost factor and an indigenous way required for the waste management of these waste have forced engineers to use fly-ash, textile waste and glass fibre for manufacturing of bricks. It helps to increase the strength of the brick and to reduce it's self-weight.

## II. ESSENTIAL MATERIALS

**FLY ASH:** Fly ash is a waste which is been generally produced in thermal power stations. It is been produced from coal. So this waste is been used as an admixture for the manufacturing of the bricks, as disposal of waste is a major problem.

**GLASS-FIBRES:** Glass fiber is a material consisting of numerous extremely fine fibers of glass. Fiber glass is a light weight, extremely strong material. These fibers are commonly used in the construction industries for high performance. Their particular characteristic is their high strength. Glass is mainly made from silicon (SiO<sub>2</sub>) with a tetrahedral structure (SiO<sub>4</sub>). Alkali Resistant fiber glass is been used having length 13 mm and diameter of 13.5µm.

**TEXTILE WASTE:** Solid textiles waste (100% polyester material) is being used. It's generally procured from houses and stitching industries and shredded into small pieces of 10mm\*10mm.

**CEMENT:** Cement play the role as a binder. OPC 53 grade is been used a binder. It has a specific gravity of 3.15 g/cm<sup>3</sup>.

## III. METHODOLOGY AND MIX PROPORTIONS

Regular fly-ash brick of ratio (1:3:6) of cement, grit and fly-ash respectively was produced and the following admixtures were added as follows during the mix as mentioned in the table below (TABLE 1). All the bricks were cured for 10 days )and later oven dried for 24hrs before use.

SL No.	Brick Name	Mix Proportion	Test-able	Remark
1	N	no addition	yes	
2	G1	with addition of 2.5gm glass fibre	yes	
3	G2	with addition of 5.0gm glass fibre	yes	
4	G3	with addition of 7.5gm glass fibre	yes	
5	C1	with addition of 15gm textile waste	yes	
6	C2	with addition of 30gm textile waste	yes	
7	C3	with addition of 45gm textile waste	yes	
8	GC1	with addition of 2.5gm glass fibre and 15gm textile waste	yes	
9	GC2	with addition of 5.0gm glass fibre and 15gm textile waste	yes	
10	GC3	with addition of 7.5gm glass fibre and 15gm textile waste	yes	
11	GC4	with addition of 2.5gm glass fibre and 30gm textile waste	yes	
12	GC5	with addition of 5.0gm glass fibre and 30gm textile waste	yes	
13	GC6	with addition of 7.5gm glass fibre and 30gm textile waste	yes	
14	GC7	with addition of 7.5gm glass fibre and 45gm textile waste	no	unable to carryout test as the samples failed during casting
15	GC8	with addition of 7.5gm glass fibre and 45gm textile waste	no	
16	GC9	with addition of 7.5gm glass fibre and 45gm textile waste	no	

TABLE 1 - MIX PROPORTION DETAILS

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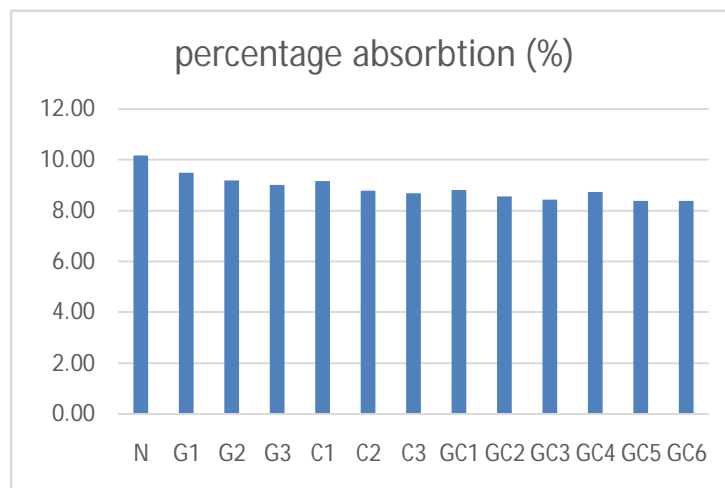
## IV. EXPERIMENTAL WORK

In the present study, fly ash bricks are subjected to the following tests to check its suitability for the construction work and are as follows:

1. **Absorption Test:** This test is done to determine the percentage water absorption by bricks. The sample is first oven dried for 24 hours and then submerged fully in water for 24 hours. The difference in weight before and after submergence is noted and percentage absorption is calculated. In any case it shouldn't exceed 20%. The results have been tabulated below in TABLE 2 and a graphical representation is also done in GRAPH 1.

SL No.	Brick Name	Dry weight (gm)	wet weight (gm)	absorbtion (gm)	percentageabsorbtion (%)
1	N	2650	2920	270	10.19
2	G1	2686	2941	255	9.49
3	G2	2728	2979	251	9.20
4	G3	2745	2993	248	9.03
5	C1	2688	2935	247	9.19
6	C2	2719	2958	239	8.79
7	C3	2750	2989	239	8.69
8	GC1	2708	2947	239	8.83
9	GC2	2722	2955	233	8.56
10	GC3	2735	2966	231	8.45
11	GC4	2731	2970	239	8.75
12	GC5	2764	2996	232	8.39
13	GC6	2739	2969	230	8.40

TABLE 2 - ABSORPTION TEST RESULTS



GRAPH 1 - ABSORPTION TEST RESULTS

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2. **Hardness Test:** This test is carried out to check if the sample is hard enough or not. It's done so by scratching the surface by finger nail and checking the impression. The results have been tabulated below in TABLE 3.

SL No.	Brick Name	Result
1	N	No impression on scartching.
2	G1	No impression on scartching.
3	G2	No impression on scartching.
4	G3	No impression on scartching.
5	C1	No impression on scartching.
6	C2	No impression on scartching.
7	C3	No impression on scartching.
8	GC1	No impression on scartching.
9	GC2	No impression on scartching.
10	GC3	No impression on scartching.
11	GC4	No impression on scartching.
12	GC5	No impression on scartching.
13	GC6	No impression on scartching.

TABLE 3 - RESULT FOR HARDNESS TEST

3. **Efflorescence Test:** From this test presences of soluble salts in bricks is determined. The sample is first oven dried for 24 hours, submerged fully in water for 24 hours and then allowed to dry in shade. If absences of any white or grey deposits indicate that the sample is free from efflorescence. In any case it shouldn't exceed 50%. The results have been tabulated below in TABLE 4.

SL No.	Brick Name	Result
1	N	grey deposits around 10%. Hence acceptable
2	G1	grey deposits around 10%. Hence acceptable
3	G2	grey deposits around 10%. Hence acceptable
4	G3	grey deposits around 10%. Hence acceptable
5	C1	grey deposits around 10%. Hence acceptable
6	C2	grey deposits around 10%. Hence acceptable
7	C3	greydeposits around 10%. Hence acceptable
8	GC1	greydeposits around 10%. Hence acceptable
9	GC2	greydeposits around 10%. Hence acceptable
10	GC3	greydeposits around 10%. Hence acceptable
11	GC4	greydeposits around 10%. Hence acceptable
12	GC5	greydeposits around 10%. Hence acceptable
13	GC6	greydeposits around 10%. Hence acceptable

TABLE 4 - RESULT FOR EFFLORESCENCE TEST

4. **Soundness Test:** Two bricks were chosen and struck together to determine clear ring sound without any brick breakage. The results have been tabulated below in TABLE 3.

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SL No.	Brick Name	Result
1	N	clear ringing sound is produced.
2	G1	clear ringing sound is produced.
3	G2	clear ringing sound is produced.
4	G3	clear ringing sound is produced.
5	C1	good sound is produced.
6	C2	good sound is produced.
7	C3	good sound is produced.
8	GC1	good sound is produced.
9	GC2	good sound is produced.
10	GC3	good sound is produced.
11	GC4	good sound is produced.
12	GC5	good sound is produced.
13	GC6	good sound is produced.

TABLE 5 - RESULT FOR SOUNDNESS TEST

5. **Shape and Size Test:** For this test the brick is thoroughly examined for any physical defects such as lumps, hole, cracks etc.
6. **Crushing strength test:** This is the most important test carried out on the bricks to check the suitability for use. This test is conducted with the help of the compression testing machine. A brick with is frog filled with mortar (cement sand ratio of 1:3) is placed in a compression testing machine. It is pressed till it breaks. Then the compression strength of the brick is recorded from the compression testing machine.

SL No.	Brick Name	Length (mm)	Width (mm)	Depth (mm)	load (kN)	Strength (N/mm <sup>2</sup> )
1	N	230	100	80	154.8	6.73
2	G1	229.8	101	80	252.2	10.87
3	G2	229.8	100	80	294.1	12.80
4	G3	230	99	80	264.8	11.63
5	C1	230.2	100	80	233.3	10.13
6	C2	230.2	100	80	288.9	12.55
7	C3	230.3	102	80	281.1	11.97
8	GC1	230.1	98	80	210	9.31
9	GC2	230	101	80	239.1	10.29
10	GC3	230.2	101	80	218.7	9.41
11	GC4	230	100	80	213.4	9.28
12	GC5	230	100	80	233.3	10.14
13	GC6	230.2	100	80	222.6	9.67

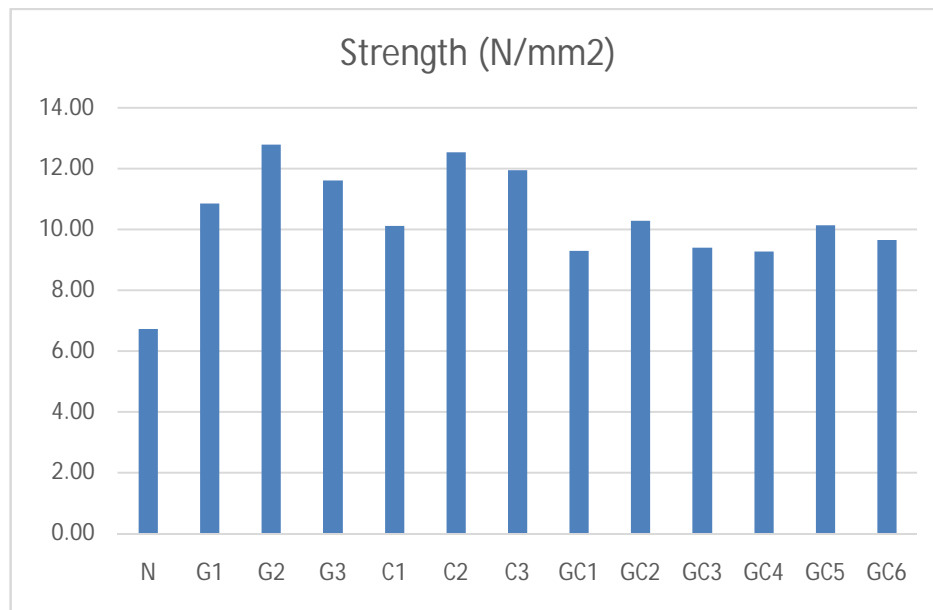
TABLE 6 - RESULT FOR COMPRESSIVE STRENGTH

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GRAPH 2 - RESULT FOR COMPRESSIVE STRENGTH

### V. RESULT

- Absorption Test:** The moisture content for normal clay brick was found to be 10.19% and as the admixtures were added absorption reduced. The least absorption was 8.39%.
- Hardness Test:** The hardness test for various fly ash bricks was conducted, test brick was taken and scratch was made on bricks surface with the help of finger nail and found no impression.
- Efflorescence Test:** The test was conducted and was found for all samples that the grey deposits was around 10%. Hence acceptable
- Soundness Test:** Two bricks and struck together to determine clear ring sound without any brick breaking. All samples produced clear ringing sound. The brick with only glass produced the best ringing sound.
- Shape and Size Test:** For this test the brick is thoroughly examined for any physical defects such as lumps, holes, cracks etc. and none defects were observed on all tested samples.
- Crushing strength test:** From the results obtained is in the range of 6.73Nn/mm<sup>2</sup> (by normal fly-ash brick) to 12.79 n/mm<sup>2</sup> (by fly-ash brick with 5gm glass fibre addition). Also, it is clear that strength with 5gm added glass fibre is 12.79 N/mm<sup>2</sup> whereas a similar maximum strength is obtained from adding 30gms of cloth which is an increase of almost 88.5% from that of normal fly-ash brick.

### VI. CONCLUSION

- Fly Ash Bricks were found to be sufficiently hard as scratching by the finger nail on the surface left no Impression on it as compared to normal bricks.
- The Efflorescence of all bricks tested were found to be slight as white or grey deposits were less than 10% on surface of the bricks which is acceptable.
- A clear ringing sound in all the Fly ash Bricks was observed.
- Structure of the bricks was found to be compact, homogeneous and free from any defects like holes, Lumps etc. as compared to normal bricks.
- Water absorption reduced as the amount of admixtures were added.

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- 6) The compressive strength of the bricks was from 6.73Nn/mm<sup>2</sup> (by normal fly-ash brick) to 12.79 n/mm<sup>2</sup> (by fly-ash brick with 5gm glass fibre addition).
- 7) From adding 30gms of cloth which is an increase of almost 88.5% from that of normal fly-ash brick which can be a cheaper alternative for glass fibre addition.

### VII. FUTURE SCOPE

As time passes the need of recycling the industrial waste is increasing. Instead of fly-ash various other waste such as wood shavings, wheat husk, polymers etc. can be used. Thermal conductivity, optimum drill position and drill hole bearing capacity and be investigated. Other admixtures should also be investigated that don't have a direct process of disposal / decomposition to reduce land pollution.

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