International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 03 | Mar 2019 www.irjet.net p-ISSN: 2395-0072

A STUDY ON THE MECHANICAL PROPERTIES OF BANANA STEM ASH CONCRETE MADE USING STRAW DIPPED WATER

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Abstract - *The project describes about the experimental study on the use of banana stem ash in replacement to Cement, by a percentage, to enhance the strength. Our Growing Society needs a sustainable technique to efficiently and effectively reinforce the building elements.We aim an outcome of valuable product using the waste dumped from agri-process. The ashof natural fibres have excellent physical and mechanical properties and can be utilized more effectively. They are economical, since waste management and birth of new entity goes hand-in-hand. We came out with the new inclusion in concrete mixture (i.e.) Straw dipped water instead of normal water.Usage of Straw dipped water enumerates the innovation.The indispensability of straw water as one of the concrete ingredients is, to develop a bacterial concrete of M25 grade and it act as a retarding agent in the concrete hardening stage. When straw is dipped into water, it develops a bacterial colony in its medium. And when mixed in right proportions, it develops a M25 grade bacterial concrete. It shows hump of advantages in new mix than conventional mix such as high strength, high load bearing capacity, crack sealing capacity*

***Key Words*: Concrete - Banana Stem Ash (BSA) - Straw dipped Water - Retarding Agent - Bacterial Concrete.**

1. INTRODUCTION

Concreting is an important step in all the works of Civil Engineering such as from building blocks to bridges and from pavements to highway lanes. It is used to enhance the strength of building elements. Nowadays, there are various types of concrete evolving overnight. In this project, we aim at producing an economic, innovative and sustainable product in concrete. We include the term "SUSTAINABLE" as we used only the ash-waste dumped in the Banana farms. We know that ash generally has pozzolanic property and it can be used optimizingly in replacement to cement in percentages. An important need why we laid down on this project is, the usage of straw dipped water as a replacement to normal water. When we dip rice straw in water, it tend to cultivate bacteria in its medium, which inaddition paves way to add-on strength, durability, self healing property in concrete. We used that medium of water as a hydrating agent, batched the ingredients, mixed in correct proportions, casted, to develop a concrete cake of M25 grade. The cement was replaced by an amount of 5%, 10%, 15%, 20% and the strength parameters of fresh concrete and hardened concrete were studied.

2. MATERIALS USED

2.1 Cement

Ordinary Portland Cement of 53 Grade conforming to IS: 12269-1987 is used. It is a prime core binding agent with high pozzolanic property.

Table -1: Properties of cement

PARTICULARS	TEST RESULTS
CONSISTENCY TEST	32%
SPECIFIC GRAVITY	3.15
INITIAL SETTING TIME	30min
FINAL SETTING TIME	600min

2.2 Aggregate

Manufacturing Sand (M-Sand) of maximum sieve size 4.75mm in right quantity is used as a fine aggregate (FA). Coarse aggregate(CA) passing through 25mm sieve size and retained on 20mm sieve size is used in proper proportion.

Fig-1: Coarse Aggregate

Table -2: Properties of Aggregate

PARTICULARS	TEST RESULTS	
	FA	CA
FINENESS MODULUS	3.196	4.82
SPECIFIC	2.67	2.85

GRAVITY		
WATER ABSORPTION	0.9%	0.6%

2.3 Banana Stem Ash (BSA)

Banana Stem Ash (BSA) of Specific Gravity 2.50 is used as replacement material to cement by small amount. It is obtained as a residue of burnt out waste which is dumped in banana farm lands.

Fig-2: Banana Stem Ash

2.4 Straw Dipped Water

Rice Straw when dipped in water and conserved for about 7 to 28 days, it generates bacterial growth. Such medium of water with pH value - 7.2 conforming to IS 456:2000, is used. The presence of Bacterial colonies such as:Cupriavidus, Acinetobacter tandoii, Citrobacter freundii is confirmed.

Fig-3: Straw Water

3. METHODOLOGY

3.1 Collection of Materials

Materials such as Cement, Aggregates, Rice Straw, Banana Stem Ash(BSA) is collected. BSA is collected from Banana farm lands immediately after the entire harvesting season ends. They are cut using cutters & pressed into grounds using heavy weight rollers.Later,dried, fired to get ash residues.

3.2. Preparation of Straw Water

Rice Straw collected from agri lands are dipped into water and then conserved for about 7 to 28 days. It is done to culture bacterial colonies. This water looks brownish and it has mineral content of rice straws.

3.3. Proportioning Of Materials

Selection of suitable ingredient to the mix and calculating their relative proportions is important. Therefore, the concept 'Mix Design' which governs all the above said facts is very much essential. Mix design which decides the proportioning of materials to achieve a homogeneous and workable concrete.
As per IS: 10262-2009, the data of following table is stipulated.

Table -3: Mix design Parameters

PARAMETERS	CEMENT	FINE AGGREGATE	COARSE AGGREGATE
STANDARD MIX RATIO (M25)	1	1	2
DERIVED MIX RATIO (M25)	0.45	0.45	0.9
UNIT WEIGHT OF QUANTITIES	648 Kg/m^3	711 Kg/m^3	1341Kg/m^3

Fig-5: Materials Proportioned

3.4. Casting of Specimen

The concrete is first casted for SlumpCone testing. It is done to arrive at suitable W/C ratio to achieve greater workability. Then, we casted the Conventional and BSA replaced concrete cubes and cylinders.Totally we casted 3cubes each for 7th day and 28th days testing and 1cube for 14th day testing at every % replacement..To obtain tensile strength of the concrete,we casted 3 cylinders for 28th day testing at each percentage replacements.Following table lists out the quantity of materials used in the casting:

Table-4: Batching of Ingredients

Description	Cement (kg)	BSA (kg)	Fine aggregate (kg)	Coarse aggregate (kg)
0%				
Cube	15.33	-	16.80	31.71
Cylinder	10.32	-	11.34	21.33
Beam	9.72	-	10.68	20.10
5%				
Cube	14.565	0.765	16.80	31.71
Cylinder	9.804	0.516	11.34	21.33
Beam	9.234	0.486	10.68	20.10
10%				
Cube	13.80	1.53	16.80	31.71
Cylinder	9.29	1.03	11.34	21.33
Beam	8.748	0.972	10.68	20.10
15%				
Cube	13.04	2.29	16.80	31.71
Cylinder	8.77	1.55	11.34	21.33
Beam	8.26	1.46	10.68	20.10
20%				
Cube	12.27	3.06	16.80	31.71
Cylinder	8.26	2.06	11.34	21.33
Beam	7.78	1.944	10.68	20.10

Fig-4: Casting the Mould

3.5. Fresh Concrete Tests

The fresh concrete is tested for Consistency and Workability.Tests carried out are Slump Cone test, Flow table test, Compaction Factor test, Veebee Consistometer test.

Table -5: FreshConcrete Test Results

PARAMETER	RESULT
Slump | W/C Ratio	6cm | 0.50
Compaction Factor	0.89
Vee-Bee Consistency	6 sec
Flow Percent	90%

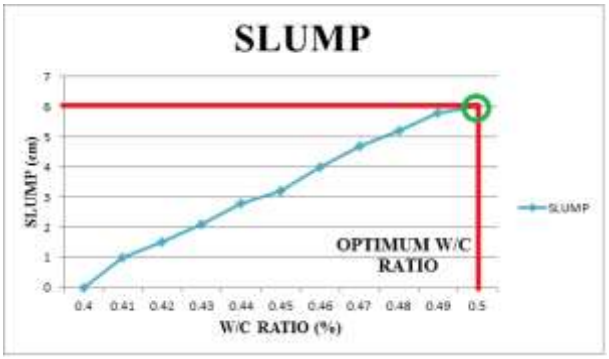


Fig-6: Slump Test graph

3.6 Curing

Wetting of Concrete is much essential, as curing helps in gaining strength to concrete. Curing of Concrete is done with intense care by immersing the specimens completely in curing tank for about 7days minimum to 28days maximum.

Fig-7: Curing the Specimen

3.7 Hardened Concrete Tests

The tests carried out on hardened concrete are Compressive strength test and Split tensile strength test.It is done to determine the compressive strength, tensile strength and flexural strength of specimens respectively.

Table -6: Mean Compressive strength test results

% BSA	COMPRESSIVE STERNGTH (MPa)		
	7days	14days	28days
0%	16.4	21.9	24.9
5%	18.3	25.5	33.5
10%	18.08	22.9	27.5
15%	15.9	20.9	23.2
20%	11.6	14.8	17.27

Fig-8: Compression Testing

Table -7: Mean Split tensile strength test results

% BSA	SPLIT TENSILE STRENGTH IN MPa
	28 days
0%	2.49
5%	2.7
10%	2.46
15%	2.16
20%	2.08

Fig-9: Split Tensile Testing

Table -8: Mean flexural strength test results

ASH REPLACEMENT	FLEXURAL STRENGTH IN MPa
	28 days
0%	1.09
5%	1.30
10%	1.24
15%	1.17
20%	1.01

Fig-10: Flexural Testing

4. COMPARISON OF STRENGTH RESULTS

4.1 Comparison of Compressive Strength

Compressive Strength results shows greater variation between conventional concrete and BSA replaced concrete.

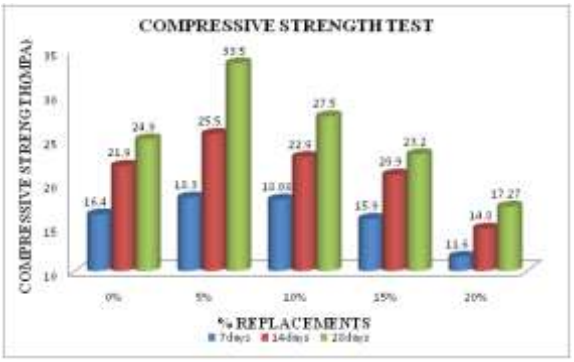


Fig-11: Compressive Strength Test Graph

4.2 Comparison Of Split Tensile Strength

Tensile strength is also one of the important factor involved in testing concrete specimen. Concrete is prone to cracking due to the main reason that, it is weaker in tension zone.So, we need to estimate the tensile load it can bear to the maximum.

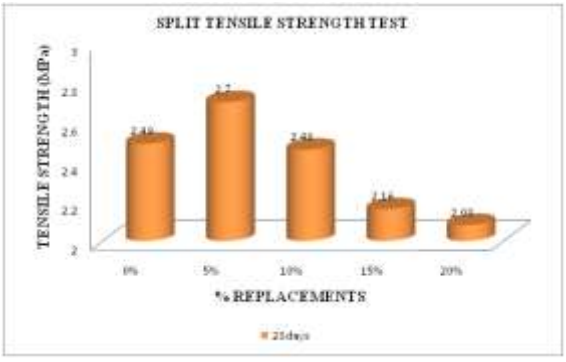


Fig-12: Split Tensile Strength Test Graph

4.3 Comparison of Flexural Strength

Flexural strength plays another important role in concrete's mechanical properties. It determines the ability of the concrete upto which it can withstand the loads as the loading at different points leads to bending in beam.

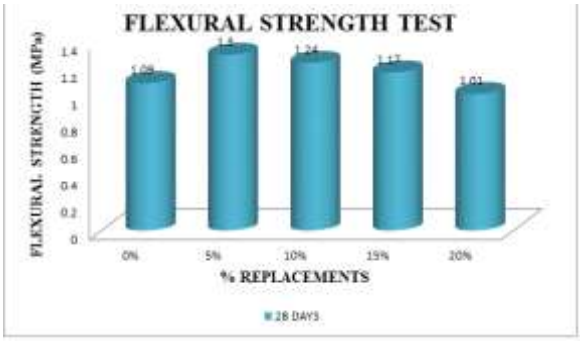
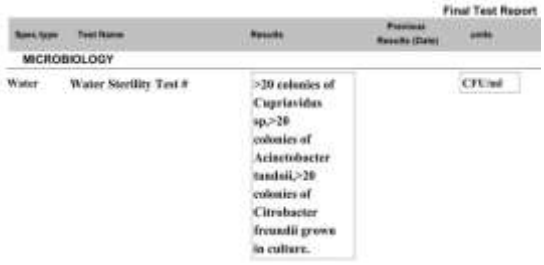


Fig-13: Flexural Strength Test Graph

4.4 Microbiological Test

The main theme of our study is to invocate bacteria into concrete without the usage of any chemical or biological reagents.So we landed in an idea of using Straw Water. When Rice straw is dipped completely into the water and kept for few days, it generate bacteria. Those bacteria which are grown naturally under room temperature is impregnated into the Concrete specimen when mixing water into the ingredients while casting.
The Bacterial growth in the medium is as follows as per the lab report given by Microbiology Lab.



Final Test Report

MICROBIOLOGY				
Water	Water Sterility Test #	>20 colonies of Cupriavidus sp.,>20 colonies of Acinetobacter tandoii,>20 colonies of Citrobacter freundii grown in culture.		CFU/ml

Fig-14: Microbiology Lab Report

These bacterial colonies helps in calcite formation.The calcite formation helps in forming limestone which is generally the most useful compound in hydration process. When cracks proliferate, it acts as binding agent and seals cracks.

5. CONCLUSIONS

The Project enumerates the comparision between the strength results of conventional and BSA replaced Concrete.The replacements were 5%, 10%, 15%, 20%. The strength results are as follows:

The optimum percentage of BSA in replacement to Cement is 5%.

The safe percentage of BSA in replacement to Cement is 10% as the strength parameter is not compromised when compared to M25 grade results.

The Compressive strength of BSA(5%) concrete increases by 1.345 times than normal M25 grade concrete.

The Tensile strength of BSA(5%) concrete increases by 1.08 times than conventional M25 grade concrete.

The breaking load of Concrete while doing Compression testing is higher, which shows that BSA concrete hydrated using Straw dipped Water gives more resistance to compressive loads.

It shows that it can withstand high compressive loads.
The phosphate in straw water makes it to act as a retarding agent, therefore the concrete setting and hardening time is delayed.

The bacterial colonies in straw water fits BSA Concrete to act as a bacterial concrete which brings another advantage i.e., an automatic crack sealing capacity.

On the whole, 'BSA replaced concrete using Straw dipped water' proves to be an economical, sustainable, innovative and durable solution to prevailing problems of the industry.

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