NOVATEUR PUBLICATIONS
JournalNX- A Multidisciplinary Peer Reviewed Journal
ISSN No: 2581 - 4230
VOLUME 12, ISSUE 6, June – 2026

BIO-BRICKS BY USING AGRICULTURE WASTE RECYCLING OF SUGARCANE BAGASSE WASTE FOR SUSTAINABLE CONSTRUCTION

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Abstract:
The present project titled “Bio bricks” focuses on the development of sustainable construction materials using agricultural waste such as sugarcane bagasse and soybean waste. Rapid growth in the construction industry has led to the excessive consumption of natural resources and increased environmental pollution. Traditional fired clay bricks release large amounts of greenhouse gases and require topsoil for manufacturing, resulting in significant environmental degradation.
In this study, agricultural waste residues are recycled and utilized as raw materials in the manufacturing of bio-bricks.
The collected waste is processed, mixed with binding materials, moulded into standard brick sizes, and the use of high-temperature firing. Various experimental tests such as compressive strength, water absorption, density, and thermal performance are conducted to evaluate the suitability of agro-waste bricks as a construction material.
The present study focuses on the development and evaluation of bio-bricks using agricultural waste as a primary raw material. Agricultural residues are combined with natural binders and subjected to molding and curing processes to produce lightweight, eco- friendly building units. The physical and mechanical properties of the bio-bricks, including compressive strength, water absorption, density, and thermal insulation, are assessed and compared with traditional construction materials.

Keywords: Bio-bricks, Agriculture Waste, Sugarcane Bagasse, Fly Ash, Compressive Strength, Eco-friendly Construction, Waste Management.

1. INTRODUCTION

The rapid growth of the construction industry has increased the demand for sustainable and eco-friendly building materials. Conventional clay bricks consume large amounts of natural resources and energy during manufacturing, which leads to environmental pollution and depletion of fertile soil. At the same time, agricultural industries generate huge quantities of waste materials that often remain unused or are disposed of by burning, causing serious environmental problems. One such agricultural waste is sugarcane bagasse.Sugarcane bagasse is the fibrous residue left after extracting juice from sugarcane in sugar industries. India, being one of the largest producers of sugarcane, generates a significant amount of bagasse every year. Improper disposal of this waste creates environmental and land pollution.

Therefore, utilizing bagasse in construction materials can provide an effective solution for waste management as well as sustainable development. Bio bricks are eco-friendly building blocks manufactured using natural or waste materials such as soil, fly ash, agricultural waste, and binding agents. In this project, sugarcane bagasse is used as a reinforcing and lightweight material in brick production. The use of bagasse in bio bricks helps reduce the overall weight of bricks, improves thermal insulation, and minimizes environmental impact. Additionally, the inclusion of fly ash and soil further enhances the sustainability of the product by reducing dependence on traditional clay. The main objective of this project is to develop sustainable bio bricks using sugarcane bagasse and to study their physical and mechanical properties such as compressive strength, water absorption, durability, and density. The project also aims to evaluate whether these bricks can be used as an alternative to conventional construction materials. The utilization of agricultural waste in bio brick production supports the concepts of green construction, waste recycling, and environmental conservation. Bio bricks made with sugarcane bagasse can contribute to low-cost housing and sustainable infrastructure development while reducing carbon emissions and industrial waste disposal problems.Thus, this project focuses on converting agricultural waste into useful construction material and promoting eco-friendly practices in the civil engineering field.

1.1 PROBLEM IDENTIFICATION:

the construction industry heavily depends on conventional clay bricks and cement-based materials for building purposes. the manufacturing of traditional bricks requires large quantities of natural clay and high-temperature burning processes, which consume significant energy and release harmful greenhouse gases into the environment. continuous excavation of clay also reduces fertile agricultural land and causes ecological imbalance.

at the same time, agricultural industries generate a large amount of waste every year. one of the major agricultural wastes is sugarcane bagasse, which is produced after extracting juice from sugarcane in sugar factories. in many areas, bagasse is eith er openly burned or dumped as waste, leading to environmental pollution, air quality deterioration, and disposal problems.

despite the availability of this agricultural waste, its utilization in construction materials is still limited. conventional building materials are becoming costly and environmentally unsustainable due to increasing demand for raw materials and rising energy consumption. therefore, there is a need to develop alternative eco-friendly building materials that are economical, lightweight, sustainable, and capable of utilizing waste products effectively.

1.2 Specific objectives:

- To develop lightweight and sustainable construction materials as an alternative to conventional clay bricks.
- To evaluate the mechanical properties of bio bricks, especially compressive strength and durability.
- To improve thermal insulation properties of bricks by incorporating bagasse fibers.
- To produce low-cost and environmentally friendly building materials suitable for sustainable infrastructure development.

2. MATERIALS USED IN BIO BRICK PRODUCTION

1 Soil

Soil is the primary constituent of the bio brick mixture. It acts as the base material and provides structural integrity to the bricks. The soil used in this project was collected from a local source and screened to remove stones, roots, and other impurities.

2 Fly Ash

Fly ash is a fine powder obtained as a by-product from thermal power plants during coal combustion. It contains silica, alumina, and calcium compounds, which improve the engineering properties of bricks.

3 Sugarcane Bagasse

Sugarcane bagasse is the fibrous residue left after extracting juice from sugarcane. It is an agricultural waste material that can be effectively utilized in bio brick production.

4 Water

Water is used for mixing all the ingredients and facilitating proper bonding between particles. Clean potable water was used during brick preparation.

3. METHODOLOGY

Step 1: Collection of Raw Materials

The required materials, namely soil, fly ash, sugarcane bagasse, and water, were collected from local sources. The materials were selected based on their availability, cost-effectiveness, and suitability for brick manufacturing.

Step 2: Preparation of Materials

The soil was dried and sieved to remove stones, roots, and other impurities. Fly ash was collected and stored in dry conditions. Sugarcane bagasse was cleaned and sun-dried to remove moisture. The dried bagasse was cut into small fibers for uniform mixing.

Step 3: Proportioning of Materials

The materials were measured according to the selected mix proportion:

Material	Percentage (%)
Soil	85%
Fly Ash	10%
Sugarcane Bagasse	5%
Water	

Step 4: Mixing

The soil and fly ash were first mixed thoroughly in dry condition. Sugarcane bagasse fibers were then added and mixed uniformly. Water was gradually added to obtain a homogeneous and workable mixture.

Step 5: Moulding

The prepared mixture was placed into brick moulds of standard size. Proper compaction was carried out manually to remove air voids and achieve the desired shape and dimensions.

Step 6: Drying

The moulded bricks were removed carefully from the moulds and kept under shade for 24–48 hours. The bricks were then sun- dried for 7–10 days to remove excess moisture and prevent cracking during firing.

Step 7: Kiln Burning (Firing)

After drying, the bricks were stacked in a kiln and fired at high temperatures (approximately 800°C–1000°C). During firing, the sugarcane bagasse burned and formed fine pores within the brick structure. The firing process improved the strength, hardness, and durability of the bricks.

Step 8: Cooling

After completion of firing, the kiln was allowed to cool gradually. The bricks were then removed and inspected for any visible defects such as cracks or deformation.

Step 9: Testing of Bio Bricks

The fired bio bricks were subjected to the following tests:
Compressive Strength
Test Water Absorption
Test Visual Inspection
Test

Step 10: Analysis and Evaluation

The test results were analyzed,to evaluate the suitability of bio bricks for construction purposes.

ECONOMIC ANALYSIS:

economic analysis was conducted to assess the cost-effectiveness of bio bricks compared to conventional clay bricks.

sr no.	rmal brick dry weight (gm)	brick weight (gm)	erence of normal and bio brick weight	percentage of difference (%)
1	2300	1700	600	26%
2	2350	1800	550	23.91%
3	2300	1800	500	21%

average difference of percentage is 23.63. the bio-bricks produced in this study are approximately 24% lighter than conventional clay bricks while utilizing agricultural waste materials. this demonstrates that bio-bricks are an environmentally friendly and economical alternative for sustainable construction applications."

TEST RESULT:

1. **COMPRESSIVE TEST:**

A compressive test on bio bricks measures how much weight the sustainable, biological materials can support before crushing. Typically conducted on a Universal Testing Machine (UTM), the test gradually applies force to dried and conditioned specimens to determine their viability for structural construction

brick identification	compressive strength (n/mm^2)	average strength (n/mm^2)
1	13.2	10.36
2	8.2	
3	9.7	

A. **sample calculation:**

for a brick size of 220 mm × 100 mm ×
70 mm: loaded area [a]= 220 x 100 =
22000 mm^2 compressive strength
formula fc = 10.36n/mm^2

average compressive strength: 10.36 n/mm² (10.36 ≈mpa)

2. **WATER ABSORPTION TEST:**

the water absorption test on bio bricks (and standard masonry units) measures porosity and durability by comparing their weight before and after 24 hours of total water submersion. the process determines how much moisture the brick absorbs, which correlates directly to its structural integrity and long-term weathering resistance.

calculate the percentage of water absorption using the following formula:

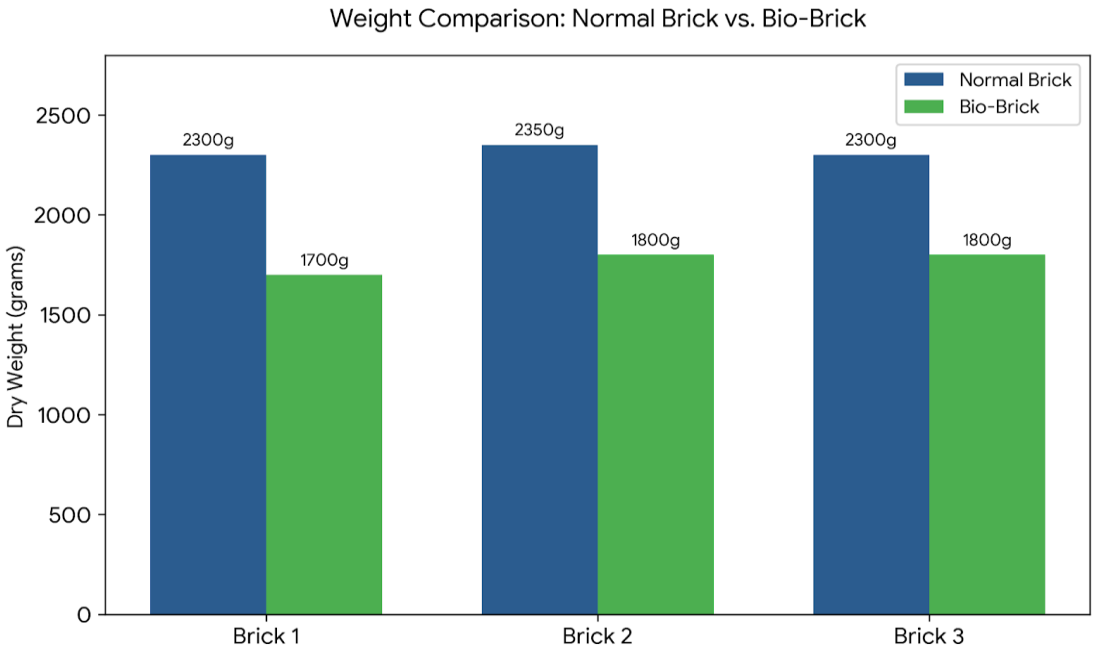
water absorption (%) = {m2 - m1}/{m1}x 100

where:

(m1) = dry weight of the bio brick

(m2) = wet weight of the bio brick.

brick identification	dry weight (gm)	wet weight (gm)	water absorption %	Average %
1	1700	2030	19.41	19.24
2	1800	2150	19.44	
3	1800	2140	18.88	



CONCLUSION

The present study successfully demonstrated the production of bio-bricks using agricultural waste materials such as sugarcane bagasse, fly ash, and soil. The developed bio-bricks achieved a compressive strength of 10.36 MPa, water absorption of 19.24%, and approximately 23.74% weight reduction compared to conventional bricks. The temperature test showed a 6°C reduction, indicating good thermal insulation properties. The results confirm that bio-bricks are lightweight, economical, eco-friendly, and suitable for sustainable construction applications. Therefore, bio-bricks can be considered a promising alternative to conventional clay bricks for green and low-cost building projects.

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