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Sustainable Earth Bricks Composed of Cowdung Ash, Bonemeal and Wood Ash

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Abstract: *While constructing (developing) any structure (asset), its impact on the environment should always be assessed. As we know, cement is a key building material that is commonly usedbut also creates pollution during its manufacturing, storage handling, transportation and usage. So, what-if this building material can be significantly replaced by some other building material that is far eco-friendlier. Mother Nature i.e. our planet Earth offers us naturally existing and abundant Soil (mud) that can be used as an alternative building material*

Keywords: abundant Soil , eco-friendlier

I. INTRODUCTION

Clay bricks are standardized rectangular units typically manufactured from fired or sun-dried clay. Production involves molding clay into uniform blocks, followed by drying and firing. In areas with limited stone availability and abundant clay resources, bricks serve as a viable substitute. Their consistent size facilitates efficient placement and reduces the need for heavy lifting equipment due to their lightweight nature. Bricklaying is a relatively straightforward process, often manageable by unskilled labor.

Clay bricks represent the earliest man-made building material, exhibiting superior fire resistance compared to stone and concrete masonry. As a fundamental construction component across all building sectors, they account for approximately 13% of overall material costs. Furthermore, structures incorporating clay bricks generally provide a more comfortable living environment than those using alternative materials.

Demand for clay bricks has steadily increased year over year, driven by urbanization, population growth, and industrialization in both the private and public sectors. A significant shift in building practices, favoring reinforced cement concrete (RCC) structures that utilize bricks, has further fueled this demand. Consequently, brick demand exhibits consistent and substantial growth. This, coupled with the need for affordable housing and rising construction material costs, has prompted research into lightweight, cost- effective brick alternatives. Conventional bricks are typically manufactured from various clays, including surface clays, shale clays, and fire clays. This study investigated the use of cow dung, coir, and lime as additives to clay bricks, resulting in a desirable lightweight and cost-effective product.

Clay :

Clay is a highly abundant natural mineral resource. Its plasticity, when mixed with water, allows for shaping and molding in brick manufacturing. Sufficient air-dried and wet strength is crucial to maintain the formed shape. While surface clay, shale clay, and fire clay exhibit similar chemical compositions, their physical characteristics vary. Manufacturers mitigate these variations by blending clays from multiple locations and sources within a single pit. However, slight property variations may occur between subsequent brick production runs from the same manufacturer. Key properties governing the strength and durability of clay bricks include the following:

Porosity is the ratio of void volume to total specimen volume, significantly influencing chemical reactivity, mechanical strength, durability, and overall brick quality. Typical clay bricks exhibit high porosity (15- 40%).

Apparent density, the ratio of dry brick weight to brick volume, indicates brick density and correlates positively with mechanical and durability properties.

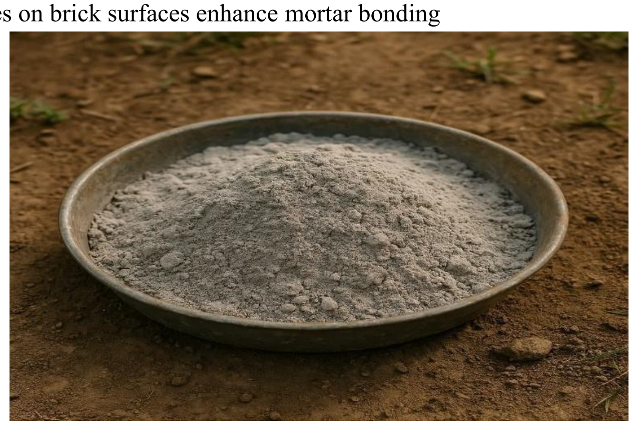
Water absorption capacity, representing fluid storage and circulation within the brick, was measured at 20.1% and 24.9% by weight for brown and red bricks, respectively.

Compressive Strength: Compressive strength can be estimated by assessing the mineral composition, texture, cracking, and porosity, which reflect the drying conditions.

Clay bricks exhibit compressive strength ranging from 1.5 MPa to 32 MPa

Cowdung Ash

Incorporating cow dung into clay modifies the clay's properties, yielding superior brick quality compared to other organic waste additives. Cow dung enhances clay plasticity, reduces green breakage, and serves as an internal fuel during firing, minimizing firing cracks. However, excessive cow dung reduces strength and density. An optimal additive ratio of 20% to 30% achieves desirable brick properties. Besides improving plasticity, cow dung acts as a reinforcing agent, reducing concentrated cracks. The dung fibers ignite during firing, promoting even firing and minimizing high- temperature gradients. Burned-out fibers create cavities, reducing unit weight and improving thermal characteristics. These cavities on brick surfaces enhance mortar bonding



Coir:

Coir, a sustainable building material derived from coconut husks, offers significant advantages for incorporation into unfired clay bricks. Its use mitigates air pollution from open burning and, at a 3% inclusion rate, largely meets desired material property requirements. The coir fibers function as a low-cost pore former, resulting in lightweight bricks. While some properties may exhibit minor reductions, the resulting bricks meet standards for non-load-bearing applications. Coir integration offers a cost-effective method for producing lightweight bricks while simultaneously providing a sustainable disposal solution, thereby minimizing environmental impact.

For optimal brick production, lime content should be limited to a maximum of 5%. Its finely powdered form minimizes brick flaking, and it effectively reduces clay brick shrinkage. However, lime lumps, when burned to quicklime, subsequently slake and expand upon contact with moisture, potentially causing brick splitting. Therefore, strict adherence to the 5% limit is crucial.

II. METHODOLOGY:

Raw materials for brick production were procured. Cow dung was dried and pulverized. Lime was incorporated following thorough cleaning. Coir fibers were obtained in a thin gauge. Clay was utilized in its natural state. The methodology encompassed preparation, mixing, molding, drying, testing, and results analysis

Preparation of clay

Mixing
↓
Moulding
↓
Drying
↓
Testing
↓
Result

Fig-1: Methodology

Clay Preparation:

High-purity clay is sourced for brick production. The topsoil layer (approximately 200 mm) is discarded to eliminate potential contaminants. Following topsoil removal, clay is excavated, spread evenly, and then manually cleaned of visible stones, organic matter, and other debris. Clay lumps are broken down, and the cleaned clay is then subjected to a four-week atmospheric weathering process for optimal softening.

Material Mixing :

Ingredient blending is performed manually. Clay, cow dung, and coir are combined in varying proportions, with 2% bonemeal & wooden ash maintained at a constant 5%. Coir and cowdung are incorporated as supplementary materials. The specific proportions are detailed in Table 1

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Table-1: Mix Proportions for 5% and 10 % Coir

Sl. No:	SET 1	SET 2
1.	5% Coir	10% Coir
2.	5% Coir + 5% Cowdung With Bonemeal constant at 2% & Wooden Ash 5%	10% Coir + 5% Cowdung With Bonemeal constant at 2% & Wooden Ash 5%
3.	5% Coir +10% Cowdung With Bonemeal constant at 2% & Wooden Ash 5%	10% Coir+10% Cowdung With Bonemeal constant at 2% & Wooden Ash 5%
4.	5% Coir +15% Cowdung With Bonemeal constant at 2% & Wooden Ash 5%	10% Coir+20% Cowdung With Bonemeal constant at 2% & Wooden Ash 5%
5.	5% Coir +20% Cowdung With Bonemeal constant at 2% & Wooden Ash 5%	10% Coir+25% Cowdung With Bonemeal constant at 2% & Wooden Ash 5%
6.	5% Coir +25% Cowdung With Bonemeal constant at 2% & Wooden Ash 5%	10% Coir+30% Cowdung With Bonemeal constant at 2% & Wooden Ash 5%

III. TESTING AND RESULTS

Following drying, the bricks underwent compressive strength and water absorption testing. These tests assess key physical properties and the bricks' resistance to cracking. Results from both tests were subsequently analyzed.

3.1 Compressive Test :

Brick compressive strength testing determines load- bearing capacity under compression using a Compression Testing Machine. This is crucial because bricks are primary components in load-bearing masonry walls, columns, and footings. To ensure accurate results, bed face irregularities are removed to create smooth, parallel surfaces. The specimen, with its mortar-filled face upward, is positioned horizontally between 3mm plywood sheets, carefully centered within the testing machine. Axial loading is then applied uniformly at 14 N/mm² per minute until failure. The maximum load at failure, recorded as the point where the indicator ceases to increase, is used to calculate compressive strength:
Compressive Strength = Maximum Load (N) / Average Bed Face Area (mm²).

3.2. Water Absorption Test On Bricks :

A water absorption test assesses brick durability, including burn quality, material properties, and weathering behavior. Bricks with less than 7% water absorption generally exhibit superior freeze-thaw resistance. Water absorption testing also determines porosity and compactness. Unfired clay should not exceed 35% absorption. The procedure involves drying specimens in a ventilated oven at 105-115°C until constant mass is achieved. After cooling to room temperature and weighing (M1), specimens are submerged in clean water for
24 hours. Following surface drying, the specimens are reweighed (M2). Water absorption is calculated as [(M2 – M1) / M1] x 100%.

3.2.1. Results :

Compression and water absorption test values were obtained for various coir and cow dung mixture proportions and are presented in the table

Table No 2: Compression test results for 5% coir addition

Sl. No:	Ratio	Weight (Kg)	Compression Value (KN)	Compression Strength (N/mm^2)
1.	5% Coir	2	225.3	11.30
2.	5%Coir+5%Cow dung	2.01	280. 4	14.20
3.	5%Coir+10%Co- wdung	2.20	315.3	15.93
4.	5%Coir+15%Co- wdung	2.24	425.2	21.31

5.	5%Coir+20%Co- wdung	3.1	474.5	23.920
6.	5%Coir+25%Co- wdung	3.58	512.6	25.60

Table-3: Compression test result for 10% coir addition

Sl. No:	Ratio	Weight (Kg)	Compression Value (KN)	Compression Strength (N/mm^2)
1.	10% Coir	2.53	229.6	10.53
2.	10%Coir+5%Cow dung	2.32	294	14.70
3.	10%Coir+10%Co -wdung	1.94	324	15.4
4.	10%Coir+15%Co -wdung	1.8	351	17.2
5.	10%Coir+20%Co -wdung	2.39	384	19.24
6.	10%Coir+25%Co -wdung	2.3	403.2	20.20

Note: Compressive strength exhibits a positive correlation with cow dung addition, provided coir and lime percentages remain constant. Maximum compressive strength is achieved .

A compressive strength of 25.63 N/mm² was achieved when incorporating 5% coir and 25% cow dung. The lowest compressive strength, 11.32 N/mm², resulted from the addition of 5% coir alone.

Table-4: Water absorption obtained for 5% coir

Sl. No	Ratio	Dry Weight (Kg)	Wet Weight (Kg)	Water Absorption (%)
1.	5% Coir	2	2.90	43
2.	5%Coir+5%C owdung	2.01	2.79	40.20
3.	5%Coir+10% Cowdung	2.27	2.910	28.53
4.	5%Coir+15% Cowdung	2.28	2.84	25.70
5.	5%Coir+20% Cowdung	3.1	3.74	21.93
6.	5%Coir+25% Cowdung	3.58	4.45	24.84

Table-5: Water absorption obtained for 10% coir

Sl.No	Ratio	Dry Weight (Kg)	Wet Weight (Kg)	Water Absorption (%)
1.	10%Coir	2.54	2.84	11.1
2.	10%Coir+5% Cowdung	2.35	2.99	28.04
3.	10%Coir+10 %Cowdung	1.99	2.65	34.14
4.	10%Coir+15 %Cowdung	1.8	2.51	39
5.	10%Coir+20 %Cowdung	2.39	3.10	30.10
6.	10%Coir+25 %Cowdung	2.3	3.04	32.9

Note: Water absorption initially increases before decreasing. Maximum water absorption, 46%, is achieved with 5% coir addition; minimum absorption is 12.1% with 10% coir addition.

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IV. IMPORTANCE OF ENVIRONMENTALLY CONSCIOUS BRICKS

The significance of environmentally conscious bricks is multifaceted: They promote sustainability by utilizing renewable and readily available materials, thereby reducing dependence on non-renewable resources and minimizing the construction industry's environmental impact. Furthermore, they facilitate improved waste management through the repurposing of agricultural and animal byproducts, a particularly valuable contribution in rural areas with substantial waste generation. Finally, their production generally requires less energy than conventional brick manufacturing, often employing lower firing temperatures or even sun-drying methods, leading to decreased energy consumption and reduced carbon emissions.

V. OBJECTIVES AND SCOPE

This study's primary objective is to investigate the viability of eco-friendly bricks manufactured from bone meal, cow dung ash, and wood ash as sustainable alternatives to conventional clay and cement bricks. This research will evaluate the mechanical properties, durability, and environmental advantages of utilizing these agricultural and animal waste materials in brick production. The study will contribute to the expanding body of knowledge on sustainable building practices and promote the use of innovative, waste- based materials within the construction industry.

5.1.1 Specific Objectives :

To accomplish this primary objective, the study will address the following specific objectives:

1. Material Characterization: Assess the physical and chemical properties of bone meal, cow dung ash, and wood ash to determine their suitability as brick manufacturing components. This includes compositional analysis, pozzolanic activity assessment, and evaluation of their potential to enhance brick performance.
2. Brick Production: We will develop a methodology for manufacturing environmentally friendly bricks utilizing varying ratios of bone meal, cow dung ash, and wood ash. This will include establishing optimal mixing, molding, and curing processes to maximize brick quality.
3. 3. Mechanical Testing: A comprehensive testing program will evaluate the compressive strength, water absorption, thermal insulation properties, and overall durability of the manufactured bricks. These results will be benchmarked against standard specifications for conventional bricks to assess their suitability for construction applications.
4. 4. Environmental Assessment: A life-cycle assessment will compare the environmental impact of producing these eco-friendly bricks to that of traditional clay bricks, focusing on carbon emissions, energy consumption, and waste reduction. This analysis will quantify the sustainability advantages of utilizing waste materials in brick production.
5. Economic Viability: A cost-benefit analysis will assess the economic implications of incorporating bone meal, cow dung ash, and wood ash into brick manufacturing, including cost comparisons, potential cost savings, and overall economic feasibility for both small-scale and large-scale production.

VI. CONCLUSIONS

Based on our study, the following conclusions have been reached:

* Compressive strength of clay bricks increases with the addition of cow dung, coir, Bonemeal, wooden ash .
* Maximum strength achieved was 25.63 N/mm², observed with a 5% coir and 25% cow dung ratio. This meets IS 1077:1992 Class 25 specifications. This significantly exceeds the typical 7.9 N/mm² strength of unfired clay bricks.
* Water absorption in unfired clay bricks typically ranges from 12% to 35%. Our results show a range of 12.15% to 46%. The brick exhibiting the highest compressive strength (25.63 N/mm²) had a water absorption of 20.86%, falling within the typical range for unfired clay bricks.
* Standard unfired clay bricks weigh 3-4 kg. In contrast, bricks incorporating cow dung, coir, and lime weighed 1.8-3.58 kg, representing a reduction in weight.

REFERENCES

[1]. Abdul Kadir, A., Mohd Zulkifl, S. N., Abdullah, M. M. A. B., & Sarani, N. A. (2016). The utilization of coconut fiber in fired clay brick. International Journal of Zero Waste Generation, 673, 213-222.

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[2]. Millogo, Y., Aubert, J.-E., Sere, A. D., & Fabbri, A. (2016). Earth blocks stabilized by cow-dung. International Journal of Civil Engineering and Technology, 6, 45-78.

[3]. Manu, D., & Yalley, P. P.-K. (2013). Strength and durability properties of cow-dung stabilized earth blocks. International Journal of Civil and Environmental Research, 3, 321-543.

[4]. Kadir, A. N. M. (2013). Effects of utilizing rice husk in fired clay bricks. International Journal of Zero Waste Generation, 1, 27-34.

[5]. Kadir, A. A., & Mohajerani, A. A. (2010). Possible utilization of cigarette butts in lightweight fired clay bricks. International Journal of Environmental Science and Engineering, 2, 115-156.

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