



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJIRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 11, Issue 2, February 2022

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 7.569



9940 572 462



6381 907 438



ijirset@gmail.com



www.ijirset.com

# An Experimental Study on Bricks using Paper Waste

**Bhagyalakshmi T M, Shilpa S K**

Lecturer, Department of Civil Engineering, Government Polytechnic, Mirle, Karnataka, India

Senior Scale Lecturer, Department of Civil Engineering, Smt. L V Government Polytechnic Hassan, Karnataka, India

**ABSTRACT:** Bricks are commonly used building material all over the world for constructing walls, pavement and other elements in masonry construction. Conventional bricks are manufactured by firing of clay in high temperature kilns. Utilization of industry and agricultural waste products in the industry has been the focus of research for economic, environmental, and technical reasons. A new nature study estimates the world has 3.04 trillion trees. Almost 4 billion trees worldwide cut down each year for making paper. The construction industry has been known as one of the largest consumers of non-renewable resources. On the other hand, more waste paper ends up in landfill or dump sites than more recycled. The purpose of this research is to determine the compressive strength, water absorption capacity, efflorescence and structure of papercrete brick which determines their aptness for use as a building material.

**KEYWORDS:** compressive strength, water absorption capacity, efflorescence, papercrete brick

## I. INTRODUCTION

The infrastructure such as buildings for housing and industry, and facilities for handling water and sewage requires large amounts of construction material. Since large demand has been placed in on building material industry especially in the last decade owing to the increase in population, there is a mismatch between demand and supply management of these materials. Hence to meet the continuously increase demand, researchers are attempting to design and develop sustainable alternative solution for the construction material. The increase in popularity of using environmental friendly, low cost and light weight construction materials in building industry has brought about the need to investigate how this can be achieved by benefiting the environment as well as maintaining the material requirement affirmed in the standards. Brick is one of the most accommodating masonry units as a building material due to its properties.

A papercrete is a complex material comprising of Portland cement, waste paper, water and sand. The amalgamation of these materials, which may give a way to provide economical housing on a large scale. According to a research, more than 450 million tons of papers are produced worldwide every year. Pulp and paper are the third largest industrial polluter of air, water and soil. In recent year, paper and paperboard constitute a greater portion of many countries municipal solid waste generation. Since the large demand has been placed on the construction industry, especially in the last decade due to increase in pollution which cause a chronic shortage of building resources, the civil engineers have been challenged to convert the industrial waste to useful building and construction materials.

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 reason 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.

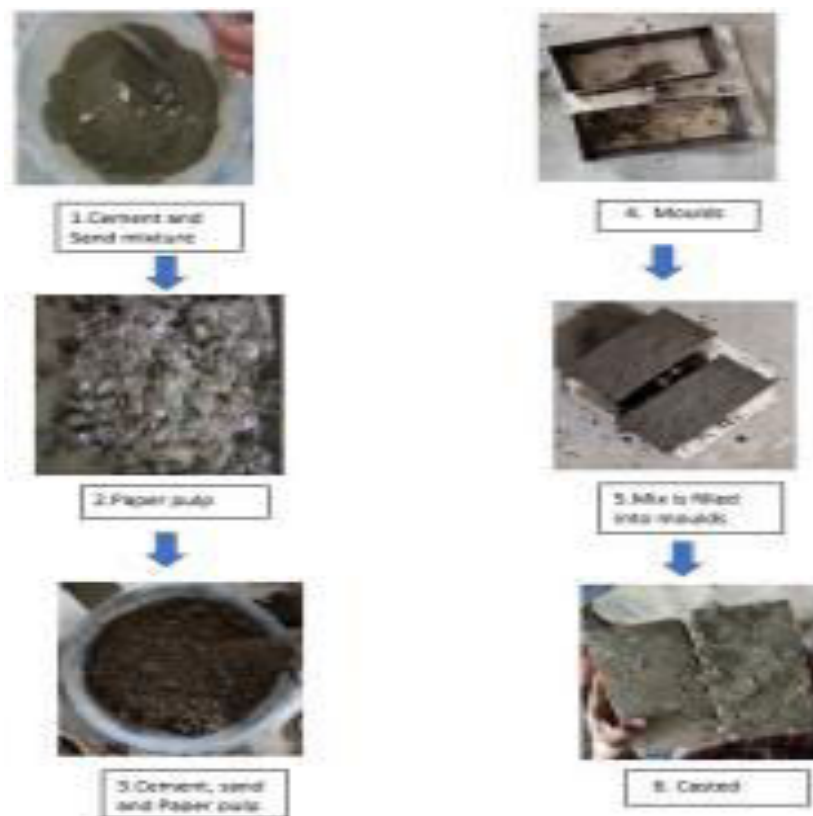
## II. METHODOLOGY

### 1. To incorporate paper waste into bricks in three different proportions.

Composition(C:S:P)	Cement	Sand	Paper Pulp
1(1:3.25:0.75)	20%	65%	15%
2(1:2.75:1.25)	20%	55%	25%
3(1:2.25:1.75)	20%	45%	35%

## 2. Procedure to cast bricks replacing sand in percentage wise with the paper waste is given below:

1. Materials like Cement, fine sand and papers were collected from different sources.
2. Waste papers like newspapers, from books and record papers. The collected papers cannot be used directly so these are kept in water tub with full of water for 3-4 days until the paper becomes soft and it can be made into paste or pulp form.
3. Then the total paper pulp is taken out and kept aside so that the excess water drains out from the pulp because if excess water is present then it cannot make good bonding with cement, sand and the setting time also changes due to excess water.
4. Cement and sand were taken in required proportions and they are mixed thoroughly to get a uniformity in the mixture. Then as per the requirement, water is added in small quantity and thoroughly mixed again
5. Into the cement and sand mixture, the paper pulp is added in small quantities with continuous mixing. Because adding total paper pulp at a time can make the mixing difficult and cannot make the mix uniform, lumps can be formed if paper pulp is added at a time
6. Then sufficient water is added to the mixture and again thoroughly mixing is done such that the mixture is uniform represented in Fig
7. 6 moulds, each of size 190\*90\*90mm are taken and the mixture (cement + sand + Paper Pulp) is filled into the mould with trowel making sure that it should spread to corners evenly. After filling remove excess material present with the help of trowel and make the surface smooth represents the casted bricks.
8. Keep the mould aside without disturbing and let it dry. Remove the brick from the mould and keep it for air drying
9. Then the Different tests is performed on the bricks as per Indian standards and results are noted down



## III. EXPERIMENTAL RESULTS

### TESTS CONDUCTED

- 1) **COMPRESSION TEST:** This test was held out by Compression Testing Machine after the 7th day from the date of casting papercrete brick. Fig shows the brick which is placed under UTM for compression test. Papercrete bricks never fail catastrophically, it gets compressed like squeezing rubber. Fig shows the brick which is tested and it is squeezed.



The papercrete bricks are having elastic behavior and less brittleness, due to this the structure was not fully collapsed, whereas the papercrete brick fails at higher load. Here in the laboratory experiment conducted only the outer faces cracked and peeled out. • First the irregularities in the surface were removed. • The brick was placed centrally on the bottom plate of the universal testing machine. • Then the upper plate of the universal testing machine was lowered down up to the brick was hold tightly without any movement. • Then load is applied on the brick axially at a rate (14 N/mm<sup>2</sup>), when cracks are appeared on the outer side of brick then loading is stopped. The brick is removed from the machine and the compressive strength obtained is noted down.

Compositions(C:S:P)	Compressive Strength(N/mm <sup>2</sup> )	
	7 Days	14 Days
1(1:3.25:0.75)	5.92	6.39
2(1:2.75:1.25)	5.64	5.88
3(1:2.25:1.75)	3.96	4.48

According to Bureau of Indian Standards (BIS):1077-1957, the minimum compressive strength of bricks is 3.50 N/mm<sup>2</sup>. But the obtained values of compressive strength are in the range of 3-7 N/mm<sup>2</sup> which is greater than the minimum value.

**2) WATER ABSORPTION TEST:**(IS:3495-PART 2- 1992): Firstly, immerse completely dried specimen in clean water at a temperature of 27±2°C for 24 hours. Then, remove the specimen and swipe out any traces of water with damp cloth and weigh the specimen after it has been removed from water.

Composition	Initial Weight(gm)	Weight after 24 hours of soaking(gm)	Difference in weight in percentage (%)
1	2734	3074	12.43
2	2658	3096	16.67
3	2132	2598	21.85

The actual water absorption capacity of the brick according standards should be less than 20% of actual weight of the brick. The test results obtained shows that when the percentage of paper pulp in the brick varies then the water absorption capacity is also varying. For the brick with less paper pulp content i.e., 15% and 25% the water absorption capacity is less and within the limits, but for paper pulp content of 35 the water absorption is more and exceeding the limits i.e., Greater than 20% of its actual weight

**3) SOUNDNESS TEST:** In this test two bricks were taken over and they were struck on each other. Fig shows how the bricks are tested for soundness. When the bricks are strong enough and not broken and a clear ringing sound is produced. Then the bricks are risk-free to use.





The bricks in which the paper pulp content is 15% and 25%, when two bricks struck each other then they produced a good metallic sound and they were not broken or damaged. But the bricks which contain 35% of paper pulp content when struck were giving a dull sound and the bricks were not broken

**4) EFFLORESCENCE:** The soluble salts, if presents in bricks will cause efflorescence on the surface of bricks. Fig shows the bricks which are kept for efflorescence test. For finding out the presence of soluble salts in a brick, this test was carried out. According to IS: 3495 part-3, ends of bricks are kept in 25mm depth water till entire water is absorbed or evaporated



There is no deposit of any salt even after repeated wetting. Here it was observed that there are no salt deposits on surface of bricks. So, the efflorescence for the bricks is Nil

**5) STRUCTURE** Bricks are taken and are broken into half to check the uniformity of mixture and to check the voids present in the brick Fig shows the structure of brick when broken into half.



Here the paper pulp that is added is spread uniformly throughout the brick and there are no lumps of the cement or papercrete. Then they are checked for pores if any, there are very less pores present and there are no large pores which can affect the working of brick. As the bricks are satisfying the conditions these bricks are acceptable as construction material.

#### IV. CONCLUSION

1. According to Bureau of Indian Standards (BIS):1077-1957, the minimum compressive strength of bricks is 3.50 N/mm<sup>2</sup>. Considering the obtained results the maximum compressive strength is 6.39 N/mm<sup>2</sup> (Composition1(1:3.25:0.75)) which is 54.77% greater than the minimum compressive strength.
2. As per the research the bricks should not absorb water more than 20%. The water absorption capacity of papercrete bricks is changing with the percentage of papercrete incorporated in the bricks. Bricks with 15% papercrete (composition1(1:3.25:0.75)) and 25% of papercrete (composition2(1:2.75:1.25)) has shown the test results within the limits (i.e., less than 20%), which is acceptable and when the percentage of papercrete increased the water absorption capacity has exceeded more than 20% which makes it not suitable.
3. Addition of papercrete up to 25% in bricks leads to well sounded bricks, further increase in percentage of papercrete doesn't give metallic sound when struck.
4. Addition of papercrete in bricks gives nil efflorescence value which is acceptable.
5. Since, papercrete brick mainly consists of waste material, it will reduce the landfill and pollution. Hence, the overall cost can be reduced as compared to conventional brick.



#### REFERENCES

1. Neha Thakur, Sandeep Salhotra (2020) An experimental investigation of papercrete bricks volume 29, No.10S,2020.
2. Yash Liladia, Shivam Malviya, Arbaz Baig (2020), The utilization of paper to produce bricks volume:07, Issue:02, Feb 2020.
3. Brij Bhushan, Varinder S Kanwar, Siby John (2019) The utilization of sludge for the brick manufacturing volume-9, Issue-2, December 2019.
4. Veenu Rani, Er. Vikram, Er. Sunil Kumar (2018) Development of ecofriendly lightweight brick using waste paper volume 5, Issue 10, June 2018.
5. Annoy Kumar Ghosh (2018) A sustainable building material volume 05, Issue 10, October 2018.
6. K. Anandaraju, B. Jose Ravindra Raj, R. Vijaya Sarathy (2015) The experimental Investigation of Papercrete Bricks volume 2, Issue 2, June 2015.
7. Rohit Kumar Arya, Rajeev Kansal (2015) utilization of waste paper to produce ecofriendly bricks volume 5, Issue 8, August 2016.
8. YD Shermale, MB Varma (2015) An efficient use of waste paper volume 5, Issue 3, 2015.
9. Maneesh Kumar CS, Ashik Moulana, Venkateshan (2015) An experimental study on use of recycle paper mill waste in light weight brick volume 01, Issue 02, May 2015



**Impact Factor:  
7.569**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 **9940 572 462**  **6381 907 438**  **ijirset@gmail.com**



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details