INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X

Impact factor: 4.295

(Volume 4, Issue 3)

Available online at: www.ijariit.com

The study of characteristic behaviour of quarry and furnace waste lightweight bricks: A review paper

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ABSTRACT

Quarry Dust and the crushed brick as alternative aggregates for concrete production for low cost housing since it is clear that the rising cost of concrete materials coupled with environmental degradation has impaired the construction industry. The following tests were carried out to determine the physical properties of these materials; density tests, silt content, water absorption, sieve analysis, specific gravity, flakiness index and aggregate crushing value. The research was conducted by testing concrete cylinder and cubes specimens at ages of 7, 14 and 28days concrete with concrete mix ratios 1:1.5:3 with a target strength of 25N/mm2 and 1:2:4 with a target strength of 20N/mm2. Samples of concrete specimens were made using varying contents of quarry dust and laterite as fine aggregate. India is a developing contrary due to there is a huge need of infrastructure that is why construction is very important. In the construction the main material his problem we are making brick using Furnace Waste. This brick is stronger economical and effective than the clay brick. This process also helps in converting industrial waste material into quality building material. In this study, the fine and coarse aggregates were completely replaced by Furnace Waste aggregates in Furnace Waste concrete. 1) A mix design was done for M20 grade of concrete by IS method. Ordinary Portland cement of 43 grade was 2) Selected and Furnace Waste aggregates were prepared by mixing Furnace Waste with cement and water. The properties of Furnace Waste. In the present study we are making three types of Furnace Waste bricks in the different percentage of cement such as 3%, 5% and without cement. And after making these bricks various tests were performed such as compressive strength test, water absorption test, efflorescence, weight test, structural test and cost analysis and these results were compared with conventional bricks results.

Keywords: *Quarry dust, Brick, Furnace waste.*

1. INTRODUCTION

In conventional concrete, weight of concrete is one of the parameters to compare with weight of Furnace Waste aggregate concrete. Normally density of concrete is in the order of 2200 to 2600 kg/m3. This heavy self-weight makes an uneconomical structural material compared to low self-weight of Furnace Waste aggregate concrete. In order to produce concrete of desired density to suit the required application, the self-weight of structural and nonstructural members are to be reduced. Hence economy is achieved in the design of supporting structural elements which lead to the development of light weight concrete. Lightweight concrete is defined as a concrete that has been made lighter than the conventional concrete by changing material composition or production method. Lightweight aggregate concrete is the concrete made by replacing the usual material aggregate by light weight aggregates Furnace Waste bricks are made of Furnace Waste, lime, gypsum cement and sand. These can be extensively used in all building constructional activities similar to that of common burnt clay bricks. The Furnace Waste bricks are comparatively lighter in weight and stronger than common clay bricks. Since Furnace Waste is being accumulated as waste material in large quantity near thermal power plants and creating serious environmental pollution problems, it utilization as main raw material in the manufacture of bricks will not only create ample opportunities for its proper and useful disposal but also help in environmental pollution control to a greater extent in the surrounding areas of power plants.

Manufacturing of commercial brick produce a lot of air pollution. The technology adopted for making. The Furnace Waste bricks are eco-friendly. It is no need fire operation in production unlike the conventional bricks

Among the traditional fossil fuel sources, coal exists in quantities capable of supplying a 3large portion of nation's energy need. That's why the power sector in India is a major consumer of coal in India and will continue to remain so far many years to come.

Combustion of coal in thermal power plant not only produce steam to run electricity-generating turbine but also produces a large quantity of by-products like Furnace Waste etc.

These are about 80 thermal power plant in India are sources of Furnace Waste, where around millions of tonnes of coal is used annually. India currently generates 100 million tons of Furnace Waste every year. This produces 30-40 million tonnes of Furnace Waste unused every year. This disposal will need thousands hectares of storage land, which may cause further ecological imbalance. In fact, this waste material is simply disposed of in the form aqueous slurry on the adjoining areas. This type of disposal not only converts useful agricultural land to waste ones but also possesses a threat to the quality of environment. The human development report (1998) of united nation development programme indicates that annually 83-163 million hectares of land is eroded in India causing productivity loss of about 4 to 6.3% of the total agricultural output worth $2.4 billion. Therefore, using Furnace Waste as a building material has assumed great significance like never before. Several investigations have been carried out throughout the world to make an attempt to use Furnace Waste in many civil engineering projects by virtue of its good properties as an ingredient of concrete. But now it is seen as an ingredient for manufacture of bricks also thereby, comparing the conventional clay.

Hence it will be of a large relief to all concerned if Furnace Waste from these thermal stations is used on a large scale. Government has formulated policies that for every construction agency within a radius 50 to 100 kilometer from a coal or lignite based thermal plant and engaged in the construction of building to use Furnace Waste brick or similar products as per minimum volume by percentage of the total brick as prescribed below:

- 25%by 31st August 2004
- 50%by 31st August 2005
- 75%by 31st August 2006
- 100%by 31st August 2007

Similarly, in respect of constructions of building within a radius of 50 kilometers from a coal or lignite based thermal power plant the minimum percentage by volume of the total brick the use of blocks and tiles made up of Furnace Waste shall be as below:

- 50% by 31st August 2004
- 100% by 31st August 2005

The importance of product is not complete without knowing its economics &various characteristics relating to its quality. It has been acknowledged that marking bricks with the conventional material is becoming costlier day by day. This is more predominant for marking conventional brick of higher compressive strengths. It is already known that the conventional red brick are susceptible to efflorescence. Also, in area of high moistures the weakness of red brick masonry due to great absorption of water is well known and needs to be improved to prevent and failure of the structure during its lifetime, further these bricks are kiln made the causing Emission of harmful gases. therefore the manufacturing process making these bricks is not ecofriendly .hence, in the ongoing search for finding new material of construction, which can replace conventional materials to save cost and natural resources which are depleting fast, it has been found that using Furnace Waste bricks in masonry structures can make the structure get rid of the above problem and it can also make the structure more durable. Furnace Waste bricks possess a high degree of toughness, durability, ductility, strength and crack resistance. Furnace Waste bricks being lighter in weight impart less self-weight to the structure and thereby can reduce the size of foundations. This controls the cost factor involved in the construction of the structure. It also increases the flexibility and ductility of a building which is a sought after characteristic in the earthquake prone area.

Large-scale use of this waste material has not been done in India, perhaps due to lack of evidence and lack of education. With industrialization, it is now time that these materials are used in the manufacture of bricks, which can cause an overall economy and can give us a less polluted environment. Furnace Waste is one such material.

The ASTM C618-93 categorizes natural pozzolanas and Furnace Wastes into the following three categories:

Class N: Raw and calcined natural Pozzolanas such as some diatomaceous earths, stuffs, opaline chert and shale, pumice and volcanic ashes are included in this category. Laterite shale and calcined kaolin clay also fall in this category of pozzolanas.

Class F: Furnace Waste normally produced from burning anthracite or bituminous coal falls in this category. This class of Furnace Waste exhibits pozzolanic property but rarely, if any, self-hardening property. These Furnace Waste contain less than 10% lime and are called low calcium Furnace Waste.

Class C: Furnace Waste normally produced from lignite or sub bituminous coal is the only material included in this category. This class of Furnace Waste has both pozzolanic and varying degree of self- cementitious properties (mostly class C Furnace Wastees contain equal or more than 10% lime)

The most commonly used and available Furnace Waste in India is of class F.

The Indian Furnace Waste can be divided into two classes depending on the combustion parameters of the boilers and the behavioral effects of resultant Furnace Waste as end product. These Furnace Wastees are:

a) Low temperature (LT) Furnace Waste produced at combustion temperature of 800-850 degree Celsius.

b) High temperature (HT) Furnace Waste produced at combustion temperature of 1000-1400 degree Celsius.

Concrete is a versatile engineering material consisting of cementing substance, aggregates, water and often controlled amount of entrained air. It is initially a plastic, workable mixture which can be moulded into a wide variety of shapes when wet. The strength is developed from hydration due to the reaction between cement and water. The products, mainly calcium silicate, calcium silicate hydrate, calcium aluminates and calcium hydroxide are relatively insoluble which bind the aggregate in a hardened matrix. According to Arai (1986) good quality concrete in Kenya is manufactured from natural river sand and natural crushed aggregates

satisfying the grading requirements of British Standards or Kenya Standards. The availability of these aggregates for concrete manufacture has become scarce in some areas due to high demand leading to over-exploitation during harvesting, excessive cost of the material on the market, reduced supply due to increasing construction activities and transportation difficulties due to the poor state of roads (Mustafa, 1990).

These materials are fast becoming rare and expensive commodities. Uncontrolled sand mining from river beds leads to problems like bank erosion lowering of water Table and other adverse effects to the environment. Likewise, quarrying of granite which is the main source of coarse aggregate has also led to similar problems.

2. LITERATURE REVIEW

The objective is to compare the structural of Furnace Waste brick with conventional brick and to determine the most suitable brick and cost optimization of Furnace Waste brick.

FURNACE WASTEBricks are eco-friendly as it protects environment though Conservation of top soil and utilization of waste products of coal or lignite based Thermal Power Plants. It is stronger than the conventional burnt clay bricks. It plays a vital role in the abetment of carbon-die-oxide a harmful greenhouse gas mass emission of which is threatening to throw the earth's atmosphere out of balance.

Motive of this thesis is to prepare material used for low cost housing project without compromising with the durability and compressive strength. Effort has been made by making different proportions of ingredients having composition of Furnace Waste , cement, lime, gypsum, and sand these standard size of brick used in structural work has been adopted low cost light weight brick will be easy to handle and transport and it will required less labour used for handing during industrial work. That will reduce the cost of construction without compromising the strength of construction.

Manufacturing of commercial brick produce a lot of air pollution. In India around 80 thermal power plants which produce a lot of Furnace Waste as a waste material. But in light weight bricks manufacturing any kind of pollution not produced. It is ecofriendly. As the Furnace Waste used in manufacturing of light weight bricks the storage of waste reduces and reduced the soil pollution

3. FUTURE SCOPE

The possibility of using innovative building materials and eco-friendly technologies, more so covering waste material like Furnace Waste is the need of the hour. Furnace Waste affects the plastic properties of concrete by improving workability, reducing water demand, reducing segregation and bleeding, and lowering heat of hydration. It also increases strength, reduces permeability, reduces corrosion of reinforcing steel, increases sulphate resistance, and reduces alkali-aggregate reaction.

This study has been undertaken to prepare material for low cost housing project without compromising with the durability and compressive strength. Effort has been made to study the behavior of Furnace Waste bricks by taking different proportions of Furnace Waste, cement, lime, gypsum and sand. Properties of Furnace Waste bricks for other proportions which have not been covered in my study can be carried out to check the durability and strength as a construction material. Research can be done for different composition of Furnace Waste brick to improve its performance. There is an imperative need to produce more building materials for various elements of construction and the role of alternative and innovative options have come into sharp focus, considering the short supply, increasing cost and energy and environment considerations for traditional and conventional materials.

- Determining the physical and mechanical properties alternative aggregates
- Determining the effects of curing methods on strength properties of concrete made of laterized quarry dust and crushed bricks as fine and coarse aggregates respectively

4. CONCLUSION

- The objective is to compare the structural of Furnace Waste brick with conventional brick and to determine the most suitable brick and cost optimization of Furnace Waste brick.
- FURNACE WASTEBricks are eco-friendly as it protects environment though Conservation of top soil and utilization of waste products of coal or lignite based Thermal Power Plants. It is stronger than the conventional burnt clay bricks. It plays a vital role in the abetment of carbon-die-oxide a harmful greenhouse gas mass emission of which is threatening to throw the earth's atmosphere out of balance.
- Motive of this thesis is to prepare material used for low cost housing project without compromising with the durability and compressive strength. Effort has been made by making different proportions of ingredients having composition of Furnace Waste , cement, lime, gypsum, and sand these standard size of brick used in structural work has been adopted low cost light weight brick will be easy to handle and transport and it will required less labour used for handing during industrial work. That will reduce the cost of construction without compromising the strength of construction.

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