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Replacement of Bananna Leaf Ash in Concrete

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Abstract - Concrete is one of the materials that are widely used in construction all around the world. This material is widely used because it has several benefits. The world is now concentrating on alternative material sources that are less harm full to the environment. The Banana Leaf Ash are agricultural waste. The Banana Leaf Ash (BLA) has potential to replace one of the construction material which is cement. The BLA contain pozzolanic reaction that usually occurs in Portland cement. Banana is one of the most well-known and useful plant in the world. Almost all the part of this plant that are, fruit, levees, flower bud, trunk and pseudo stem, can be utilized. It is inexpensive, renewable and environment friendly.

Key Words: *Concrete, Compressive Strength, Banana leaf ash, IS Codes and Environmental Problems.*

1.INTRODUCTION

Concrete is one of the materials that are widely used in construction all around the world. It is used to build schools, buildings, tunnels, apartments, bridges, and more. This material is widely used because it has several benefits such as, more durable, energy-efficient, low maintenance, affordability, fire-resistance, excellent thermal mass and also versatility. Concrete is consists of four different type of ingredients, that is course aggregate, fine aggregate, Portland cement, and also water. But concrete has its own disadvantages due to considerable brittleness, which results in poor fracture toughness, poor resistance to crack propagation, and low impact strength. Concrete is the one of the broadly used material in construction industry.

New developments continue in the application of concrete materials. There are many researchers used natural fiber as cementitious material to increase the concrete strength. The investigation has been carried out using several natural fibers as cementitious materials such as, bamboo, jute, banana, hemp and also rice husk. Nowadays, many studies had been done to utilize natural waste as cementitious material replacing Ordinary Portland Cement (OPC). For example, rice husk which have reactive pozzolanic properties. In this research, banana fiber ash was used as cementitious material to produced high strength concrete. Banana fiber ash has its own properties that can be found in stem itself. It has low density, appropriate stifffiess, high disposability, and renewable.

2. LITERATURE SURVEY

Neha Tirkey and G.B. Ramesh et. al, (2018) As an example use of plastic, glass and other many types of by products are used as a fiber in concrete mix. The main aim of mixing these types of constituents to concrete are to avoid crack, to maintain sustainability, to gain durability and to gain the flexural strength. This paper describes about the use of banana peel and its leaf being mixed with different grades of concrete which resulted in good tensile strength and with an amount of decrease in cement content. The compressive strength with fiber content 0.5% is higher than that of 1%. On average, specimen reinforced with 10mm fibers performed better, in both flexural and compressive strength compared to the unreinforced specimen. With fiber reinforcement the intensity of cracks development in the concrete is lesser than the conventional one. The split tensile strength is increased with the increment of fiber content in the concrete. Consequently, experimental work and sample size will be increased to validate these initial finding.

Banana leaf ash can be classified as pozzolanic material in civil engineering construction with several benefits such as lower cost and give equivalent reduction to environmental impact. The banana leaf ash has been proved to increase the strength of concrete and demonstrate pozzolanic activity by replacing 10% of banana leaf ash into the concrete (Rodrigo C.K , 2014).

Jugal R. Pawar and Aman S. Khaire etl. al, (2018) :This study was under taken to know the concrete properties using Banana Leaves ash. Concrete is one of the materials that is widely used in construction all around the world. This material is widely used because it has several benefits such as durable, energy-efficient, low maintenance, affordability, fire-resistance, excellent thermal mass and also versatility. The project deals with the comparative study of properties of concrete by using Banana Leaves Ash as a cementitious material in the concrete mix. The ash produced from various types of agricultural waste can be used effectively as a partial replacement of cement. Some researchers evaluated the presence of pozzolanic activity in the deriving ash of Banana Leaves. After burning dry leaves it gives 20% ash by its dry weight. Means if we dry 500 kg of fresh leaves and stems of banana tree, we will get 100 kg dry leaves and 20 kg of leaves ash. The BLA will be used in cement to replace about 0%, 15% & 25% respectively. As the percentage of BLA increases in the concrete the compressive strength attends the desired strength at 28 days for 15 % replacement with cement & decreases for 25 % replacement.The Flexural & Split Tensile strength increases for 15% replacement & slightly decrease for 25 % respectively as compare to normal mix. From the above graphs we can conclude that the Compressive, Flexural & Split tensile strength increases at 15 % replacement of cement with

BLA.The optimum percentage of cement for partial replacement with BLA is 15 %.

S.Sakthivel, R.Parameswari, M.Gomathi, and S.Sangeetha et. al, This experimental investigation was undertaken to know the concrete property by using Banana Leaf As and Banana leaf. Concrete is one of the materials that are widely used in construction all around the world. The BLA is used in cement to replace about different %. The usage of Banana leaf (BLA) to enhancing the properties of concrete. Concrete is good in compression and weak in tension. The leaf in concrete generally increases both compression and tension in concrete. In this experiment BF is added as a additional material for about 0.2%. To determine the strength of the concrete to produce good cementitious material by using BLA and to increase the tensile strength BF is added. The addition of Banana Leaf Ash slightly increases the compressive strength of the concrete in 2% and 6%. This gives clear idea about the replacement can done by the ash is successfully fulfill the cementitious properties. Addition of Banana fiber to the conventional mix by 0.2% increases the tensile strength of the concrete.

Chemical Properties of Cement			
Sr. No.	Common Name	Oxide	Composition % (Limit)
1	Lime	CaO	60-67
2	Silica	SiO2	17-25
3	Alumina	Al2O3	3-8
4	Iron Oxide	Fe2O3	0.5-6.0
5	Sulfur Trioxide	SO3	2.0-3.5
6	Magnesia	MgO	0.5-4.0
7	Alkalis	Na2O & K2O	0.3-1.2
8	Loss on ignition	---	1-2
9	Insoluble residue	---	0.5

Table -1: Chemical Properties of Cement

Fine aggregate: Aggregates which occupy nearly 70 to 75 percent volume of concrete are sometimes viewed as inert ingredients in more than one sense. However, it is now well recognized that physical, chemical and thermal properties of aggregates substantially influence the properties and performance of concrete. The fine aggregate (sand) used was clean dry sand was sieved in 4.75 mm sieve to remove all pebbles.

Coarse aggregate: Course aggregate is used for making concrete. They may be in the form of irregular broken stone or naturally occurring gravel. Material which is large to be retained on 4.75mm sieve size is called coarse aggregates. Its maximum size can be up to 40 mm.

Water: water plays an important role in the formation of concrete as it participates in a chemical reaction with cement. Due to the presence of water, the gel is formed which helps in increase of strength of concrete. Water used for mixing and curing shall be clean and free from injurious quantities of alkali's, acids, oils, salts, sugar, organic materials, vegetable growth or other substance that may be deleterious to bricks, stone, concrete or steel. Portable water is generally considered satisfactory for mixing. The pH value of water shall not be less than the following concentrations represent the maximum permissible values.

A. Limits of acidity: To neutralize 100ml sample of water, using phenolphthalein as an indicator, it should not require more than 5ml of 0.02 normal NaOH. The details of the test shall be as given in IS 3025.

B. Limits of alkalinity: To neutralize 100ml sample of water, using mixed indicator, it should not require more than 25ml of 0.02 normal H2SO4. The details of tests shall be as given in IS 3025.

C. Percentage of solids: Maximum permissible limits of solids when tested in accordance with IS 3025 shall be as under:

The physical and chemical properties of groundwater shall be tested along with soil investigation and if the water is not found conforming to the requirements of IS 456 – 2000, the tender documents shall clearly specify that the contractor has to arrange good quality water construction indicating the source.

A. Water found satisfactory for mixing is also suitable for curing. However, water used for curing shall not produce any objectionable stain or unsightly deposit on the surface.

B. Sea water shall not be used for mixing or curing.

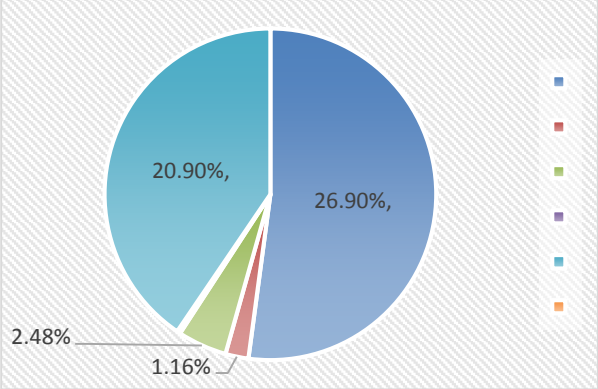
C. Water from each source shall be tested before the commencement of the work and thereafter once in every three months till the completion of the work. In the case of ground water, testing shall also be done for a different point of drawdown. Water from each source shall be got tested during the dry season before monsoon and again after the monsoon.

Banana leaf ash : Banana plants, which belong to the family of musaceae, are native to the Malaysia- Indonesian region of south-east Asia. Bananas are widely produced and abundant natural resources in tropical and subtropical countries in the world. The banana plants are considered as one of the world's most useful plants. Almost all the parts of this plant. For example, fruit, peel, leaf, pseudeo-stem, stalk, and inflorescence (flower), can be utilized. They are used in several food and non-food-related application, for example as thickener, colorant and flavoring, macro- and micro-nutrient source, livestock feed, fibers, bioactive compound source, and organic fertilizers. The banana leaf is frequently used in food processing (in some countries, e.g. Indonesia), food esthetic, food packaging, etc. the extraction process is conducted as soon as the pseudo-stem's leaves are cut. Banana leaf ash is an agricultural waste that as potential to replace one of the construction material which is cement. Because it contains a pozzolanic reaction that usually occurs in Portland cement. This ash as a potential to improve the performance of the concrete.

Fig -1: Figure

Composition of Banana Stem Fiber:

Sr. No.	Constituents	Percentage
1	Silicon dioxide	26.97%
2	Iron oxide	2.48%
3	Aluminum oxide	1.16%
4	Sodium oxide	0.17%
5	Loss of ignition	20.94%



3. TEST CONDUCTED

A. Test Conducted On Cement :

a. Fineness Test: Fineness of cement is property of cement that indicate particle size of cement and specific surface area. And indirectly effect heat of hydration.

b. Consistency Test: The standard consistency of a cement paste is defined as that consistency which will permit the vicat plunger to penetrate to a point 5 to 7mm from the bottom of the vicat mould.So, "consistency" means how much amount of water added to the cement.

c. Initial Setting Time: Setting time is the time required for stiffening of cement paste to a defined consistency. Indirectly related to the initial chemical reaction of cement with water to form aluminum-silicate compound. Initial setting time is the time when the paste starts losing its plasticity.

d. Final Setting Time: Final setting time is the time when the paste completely loses its plasticity. It is the time taken for the cement paste or cement concrete to harden sufficiently and attain the shape of the mould in which it is cast.

e. Specific Gravity: The specific gravity is normally defined as the ratio between the weight of a given volume of material and weight of an equal volume of water. The portland cement have a specific gravity of value around 3.15

f. Density of cement: Density is simply a mass to volume ratio. Some people considering concrete counter tops may wonder if lightweight concrete should be used to minimize stress on the cabinetry and flooring below. But with standard counter top thickness of 1.5 inches, normal weight concrete weighs about 18 lbs.

g. Soundness: The ability of cement to retain its volume after it gets hardened is known as Soundness of Cement. ... The test conducted to identify the excess amount of lime in cement is known as soundness test of cement.

B. Test Conducted On Sand

a. Fineness modulus of sand: Fineness modulus of sand (fine aggregate) is an index number which represents the mean size of the particles in sand. It is calculated by performing sieve analysis with standard sieves. The cumulative percentage retained on each sieve is added and subtracted by 100 gives the value of fineness modulus.

b. Bulking Density: Bulking of Sand Significance. In simplified terms, it can be said that bulking of sand is simply the looseness of soil without compacting. Usually, water reduces the pores in sand and compacts the sand. Sand is used in concrete for reduction of segregation and fill out the pores between cement and coarse aggregates.

c. Specific gravity: Specific gravity of fine aggregate (sand) is the ratio of the weight of given volume of aggregates to the weight of equal volume of water. The specific gravity of sands is considered to be around 2.68 .

C. Test Conducted On Coarse Aggregate

a. Impact value: The aggregate impact value is a measure of resistance to sudden impact or shock, which may differ from its resistance to gradually applied compressive load.

b. Crushing test: The strength of coarse aggregates is assessed by aggregates crushing test. The aggregate crushing value provides a relative measure of resistance to crushing under a gradually applied compressive load. To achieve a high quality of pavement, aggregate possessing low aggregate crushing value should be preferred.

c. Fineness modulus: Fineness modulus of coarse aggregates represents the average size of the particles in the coarse aggregate by an index number

d. Bulk density: Bulk density of aggregates is the mass of aggregates required to fill the container of a unit volume after aggregates are batched based on volume. It depends on the packing of aggregate i.e. Either loosely packed aggregates or well dense compacted aggregates.

e. Specific gravity: It is formally defined as the ratio of the mass of a unit volume of aggregate, including the water permeable voids, at a stated temperature to the mass of an equal volume of gas-free distilled water at the stated temperature. Bulk Saturated Surface Dry (SSD) Specific Gravity.

SR. NO.	TEST	RESULT OPTAINED	STANDARD VALUE AS PER IS2386
1.	Impact value	7.23%	Not more than 45%
2.	Crushing test	17.29%	Not more than 45%
3.	Fineness modulus	6.9	6.5 TO 8
4.	Bulk density	1.29kg/lit	1.2 TO 1.8kg/lit
5.	Specific gravity	2.72	2.62 TO 2.8

4. MIX DESIGN

Mix proportion	M15 (1:2:4)
Type of cement	PPC
W/C Ratio	0.5

5. OBSERVATION

- Size of cube = 150mmx150mmx150mm
- Mix proportion = M15
- Area of specimen= 150x150mm
- Duration of testing = 7 & 28 days
- Percentage of leaf ash = 0%, 5%, 10%, 15%,20%

1. Compressive strength:

Compressive Strength test was done according to IS: 456. Compression is the most common test conducted on hardened concrete partly because it is an easy test to perform. The cube specimen is of size (15x15x15) cm. the largest size of aggregate does not exceed 20mm, 10cm size cubes may also be used alternative the compressive strength test specimen. Determine following formula:

Compressive Strength (MPa) = Load carried in N /Bearing area in mm^2

Ash%	7 day	28 day
0%	8.35 N/mm2	16.2 N/mm2
5%	8.67 N/mm2	17.10 N/mm2
10%	9.05 N/mm2	16.55 N/mm2
15%	8.45 N/mm2	16.25 N/mm2
20%	8.05 N/mm2	15.68 N/mm2

6. CONCLUSIONS

Result shows that upto 15% replacement of banana leaf ash the overall strength of concrete is gradually increased as compare to the plain concrete At 20% strength is decreased as compared to plain concrete. The cracking resistance of the concrete has also improved to a greater extent. As per results it shows that the replacement of banana leaf ash upto 15% is considerable.

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The heading should be treated as a 3rd level heading and should not be assigned a number.

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