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Study of Compressive Strength of Fly-SH Brick

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***Abstract* :- In India, the bricks are mainly composed by Clay, which are generally made by traditional or unorganised way in small scale industries. These bricks are very much essential in building construction. According to a statistical view around 250 billion bricks annually are being produced by brick industries. Manufacturing of RCB(Red Clay Bricks) consumes huge amount of clay that leads to erosion of top soil and also land degradation chances gets increased. Huge amount of areas are being used up by the developing countries for the construction of buildings which in case uses soil up to 1m to 2m depth from the agricultural land. The firing of bricks in Kiln is a important step in manufacturing process of brick which causes environmental pollution and health issues also causes air pollution and harms the workers working in that kiln. To avoid these above issues and to make use of waste produced from these industries as a residue, a brick is being introduced known as FAB(FLY ASH BRICK), that contains ingredients like Lime, Gypsum, Fine Aggregate, Fly-Ash, Cement & required proportion of water. The main objective of this paper is to briefly explain the manufacturing of FAB in n this highly developing world and to study it's advantages of using in construction sites or as a construction material. In this paper the Author has clearly explained the advantages of FAB rather than using Clay or RB. Manufacturing of FAB is fine in three phases i.e. 3%,5%, and without cement which are taken for testing it's compressive strength test and to study the water absorption, efflorescence where it is found that the compressive strength of FAB that contains 5% of Fly-Ash is 153.4kg which is maximum than that of 1st class bricks by 40% approximately. Steps has been taken for manufacturing the bricks with different compositions of above said ingredients.**

Keywords:- RCB(Red Clay Brick),FAB(Fly Ash Brick) KILN,RB(Red Brick), Efflorescence, CST(Compressive Strength Test).

1- INTRODUCTION:-

In the developing countries the energy requirements are being fulfilled by the combustion of coal. This disposal of waste is increasing as a huge amount of thermal waste that is being produced from coal-fired thermal power plants which is termed as FLY-ASH. These fly ash are non-combustible mineral portion of coal which remains as a residue from various industries, thermal power plants and factories. The powdery substances obtained from dust collectors, industries, factories are being use as a coal fuel which is termed as Fly-Ash, and the product being manufactured from it is termed as F.A.B. F.A.B. has a composition of fly ash(contains silica-50% and alumina-7.8%, magnesia), gypsum, lime and fine aggregate(15). Fly Ash is of two types i.e. Class C & Class F. As there is a major growing demands of industries, fly ash are being consumed as a waste material in the form for thermal power plants. Due to the increasing demands of power requirements are going up and the amount of waste produced will also grow up enormously which also needs it's safe disposal. These Fly Ash Bricks are being used in the construction industry i.e. for manufacturing of bricks which is helpful in its disposal facilities and also reduce pollution. These are provided in free of cost to the games those who need it. The raw materials are being taken in a container in desired proportions and are being mixed well for 4-5 minutes then are being compressed. After that bricks are taken for curing process of 14 days and 7days are taken for its drying process. The strength varies depending upon its composition. The fly ash bricks are comparatively light in weight and are stronger as compared to traditional bricks. Around 259 billion bricks are being produced in an year that are being used for all kinds of construction works. According to a statistics to manufacture 60 billion bricks around 185 million tons of top soil are being used up. In comparison to that a total 7500 hectares of fertile land are being deliberately eroded to meet the demands of clay bricks for construction in a year. These activities may harm our environment and there will be no fertile land left out for agriculture for our future generation (4). The F type Fly Ash contains low calcium which had Sio2, Fe2O3 &Al2O3 that is greater than 70(ASTM C 618). In current situation around 160 million tons of fly ash bricks are being generated by thermal power plants all over India(5). The total calculation for Fly-Ash as a residue would be expected as 900 million tons during the year 2031-2032. Keeping in view the superior quality and eco-friendly nature of Fly-Ash Bricks, the Government of INDUA has made it as a illegal to use R.B. in the construction works. Around 150 million fly ash bricks have been manufactured and are used in house consumption (6). All the manufacturing plants of fly ash are working in a process of FAL-G Technology that uses lime or cement, fly ash and gypsum to produce bricks. Few researchers took the initiative in developing eco-friendly & with environmental concern.(7,8,9).

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2- MANUFACTURING METHOD:-

These bricks are prepared by use of different semi automatic and automatic machines where the moulds are used in method of manufacturing that leads to frequently size change of bricks which results in poor exterior quality of bricks. Manufacturing of fly ash bricks in the plants are being made by machines which reduces the labourers number and makes it less cost-effective which can be affordable to class families i.e. being Lowe to higher class families.

3- MANUFACTURING PROCESS:-

Fly Ash Bricks are being manufactured by the use of waste material that are originated from other power plants, factories that generates waste as a residue. As far as the manufacturing is considered it contain two parts first is solid part that contains the powered ash and the second is liquid part that contains ingredients as water. So far the other ingredients are taken in a proportion required for **10.1- Fly-Ash Brick After Being Casted**:-

with silica of fly ash that forms calcium silicate hydrates(C-S-H) that binds the ingredients to firm brick and act as a binder material. The superior quality of bricks is highly dependable on the quality of fly ash are being taken(12). The process of manufacturing of fly ash Brick as follows:-

(a) This manufacturing process of brick contains the ingredients like fly ash, fine aggregate, lime and gypsum that is mixed with a proper proportion of water.
(b) Firstly the lime of 100gm and gypsum of 50gm are added and mixed properly in an container.
(c) After complete proper mixing is done then it is taken out in an another container.
(d) After that fly ash and fine aggregates are mixed thoroughly in a required quantity (i.e. 1kg & 400gmm respectively for this experiment).
(e) Aluminium is then mixed with the above process at a quantity of 10gm so as to increase the setting time of cement with the other ingredients.
(f) Now again the mixture is then mixed properly to firm a uniform mixture.
(g) Then water is added to the above mixture for dry mix of fly ash, fine aggregate so that a vibrant stage of that mix can be achieved.
(h) A note is to kept that the quantity of water should not be more than per kg of cement and water-cement ratio must not exceed 0.6%.
(i) After the quantity of mixture is more, then the process of transferring the mould should be carried out.
(j) Moulds that are used in this experiment are of 20mm X 10mm X 10mm and 19mm X 9mm X 9mm same as the size of Standard and Nominal size of bricks according to B.I.S Code.
(k) The placing of mixture in the mould is done in three layers with tamping it 25timed so that to settle it in that mould.
(l) Then the mould is properly placed at a safe corner in order to avoid any breakage of the mould.
(m) Before placing the mixture in the mould, the mould is riensed withgrease oil to avoid any sticking of mixture with the mould.
(n) Then the mould is tighten with the plank which is being provided at both the sides of the mould being used in this experiment.
(o) After that the mould is being left for 24 hours and then it is being separated.
(p) The placing of brick is done carefully in order to avoid breaking due to pressure applied over the bricks.
(q) The same process of being repeated for 4 moulds that are being used up for this experiment in order to get more bricks for compressive testing.
(r) Then these bricks are taken for curing process in a sink and left for 24 hours(as aluminium is being added do it's reduced the curing time too).
(s) Water curing is done after 24 hours and required strength of the bricks is being checked in the Compression Test .

4- INGREDIENTS SELECTIONS & THEIR PROPORTION:-

INGREDIENTS	QUANTITY
Fly Ash	1kg
Fine Aggregate	400gm
Lime	100gm
Gypsum	50gm
Aluminium	10gm

5- DRYING & CURING OF BRICKS:-

After manufacturing of bricks, those bricks are being taken for drying process which is 24hours and then the brick mould are being removed and again the bricks are further drying process. Curing may be defined as the process of watering the bricks. This process is again carried out for 24 hours from the date of manufacturing of bricks after the process of sun and air dry.

6- BRICK TESTING:-

These Fly Ash Bricks testing can be done after 24 hours because Aluminium is being added which reduces the curing period and increases the setting time of cement with other ingredients. So basically these process is carried out after 24 hours from the date of manufacture of brick.

1- **Size of brick:-** The size of brick is being taken as per the B.I.S Code for both Standard and Nominal size of brick which is 20mm X 10mm X 10mm and 19mm X 9mm X 9mm respectively. After this the bricks size is being tested by Slump test and Compressive Strength.
2- **Water Absorption Test:-** F.A.B. should not absorb more 12% of water by its total weight. The bricks which is being taken for testing in UTM that should be dried up in an oven at a temperature of 105 C to 115 C until it can attain it's constant weight for being cooler at a room temperature and that weight is taken as W1. Then the brick is kept in clean water for 24 hours at a temperature of 27 to 20 C. Bricks are being removed and then wiped out for any water traces on its surface and that weight is taken as W2. Water Absorption in % =. (W2- W1/W1)X100.(13).

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3- **Efflorescence Test:-**For conducting this test the brick blocks are kept in a vertical manner so that it's one end immersed in water. The total depth of brick immersed in water is 2.5 cm. After this the entire arrangements is being kept in a warm water that is to be in a room temperature of 20 C to 30 C until it gets evaporated. During the process the water placed in the container gets absorbed and the surplus water also gets evaporated, then repeat the process again as before. After completing this process the bricks are examined the total percentageof white spots on the surface of the brick. This testing is done to see that if any salt deposit is found on the surface then it is rated Effloresced an if there is no salt deposit then it is as Non Effloresced.

4- **Compressive Strength Test:-** This test is actually carried out after the curing period of 7,14 & 28 days, the formula for calculating it as follows:-

Compressive strength= Applied Maximum Load X 1000(N)/ Cross Sectional Area(mm2)(12).

The Compressive Strength of fly ash Brick is three times more than the strength of red bricks or clay bricks. Clay bricks minimum compressive strength is 3.5N/mm2 which is much more smaller than the fly ash bricks i.e. 10-12 N/mm2. For testing the specimen firstly it being placed in a calibrated compressive testing machine capacity of 3000KN and has to apply a uniform loaf at the rate of 2.9 KN/mm2. The load at which the specimen gets it failure that load is the total resting power of the fly ash Brick. According to this experiment the failure load is 153.4KN.(13).

7- TABLES ON COMPARISON OF CLAY BRICKS AND FLY ASH BRICKS:-

SL.NO.	RED BRICK	FLY-ASH BRICK
1	Colour varies according to soil	Uniform colour remains like cement
2	Not-Uniform shape as it is hand made	Uniform shape
3	Bonding is less	Dense composition
4	Requires Plastering	Requires No Plastering
5	Heavier in Weight	Light in weight
6	Compressive Strength is 35 kg/cm2	Compressive Strength is 100 kg/cm2
7	Porous is more	Less Porous
8	Thermal Conductivity is 1.25 to 1.35 W/m2 C	Thermal Conductivity is 0.90 to 1.05 W/m2 C
9	Water Absorption is 20-25%	Water Aborption is 6-12 %

8- TABLES ON SIEVE ANALYSIS OF FINE AGGREGATE:-

SIZE OF THE SIEVE	WEIGHT RETAINED IN IS SIEVE(gm)	CUMMULATIVE WEIGHT RETAINED IN IS SIEVE	PERCENATGE RETAINED	PERCENATGE PASSING	GRADING LIMKT ACCORDING TO IS SIEVE:-383-1970
10 mm	0	0	0	100	ZONE-III
4.75 mm	0	0	0	100	ZONE-III
2.36 mm	11	6	2.1	97.9	ZONE-III
1.18 mm	34	30	4.5	95.5	ZONE-III
600 micron	165	195	21	79	ZONE-III
300 micron	622	832	83.2	16.8	ZONE-III
150 micron	98	930	93	7	ZONE-III

9- EXPERIMENTAL DETAILS:-

In this experiment we have taken three different compositions for making fly ash bricks:-

A- Fly ash(55), Lime (20%), Sand(20%), Gypsum(5%),Cement(0%)

B- Fly ash(52), Lime (20%), Sand(20%), Gypsum(5%),Cement(3%)

C- Fly ash(50), Lime (20%), Sand(20%), Gypsum(5%),Cement(5%)

Tables on Compressive Strength Test:-

TYPE OF SPECIMEN	FAILURE LOAD	AVERAGE COMPRESSIVE STRENGTH	% INCREASE AVERAGE COMPRESSIVE STRENGTH
CONVENTIONAL BRICK	210.5	93.76	-
FLY-ASH BRICK(0%)	285.6	126.8	35%
FLY-ASH BRICK(3%)	317.8	145	51.8%
FLY-ASH BRICK(5%)	343.2	153.4	63.31%

10- PICTURES RELATED TO THIS EXPERIMENT:-

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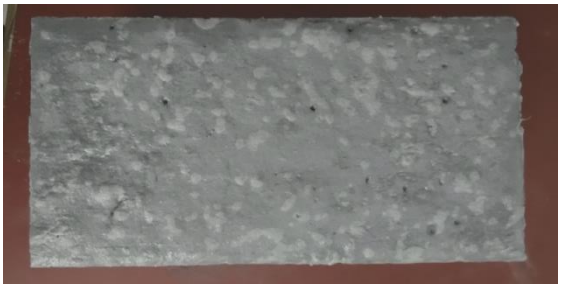
10.1- Fly-Ash Brick After Being Casted:-

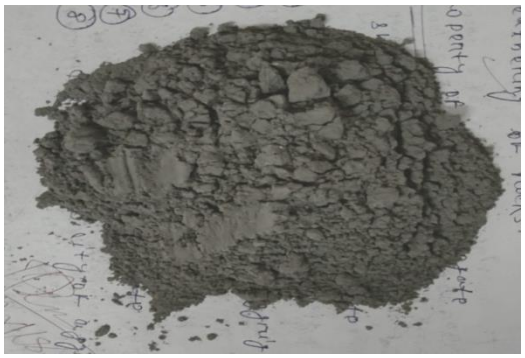


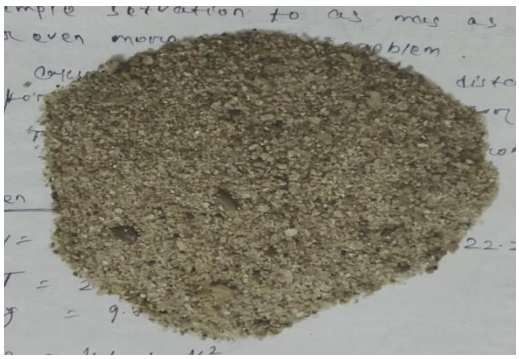
10.2- Pictures of The Wooden Mould:-

10.3- Picture of the Ingredients Used:-

10.3.1- GYPSUM:-

10.3.2- FLY-ASH BRICK





10.3.3- Fine Aggregate

10.3.4- All INGREDIENTS AT A GLANCE:-

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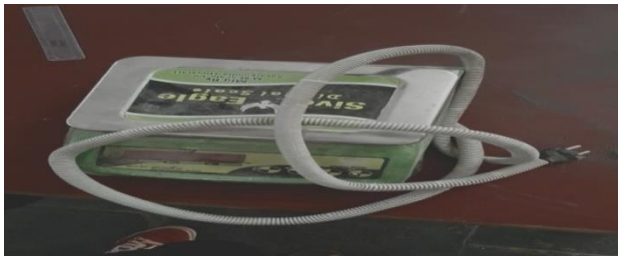
10.4- OTHER INSTRUMENTS USED FOR MIXING THE FLY-ASH BRICKS:-

10.4.1- TROWEL:-

10.4.2- TAMPING ROD:-

10.4.3- WEIGHING MACHINE(5KG):-



10.5- SIEVE USED FOR SIEVING FINE AGGREGATE:-

N

10.6- FLY-ASH BRICK BEING UNDERGONE CURING PROCESS:-

11- CONCLUSION:-

From this experiment we conclude that there can be production of lightweight fly ash brick at a temperature around 550 C. The perfect combination for manufacturing a fly ash brick is 70/30 fly ash with 15% of fine aggregate and 5% of gypsum can give a better fly ash which is better in modularity, higher in strength. The combination ratio of 3% & 5% of cement in fly-ash can give a compressive strength of 51.8% & 63% respectively which is generally more than that as compared to Class-I Bricks. These bricks are 3 times stronger than the conventional brick which is available in mrket as red bricks or clay bricks.

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