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REPLACEMENT OF FERTILE SOIL OF FARMING BY INDUSTRIAL WASTE IN BURNT CLAY BRICKS

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Abstract

In present fly ash in dry state with low quantity was used as raw material to replace clay to make fired bricks The effect of fly-ash on replacing clay with firing parameters and properties of bricks were studied. The combination of fly ash and clay with bagasse, wheat husk, waste glass powder. (WGP) The results indicate that the plasticity index of mixture of fly ash and clay decrease dramatically with increasing of replacing ratio of fly ash. Additive may be chosen to improve the plasticity index of mixture to meet plastic an extrusion used in most of the brick making factories. The sintering temperature of the bricks with high fly ash replacement rate was about 1050 ℃ The properties of fired bricks were improved by using pulverized fly ash in high proportion and with the combination of other by-products of the industries with the clay Plenty of crushed fly ash is used and other industrial by-products have been combined with clay to improve the properties of fired bricks. Calcined bricks with high volumetric fly ash content are characterized by high compressive strength, low water absorption, no cracking due to lime, no frost and high frost resistance.

Keywords: *Brick; Fly ash; Clay; Bagasse; Wheat husk; WGP (Waste Glass Powder)*

I. INTRODUCTION

Burnt clay bricks are widely used in almost all of India and are probably the most valuable building materials. But the unrestricted use of clay is dangerous to society as all brick kilns in India depend on the good quality clay found in agricultural fields and are estimated to weigh 3 kg/ brick. The total amount of clay extracted from agricultural fields per day was more than 300 million tons per 10,000 bricks. Currently, India has the capacity to produce more than 10,000 Crore bricks through a facility of about 45,000 (Bhatta), in the informal sector. So the use of industrial waste products such as fly ash, bagasse, wheat husk, rice husk, waste glass powder can be used for making the bricks as an ecologically and is economically beneficial as in addition to conserving high value agricultural land, it meets the social objective of disposing of industrial waste i.e. fly ash which otherwise is a pollutant and a nuisance. The ever

increasing volume of fly ash quantities in the world has not been remotely matched by its utilization and environmental concerns have been raised in some parts of a land where coal is a major source of energy and where bricks are also a major building material. Such concerns have led to legislation requiring the brick industry to incorporate at least 25% by weight of fly ash and or to the floor or lake ash in brick making if the industry is within 50 km from a coal power generation plant. Some successful ventures have been reported where fly ash was incorporated in the mixture at the rate of 20% to 50%. Nevertheless, there is only little evidence that incorporation of fly ash in the brick mixture has exceeded the 30% by volume, even when the legislation was obeyed. Reasons behind such reluctance are clear.

II. LITERATURE REVIEW

1. Saif A. usmani IJESC 2017 An attempt has been made to investigate the effect on mechanical properties of bricks when blended with various wastes. Puzzolonic material along with certain waste material blends will be studied, various mechanical properties and their variation with change in composition is involved in the scope of this study. Traditional brick-making would be the focus of research; the most suitable material will be suggested based on the finding.
2. Ajay kumar et al. IJASGE 2017 Rice husk has been used directly or in the form of ash either as a value added material for manufacturing and synthesizing new materials or as a low cost substitute material for modifying the properties of existing products. Presence of silica is an additional advantage in comparison to other byproduct materials which makes RH an important material for a wide range of manufacturing and application oriented processes.
3. Mr. Santosh et al. (2012) Reported that Addition of different % of Wheat Husk Ash (WHA) the water content decrease up to a limit afterwards again it increases. This is more effective for addition of 9% (optimum) WHA. Addition of different % of WHA the dry density increases up to a limit afterwards again it decreases. This is more effective for addition of 9% (optimum) WHA. The stress against different days for varying % WHA, for varying % of WHA, as number of day's increases stress also increases. This is more effective for 7days.
4. Bangar Sayali S. et al IJERT 2018 concluded that with partial replacement of fly ash in clay with SCBA strength of brick can be increased with reduction in use of clay. They even concluded that Bagasse Ash best use is with addition in bricks rather than land filling.
5. Nonthaphong Phonphuak et al. CMJS (2018) had concluded that blended SCBA (sugarcane bagasse ash) in clay had higher compressive strength, tensile strength and flexural strength in comparison to that of without SCBA .They came to a conclusion that cement can be partially replaced by SCBA upto a extent of 15%. They even concluded that with addition of more SCBA the density of concrete will decrease and low weight brick will get produced.

III. METHODOLOGY

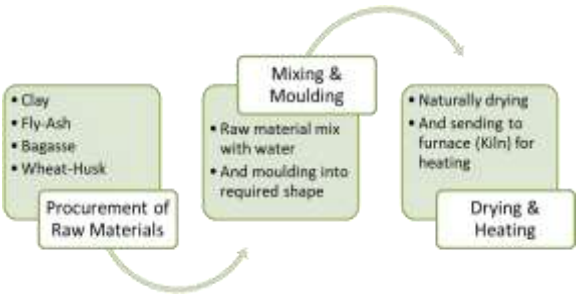

Fig-1 Method of processing of raw material

1) Raw materials

a) Pure clay soil

Clay contains the smallest particles of any other type of soil. The particles are so densely packed that there is little or no air space. They range from clay to loam. Usually light gray to dark gray.

Fig-2 Pure clay soil

b) Fly ash

Fly ash is a product of coal combustion and consists of solid particles (fine particles of the burned fuel) that are removed from coal-fired boilers along with the flue gases. Ash falling to the bottom of the boiler combustion chamber is called ash. In modern coal-fired power plants, fly ash is usually captured by electrostatic precipitators or other particulate filtering equipment before the flue gases reach the chimney. Together with the ash removed from the bottom of the boiler, it is known as coal ash or fly ash.

Fig-3 Fly ash

c) Bagasse

Bagasse is the dry, fibrous substance left over after extracting the juice from crushed sugarcane or stalks of sorghum. It is used as a biofuel for the production of heat, energy and electricity, as well as for the production of pulp and building materials.

Fig-4 Bagasse

d) Wheat husk

Wheat husks are lignocellulosic waste, accounting for about 15-20% of wheat, and wheat husks are used to some extent as livestock feed, fuel and additives.

Fig-5 Wheat husk

e) Coal or Soybeans husk waste

Coal is a combustible black or brownish-black sedimentary rock, formed as rock strata called coal seams. Coal has a very high calorific value.

Fig-6 Coal

Soybean husk waste is by product of soybean industry which also has a high calorific value but less than coal.

Fig-7 Soybean husk

f) Water

Water is an inorganic, transparent, tasteless, odorless, almost colorless chemical that is a major component of Earth's hydrosphere.

2) Site selection

a. The ground should be of plain surface.
b. The site should be connected with communicating roads for transporting materials etc.
c. All conditions for workers must be made on site.

Fig-8 Level Plain 1

Fig-9 Level Plain 2

3) Unfired bricks making

a) Sorting

Firstly the clay soil is finely sorted, with that Bagasse and wheat husk is also sorted properly.

b) Weighing

Now taking the sorted material to weighing in proper proportion with respect to each other.

c) Mixing

All the above weigh materials are now mixed in whichever proportion they are taken with the help of water and making a proper texture and consistency of the mix.

Fig-10 Dry Mix

Fig-11 Wet Mix

d) Molding

Now taking a mold's to mold the above mixture in proper shape and size as per the requirement of the bricks

Fig-12 Moulds

e) Drying

Allowing drying the bricks in sun i.e. sun drying of the bricks till they dry properly. (Unburnt clay bricks)

Fig-13 Sun Drying for 3Day

Fig-14 Sun Drying at 7 Day

4) Heating program

a) Levelling

The site must be leveled for making a base of the burner, (Bhatta's) with laying of a Jama bricks at the bottom most level.

Fig-15 Levelling of batta (brick kiln)

b) Layering

Now the Jama bricks the layer of coal followed by unburnt clay brick layer (3-5) then again coal layer and so on till the height it needed to be taken.

Fig-16 Layering of coal in brick kiln

c) Firing

The whole layer is now set to fire through a window provided at the bottom base with a large size coal pieces. Or the whole setup can also be run on the soybean husk waste. (Required quantity will be more as compare to coal)

Fig-17 Fired brick kiln

IV. TESTING

1) Absorption test

The absorption test can be used as an indicator of the strength properties of a brick, such as the quality of the brick, the degree of charring, and the weathering behavior.

Fig-18 Absorption test

2) Hardness test

The hardness of a brick usually refers to the scratch resistance of the brick.

Fig-19 Hardness test

3) Efflorescence test

A good brick should not contain soluble salts. The presence of soluble salts in bricks leads to the formation of efflorescence in the bricks, which deteriorates the quality of the bricks.

Fig-20 Efflorescence test

4) Soundness test

A brick strength test is performed to determine the properties of a brick upon sudden impact.

5) Shape and size test

To maintain the uniformity of the structure, the bricks must be of the same shape and size. A good brick should have a regular rectangular shape with sharp edges.

Fig-21 Shape and size test

6) Colour test

The Brick Color Test is simply a visual inspection of a brick for an acceptable bright and uniform color throughout the brick body.

Fig-22 Colour test

7) Crushing strength test

Crushing Strength Test because bricks used for bricks are generally subjected to compressive loads, the compressive strength of bricks must be determined.

Fig-23 Crushing Strength test

V. OBSERVATIONS

1. Produce cost effective fired clay bricks by use of the fly-ash, and other by-products of industries to provide an economical construction material.
2. Helps to reduce the industrial by products to minimise the natural resources and reduce the environmental and ecological challenges associated with fly-ash (by-products).
3. Characteristics and engineering properties of the scba, wheat husk, rice husk and fly-ash samples collected to provide the best suitable combination these by-products and other constituent's proportion for higher compressive strength of brick.
4. Provide light weight brick with proper water absorption property to get high compression strength and durability compare to full clay burnt bricks.

VI. RESULT

Increase in the compressive strength of bricks, by the use of industrial by-products such as fly-ash, wheat-husk, and SCBA in manufacturing of bricks.

Table-1 Ratios of raw materials

Fly-ash:Clay:Scba:Wheat-husk (by volume)	Firing temperature (C)	Apparent porosity (%)	Water absorption (%)	Compressive strength (MPa)
25:25:25:25	1000 1050	40.62 39.76	28.08 27.54	21.50 27.80
30:30:20:20	1000 1050	39.80 38.14	27.86 27.24	25.40 37.10
40:40:10:10	1000 1050	39.76 38.68	27.54 24.47	27.80 21.80
50:30:10:10	1000 1050	36.65 33.88	23.62 19.53	25.41 16.84

- ✓ Water absorption 19%
- ✓ Shape and Size Appropriate
- ✓ Hardness Strong Enough
- ✓ Cracking by lime No
- ✓ Scratch Resistant
- ✓ Colour Bright Red
- ✓ External appearance No cracking
- ✓ Compressive strength 16.9 Mpa

VII. CONCLUSION

1. The compressive strength of fired bricks was 16.84 MPa, meets the strength requirement of fired bricks. Fired bricks with high replacing ratio of fly ash make the brick 0.5 kg lighter than fired clay bricks that is favourable for the building.
2. The water absorption of bricks was 19% when bricks immersed in water for 24 h. So the fired bricks with high volume ratio of fly ash had better property of fastness to efflorescence.

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