

Utilization of Paper to Produce Bricks

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Abstract - The objective of present research is to employ the waste materials like paper and to substitute the costly and rare conventional building brick, which satisfies the characteristics such as Cost effective, Environmental friendly, Less weight, Inflammable, Easily available, Establishing the industries, Increase there strength by adding other materials, Decrease the water absorption capacity, Increase fire resistance capacity, Trying to reduce concrete amount necessitate with same strength, Ultimately reduced CO2 amount, Decreases in the carbon footprint of the house, Use the different materials in the place of cement as binding material.

The aim of this research is to -

- 1] Manufacture brick using sludge along with fly ash as a binding material and mixed with construction & demolition waste in various ratios
- 2] Compare the compressive strength, water absorption assigned by the Indian Standard Specifications for load bearing bricks.
- 3] Comparison of the designed brick with traditional clay brick, fly ash brick, concrete brick.

1. INTRODUCTION

The large requirement has been placed on the construction industry, particularly in the last decade due to significant increase in pollution which cause a chronic shortage of building resources, the civil engineers have been dare to transform the industrial waste to useful building and construction materials. One absolute recycle possibility is using waste paper as a construction material. Since the construction field uses up a significant quantity of non-renewable resources, therefore the potential function of waste paper for producing a low cost and light weight composite brick for construction not only yields the probable use of waste paper recycling but it will likewise bring down the demand pressure on global natural resources.

A papercrete is a complex material comprising of Portland cement, waste paper, water and/or sand. The amalgamation of these materials, which may give a way to provide economical housing on a large scale. Papercrete have been appeared to be low-cost stand-in building material; to have good sound absorption and thermal insulation; to be a light weighted and fire-resistant

material. Although it is originally developed 80 years ago, but it has only recently been rediscovered and only few research works have been done to determine their structural suitability.

1.1 Bricks

A brick is material of building utilized to make partition walls, road pavements and other elements in masonry construction. Traditionally, the term brick relate to a unit tranquil of clay, but it is now used to refer any rectangular units laid in mortar. A brick can be combination of clay-bearing soil, sand, and lime, or concrete materials. Bricks are made in many classes, sort, materials, and sizes which differ with region and time period, and are produced in mass quantities. Block is a analogous term referring to a rectangular building unit composed of connatural materials, but is ordinarily larger than a brick. Lightweight bricks (also called lightweight blocks) are made from enlarged clay aggregate. bricks are used in Construction of walls of any size Construction of floors, Construction of arches and cornices, Construction of brick retaining wall, Making Khoa (Broken bricks of required size) to utilise as an aggregate in concrete, Fabrication of surki (powdered bricks) to be used in lime plaster and lime concrete.

1.2 Paper

Paper is a natural polymer which include wood cellulose. Cellulose is made of units of monomer glucose. Although comprising various hydroxyl groups, cellulose is water insoluble. The explanation is the stiffness of the chain and hydrogen bonding between two OH groups on side by side chains. The chains also pack regularly in places to make hard, stable crystalline region that yields the bundle chains even more steadiness and strength. Paper is a thin material made by the adjutory unneurotic moist fibers of cellulose pulp taken from wood, rags or grasses, and air-dried them into flexible sheets. It is a versatile material with many utility, including writing, printing, packaging, cleaning, and a many of industrial and construction processes. To make pulp from wood, a chemical pulping process abstracted lignin from cellulose fibers. This is accomplished by dissolution of lignin in a cooking liquor, so that it may be washed from the cellulose; this preserves the length of the cellulose fibers.

2. Experimental Procedure

According to investigation, up to now, there is no hard and fast rule for formal mix design of papercrete, and in that regard no hard operation for casting the bricks. Thus, in this research, some laboratory tests were performed to acquire some mechanical properties of papercrete.

2.1 Mould Preparation

After assembling all the materials, a mould was braced. A wooden modular brick mould was prepared of size 200mm X 100mm X 100mm. Joints were made without any hole or gap to prevent any leakage.



2.2 Pulp Generation

The papers, which were gathered, cannot be utilized straightaway. It should be made into a paper pulp before mixing with other elements. The papers were kept in the tank for 3 to 4 days, otherwise until the papers degrade into a paste-like form. Then the paper paste taken out of the water and taken to the mixer machine to make it as a paper pulp.

2.3 Mixing and Casting

Mixing was done after all the constituent were ready. In this project, mixing was done manually. A trial combination of cement: sand: paper sludge (1.5:1.5:3) was used in this experiment. After the mixing, it should be place in the mould within 30 minutes and tamped with wooden tamper and the surface of the brick should be dressed by shovel or ooden tamper. The casted papercrete bricks must be allowed for sun drying for 14 days. There is no such specific care needed for curing of bricks because the paper used in bricks itself hold water for a long time.



3. Results and Discussion

After casting of the bricks they are tested under compressive test, water absorption test, soundness test, hardness test whose results are mentioned below:-

3.1 Compression Test

This test was held out by Compression Testing Machine after the 14th, 21th and 28th day from the date of casting paper Crete brick. Paper Crete bricks never go wrong catastrophically, it just compressed like squeezing rubber. Therefore, great care must be advised during testing the papercrete brick because in papercrete load should be applied upto one-half compression only. The papercrete bricks possess elastic behavior and small brittleness, owing to this the structure was not completely collapsed, when the papercrete brick fails at higher loading, Only the outer faces chapped and peeled out.



Table -1: Compressive Strength of bricks with no. of days

Types of brick	14 Days	21 Days	28 Days
Clay brick	1,75 N/mm ²	2.03 N/mm ²	2.33 N/mm ²
Fly ash brick	3.75 N/mm ²	5 N/mm ²	5.25 N/mm ²
Concrete brick	3.75 N/mm ²	5 N/mm ²	5.25 N/mm ²
Waste paper	3 N/mm ²	2.75 N/mm ²	3.25 N/mm ²

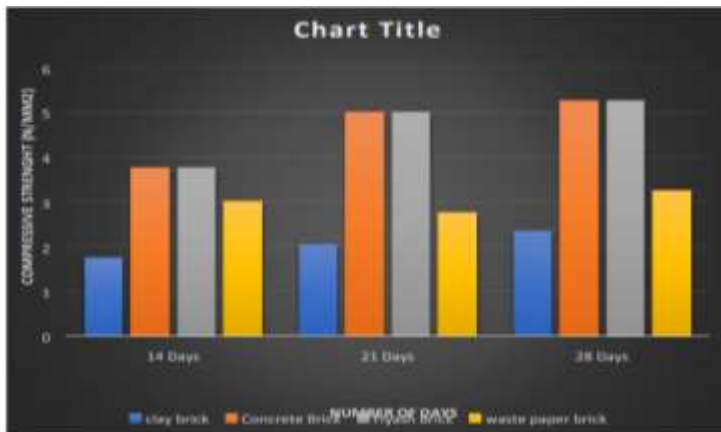


Chart -1 Variation in Compressive Strength of papercrete brick with no. of days

3.2 Weight

The common customary clay bricks weight variegate from 3 – 4 kg compare to the papercrete bricks whose weight varies from 1 – 2 kg. The maximum weight is less than 2 kg only. All the bricks were weighed in a well conditioned electronic weighing machine. Sand based papercrete bricks are holding weight 2/3rd of the conventional clay brick only. So these bricks are lightweight and thus helpful to cut the total cost of construction due to significant reduction in total dead load of the structure.

Table -2: Weight of papercrete bricks on different days.

Types of Brick	14 days	21 days	28 days
Clay Brick	3.22Kg	3.13Kg	3.08Kg
Concrete Brick	3.63Kg	3.59Kg	3.44Kg
Flyash Brick	3.70Kg	3.64Kg	3.57Kg
Waste paper Brick	2.87 Kg	2.85Kg	2.82Kg

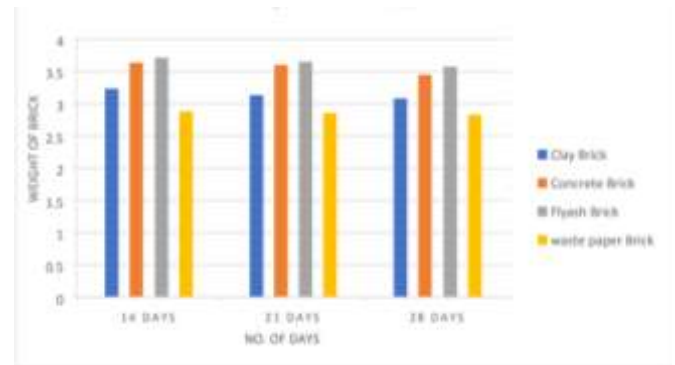


Chart -2 Weight of Papercrete bricks.

3.3 Water Absorption Test

Water absorption test is needed to check whether the bricks are suited for water logged areas or not. As per standards the bricks should not soak-up water more than 20% of its free-handed weight.

Table -3: Water absorbtion % in different bricks

Types of Brick	Dry Weight	% OF WATER ABSORPTION (24 hours)
Clay Brick	2.800	12.33%
Concrete Brick	3.190	10.66%
Flyash Brick	3.280	11%
Waste Paper Brick	2.500	14%

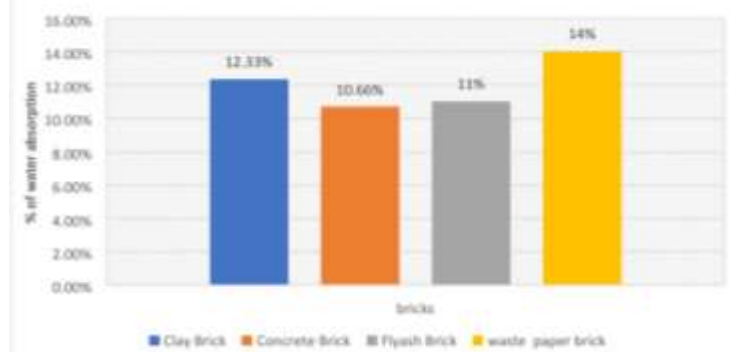


Chart -3: Water absorbtion

3.4 Hardness Test

In this test, a abrasion was made on brick surfaces. While the dent was made with the help of finger nail on the bricks, very light impression was left on the fibrous concrete brick surface. Hence, this test concludes s that fibrous concrete bricks are sufficiently hard.

3.5 Soundness Test

In this test two bricks were taken over and they were hitted on each other. The bricks were strong enough and not broken and a clear ringing sound was produced. Hence, the bricks are risk-free to use.

4. CONCLUSIONS

From the results receive, the following conclusions were determined:

☑ Considering the preferred compressive strength shown by the tested specimen, it is lucid that papercrete have the ability to provide an ecofriendly, light weight concrete block with the usage of fewer number of natural resources. Though the outcome obtained during compression test appeared that papercrete bricks are acceptable for non load bearing walls only.

☑ As per research the bricks should not absorb water greater than 20%. The water absorption capacity of papercrete From the results receive, the following conclusions were determined:

☑ Considering the preferred compressive strength shown by the tested specimen, it is lucid that papercrete have the ability to provide an ecofriendly, light weight concrete block with the usage of fewer number of natural resources. Though the outcome obtained during compression test appeared that papercrete bricks are acceptable for non load bearing walls only.

☑ As per research the bricks should not absorb water greater than 20%. The water absorption capacity of papercrete brick was found to be more than 20%, which makes it not suited for water logging and external walls. However, by providing a waterproof coating (Geobond or silicon founded waterproofing it can also be used as external wall.

☑ The free weight of the papercrete brick was 1/3rd to 2/5th lesser than the customary clay brick. Due to less weight of papercrete bricks, the total dead load of the building will be decreased. Due to lighter weight and more flexibility, these bricks are potentially idealistic material for earthquake prone regions.

☑ Papercrete has a high fire impedance, good sound assimilative, good thermal resistance with an Resistivity value between 2 to 3 per inch. In walls 12 to 16 inches thick, the high energy saving of papercrete will be a great asset for the house dwellers and environment.

☑ These bricks does not expand nor contracts hence, sheets of glass or glass block can be fixed in and trimmed with papercrete.

Since, papercrete brick primarily consists of waste material, it will lessen the landfills and pollution. Hence, the overall cost is very low as contrary to conventional brick. It has been observed that by using papercrete bricks in a building construction, the absolute cost was reduced from 20% to 50%.

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