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Experimental Investigation on Natural Fiber Concrete with Palm Oil Tree Fiber

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Abstract: *Investigation on strength development of concrete using palm oil tree fiber was conducted. Preliminary results suggested that as the length of fiber increases, the tendency of fiber to ball up increases. Fiber lengths of 2 cm, 3 cm and 6 cm were used with two percentages of fiber 2% and 4 % of cement weight respectively. Comparative result of compressive strength, split tensile strength, flexural strength of conventional concrete cube, cylinder and prism are investigated. The optimum fiber length for both percentages was 4 cm and 2cm respectively.*

Keywords: Palm oil tree fiber, compressive strength, flexural strength, split tensile strength

I. INTRODUCTION

Concrete is the most widely used construction material which has several desirable properties like high compressive strength, stiffness and durability under normal usual environmental factors. While at the same time concrete found to be brittle and weak in tension. It is well known that concrete is mixed with other material was applied for resistance purpose. Palm oil tree fiber is a composite material consisting of a mortar of ordinary Portland cement, and fine aggregate reinforced with alkali resistant glass fibers.

Fiber reinforced concrete (FRC) is concrete made primarily of ordinary Portland cement, aggregates and discrete and reinforcing fibers. Due to the presence of these uniformly dispersed fibers, cracking strength of concrete is increased and the fibers acting as crack arresters.

Palm Oil residues contain huge amounts of lignocellulosic materials such as empty fruit bunches oil palm fronds and trunks that help to strengthen the bonding or structure of building materials. These residues are an asset for the country to turn its abundant supply of oil palm industry by-products into value-added product results in optimizing the usage of these residues and completely scrap the idea of burning these residues that often create environmental problems by generating severe air pollution that is against the Environment Protection.

2. MATERIALS USED:

2.1 Cement: Cement is the essential binding material used for the production of concrete. For using in cement in important and major works it is incumbent.

Ordinary Portland cement (OPC) is the far by the most important type of cement. The OPC was classified into three grades, namely 33 grade, 43

grade, 53grade depending the strength of cement at 28 days when tested as per **IS 4031-1998.**

2.2 Aggregates: Aggregate are the important constituents of concrete, they give body to the concrete, reduces shrinkage and effect economy.

Aggregate are divided into two categories from the consideration of size they are,

1. Fine Aggregate.
2. Coarse Aggregate.

Local aggregate, comprising 20 mm, and less than 20 mm coarse aggregate and fine aggregate, in saturated surface dry condition, were obtained in the fine.

Generally the size of aggregate bigger than 4.75mm is considered as coarse aggregate whose size is 4.75 mm and less is considered as fine aggregate.

2.3 Water: Specification of water for making concrete is important if the pH value of water lies between 6 and 8 and the water is free from organic matters. Clean portable water conforming to IS 456-2000 was used. In this study, portable tap water with pH value of 7.0 is used for casting and Using, the specimen as well.

2.4 Palm oil tree fiber: Palm oil fibers were obtained from the palm oil factory. These fibers come in various lengths and are chemically treated. From the previous study, when the fibers are added as it is in the concrete, the fibers tend to ball itself together to each other results in uneven distribution throughout the concrete; hence different lengths ranging from 1- 5 cm were used for this study. Ordinary Portland cement was used as binding material.

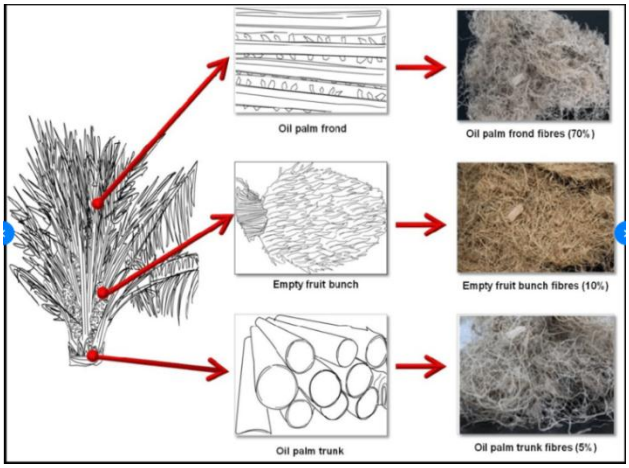


Fig -1: palm oil tree fiber

2.4.1 Fiber length: The lengths of fiber were chosen based on an investigation done using various lengths ranging from 1 cm to 5 cm. Each length was immersed in 500 ml of distilled water. Results through observation of the fiber in water indicated that the fiber tends to ball itself as the fiber lengths increase. For this study, 1 cm and 5 cm fiber length was chosen.

2.4.2 Alkalinity treatment of fiber: Alkaline treatment is a well-known treatment of surface modification of natural fiber for making natural fiber reinforced concrete. This treatment removes lignin, hemicellulose, wax, and oil covering the surface of the fiber

3. MATERIAL AND THEIR SPECIFICATION:

Table- 1: Properties of sand

SL. NO.	TYPES OF TEST	VALUES OBTAINED FOR SAND
1	Fineness Modulus	2.541
2	Specific Gravity	2.68
3	Water Absorption	1%

Table -2: Properties of coarse aggregate

SL. NO.	TYPES OF TEST	VALUES OBTAINED FOR COARSE AGGREGATE
1	Fineness Modulus	2.29
2	Specific Gravity	2.65
3	Water Absorption	0.5%
4	Aggregate Crushing Value	2%
5	Aggregate Impact Value	8.12%
6	Aggregate Abrasion Value	18%

Table -3: Properties of cement

SL. NO.	PROPERTIES TEST	VALUES OBTAINED FOR CEMENT
1	Fineness test by sieving	4%
2	Initial setting time	35 minutes
3	Final setting time	9 hours
4	Specific gravity	3.69

4. TEST ON FRESH CONCRETE:

Fresh concrete or plastic concrete is a freshly mixed material which can be mould into any shape. The fresh concrete test are listed below,

1. Slump test
2. Compaction factor test
3. Flow table
4. Vee-bee consistometer test

5. CASTING OF CONCRETE:

In this project, 0%, 2%, 4% and 6% addition of palm oil fiber for M30 grade concrete. The replacement percent is by volume of total aggregate content derived from the mixture proportioned. The concrete mixture is calculated out in design mix proportion given above and casted into various moulds for various testing and left to dry and curing. Cube specimens of size 150 mm x 150 mm x 150 mm cylinder specimens of 150 mm diameter and 300mm height and prism specimen of size 100mm x 100mm x 500mm are moulded. The tests performed on hardened concrete after 7, 14. 28 days of curing were compression test, flexure test and split tensile test.

Fig-2: Casting of concrete

6. CURING OF CONCRETE MOULD:

All the casted specimens were de-moulded after 24 hours and were placed in curing tank for a period 7 to 28 days. The specimens were taken for testing such as compression test, split tensile strength test and flexure test. The cubes left to dry out mould to set completely and taken into curing tank for attaining maximum strength

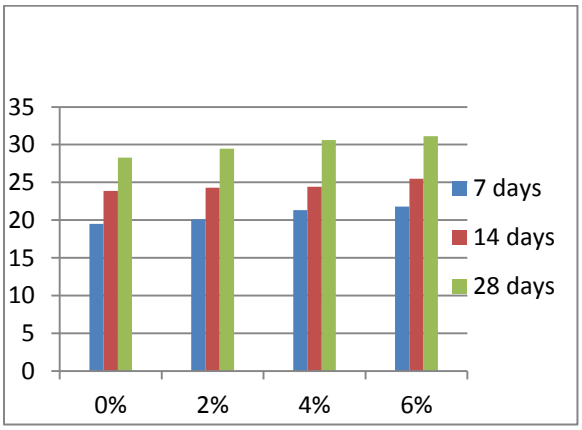
Fig -3: Curing of moulds

7. HARDENED CONCRETE TEST:

7.1. Compression test on cubes

Table -4: Compressive strength of cubes

% of fiber	7days (N/mm²)	14days (N/mm²)	28days (N/mm²)
0	19.48	23.85	28.29
2	20.08	24.3	29.48
4	21.33	24.44	30.6
6	21.81	25.48	31.11



Graph -1: Compression strength of cubes

7.2. Split tensile strength on cylinders

Table -5: Split tensile strength

% of fiber	7 days (N/mm²)	14 days (N/mm²)	28 days (N/mm²)
0	4.38	5.87	6.57
2	4.52	6.15	7.002
4	5.12	6.61	7.35
6	5.19	6.75	7.49

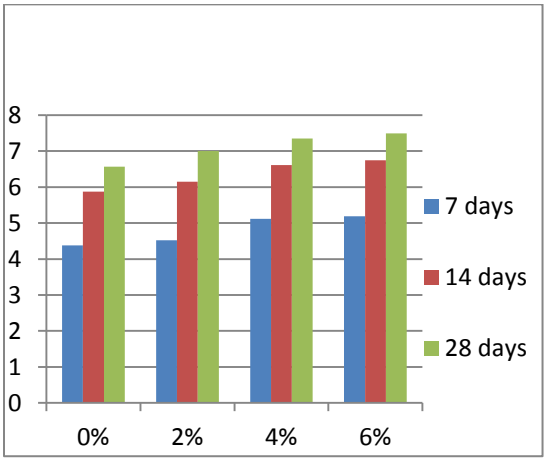


Chart -2: Split tensile strength of cylinders

7.3. Flexural strength on prisms

Table - 6: Flexural strength

% of fiber	7 days (N/mm²)	14 days (N/mm²)	28 days (N/mm²)
0	13.5	15	17
2	14	17	19
4	17	19.5	20.5
6	18	20	22

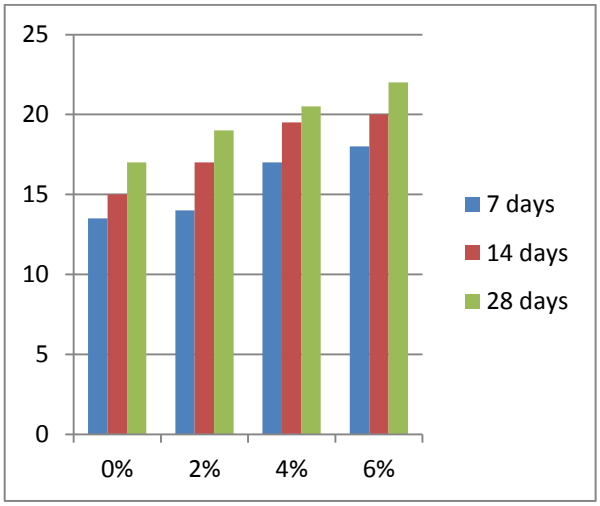


Chart -3: Flexural strength of prisms

8. Conclusion:

Concrete with waste palm oil tree fiber can be used not only as an effective agricultural waste management practice but also a strategy to produce more economic and sustainable building materials. It reduces the weight of concrete and thus if mortar with fibers can be made into light weight concrete.

It was observed that the compressive strength, split tensile strength and flexural strength of concrete are gradually increased up to 6% addition of palm oil tree fiber.

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