International Journal of Research in Engineering, Science and Management
Volume-3, Issue-2, February-2020
www.ijresm.com | ISSN (Online): 2581-5792

Experimental Investigation on Concrete by Using Babool Tree Leaves

A. M. Arunmohan[1], C. Santha Kumar[2], R. Vasanth[3]
[1]*Assistant Professor, Department of Civil Engineering, Sethu Institute of Technology, Kariapatti, India*
[2,3]*UG Student, Department of Civil Engineering, Sethu Institute of Technology, Kariapatti, India*

***Abstract*: With increasing demand and consumption of cement, researchers and scientist are in search of developing alternate binders that are eco-friendly and contribute towards waste management. The utilization of industrial and agricultural waste produced by industrial processes has been the focus on waste reduction. One of the agro waste babool tree leave's ash which is a waste product obtained from babool tree. Then ash produced by burning babool tree leaves in uncontrolled condition and at very high temperature.**

***Keywords*: Utilization, Agro Waste, High temperature.**

1. Introduction

Portland Pozzolona Cement concrete is a mixture of Portland Pozzolona cement, aggregates and water. Concrete is the most often used construction material. Due to increase in infrastructure developments, the demand for concrete would increase in the future. We know that the cement is conventionally used as the primary binder to produce concrete. The environmental issues associated with the production of Portland Pozzolona cement (PPC) are the climatic change due to global warming. He global warming is caused by the emission of greenhouse gases, such as carbon-di-oxide CO_2, to the atmosphere by human activities. The cement industry is responsible for about 6% of all CO_2 emissions, because the production of one ton of Portland Pozzolona cement emits approximately one ton of CO_2 into the atmosphere. In order to address the environment effect associated with the Portland Pozzolona cement, there is a need to use other binders to make concrete. Although the use of Portland Pozzolona cement is still the foreseeable future, many effects are being made in order to reduce the use of Portland Pozzolona cement in concrete. These effects include the utilization of supplementary cementing materials such as babool tree leaves ash. In this respect, the babool tree materials ash considerable promise for application in concrete industry as an alternative binder to the Portland Pozzolona cement. In terms reducing the global warming and water absorption, the babool tree ash could reduce the CO_2 emissions to the atmosphere caused by cement, aggregates and babool tree ash in industries by about 80%. In the light of the above, the project was focused the development of mixture proportions, the manufacture of cement with babool tree material ash as initially and partially in concrete the effect of main parameters on the short term engineering properties of fresh and hardened concrete.

2. Objectives and scope

1. The use of babool tree material's ash as a replacement for cement in concrete offers many advantages and little cost.
2. The small size of the ash particles is a key to producing smooth cement paste, allowing better bonding between aggregate and cement and resulting.
3. The spherical shapes of the particles increase the concrete workability.
4. In the presence of water, ash will harden and gain strength over time.

Durability is the ability to withstand long time exposure without significant deterioration. A durable material helps the environment by conserving resources and reducing wastes and the environmental impacts of repair and replacement. Construction and demolition waste contribute to solid waste going to landfills. The production of new building materials depletes natural resources and can produce air and water pollution. Durability of concrete may be defined as the ability of concrete to resist weathering action, chemical attack and abrasion while maintaining its desired engineering properties. Different concrete requires different degree of durability depending on the exposure environment and property desired. For example, concrete exposed to tidal seawater will have different than an indoor concrete floor.

3. Materials and testing

A. Babool leaves ash

One of the agro waste babool tree leave's ash which is a waste product obtained from babool tree. Then ash produced by burning babool tree leaves in uncontrolled condition and at very high temperature.

B. Cement

In this study Portland Pozzolona Cement (PPC) grade 43 has been used throughout, conforming to IS 8112:1989 (20) standards. The Mechanical properties of cement were studied as follows.

Table 1
Fineness Modulus of BLA

Is sieve size (mm)	Weight Retained on each sieve (gm)	Cumulative Weight Retained (gm)	Cumulative % Weight Retained	Cumulative % Passing
4.75	-	-	-	-
2.36	70.00	70.00	3.50	96.50
1.18	98.00	168.00	8.40	91.60
600µ	985.50	1153.50	57.68	42.33
300µ	726.50	1880.00	94.00	6.00
150µ	95.00	1975.00	98.75	1.25
Pan	25.00	2000.00	100.00	0.00
Fineness Modulus			2.62%	

Fig. 1. Cement

Specific Gravity of Cement:

Weight of Empty Density bottle, W_1 = 34g
Weight of Density bottle + Water, W_2 = 54g
Weight of Density bottle + Kerosene, W_3= 87.7g
Weight of Density bottle + Cement + Kerosene, W_4 = 75.7g

$$\text{Specific gravity of cement} = \frac{(W2-W1)}{GL((W4-W1)-(W3-W2))}$$

$$= \frac{(54-34)}{0.79((75.7-34)-(87.7-54))}$$

Specific gravity of cement = 3.15

Fineness test on Cement:

Fineness of cement has an important bearing in the rate of hydration and the hence the rate of gain strength.

Table 2
Fineness test by sieve analysis

S.No.	Observation	Trial -1	Trial – 2	Trial - 3
1	Weight of cement (w_1) kg	100	100	100
2	Weight of residue (w_2) kg	8	7	8
3	Fineness modulus (w_1/w_2)kg	8%	7%	8%

The percentage of residue left on the IS 90µ sieve is 7.67%. Since this value is less than 10%.

Table 3
Initial setting time

S.No.	Time(min)	Initial Reading (mm)	Final Reading (mm)	Height penetrated from top (mm)
1	0	0	0	0
2	10	0	0	0
3	20	0	0	0
4	30	0	5	5

Therefore, the initial setting time of cement is 30 min.
The consolidated test results of the cement are tabulated below.

Table 4
Test Results of PPC

S. No.	Tests	Results Obtained
1	Specific Gravity	3.15
2	Fineness Modulus	7.67%
3	Normal Consistency	36%
4	Initial Setting Time	30min

C. *Aggregates*

The aggregate in the matrix or principal structure consists of relatively inert, fine and coarse materials. The aggregate for concrete varies in sizes, but in any mix the particles of different sizes are used. The particle size distribution is called the grading of the concrete. While producing the good quality concrete, the aggregate is used at least from two sizes group.

D. *Fine aggregate*

IS 383: 1963(21) destines the fine aggregate is the aggregate which will pass through the 4.75mm IS Sieve. The fine aggregate is often termed as sand size aggregate.

Fig. 2. Fine aggregate

E. *Specific Gravity*

Specific gravity of fine aggregate is used in design calculations of the concrete mix. If the specific gravity of each constituent is known, its weight can be converted into solid volume and hence a theoretical yield of concrete per unit volume can be calculated. Average specific gravity of the fine aggregate varies from 2.6 to 2.8

Weight of empty pycnometer, W_1 = 650g
Weight of pycnometer + sand, W_2 = 1291g
Weight of pycnometer + sand + water, W_3 = 1897.3g
Weight of pycnometer + water, W_4= 1503.7g

$$\text{Specific gravity of F.A} = \frac{(w2-w1)}{(w2-w1)-(w3-w4)}$$

$$= \frac{(1291-650)}{(1291-650)-(1897.3-1503.7)}$$

=2.59

F. Fineness modulus of FA

Sieve analysis is the name to the operation for dividing the sample into the various fraction each consisting of particles of the same size. The sieve analysis is conducted to determine the particle size distribution in sample of aggregate, which is called graduation. In this a term known as "FINENESS MODULUS" is being used. The fineness modulus is the numerical index of fineness, giving some ideas of the mean size of the particle present in the entire body of the aggregate. To determine the graduation of fine aggregate 1KG of sample is taken and the sieve analysis is carried out. The results obtained are tabulated below.

Table 5
Sieve Analysis of FA

Is Sieve Size	Weight Retained on Each sieve (gm)	Cumulative Weight retained (gm)	Cumulative % Weight Retained	Cumulative % Passing
4.75mm	6	6	0.6	99.4
2.36mm	84	90	9	91
1.18mm	240	330	33	67
600µ	482	812	81.2	18.8
300µ	183	995	99.5	0.5
150µ	5	1000	100	0
Pan	-	-	-	-
Fineness Modulus			2.23	

Fineness Modulus of FA = 2.23%

Table 6
Test Results for FA

S.No.	Tests	Results Obtained
1	Specific Gravity	2.59
2	Fineness Modulus	2.23%

G. Coarse aggregate

Coarse aggregate shall consist of crushed or broken stones which is hard, strong, dense, durable, clean, proper gradation and free from coating likely to prevent proper adhesion of mortar. The aggregate shall generally be cubical in shape as far as possible flaky, elongated pieces are avoided. Unless special stones in particular quarries are mentioned in special provisions. Aggregate shall be broken from the best trap granite quarry atones in that order available in the region and approved by the engineer.

Fig. 3. Coarse Aggregate

Specific gravity of CA:

Weight of dry pycnometer, W_1 =650g
Weight of pycnometer + sand, W_2 = 1301g
Weight of pycnometer + sand + water, W_3 = 1921.3g
Weight of pycnometer + water, W_4 = 1507g

Specific gravity of CA $= \frac{(w2-w1)}{(w2-w1)-(w3-w4)} = 2.75$

H. Fineness modulus of CA

Table 7
Fineness Modulus of CA

IS Sieve Size (mm)	Weight Retained on Each sieve (gm)	Cumulative weight retained (gm)	Cumulative % weight retained	Cumulative % Passing
40	-	-	-	-
20	700	700	70	30
16	276	976	97.6	2.4
12.5	24	1000	100	0
10	-	-	-	-
Pan	-	-	-	-

Fineness modulus of CA =1.68

I. Mix design

Mix Design for M_{30} Grade Concrete:
Design Stipulations:
Characteristic compressive strength required =30N/mm²
In the field at 28 days
Maximum size of aggregate=20mm
Degree of workability = Medium (slump test)
Degree of quality control = Good
Type of exposure = Mild
Minimum cement constant = 300kg/mm³
Test data for Materials:
Cement used – Portland Pozzolona Cement satisfying the requirement's of
IS 269: 1976 (PPC)
Specific gravity of Cement =3.15
Specific gravity of CA=2.75
Specific gravity of FA=2.59
Target Mean Strength of Concrete:
Tolerance factor =1.65
Standard deviation =5
Target mean strength of concrete= fck+ts
=30+(1.65*5)
=38.25Mpa

Selection of water and sand content:
From code book IS456:2000, table:5
Water cement ratio=0.45
Selection of water content:
From code book IS10262:2009
Water content per cubic meter of concrete =186kg
Determination of Cement Content:
Water cement ratio =0.45
Water content =186kg/m³
Cement =413.3kg/m³
Determination of FA:
As per IS10262-2009, Table-3
Volume of CA=0.62

Volume of FA=1-0.62
Volume of concrete(a)=1m^3
Volume of cement(b)=(mass/specific gravity)*(1/1000)
=(413.3/3.15)*(1/1000)
= 0.131m^3
Volume of water (c)= (186/1)*(1/1000)
=0.186m^3
Volume of all aggregate (e)= a-(b+c)
=1-(0.131+0.186)
=0.683m^3
Mass of CA = (Mass of CA* specific gravity of CA
= (0.683*0.62*2.75*1000)
=1164.5 kg
Mass of FA = (Mass of FA* specific gravity of FA*1000)
= (0.683*0.38*2.59*1000
=672.21 kg
Consolidate results are given below.

4. Experimental investigation

A. General

The following tests were conducted to study the strength properties of hand mixed concrete exposed normal atmospheric curing. The compressive strength test was conducted at the age of 7 days, 14 days & 28 days and the results were compared with theoretical values obtained from Indian Standards for ordinary control concrete of grade M_{30}.

B. Compressive strength test

The compressive strength was conducted in accordance with BIS 516:1959 methods of test strength of concrete. The tests were done at the end of 7th day, 14th day and 28th day curing period to study the gradual attainment of strength of babool tree ash concrete. These cubes were tested in each curing period. The size of cube specimen is 150mm x 150mm.

Fig. 4. Cube and cylinder during testing

C. Compressive strength of Cube

The compressive strength of 30.3N/mm² was obtained at 0% replacement and it was increased by 3% in 5% replacement and 5% decrease in 10% replacement and 22 % decrease in 20% replacement at 28 days of curing age. Although it is seen that we can replace the cement up to 5% to get the desired strength of concrete.

Table 8
Compressive strength of Concrete for M30 at 7 days

Grade of concrete Cube	Proportion	Weight (kg)	Load (kn)	Area (mm^2)	Compressive strength (n/mm^2)	
M30	0%	8.3	473	22500	21	20.6
		8	447		19.9	
		8.1	454		20.2	
M30	5%	8	470	22500	20.9	21.3
		8.5	486		21.6	
		8.1	482		21.4	
M30	10%	8.7	450	22500	20	19.9
		8.3	453		20.1	
		8.5	441		19.6	
M30	20%	8.1	325	22500	14.4	14.5
		8	347		15.4	
		8.1	310		13.8	

Table 9
Compressive Strength of Concrete for M30 at 14 days

Grade of concrete Cube	Proportion	Weight (kg)	Load (kn)	Area (mm^2)	Compressive strength (n/mm^2)	
M30	0%	8.3	548	22500	24.4	25.2
		8.1	589		26.2	
		8.1	563		25	
M30	5%	8.2	572	22500	25.4	26.1
		8.7	603		26.8	
		8.3	587		26.1	
M30	10%	8.3	496	22500	22	23.2
		8.1	537		23.9	
		8	532		23.6	
M30	20%	8.2	432	22500	19.2	19.9
		8.5	449		19.9	
		8.7	461		20.5	

Table 10
Compressive Strength of Concrete for M_{30} at 28 days

Grade of concrete Cube	Proportion	Weigth (kg)	Load (kn)	Area (mm^2)	Compressive strength (n/mm^2)	
M30	0%	8.5	689	22500	30.6	30.3
		8.3	685		30.4	
		8	676		30	
M30	5%	8.2	716	22500	31.8	31.2
		8.6	709		31.5	
		8.7	682		30.3	
M30	10%	8.4	650	22500	28.9	28.7
		8	639		28.4	
		8.9	647		28.8	
M30	20%	8.3	530	22500	23.6	23.5
		8.1	518		23	
		8	535		23.8	

Table 11
Comparison of Compressive strength of Concrete M_{30} **grade**

Proportion	Compressive Strength of Concrete		
Curing Age	7 days	14 days	28 days
0%	20.6	25.2	30.3
5%	21.3	26.1	31.2
10%	19.9	23.2	28.7
20%	14.5	19.9	23.5

D. Compressive strength of Cylinder

The compressive strength of 30.3N/mm² was obtained at 0% replacement and it was increased by 3% in 5% replacement and 5% decrease in 10% replacement and 22 % decrease in 20%

International Journal of Research in Engineering, Science and Management
Volume-3, Issue-2, February-2020
www.ijresm.com | ISSN (Online): 2581-5792

replacement at 28 days of curing age. Although it is seen that we can replace the cement up to 5% to get the desired strength of concrete.

Table 12
Compressive strength of Concrete for M_{30} at 7 days

Grade of concrete Cylinder	Proportion	Weight (kg)	Load (kn)	Area (mm^2)	Compressive strength (n/mm^2)	
M30	0%	12.3	365	17671.5	20.7	21.1
		12	371		20.9	
		12.1	384		21.7	
M30	5%	12.5	385	17671.5	21.8	21.5
		12.5	373		21.1	
		12.1	382		21.6	
M30	10%	12.7	345	17671.5	19.5	19.9
		12.3	363		20.5	
		12.5	352		19.9	
M30	20%	12.1	285	17671.5	16.1	14.9
		12	232		13.1	
		12.1	273		15.4	

Table 13
Compressive strength of Concrete for M_{30} at 28 days

Grade of concrete Cylinder	Proportion	Weight (kg)	Load (kn)	Area (mm^2)	Compressive strength (n/mm^2)	
M30	0%	12.3	541	17671.5	30.6	30.3
		12	562		31.8	
		12.1	546		30.9	
M30	5%	12.5	567	17671.5	32.1	31.3
		12.5	553		31.3	
		12.1	539		30.5	
M30	10%	12.7	525	17671.5	29.7	29.7
		12.3	520		29.4	
		12.5	533		30.1	
M30	20%	12.1	420	17671.5	23.8	23.5
		12	412		23.3	
		12.1	407		23.3	

5. Conclusion

From the present investigation on the Effect of Experimental Investigation on Concrete by Using Babool Tree Leaves, the following conclusions have been made:

- The Results encourage the use of Babool Tree Leaves ash with concrete for Partial Replacement in the mixing of concrete.
- Hereby, I conclude that, by adding Babool Tree Leaves ash of 5%, 10% and 20% in concrete for the replacement of fine aggregate, the compressive strength will be increased.
- The 5% replacement of Babool Tree Leaves ash give better results than other percentage of replacement.
- Using Babool Leaves Ash as fine aggregate in concrete can reduce the material cost in construction and in decrease in Global warming.

Acknowledgement

The first author thanks Assistant Professor Dr. A. M. Arun Mohan of Sethu Institute of Technology who provided insight and expertise that greatly assisted his research. He also thanks his students from Sethu Institute of Technology for developing this paper.

References

[1] Aiswarya V. S. “Palm Oil Fuel Ash as Partial Replacement of Cement in Concrete,” March 2017.
[2] Amar. R, “An Experimental Investigation On Utilization of Waste Foundry Sand and Granulated Blast Furnace Slag as Partial Replacement to Sand in Fly Ash Bricks,” February 2015.
[3] Arvind Singh Gaur, “Effect of Partial Replacement of Cement by Ground – Granulated Blast- Furnace Slag and Fine Aggregate by Marble Slurry On Properties of Concrete,” 2017.
[4] P. Ashok Kumar, “Experimental Study On Partial Replacement of Cement by Coconut Pith Ash in Concrete,” March 2016.
[5] V. N. Dwivedi, “A New Pozzolanic Material for Cement Industry: Bamboo Leaf Ash,” November 2006.
[6] D. Gowsika, “Experimental Investigation of Egg Shell Powder as Partial Replacement with Cement in Concrete,” August 2014.