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“ANEXPERIMENTALSTUDYONSTRENGTH PROPERTIES OF LIME-CLAY SUGARCANE BAGASSE FIBER BLOCKS”

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Abstract: India is one of the world's leading producers of sugarcane, with an annual production of 250–300 million tons. The residual bagasse is turned into bagasse fiber, even though the primary issue is how to get rid of the sugarcane trash, or bagasse, that's left over after the juice is removed. Since the manufacture of cement increases carbon dioxide emissions, lime is usedinstead of cement, which is harmful to the environment. This project's main objective is to produce stabilized sugarcane bagasse lime clay blocks that are green and environmentally beneficial, all while resurrecting traditional building methods. Without compromising the material's mechanical properties, this will be accomplished by using locally produced lime, clay, and agricultural waste, such as sugarcane bagasse fibers. First, there are blocks made of lime with different percentages of sugarcane bagasse fibers, and second, there are blocks made of different lime with different percentages of $CaCo_3$ while keeping sugarcane bagasse fibers constant. The third set of blocks is composed of different amounts of lime relative to the different percentages of clay, keeping the fibers from sugarcane bagasse constant.

KEYWORDS:**Sugarcanebagassefibers,fiberreinforcementimpact,Insulation.**

1. INTRODUCTION

Incorporatingsustainablematerialsintomodern construction is crucialfor eco-friendlybuildingpractices andaddressingclimate change. Lime blocks, made of lime, sand, andnatural minerals, are valued for their breathability, flexibility, and environmental benefits, enhancing indoor air qualityand structural durability. Similarly, sugarcane bagasse, a fibrous byproduct of sugar production, is an abundant, renewable, and biodegradable material, fitting well with circular economyprinciples byconverting agricultural waste into construction resources.

This studyinvestigates theintegration of sugarcane bagasse fibers with lime-clayblocks to enhance their mechanical properties. Byusing bagasse fibers, known for their high tensile strength and low density, theresearch aims to improve the structural integrityandenvironmentalperformanceofthesebuildingmaterials.Repurposingbagassenot onlyaddresses wastemanagement but also aims to reduce air pollution linked to traditional construction.

The research thoroughlyexamines the mechanical feasibilityof lime-claysugarcane bagasse fiber blocks, aiming to establish themassustainableandrobust alternativesfor modern construction.Thisinterdisciplinaryapproach promotessustainability and innovation, addressing the urgent environmental challenges of contemporary infrastructure development.

2. SUGARCANEBAGASSEFIBERS

Sugarcane bagasse fibers, a byproduct of sugarcane processing, are sustainable and versatilematerials with manyapplications. Extracted from the stalks after juice extraction, these fibers are renewable and abundant, offering an eco-friendly alternative to fossil fuel-based materials andhelpingtoreduce environmental impact. These lightweight fibers are known for their strength and durability, making them suitable for various industrial uses. Theycan be processed into mats, boards, and pellets, serving diverse industries. Interest in using sugarcane bagasse fibers as a sustainable substitute has grown in packaging, construction, and automotivesectors. In packaging,theycan createbiodegradablecontainers,reducingplasticuse. In construction,theycan beused in particleboards, providing a renewable alternative to wood products. In the automotive industry, these fibers help produce lightweight composites, improving fuel efficiency and lowering emissions. Additionally, bagasse fibers are useful in wastewater treatment and soil stabilization due to their porous and moisture-absorbing nature, which aids in filtering contaminants and improving soil structure. Overall, sugarcane bagasse fibers offer environmental and economic benefits across various industries.As sustainabilityefforts grow, their use is expected to increase, supporting a greener future.

3. OBJECTIVES

The main objective of the project is to find an eco-friendly alternative to the cement block using Lime as it is a naturally occurring abundant material because cement production leads to a lot of CO_2emissions which is the main cause of Global Warming and air pollution.

3. MaterialsUsed

- Clay
- Lime
- SugarcaneBagassefiber
- CalciumCarbonate(CaCo3)
- Moulds(100x100x100) mm
- Lubricant

4. ChemicalComposition

4.1Thechemicalcompositionofsugarcanebagassefibers

Sugarcane bagasse fibers aremade upofcellulose, hemicelluloses, lignin, anda fewextractives. The bulkofthe fibers aremade ofcellulose, which givesthemstrength.Hemicellitatesandlignin addtothefibers' overallstructure.Theprecisepercentagescan change, but generallyspeaking, cellulose makes up40–45%,hemicelluloses 25–30%, andlignin 20–30%.These elements affect the characteristics of sugarcane bagasse fibers and how well-suited they are for different uses.

4.2TheChemicalCompositionofClay

The chemical makeup of brick clay is composed of silica (SiO_2), which gives it strength, and alumina (Al2O3), which affects plasticity and facilitates molding. Iron oxide ($Fe2O_3$) degrades in excess and has an impact on color. Lime (CaO) functions as a flux, but too much of it causes problems. Refractoriness isinfluenced by magnesium (MgO),and efflorescence can be brought on by greater alkalies (Na_2O, K_2O). Plasticity is impacted by organic matter, and too much of it degrades quality. Water content is important for molding and plasticity; high sulfur content can discolor bricks; low sulfur content is better for high-qualitybricks.

4.3TheChemicalCompositionof Lime

Calciumandoxygen makeupthemajorityofthechemicalcompound known asquicklime,or calcium oxide(CaO).Becauseof its chemical formula, CaO, one calcium (Ca) and one oxygen (O) atom make up each molecule. Heating limestone (calcium carbonate, or $CaCO_3$) to a high temperature yields quicklime.

5. Methodology

- RawMaterials Preparation
- Mixing
- AdditionofWater
- Molding
- Drying
- Tests
- Trailmix

5.1. RawMaterialsPreparation

- Gatherbagassefibersfromtheprocessingofsugarcane.
- Makesuretherearenocontaminantsandthebagasseis clean.
- Chopthebagassefibertothedesiredlength.(25mm)
- Acquirelime.

5.2. Mixing

- Mixtheproperamountsofrawmaterialstoacquiredesiredresults.
- Themixingwasdonein3differentcombinationsoftherawmaterial.
- In the mixing of the first set, the water and lime are kept constant. The sugarcane bagasse was added in varying percentages of 0, 0.5, 0.25, 0.75, and 1, among which we aim to find the percentage of fiber that imparts the highest compressive strength.
- In the mixing of the second set, the water and sugarcane bagasse are kept constant. CaCo3 is added in the varying percentages of 5,10,15,&20 to the weight of the lime.
- In themixing ofthethirdset,thewater and sugarcanebagassearekept constant.Clayis added in thevarying percentages of 5,10,15,20 to the weight of the lime.

5.3. AdditionofWater:

- Whilemixing,graduallyaddwatertothemixture.
- Reachaconsistencythatisjustwetenoughtosupportmolding.
- Watershouldbeaddedtothemixturegraduallywhilebeingconstantlystirred.
- Makesurethemixtureformsuniformly.

5.4Molding:

- Transferthemixtureinto100×100×100mmmolds.Toeliminateairspaces,firmlycompactthemixture.

5.5. Drying:

- Allowtheblockstodryinthesunshadefor15daysaftermixing,togetridofanylastbitsofmoisture.
- Toavoidcracking,makesurethedryingprocessisslow.

5.6. Tests:

- Oncetheblocksaredry,theyaretestedfor compressivestrength

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5.7. Trail mix:

- Trailmixeswerecarriedouttoobtaintheoptimumquantityoflimeandwaterrequiredandtestedforcompressive strength (moulds were de-moulded at 7 days, air-cured, and tested for compressive strength at the age of 15 days).
- Whilemixing,graduallyaddwatertothemixture.
- Reachaconsistencythatisjustwetenoughtosupportmolding.
- Watershouldbeaddedtothemixturegraduallywhilebeingconstantlystirred.
- Makesurethemixtureformsuniformly.

SLNo.	PARTICULARS	COMPRESSIVELOAD
1	75%	15kN
2	80%	11kN
3	85%	8kN

6. Results

6.1Sugarcanebagassecontent- Set 1

0%

Sl.No	Compressiveload	Compressivestrength	Proportions
01	16kN	1.6N/mm^2	Lime:950gm Water:710ml Bagasse:0gm
02	18kN	1.8N/mm^2	
03	20kN	2.0N/mm^2	

Avg:	18kN	1.8N/mm^2	

0.25%

Sl.No	Compressiveload	Compressivestrength	Proportions
01	14kN	1.4N/mm^2	Lime: 950gm Water: 710ml Bagasse:2.4gm
02	18kN	1.8N/mm^2	
03	18kN	1.8N/mm^2	
Avg:	16.66kN	1.6N/mm^2	

0.5%

Sl.No	Compressiveload	Compressivestrength	Proportions
01	12kN	1.2N/mm^2	Lime: 950gm Water: 710ml Bagasse:4.5gm
02	18kN	1.8N/mm^2	
03	14kN	1.4N/mm^2	
Avg:	14.66kN	1.46N/mm^2	

0.75%

Sl.No	Compressiveload	Compressivestrength	Proportions
01	20kN	2.0N/mm^2	Lime:950gm Water:710ml Bagasse:7gm
02	26kN	2.6N/mm^2	
03	24kN	2.4N/mm^2	
Avg:	23.33kN	2.3N/mm^2	

1%

Sl.No	Compressiveload	Compressivestrength	Proportions
01	14kN	1.4N/mm^2	Lime: 950gm Water: 710 ml Bagasse:9.5gm
02	16kN	1.6N/mm^2	
03	14kN	1.4N/mm^2	
Avg:	14.66kN	1.4N/mm^2	

6.2CalciumCarbonate(CaCO3)–Set2

5%

Sl.No	Compressiveload	Compressivestrength	Proportions
01	16kN	1.6N/mm^2	Lime: 902 gm CaCO3:47.5 gm Water:710ml Bagasse:7gm
02	14kN	1.4N/mm^2	
03	16kN	1.6N/mm^2	
Avg:	15.33kN	1.5N/mm^2	

10%

Sl.No	Compressiveload	Compressivestrength	Proportions
01	16kN	1.6N/mm^2	Lime:855gm
02	18kN	1.8N/mm^2	CaCO3:95 gm Water:710 ml Bagasse:7gm
03	16kN	1.6N/mm^2	
Avg:	16kN	1.6N/mm^2	

15%

Sl.No	Compressiveload	Compressivestrength	Proportions
01	14kN	1.4N/mm^2	Lime: 807gm CaCO3:142.5 gm Water:710ml Bagasse:7gm
02	12kN	1.2N/mm^2	
03	14kN	1.4N/mm^2	
Avg:	13.33kN	1.3N/mm^2	

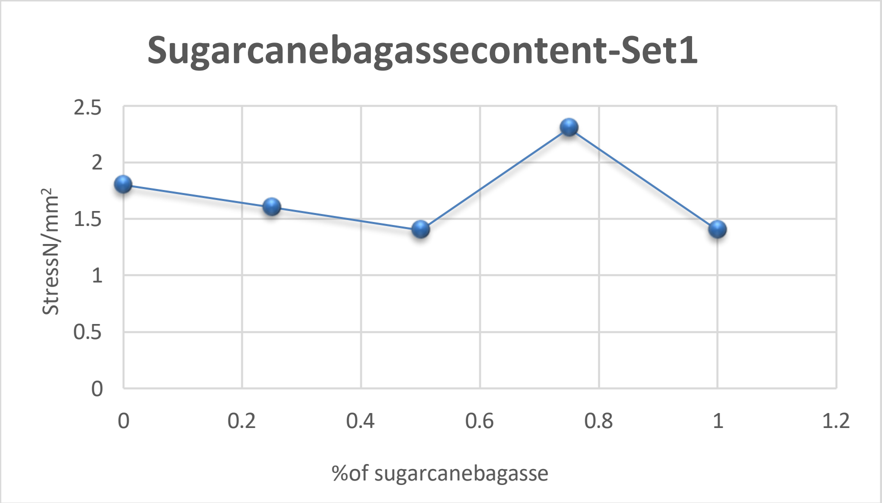
20%

Sl.No	Compressiveload	Compressivestrength	Proportions
01	14kN	1.4N/mm^2	Lime: 760gm CaCO3:190gm Water:710ml Bagasse:7gm
02	14kN	1.4N/mm^2	
03	16kN	1.6N/mm^2	
Avg:	14.6kN	1.4N/mm^2	

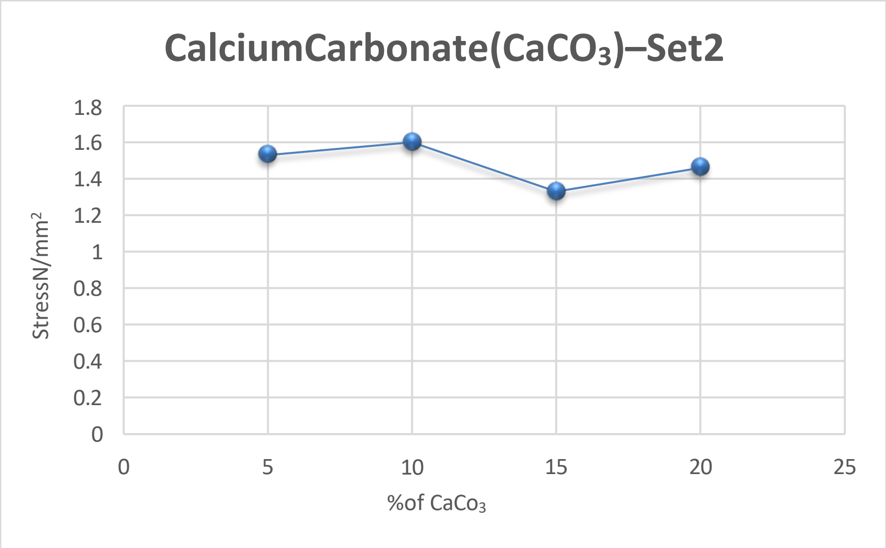
6.3.Clay–Set3

5%

Sl.No	Compressiveload	Compressivestrength	Proportions
01	14kN	$1.4 N/mm^2$	Lime:902gm Clay:47.5gm Water: 710ml Bagasse:7gm
02	12kN	$1.2 N/mm^2$	
03	10kN	$1.0 N/mm^2$	
		n^2	



trength	Proportions
n^2	Lime:855gm Clay:95gm Water: 710ml Bagasse:7gm
n^2	
n^2	
n^2	



trength	Proportions
n^2	Lime: 807gm Clay:142.5gm Water: 710ml Bagasse:7gm
n^2	
n^2	
n^2	

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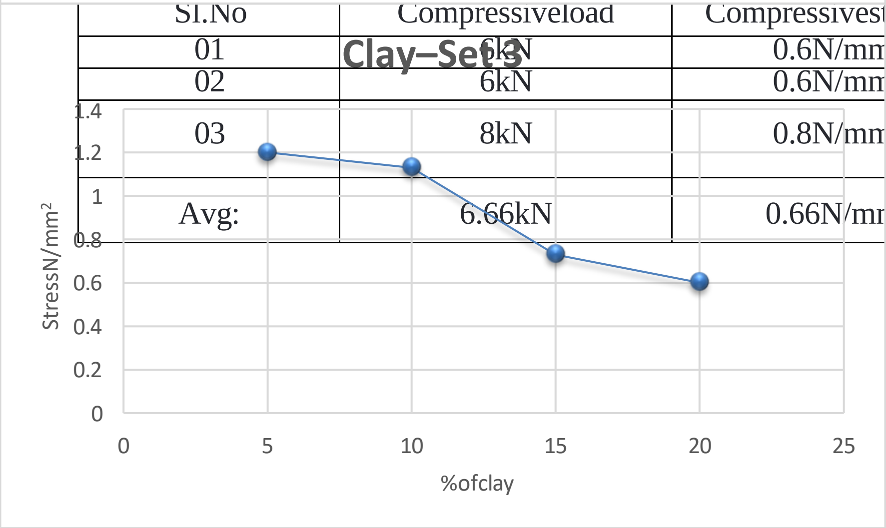
Sl.No	Compressiveload	Compressivestrength	Proportions
01	6kN	$0.6 N/mm^2$	Lime:760gm Clay:190gm Water: 710ml Bagasse:7gm
02	6kN	$0.6 N/mm^2$	
03	8kN	$0.8 N/mm^2$	
Avg:	6.66kN	$0.66 N/mm^2$	



Conclusion

For our project, we prepared a total of 39 blocks, each with varying percentages of lime, sugarcane bagasse fibers, calcium carbonate (CaCO3), and clay to assess their impact on compressive strength. The observations from the differentsets of blocksare detailed below:

- First Set of Observations: We found that adding 0.75% sugarcane bagasse fibers to the mix yielded thehighest compressive strength of 2.3 N/mm^2. This indicates that the fibers significantlyenhance the structural integrityof the blocks, likelydue to their high tensile strength and ability to distribute stress within the composite material.
- Second Set of Observations: When we incorporated 10% $CaCO_3$ into the blocks, the maximum compressive strength achieved was 1.6 N/mm^2. While this is lower than the strength observed with bagasse fibers, it still suggests that CaCO3 contributes positivelyto the structural properties of the blocks, potentiallyby filling voids and improving density.
- Third Set of Observations: Adding 5% clay resulted in blocks with a maximum compressive strength of 1.2 N/mm^2. Although clay contributes to the cohesiveness and workability of the mix, its impact on compressive strength is less pronounced compared to bagasse fibers and $CaCO_3$.
- Final Analysis: Among all 39 blocks tested, the block containing constant amounts of lime and water, with the addition of 0.75% sugarcane bagasse fibers, exhibited the highest compressive strength. This outcome underscores the effectiveness of sugarcane bagasse fibers in reinforcing the material, making it a promising sustainable alternative for enhancing the durability and performance of construction materials.

Overall, these findings highlight the potential of using sugarcane bagasse fibers in construction to produce stronger and more sustainable building materials. The study's results suggest that carefully adjusting the composition of these blocks can lead to significant improvements in their mechanical properties, contributing to more resilient and environmentally friendly construction practices.

Reference

1. Vithalkar, B. A., Aru, R. S., Rathod, A. V., Khedka, V. H., Anjkar, A. G., Khandare, D. A., &Shirbhate, R. S. (2022). Utilization of Sugar Mill Waste in Manufacturing of Bricks. *International Journal of Aquatic Science*, *Vol 13,*(Issue 01,)
2. Danso,H.,Martinson,B.,Ali,M.,&Williams,J.B.(2015).EFFECTOFSUGARCANEBAGASSEFIBREONTHE STRENGTHPROPERTIES OF SOIL BLOCKS. *First International Conference onBio-BasedBuildingMaterials*, *VOL33*(Issue 02,).
3. Singh, P., Kumar, R., &Murugesan, K. (2022). FlyAsh &SugarcaneBagasseBricks (Studyfor theCompressiveStrength with Varying Material Composition & Water Absorption Test). *International Journal of Research in Engineering and Science*, *vol 10*(issue 10).
4. Kazmi, S. M. S., Munir, M. J., Abbas, S., Saleem, M. A., Khitab, A., & Rizwan, M. (2017). Development of Lighter and Eco-Friendly Burnt Clay Bricks Incorporating Sugarcane Bagasse Ash. *Pak. J. Engg. &Appl*, *vol 21*.