

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 8, August 2019

Experimental Study on Strength Behaviour of Herbocrete Concrete

Dr. T. Siva Sankar Reddy¹, Mrs. P. Nirupama²

Professor, Guru Nanak Institutions Technical campus Ibrahimpatnam, Hyderabad, India¹

Assistant Professor, Guru Nanak Institutions Technical campus Ibrahimpatnam, Hyderabad, India²

ABSTRACT: Over the last twenty years, remarkable advances have taken place in the research and application of concrete, which exhibits excellent rheological behaviors that include workability, improved in mechanical and durability performance with high compressive strength, and non-brittleness behavior. It is the 'future' material with the potential to be viable admixtures for improving the sustainability of buildings and other infrastructure components. This research investigated the effect of materials constituents such as terminaliachebula (2.5%, 5.0%, 7.5%, and 10%), Jaggery (2.5%, 5.0%, 7.5%, 10%) different aggregate size on compressive strength and density properties of concrete. Failure load was calculated from experimental results at 7 and 28 days was obtained by conducting compressive strength for hardened concrete are verified and the results are analyzed. This paper will give an overview of strength behavior of herbocrete concrete focusing on its fundamental introduction, design, applications and challenges.

KEYWORDS: Terminaliachebula; Jaggery; Compressive strength.

I. INTRODUCTION

Construction industry is second largest industry in India. In recent past, attempts are being made to enhance the fresh state and hardened properties (compressive and tensile strength) by addition of chemicals in construction leads to different types and different levels of pollution. Our ancestors have used various plants as admixture in construction for more than 100 years to improve overall performance of the structure. Herbal admixture will definitely improve strength and durability of the concrete but the same time does not prove the natural organic plants extract can also be used as alternative to chemical admixture. We aim at studying the possibility of using Terminaliachebula as admixtures in concrete in order to ensure an eco-friendly greener construction with sufficiently high strength, enhanced durability at reasonably lower cost. **Vigneshbharathy and R.Sathishkumar (2013)** They are investigated on mortar cubes with adding of kadukkai and taking tested compressive strength, workability and porosity of mortar cubes. It has given the optimum results compared with reference mortar cubes. Terminaliachebula was used as admixtures in concrete in order to ensure an eco-friendly greener construction with sufficiently high strength, enhanced durability at reasonably lower cost. Terminaliachebula added to cement mortar has no effect on workability but increases the compressive strength of reference mortar. **Manmadhan Nair (2003)** was reclaiming heritage discussed about the renovation work carried out at Fort at Vettimurichakotta, Pazhavangadi, East Fort, West Fort, Puthen Street, Sreevaraham and Virakupurakkotta, Kerala, India using different composition of the plaster mixture which was discovered from a palm leaf manuscript found in the Padmanabhapuram Palace. An assortment of elements including a variety of herbs and fruits and a particular species of cactus were blended with palm jaggery and left to ferment for 15 days. This concoction was mixed with lime to prepare the plaster. From this literature study, some idea about the natural admixtures was used in both mortar and concrete. I have plan use the 10 combination of kadukkai and eggshell powder in concrete for determining the compressive strength, flexural strength, split tensile strength.

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II. MATERIALS AND EXPERIMENTAL WORK

2.1: MATERIALS:

Ordinary Portland Cement:

The OPC was classified in to 3 grades, namely 33 grade, 43 grade and 53 grade depending upon the strength of the cement at 28 days when tested as per IS - 4031-1988. If the 28 days strength is not 53 N/mm², it is called 53 grade cement.

Fine aggregate:

Fine aggregate is a granular material composed of finely divided rock and mineral particles. It is defined by size. Being finer than gravel and coarser than silt. Sand can also refer to a textural class of soil or soil type; i.e, a soil containing more than 85 percent sand sized particles by mass.

Coarse Aggregate:

Since the least 60-70% of the volume of concrete is occupied by aggregate, it is no surprising that its quality is of considerable importance. The properties of aggregate greatly affect durability and structural performance of the concrete. The particles size greater than 4.75 mm is greatly categorized as coarse aggregate and up to 20 mm size aggregate.

Terminaliachebula (kadukkai):

This is the locally available natural admixture. Generally the kadukkai is used in medicals. And in our ancestors have used various plants as admixture in construction for more than 10 000 years to improve overall performance of the structure. Herbal admixture (kadukkai) will definitely improve the strength and durability of the concrete but at the same does not produce any harm to our environment.



Fig No :1 Terminaliachebula (kadukkai)

Jaggery:

Jaggery, a product of sugarcane, is such a product which is rich in important minerals (viz Calcium, Magnesium, Potassium, Phosphorus, Sodium, Iron, Manganese, Zinc, Copper, and Chloride). Jaggery is a natural traditional sweetener made by concentrating the extracted sugarcane juice. It is a traditional unrefined non-centrifugal sugar consumed in Asia, Africa, Latin America and Caribbean. Contains all minerals in the sugarcane juice. This is the locally available natural admixture. Jaggery is the retarder and function of the retarder is to increase the setting of the concrete.

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Fig: 2 jaggery

2.2: EXPERIMENTAL WORK:

Table: 1 Batching of materials for cubes

S.No	Percentage of fine aggregate replaced	Weight of cement per 6 cubes in kgs	Weight of Sand aggregate in kgs	Weight of coarse aggregate in kgs		w/c ratio
				12mm	20mm	
1	0	10	16.7	7.87	14.62	0.45
2	2.5	10	16.7	7.87	14.62	0.45
3	5	10	16.7	7.87	14.62	0.45
4	7.5	10	16.7	7.87	14.62	0.45
5	10	10	16.7	7.87	14.62	0.45

Table No: 2 Test results of workability by slump cone and compaction factor test

S.No	Percentages of kadukkai & jaggery water replaced	Slump value in mm	Workability by compaction factor
1	0	168	0.93
2	2.5	160	0.93
3	5	140	0.93
4	7.5	1	0.95
5	10	120	0.98

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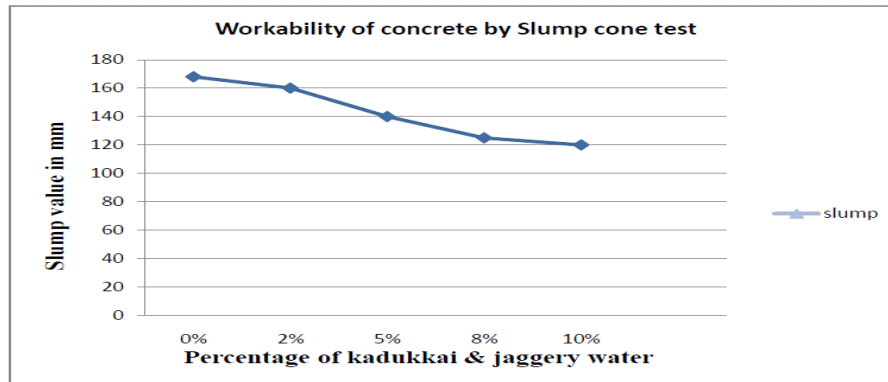


Fig no: 3 Workability of concrete by Slump cone test

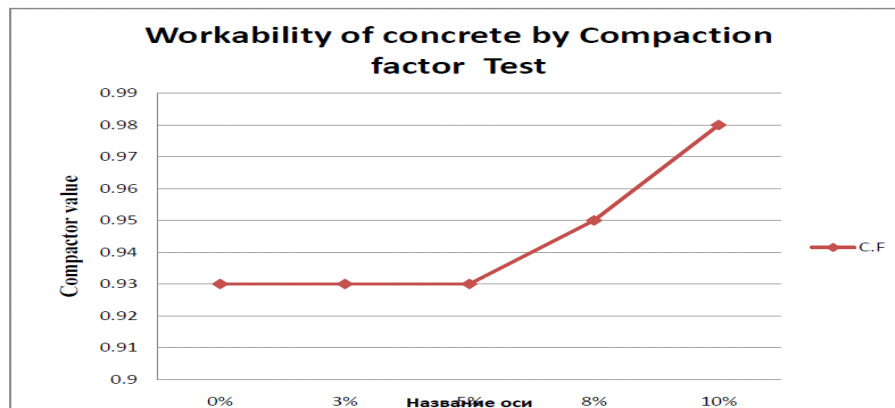


Fig no : 4 Workability of concrete by Compaction factor test

Table: 3 MIX DESIGN PROPORTIONS

Water	Cement	Fine Aggregate	Coarse Aggregate
197.16	435	729	980
0.453	1	1.67	2.27

Compressive strength test:

It is one of the most important properties of concrete and influences many other describable properties of the hardened concrete. The mean compressive strength required at a specific age, usually 28 days, determines the nominal water-cement ratio of the mix. The other factor affecting the strength of concrete at a given age and cured at a prescribed temperature is the degree of compaction. According to Abraham's law the strength of fully compacted concrete is inversely proportional to the water-cement ratio.

For concrete cubes:

TRAIL 1=Conventional concrete.

TRAIL 2=2.5% of Kadukkai and 2.5% of Jaggery extract to weight of water.

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TRAIL 3=5% of Kadukkai and 5% of Jaggery extract to weight of water.

TRAIL 4=7.5% of Kadukkai and 7.5% of Jaggery extract to weight of water.

TRAIL 5=10% of Kadukkai and 10% of Jaggery extract to weight of water.

Table: 4 Mix proportions of concrete trials

Trial no.	Weight of cement (kg)	Weight of fine aggregate (kg)	Weight of coarse aggregate (kg)	% of Kadukkai extract	% of Jaggery extract	No. of samples
T 1	10	16.7	22.5	-	-	6
T 2	10	16.7	22.5	2.5%	2.5%	6
T 3	10	16.7	22.5	5%	5%	6
T 4	10	16.7	22.5	7.5%	7.5%	6
T 5	10	16.7	22.5	10%	10%	6

Table No: 5 Compressive strength after 7 days & 28 days of curing under 0% Kadukkai&jaggery water

Cube No	Weight in grams	Days of curing	Failure Load in KN	Area in cm ²	Compressive strength in (N/mm ²)	Average Compressive strength (N/mm ²)
1	8420	7	900	225	40	42.37
2	8394	7	1040	225	46.22	
3	8417	7	920	225	40.89	
4	8370	28	1200	225	53.33	51.7
5	8440	28	1160	225	51.55	
6	8390	28	1130	225	50.22	

Table No: 6 Compressive strength after 7 days & 28 days of curing under 2.5% Kadukkai&jaggery water

Cube No	Weight in grams	Days of curing	Failure Load in KN	Area in cm ²	Compressive strength in (N/mm ²)	Average Compressive strength (N/mm ²)
1	8320	7	1100	225	48.88	48.44
2	8247	7	1050	225	46.66	
3	8394	7	1120	225	49.78	
4	8360	28	1220	225	54.22	55.7
5	8402	28	1280	225	56.89	
6	8394	28	1260	225	56	

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**Table No: 7 Compressive strength after 7 days & 28 days of curing under 5%
Kadukkai&jaggery water**

Cube No	Weight in grams	Days of curing	Failure Load in KN	Area in cm ²	Compressive strength in (N/mm ²)	Average Compressive strength (N/mm ²)
1	8280	7	1200	225	53.33	52.29
2	8374	7	1150	225	51.11	
3	8420	7	1180	225	52.44	
4	8376	28	1300	225	57.76	58.37
5	8340	28	1340	225	59.56	
6	8354	28	1300	225	57.78	

**Table No: 8 Compressive strength after 7 days & 28 days of curing under 7.5%
Kadukkai&jaggery water**

Cube No	Weight in grams	Days of curing	Failure Load in KN	Area in cm ²	Compressive strength in (N/mm ²)	Average Compressive strength (N/mm ²)
1	8430	7	1100	225	48.89	49.18
2	8392	7	1060	225	47.11	
3	8333	7	1180	225	52.44	
4	8290	28	1240	225	55.11	56.59
5	8315	28	1300	225	57.78	
6	8345	28	1280	225	56.88	

**Table No: 9 Compressive strength after 7 days & 28 days of curing under 10%
Kadukkai&jaggery water**

Cube No	Weight in grams	Days of curing	Failure Load in KN	Area in cm ²	Compressive strength in (N/mm ²)	Average Compressive strength (N/mm ²)
1	8320	7	1020	225	45.33	45.33
2	8360	7	1000	225	44.44	
3	8393	7	1040	225	46.22	
4	8421	28	1180	225	52.44	53.92
5	8430	28	1240	225	55.11	
6	8382	28	1220	225	54.22	

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Table no: 10 Compressive strength Results of various concrete Trail Mixes

S.No.	Trial mix(TM)	Percentage of Kadukkai and Jaggery extract	Compressive strength(N/mm ²)	
			7 days	28 days
1.	TM ₁	-	42.37	51.7
2.	TM ₂	2.5%	48.44	55.7
3.	TM ₃	5%	52.29	58.37
4.	TM ₄	7.5%	49.18	56.59
5.	TM ₅	10%	45.33	53.92

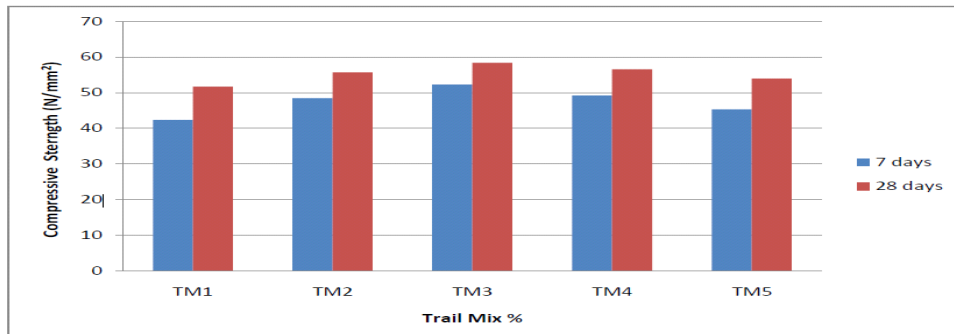


Fig no: 3 Compressive strength results of concrete for 7days and 28days

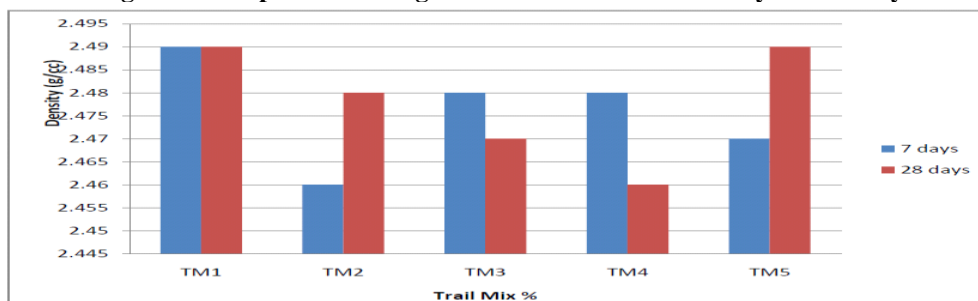


Fig no: 4 Density results of concrete for 7days and 28 days

III. CONCLUSIONS

On the basis of results produced in this study it is concluded that:

The incorporation admixture in concrete will modify the hard and fresh property of concrete. The usage of natural admixture which leads to reduce the Co₂ emission from the concrete and it change the mechanical behavior of concrete. The results show that the maximum compressive strength for concrete is achieved with 5% of Kadukkai and Jaggery solution of water at 7 days is 52.29 N/mm². The results show that the maximum compressive strength for

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concrete is achieved with 5% of Kadukkai and Jaggery solution of water at 28 days is 58.37 N/mm². The compressive strength is increased by about 1.23 times of reference concrete for 7 days & 28 days fermentation of 5% of Terminalia chebula extract and Jaggery extract. The compressive strength was decreased by 7.5%, 10% as compared with 5% compressive strength. The reason of decrease the compressive strength for 7.5%, 10% is, The jaggery is the retarder. So, this jaggery water % increases then the strength will be decreases. So, the jaggery content was used up to certain limit. The natural admixtures are environmentally friendly. And they treated like pollution free admixture then compared to chemical admixture. It is acted as retarders in concrete so which is used to hot climatic condition at the same time which is not affecting the strength of concrete.

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