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INVESTIGATING PROPERTIES OF CONCRETE ON PARTIALLY REPLACING CEMENT BY COCONUT FIBRE ASH AND CHALK POWDER

[1]ADIL FAYAZ GANIE & [2]ER. ANUJ SACHAR

[1]*M.Tech Student (Building Construction Management), RIMT University, Punjab*
[2]*Assistant Professor, Department of Civil Engineering, RIMT University Punjab*

ABSTRACT

In this study, we used a variety of materials to substitute the cement, including chalk powder, coconut fibre ash, and a combination of both chalk and coconut fibre ash. .The research work is carried out on high strength concrete of M-35 Grade. High strength concrete are such type of concrete which possess high strength and high durability when compared it with the normal conventional concrete. The formation of high strength concrete is sometime turgid because of the fact that the mixture of the ingredients is to taken in such a way that the desired strength of solid mass is obtained after hardening. The expectation is to obtain high strength properties with low permeability. High strength concrete is not unique type of concrete, the materials used in high strength concrete is same as that used in conventional concrete. The use of various admixtures, such as super plasticizers, greatly improves the qualities of the material, such as strength, workability, and permeability. As a result, using coconut fibre as a partial replacement for cement can significantly reduce the pollution generated by this agricultural waste. A considerable volume of agricultural waste has been thrown in tropical countries, primarily in Asia, including countries such as Malaysia, Thailand, India, and the Philippines, posing an environmental concern if not properly disposed off.

Keywords; ***Admixture, coconut fibre ash, chalk powder, concrete, plasticizer.***

INTRODUCTION

The expectation is to obtain high strength properties with low permeability. High strength Concrete is a construction material made out of gravel or broken stone, sand, cement, and water. The mixture can be poured into any shape or size mould, hardening to a solid stone-like mass. The hardened solid mass's strength can be boosted by adding admixtures. The goal of the admixtures is to improve the properties of the intended solid mass to some

extent. Concrete can be characterised as a paste and aggregate mixture in layman's terms. In this study, we used a variety of materials to substitute the cement, including chalk powder, coconut fibre ash, and a combination of both chalk and coconut fibre ash. The research work is carried out on high strength concrete of M-35 Grade. High strength concrete are such type of concrete which possess high strength and high durability when compared it with the normal conventional concrete. The formation of high strength concrete is sometime turgid because of the fact that the mixture of the ingredients is to taken in such a way that the desired strength of solid mass is obtained after hardening. Concrete is not unique type of concrete, the materials used in high strength concrete is same as that used in conventional concrete. The use of various admixtures, such as super plasticizers, greatly improves the qualities of the material, such as strength, workability, and permeability.

LITERATURE REVIEW

Various researchers have used various fibres, both man-made and natural, to partially replace cement during the last few decades. The feasibility of employing chalk powder as a material in combination with additives such as coconut fibre ash, cement, and other materials must be investigated, and if proven to be suitable, it might be a viable alternative for improving both engineering qualities and concrete cost. As a result, it's possible that chalk powder and coconut fibre ash will be used in construction.

(Ali 2010)[5] in research paper entitled “Coconut Fibre- A Versatile Material and its Applications in Engineering” describes the adaptability of coconut fibre as the most flexible material and its uses in different streams of engineering, especially as a building material by not only studying the physical, mechanical and chemical of the coconut fibre but also studied the properties of composites (cement paste, mortar and/or concrete) in which coconut fibre was used as reinforcement. His main aim was to grow knowledge of coconut fibres to be used as a building material in civil engineering.

(Wungko & Bindumathi 2017)[13]in research paper entitled “Examining Concrete Properties using Coconut Fiber Ash and Fly Ash as Partial Replacement for Cement” aim to check the properties of the concrete when coconut fiber ash and fly ash were used for the partial replacements for the cement. The strength were determined on 3, 7, 28, 56 and 90 days of curing of the specimen. The whole research was conducted on M35 grade of concrete, and a total of 8 mixes corresponding to various percentage replacement was prepared. These mix were inclusion of the separate mixes for the conventional concrete. The various results for the compressive strength was obtained and was compared with the conventional compressive strength results. The quantity coconut fiber ash that was added ranged 20% to 40%, while that of fly ash ranged 10% to 25%.

METHODOLOGY

The experiment was conducted on high-strength concrete with a mix grade of M35. This study will look at the specimen's workability, compression strength, and flexural strength, and the results will be presented in the form of a graph that compares the specimen's properties to those of regular concrete. The specimen will be cured for three days, seven days, and twenty-eight days. The following is a general idea of how many cubes should be casted for a compression strength test using a compression testing machine.

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3.7 M-35 GRADE CONCRETE MIX DESIGN

1) Design stipulations for proportioning

The blend is designed using IS specifications [BIS 10262-1982 and BIS 456-2000]. Moulds are made based on the mix design, and these moulds are subjected to several tests to guarantee that the strength requirements are met. The mix design is as follows: 28-day mix design using the Indian standard approach.

Grade designation = M35
Compressive strength = 35 N/mm^2
Degree of quality control = Good
Maximum size of coarse aggregate = 20 mm
Types of aggregate = crushed angular aggregate
Exposure conditions = Mild
Minimum cement content = 300 kg/m^3 Maximum cement content = 450 kg/m^3
Maximum water cement ratio = 0.45

2) Test data for materials

Type of cement	=	Khyber Cement 43 Grade (OPC)
Specific gravity of cement	=	3.14
Specific gravity of coarse aggregate	=	2.60
Specific gravity of fine aggregate	=	2.70

3) Mix design for M35 concrete; *Target mean strength of concrete*

For a tolerance factor of 1.65 and using table 1 from IS 10262-2000, the standard deviation S = 5 N/mm^2.
So, Target mean strength can be given by,
Characteristic cure strength = 35 + (5x1.65) = 43.24 N/mm^2.

Selection of water cement ratio

From table 5 from IS 456-2000, maximum water cement ratio = 0.45
Adopt water cement ratio as 0.45 Hence ok.

Selection of water cement content

From table 2 of IS 10262-2009, maximum water content is 186 liter (for 100mm) slump range for 20mm aggregate.
Estimate water content for 100mm slump = 186 kg/m^3
Required water content = 186 + 11 = 197 kg/m^3

Calculation of cement content

Water cement ratio
Water
Cement

Cement content = 437.71 kg/m3
From table 5 of IS 456, minimum cement content,
Content for 'Moderate' exposure condition = 400 Kg/m^3
400 Kg/m^3< 437.71 Kg/m^3 Hence ok.

Proportion of volume of coarse and fine aggregate

From table 3, of IS 10262 volume of coarse aggregate corresponding to 20 mm size aggregate and fine aggregate corresponding to zone – II, and water cement ratio of 0.50 = 0.60 For W/C of 0.45, coarse aggregate is to be increased to decrease fine aggregate content.
Volume of coarse aggregate = 0.61 * 0.9 = 0.549
Volume of fine aggregate = 1 – 0.55 = 0.450

4. Mix calculation

The calculations per unit volume of concrete shall be as follows;

a) Volume of concrete

b) Volume of cement

$$= \left[\frac{437.7}{3.15}\right] \times \left[\frac{1}{1000}\right]$$

$$= 0.137\ m^3$$

c) Volume of water

$$= \left[\frac{mass\ of\ water}{specific\ gravity\ of\ water}\right] \times \left[\frac{1}{1000}\right]$$

$$= \left[\frac{197}{1000}\right]$$

$$= 0.1968\ m^3$$

d) Volume of all in aggregate
$= [a - [b + c + d]]$

$= 1 - [0.138 + 0.197]$

$= 0.6539\ m^3$

e) Volume of coarse aggregate

$= 93.49\ Kg/m^3$

f) Mass of fine aggregate

Table 3.10: Conventional mix proportion.

	Cement	Fine aggregate	Coarse aggregate	Water
Weight (kg/m^3)	43.7	79.4	93.5	19.7 L
Mix Ratio	1	1.84	2.17	0.45

Table 3.11:Mix Design Proportions for 1 Conventional concrete cube of size 150 x 150 x 150 mm.

W/C ratio	Cement	Fine Aggregate	Coarse Aggregate	Water
0.45	1.47 kg	2.72 kg	3.20 kg	0.66 l

For 9 Cubes, we require:

Cement = 1.47 x 9 = 13.2 kg

Fine aggregate = 2.72 x 9 = 24.4 kg

Coarse aggregate = 3.20 x 9 = 28.8 kg

Water = 0.66 x 9 = 5.9 l

TESTS TO BE PERFORMED

1. **Workability test**
2. **Compressive strength test**
3. **Flexural strength test**

TEST RESULTS

Table 4.1: Slump value for concrete with chalk powder.

Replacement %	Slump Value CP (mm)	Slump Value CFA (mm)	Slump Value CP & CFA(mm)
0	100	100	100
5	110	95	95
10	90	100	105
15	80	115	85

Table 4.7: Compressive Strength of concrete with 10% replacement of cement by CFA.

S.No.	After 3 Days			After 7 Days			After 28 Days		
	Cube Weight (Kg)	Load (KN)	Compressive Strength N/mm^2	Cube Weight (Kg)	Load (KN)	Compressive Strength N/mm^2	Cube Weight (Kg)	Load (KN)	Compressive Strength N/mm^2
1.	8.096	385	17.11	8.168	600	26.67	8.267	907	40.31
2.	7.929	395	17.56	8.340	608	27.02	8.161	905	40.22
3.	8.054	388	17.24	8.529	595	26.44	8.192	910	40.44
Average			**17.3**			**26.7**			**40.3**

Table 4.14: Flexural Strength of concrete with 10% replacement of cement by CP.

S.No.	After 3 Days			After 7 Days			After 28 Days		
	Beam Weight (Kg)	Load (KN)	Flexural Strength N/mm^2	Beam Weight (Kg)	Load (KN)	Flexural Strength N/mm^2	Beam Weight (Kg)	Load (KN)	Flexural Strength N/mm^2
1.	13.294	6.80	2.72	13.984	8.70	3.48	13.472	15.50	6.20
2.	13.251	7.10	2.84	13.393	8.55	3.42	13.923	16.40	6.56
3.	13.641	6.45	2.58	13.594	7.85	3.14	13.975	17.15	6.86
Average			**2.7**			**3.35**			**6.55**

CONCLUSIONS

- For acceptable strength and eco-friendly construction, we should consider using Chalk Powder and Coconut Fiber Ash as a partial replacement for cement up to a certain proportion.
- By using naturally available resources as a construction material, the construction costs can be reduced. Agricultural waste, as well as the resources used for the replacement, are readily available. This study found that a particular percentage of chalk powder and coconut fibre ash can have significant favourable benefits. As a result, it can be used as a construction material.
- It has been discovered that replacing up to 10% of the cement with Chalk Powder can improve the compressive and flexural strength of M-35 grade concrete.
- When Coconut Fiber Ash in proportion of 5-10 % was first used as replacement of cement , the compressive as well as flexural changed by 5% and decreased on further addition .

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