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Reuse of Natural Material for making Light Weight Concrete

Silky J Sharma[1], Siddhi Thakur[2], Swapnali Onkar[3]
[1, 2, 3]*Department Civil engineering, Vidya Vikas Education Trust's, Universal College of Engineering, Vasai (Palghar), India*

Abstract: ***Concrete elements are the heaviest weight in structure, and it is the main component to add up in the dead load of structure. Hence lightweight concrete is used to minimize the overall dead load in structures; also lightweight concrete has remarkable fire resistance quality more than normal weight aggregate concrete.***
Therefore in this dissertation lightweight concrete is made with the help of cellular lightweight concrete (CLC) foam and lightweight expanded clay aggregates (LECA) .The density of foam concrete is 400-1850 kg/m^3 with random air voids created from the mixture of foam agents in mortar. LECA produced in a rotary kiln which is approximately 50% lighter than normal aggregates which is a new method in minimizing concrete self-weight. Hence their effectiveness is checked by doing various tests on these concretes.
These concrete reduces dead loads on the structure and foundation, also contributes to energy conservation and lowers the labor cost during construction.
Keyword: concrete, lightweight, cellular lightweight concrete (CLC), Lightweight expanded clay aggregates (Leca).

I. INTRODUCTION

Lightweight concrete has been used in numerous industries .Lightweight concrete are type of concrete which includes an enlarging agent which increases the volume of the mixture while giving additional qualities such as strength to weight, thermal insulating. It is lighter than compared to the conventional concrete. Lightweight concrete is generally of three types: aggregate concrete, aerated concrete and no-fines concrete. The aerated ones are those in which foam is used for production. Whereas expanded clay aggregates are used for production of aggregate concrete.

Expanded clay aggregates due to its various advantages compared to other raw materials have been used in many places Expanded clay aggregate not only makes it light weight but also attain good compressive strength. It has great advantage of being not only light weight but has improved thermal and sound insulation properties.

Its good water absorption quality makes it more flexible for use. It has great resistance against the acidic and alkaline substance. The manufacturing of this expanded clay is a non Expanded clay aggregate not only makes it light weight but also attain good compressive strength. It many experiments it was found that its heat absorption property is 15% greater than other conventional concrete. The manufacturing of this expanded clay is a non toxic and eco-friendly unlike other compounds used in concrete.

Aerated concrete are the air entraining concrete.

The clc foam used is the protein based foaming agent. These foams have self compacting properties making it flexible to pump over major height and distances. The lower density (400-600kg/m^3) makes it ideal for thermal and sound insulation and has an positive impact for using it for high rise structural work. Its resistance towards freezing issues and advanced strength to weight ratio makes it more liable for use.

Light Weight Concrete is produced using light weight aggregates. For the most part light weight concrete is not as strong as concrete made with typical aggregates. It is in this way typically utilized when the lightness of the concrete is useful and when high quality is not needed

As in recent years buildings are designed by selecting criteria of environment protection using these expanded clay aggregate will also contribute to nature.

II. EXPERIMENTAL PROGRAM

For checking the properties of the concrete different test were carried out compressive strength test ,rapid chlorine ion penetration test , water absorption test on both type of concrete.

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III. MATERIALS AND METHODOLGY

A. Compressive Strength Test

150mmx150mmx150mm cubes were casted for carrying out compression strength test, 7day, and 28day strength of the specimens were measured. Th specimens were tested on a universal testing machine with capacity of 2000kN. To determine the compressive strength, we casted cubes with LECA and CLC foam, and by varying w/c ratio and by adding different percentage of coconut coir. After casting and curing, the specimens are tested at 7, and 28 days at UTM as per IS. 516-1959. the compressive strength results are given in the below.

1) For Expanded clay Aggregate Concrete

Table No 1: 7-day compression test on LECA concrete

7 day of testing (no. of cubes)	Wt. of cube with15% Cocopeat (kg)	Compressive strength (N/mm^2)	Wt. of cube with 10% Cocopeat(kg)	Compressive strength(N/mm2)
Cube 1	3.995	9.96	4.315	10.11
Cube 2	4.226	10.22	4.105	10.83
Cube 3	4.015	10.54	4.350	11.35

Table No 2: 28-day compression test on LECA concrete

28 day of testing (no. of cubes)	Wt. of cube with 15% Cocopeat(kg)	Compressive strength (N/mm^2)	Wt. of cube with 10% Cocopeat(kg)	Compressive strength(N/mm^2)
Cube 1	4.322	17.22	4.445	18.55
Cube 2	4.568	18.15	4.325	17.14
Cube 3	4.112	17.52	4.594	19.09

Table No 3: Avg. compression test on LECA concrete

Days of testing	Avg. Wt. of cube with 15%cocopeat(kg)	Avg. Compressive strength(N/mm2)	Avg. Wt. of cube with 10% coconut peat (kg)	Avg. Compressive strength(N/mm2)
7 day	4.078	10.24	4.256	10.76
28 day	4.334	17.63	4.454	18.26

2) For CLC foam Concrete

Table No 4: 7-day compression test on CLC concrete

7 day of testing (no. of cubes)	Wt. of cube with 15% coconut coir(kg)	Compressive strength(N/ mm2)	Wt. of cube with 10% coconut coir(kg)	Compressive strength(N/ mm2)
Cube 1	7.899	9.23	7.85	9.56
Cube 2	7.54	8.561	7.95	9.88
Cube 3	7.144	8.44	7.67	8.65

Table No 5: 28-day compression test on CLC concr**ete**

28 day of testing (no. of cubes)	Wt. of cube with 15%coconut peat(kg)	Compressive strength(N/mm2)	Wt. of cube with 10% coconut peat(kg)	Compressive strength(N/mm2)
Cube 1	8.12	16.16	7.94	15.85
Cube 2	7.95	15.95	8.25	16.24
Cube 3	7.64	15.65	8.35	16.46

Table No 6 : Avg. day compression test on CLC concrete

Days of testing	Avg. Wt. of cube with 15% coconut peat(kg)	Avg. Compressive strength(N/mm2)	Avg. Wt. of cube with 10% coconut peat(kg)	Avg. Compressive strength(N/mm2)
7 day	7.52	8.743	7.82	9.36
28 day	7.90	15.92	8.18	16.18

Hence, it was observed that expanded clay aggregates give better compressive strength than foam concrete. also concrete with 10% CP had better compressive strength but the weight was more than the concrete blocks with 15% CP.

B. Rapid Chloride ion Penetration test

Rapid Chloride Permeability Test Equipment (RCPT) is used to evaluate the resistance of a concrete sample to the penetration of chloride ions. Test is performed by placing a 100 mm diameter concrete cylinder into the sample cells that contain 3.0 % salt solution and 0.3 N sodium hydroxide solution. A voltage of 60 V DC is maintained across the ends of the sample throughout the test and the charge that passes through the sample is recorded. Based on the charge, a qualitative rating can be made of concrete's permeability.

Test was conducted for 10% coconut coir concrete in LECA concrete as well as the foam concrete.

Table No 7: Rcpt results

	LECA concrete	CLC foam concrete
Total charge (Coulombs) passed through concrete	2025	1650

Table No 8: Rcpt results guidelines

Charge passed (coulombs)	Chloride ion penetrability
>4000	High
2000-4000	Moderate
1000-2000	Low
100-1000	Very low
<100	Negligible

1) *Results:* Hence, expanded clay aggregate have moderate amount of chloride and CLC foam concrete has comparatively low chloride ion penetrability. There it is concluded that CLC foam are much durable and corrosion resistant than LECA concrete.

C. Water Absorption Test

1) *For Light Expanded Clay Aggregate Aggregates:* The important property of light weight expanded clay aggregate is water absorption which plays an important role on the proportioning of concrete mixtures. Porous nature of the aggregate (is responsible for its high absorption).This high absorption is not encouraging the development of good concrete, unless proper counter measures are available. Sealing all the pores is not a suitable practice to reduce the absorption, because it will lead to increase in the density of the aggregates.

Table No 9 : Water absorption test on LECA concrete

Sample	Water absorption in %
Cube 1 (10% coconut coir)	12.65
Cube 2 (15% coconut coir)	12.3

2) *For foam Concrete:* Water absorption of foams concrete is influenced by the connection of pores and voids. This formation is different with the inclusion of fly ash in the mix. Pores in some instances also relate to the total volume of foam in a mix. Differences in water absorption is in response to the densities low densities result in higher water absorption and this is because of large volume of pores.

Table No 10 : Water absorption test result on foamed concrete

Sample	Water absorption in %
Cube 1 (10% coconut coir)	0.089-0.097
Cube 2 (15% coconut coir)	0.087-0.091

In this study it was found that flyash as cement replacement gave lower ranger of water absorption percentage. This may be as a result of uniform distribution of pores structure of flyash present in the mix

D. Initial Surface Absorption Test

1) Test on Foamed Concrete: The rate of water absorption by the surface zone of concrete under a fixed hydrostatic head was determined during a prescribed period between 10 minutes and two hours. The results showed that the initial surface absorption was more than 3.6 ml/m2 /sec for all specimens, and this verifies that the foamed concrete has an excessive porosity. The specimens were tested at age of (28) days.

IV. CONCLUSION

To conclude with the main aim of this dissertation is to produce lightweight concrete also by making use of natural waste like coconut coir which is readily available. Further, it acts as a source of income for the coconut producer who gets the benefits of the new demand generated by the construction industry. In addition to this, it is an efficient method for the disposal of coir mattress waste which will reduce the demand for additional waste disposal infrastructure and decrease the load on existing landfills and incinerators many researchers have been experimenting with various materials to make lightweight concrete to reduce its density with some similar physical and mechanical properties to normal concrete. hence the test results showed that compressive strength of LECA concrete is more than foam concrete also the weight was less, hence this concrete can be effectively used where the dead load of concrete is to be reduced. Similarly, by RCPT test we know that LECA as much chloride content than foamed concrete hence corrosion in LECA concrete is likely to be more than in foamed concrete. In water absorption test it is observed that the LECA concrete absorbs much water than the foamed as the clay aggregates has a lot of pores which tends to absorb more water hence water ratio required is also more.

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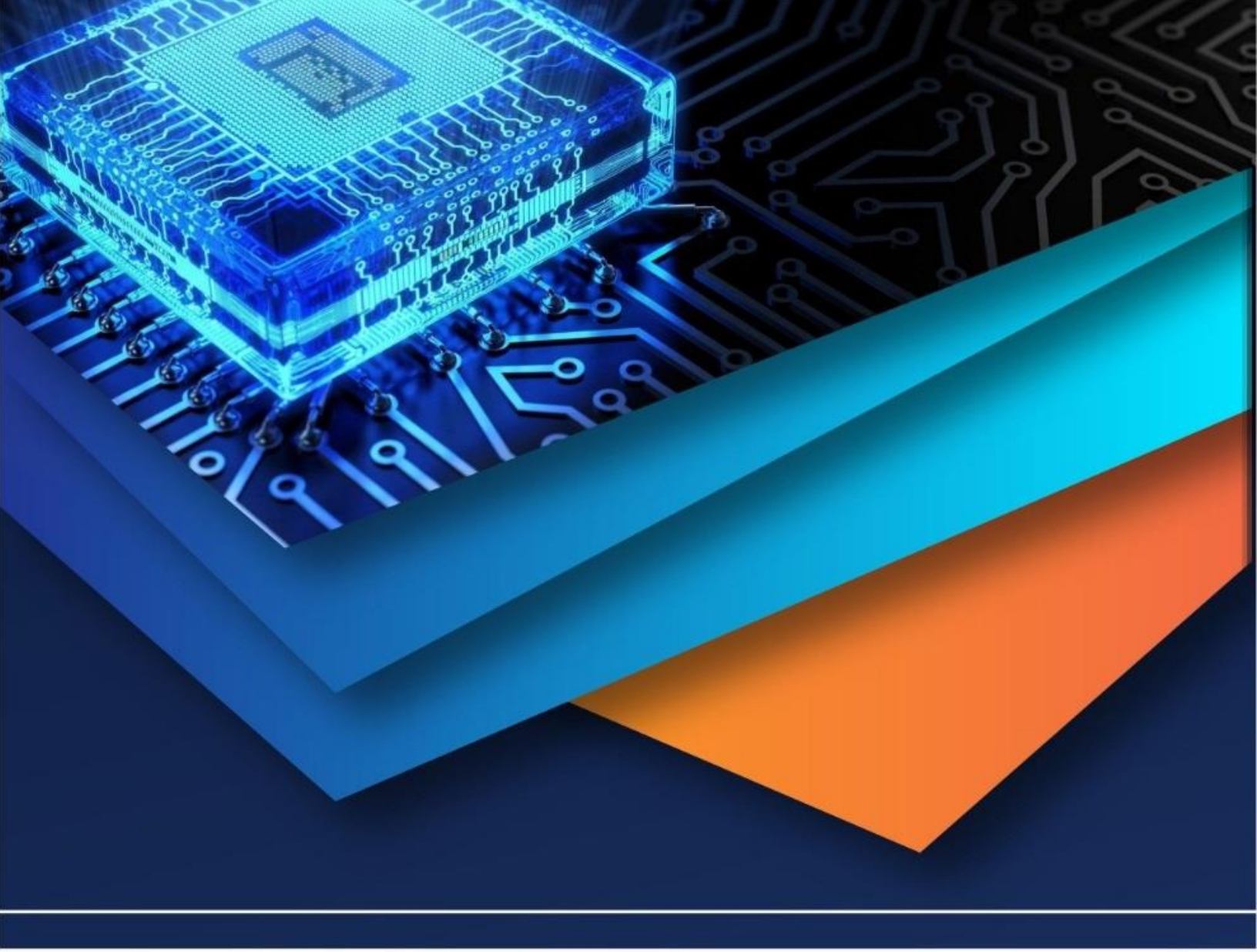

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