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An Experimental Investigation on Suitability of Cow Waste in Construction Material

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ABSTRACT: The growing demand for sustainable construction materials has led to the exploration of eco-friendly alternatives in cement production. This study investigates the feasibility of partially replacing cement with cow dung ash (CDA) in concrete, aiming to reduce environmental impacts, improve cost efficiency, and promote waste recycling. Cow dung, an agricultural waste, is burned under controlled conditions to produce ash, which is rich in pozzolanic properties due to its silica and alumina content.

KEYWORDS: Cow Dung, Cow Urine, Lime.

I. INTRODUCTION

The forts which are built in ancient period by our Maharaja are found in good condition because the materials and the techniques which were used at that time are superior. The material which is used in ancient time are much stronger than the today's construction material. There are many alternative traditional materials which can be used in place of the modern materials. Cow dung, gypsum and lime are the materials use in the ancient time to build the fort or houses. Because these materials are used to decrease the conduction of heat and also, they are waterproof. In Indian villages the paste of the white soil and the cow dung is applied on the floor and wall for thermal insulation purpose. The ingredients use for making cow dung plaster are gypsum, cow dung powder, white soil and last but on least citric acid and for cow dung brick are cow dung, lime, cow urine and last white soil. In this study we know about what is cow dung plaster and cow dung brick and its advantages.

PROBLEM STATEMENT:

The populations in developing countries like Rwanda are highly increasing day by day. So, they need infrastructures facilities such as buildings, highways, hydraulic structures, airports, parking to accommodate them effectively. Those infrastructures require construction materials primarily concrete and others.

SCOPE OF THE RESEARCH

This study is not limited to the application cow dung ash (CDA) in construction industry. This paper mainly highlights the significance and necessity of consumption of the waste material for manufacturing of sustainable concrete for construction. There is a need to search for supplementary cementitious materials for utilization as partial substitute for cement in the field of civil engineering.

II. LITERATURE REVIEW

1. **Dhiraj Thakur et.al (2019)** Presented the effect on concrete by adding cow dung ash to the cement. The cement in concrete is replaced with cow dung ash in different proportion by weight (like 5%, 10% and 15%). The strengths of concrete (compressive & tensile) were tested at different curing periods (7, 14 and 28 days). Tests like determination of bulk density, workability and settling time of cow dung ash for different proportion are conducted on samples.

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- 2. Duna Samson et.al (2014) Reported the investigation into the pozzolanic potentials of cow dung ash. Cow dung was calcined at a temperature range of 400-500, sieving was done through 212µm sieve and characterization was done using chemical and physical methods. CDA proportion used in cement was 0 to 30% (at 5% interval). Different test like soundness Standard consistency and setting time test were conducted on the fresh cement paste, while on the hardened mortar samples compressive strength test was conducted at different curing time of 7, 28, 60 and 90days. The sum of Fe2O3, A1203 and SiO2 in CDA exceeds the 70% minimum specified by standard ASTMC 618-12.
- 3. Leopold Mbereyaho et.al (2020) Concludes the performance of cow dung mixed with cohesive soil mortar and establish recommended mix content for work of plastering. Twelve samples of soil mortar were prepared with cow dung (10%, 20%, 30% and 40%), and dried for 28 days before performing tests for water absorption, shrinkage, specific gravity, weathering resistance and Atterberg limit tests.

III. PROBLEM DEFINITION

The construction industry is a significant contributor to environmental degradation, primarily due to the excessive use of cement, which has a high carbon footprint. Cement production accounts for a substantial portion of global CO_2 emissions, and the disposal of cow dung, a common agricultural waste, presents challenges in terms of waste management and environmental pollution. As a solution to these issues, this study investigates the partial replacement of cement with cow dung ash and cow dung tiles as sustainable building materials.

IV. FUTURE SCOPE

- 1. Extended Material Characterization
- 2. Optimization of Mix Design
- 3. Performance Under Extreme Conditions
- 4. Structural Applications
- 5. Life Cycle Assessment (LCA)

V. OBJECTIVE

- To examine the effectiveness of using CDA as partial replacement of cement by studying strength parameters.
- To investigate the compressive strength of concrete with CDA to that of normal concrete.
- To prepare high strength, eco-friendly and cost effective concrete.
- To attain conventional concrete strength by partial replacement of cement with CDA.
- To evaluate the significance of consumption of the waste material for manufacturing of sustainable concrete for construction.

VI. METHODOLOGY

METHODOLOGY

Batching:

- Weigh the materials (cement, cow dung powder, lotus leaf powder, limestone powder, and sandalwood powder) based on the decided substitution percentages.
- Weigh the required amount of water to ensure the desired consistency for mixing (typically 0.4-0.5 times the weight of cement).

Dry Mixing:

- Mix the dry ingredients (cement, cow dung, lotus leaves powder, limestone powder, and sandalwood powder) thoroughly in a mechanical mixer or by hand to ensure uniform distribution of all materials.
- Ensure that the mixture is homogeneous.





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Adding Water:

• Gradually add water to the dry mixture, mixing continuously until the desired consistency is achieved. The mixture should be workable but not too fluid, depending on the intended purpose (e.g., casting tiles, concrete slabs, etc.).

Casting:

- Pour the mixture into molds, or if casting tiles, shape it into the desired tile format.
- Compact the mixture if necessary to remove air pockets and ensure uniformity.

Curing:

- Allow the mixture to cure for at least 7 days in a controlled environment (usually by keeping the mold moist and covered).
- Depending on the final product, curing time can be adjusted. Concrete typically gains most of its strength within 28 days.

VII. DETAILS OF DESIGN WORKING AND PROCESS

Experimental Material Cow Dung Ash Block

1. Cement:

The cement used to be Portland Pozzolana Cement (PPC). The Portland Pozzolana cement is produce by mixing ordinary Portland cement with 10 to 25 percent of the pozzolanic material. Fineness should not be less than 300 m2/kg. The initial and final setting times were found as 30 minutes and 10 hours respectively.

2. Sand:

M- sand was used as fine aggregate. The specific gravity and fineness modulus was 2.67 and 2.93 respectively. Silt content as the total quantity of fine particles of deleterious materials having particle from 0.06 mm to 0.002 mm present in sand.

3. Coarse Aggregate:

The 20mm size aggregates were tested and the specific gravity value of 2.78 and fineness modulus of 7 find and selected. Smaller sized aggregates produce higher concrete strength.

4. Water:

Potable water used for mixing and curing purposes. Preparing of concrete and for this purpose used in the Water cement ratio is W/C of 0.60 (60%) water range 6 to 7.5PPM. cement should not be before 90 days

5. Cow Dung Ash:

Cow dung ash has chemical properties wide-range in Nitrogen, Potassium and calcium. It has extremely high carbon to the Nitrogen ratio. While it has physical properties such as it is huge in size, has large ash content and burning ratio is low.

VIII. TESTS ON CONCRETE

SLUMP CONE TEST

A slump cone test measures the consistency of fresh concrete by determining how easily it flows. This test is performed to ensure that concrete batches are of consistent quality and strength.



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MIX DESIGN

Percentage of CDA Replacement	W/C	No. Of Block	Cement	Ash	Sand	Aggregate
5	0.6	1	1.35	0.071	2.137	4.275
10	0.6	1	1.28	0.142	2.137	4.275
15	0.6	1	1.14	0.285	2.137	4.275

IX. RESULTS AND DISCUSSIONS

RESULTS AND DISCUSSIONS

Compressive strength The strength in compression has a definite relationship with all other properties of concrete In India cubical moulds of size 150mm *150mm had casted and tested for 7 days,14 days and 21 days. The test results are tabulated below

S NO	% COW DUNG ASH	Compressive strength (N/mm2)			
51110		7 Days	14 Days	21 Days	
1	5	14.45	18.4	22.8	
2	10	17.1	19.90	26.28	
3	15	16.69	18.90	21.22	

APPLICATIONS

Concrete Production:Eco-friendly Concrete: Cow dung ash can be used as a partial replacement for cement in the production of eco-friendly concrete for residential, commercial, and industrial buildings. This reduces the carbon footprint of cement manufacturing and promotes sustainability.

Masonry Blocks: Cow Dung Ash Blocks: CDA can be used to manufacture lightweight masonry blocks that are suitable for non-load-bearing walls in low-rise buildings. These blocks have better insulation properties and contribute to energy-efficient buildings by maintaining internal temperatures.

X. CONCLUSION & RECOMMENDATION

CONCLUSION

Experimental investigations carried out to study the cow dung ash on the strength of concrete. Cement was partially replaced with four percentages (5%, 10%, and 20%) of cow dung ash by weight. The compressive strengths of the concrete specimens were determined at 7, 14 and 28 days respectively. Test results indicated that the consistency limits increased up to an optimum content and decreased further with the increase in the % of CDA in cement.

The compressive strength is increased when the cement was replaced by 10% of CDA and decreased with increase in the cow dung ash content. Hence, it is concluded that the 10% cement can be replaced with CDA in Concrete.



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