COMPARATIVE STUDY ON JUTE FIBRE AND BANANA FIBRE IN FLY ASH BRICKS

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Abstract: **Increasing concern about the global warming, primarily due to deforestation has led to the ban on use of clay brick by government in buildings construction. Subsequently, a large action plan for the development use of fly ash bricks substitute has resulted in creation of more awareness about the use of fly ash based building materials. In the past one decade or so the joint efforts by R & D organizations, private industries and funding agencies provided the much needed thrust for the actual transfer of technical know-how and product to the end users. Most of the developing countries are very rich in agricultural and natural fibre. Except a few exceptions, a large part of agricultural waste is being used as a fuel. India alone produces more than 400 million tonnes of agricultural waste annually. It has got a very large percentage of the total world production of rice husk, jute, stalk, jute fibre, banana fibre and coconut fibre. All these natural fibres have excellent physical and mechanical properties and can be utilized more effectively in the development of building materials (Inclusion in fly ash bricks) for various building applications.**

Keywords: Natural Fibre, Jute Fibre, Banana Fibre, Fly Ash Bricks, Compressive Strength, Water Absorption

INTRODUCTION

FLY ASH is a finely divided residue resulting from the combustion of ground or powdered bituminous coal or sub bituminous coal (lignite) and transported by the flue gases of boilers fired by pulverized coal or lignite. Fly ash is a waste by-product material that must be disposed of or recycled. It consists mainly of spherical glassy particle ranging from 1 to 150 µm in diameter, of which the bulk passes through a 45- µm sieve.

FIGURE 1: FLY ASH

CLASS C FLY ASH:

Fly ash produced from the burning of younger lignite or sub-bituminous coal, in addition to having pozzolonic 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 (SO_4) contents are generally higher in Class C fly ashes.

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

CLASS F FLY ASH:

The burning of harder, older anthracite and bituminous coal typically produces Class F fly ash. This fly ash is pozzolonic in nature, and contains less than 10% lime (CaO). Possessing pozzolonic 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 cementitious 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 geo-polymer.

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

EXPERIMENTAL MATERIALS

a) Fly Ash (Class F)

An Experimental work was carried out with Class F type of Fly Ash. The chemical compositions of Fly Ash are given in following Table 1.

TABLE 1
CHEMICAL COMPOSITIONS OF FLY ASH

SR. NO.	CHEMICAL COMPOSITIONS	% VALUE
1	Silicon dioxide (SiO_2)	62.22
2	Magnesium oxide (MgO)	6.09
3	Total Sulphur trioxide (SO_3)	3.00
4	Calcium Oxide(Cao)	5.30
5	Aluminium Oxide (Al_2O_3)	7.63
6	Ferric Oxide (Fe_2O_3)	7.63
7	Loss on ignition	0.13

b) Lime

An Experimental work is carried out with Acetylene carbide waste lime. The chemical compositions of lime are shown in following Table 2.

TABLE 2
CHEMICAL COMPOSITIONS OF LIME

SR. NO.	CHEMICAL COMPOSITIONS	% VALUE
1	Silicon dioxide (SiO_2)	5.39
2	Magnesium oxide (MgO)	2.42
3	Sulphur trioxide (SO_3)	0.98
4	Calcium Oxide(Cao)	28.60
5	Aluminum Oxide (Al_2O_3)	1.06
6	Ferric Oxide (Fe_2O_3)	0.39
7	Loss on ignition	25.25

c) Jute Fibre

The fibres are extracted from the ribbon of the stem. When harvested the plants are cut near the grouted with a sickle shaped knife. The small fibres, 5 mm, are obtained by successively rating in water, see Figure-2 beating, stripping the fibre, from the core and drying. Due to its short fibre length, jute is the weakest stem fibre, although it withstands rotting very easily. It is used as packaging material (bags), carpet backing, ropes, yarns and wall decoration.

FIGURE 2: JUTE FIBRE

d) Banana Fibre

FIGURE 3: BANANA FIBRE

These fibres are extracted from the banana stem. The availabilities of this fibre from banana stem are 5 to 10%. The use of banana stem is very useful to produce paper, yarn, fabrics etc.

SOURCE OF MATERIAL

TABLE 3
SOURCE OF MATERIAL

SR. NO	INGREDIENTS	SOURCES
1	Fly Ash	Nova, Ahmadabad, Gujarat
2	Sand	Bodeli, Gujarat
3	Quarry Dust	Sevaliya, Gujarat
4	Sludge Lime	Kota, Rajasthan
5	Jute Fibre	Sugam Hardware, Anand, Gujarat
6	Banana Fibre	Navsari Agriculture University, Navsari, Gujarat

EXPERIENTIAL METHODOLOGY

Various raw materials of brick mix in desired proportion are blended intimately in dry or wet form. In this Standard Mix proportion Natural fibre are added 0.5%, 1%, 1.5%, 2% and 2.5% by weight of brick.

FIGURE 4: SET UP OF AUTOMATIC FLY ASH BRICK PLANT

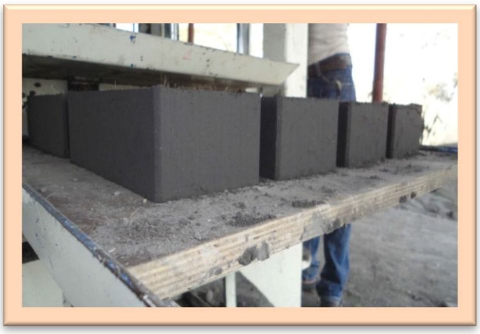

FIGURE 5: FINAL FINISH PRODUCTS

- The wet brick-mix is fed into the machine mould. The vibration is given for a while and the mould is again fed. The striper head is pressed and vibration is given simultaneously for about 8 seconds. The mould is lifted and bricks produced pallet is removed and kept on the platform for air drying.
- Next day the bricks produced on the previous day are put in the stack. The stack is formed with care to see that curing water and air for drying reach to every brick.
- After 3 days the hot water from the solar collector in small quantity is poured on the fresh stack without any pressure.
- After 5 days the solar collector water is poured on the bricks stack for 2 times a day.
- The bricks in stack after each watering are immediately covered with black PVC tarpaulin, with a clear space of 250 mm form the layers of the bricks, inside the closed cover.
- The curing is continued for 15 days and the tarpaulin cover is removed. The bricks are then left in the stack for drying or heating the bricks stack.
- The bricks are ready for dispatch after 22 days from the date of manufacture.
- The comprehensive strength of the bricks produced from the brick-mix and the manufacturing process suggested here in will be 80 kg/cm² to100 kg/cm².

It is observed that the bricks produced are found to be superior then that of conventional Red burnt clay bricks.

Compressive Strength

FIGURE 6: TESTING OF SAMPLE BRICKS

FIGURE 7: TESTING OF SAMPLE BRICKS

EXPERIENTIAL RESULTS

TABLE 4
REASULTS OF COMPRESSIVE STRENGTH TEST

Types of brick	Average Compressive Strength (N/mm^2)		
	7 Days	14 Days	21 Days
Fly Ash	6.123	6.685	7.896
Clay	5.078	5.339	5.557
JF_1	6.614	6.813	8.061
JF_2	5.903	6.068	7.026
JF_3	5.180	5.210	6.052
JF_4	5.086	5.112	5.965
JF_5	4.801	4.983	5.513
BF_1	6.630	6.812	8.051
BF_2	6.343	6.423	7.809
BF_3	5.310	5.738	6.825
BF_4	5.212	5.524	6.742
BF_5	6.117	5.512	6.124

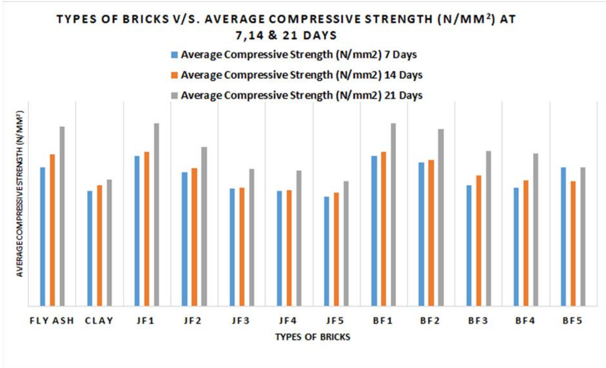

FIGURE 8: TYPES OF BRICKS V/S AVERAGE COMPRESSIVE STRENGTH (N/mm^2) AT 7, 14 AND 21 DAYS

Water Absorption Test

FIGURE 9: DRY WEIGHT OF SAMPLE BRICK

FIGURE 10: CURING OF SAMPLE BRICK

TABLE 5
RESULTS OF WATER ABSORPTION TEST

Types of brick	Average Water Absorption (%)		
	7 Days	14 Days	21 Days
Fly Ash	13.231	12.125	10.192
Clay	18.234	17.264	14.231
JF_1	14.356	12.254	10.236
JF_2	14.625	13.365	10.986
JF3	14.982	13.437	12.563
JF_4	15.361	13.261	12.981
JF_5	16.129	15.127	13.231
BF_1	14.025	12.421	10.287
BF_2	15.021	13.478	11.021
BF_3	15.124	13.625	12.125
BF_4	15.261	14.327	12.531
BF_5	16.256	15.124	12.782

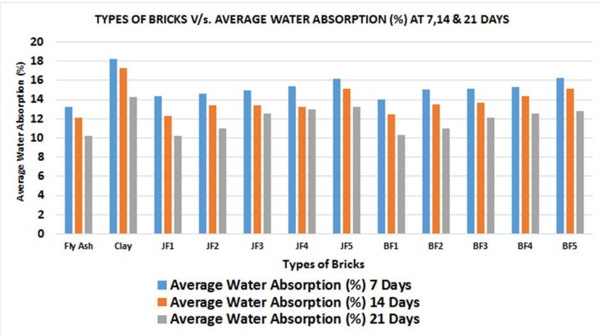

FIGURE 11: TYPES OF BRICKS V/S AVERAGE WATER ABSORPTION (%) AT 7, 14 AND 21 DAYS

CONCLUSIONS

After all the effort and present experimental work the following observation are made by replacement jute fibre and banana fibre in fly ash bricks with different percentage and conclude that….

a) Class F Fly ash is utilized in the brick manufacturing work as judicious decision taken by Engineers.
b) As the percentage of the jute fibre in brick increases, the compressive strength of the brick increases. In this experimental work 0.5% fibre addition in the brick gives the maximum strength 8.061 N/mm^2 after 21 days. Also Banana fibre 0.5% addition in the brick gives the maximum strength 8.051 N/mm^2 after 21 days.
c) As the compressive strength of the brick increases, the water absorption of the brick decreases. In this experimental work maximum compressive strength after 21 days is 8.061 N/mm^2, where minimum water absorption is 10.236% after 21 days in Jute Fibre Fly Ash Brick.
d) As the compressive strength of the brick increases, the water absorption of the brick decreases. In this experimental work maximum compressive strength after 21 days is 8.051 N/mm^2, where minimum water absorption is 10.287% after 21 days in Banana Fibre Fly Ash Brick.
e) Use of fly ash and Natural fibre help in prevention of environmental degradation and use of agriculture land utilised in clay brick production.

ACKNOWLEDGEMENT

The Authors thankfully acknowledge to Dr. C. L. Patel, Chairman, Charutar Vidya Mandal, Er.V.M.Patel, Hon. Jt. Secretary, Charutar Vidya Mandal, Dr. F.S.Umrigar, Principal, Prof.J.J.Bhavsar, Associate Professor and PG (Construction Engineering and Management) Coordinator, B.V.M. Engineering College, Mr. Yatinbhai Desai, Jay Maharaj construction, Vallabh Vidyanagar, Gujarat, India for their motivations and infrastructural support to carry out this research.

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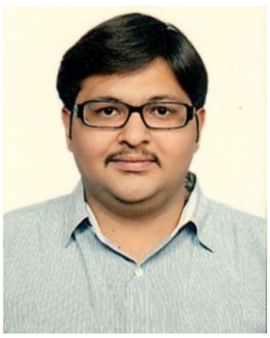

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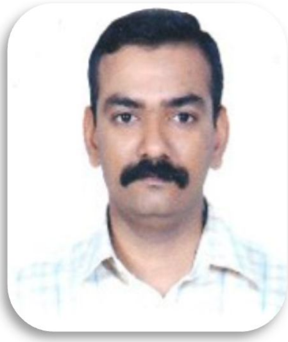

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