

Application of Papercrete in Concrete

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Abstract— CO₂ emission from construction sites due to use of cement is a worldwide concern. However, the use of cement is continuously used people’s desire to live in an eco-environment is continuously increasing. To resolve these issues various innovative ideas are being developed, and hence this study carried out. Paper Crete is an innovative composite material made by imparting waste paper as a partial replacement of Portland cement. Use of waste paper as Paper Crete not only reduces the amount of cement but also makes environment friendly building materials.

Key words: Cement Concrete, Paper Crete, Tensile Strength

admixture to overcome the limitation posed by Paper Crete had been observed.

The effect of varying binder to paper ratio and variation of Sand to binder ratio had been studied on the various engineering properties had been studied [10]. Various experiments were performed to obtain the values of shrinkage, density, and compressive strength of Paper Crete. The stress-strain curves of Paper Crete with different waste paper contents were plotted. The stress-strain curves showed that the range of ultimate strain was found to be 0.002-0.003, 0.005-0.007 and 0.008-0.010 when included waste paper replacement ratio of Paper Crete is 5%, 10% and 15%, respectively.

I. INTRODUCTION

Paper Crete is a fairly new ingredient in the natural building world. It is principally paper fiber added to a binder material such as Portland cement or clay and/or other dirt added. Addition of cement does not make this material not as "green" as would be ideal, but even a decrease in a small amount of cement used can be a reasonable adjustment which can be offered by Paper Crete.

Paper Crete can be classified as a type of industrial strength paper maché made with waste or recycled paper or cardboard, sand and Portland cement. Many varieties of Paper Crete are possible owing to the percentage of paper mixed with the binder material this results in Paper Crete of varying properties. The basic constituents of Paper Crete are:

- Paper: usually waste paper such as used newsprint or cardboard.
- Aggregate – coarse or fine aggregate such as sand can be used according to the required strength of the Paper Crete.
- Cement or Clay: it is used as a binder and provides strength and rigidity to the Paper Crete.
- Water

This study is aimed to evaluate the important engineering properties such as compressive and splitting tensile strength of Paper Crete containing waste papers as a partial replacement of Portland cement.

II. LITERATURE SURVEY

Innovative brick material using waste paper has been developed to replace the existing clay bricks [8]. Investigative study of the possible use of waste paper in production of low-cost and light weight composite brick material using Paper Crete as a building material has been performed.

It was concluded that Paper Crete bricks are suitable only for non-load bearing walls and its shrinkage is minimum with lesser weight.

Paper Crete building blocks were manufactures and its mechanical properties and its relevance with the existing construction technology was studied [9]. The applications, limitations and possible modifications by means of

III. EXPERIMENTAL PROGRAM

A. Mix proportion of Paper Crete

Waste newspaper was used for this experiment among lots of waste papers. Paper mainly comprise of inorganic materials and cellulose fiber so that it can be used as binder by replacing the cement since it is expected that cellulose fiber of newspaper will have great combination with cement paste.

In this study waste paper is used as a replacement to ordinary Portland cement at 5% (Mix 1), 10% (Mix 2), and 15% (Mix 3) at affix water- binder ratio of 85%. Since paper has high absorption capacity each mix comprise of 5% superplasticizer to solve the problem of workability. OPC 53 Grade conforming to Indian Standard IS 12269:1987 is used as a binder material.

Specimen	Water/Binder	Paper/Binder	Ingredients (Kg)				
			Waste Paper	Water	Cement	Sand	SP
Mix 1	1.88	34.05	50	450	950	1000	50
Mix 2	2.0	19.81	100	900	900	1000	50
Mix 3	1.51	14.80	150	850	850	1000	50

Table 1: Mix proportions of different mix

B. Experimental procedure

Total of 9 cube specimen of 150 mm × 150 mm × 150 mm, and 9 cylindrical specimen of 100 mm × 200 mm are cast for compressive strength and splitting tensile strength respectively. Therefore overall 18 specimens were cast to obtain the various engineering properties of Paper Crete.

The density of the specimens is found out at the 28th day after demolding.

To prevent clumping of paper when mixed with water, waste paper is chopped in very small fibers before mixing for proper distribution of paper in the matrix. Then it is mixed with Portland cement and sand with dry condition using the hand mixer for about 5 minutes and later with

superplasticizer and water for another 5 minutes.

The produced specimens were cured in laboratory at an ambient temperature after they were demolded the next day after pouring of concrete.

IV. RESULTS AND DISCUSSIONS

The density, compressive strength and splitting tensile strength test results are given in Table.1. The density, compressive strength and splitting tensile strength is measured after 28 days from demolding. The results of each test is average of the three blocks.

Specimen	Density (g/cm ³)	Compressive strength (MPa)	Splitting tensile strength(MPa)
Mix 1	1.88	34.05	3.638
Mix 2	1.64	19.81	2.833
Mix 3	1.51	14.80	2.247

Table 2: Experimental results at 28 days after demolding

1) Density

The density is inversely proportional to the percentage of waste paper in Paper Crete. Due to lower density of paper the overall density of specimens were reduced resulting in light weightness.

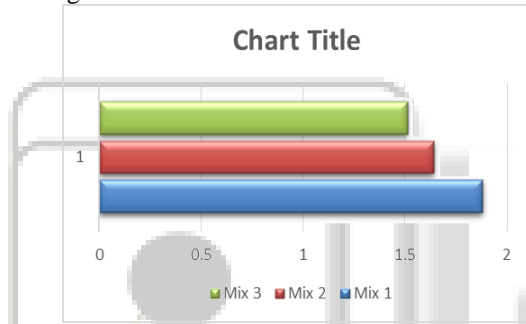


Fig. 1: Density of various mix at 28 days

2) Compressive strength

The average compressive strength of mix 1 comes out to be about 34.05 N/mm², for mix 3 it is 19.81 N/mm² and consequently for mix 3 it is 14.80 N/mm².

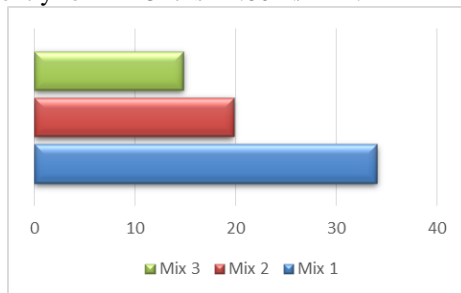


Fig. 2: Compressive strength at 28 days

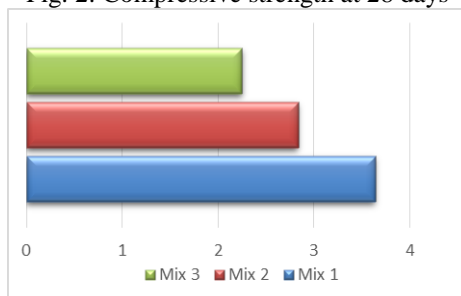


Fig. 3: Splitting tensile strength at 28 days

3) Splitting Tensile Strength

The average 28 days splitting tensile strength for mix 1 comes out to be 3.639 N/mm², for mix 2 it is 2.833 and for mix 3 it is about 2.247.

V. CONCLUSION

Based on the experimental investigation following conclusion can be made:

- 1) The density of Paper Crete is decreased when the replacement ratio of waste paper in Paper Crete is increased. When paper replacement ratio was 5%, density is measured 1.88g/cm³, and it is reduced subsequently to 15% and 22%, respectively when percentage of paper is increased to 10% and 15%.
- 2) The compressive strength of mix 1 is 34 MPa. And it is reduced to 38% and 53%, respectively, when replacement ratio of waste paper was increased to 10% and 15%. It is seen that according to the percentage replacement of paper the change in compressive strength is appreciable.
- 3) The splitting tensile strength of mix 1 is 3.60 MPa, mix 2 is 2.9 MPa and PC was 2.53 MPa. A decreasing trend is shown in the splitting tensile strength as the percentage of paper is increased.

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