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EXPERIMENTAL INVESTIGATION OF FLAX FIBRE AND TILE POWDER AS PARTIALREPLACEMENT OF CEMENT IN M25 GRADE CONCRETE

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Abstract –

Many types of fibres, including some natural fibres, have been used extensively in architectural applications. An important use of the mechanical properties of natural fibres is for tensile reinforcement and volume filling within the matrix of a composite material; cementitious, polymeric, earthy, or other type. Natural fibres provide a readily available and less expensive source of mechanically useful cellulose. And the tile industry inevitably produces waste, regardless of improvements in manufacturing processes. In the tile industry, 15% to 30% of production is wasted. These residues are currently a problem in society and require appropriate disposal methods to achieve sustainable development. In this work, the behaviour of concrete by partial replacement of cement with flax fibres and tile powder in the range of 5%, 10% and 15% for M25 concrete is studied and tested and compared with conventional concrete. Compression, split tensile and flexural strength are performed at 7, 14 and 28 days. Test results show that flax fibre, tile powder and a combination of flax fibre and tile powder have higher strengths at 10% replacement of concrete without affecting the properties of Grade M25 concrete.

Key Words: *Natural fibre, Tile powder, flax fibre*

1. MATERIALS USED

1.1 Cement

Ordinary Portland cement of 53 grade cement according to IS 8112:1989 is used in this study. The cement has specific gravity 3.14. The initial setting time and final setting time are found to be 30 minutes and 600 minutes respectively.

1.2 Flax Fibre

The Flax fiber reinforced concrete (FFFRC) contains randomly distributed short discrete Flax fibers and it act as internal reinforcement so as to enhance the properties of the cementitious composite concrete. fiber having different lengths available such as 10 mm, 12mm, 24mm, 40mm etc. In this study the Flax fibers with 10mm length is used.

1.3 Tile powder

This waste was collected in the form of pest and after drying, hand crushing, and sieving through #300 micron sieves it can be used as replacement in cement in concrete. The tile dust is obtained from ceramics. The tile dust has specific gravity 2.62 and the fineness is found to be 7.5%.

1.4 Fine aggregates

The locally available river sand conforming to zone-II of IS 383-1970 is used as fine aggregate. The specific gravity of sand is 2.7 and fineness modulus is 2.5. The bulk density value is obtained as 1718 Kg/m3 and water absorption is 0.2%.

1.5 Coarse aggregates

The locally available crushed granite stone is used as coarse aggregate. The coarse aggregate with a maximum size 20mm having a specific gravity 2.7 and fineness modulus of 7.5 is used. The bulk density value obtained is 1605 Kg/m3 respectively and water absorption is 2.4%. The coarse aggregate with a size of 10mm having specific gravity 2.76 and fineness modulus of 6.073 is used. The bulk density and water absorption values obtained are 1561 kg/m3 and 0.4%.

1.6 Water

Fresh and clean water is used for casting of specimen. The water has relatively lesser amount of organic matters, silt, oil, sugar, chloride, and acidic material as per requirements of Indian standard. Cement paste is formed by combining water with a cementitious material by the process of hydration. Cement paste glues the aggregates together fills voids within it, and makes floor freely. W/c ratio is maintained at 0.45.

2. METHODOLOGY

Flax Fibre, Tile powder and a mixture of Flax fibre and tile powder are used as a replacement for cement and the evaluation begins with the concrete testing. With the conventional concrete, 5%, 10% and 15% of the Flax Fibre, Tile powder and a mixture of

Flax fibre and tile powder are replaced with cement. The results of Flax Fibre, Tile powder and a mixture of Flax fibre and tile powder concrete are compared with the results of conventional concrete. 3 trails are conducted for each proportion of Flax Fibre, Tile powder and a mixture of Flax fibre and tile powder i.e. for every replacement. After 1 day the specimens are demoulded and curing was continued till the specimens were tested after 7, 14 and 28 days for compression, split tensile and flexural strengths.

2.1. PROCEDURE

- **Collection Of Materials**
- **Mixing Process**
- **Moulding Process**
- **Removing Of Mould**
- **Curing**
- **Testing**

1. Physical Property of Material:

Experiments will be used to establish physical properties such as colour, specific gravity, initial setting time, moisture content, and so on.

2. Mixing Procedure:

Concrete is to be created by Mix Design according to IS Code for this experimental investigation. Concrete should be prepared in particular proportions and w/c ratios for the current study, with Coconut Shell Carbon Powder added as 1% of cement weight by increments. By calculating mix design manually we got ratio as 1 : 1.46 : 2.61 for 0.45 water cement ratio.

3. Moulding Process:

Concrete mixer moulded in 150*150*150 mm^3 cubes. In all, 90 cubes should be formed, with 20 cubes examined at each interval of 7, 14 and 28 days.

4. Mould Removal:

The concrete hardened after 24 hours and then the moulds are removed.

5. Curing:

Concrete cubes are typically cured in fresh water at room temperature for 7 to 28 days.

6. Testing Process:

To establish the physical properties of the material, specific gravity of cement, initial setting time, moisture content and standard consistency should be determined. Compressive strength testing, Split tensile strength test was to be performed using a CTM machine & Flexural strength test was done by using Loading Frame.

3. TESTING OF SPECIMENS

Specimens were tested after 7, 14, and 28 days of cure following casting. The technique for testing specimens is described in this article for assessing different qualities such as compressive strength, splitting tensile strength, and flexural strength.

3.1. RESULTS OF SLUMP TEST

MIX	FF&TP Replacement	Slump Value (mm)
Conventional concrete		
M0	0%	65
Flax fibre RCC		
M1	5%	66
M2	10%	71
M3	15%	68
Tile powder RCC		
M4	5%	67
M5	10%	75
M6	15%	70

Table 3.1: Result of Slumps

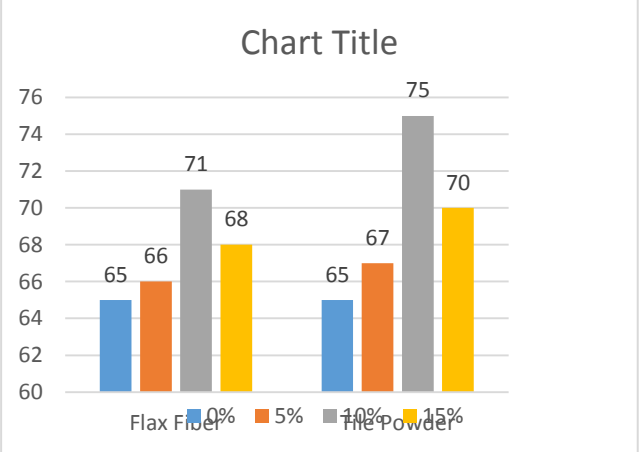

Fig 3.1 - Results of Slump Value

3.2. COMPRESSIVE STRENGTH TEST

Nine cubes sized 150mm x 150mm x 150mm of nominal mix were casted & cured to be tested at 7, 14 and 28 days respectively. But Nine cubes of each trail mix for partial replacement of coconut shell carbon powder concrete were casted and tested at 7, 14 and 28 days respectively. Details the values of compressive strength for different batches.

Table 3.2 - Compressive strength Results

MIX	FF REPLACEMENT	COMPRESSIVE STRENGTH for flax fibre(N/mm²)		
		7 Days	14 Days	28 Days
M0	0%	17.42	26.48	30.89
M1	5%	19.04	26.3	30.23
M2	10%	20.54	28.36	32.6
M3	15%	19.78	27.31	31.4

Table 3.2.1 – Flax Fibre Compressive strength

MIX	TP REPLACEMENT	COMPRESSIVE STRENGTH for Tile powder(N/mm²)		
		7 Days	14 Days	28 Days
M4	5%	21.6	29.83	34.29
M5	10%	22.94	31.68	36.41
M6	15%	22.06	30.46	35.01

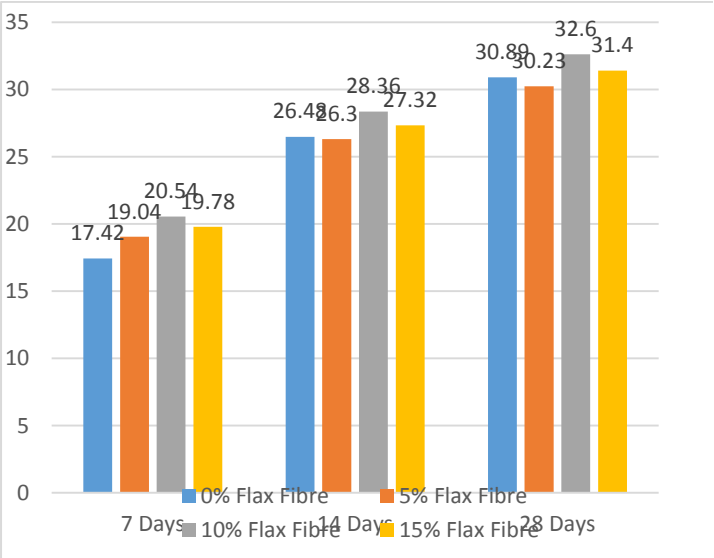

Fig 3.2.1 Flax fibre compressive strength

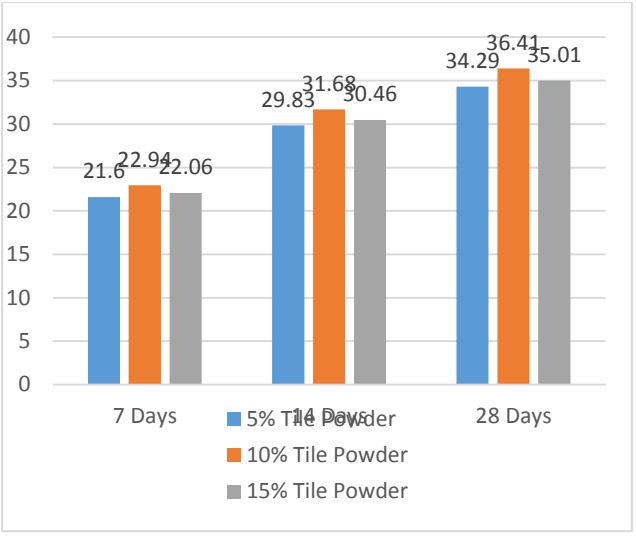

Fig 3.2.2 – Result of Compressive strength

1.1. SPLIT TENSILE STRENGTH TEST

Six cubes sized 150mm x 300mm cylinder of nominal mix were casted & cured to be tested at 7, and 28 days respectively. But Six cylinders of each trail mix for partial replacement of coconut shell carbon powder concrete were casted and tested at 7 and 28 days respectively. Details the values of split tensile strength for different batches.

Table 3.3 – Split tensile strength Results

MIX	FF REPLACEMENT	SPLIT TENSILE STRENGTH(N/mm²)	
		7 Days	28 Days
M0	0%	1.81	2.97
M1	5%	1.86	2.96
M2	10%	2.27	3.6
M3	15%	1.95	3.1

Table 3.3.1 – Flax fibre split tensile strength

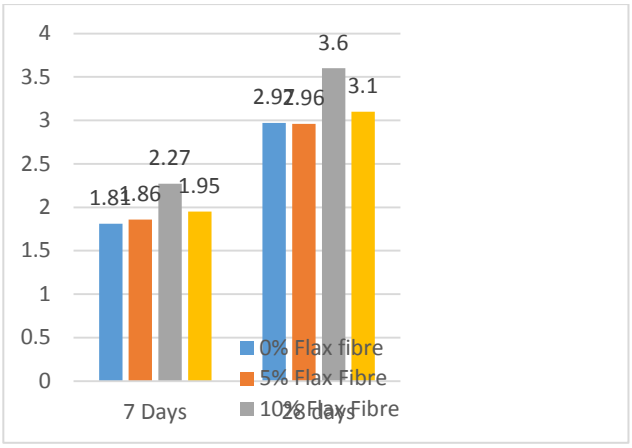

Fig 3.3.1 - Flax fibre split tensile strength

MIX	TP REPLACEMENT	SPLIT TENSILE STRENGTH(N/mm²)	
		7 Days	28 Days
M4	5%	1.97	3.12
M5	10%	2.49	3.95
M6	15%	2.3	3.65

Table 3.3.1 – Tile powder split tensile strength

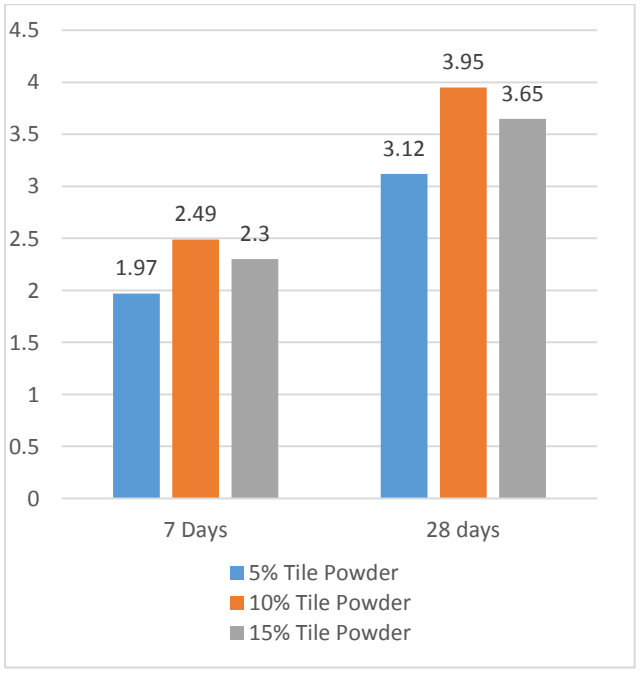

Fig 3.3.1 – Tile powder split tensile strength

1.1. FLEXURAL STRENGTH TEST

Six bars sized 750mm x 100mm x 100mm bars of nominal mix were casted & cured to be tested at 7, and 28 days respectively. But Six bars of each trail mix for partial replacement of coconut shell carbon powder concrete were casted and tested at 7 and 28 days respectively. Details the values of flexural strength for different batches.

MIX	FF REPLACEMENT	FLEXURAL STRENGTH(N/mm²)	
		7 Days	28 Days
M0	0%	2.51	3.98
M1	5%	2.53	4.01
M2	10%	3.09	4.9
M3	15%	2.72	4.32

Table 3.4.1 – Flax Fibre Flexural strength

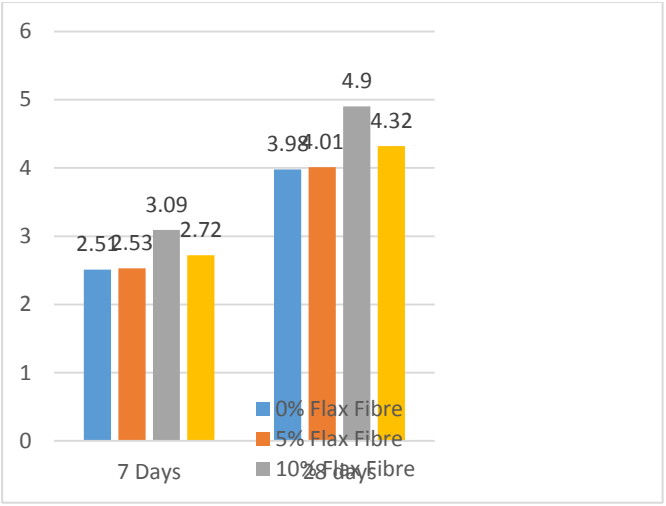

Fig 3.4.1 - Flax Fibre Flexural strength

MIX	TP REPLACEMENT	FLEXURAL STRENGTH(N/mm²)	
		7 Days	28 Days
M4	5%	3.14	4.98
M5	10%	3.48	5.53
M6	15%	3.27	5.19

Table 3.4.2 – Tile powder Flexural strength

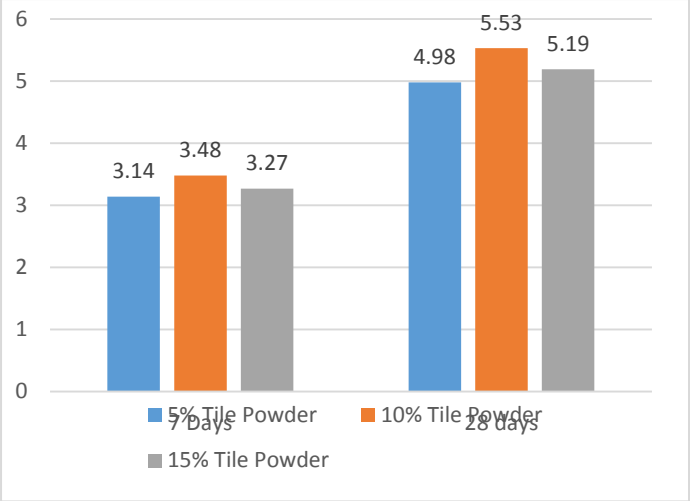

Fig 3.4.2 – Tile powder Flexural strength

4. CONCLUSIONS

Post completion with this investigation, the following findings were reached:

- Workability is observed at increased with the addition of Flax fiber.
- Workability is observed at increased with the addition of Tile Powder.
- Maximum compressive strength value was observe at 0.45 w/c ratio of 10% of Flax fiber.
- Maximum compressive strength value was observe at 0.45 w/c ratio of 10% of Tile Powder.
- Maximum Split tensile strength value was observe at 0.45 w/c ratio of 10% Flax fiber.
- Maximum Split tensile strength value was observe at 0.45 w/c ratio of 10% Tile Powder.
- Maximum Flexural strength value was observe at 0.45 w/c ratio of 10% Flax fiber.
- Maximum Flexural strength value was observe at 0.45 w/c ratio of 10% Tile Powder.

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