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# REPLACEMENT OF ORDINARY BRICKS BY PAPERCRETE CONCRETE BRICKS IN BUILDING

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***ABSTRACT***

***The high volume of concrete offers a holistic solution to the problem of meeting the increasing demands for concrete in the future in a sustainable manner and at a reduced or no additional cost and at the same time reducing the environmental impact of industries that are vital to economic development. As natural sources of aggregates are becoming exhausted, it turns out urgent to development. The majority of abandoned paper waste is accumulated from the countries all over the world causes certain series environmental problems. This project deals a parametric experimental study which investigates the potential use of paper waste for producing a low-cost and light weight composite brick as a building material. An experimental investigation has been carried out to optimization of mix for papercrete bricks depending upon the compressive strength, unit weight, and water absorption.***

***KEYWORDS**: Concrete, aggregate, methods, strength, durability, paper pulp, fly ash*

## INTRODUCTION

Since great demand has been placed in the building materials industry, particularly in the past decade, due to the increasing population which causes a chronic shortage of building materials, civil engineers have been challenged to convert industrial waste into useful building and construction materials accumulating unmanaged waste. Especially in developing countries has resulted in growing environmental concern. The use of pulp in concrete formulations has been studied as an alternative to disposal in landfills. Using an adequate amount of pulp and water, concrete mixtures have been produced and compared in terms sagging and resistance with conventional concrete.

The concrete samples were tested in three series of tests: compression test, splitting tensile test and bending test. These tests were performed to assess the mechanical properties up to 28 days. As a result, the compressive, tensile

and flexural strength by splitting increased by up to 10% of pulp addition and a further increase in pulp gradually reduced the strengths. Research on the use of paper sludge can be continued in the manufacture of concrete as a new recycled material

## LITERATURE REVIEW

India's per capita consumption of paper is around 4.00 Kg. With the expected increase in literacy rate and growing economy, an increase in per capita consumption of paper is expected. The demand for upstream market of paper products like, tissue paper, tea bags, filter paper, lightweight online- coated paper, medical grade coated paper etc., is shooting up. Due to this tremendous increase in use of paper, 1600 $m^3$ papers are wasted in India per day.

**Parviz et al (1994) proffered the durability and moisture effects on waste paper – fiber – cement composites.** They posited that the increase in the moisture content of virgin and recycled composites reduced the flexural strength and stiffness while it increased the toughness of the composites. The effects of long-term immersion in hot water on the flexural strength, stiffness and toughness of recycled composites were not statistically significant at 95% level of confidence. The flexural stiffness of virgin and recycled composites was affected differently by this ageing process. Also, they reported 30% replacement of cement with silica fume in recycled fiber and that cement composites appeared to be highly effective in controlling the aging mechanisms and moisture effects. This approach presents a practical, economic and efficient way of enhancing the durability and moisture resistance of waste paper – fiber – cement composites.

**Ahmadi et al (2001) reported the results of an investigation on the utilization of paper waste sludge** obtained from a paper manufacturing industry, as a replacement to the mineral filler material in various concrete mixes. The physical and chemical properties of the waste material were studied. The test results revealed that as the content of the waste increased the water to cement ratio for the mix also increased, since the waste has a high degree of water absorption Therefore, an additional amount of water was required for cement hydration. The results obtained showed that as the amount of the waste increased, the basic strengths, such as compressive strength, decreased. A maximum of 5% content of the waste as a replacement to the fine sand in concrete mix can be used successfully as construction materials, such as in concrete masonry construction with a compressive strength of 8 MPa, splitting strength of 1.3 MPa, and water absorption of 11.9% with a density of 20 $kN/m^3$.

**Solberg (2002) stated that landfills in most parts of the country were clogged with wastepaper and cardboard.** Millions of people lived in substandard housing or have no housing at all. When wastepaper is recycled as papercrete to construct houses for these people and when landfills are removed, these problems can be solved.

## METHODOLOGY

### MATERIAL USED

### CEMENT

Khyber ordinary Portland cement of 43 grade confining to IS 8112 was used throughout the work.

## SAND

Sand ( Fine aggregates) used throughout the work comprised of clean river sand with size of 10mm (100%) 4.75mm (90%) 2.36mm (75%) 1.18mm (55%) 600 micron (35%) 300 micron (8%) and 150 micron(0-10%) conforming to zone II as per IS383-1970 with specific gravity of 2.6.

## COARSE AGGEGRATE

Coarse aggregates used consisted of machine crushed paper circular in shape.

## MATERIAL COLLECTION

The materials used in the project mainly include paper, cement and sand. The paper used was drawings and newsprint, which were collected mainly from the BGSBU Engineering and Technical Collage Drawing Lab. The paper is a small piece of tea red and then soaked in water for about 24 hours. Then, remove the paper from the paper bucket and grind it into the same way you would with a household grinder. After that, the water was manually drawn from the pulp and then dried for 2 hours. Paper is then provided for the project.

## SOAKING OF PAPER IN WATER

**Paper Pulp Soaked In Water**

Pulp soaking in water manually cut the collected paper into small pieces and soak it in water for 24 hours. After that, the mixed pulp is taken out from the soaking container, and then water is extracted from the pulp, and the pulp is prepared by grinding and mixing the paper in a household grinder. Use a syntactic cloth with holes in it to pump the water out.

## MIXING OF PAPER PASTE

The ground pulp is manually mixed by hand to have a homogeneous mixture. After that, remove the water by hand. After the water was taken out of the water, the pulp was dried for 2 hours.

**Mixed Paper Pulp**

## TEST RESULTS

### FINENESS (IS 4031: 1996)

The fineness of cement has an important bearing in the rate of hydration and hence on the rate of gain of strength and also on the rate of evolution of heat. Finer cement offers a great surface area for hydration and hence faster the development of strength. But the disadvantages of fine grinding are that the cement becomes susceptible to air set air early deterioration. Increase in fineness of cement is also found to increase the dry strength of cement .Sieve tests has been employed for the testing purpose. This has been performed by sieving 100 gram of cement through IS sieve no. 9(90 micron) for 15 minutes.

**Observations of Fineness Test**

| S.No. | Weight of Cement (g) | Weight of residue left on Sieve(g) | Percentage Residue | Average Value(%) | Remarks |
|---|---|---|---|---|---|
| 1. | 100 | 0.55 | 0.55 | 0.553 | Satisfies the Fineness Test |
| 2. | 100 | 0.41 | 0.41 | | |
| 3. | 100 | 0.70 | 0.70 | | |

**RESULT:** Fineness Value = 0.553(Should be more than 10%)

**STNDARD CONSISTENCY (IS 4031:1988)**

For finding initial setting time, final setting time, soundness of cement and strength a parameter know as standard consistency has to be used. The apparatus used for this test is Vicat's Apparatu observations of consistency test

| S.No. | Weight of Cement(g) | %age of water by weight of cement | Weight of water added(g) | Penetration of plunger(mm) | Standard Consistency(%) |
|---|---|---|---|---|---|
| 1. | 400 | 26 | 104 | 22 | 30 |
| 2. | 400 | 28 | 112 | 28 | |
| 3. | 400 | 30 | 120 | 34 | |

**RESULT:** Standard Consistency = 30% (should be about 30% by weight of cement)

**SETTING TIMES (IS 4031 Part – 5:1988)**

**Initial setting time:** It is regarded as time elapsed between the movements that the water is added to the cement to the time that the paste starts losing its plasticity or it is the time interval for which the cement products remain in the plastic condition. Normally a cement paste should have a minimum initial setting time of 30 minutes.
**Final setting time:** It is the time between the movement that the water is added to the cement, to the time when the paste has completely lost its plasticity and has attained sufficient firmness to resist a certain definite pressure. This time should not be more than 10 hours.
Both initial and final setting times are determined with the help of Vicat's Apparatus using a cement quantity of 400 g and mixing it with 0.85 times the water required to produce paste of standard consistency.

| Weight of cement taken (g) | Weight of water added(g) | Penetration of needle(mm) | Initial setting time | Final setting time |
|---|---|---|---|---|
| 400 | 102 | 35 | 2 hours | 5 hours and 10 minutes |

**Initial And Final Setting Time By Vicat's Apparatus**

**RESULTS**: Initial setting time = 2 hours (should not be less than 30 minutes)
Final setting time = 5 hours and 10 minutes (should not be more than 10 hours)

**1 COMPRESSIVE STRENGTH (IS 3495 Part-1:1992)**

The compressive strength of hardened cement is the most important of all the properties. The strength tests are not made on need cement based because of difficulties of excessive shrinkage and subsequent cracking of neat cement.

The strength of cement are indirectly found on cement sand mortar (1:3) mixed with water of quantity ((p/4) + 3) % of the combined weight cement and sand. The mixture is cast into cube mould of size 75 mm. After setting of cement the cubes are kept for curing till the time of testing (7 and 28 days).

**RESULT**: Average 7 days compressive strength of cement = 32.38 N/mm² (should be more than 30.1 N/mm²)

Average 28 days compressive strength of cement = 45.47 N/mm² (should be more than 43 N/mm²) The paper, sand and cement were used in three ratios in our project. The sand and cement were sieved to get them out of impurities and for proper zoning of sand. Then these were mixed in trial ratios to be used in our project and moulds were casted. 27 moulds were casted for compressive strength test after 3 day, 7 day and 28 days compressive. Insitu tests were conducted for each trial. All the moulds were casted in concrete lab under normal temperature and properly supervision of our guide

## OBSERVATION AND CALCULATIONS

**Trial No.1 (1:1.5:3)**

**Table 5.5: Compressive Strength Results**

| Sample No. | Slump (mm) | Load at Failure (KN) 3 days | 3 days Compressive strength N/mm² | Load at failure (KN) 7 days | 7 Days Compressive Strength N/mm² | Load at failure (KN) 28 days | 28 days compressive strength N/mm² |
|---|---|---|---|---|---|---|---|
| 1 | 25 | 25 | 2.5 | 56 | 5.6 | | |
| 2 | 25 | 28 | 2.8 | 59 | 5.9 | | |
| 3 | 25 | 38 | 3.8 | 67 | 6.7 | | |

## RESULTS

Average compressive strength after 7 days =3.0 N/mm²
Average compressive strength after 28 days =6.0 N/mm²

## CONCLUSIONS

After careful and elaborate study of the use of paper in cement concrete, it can be calculated that.

a) The average compressive strength after 3 days and 7 days of ratio (1:1.5:3) , (1:1:2) and (1:1:1.5) is 3.0 N/mm², 6.0 N/mm²

b) The average split tensile strength after 7 days of ratio (1:1.5:3) and (1:1:2) is 0.30 N/mm² and 0.38 N/mm²

c) Since, the waste materials are used, it will reduce the landfills and pollution

d) Paper concrete is light weight, and flexible is potentially an idle material for earth quick prone areas

e) The paper concrete can be used for non-load bearing portion walls

In future research we go for the definite and perfect mix proportion i.e. mix design for the papercrete. It will also give the results of papercrete strengths by doing compressive and flexural strengths.

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