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An Investigation of Compressive Strength on Concrete by Using Waste Cardboard

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ABSTRACT: Paper industries and Cardboard is increasing with the everyday increase of their product's usage around the world. To deal with the demand of building material in construction field and to reuse the waste cardboard, innovative composite concrete mix is manufactured by replacing aggregate with the waste cardboard pulp. Present study is depending on investigation of compressive strength of concrete by using partial replacement of waste cardboard material. To determine strength of concrete compressive testing machine is used. The main objective of this research is to investigate the best mix proportion of cardboard performing comparative analysis of three different mix proportions. From the result, it is found that by adding 25% of cardboard got efficient result. In Present examination the potential use of waste solid total for making new cement was looked into. The properties of reused totals were tried for use in concrete. M-60 review solid blend was composed and new cements were made with 10%, 20%,30% and 40% coarse reused totals supplanting the characteristic total. Different tests were performed on crisp and solidified cement for it toughness properties. The outcomes show that the properties of the cements made with characteristic total and waste solid total up to 40% have just slight contrasts.

KEYWORDS: Waste Cardboard, tensile strength, compressive strength, waste cardboard sludge, concrete mixture

I. INTRODUCTION

Now a days the population is continuously increasing which increases the demand of structures. As the demand of construction material increases, proportionality the cost of material increases and the availability of material decreases. There are over 407 million metric ton of cardboard being manufactured according to survey. In the United State and Canada, there are approximately 1500 corrugated packing plant. The demand for using cardboard as packaging material has made it single largest waste product (by weight) in trash and it is estimated that over 24million tons of cardboard discarded each year into the landfill creating serious environmental problems. The industries are conscious about recycling the cardboard for environmental and economic reasons. Therefore, special research has been carried out to utilize waste cardboard in construction material up to some proportion. Partial replacement of aggregate by cardboard sludge to gain compressive strength of cubic specimen.

Although cement constitutes only about 10 per cent of the volume of the concrete mix, it is the active portion of the binding medium and the only scientifically controlled ingredient of concrete. Identifying a waste that resembles the properties close to that of cement and establishing their utility for partial use in cement is essential. As wastepaper sludge ash contains higher percentage of silicon dioxide SiO2, it may provide extra strength to concrete. The present study is aimed at developing a concrete using the waste cardboard sludge ash, an industrial waste of paper mills as a partial replacement material for cement. This not only reduces the cost of construction but also helps to beat the environmental problems of the region associated with disposal of waste cardboard sludge.

In the developing countries, the disposal of waste paper is a major problem. According to a research, more than 400 million tons of papers are produced worldwide every year. It is estimated that by 2020, paper mills will be producing 450 million tons of paper and paperboard each year. We obviously need this product and a reduction of use is not in the prospect. Pulp and paper is the 3rd 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. According to the Environment

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Protection Agency (EPA), the Unites States recycles about 50% of discarded paper annually. This means that about 60% or 50 million tons of paper ends up in landfill sites while some are incinerated. Waste paper reusing has not been able to match waste paper generation. Since the large demand has been placed for 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. One exclusive recycle opportunity is using waste paper as a construction material. In recent years, there has been a renaissance of interest in traditional building material, particularly those made from renewable or recycled materials "papercrete" is one of such materials attracting public interest. Papercrete gets the name from fact that most formulas purpose of a mixture of water and the cement with cellulose fiber.

II. MATERIALS

All relevant tests on cement, fine aggregate, coarse aggregate, waste paper sludge ash are conducted to ensure their suitability for use in structural concrete.

1. Cement

In the present work Portland cement of 53 Grade is used throughout the work. The properties of the cement are as follows

Cement grade	53 grade OPC	(Confirming to IS: 8112-1989)
Fineness	6.8%	(IS: 4031 – 1996 (Part 1))
Standard Consistency 33%		(IS: 4031 – 1996 (Part 4))
Soundness	2 mm	(IS: 4031 – 1996 (Part 3))
Specific gravity	3.1	(IS: 4031 – 1988 (Part 11))
Initial setting time	45 min	(IS: 4031 – 1988 (Part 5))
Final setting time	6 hrs	(IS: 4031 – 1988 (Part 5))

2. Coarse Aggregate

Machine Crushed granite aggregate confirming to IS 383- 1970 consisting 20 mm maximum size of aggregate has been obtained from the local quarry. The properties of the coarse aggregate are as follows.

Fineness modulus	9.09	(IS 383- 1970)
Specific gravity	2.61	(IS: 2386 – 1963 (Part 3))
Water Absorption value	0.3 %	(IS: 2386 – 1963 (Part 3))
Flakiness index	11 %	(IS: 2386 – 1963 (Part 1))
Elongation index	13 %	(IS: 2386 – 1963 (Part 1))
Aggregate Impact Value	12 %	(IS: 9377 – 1979)
Aggregate Crushing Value	18 %	(IS: 9377 – 1979)
Aggregate Abrasion Value	15 %	(IS: 10070 – 1982)

3. Fine Aggregate

The locally available natural river sand is procured. The properties of the fine aggregate are as follows.

Fineness modulus	3.2	(IS: 383 - 1970)
Specific gravity	2.66	(IS: 2386 – 1963 (Part 3))
Water Absorption	NIL	(IS: 2386 – 1963 (Part 3))
Free surface moisture	NIL	
Zone of Sand II		(IS: 2386 – 1963 (Part 1))

4. Waste Cardboard Sludge

The material is a by-product of the de-inking and re-pulping of paper. The material is viscous, sticky and hard to dry and can vary in viscosity and lumpiness. Physical Properties like specific gravity is 2.58, grayish white appearance and fineness of 98%.Table 1gives the chemical composition of waste paper sludge ash

Chemical composition of waste paper sludge ash

Constituent.	**% in waste paper sludge ash**
SiO2	67.330
Al2O3	2.620
Fe2O3	1.420
TiO2	0.157

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CaO	12.450
MgO	2.738
Na2O	12.050
K2O	0.638
ZrO2	0.019
ZnO	0.008
SrO	0.016
P2O5	0.051
NiO	0.014
CuO	0.009
Cr2O3	0.022

The cardboard production is technological process and sufficient amount of cardboard is produced in industries. The cardboard is chemical composition of lignin (C31 H34 O11) n, which is obtained from tranks of trees and also obtained from recycled cardboard. It is chemical composition of glucan, lignin, xylan and crude proteins. The production of cardboard is done by pressing together most fibres, typically cellulose pulp derived from wood, rags or grasses and drying them into flexible sheets. Paperboard, sometimes known as cardboard, is generally thicker (usually 0.25 mm or 10 mm) than paper.

Fig.(1) Cardboard

5. Water

Generally, cement requires about 3/10 of its weight of water for hydration. Hence the minimum water-cement ratio required is 0.35. But the concrete containing water in this proportion will be very harsh and difficult to place. Additional water is required to lubricate the mix, which makes the concrete workable.

III. RESEARCH METHODOLOGY

This chapter describes the experimental program that was designed for the project.

1. Objective: In this project, it is planned to cast a composite cardboard pulp concrete cubes of size 150mmX150mmX150mm of M25 grade of concrete and test the specimens after 7,14 and 28 days curing in a lab under water for compressive strength.

2.Preparation of specimen: The experimental program was planned with an objective to understand and investigate the effect of addition of cardboard. Therefore, the compressive strength of cardboard concrete-based material was determined after 7,14 and 28 days of curing period. A series of compressive test were conducted on the cubes specimen prepared by different ratios of cardboard pulp as a replacement of coarse aggregate. The mix ratios considered for this project were 25%, 50% and 75% replacement.

Table no.1 gives the experimental program for compression test specimen, total nine cubes specimen were casting.

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Table No.1 : Mix proportion

Mix Proportion (cement , sand , cardboard + aggregate)	Cardboard replacement in %
1:1.5:1	75% cardboard
1:2:1	50% cardboard
1:4:2	25% cardboard

3. Preparation of cardboardpulp: The waste cardboard cannot be used directly, so that cardboard get cut into small pieces and it dipped into the water for two days.
Cardboard pieces soaked the water and it get converted into its pulp form.

Fig.(2). Pulp preparation

4. Size of mould: The 150mmX150mmX150mm size of mould is used. By proper joining and bolting the iron plates the mould get made out.
5. Weighing of material: Weighing of different type of material before the material use for mixing to reduce the errors and for proper proportion of mixing of materials. Weighing is important for small type of mixing. Every cube required a proper proportion of material to not to waste the material.
6. Mixing of material:hand mixing procedures have to be carried out only for small concrete work. This means we must not mix large quantities at the same time. The whole mixing must done neatly and uniformly without a hurry. As the project based on trail and error method. The mixing material is hand mixing with the help of trowel and phavada. This is a basic technique of mixing of material. Usually adopted by every labour.
7. Placing/Filling of concrete in mould:concrete is filled in the mould using a trowel in two layer. The first layer of mould is concrete slurry for proper combination of second layer in the mould.
The test moulds are kept ready before preparing the mix. Tighten the bolts of the moulds carefully because if bolts of the moulds are not kept tight the concrete slurry coming out of the mould. When the vibration takes place. The moulds are cleaned and oiled on all contact surface of the moulds and place the moulds in layers and vibrated or tamped 25 times at a time. The top surface of concrete is stuck off level with trowel. The number and date of casting are put on the top surface of the cubes.

Fig.(3). Moulded cube

8. Tampingrod:after concrete placed cubes with trowel the concrete tamped 25 times at a one time. This is combined till the cube filled fully. In a time, 25 times the rod tamped. This repeats 3 times for a single cubes.

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9. Placing of blocks:blocks (concrete cubes) are placed on a flat surface for drying purpose. After 24 hours of settling the cubes are in water for curing purpose.

10. Testing of concrete cubes: compressive strength of the concrete cubes was tested on compressive testing machine (CTM) and universal testing machine (UTM).

Fig.(4). Compression test setup

To calculate the compressive strength of concrete cubes the compression testing machine having capacity of 1000KN was used. In this test the strength obtained in ton. The measured compressive strength of the specimen shall be calculated by dividing maximum load applied to the specimen during the test by cross-sessional area calculated from mean dimension of the section and shall be expressed to the nearest N/mm².

Compressive strength is calculated by the formula.

Compressive strength(N/mm²) =total load applied / cross sectional area

IV. RESULT & DISCUSSION

Compressive Strength of Concrete Cubes is given as follows…

The test was conducted on 150mm*150mm*150mm cube specimen at 7, 14 and 28 days. The sample cubes were placed in the testing machine.

Loading were applied on the sample until the sample fails where the reading started to decline and the test was repeatedly conducted on another two more cubes.

Compressive test results after 7, 14 and 28 days are represented in the table

Table No.2: Observation table

Mix Proportion	7Days (N/mm2)	14 Days (N/mm2)	28 Days (N/mm2)
1:1.5:1	0.8	2	2.6
1:2:1	2	3.1	4.2
1:4:2	2.4	4.2	5.3

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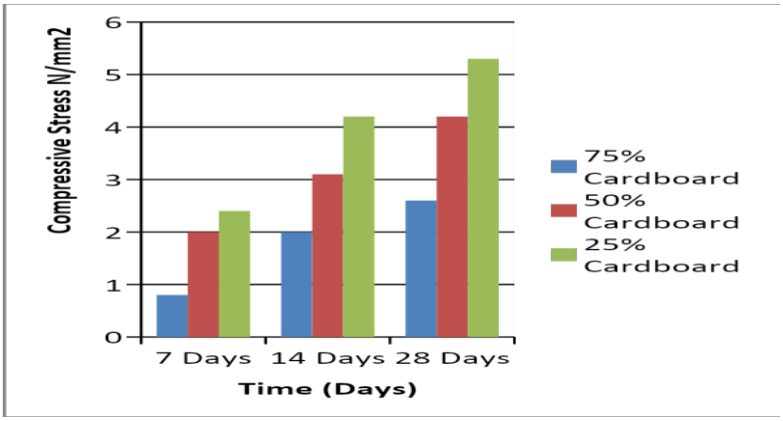

V. CONCLUSION

The compressive strength is maximum in the ratio (1:4:2) and the minimum strength is obtained in the ratio (1:1.5:1). Hence itconcludes that 25% replacement of cardboard with aggregate in concrete mix gives the better strength for axial loading on the cubic specimen. In the result and conclusion, it has been observed that increase in compressive strength of concrete by decreasing the percentage of waste cardboard.

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