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Experimental Investigation on Partial Replacement of Cement by Neem Leaves Ash

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Abstract: As a result of the rising cost of building materials, it has become necessary to search for the affordable and cheaply obtainable material which might be partially replaced cement in the production of concrete. This project is an experimental study on the use of Neem Leaf Ash (NLA) as partial replacement for cement. Then , Neem leaves were dried, burnt and heated in a furnace to produce Neem Leaf Ash, which was discovered to possess pozzolanic properties. The Ordinary Portland cement was replaced by NLA at 05%, 10% and 15% by weight and the cubes were crushed to know the compressive strength of the concrete at different curing days. The results revealed that, the workability and strength properties of the resulting concrete was dependent on the water cement ratio, total days of curing, and percentage of replacement of NLA for OPC. It was noticed that the result of 5% and 10% NLA were gradually increasing at 28 days. We hope that this project work will provide a quick reference to practicing Engineer, who will find NLA as a good partial replacement for cement in concrete, thus reducing cost of concrete production.

Keywords: Cement, Fine aggregate, Coarse aggregate, Neem leaves ash.

I. Introduction

Ordinary Portland cement is one of the most important binding materials in terms of quantity produced. Since it is manufactured at very high temperatures, it consumes a lot of energy. Along with huge amounts of energy consumption, it emits harmful gases, which pollute the atmosphere. This affects the durability of Portland cement pastes, mortars and concretes. Natural pozzolans are vitreous cementitious materials, which by themselves possess little or no cementing value, but finely ground in the presence of moisture, they will chemically react with calcium hydroxide at ordinary temperatures to form hydrated phases possessing cementing properties. A sincere attempt has been made to study the possibility of using bamboo leaf ash as a partial substitute to cement, as it is amorphous in nature and has been found to have pozzolanic properties after calcination. Neem is a composite material which grows abundantly in our country. Since the cost of cement is high, neem leaves ashes are partially replaced with cement. Using the facilities present nowadays partial replacement by increasing the percentages of the neem leaves ash as 5% ,10%, 15% and decreasing the amount of cement the strengths such as compressive strength and tensile strength have been planned in our project.

II. Materials and Methods

Cement

The Bureau of Indian Standards (BIS) has classified OPC in three different grades. The grades are (i) 33 grade (ii) 43 grade (iii) 53 grade. The binding materials usedin concrete are Ordinary Portland Cement. This cement is of 43 grades conforming to IS 456-2000 and is having desired properties. The compressive strength of cement is checked by casting cube and testing under compressive testing machine and tensile strength of cement is checked by casting cylinder and testing under tensile testing machine.

Fine aggregate

Aggregate which is passed through 4.75 sieve and retained on 75 micron(0.075mm) is termed as fine aggregate. Fine aggregate is added to concrete to assist workability and to bring uniformity in mixture. Usually, the natural river sand is used as fine aggregate.

Coarse aggregate

The coarse aggregate for the works should be river gravel or crushed stone. Angular shape aggregate of is 20mm and below. It should be hard, strong, dense, durable, clean and free from clay or vegetable matter. The pieces of aggregates should be cubical, or rounded shaped and should have granular or smooth surfaces.Coarse

aggregates containing flat, elongated or flaky pieces or mica should be rejected. The grading of coarse aggregates should be as per specifications of IS 383-1970.

Neem leaves ash

Neem leaves are easily available materials which has good chemical properties. It has high calcium content which is very important for binding property. Neem leaves are collected and dried for few days. After that, they are burned to get ashes. These ashes were sieved and used for preparing concrete.

Table 1: Composition of NLA

Composition	*Value(wt)*
Ca	0.70
K	0.25
Mg	0.29
S	0.06
Al	0.05
Na	0.06
Si	0.12
Cl	0.07

Figure 1: Neem leaves ash

Preparation of Specimens

Specimens were prepared using cube moulds and cylinder moulds. Initially, neem leaves ashes were weighed and added with cement. Then fine aggregates and cement were mixed. Then coarse aggregates added .They are mixed well and required amount of water was added and mixed well.

The moulds were locked using screws and after applying oil, the concrete mixture was poured inside the mould in layers. Each layer of concrete was compacted using a table vibrator. Next, it was kept for drying in the open place for 24 hours. After 24 hours, they were demoulded and kept inside the water for curing.

Totally 9 cubes (150 mm x 150 mm x 150 mm) for each compressive strength and 9 cylinders (150 mm diameter and 300 mm height) for each split tensile test were casted. Standard cast iron moulds were used for casting the test specimens.

Testing of Specimens

Laboratory tests includes compression strength test, split tensile strength test as per IS 516-1959, carried out on the concrete mixes at the specified ages (7,14,28 days).

III. Result and Discussion

Compressive strength of concrete with Neem leaves ash-

The Cube specimens are tested using compression testing machine to determine the compressive strength. The tests were conducted at 7 days,14 days and 28 days. The tests were carried out according to IS 516-1959

Compressive Strength = $\frac{\textit{Load Applied}}{\textit{Area of the specimen}}$ **(N/mm^2)**

Table 2: Comparative Compressive Strength of Cubes

Curing days	*Normal Cube ((N/mm^2)*	*Cube with NLA(N/mm^2)*		
		5%	*10%*	*15%*
7 days	16.07	16.58	16.66	16.40
14 days	23.25	23.40	23.55	23.1
28 days	25.40	26.14	26.51	25.25

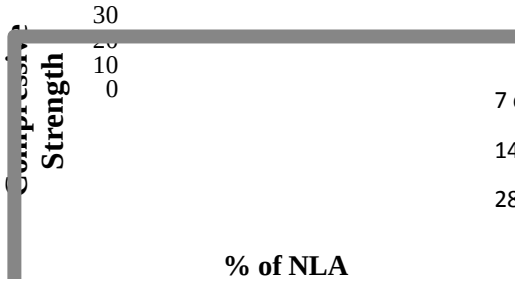

Figure 2: Comparative compressive strength at 7 days,14 days and 28 days of curing
The table 2 shows the compressive strength of concrete with Neem leaves ash at 7 days and 28 days of curing.

Split Tensile Strength of Concrete with Neem leaves ash-

The Cylinder specimens are tested using compression testing machine to determine the split tensile strength. The tests were conducted at 7 days,14 days and 28 days. The tests were carried out according to IS 516-1959. The determination of tensile strength of concrete is necessary to determine the load at which the concrete members may crack.

Split tensile Strength = $\frac{2P}{\pi L D}$ **(N/mm^2)**

Table 3: Comparative Split Tensile Strength of Cylinders

Curing days	Normal Cube ((N/mm^2)	Cube with NLA(N/mm^2)		
		5%	10%	15%
7 days	1.98	2.12	2.33	2.37
14 days	2.19	2.40	2.58	2.73
28 days	2.49	2.63	3.01	3.06

The table 3 shows the split tensile strength of concrete with Neem leaves ash at 7 days,14 days and 28 days of curing. Compare to the concrete cylinders with Neem leaves ash.

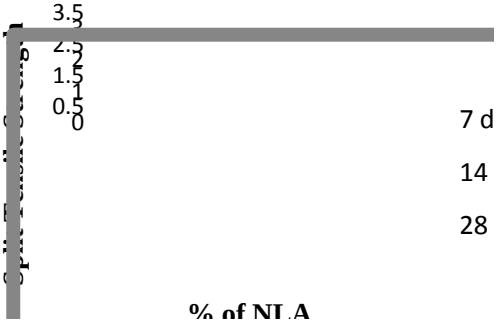

Figure 4: Comparative Split Tensile strength at 7 days, 14 days and 28 days of curing

Conclusion

The conclusions are drawn from the experimental investigation. As per the investigation of experiments, it is proved that partial replacement of neem leaves ashes with minimum amount (5%,10%)gives more strength and decreases while adding more amount of neem leaves ahes(15%).From the Edax test, it is found that neem leaves ashes has more calcium content. Calcium content increases the binding property which is an major property in cement. Since it has the property of cement, it can be replaced as cement and we have used here.

Compressive Strength:

From our experimental investigation, the compressive strength gradually increases while adding 5% of NLA and 10% of NLA. But it starts decreasing in 15% of NLA

Split Tensile Strength:

From our experimental investigation, the split tensile strength gradually increases in every percentages of NLA.

Neem leaves are economical compared with cement. It is also the easily available material. In future, when the demand and cost of the cement will increase even more, there is a good replacing material as a cement.

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