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Effect of coconut fibre ash on strength properties of concrete

Sanjay Sen[1], Rajeev Chandak[2],
[1]Student M.E. Structural Engineering, Department of Civil Engineering Jabalpur Engineering College Jabalpur, India
[2]Professor, Department of Civil Engineering Jabalpur Engineering College Jabalpur, India

Abstract
Concrete is the construction material which is obtained by mixing of cement, water and aggregate in required proportions. The day by day the cost of cement is increasing, yet the need for building and other construction requiring this material keep growing with an increase in the population, thus the need to find alternative binding materials that can be used solely or in partial replacement of cement. Agricultural waste material**,** In this case coconut fibre ash, which is an environmental pollutant. Coconut fibres are collected and the fibre are properly dried and burnt in the open air with a temperature range of 600^0 c to 700^0 c. when the fibres turned into ash. The ash was collected and made to pass through 150 micron sieve. This work presents the results of laboratory test carried out using coconut fibre ash (CFA) as a partial replacement for cement in concrete production. Concrete cubes are cast and tested at curing aging of 7, 28, 60, & 90 days using 0, 5, 10, 15, 20, & 25 percent replacement levels. The slump test results show that the workability of the concrete decreased as the CFA content increased & the compressive strength of CFA concrete increased with curing aging but decrease with increasing the percentage of coconut fibre ash. The percentage strength gained at 90 days for 5% and 10% for the control of 0% is 96.22% & 86.12% respectively. The optimum compressive strength of 59.25N/mm^2 was obtained at 5% replacement at 90 days of ages. The percentage strength at this optimum point of the control is 96.22%.
Keywords: coconut fibre ash, concrete, compressive strength, cement.

I. Introduction

Concrete is the second largest material consumed by the human being in the world next to water. Environmental attack can severely reduce the strength and life of the concrete. There is currently a great deal of interest in developing the technology for using natural fibres materials in cement composites. Natural fibres exist in reasonably large quantities all over the world and natural vegetable fibres are produced in most developing countries. Natural fibres have been used to reinforce inorganic materials for thousands of years.

To reduce the impact on the environment due to industrial and agricultural waste products such as (coconut fibers) COIR and Rice Husk Ash. which are the waste products of paddy industry and agricultural industry. Use of these materials in concrete is not only improves the strength of concrete, but also leads to the proper disposal of these materials, resulting in reducing the impact of these materials on the environment. It is found that the rice husk ash is obtained by burning of rice husk in a controlled way, which is highly reactive pozzolonic material and the coir having excellent mechanical and physical properties to be utilized in an effective way in the development of composite materials.

II. Material used and Method

The materials used during the study include:
Coconut fibre ash: Coconut fibre was obtained locally in temple of Tripur sundari (M.P) & Ordinary Portland Cement 43 grade cement (Jaypee cement) was used available locally in plant. Water: portable water free from suspended particles and chemical substances was used for both mixing and curing of concrete. Superplasticizer: To impart the additional desired properties a superplasticizer (VITCON 9001) was used. Dosage of super plasticizer was added 2.0% by weight of cement. The fine aggregates used in this investigation were Narmada river sand passing through 4.75 mm sieve with specific gravity of 2.65. The grading zone of fine aggregates was zone II as per Indian standard specification. Coarse aggregates. Two fractions of coarse aggregates were used, 20mm size having a specific gravity of 2.84, and 10mm size having a specific gravity of 2.83. The fibres were properly dried and burnt in the open air with a temperature range of 600^0C to 700^0 C when the fibres turned into ash. The ash was collected and made to pass through 150 micron sieve.

Figure 1. Coconut fibre ash mix in concrete proportion.

Sample of the ash was taken to the laboratory to determine the chemical composition of the coconut fibre ash. The chemical composition is presented in table 1 below. Concrete cubes of size, 150mm x 150mm x 150mm were produced by replacing the cement content, partially with the coconut fibre ash. The percentage replacements used were 0%, 5%, 10%, 15%, 20% and 25%. A total of 72 specimens were cast and cured in the curing tank for periods of 7, 28, 60 and 90 days. Three specimens were crushed using the universal testing machine at the end of each curing regime and the average strength was recorded.

Figure 2. Compaction of concrete. (vibration)

III. Result and Discussion

The result of the chemical analysis carried out on the coconut fibre ash is present on table 1. According to M.S. Shetty the raw materials used for the manufacture of cement consist mainly of lime, silica, alumina, and iron oxide. Generally the chemical analysis of coconut fibre ash reveals that it contains some quantities of these elements. Hence CFA can be used effectively as a supplementary cementitious material.

Table-1 Chemical Composition of Coconut Fibre Ash

Constituents	Percentage composition (%)
Sio_2	13.78
Al_2O_3	36.24
Fe_2O_3	0.15
Cao	33.37
Mgo	20.06
So_3	0.007
MnO	0.13
K_2O	0.73
P_2O_5	0.021
Na_2O	0.38
LOI	2.14

Table 2 shows the slump test result & it can be observed that the slump value decrease with increasing the percentage of coconut fibre ash. This indicates that the concrete became less workable (stiff) as the CFA content increased.

Table2: Slump test result of coconut fibre ash concrete.

% replacement	slump
0	110
5	103
10	96
15	90
20	86
25	82

The compressive strength test result for the various curing ages are shown in table 3.

Table 3: Compressive strength test result of coconut fibre ash concrete at different ages.

% replacement	Compressive strength (N/mm^2)			
	7 days	28 days	60 days	90 days
0	32.59	50.96	57.59	61.58
5	30.33	47.33	53.38	59.25
10	22.52	32.59	42.40	53.03
15	18.78	25.92	30.00	32.58
20	14.67	22.51	26.05	28.14
25	13.33	20.22	22.80	25.00

The compressive strength of CFA concrete increased with curing aging, but decrease with increasing the percentage of coconut fibre ash. The percentage strength gained at 90 days for 5% and 10% for the control of 0% is 96.22% & 86.12% respectively. The optimum compressive strength of $59.25N/mm^2$ was obtained at 5% replacement at 90 days of ages. The percentage strength at this optimum point of the control is 96.22%.

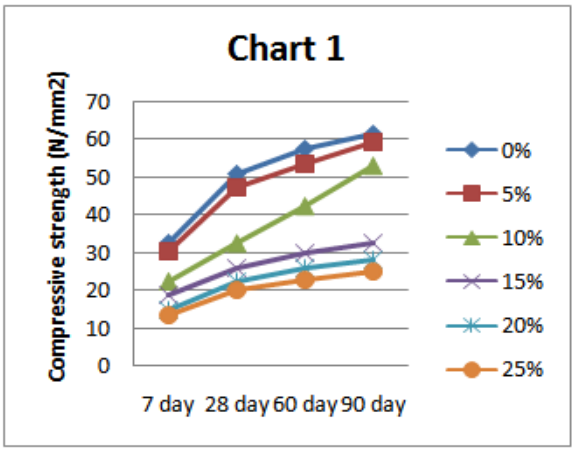

Figure 3. Effect of curing on CFA concrete.

Fig.3 shows the effect of curing on CFA concrete. An increasing trend in the strength of the CFA concrete as the days of curing increases is indicated. The effect of the different curing ages on the strength of CFA concrete is shown in Figure 3. This strength development is believed to continue as long as the curing period is prolonged to allow hydration process to be complete.

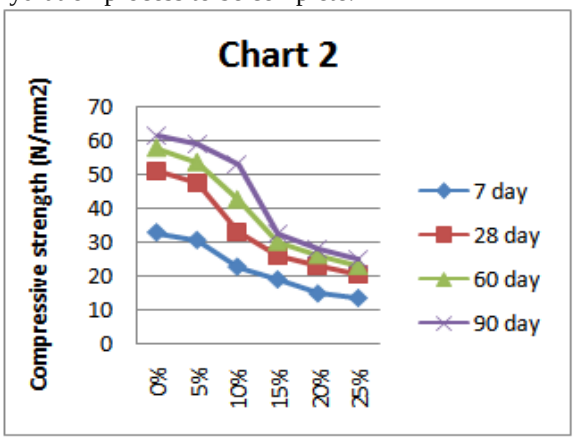

Figure 4. Effect of percentage replacement of cement with CFA on compressive strength of concrete.

The strength of the CFA concrete reduces as the percentage replacement of cement with the ash increases. The effect of the percentage replacement of cement with CFA on the strength of the CFA concrete can be deduced from Figure 4.

IV. Conclusion

From the test results, the following conclusion is drawn.

1. Compressive strength gradually reduces with increase in percentage of coconut fibre ash. The reduction is prominent even for 10%. The optimum compressive strength of 59.25 N/mm^2 was obtained at 5% replacement at 90 days of ages.
2. The compressive strength of coconut fibre ash concrete increased with curing aging.
3. The slump value decreases with increasing the percentage of coconut fibre ash. This indicates that the concrete became less workable (stiff) as the CFA content increased.

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