UTILIZATION OF COCONUT SHELL CARBON POWDER AS PARTIAL REPLACEMENT OF CEMENT IN M25 GRADE CONCRETE

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Abstract –

Concrete may be strong in compressive strength but it is weak to its tensile strength as it is having high load bearing capacity rather than the tensile strength. To increase different mechanical properties of concrete different types of materials are being used in present day market.

The objective of this research is to investigate the potential use of Coconut Shell Carbon Powder (CSCP) as a cementitious material in concrete mixes. The overall procedure for making CSCP from coconut shells includes the pyrolysis of coconut shells into char, followed by steam activation in a fluidized bed reactor. The activated carbon that results is 97% pure. Concrete made with CSCP as a partial cement substitute at levels of 1%, 2%, 3%, and 4% by weight of cement has superior performance characteristics when compared to normal concrete, according to research. Furthermore, the use of CSCP would result in a reduction of the environmental greenhouse effects.

Concerns and the requirement to conserve energy and resources, efforts have been made to burn the coconut shells at a controlled temperature and atmosphere, and to utilize the ash so produced as a supplementary cementing material.

***Key Words**: Carbon Powder, Activated Carbon, CSCP, Coconut Shells.*

1. MATERIALS USED

1.1 Coconut Shell carbon Powder (CSCP)

Activated carbon is a low-cost material with distinguishable properties like high specific surface area, high porosity, and desired surface functionalisation. Because of that, activated carbon is diversely used for effective applications in adsorption, removal of pollutants, water treatment, and energy, etc.

There are four types of carbon powder material. They are:

a. Coconut shell Carbon powder,
b. Fruit shell carbon powder,
c. Coal carbon powder,
d. Wood carbon powder.

1.2 Cement

Ordinary Portland cement (OPC) of grade 53 was used, with composition and properties which fulfil Indian standard organisation requirements.

1.3 Water

Water is essential in the production of concrete since it initiates the interaction between the cement, pozzolan, and aggregates. It aids in hydrating the mixture. The water utilised in this study was plain water.

1.4 Aggregates

This research is limited to sand gathered from the river. The sand was collected to ensure that there was no allowance for potentially harmful materials in the sand. In this study, aggregates with a maximum size of 20mm have been used.

FIG 1.1 COCONUT SHELL CARBON POWDER

2. METHODOLOGY

The fundamental goal of this work is to examine the potential of coconut shell carbon powder as a pozzolanic material for cement replacement in concrete. However, it is believed that the addition of coconut shell carbon powder in concrete will increase its strength qualities.

Furthermore, it is an attempt to build concrete utilising coconut shell carbon powder as a source material for partial replacement of cement, which meets the different structural features of concrete such as compressive strength, split tensile strength and flexural strength.

It is also envisaged that the project's ultimate output would have a positive overall impact on the usefulness of coconut shell carbon powder concrete in the sphere of civil engineering construction activity.

Because the following characteristics impact the behavior of the coconut shell carbon powder concrete, they are kept constant for the experimental work:

a) Percentage of cement replaced by CSCP,

b) CSCP fineness,

c) CSCP chemical composition,

d) Water-to-cementitious-material (w/c) ratio.

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 : 1.48 : 2.67 for 0.46 water cement ratio.

3. **Moulding Process:**

Concrete mixer moulded in 150*150*150 mm^3 cubes. In all, 72 cubes should be formed, with 18 cubes examined at each interval of 7, 14, and 28 days.

4. **Mould Removal:**

Molds are removed after 24 hours.

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 evaluated 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	CSCP Replacement	Slump Value(mm)
M0	0%	78
M1	1%	79
M2	2%	81
M3	3%	77
M4	4%	75

Table 3.1: Result of Slumps

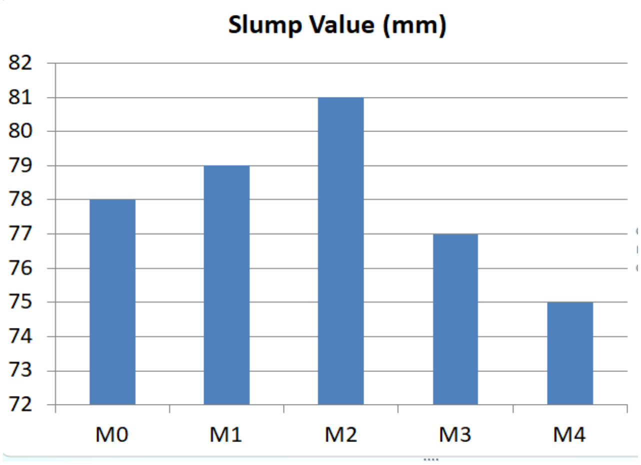

Fig 3.1 - Results of Slump Value

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	CSCP REPLACE MENT	COMPRESSIVE STRENGTH (N/mm²)		
		7 Days	14 Days	28 Days
M0	0%	18.25	27.58	31.71
M1	1%	21.03	30.09	33.98
M2	2%	23.13	33.36	37.16
M3	3%	24.96	37.42	40.28
M4	4%	26.83	39.87	44.20

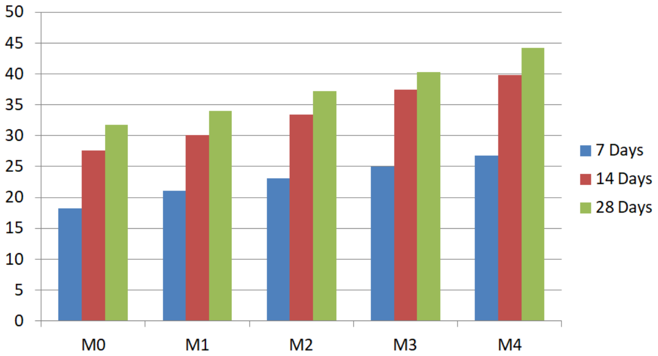

Fig 3.2 – Result of Compressive strength

3.3. 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	CSCP REPLACEMEN T	SPLIT TENSILE STRENGTH(N/mm²)	
		7 Days	28 Days
M0	0%	1.76	3.43
M1	1%	2.78	3.67
M2	2%	2.88	3.79
M3	3%	2.97	3.91
M4	4%	3.05	4.11

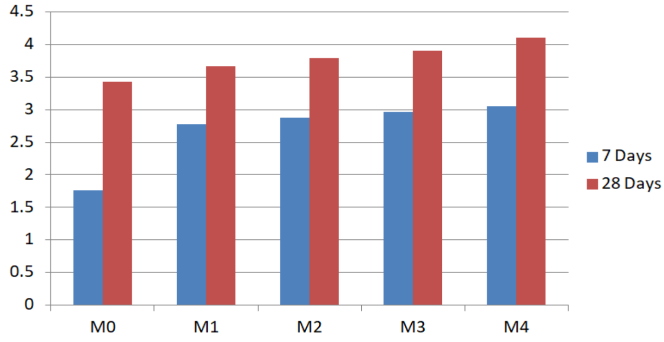

Fig 3.3 – Result of Split tensile strength

3.4. 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.

Table 3.4 – Flexural strength Results

MIX	CSCP REPLACEMENT	FLEXURAL STRENGTH(N/mm²)	
		7 Days	28 Days
M0	0%	2.67	6.71
M1	1%	4.21	7.08
M2	2%	4.37	7.27
M3	3%	4.5	7.45
M4	4%	4.63	7.75

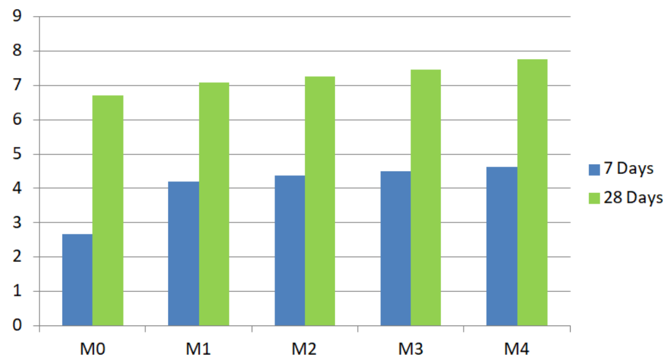

Fig 3.4 – Result of Flexural strength

4. CONCLUSIONS

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

- Coconut shell carbon powder is a highly reactive pozzolanic substance that can be utilised as an additive to cement in the production of high-performance concrete.

- Setting Time of concrete is decreased by an hour when is compared with nominal mix of M25 grade.
- Compressive strength of M25 grade of concrete increases with the addition of Carbon Powder at 4% by 39.37%.
- Split tensile of M25 grade of concrete increases with the addition of Carbon Powder at 4% by 19.92%. .
- Flexural strength of M25 grade of concrete increases with the addition of Carbon Powder at 4% by 15.42%.

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