WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Light Weight Concrete by Using LECA And Fly Ash - Review Paper

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A B S T R A C T

Experimental study on effect of partial replacement of fine aggregate by Light weight coarse aggregate (LECA). LECA is also more or less similar to properties of Jelly. LECA are expanded clay aggregates manufactured in a rotary kiln which consists of a long, large-diameter steel cylinder inclined at an angle of about so to the horizontal. LECA is used in concrete to minimize the demand of coarse aggregate and also in design of concrete structures, self weight occupies very large portion of total load coming on the structures critically in cases such as weak soils and tall structures. also impressive benefits in lessening density of concrete, thus contributing towards economy of work. The light weight concrete gives low density than conventional concrete and has better thermal insulation comparatively. Main intention of carrying out this project is to compare the weight of concrete and strength properties viz. cube compressive strength, split tensile strength cylinders and flexural strength of light weight concrete against conventional concrete by partially replacing natural aggregates by LECA. One such waste material is fly ash, which is produced in large quantities from thermal power plants as a by-product. A substantial amount of fly ash is left unused posing environmental and storage problems. The production of sintered lightweight aggregate with fly ash is an effective method to dispose of fly ash in large quantities. The partially replaced coarse aggregate by using LECA and Fly ash in various trial percentage and the conventional water cement ratio and standard proportion to be use for experiment.

Keywords: Lightweight concrete, LECA , Fly Ash, strength, properties.

Introduction

Concrete is the most important building material used in the construction industry globally. One of the disadvantages of conventional concrete is the high self weight of concrete. Density of the normal concrete is in the order of 2200 to 2600 kg/m3. This heavy self weight results in larger dimensions of load bearing elements and foundations making it to some extent an uneconomical material. Attempts have been made in the past to reduce the self weight of concrete thereby increasing efficiency of concrete as a structural material. This resulted in evolution of light weight concrete with densities of the order of 300 to 1850 kg/m3. Light weight concrete has become more popular in recent years owing to the tremendous advantage it offers over conventional concrete. Some of the advantages of having light weight concrete are that it helps in reduction of dead load, increases the progress of building and lowers handling costs. Another most important characteristic of light weight concrete is the relatively low thermal conductivity and high sound insulation.

Fly ash is a waste material which generates twin problems of discarding as well as environmental degradation, due to its nature of causing air and water pollution on a large scale. Nearly145 coal-based thermal power stations in India are producing over 184 million tons fly ash per year out of which only 56% was utilized effectively and the remaining is still a concern to the community. Therefore, the manufacture of sintered fly ash lightweight aggregate is an appropriate step to utilize a large quantity of fly ash in concrete. However, a non-existence of worthwhile technology to produce sintered fly-ash lightweight aggregates and the absence of a market has deterred Indian entrepreneurs from producing sintered fly-ash aggregate. Recently a couple of industry players in India have focused their attention on the development of sintered fly ash light weight aggregates commercially on a large scale from the fly ash obtained from their captive power plants. As such, there is no Indian standard available for the lightweight aggregates. More recently, pilot studies by the authors have established that this material displays substantial potential for use in structural concrete.

Use of LECA with Fly Ash

experimental investigation was done on concrete using LECA as a coarse aggregate. LECA were used in different percentages of total coarse aggregate. Different mix proportions are prepared. For each batch of mixing, the quantity of cement and sand were same while the LECA % was different for different mix with different proportion of fly Ash . Water-cement ratio is an important parameter in the concrete mix design, which has vital impact on the fresh and hardened properties of concrete. For normal concrete; by decreasing the water to cement ratio, exponential increment in the compressive strength was noticed which is same for LWC. In the experimental investigation, the concrete cubes were used to analyse the compressive strength of LWC using different % of aggregate and w/c ratio. Casting was done mechanically using drum-mixer, and vibration process. The partially replaced coarse aggregate by using LECA and Fly ash in various trial percentage and the conventional water cement ratio and standard proportion to be use for experiment.

Literature Survey

- **M.RAMYA** Conclude that compressive strength at 7 days and 28 days decreased to 22.222 N/mm2and 26.667 N/mm2 respectively for LWSCC 10. Beyond 15 % of LECA content in fine aggregate i.e. LWSCC 15, the compressive strength reduces suddenly to 15.259 N/mm2 and 21.037 N/mm2 respectively, which is probable due to weaker nature and unavailability of enough water for hydration due to very pronounced water absorption characteristics of LECA With further replacement of fine aggregate by LECA, light weight concrete with unit weight of range 300 kg/m3 to 1850 kg/m3 can be obtained. From this experimental study, 5% is considered as optimum in replacing fine aggregate in self compacting concrete by Light Expanded Clay Aggregate (LECA).
- **M. Priyanka** conclude that LECA can be used in the production of Lightweight Geopolymer concrete. As the percentage of LECA increased compressive strength is decreasing but due to Geopolymerization in the concrete the strength is more than the conventional concrete. Similarly the density is decreased by increasing LECA percentage, strength gained at 60% LECA at 1550 Kg/m3 is more than 25 MPa hence we can use the concrete as structural lightweight concrete. The workability of the concrete is increasing with increasing LECA due to Shape of the aggregate while 0.5 A/B ratio gives good workability to give good strength.
- **Manu S. Nadesan** conclude that SLWACs developed with the proposed methodology could be able to achieve compressive strengths between 28 and 70 MPa without using any mineral additives. Also, all the concretes maintained air dry densities below 2000 kg/m3 and obtained their design slumps. A new strength to water-cement ratio relationship was established for the development of sintered fly ash LWAC.
- **Rajesh Kumar** conclude that the optimizations of LECA aggregate, cement, SP content, fly and marble slurry have been done using different test according to IS codes. Several mix designs were prepared, and testing was done to get the optimized mix proportion. Parameter that has significant influence on the aggregate properties, has been thoroughly discussed. The current study discussed the physical and mechanical characteristics of expanded clay LWC. Thus, the use of LECA with 15% FA+ 15% MS as a cement replacement in LWC; shows better compressive, and lower thermal conductivity. Hence, it can be proposed for structural purpose.
- **N. Ramanjaneyulu** conclude that Density of concrete is found to decrease with the increase in the percentage replacement of normal aggregate with LECA. Due to light weight, LECA was found to be floating on the surface of the concrete causing problems for the flow of SCC. Compressive strength of light weight SCC with LECA was found to increase when LECA is immersed in water for 24 hours before making concrete. The sorptivity of light weight SCC was found to be more when SCC with LECA portion is immersed in water when compared to other part of concrete.
- **R.N. Raj Prakash** conclude that the main aim of the project is to reduce the weight of the concrete. from the above report we can achieve a compressive strength of 29.85 N/mm2 at 20% LECA replaced and also achieve 25.40 N/mm2 at 40% LECA replaced to normal coarse aggregate when cured at 28 days and also we can see a mere improvement in compressive strength if cured like 60 days and more with which we can manage the compressive strength. By reducing the weight of concrete we can reduce the dead weight of concrete and reduce the construction cost by reducing the cost spend on foundation. There is reduction in density of light weight aggregate concrete using LECA as compared to conventional concrete. The Workability of LWAC gets considerably increased when LECA is used as coarse aggregate.
- **PRADEEP P** conclude that the Internal curing using pre-soaked LECA replacing coarse aggregate volume up to 20% is an effective method of curing concrete. At higher replacement levels, the lower crushing strength of LECA resulted in decreased strength of concrete. Considering the various replacement percentages (10, 15, 20 and 25%) of LECA, internal curing is most effective in a mix with 15% LECA. Concrete with 15% LECA obtained an increased 28-days compressive strength of 17.5% and also showed an increased variation at later ages when compared to normal. 20% replacement of coarse aggregate volume with LECA gives a weight reduction of 9.2% along with satisfying the strength requirements of concrete.

- **Yosef Askari Dolatabad** conclude that the addition of lightweight aggregates to the concrete decreased the performance of fresh concrete due to the increasing water absorption of these aggregates. The results of the compressive strength, tensile strength, and flexural strength tests revealed that the addition of lightweight aggregates decreased these strength due to a decrease in the specific weight of concrete.
- **T. Sonia** conclude that the density of concrete is found to decrease with the increase in percentage replacement of normal aggregate by Light Expanded Clay Aggregate. Compressive Strength and split tensile strength of concrete is found to decrease from 34.60 to 21.77 MPa and 3.20 to 1.5 MPa respectively with increase in Leca content from 0% to 100%. The Leca concretes when replaced with 40% and 60% of coarse aggregates shown better results, when compared to conventional concrete. The experimental work carried out to optimize the fly ash content in cement and from the results obtained, I recommended the replacement of cement by 15% fly ash gives better results. The usage of fly ash and Leca, 15%and 40% shows better compressive strength, tensile strength, results with other mix proportion and hence it can be proposed for structural purposes.
- **Abhishek Kumar Singh** conclude that the results of the investigation show that as the amount of leca increases, the compressive strength of the cube decreases. With an increase in the amount of leca, the split tensile strength gradually decreases. With a above percentage of regular aggregate replaced with leca, the density of concrete is shown to decrease. When 50% of the leca is replaced with regular aggregate, the compressive strength, tensile strength and density are improved, as compared with other mix proportions.
- **Chiru K S** conclude that the Leca can be used as a light weight aggregate in replacement of normal conventional aggregate. By using 25% of LECA as a partial replacement to normal convential aggregate compressive strength is promising. The density of concrete is found to decrease with the increase in percentage replacement of normal aggregate by leca. The light weight aggregate is having good interlocking bonds between the particles so therefore it is structurally sound. Increasing the percentage of light weight aggregate decreases the overall mass of the structure. • The structural lightweight concrete is a sustainable material as the aggregate used is economical when compared to coarse aggregate and it is extensively used in agriculture usage.
- **Khaled Heiza** conclude that It is possible to manufacture a structural light weight concrete with low density and high self-compacting characteristics using expanded clay aggregate (LECA). The way of mixing of this concrete is different: lightweight aggregate (LECA) is recommended to be prewetted either in the mixing device by batching light weight aggregate (LECA) and water (and adding the rest of materials after a while) or before the process of mixing (in the store or similar). Pre-wetted light weight aggregate (LECA) gives higher stability of rheological behavior of fresh concrete and foaming of cement matrix is better to control. In condition of fresh properties, the passing ability and filling capacity increase with the increases of w/b and there is a great effect when (HRWRA) increased.

Research gap

Sr. no	Author & Paper	Literature review	Research Gap
1	**M.RAMYA** EXPERIMENTAL STUDY ON LIGHT WEIGHT CONCRETE USING LECA	In this research paper comparing the weight of concrete and strength properties viz. cube compressive strength, split tensile strength cylinders and flexural strength of light weight concrete against conventional concrete by partially replacing natural aggregates by LECA by 20%, 40%, 60%, 80% and 100%. Lightweight aggregate has been effectively utilized for well more than two millennia.	water absorption characteristics of LECA With further replacement of fine aggregate by LECA, light weight concrete with unit weight of range 300 kg/m3 to 1850 kg/m3 can be obtained.
2	**N. Ramanjaneyulu** Strength and Durability Studies on Light Weight Self-Compacting Concrete with LECA as Partial Replacement of Coarse Aggregate	In this research work, The grades of the concrete investigated are M20, M30, M40 and M60 which consist of low, standard and high strength concretes. The durability studies include sorptivity, acid and sulphate resistance. The densities of LWSCC varied from 1870 kg/m3 to 1950 kg/m3 . The sorptivity was found to be more. Acid and sulphate resistance were found to be less in LWSCC. The paper describes the details of investigations and results on LECA based LWSCC.	The sorptivity of light weight SCC was found to be more when SCC with LECA portion is immersed in water when compared to other part of concrete.
3	**Rajesh Kumar** Microstructural and Thermo- mechanical Properties of Energy- Efficient Structural	In this research paper desirable mechanical and thermal properties of the developed LWC have been determined. Test results showed that LWC using	use of LECA with 15% FA+ 15% MS as a cement replacement in LWC; shows

	Lightweight Concrete with LECA, Fly ash and Marble slurry	LECA along with 15% FA and 15% MS as replacements for cement, improved the compressive strength and thermal performance compared to the control concrete (CC) mix. It was further concluded that the LWC with LECA, FA and MS could be successfully used for making energy- efficient and cost-effective buildings.	better compressive, and lower thermal conductivity. Hence, it can be proposed for structural purpose.
4	**M.Priyanka** Development of mix proportions of geopolymer lightweight aggregate concrete with LECA	In this research work, Investigates the strength of fly ash based geopolymer concrete produced with Lightweight Expanded Clay Aggregates (LECA). Twenty concrete mixes were prepared to get an appropriate mix design for LWGPC. A mixture of sodium hydroxide and sodium silicate with 8 molarity was used as an alkali activator. The variables in the study include alkaline to binder ratio and percentage of LECA to produce concrete of densities 1800 kg/m3 and 2000 kg/m3 . Fresh and harden characteristics of LWGPC are discussed in the form of slump and compressive strength respectively.	density is decreased by increasing LECA percentage, strength gained at 60% LECA at 1550 Kg/m3 is more than 25 MPa
5	**Manu S. Nadesan** Mix design and properties of fly ash waste lightweight aggregates in structural lightweight concrete	The present study is an attempt to establish a new mix design procedure for the development of sintered fly ash lightweight aggregate concretes, which is simple and more reliable than the existing procedures. Also, the proposed methodology has been validated by developing a spectrum of concretes having water cement ratios varying from 0.25 to 0.75. From the study, it is obvious that the development of 70 MPa concrete is possible by using cement alone without any additives. Also, it is ensured that all the concretes have densities less than 2000 kg/m3.	concretes maintained air dry densities below 2000 kg/m3 and obtained their design slumps.

References

[1] M.Ramya, S.Keerthipriyan[2], “Experimental Study On Light Weight Concrete Using LECA (Light Weight Expanded Clay Aggregate)” IRJET ,Impact Factor value: 7.529 ,ISO 9001:2008 Certified Journal.

[2] M. Priyanka , M. Karthikeyan , M. Sri Rama Chand , “Development of mix proportions of geopolymer lightweight aggregate concrete with LECA” ELSEVIER, 27 (2020) 958–962.

[3] Rajesh Kumar, Rajni Lakhani , Abhilasha , Neha Rawat and Shahnawaz Khan, “Microstructural and Thermo- mechanical Properties of Energy-Efficient Structural Lightweight Concrete with LECA, Fly ash and Marble slurry”, A CSIR One Week One Lab Initiatives.

[4] N. Ramanjaneyulu , Kakustham Srigiri , and M.V. Seshagiri Rao[3], “Strength and Durability Studies on Light Weight Self-Compacting Concrete with LECA as Partial Replacement of Coarse Aggregate”, CVR Journal of science and technology, Volume 15, December 2018 .

[5] Khaled M. Heiza ; Fatma M. Eid ; Taha Masoud, “Light Weight Self Compacting Concrete With Light Expanded Clay Aggregate (LECA)”, ERJ Engineering Research Journal, Vol. 40, No. 1 , January 2017, PP: 65-71.

6] Swathi Arivalagan, “Experimental Analysis On Light Weight CONCRETE”, Creative Commons Attribution-Non Commercial-No Derivatives 4.0 International License (CC BY-NC-ND)

[7] R.N. Raj Prakash*, A.Krishnamoorthi “Experimental Study On Light Weight Concrete Using Leca” /International Journal of ChemTech Research, 2017,10(8): 98-109.

[8] Alaa H. Abdullah and Shatha D. Mohammed, “Effect of lightweight expanded clay aggregate as partial replacement of coarse aggregate on the mechanical properties of fire-exposed concrete” Journal of the Mechanical Behavior of Materials 2023; 32: 20220299

[9] Pradeep P., BeenamoL , Hari S. Nair, "Effect Of Pre-Soaked Light Expanded Clay Aggregate On Strength, Durability And Flexural Behaviour Of High-Performance Concrete" Journal of Engineering Science and Technology Vol. 14, No. 5 (2019) 2629 – 2642.

[10] Yosef Askari Dolatabad1, Reza Kamgar and Mohammad Amin Jamali Tazangi "Effects of Perlite, Leca, and Scoria as Lightweight Aggregates on Properties of Fresh and Hard Self-Compacting Concretes" ournal of Advanced Concrete Technology Vol. 18, 633-647
[11] T. Sonia , R. Subashini , R. Banupriya, "Experimental Investigation on Mechanical Properties of Light Weight Concrete Using Leca", International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Volume 5 Issue 11.

[12] Abhishek Kumar Singh , R. Niveda , Ashish Anand , Ajay Yadav , Diwakar Kumar , Gaurav Verma, "Mechanical Properties of Light Weight Concrete using Lightweight Expanded Clay Aggregate" International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538 Volume 10 Issue V

[13] Chiru K S, Manjesha G, Satishkumar N, Srinatha V, "Experimental Study on Light Weight Concrete by using LECA and Fly ash", International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181