

Use of Waste Paper Pulp and Fly Ash by Partial Replacement of Cement in Concrete

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Abstract— The use of paper-mill pulp and fly ash in concrete formulations was investigated as an alternative to landfill disposal. The cement has been replaced by sludge and fly ash accordingly in the range of 5% to 20% by weight for M-20. By using adequate amount of the waste paper pulp, fly ash and water, concrete mixtures were produced and compared in terms of slump and strength with the conventional concrete. Development of concrete by using paper sludge and fly ash for building & construction works. The concrete specimens were tested in three series of test as compression test, splitting tensile test and flexural test. These tests were carried out to evaluate the mechanical properties for up to 28 days. As a result, the compressive, splitting tensile and flexural strength increased up to 15 % addition of waste paper pulp and fly ash then further increased in waste paper pulp and fly ash reduces the strengths gradually.

Key words: Compressive Strength, Durability, Split Tensile Strength, Waste Paper Sludge Ash Concrete

Objective of this Study:

- Development of concrete using the waste materials like recycled paper industry sludge and fly ash. For making new type of eco-friendly and cost effective materials.
- Design Mix for M-20 concrete by partial replacement of cement by paper sludge and fly ash.

I. INTRODUCTION

Due to industrialization, expansive quantities of waste items have been created since the most recent years. Be that as it may, as there is improvement in the innovation along these lines, different ways are created to deliver squanders. In development area there is acknowledgment of substantial number of amounts of items and it likewise permit huge scope of characteristics and everyone has fitting utilize (1). In the event that pozzolanic materials utilized as a part of place of Portland bond then we can spare capital expenses and it is eco-accommodating moreover.

Mash and paper process leftover solids additionally called slime. Ooze is made for the most part out of cellulose strands, dampness and paper influencing fillers to like kaolinite dirt and calcium carbonate. The crude dry paper ooze for the most part contains silica and calcium oxide took after by [1] alumina and magnesium oxide. Around 300 kg of slime is delivered for each tone of reused paper. This is a moderately extensive volume of slime delivered every day that makes genuine transfer issues as paper process slop is cumbersome. The usage of waste paper slime in concrete has a genuine plausibility of noteworthy decline in nature contamination and recognizably streamlines the cost of common development. It was initially presented as manufactured pozzolana. Paper ooze carries on like bond on account of silica and magnesium properties which enhance

the setting of the solid [1]. The amount of ooze differs from factory to process. The measure of slime created by a reused paper process is extraordinarily reliant on the sort of outfit being utilized and finished result being made. Paper process ooze can be utilized as an elective material connected as incomplete substitution of bond in assembling crisp cement planned to be utilized for minimal effort lodging ventures. At the point when pozzolanic materials are joined to concrete, the silica exhibit in these materials responds with the calcium hydroxide discharged amid the hydration of bond and structures extra calcium silicate hydrate, which enhances mechanical properties however just up to a specific degree. By utilizing sufficient measure of the waste paper ooze, solid blend is created and [2] contrasted as far as quality and customary cement .

II. REVIEW OF LITERATURE

Sumit Balwaik et al (2016) inspected from paper-process mash in solid plans was explored as a contrasting option to arrive fill transfer. The bond has been supplanted by wastepaper slop as needs be in the scope of 5% to 20%by weight for M-20 and M-30 blend. By utilizing satisfactory measure of the waste paper mash and water, solid blends were delivered and looked at as far as droop and quality with the regular cement. The solid examples were tried in three arrangement of test as pressure test, part elastic test and flexural test. These tests were done to assess the mechanical properties for up to 28 days. Subsequently, the compressive, part tractable and flexural quality expanded up to 10% expansion of waste paper mash and further expanded in wastepaper mash lessens the qualities slowly. There seek on utilization of paper slime can be additionally done in solid assembling as another reused materials.

Rasheed Khan et al (2017) was analyze the real part in any development action is the cost of the material. In creating nations, the undiscovered or unused assets are should have been recognized for its potential use in the development divisions. The one such asset is squander paper. Paper mash included with concrete and sand solidifies and shapes a light weight development material called Paper Crete, which fulfills a significant number of the building properties required for development. Paper Crete has focal points like minimal effort, practical and it is eco-accommodating. In this examination, paper Crete squares are made and their building properties are contemplated.

III. METHODOLOGY

A. Materials use in present study

In the experimental programmed, the comparison of the properties of Self Compacting Concrete made with paper pulp and Fly Ash,. The material used during the

experimentation and the basic tests carried out on concrete samples in plastic stage are discussed in this chapter, followed by a brief description about mix design and curing procedure adopted. At the end, the various tests conducted on the specimens are discussed.

B. Material Used

In this section a brief discussion is done on the material used in this work. Various tests performed on this material are also discussed.

- 1) Cement
- 2) Sand
- 3) Aggregate
- 4) Water
- 5) Fly ash
- 6) Paper pulp

IV. RESULTS & DISCUSSION

A. Experimental Study

M-20 Grade of concrete has been prepared from different types of cement paper pulp and fly ash replacement as binder mix and sand as fine aggregate and course aggregate. Then its physical properties like slump test, water absorption, Compressive strength, Tensile strength and Flexural Strength test have been investigated. These test results both in tabular form and graphical presentation are given below

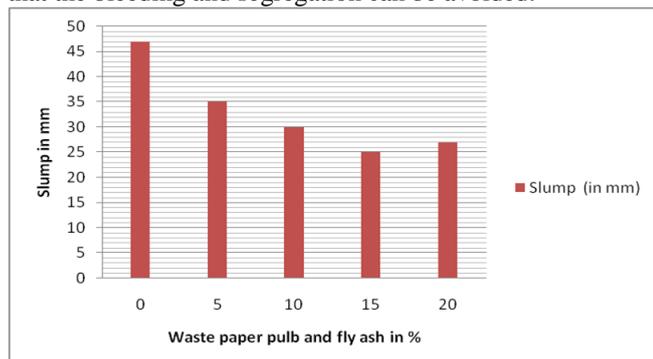
B. Slump Test

With the addition of paper pulp sludge and fly ash, the slump loss with time is directly proportional to increase in the paper pulp and fly ash content due to the introduction of large surface area in the concrete mix by its addition. Although the slump decreases. Slump test values each proposition of paper pulp shown in table 5.1.

Waste Paper Pulp and fly ash (in %)	Slump (in mm)
0	47
5	35
10	30
15	25
20	27

Table 5.1: Slump Test

Slump is the vertical settlement of the concrete after the mould has been withdrawn, i.e. the difference between the height of the mould and the highest point of the subsided concrete. The concrete with 0 to 30 mm slump has very low degree of workability. However, to maintain the required workability of the sample we can add definite amount of specified admixture according to the purpose so that the bleeding and segregation can be avoided.



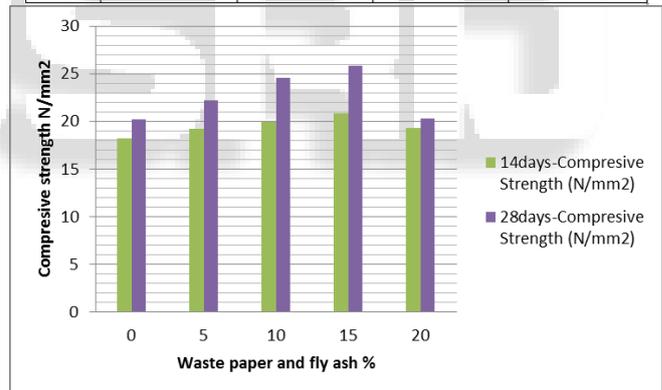
C. Compressive Strength Test

The tests for discovering the compressive quality were done on the blend arranged by supplanting the concrete by paper sludge and fly ash from scope of 5% to 20%. The readied blend have great workability and different properties as same starting at crisp cement. The example 3D squares were placed up in the water tank for curing. The example 3D squares were acquired the testing lab after indicated days of curing. The compressive quality test was finished by compressive quality testing machine as depicted in the Seems to be: 516-1959.



1) Compressive Strength Test Results

Mix	Waste Paper Pulp in %	Fly ash in%	14days-Compressive Strength (N/mm ²)	28days-Compressive Strength (N/mm ²)
M-20	0	0	18.20	20.20
	5	5	19.23	22.23
	10	10	19.95	24.58
	15	15	20.81	25.81
	20	20	19.32	20.32

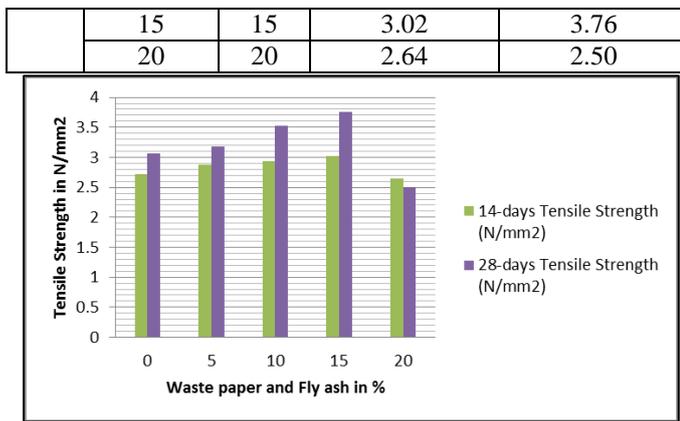


D. Split Tensile Test

The part rigidity test were done on the chamber size of The extent of barrels 300 mm length and 150 mm width are set in the machine with the end goal that heap is connected on the contrary side of the 3D squares are threw. Adjust precisely and stack is connected, till the example breaks. The greatest load connected should then be recorded. The presence of the solid and any bizarre highlights in the sort of disappointment are additionally noted down. According to IS : 5816-1999 The recipe utilized for count;

E. Tensile strength test

Mix	Waste Paper Pulp in %	Fly ash in%	14-days Tensile Strength (N/mm ²)	28-days Tensile Strength (N/mm ²)
M-20	0	0	2.72	3.07
	5	5	2.88	3.18
	10	10	2.94	3.52



F. Flexural Strength Test

In the study load applied axially without subjecting the specimen to any tensional stress or restraints. During the testing, Apply the load at a rate that constantly increases the maximum stress until rupture occurs. The fracture indicates in the tension surface within the middle third of span length.

Mix	Waste Paper Pulp in %	Fly ash in%	14-days Flexural Strength (N/mm²)	28-days Flexural Strength (N/mm²)
M-20	0	0	8.13	9.50
	5	5	9.14	10.27
	10	10	9.67	10.84
	15	15	10.37	13.84
	20	20	8.80	11.72

G. Cost Economics

S.No.	Material	Rate (Rs./Kg)
1	Cement	7
2	Fine Aggregate	0.8
3	Coarse Aggregate	1.2
4	Paper Industry Sludge	1.5
5	Fly ash	1

V. CONCLUSION

To the best degree conceivable, all sensible and legitimate blending, examining and testing methods were taken after to create the information in this report. It is hard to keep up homogeneity from blend to blend - don't worry about it over the whole nation or world. Stringent homogeneity may not be an issue, however until the point that all the more testing is done, it needs to in any event be considered. In light of a legitimate concern for outright straightforwardness, there are a couple of compressive test outcomes, which appear to be atypical to us. On the off chance that you examine the tables precisely, you will discover a few outcomes, which don't appear to track well with others. Possibly the test outcomes are defective or maybe there was an issue with the blend. We can't clarify some of these outcomes and it will take rehased trial of tests from a solitary blend to see whether the test wasn't right or the blend differed. Recipes and techniques develop and change as we take in more, and any material can be hazardous if blended or introduced shamefully. In this way, we should start with this disclaimer.

1) In light of the outcomes displayed over, the accompanying conclusions can be drawn:

- 2) The droop expanded up to 15% substitution of bond, over 15% the droop diminished as the paper and fly mash content in the solid blends was expanded.
- 3) Generally, the compressive, part malleable and flexural quality expanded up to 15% expansion of waste paper and fly ash mash and further expanded in squander paper and fly ash mash decreases the qualities progressively.
- 4) There was an expansion in water assimilation of the solid blends as the substance of the paper and fly ash mash expanded. This marvel is normal since more measure of paper and fly mash in term of amount will include in the hydration procedure. In this manner, extra measure of water was required for cement hydration which is the common solution to this kind of problem. However, higher water content decreases the strength of concrete.
- 5) The most suitable mix proportion is the 15 % replacement of waste paper pulp and fly ash to cement.
- 6) Use of waste paper pulp and fly ash in concrete can save the pulp and paper industry disposal costs and produce a 'greener' concrete for construction.
- 7) The use of 15 % of paper pulp and fly ash also reduces cost of construction of concrete by 710 Rs./m³. As such if we use the material in large building construction project where massive concrete work is going high reduction in concrete can be done.

VI. FUTURE SCOPE

There is a great deal of extension for additionally look into and significant work in this undertaking. Some of these incorporate the investigation of:

- 1) Trying to decrease the measure of cement required to set up the paper Crete with same quality and furthermore eventually diminish CO₂ sum.
- 2) Use of various materials at the place of concrete, for example, gypsum and lime.
- 3) The impact of supplementary cementations materials like meta kaolin, impact heater slag, ground granulated impact heater slag, and so forth., on the quality and sturdiness of light weight paper Crete can be fulfilling.
- 4) The quality and strength of other paper Crete building components like divider boards, floor pieces, and so on., are to be examined.

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