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RESEARCH ARTICLE

FEASIBILITY STUDY OF BAMBOO STICK ASH AND BAMBOO LEAF ASH ON CONCRETE MEMBERS

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A B S T R A C T

Concrete is being widely used in all infrastructures and its material is mainly very expensive for the construction. The Bamboo sticks are unutilized in the concrete work and hence their usage may help to decrease the cost of construction. The use of waste materials in concrete production is becoming worldwide practice. The assessment of the activity of cement materials is becoming increasingly important because of the need for more sustainable cementing product. The early work has been carried out with partial replacement of Bamboo leaf ash with cement in order to increase the tensile strength of concrete and compressive strength has been decreased. Now we are using partial replacement of stick ash with cement in order to increase the compressive strength of concrete. The use of Bamboo stick and leaf ash with the partial replacement of cement is used in the concrete in order to know the compressive strength and tensile strength. Compressive strength of 28 days curing with partial replacement of BSA to cement gives 25 N /mm^2 at 5% of ash replacement and it is observed that 20% of strength is decreased than conventional concrete. Compressive strength of 28 days curing with partial replacement of BLA to cement gives 26.20 N /mm^2 at 10% of ash replacement and it is observed that 17% of strength is decreased than conventional concrete. Tensile strength of 28 days curing with partial replacement of BSA to cement gives 2.65 N/mm2 at 5% ash replacement and it is observed that 44% of strength is decreased than conventional concrete.

Tensile strength of 28 days curing with partial replacement of BSA to cement gives 2.65 N/mm2 at 10% ash replacement and it is observed that 44% of strength is decreased than conventional concrete. The partial replacement is done with the following percentages of 0, 5, 10, 15 with Bamboo stick and leaf ash separately. Thus, from the results obtained, it can be concluded that use of bla as a supplimentory for cement gives good result.

INTRODUCTION

General

Concrete is one of the major construction material used, which is next to the consumption of water by the mankind. It is estimated that six billion tonnes of concrete is produced every year throughout the world. This is due to the availability of the abundance of the raw materials, low relative cost and adoptability of concrete forming various shapes. The extraction of raw materials causes depletion of resources. In recent times, the environmentalists are more concerned regarding the cement manufacture.

One tonne of cement manufacture emits approximately one tonne of CO_2 in to the atmosphere. This causes greenhouse effect and global warming of the planet. Hence an emission of six billion tonnes of CO_2 every year which causes an environmental impact. The way to reduce the environmental impact is the use of supplementary cementitious materials. These alternative materials are generally selected on the basis of additional functionality that they offer and their cost effectiveness. Typical examples are fly ash, slag cement formerly called ground granulated blast furnace slag, silica fume, rice husk and egg shell, one such material is Areca nut husk ash.

The applications of BSA and BLA are replaced in varying proportions to the cement depending on their chemical composition. The use of these materials in concrete, apart from the environmental benefits, also produces good effects on the properties of final products. One of the waste materials used in the concrete industry is BSA and BLA. Most of the aggregates used in our country are river sand as fine aggregates and crushed rock of quarries as coarse aggregates. Fine aggregates used for concrete should conform to the requirements for the prescribed grading zone. Natural or river sand may not conform to all the above requirements and may have to be improved in quality. The sand mining from our rivers have become objectionably excessive in view of both economy and environment. It has now reached stage where it is killing all our rivers day by day. Hence sand mining has to be discouraged so as to save the rivers of our country from total death. The problem of how to meet the increasing demand and cost of concrete in sustainable manner is a challenge in the field of civil engineering and environmental.

Because of environmental and economic reasons it require thinking about the use of industrial wastes and naturally available waste material as alternative materials in concrete production, which not only reduces the cost of production of concrete but also controls the pollution relatively**.**

Aims and Objectives of the study

The aim of the research is to evaluate the performance and suitability of BSA and BLA as a cementitious material for the use of ordinary Portland cement (OPC) in the production of concrete.

To evaluate the different strength properties of concrete mixture with BSA and BLA replaced in percentage to the cement and for making workable, high strength and durable concrete.

- This project involves the using of bamboo stick ash and leaf ash respectively in concrete to obtain durability property.
- To study the effect of partial replacement of Cement with the Bamboo stick ash and bamboo leaf ash and find its effect on the strength of concrete.
- Study of strength property of concrete at the ages of 7, and 28 days for 0%, 5%, 10%, 15% replacement of cement with bamboo ash.
- Comparative study of strength properties and obtaining the results for different proportions of bamboo ash concrete blocks containing natural sand and bamboo ash in partial replacement to cement.

MATERIALS USED AND METHODOLOGY

Ordinary Portland cement of 43 grade ACC cement conforming to IS: 8112-2013 was used. Crushed stone aggregate with a maximum particle size 20mm downsize was obtained from local quarry & was used as coarse aggregate. Local clean river sand passing through 4.75 mm sieve conforming to grading zone II of IS: 383-1970 [16] was used as fine aggregate in all concrete mixes. Sieve analysis of all fine aggregates & coarse aggregate was carried in the laboratory. The w/c ratio was kept constant for all the mixes. Mix proportion of M20 grade was used to produce the mixes as per IS: 10262: 2009.

A careful procedure was adopted in the batching, mixing and casting operations. The cement coarse aggregates and fine aggregates were weighed first with an accuracy of 0.5 grams. The concrete mixture was prepared by hand mixing. BSA and BLA were obtained from Tumkur and they were incinerated in open furnace. The varying proportions of BSA and BLA and cement were fed into the tray separately first and mixed thoroughly then coarse aggregates and fine aggregate were added to it. Then water was carefully added as per the mix design and that is 0.45. Cubical moulds of size 150mm× 150mm×150mm were casted for compression strength testing and cylindrical moulds of 150 mm diameter & 300 mm length were casted for split tensile test. The moulds were cleaned & oiled properly before every pouring. The concrete was filled in the moulds in three layers, each layer being tamped with tamping rod. The specimens were allowed to remain in the steel mould for the first 24 hours at ambient condition. After that these were demoulded with care so that no edges were broken and were placed in the curing tank at the ambient temperature for curing. At the end of every curing period, the samples were taken out of curing tank and were tested for age 7 days and 28 days.

Mix Design

Concrete mix design is an attempt to ensure the judicious proportions of constituent materials so as to meet the requirements of the structure to be constructed. The strength level required, age, material characteristics and type of application greatly influence the mix proportions. Raw material properties and quantities must be selected to achieve the desired mix in terms of strength, durability, flow ability, workability and economy.

Table 1 Materials Required For $1m^3$ of Concrete

Constituents	Quantity
Cement	437.77 Kg
Coarse aggregate	1020.21 Kg
Fine aggregate	732.17 Kg
Water	197 Liter

The investigation was done on the proportion 1:1.65:2.33. For conventional concrete mix there is no change, where as for other mixes like partial replacement of BSA and BLA to cement with varying percentages.

Table 2 Replacement of Cement by BLA & BSA

Mix Id	Cement	BSA and BLA
S_5,L_5	95	5
S_{10},L_{10}	90	10
S_{15},L_{15}	85	15
S_{20},L_{20}	80	20

Casting, Curing and Testing of the Specimen

Casting of specimen

Cement, Fine & Coarse aggregate were taken in mix proportion 1:1.65:2.33 which correspond to M25 grade of concrete. Cement is replaced with BLA & BSA with varying percentages. All the ingredients were dry mixed homo geneously. To this dry mix, water-cement ratio of 0.45 was added and the entire mix was again homogeneously mixed. This wet concrete was poured into the moulds which was compacted by tamping rod in three layers and then kept into the vibrator for compaction. After the compaction, the specimens were given smooth finishes and were covered with gunny bags. After 24 hours, the specimens were de moulded.

Curing of the specimens

The de moulded specimens were transferred to curing. The curing is done in the water, where they were allowed to cure for 7 & 28 days.

Testing of the specimens

The test specimens for compressive strength test were made of cubes having a size of 150mm x 150mm x 150mm cast iron steel moulds were used. For each mix proportion two numbers of cubes were cast and tested at the age of 7 days and 28 days. The test specimens for split tensile strength test were made of cylinders having a size of 100mm diameter and 300mm high cast iron moulds were used. For each mix proportion two numbers of cylinders were cast and tested at 7 days & 28 days.

Compressive Strength Test

Specimens of dimensions 150x150x150mm were prepared. They are tested on 2000kN capacity compression testing

machine as per IS 516-1959. The compressive strength is calculated by using the equation,

F=P/A
Where; F=> Compressive stress in N/mm2
P=> Maximum load in N
A=> Cross sectional area in mm2

The average Compressive strength of various proportions is given in table.

Table 3 Compresive Strength of BLA & BSA Specimeus

% of BLA and BSA	7days N/mm²	28days N/mm²
L_5	22.35	24.88
L_{10}	20.13	26.20
L_{15}	17.56	23.24
S_5	26.57	27.00
S_{10}	23.33	23.90
S_{15}	22.11	23.50

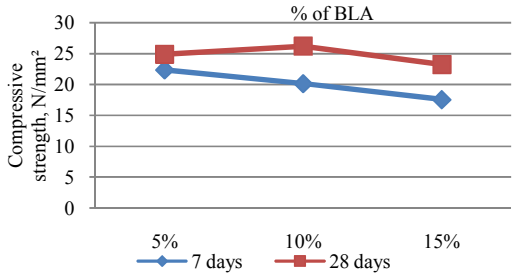

Figure 1 Comparison of Compresive Strength of BLA Specimeus

- Compressive strength of 28 days curing with partial replacement of BSA to cement gives 25 N /mm^2 at 5% of ash replacement and it is observed that 20% of strength is decreased than conventional concrete.
- Compressive strength of 28 days curing with partial replacement of BLA to cement gives 26.20 N /mm^2 at 10% of ash replacement and it is observed that 17% of strength is decreased than conventional concrete.

Split tensile Strength test

Cylindrical specimens of diameter 150mm and length 300mm were prepared. Split tensile test was carried out on 2000 KN capacity compression testing machine as per IS 5816-1999. The tensile strength is calculated using the equation.

F=2P/ (π x D x L)
Where; F=> Split tensile stress in N/mm2
P=> Load at failure in N
D=> Dia of the cylindrical specimen in mm
L=> Length of the cylindrical specimen in mm

The average split tensile strength of various proportions is given in table.

Table 4 Split Tensile Strength of BLA & BSA Specimeus

% of BLA and BSA	7days N/mm²	28days N/mm²
L_5	2.35	2.54
L_{10}	2.10	2.65
L_{15}	1.85	2.24
S_5	2.53	2.65
S_{10}	2.19	2.35
S_{15}	2.01	2.12

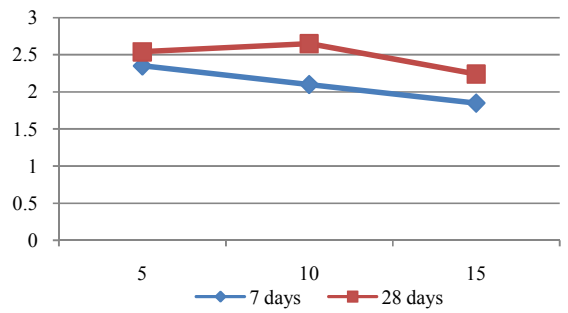

Figure 2

- Tensile strength of 28 days curing with partial replacement of BSA to cement gives 2.65 N/mm^2 at 5% ash replacement and it is observed that 44% of strength is decreased than conventional concrete.
- Tensile strength of 28 days curing with partial replacement of BSA to cement gives 2.65 N/mm^2 at 10% ash replacement and it is observed that 44% of strength is decreased than conventional concrete.

RESULTS AND DISCUSSION

Table 5

Materials	Characteristics	Result
Cement	Standard consistency	30%
	Initial setting time	150min
	Final setting time	300min
	Specific gravity	2.98
Fine aggregate	Specific gravity	2.6
	Sieve analysis	Zone- II
	Water absorption	1%
	Moisture content	Nil
Coarse aggregate	Specific gravity	2.7
	Sieve analysis	20mm down size
	Water absorption	0.6%
	Moisture content	Nil

CONCLUSION

- ✓ The use of bamboo stick ash as a partial replacement for cement in the concrete, the compressive strength of concrete is found to be increased at 5%.
- ✓ The split tensile strength of concrete was also found to be increased at 5% for the partial replacement of bamboo stick ash.
- ✓ The use of bamboo leaf ash as a partial replacement for cement in the concrete, the compressive strength of concrete is found to be increased at 10%.
- ✓ The split tensile strength of concrete was also found to be increased at 10% for the partial replacement of bamboo leaf ash.
- ✓ Hence the use of bamboo leaf ash as a supplementary for cement gives a good result.

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