Eco-friendly Brick Construction Using Waste Materials

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Abstract- ***The main objective of the present work is to study how pollution can be controlled. In the present study, the strength variation in brick by replacing clay with waste materials was observed. In the present thesis the analysis of brick has been carried out by application of various waste materials in brick by using conducting compressive strength and water absorption test.The future scope appears to be more promising with stronger and more durable brick emerging into the market along with various industrial and agro waste to be mixed with clay for giving more hope as well as challenge to the eco-friendly in the years to come.***

Indexed Terms- ***Clay, Granite Waste Powder, Ceramic Waste Powder, Rice Husk, Sugarcane Bagasse Ash***

I. INTRODUCTION

The increase in the popularity of using environment friendly, low cost and lightweight construction materials in building industry has brought about the need to investigate how this can be achieved by benefiting the environment as well as maintaining the material requirements affirmed in the standard. Recycling of waste generated from industrial and agricultural activities as building materials appears to be viable solution not only to pollution problem but also to the problem of economic design of buildings. Influence of Marble and Aluminum Waste Powder on the Performance of Bricks have shown that Adding marble powder and aluminum powder in the composition of brick, the qualitative tests like compressive strength test and water absorption test give better results. RihanMaaze, Vinod Kumar, Sandeep Kumar Mishra. 2016.

Brick belongs to the wide family of construction materials since it is mainly used for the construction of outer and inner walls in buildings. The brick industry is the most indicated technological activity sector to absorb solid waste due to the large quantity of raw material used by the sector as well as by the large volume of final products in construction.

Various attempts have been made to incorporate various waste materials in bricks production such as Natural Fibers, Textile Laundry Wastewater Sludge, Foundry Sand, Granite Sawing Waste, Processed Waste Tea, Sewage Sludge, Structural Glass Waste, Fly Ash, Sugar Cane Baggase Ash, Organic Residue, Steel Dust, Rice Husk Ash, Silica Fume, And Marble, and Municipal Solid Incineration Fly Ash Slag. Bricks are prepared from natural waste material which comprises of sugar bagasse ash and shown that maximum compressive strength can be attained. Bagasse ash bricks can reduce the seismic weight of building. Rohan Rajput, Mayank Gupta-2016.

This review in the earlier studies highlights the effects of various waste materials on the bricks property like physical and mechanical properties as well as thermal insulation.

II. OBJECTIVE OF THE PRESENT STUDY

The main objective of the present work is to study is to control the pollution. In the present study the strength variation in brick of various properties replacing clay with waste materials such as Granite waste, Ceramic waste, Rice husk, Sugarcane bagasse ash was observed. In the present thesis the analysis of brick has been carried out by application of various waste materials such as Granite waste, Ceramic waste, Rice husk, Sugarcane bagasse ash in brick by conducting concerned tests.

The future scope appears to be more promising with stronger and more durable brick emerging into the market along with various industrial and agro waste to be mixed with clay for giving more hope as well as challenge to the eco-friendlyand pollution free environment in the years to come.

III. MATERIALS

3.1 CLAY

Soil used for brick manufacturing can be of any type with good plasticity. Clay, loam and laterite are the most commonly used types of soil. the clay used for this study is collected locally from Anekal area.

3.2 GRANITE WASTE POWDER

Granite powder is an industrial byproduct obtained from crushing of granite stone and granite stone polishing industry in a powder form. Inhalation of granite powder fine particles is a health hazard and is a cause of lung diseases especially for people living near granite mills. Granite powder is used as partial replacement of clay in brick. One of the most important benefits of substituting granite powder in concrete is on human health i.e., reducing the amount of silica in the air thus reducing the risk of silicosis.

3.3 CERAMIC WASTE POWDER

Indian Ceramic production is 100 Million ton per year. In the Ceramic industry, about 15%- 30% waste material generated from the total production. This waste is not recycled in any form at present. This leads to serious environmental and dust pollution and occupation of a vast area of land, especially after the powder dries up so it is necessary to dispose the Ceramic waste quickly and use in the construction industry. As the Ceramic waste is piling up every day, there is a pressure on ceramic industries to find a solution for its disposal. Ceramic waste can be used in brick to improve its strength and other durability factors. Ceramic waste powder is formed by crushing the ceramic material.

3.4 RICE HUSK

Rice Husk is an agricultural residue abundantly available in rice producing countries. The husk surrounds the rice grain. During milling of paddy about 78 % of weight is received as rice, broken rice and bran. Rest 22 % of the weight of paddy is received as husk. This husk is used as fuel in the rice mills to generate steam for the parboiling process. It contains about 75 % organic volatile matter. Highly porous and lightweight, with a very high external surface area, its absorbent and insulating properties are useful to many industrial applications, such as acting as a strengthening agent in building materials. Rice husks are processed into rectangular shaped particle boards.

3.5 SUGARCANE BAGASSE ASH

Sugarcane Bagasse Ash is a waste-product of the sugar cleansing industry. The bagasse is fibrous in nature. A very large amount of bagasse ash is obtained from these industries which require its disposal and environmental problems. The bagasse ash can be used as partial replacement of clay in bricks with significant alteration in properties of bricks. In present study, the effect of bagasse ash is investigated when used as replacement in clay bricks. The bricks prepared with different amount of bagasse ash and clay are tested for strength and other properties.

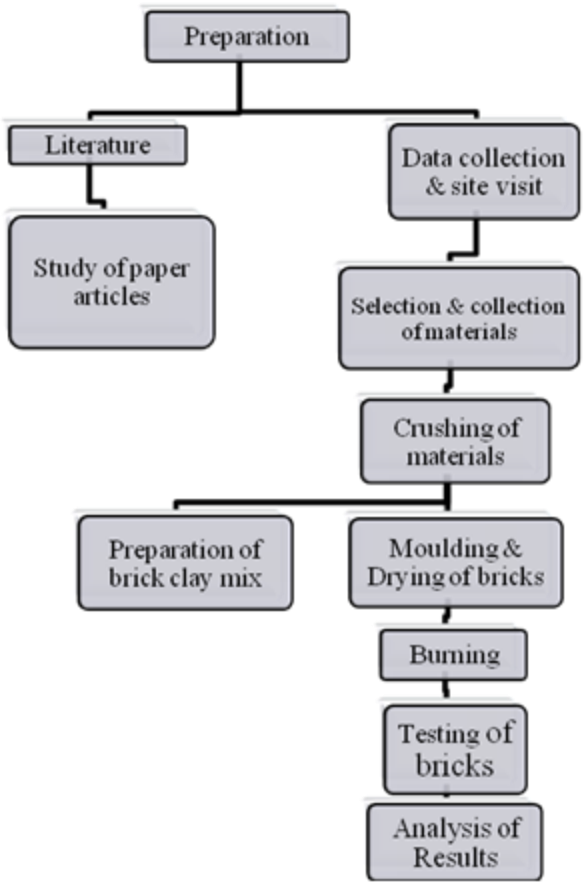
IV. METHODOLOGY

In this first stage, the soil is excavated and then laid on a leveled ground where it is cleaned of all sorts of impurities (like vegetation matter, stones, pebbles etc). Once the material is clear from all impurities, it is left exposed to weather for few months, this process is known as weathering. After this, the soil is mixed with industrial and agro waste to prepare good brick earth. Post raw materials are mixed; it is tempered in a pug mill by thoroughly breaking, watering and kneading it. Mix Proportion of waste materials like ceramic waste, granite powder, Rice husk and Sugarcane bagasse used in brick manufacture is mentioned in Table.

V. EXPERIMENTS CONDUCTED ON BRICKS

1 COMPRESSIVE STRENGTH – BIS:1077-1957
2 WATER ABSORPTION - IS3495 (PARTII):1992
3 DROP TEST
4 SOUNDNESS TEST OF BRICKS
5 HARDNESS TEST OF BRICK

All the above mentioned tests were conducted on bricks prepared for the various proportions shown in tabular column. The results and the discussions are limited to test on compressive strength in this paper.



Clay (%)	Powder of ceramic waste (%)	Powder of Granite waste (%)	Rice husk (%)	Sugar Cane Bagasse Ash (%)
100 (Normal Brick)	0	0	0	0
92	-	8	-	-
88	12	12	12	12
84	16	16	16	16
80	20	20	-	-

Clay (%)	Granite + Ceramic waste (%)	Rice Husk + Sugarcane Bagasse Ash (%)
88	6 + 6 = 12	6 + 6 = 12
84	8+8 =16	8+8 =16

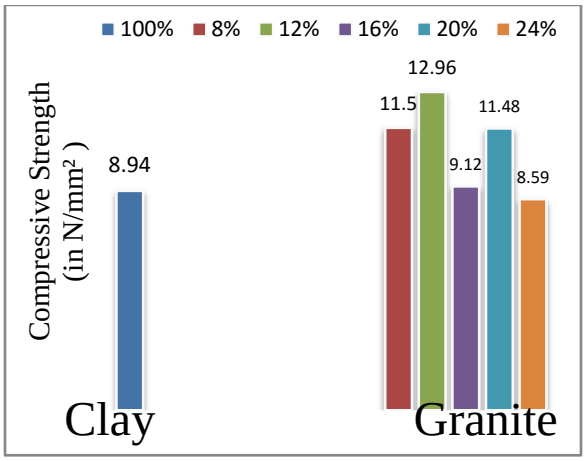
Clay(%)	Ceramic + Granite + Sugarcane Bagasse Ash + Rice Husk = %
88	3 + 3 + 3 + 3 =12
84	4 + 4 + 4 + 4 =16

VI. RESULTS AND DISSCUSION

The results show that the compressive strength for the brick made with pure clay has the strength of 8.94 N/mm^2. The compressive strength of bricks decreased with the increase in Rice husk and sugarcane bagasse ash, Ceramic powder and Granite powder content. Although the compressive strength reduced up to 12.19% and 7.15% for Rice Husk, also reduced up to 24% and 28% for Sugarcane bagasse ash. Ceramic powder and Granite powder respectively, it was found that all the bricks satisfied the maximum compressive strength requirement as per IS 1077:1957. As per IS 1077:1957 the minimum compressive strength brick is 3.5 N/mm^2. Among the various materials Ceramic powder and Granite powder has maximum compressivestrength. Also by mixing of double mixes of ceramic and granite powder was found that maximum compressive strength compare to normal brick. The double mix of rice husk and sugarcane bagasse ash was found to have low compressive strength. The three material mix of waste was found to have low compressive strength compare to normal brick strength). Finally the four mixes of waste materials were found that good up to 12% and then strength is decreased for 16% mix .The graphical representation is shown for clay -100% and different percent of Granite.

Clay (%)	Replacing material (%)	Waste Material	Load at Failure (KN)	Compressive Strength (N/mm²)
100 (Normal)	0	-	196.7	8.94
92	8	Granite	253.2	11.50
88	12	Ceramic	217.6	9.890
		Granite	285.2	12.96
		Sugarcane Bagasse Ash	47.5	2.15
		Rice Husk	24.1	1.09

		CG	192.6	8.75
		RS	30.00	1.36
		CRG	38.5	1.75
		CGSR	77.2	3.509
84	16	Ceramic	199.3	9.05
		Granite	200.7	9.12
		Sugarcane Bagasse Ash	55.3	2.513
		Rice Husk	15.1	0.68
		CG	200.7	9.12
		CGSR	41.1	1.86
80	20	Ceramic	207.6	9.436
		Granite	252.7	11.48
76	24	Granite	189.0	8.59



CONCLUSION

- By utilization of Industrial and agricultural waste in production of Brick has productive way of disposal of rice husk, Sugarcane Bagasse Ash, Ceramic powder and Granite powder.
- The water absorption of the bricks increased with the increase in Rice Husk, Sugarcane Bagasse Ash.
- Compressive strength of brick is increased with increase of Ceramic and Granite powder up to 15 to 30%, can be used for load bearing walls.
- Agriculture waste (Rice Husk and Sugarcane Bagasse Ash) utilization in burnt clay bricks is an effective way of disposal of waste materials leading to sustainable construction.
- Lighter bricks can be produced after addition of Rice Husk and Sugarcane Bagasse Ash in burnt clay bricks. Lighter bricks are helpful in achieving economy during construction.
- Weight of bricks has increased after addition of Ceramic and Granite powder than the normal brick.
- This type of bricks can be used in aprons where the self-weight of apron acts downward to counter uplift force.
- Water absorption content of bricks is more than 20% in the addition of Rice Husk and Sugarcane Bagasse Ash.
- Rice Husk bricks can be used for partition wall and also can be used for footpath so it will drain off the water from the surface.
- Environmental effects of wastes and disposal problems of waste can be reduced through this research.

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