

The Experimental Study And Utilization of Sustainable Material Papercrete

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Abstract- Now a day's civil industry consumes large amount of nonrenewable resources which is creating environmental hazards, waste of material such as paper, coal, water etc. and energy. In India only 75 – 80 percentage waste is collected and out of that only 22 – 28percentage of total waste paper is recycled but in other countries it is: Germany 87 percentage, USA 37percentage, Europe 71.5percentage, Sweden 99percentage. At the same time more and more waste paper ends up in land filling and dumping which causes air, land pollution. As a result to take step towards sustainable development we should use waste paper as a construction material. This experimental program is about finding out the sustainability, water absorption capacity, fire resistance, performing various tests, mix proportions and economical solution.

Keywords- low-cost housing, recycling, sustainability, waste paper.

I. INTRODUCTION

Papercrete is the concrete made with paper. Papercrete is a composite material comprising of Portland cement, waste paper, water and/or sand. It is like replacing coarse-grained fraction and/or sand of Portland cement concrete with waste paper. Paper adobe or padobe is another material sometimes referred to as a form of papercrete. It is produced by mixing waste paper with earth materials (such as mud or sandy-clay). Papercrete have been reported: to be a cheap alternative building construction material, to have good sound absorption and thermal insulation, to be a lightweight and fire-resistant material In this we have modified the product Papercrete with different material which are paper smashed finely with water, OPC (Ordinary Portland Cement), fined and crushed sand, micro silica, GGBS (Ground Granulated Blast Furnace Slag), Fly ash. Also, these materials with different proportions.

The current stage of recycling technique of paper waste mainly includes –

1. Recycling in technological flow that generated it.

2. Manufacture of products for construction.
3. Manufacture of fuels obtained from paper waste (Mixed with plastic and wood waste).

There are many beneficiary facts about Papercrete as a construction material which are light weight. Readily available, cheaper, easy to use, no big machineries required, easy to mould in any shape.

Test to be conducted on Papercrete –

1. Slump Test
2. Compression Test
3. Tensile Test
4. Water (Permeability) Absorption capacity
5. Fire resistance
6. Chemical Test

Advantages of Papercrete –

1. Very low energy is required to produce Papercrete.
2. Light weight material.
3. Locally available.
4. Eco-friendly, sustainable.
5. Heat and sound insulating material.
6. Economical product.
7. Helps to reduce carbon footprint.

Disadvantages of Papercrete -

1. Proper research is not done. (Mechanical and chemical properties of material are completely unknown)
2. Optimum mix design is not yet finalized.
3. It's a brittle material.
4. Production requires large amount of water.
5. It is not waterproof and flameproof.
6. Machineries, techniques not developed for production of Papercrete.

II. LITERATURE REVIEW

1. Joo-Hong Chung¹, a, Byoung-Hoon Kim¹, b, Hyun-ki Choi¹, c and Chang-Sik Choi¹ stated that the purpose of this study is to investigate mechanical properties of Papercrete such as compressive strength and modulus of elasticity due to

paper mixing ratio. Papercrete is made up of cement and waste paper. People have been using Papercrete without a clear understanding of its structural properties. According to simple compressive and Tensile test, Papercrete has 1.2MPa compressive strength and 2~5MPa Tensile strength. However these properties of Papercrete vary with paper mixing ratio. Accordingly, in this study, the Papercrete which has variety paper mixing ratio was produced for finding out mechanical properties of Papercrete. To obtain some mechanical and physical parameters of Papercrete, several laboratory tests were performed. The results of tests showed that the compressive strength is more than 1.2MPa. The experimental results of Papercrete will provide some recommendations for using Papercrete.

2. Isaac I. Akinwumi*, Olasunkanmi M. Olatunbosun, Oluwarotimi M. Olofinnade, Paul O. Awoyera stated as the construction industry consumes a large amount of non-renewable resources. On the other hand, more waste paper ends up in landfill or dump sites than those recycled. Consequently, recycling waste paper for use as a construction material constitutes a step towards sustainable development. This research effort aims at determining the density, water absorption capacity, compressive strength and fire resistance of Papercrete produced using waste newspaper and office paper in order to ascertain their suitability for use as a building construction material. For each of the mix proportions considered, the bulk density, water absorption, compressive strength and fire resistance of Papercrete made with newspaper were found to be higher than those made with office paper. The water absorption and fire resistance of Papercrete were found to be high and increased with increasing waste paper content while the bulk density and compressive strength of Papercrete were low and decreased with increasing waste paper content. Papercrete was recommended to be an effective and sustainable material for the production of lightweight and fire-resistant hollow or solid blocks to be used to make partition walls of especially high-rise buildings. Mix proportions were recommended for production of hollow and solid blocks using Papercrete.

3. Claudia aciu, Dana Adriana Ilutiu – Varvara, Nicoleta Cobizan, stated that the paper presents a study on the recycling of paper waste, which is frequently found in almost all activity areas, in order to obtain an ecological mortar. The materials used in four mortar recipes, as well as the methods for their preparations are presented. The research leads to the conclusion that the methods for the preparation of plastering mortars with paper waste allows for the use of non-polluting technology with low energy consumption. Following the tests to which the test tubes were submitted, the optimal

proportions of paper in the recipe for the manufacturing of the material was determined.

4. Patil Asha, Miss. Sarvankar Dipti, Miss. Palte Rupali, Prof. Patil Prerana. Stated that in construction field is widely developed from day to day. The development is causing the increasing needs of raw materials such as gravel. This high demand is causing the materials becoming extinct. Apart from that, this world also had facing the high amount of waste products which including waste paper. Research has proven that the waste paper can be used as recycled paper in construction field. The construction industry consumes a large amount of non-renewable resources. On the other hand, more waste paper ends up in landfill or dump sites than those recycled. Consequently, recycling waste paper for use as a construction material constitutes a step towards sustainable development. Papercrete is a kind of fibrous cement, made by shredding paper (old newspapers, magazines paper, cardboard etc.) into pulp in water and additional ordinary Portland cement to it and in some case sandy soil to be used as an additive. Papercrete is a sustainable building material due to reduced amount of cement usage and recycled paper being put to good use. This research effort aims at determining the workability of fresh papercrete produced using waste office paper in order to ascertain their suitability for use as a building construction material. For each of the mix proportions considered, replacement of volume of aggregate by paper pulp is carried out ranging from 10percentage to 20percentage with constant interval of 2.5percentage. Papercrete was recommended to be an effective and sustainable material for the production of lightweight.

III. AIM AND SCOPE

1. Finding out different properties required as per the requirement of Indian Standard Codes for Bricks/Blocks and economically cheaper option.
2. Finding out different mix proportions for different material and check by performing various tests.
3. Cost analysis for economically cheaper material compared to standard clay bricks.
4. Finding more sustainable product by using fly ash, micro silica and GGBS (ground granulated blast furnace slag).

IV. METHODOLOGY

This investigation is about partially replacement of paper to the aggregate by using fly ash, alccofine1203, cement that produce maximum compressive strength. Also, other properties are determined such as slump- Workability. The concrete was prepared with varying percentage paper (0, 10, 12.50, and 15percentage) With water cement ratio 0.45 and

using super plasticizer. The materials used for M20 grade concrete were as - Cement: The 53 grade Portland JK super Cement (PC) was used. It conforms to IS 12269:1987 (Bureau of Indian Standards 1987) specifications.

Table 1. Physical and Chemical properties of Portland cement

SN	Name of Test	Result
Physical		
1	Specific gravity	3.15
3	Setting Time	
	Initial (minutes)	155
	Final (minutes)	260
Chemical		
1	2.8 SiO ₂ + 1.2 Al ₂ O ₃ + 0.65 Fe ₂ O ₃	0.88
2	Al ₂ O ₃ / Fe ₂ O ₃	1.23
3	Insoluble residue (percentage by mass)	1.34
4	Magnesia (percentage by mass)	0.90
5	Sulphuric Anhydride (percentage by mass)	1.92
6	Total loss on ignition (percentage by mass)	1.41
4	Total chlorides (percentage by mass)	0.013

Fine Aggregate:

The locally available natural sand used for the experimental works. For sieve analysis 1 kg sample is taken. Table 2 Grading and Property of Fine Aggregate

Description	Fine Aggregate	
	Percentage weight Retained	cumulative weight retain
4.75 mm	0	0
2.36 mm	48.2	48.2
1.18 mm	71.9	120.1
500 micron	290.8	410.9
250 micron	466.7	877.6
150 micron	92.3	969.9
75 micron	22.2	992.1
Fineness Modulus	2.46	
Specific Gravity	2.65	

Coarse Aggregates:

Locally available coarse aggregate having the size 4.75 mm to 20 mm was used in the present work.

Table 3 Grading and Property of Course Aggregate

Description	Sand / Fine Aggregate	
	Percentage weight	cumulative weight retain
Grading of Particle (I. S. Sieve)		

	Retained	
16 mm	73.25	73.25
10 mm	172.6	245.85
4.75 mm	--	--
2.36 mm	--	--
1.18 mm	--	--
500 micron	--	--
250 micron	--	--
150 micron	--	--
Fineness Modulus	6.31	
Specific Gravity	2.78	

Superplasticizer:

Superplasticizer was used as water reducing admixture. It will be help to increase workability.

Alcofine1203:

Low calcium silicate (mineral) additive for mortars and concrete. It improves packing density of mortar / concrete. It mixes in concrete to gain strength with high pozzolanic material contents like fly ash, GGBS, etc. Dosage as per requirement in between 4 percentage to 8 percentage.

Table 4 Standards as per IRC SP: 70, IS: 456, IS: 12089.

S.N.	Property	Unit	Value
1	Average Particle size	Microns	04-06
2	Fineness	cm ² /gm	12000
3	Specific Gravity	-	2.86 ± 0.02
4	Bulk Density	Kg/m ³	600 - 700

Paper

Paper in the form of paper pulp is used in Papercrete. It is an anisotropic material which is why its quality and strength depends upon different directions.

Paper wood cellulose material.

Paper weight – 42 Grams / mm²

Thickness – 0.06 mm.

4. Results - Performed test are:

1. Fresh concrete – Workability and
2. Hardened concrete – Compressive test

Table 5.M20 mix proportions CM,M1,M2 and M3 in percentage

M20	CM	M1	M2	M3
OPC -53	70	70	70	70
Fly ash	25	25	25	25
Alcofine1203	5	5	5	5
Fine Aggregate	54	47	45	43

C.A.1	23	21.5	21.25	21
C.A.2	23	21.5	21.25	21
Paper	0	10	12.5	15
Water	100	100	100	100
Admixture	1.2	1.2	1.2	1.2

4.1 Lab Work Photos



4.2 Slump workability test –

As per IS 1199-1959

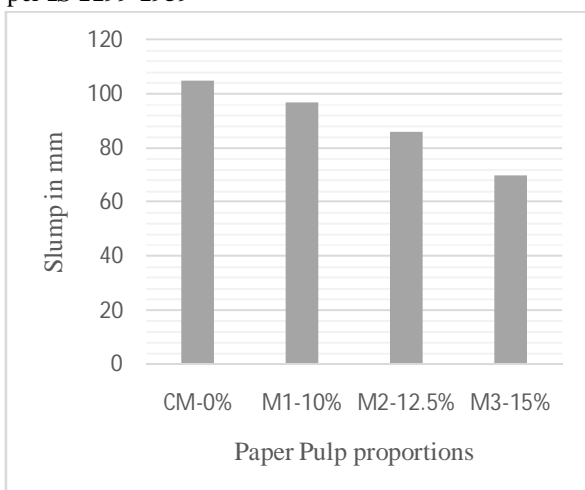


Fig.1 shows Slump in mm. Vs. Paper Pulp Proportions in percentage

4.3 Compressive strength test –

As per IS 516 – 1968.

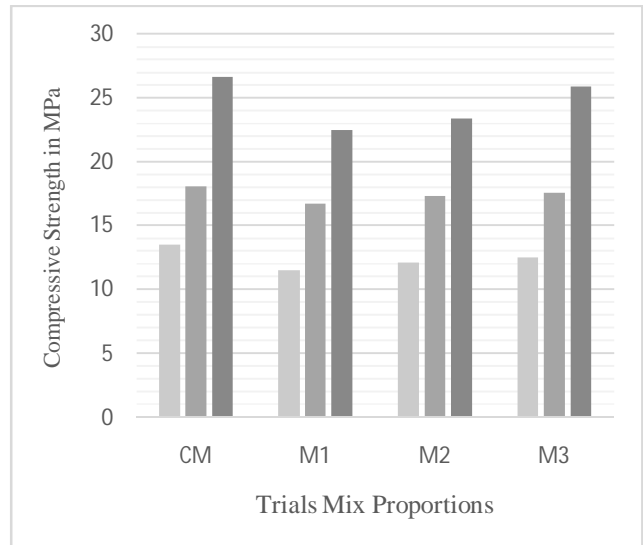


Fig.2 shows Compressive strength in Mpa vs Mix proportions in percentage.

V. CONCLUSION

From the observation and discussion on the test results following conclusion can be made

- 1) In ternary blended concrete, the replacement of 15percentage fly ash and Aggregate gives good result.
- 2) As replacement of paper to aggregate increases workability reduces shown in fig.1 of slump test of concrete
- 3) At 15 percentage replacement compressive and tensile strength of concrete will be slightly less at 7, 28, 56 days.
- 4) Papercrete is a lightweight material and can be used for arches, domes. It can be used in a brick or masonry wall form.
- 5) There is no standard mix designs and results but it can be used as a building construction material.
- 6) It is an economical product.

Future scope of the project –

Composite material using Papercrete can be found out for standard mix proportions for various purpose as follows –

1. Paper/Cement/Sand,
2. Paper/Cement/Sand/Fly ash,
3. Paper/Cement/Micro silica/Sand/Fly ash,
4. Paper/Cement/GGBS/Sand/Fly ash,

5. Paper/Cement/GGBS/Micro silica/Sand/Fly ash.

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