Research Paper Engineering

A Comparative Review on: Effect of Natural Fibres Inclusion in Fly Ash Bricks

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ABSTRACT

In India, large quantities of fly ash being generated, as most of our energy demand is met through coal based thermal power station. The fly ash generation is expected to grow further as coal would continue to remain major source of energy at least for next 25 years. The fly ash which is a resource material, if not manage well, may pose environmental challenges. At the same time world-wide agricultural footprint is fast growing, with vast agricultural land cultivation and active expansion of the agro-based industries. The resulting large quantities of agricultural wastes, unfortunately, are not always well managed or utilized. These wastes can be recycled, such as by retrieving fibres from disposed leaves and fruits bunches, and then incorporate in brick making. The natural fibres were sourced from coconut fibre, human hair fibre, pineapple fibre, oil pam fibre added within the range. This review describes change in the physical properties such as weight, density etc. and mechanical properties like compressive strength of fly ash bricks and clay bricks made by adding different natural fibres.

Keywords : Fibre Fly ash bricks, Fibre Clay Bricks, Natural fibre in Bricks, Cost, and Strength.

Fly ash is comprised of the non-combustible mineral portion of coal. When coal is consumed in a power plant, it is first ground to the fineness of powder. Blown into the power plant's boiler, the carbon is consumed — leaving molten particles rich in silica, alumina and calcium. These particles solidify as microscopic, glassy spheres that are collected from the power plant's exhaust before they can "fly" away — hence the product's name: Fly Ash.

A. CLASS C FLY ASH:

Fly ash produced from the burning of younger lignite or subbituminous coal, in addition to having pozzolanic properties, also has some self-cementing properties. In the presence of water, Class C fly ash will harden and gain strength over time. Class C fly ash generally contains more than 20% lime (CaO). Unlike Class F, self-cementing Class C fly ash does not require an activator. Alkali and Sulphate (SO4) contents are generally higher in Class C fly ashes.

Class C has $SiO_2 + Al_2O_3 + Fe_2O_3 = 50\%$

B. CLASS F FLY ASH:

The burning of harder, older anthracite and bituminous coal typically produces Class F fly ash. This fly ash is pozzolanic in nature, and contains less than 10% lime (CaO). Possessing pozzolanic properties, the glassy silica and alumina of Class F fly ash requires a cementing agent, such as Portland cement, quicklime, or hydrated lime, with the presence of water in order to react and produce cementatious compounds. Alternatively, in addition of a chemical activator such as sodium silicate (water glass) to a Class F ash can leads to the formation of a geopolymer.

Class F has $SiO_2 + Al_2O_3 + Fe_2O_3 = 70\%$

II. Properties

A. PHYSICAL:

Fly ash consists of fine, powdery particle that are predominantly spherical in shape, either solid or hollow, and mostly glassy in nature. The particle size distribution of most bituminous coal fly ash is generally similar to that of silt (less than a 0.075 mm or No. sieve). Although sub bituminous coal fly ash is also silt-sized, they are generally slightly coarser than bituminous coal fly ash.

The specific gravity of fly ash usually ranges from 2.1 to 3.0, while its specific surfacemay range from 170 to 1000 m2/kg.

The colour of fly ash can vary from tan to grey to black, depending on the amount of unburned carbon in the ash. Bituminous fly ashes are usually some shade of grey, with the lighter shades of grey generally indicating higher qualities of fly ash.

B. CHEMICAL

The chemical properties of fly ash are influenced to a great extent by those of the coal burned and the techniques used for handling and storage. There are basically four types, or ranks, of coal, each of which varies in terms of its heating value, its chemical composition, ash content, and geological origin. The four types, or ranks, of coal are anthracite, bituminous, sub bituminous, and lignite. In addition to being handled in a dry, conditioned, or wet form, fly ash is also sometimes classified according to the type of coal from which the ash was derived.

The principal components of bituminous coal fly ash are silica, alumina, iron oxide, and calcium, with varying amounts of carbon, as measured by the loss on ignition (LOI). Lignite and sub bituminous coal fly ashes are characterized by higher concentrations of calcium and magnesium oxide and reduced percentages of silica and iron oxide, as well as lower carbon content, compared with bituminous coal fly ash. Very little anthracite coal is burned in utility boilers, so there are only small amounts of anthracite coal fly ash.

Fly Ash Lime Gypsum Bricks

Fly ash lime gypsum bricks /blocks technology has been developed successfully by national thermal power corporation (NTPC), Bhanu International and Ahmedabad Electric Company (ACE) for manufacturing bricks/blocks which canreplace burnt clay bricks as a walling unit building material.

TABLE 1: ADVANTAGE OF FLY ASH BRICKS

Sr. No.	Items	Description
1	Environmental Effect	Eco. Friendly for nature. Minimize global warming effect.
2	Availability	Good alternative of clay bricks.

3	Cost	Low in cost.
4	Disposal	No problem in disposal.
5	Raw Material	Less require as compare to other product.
6	Consumption of fly ash	55-70 %
7	Saving cement in cement mortar.	20-25 %
8	Energy consumption	Less as compare to clay bricks.
9	Productivity	Fast as compare to clay bricks.
10	Wastage in transport & moulding.	Very less as compare to other product.

TABLE 2: DISADVANTAGE OF FLY ASH BRICKS

Sr. No.	Items	Description
1	Sound insulator	Not good sound insulator.
2	Plastering work	More difficult as compare to clay bricks.
3	Excavation of soil	May leads to environmental effect.

III. Case Study

A. EXPERIMENTAL WORK ON: NATURAL FIBRE IN FLY ASH BRICKS.

To carry techno-economical study of fibre fly ash bricks main ingredients are: fly ash, lime, quarry dust, and sand. In addition to these major materials, other less utilized ingredients like: Human hair which are available from various materials, coconut fibre which are available from various Hindu temple as waste materials. Table: 3shows information about sources of various raw materials for experimental work.

TABLE 3: SOURCES OF RAW MATERIALS FOR FIBRE FLY ASH BRICKS.

Sr. No.	Raw Material	Availability
1	Fly Ash	NOVA, Ahmedabad, Gujarat.
2	Sand	Kheda, Gujarat.
3	Quarry Dust	Sevaliya, Gujarat.
4	Sludge Lime	Kota, Rajasthan.
5	Coconut Fibre	Various Hindu temples, V.V.Nagar, Anand, Gujarat.
6	Human Hair	Various Hair Saloon, V.V.Nagar, Anand, Gujarat

As per this study we can say the result comparison is given in below TABLE: 4 only for the most feasible one sample of human hair fibre (Sample H) and coconut fibre (Sample J).

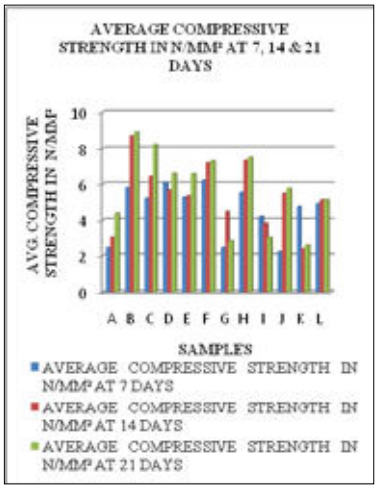

FIGURE: 1 SAMPLES V/S COMPRESSIVE STRENGTH N/mm2

TABLE 4: COMPARISONS BETWEEN STD. FLY ASH BRICKS, HUMAN HAIR FIBRE FLY ASH BRICKS AND CO-CONUT FIBRE FLY ASH BRICKS.

Sr. No	Parameters	Result (length 50 mm.)		
		Fly ash	Human Hair Fibre	Coconut Fibre
1	Weight (Kg.) before water absorption.	2.71	2.84	2.46
2	Cost in Rs.	2.25	2.31	2.21
3	Water Absorption in %.	7.82	6.26	5.63
4	Compressive Strength (After 21 Days) in N/mm2	4.38	2.85	5.74
5	Density in Kg/m3	1576	1646	1426

B. EXPERIMENTAL WORK ON: NATURAL FIBRE IN CLAY ASH BRICKS

To carry techno-economical study of natural fibre clay ash bricks main ingredients are: clay and sand. In addition to these major materials, other less utilized ingredients like: Oil palm trunk fibre, oil palm fruit bunch fibre, wood ash, rice husk. Table: 4 shows information about sources of various raw materials for experimental work.

TABLE 5: SOURCES OF RAW MATERIALS FOR FIBRE CLAY ASH BRICKS

Sr. No.	Raw Materials	Availability
1	Oil Palm Trunk Fibre	Wood Chemistry Division from Forest Research Institute Malaysia.
2	Oil Palm Fruit Bunch Fibre	Wood Chemistry Division From Forest Research Institute Malaysia.
3	Wood Ash	By Product created during combustion of wood product.
4	Rice Husk	By Product of the rice milling industries.

a) EXPERIMENTAL WORK OF CLAY BRICKS MADE BY ADDING OIL PALM TRUNK FIBRE AND OIL PALM FRUIT BUNCH FIBRE.

In this work there are two types of fibre used oil palm trunk fibre and oil palm fruit bunch fibre. Study is done by adding natural fibres 1%, 2%, 3%, 4% and 5% of cement content. In this study result of compressive strength maximum in optimum content of 2% oil palm trunk fibre and 3% oil palm fruit bunch fibre. Results at optimum content of 2% oil palm trunk fibre and 3% oil palm fruit bunch fibre are shown in TABLE 6.

TABLE 6: COMPARISONS BETWEEN CLAY BRICKS MADE BY ADDING OIL PALM TRUNK FIBRE AND OIL PALM FRUIT BUNCH FIBRE.

Sr. No	Parameters	Result	
		2% Oil Palm Trunk Fibre	3% Oil Palm Fruit Bunch Fibre
1	Water Absorption in %	19.52	19.33
2	Compressive Strength (After 21 Days) in KN/m2	8.49	9.03
3	Density in Kg/m3	2087.04	2106.28

b) EXPERIMENTAL WORK OF CLAY BRICKS MADE BY ADDING WOOD ASH AND RICE HUSK.

In this work there are two types of fibre used wood ash and rice husk. Also the specific gravity of material is given in the TABLE 7 and also in TABLE 8 shows the results of experimental work of making clay bricks by adding wood ash and rice husk.

TABLE 7: SPECIFIC GRAVITY OF VARIOUS MATERIALS USED TO MAKE CLAY BRICK BY ADDING WOOD ASH AND RICE HUSK.

Sr. No.	Material	Specific Gravity
1	Clay	2.16
2	Wood Ash	2.16
3	Rice Husk	0.43
4	Cement	3.16
5	Fly Ash	2.31

TABLE 8: COMPARISONS OF COMPRESSIVE STRENGTHS OF CLAY BRICKS MADE BY ADDING WOOD ASH AND RICE HUSK.

Sr. No.	% of Fibre	Compressive Strength in N/mm2		
		clay	Wood Ash	Rice Husk
1	4	4.40	5.78	3.15
2	8	4.40	6.31	3.68
3	12	4.40	7.36	2.10
4	16	4.40	10.00	1.05

IV. Conclusion

The used brick in 1 m3 are 500. The quantity of fly ash used is 500 x 0.00198375 = 0.991875 x 0.60 = 0.5951 m3, which is considering depth of saves 0.5951 m2 of agricultural land.

TABLE 9: USE OF THERMAL WASTE AND NATURAL FIBREIN FLY ASH BRICKS PER 1 m3 VOLUME

Bricks	Use of Thermal Waste.(Kg.)	Use of natural fibre(Kg.)
Fly Ash	926.25	-
Human Hair Fibre.	918.53	7.72
Coconut Fibre.	922.39	3.86

TABLE 10: USE OF CLAY AND AGRICULTURAL WASTE IN CLAY BRICKS PER 1 m3 VOLUME

Bricks	Use of clay (Kg.)	Use of Agricultural Waste. (Kg.)
Clay	1118.83	-
2% Oil Palm Trunk Fibre	1118.83	1.92
3% Oil Palm Fruit Bunch Fibre	1118.83	2.88
8% Wood Ash	1118.83	127.83
16% Rice Husk	1118.83	255.66

Use of fly ash, natural fibre & agricultural waste help in environmental prevention and prevention of agriculture land utilised in brick production.

Also theuse of fly ash, natural fibre & agricultural waste improve the physical properties and compressive strength of fly ash bricks and clay bricks. The present study was done for finding most achievable, economical as well as technically feasible mix for production of Fibre Fly Ash Bricks and Fibre Clay Bricks with its optimum content.

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