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Manufacturing of Bricks by using Waste Foundry Sand

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Abstract: *The foundry is an industrial sector where various iron, scrap steel, and ferroalloys are melted down in arc furnaces or cupolas, shaped in sand, ceramic, or metal moulds, and the cast, steel, nodular, and tempered foundry products needed in industry are produced as raw or processed materials. Especially in establishments such as factories and workshops that produce parts of the automotive, construction, and machine and in steel industry, foundry sand is used to mould foundry products (iron-steel industry and aluminium- and copper-based alloys).Foundry sand is used to prepare metal foundry moulds. For 1 ton of production, 4-5 tons of sand is required. This ratio may be changed based on the type of the metal that needs to be casted, part size, and moulding technique. Sands that contain more than 90% of silica and 7–15% clay (bentonite or kaolinite clay) and have a sintering temperature of over 1500°C are defined as foundry sands. Foundry sand disposal is a herculean task for the industrial sector in today's scenario. In order to overcome this problem to some extent, it is required to convert it into some useful products. Hence, this project gains its importance for the effective utilization of foundry sand into foundry sand bricks.*

Keywords: Red Soil, Bagas And Foundry Sand etc

I. INTRODUCTION

One of the preferred walling materials in India is clay fired bricks, that has a long and rich history of production dated back to Indus valley civilization (2500–1500 BCE). India is the second largest producer of bricks in the world, with over 240 billion bricks produced annually. The Indian economy is growing with a current target set to achieve an annual growth rate of 9%. The constant growth in economy and population, along with urbanization has resulted in increasing demand for buildings and infrastructure. In a published report 'Environmental and Energy Sustainability: An approach for India', it was estimated that the building construction sector in India would grow at a rate of 6.6% per year till the period of 2030, since 80% of India of 2030 is yet to be built. The constant growth in the construction sector will increase the demand on construction materials like bricks. At the same time major challenge faced in India is the use of agricultural clay for manufacturing of bricks, which is of great significance for farmers. To protect the agricultural land, government of India is prohibiting its use for brick manufacturing, and encouraging use of alternative materials. The use of industrial waste can address some of the issues faced by the construction industry, as well as find great means for waste disposal. Laboratory scale trials have shown that variety types of industrial waste can be used as raw materials for manufacturing bricks with acceptable quality. These include hematite tailings, fly ash, granite sawing waste, gold mill tailings, quarry residues and waste steel slag, paper processing residue, cigarette butts, rice husk ash, sawdust and marble residue, river sediment, sugarcane bagasse ash, waste tea, waste marble powder, PC and TV waste glass, Kraft pulp production residue, municipal solid waste incinerator fly ash slag, petroleum effluent treatment plant sludge, etc. Based on laboratory scale trials the technical feasibility of waste utilization in brick manufacturing provides a very viable option

Foundry industries are responsible for generation of huge solid waste like WFS. The disposal of waste sand in the environment, typically in landfill causes direct contamination of soil due to metals. It may also contaminate the groundwater resources and surrounding superficial environment.

1.1 Red Soil : It is the soil of the tropical regions of the country. This typical soil is found in those regions which receive heavy rainfall. This soil is poor in lime content and hence it is more acidic. It is basically red in colour because of the presence of iron oxides. Red soils are well developed in the southern region of Western Ghats and Orissa`s Eastern

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Ghats. This soil contains least moisture content. Red Soils are mostly found on the plateau in the east spreading partly over Orissa and Tamil Nadu, parts of Chhota Nagpur and Meghalaya

It has got its name from its colour.It is porous and has a high percentage of iron oxide.In general, it is found to be shallow and its pH value ranges from 6.6 to 8.0.

1.2 Due to ever increasing quantities of waste materials and industrial by-products, solid waste management is the prime concern in the world. Scarcity of land-filling space and because of its ever-increasing cost, recycling and utilization of industrial by-products and waste materials has become an attractive proposition to disposal. There are several types of industrial by-products and waste materials. The utilization of such materials in concrete not only makes it economical, but also helps in reducing disposal concerns.

II. METHODOLOGY

2.1 Steps included in Brick making

2.1.1 Properties of Red soil:

It has got its name from its colour.It is porous and has a high percentage of iron oxide.In general, it is found to be shallow and its pH value ranges from 6.6 to 8.0.

It is loose and aerated and is poor in termof the quantity of nitrogen, phosphorus, potassium and organic matte It is not fertile, but it does respond to fertilisers. It needs irrigation support if it is to be.

2.1.2 Properties of foundry sand:

- Strength:-The ability of the sand mould to hold its geometric shape under the conditions ofmechanical stress.
- Permeability:-The ability of a sand mould to permit the escape of gases and steam during the castingprocess.
- Moisture Content:-Moisture content affects a mould's strength and permeability: a mould with too little moisture may break apart, while a mould with too much moisture can cause steam bubbles to be entrapped in the casting.
- Flowability:-The capacity of the sand to fill small cavities in the pattern. High flowability creates a more precise mould, and is therefore useful for detailed castings.

III. TEST ON CEMENT

In this project the soil is checked using various types of tests. The three are as follows -

- Water content determination
- Liquid limit
- Plastic limit

Table-1 Water content determination:- Record the moisture can and lid number. Determine and record the weight of an empty cleanand dry moisture can with lid (w1)

Place the moist soil in the moisture can and secure the lid. Determine and record the weightof moisture can with the lid (w2)

Remove the lid and place the moisture can in the drying oven that is set at 105 .the dying period is usually 16-24 hours.

Remove the moisture can, carefully but securely, replace the lid on moisture can and allow it to cool to room temperature. Determine and record the weight of moisture can with lid (w3).

Record all the observation in perform and determine water content.

Sr. No	Particulars	Weight (gm)
1	Wt of empty can with lid (w1)	37
2	Wt of can with lid+ wet soil (w2)	88
3	Wt of can with lid+ dry	70

Liquid Limit:

Test Procedure

- Take 100g of soil passing through 425-micron sieve. Thoroughly mix the soil with a smallamount of distilled water to form uniform paste.

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- Adjust the liquid limit apparatus by checking the height of drop cup. The point on the cupthat comes in contact with the base should rise to height of10mm. The block on end of groove should be used as gage.
- Place a portion of previously mixed soil into the cup of the liquid limit apparatus at the point where the cup rests on the base. Squeeze the soil down to eliminate air pockets and spread it into cup to a depth of about 10mm at its deepest point. The soil pat should from an approximately horizontal surface.
- Draw the grooving tool through the sample along the symmetrical axis of the cup to cut a clean straight groove, holding the tool perpendicular to the cup.
- Rotate the handle of apparatus to a rate of approximately two drops per second and count the the number of drops, N, it takes to make the two halves of the soil pat comes into contact at the bottom of the groove along a distance of 13mm. Record the number of drops. If dropsexceeds 50 go to step 2.

Take the sample into moisture can, using the spatula where the groove came into contact

Determination no.	1.	2.
No. Of blows	40	25
Container no.	10	12
Weight of container (g)	36	34
Weight of container + Wet soil (g)	50	43
Weight of container + Dry soil (g)	48	41
Weight of water (g)	6	5
Weight of dry soil (g)	12	7
Water content (%)	16.66%	28.57%

Plastic Limit:-

- Take about 20g soil sample passing through 425 micron sieve and add distilled water until the soil is at consistency where it can be moulded into ball without sticking to the hands.
- Take apportion of a ball and roll it on a glass plate with the palm of the hand to form thethread of uniform diameter throughout its length. The diameter is around 3.2 mm takingno more than two minutes.
- When the diameter of the thread reaches the correct diameter, the soil is remoulded again in to ball. This process of rolling and remoulding is repeated until the thread starts just crumbling at diameter 3.2 mm.

Determination no.	1.	2.
No. of blows	40	25
Container no.	9	5
Weight of container (g)	35	36
Weight of container + wet soil (g)	38	41
Weight of container + Dry soil (g)	37	40
Weight of water (g)	6	5
Weight of dry soil (g)	2	4
Water content (%)	50%	25%

Manufacturing process of brick:-

- Preparation of Clay
- Mouldling

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- Drying
- Burning

SR NO	SAMPLE PROPORTION	AREA (cm^2)	LOAD (KN)	Compressive Strengh (Kg/cm)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
1.	10% WFS 90%Soil	348.88	94.5	427.15	42.18	43.91
			95.14	429.13	42.08	
			93.10	423.16	41.49	
2.	20% WFS 80%Soil	348.88	90.5	410.15	40.22	40.15
			88.2	407.2	39.93	
			90.87	411.1	40.31	
3.	40% WFS 60%Soil	348.88	72.5	327.5	32.11	32.0
			75	332.17	32.37	
			69.1	321.6	31.53	
4.	Normal brick	348.88	100.5	455.47	44.66	44.98
			102.2	469.73	46.06	
			99.8	451.2	44.24	

Preparation Of Clay:
Steps Involved are:

- Unsoiling
- Digging
- Cleaning
- Weathering
- Blending
- Tempering

a. Unsoiling : It is the process in which top 20cm of the soil is removed it is practically not possible to carryout the cleaning of the soil.
b. Digging: The Remaining soil id dugg out & spread over the level field.
c. Cleaning: It is the process of removal of impurities from the soil in which it is being cleaned for the presence of stones, organic matter, pebbles,etc.
d. Weathering: It is the process in which cleaned soil is expressed to the atmosphere for few weeks in order tocarryout Softening Of Soil.
e. Blending: It is process in which clay is made loose and any Required ingredient is spread over it.
f. Tempering: It is the process in which water is added in the clay in order to bring it to required plasticity asrequired for Moulding.

Table-1: Material Required

Sr. No	Material Used
1	Red Soil
2	Bagas
3	Waste Foundry Sand

Mould Size :- (228mm x 152mm x 101mm.)

Testing On Bricks

Compressive test:-

During the compressive tests on the bricks, failure could be seen occur along the horizontal middle axis of four sides of the bricks. The sides of the bricks were broken off in the form such that several layers were being peeled off from the

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sides of the bricks when loading was appliedonto the specimens. The surfaces were broken off and got into crack at the middle of the bricks. Figure 9.1 shows the brick with crack. The characteristic compressive strength of the bricks. Obtained was 5.54N/mm2 for 30%WFS.

Water Absorption Limit:-

From observing the Water Absorption Limit for bricks having different mix proportions, the dried brick was immersed completely in clean water at temperature of 27+2°C for 24 hour. This WFS brick when tested in accordance with the procedure laid down in IS 3495 Part II-1976. The following table 9.2 shows the results obtained from the water absorption limit of blocks

Table - 1

SR NO	SAMPLE PROPORTION	Weight (kg)(W1)	Weight of Brick aftera bsorption (kg) (W2)	Water Absorption(%)	Average Water Absorption(%)
1.	10% WFS 90% Soil	3.32	3.75	12.95	14.31
		3.38	3.83	13.31	
		3.3	3.85	16.67	
2.	20% WFS 80% Soil	3.4	3.94	15.88	14.44
		3.45	3.98	15.36	
		3.48	3.90	12.07	
3.	40% WFS 60% Soil	2.98	3.41	14.43	17.26
		2.94	3.54	20.41	
6	Normal brick	3.30	3.83	16.06	13.52
		3.32	3.72	1.05	
		3.29	3.70	12.46	

Based on the discussion on results obtained, the optimum replacement level of Waste foundry sand as clay was found and from the compressive strength test, it was determined that the brick waste foundry sand as clay gives more or less compressive strength as the normal brick. From the water absorption test, it was found that the brick using waste foundry sand as clay have more or less same water absorption limit.

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