International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 03 | Mar-2018 www.irjet.net p-ISSN: 2395-0072

Study on Light Weight Characteristics of Self Compacting Concrete Using Fine Pumice Powder and Coconut Shell

Prof R. D. Shambharkar[1], Aditya Sawarkar[2], Kunal Rewatkar[3], Dolly Wanjari[4]

[1]*Assistant professor, Civil Engineering Department, DBACER, Nagpur.*
[2 3 4] *B.E. Student, Civil Engineering Department, DBACER Nagpur.*

Abstract – *This paper presents the compressive strength of lightweight aggregate using pumice stone powder and coconut shell. The coconut shell and pumice stone powder use as lightweight aggregate. In our project, we are replacing pumice stone powder by fine aggregate in fix percentage and waste coconut shell may be utilized to replace natural coarse aggregate. In this study, produce M20 grade of concrete by replacing natural coarse aggregate partially with waste coconut shells such as 5%, 10%, 15%, 20%, 25% and 30% by weight with waste coconut shell. In all totals, thirty- Six (36) cubes were cast and their compressive strength is evaluated at 7 and 28 days. The compressive strength of concrete was reduced as the percentage replacement increased and density of coconut shell is evaluated for different concrete cubes. The results showed that coconut shell concrete can be used in lightweight concrete construction. Utilization of coconut shell is cost effective and eco-friendly.*

Key Words: Coarse aggregate, concrete, coconut shell, compressive strength, lightweight concrete.

1. INTRODUCTION

Concrete is the world's most widely used construction material owing to its excellent versatility, availability, and economy. Despite all advantages associated with the use of concrete in civil engineering infrastructures, its use is sometimes limited in some structures because of its high self-weight compared to other experienced a shortage of skilled workers as a result of an aging workforce and the difficulty to attract a new generation of skilled workers. Therefore, over the last few decades, there has been a tremendous interest to develop new high-performance material that require less skilled workers to b placed/used. In this regard, the development of new types of high performance concrete, such as self compacting concrete (SCC) and lightweight concrete (LWC) responds to some of the urgent needs of the construction sector. The development of SCC has been perceived by many specialists as a giant step towards achieving high-performance cement-based material.

The utilization of concrete is increasing at a higher rate due to developing infrastructure and construction activities all around the world. In addition, concrete is the 2nd most consumed substance in the world behind water. About 7.23 billion tons of concrete are produce every year. Annual production represents one ton for every individual on the planet. Production of concrete is increasing due to high growth of infrastructure development and construction activities in the world. However, there are some negative impact of more production of concrete like continuous extensive extraction of aggregate from natural resources will lead to its depletion and ecological imbalance.

Concrete production demands its constituents like aggregate, cement, water, and mixtures. Sources of conventional aggregate occupy the major part of the concrete. Increasing demand for natural aggregate shown that crushed stone demand will be 2050 million metric tons in 2020. This huge demand of natural aggregate raises a serious question about the preservation of natural aggregate sources for sustainable development. Extraction and processing of aggregate are also a major concern for the environment. Hence the coconut shell waste use as aggregate in concrete production not only protects the environment but also makes concrete a sustainable and environmentally friendly construction material. The high demand for concrete in the construction using normal weight aggregate such as gravel and granite drastically reduces the natural stone deposits and this has damaged the environment thereby causing ecological imbalance. Therefore, there is a need to explore and to find out suitable replacement material to substitute the natural stone. In developed nations, the construction industries have identified many artificial and natural lightweight aggregate (LWA) that have replace conventional aggregate thereby reducing the size of structural members. Coconut shell is categorized as lightweight aggregate.

1.1 Literature review

Siti aminah bt tukiman and sabarudin bin mohd (2009)[1] replaced coarse aggregate by coconut shell and grained palm kernel in their study. Percentage of replacement by coconut shell were 0%, 5%, 25%, 50%, 75%, 100% respectively. Conclusion is that the combination of these materials has potential of being used as lightweight aggregate in concrete and also has reduce the material cost in construction.

Olutoge (2010)[2] studied the saw dust and palm kernel shells (PKS). Fine aggregate are replaced by saw dust and coarse aggregate by palm kernel shells in reinforced concrete slab casting. Conventional aggregate were replaced by saw dust and PKS in same ratios of 0%, 25%, 50%, 75%, and 100%. Compressive and flexural strength

were noted at difference time intervals. It was seen that at 25% sawdust and PKS can produce lightweight reinforced concrete slab that can be used where low stress is required at reduce cost 7.43% reduction can be achieved.

J.p ries (2011) observed that lightweight aggregate plays important role in today's move towards sustainable concrete. Lightweight aggregate contribute to sustainable development by lowering transportation requirements, optimizing structural efficiency that result in a reduction in the amount of overall building material being used conserving energy, reducing labour demand and increasing the life of structural concrete.

Abubakar and muhammed saleh abubakar (2011) [3] compared the physical and mechanical properties of coconut shell and crushed granite rock also a total of 72 cubes of size 150×150×150mm with different mix ratio of 1:2:4, 1:1.5:3, 1:3:6 were casted and tested for evaluating different properties. Aggregate crushing value (ACV) for coarse aggregate was 21.84 and 4.71 for coconut shell, elongation and flakiness index were 58.54 and 15.69 respectively for gravels, while for coconut shell, it was 50.56 and 99.19 respectively compressive strength of concrete cubes in N/mm^2 of coconut shell at 7,14,21 and 28 days with mix ratio of 1:2:4, 1:1.5:3, and 1:3:6 are (8.6, 8.9, 6.4), (9, 6, 11.2, 8.7), (13.6, 13.1,10.7) and (15.1, 16.5, 11) respectively, likewise (19.1, 18.5, 9.6), (22.5, 23.0, 10.4), (28.1,30.0,15) respectively for gravel. Since the concrete strength of coconut shell with mix ratio 1:1.5:3, attained 16.5 N/mm^2 compressive strength at 28 days it can be used in plain concrete works, cost reduction of 48% will be achieved.

Maninder Kaur and Manpreet Kaur (2012)[4] published a review paper in which it is concluded that use of coconut shells in cement concrete can help in waste reduction and pollution reduction. It is also expected to serve the purpose of encouraging housing, developers in investing these materials in house construction. It is also concluded that the coconut shell are more suitable as low strength giving lightweight aggregate when used to replace common coarse aggregate in concrete production.

Daniel yaw osei (2013)[5] In this experimental study coarse aggregate is partially replaced by coconut shell were -0%, 20%, 30%, 40%, 50%, 100%. He concluded that coconut shell can be used as to produce light weight concrete and 18.5% replacement of crushed granite with coconut shell can be used to produce structural concrete.

Parag Kambli and Sandhya Mathapati (2014)[6] prepare three mix design for M20, M35, M50 grades of concrete. Percentage replacement by coconut shell varied as 0%, 10%, 20%, 30%, 40% respectively. It is concluded in this study that for M20 grade concrete cubes with 30% replacement of coconut shell aggregate had given strength of 23 MPa at 28 days. Concrete cubes with 30% replacement of coconut shell aggregate had given strength of 42 MPa at 28 days for M35. For M50 grade concrete cubes with replacement of coconut shell aggregate had given strength of 51 MPa at 28 days.

Dewanshu ahlawat and L.G. Kalukar (2014)[7] explored the possibility of producing M20 concrete by replacing conventional aggregate of granite by coconut shell. Forty five cubes were casted. Percentage of replacement of conventional coarse aggregate by coconut shell were 2.5%, 5%, 7.5%, 10%. Compressive strength were 19.71, 19.53, 19.08, 18.91 N/mm2 respectively at 28 days. Workability and compressive strength had been evaluated at 7 ,14 and 28 days.

1.2 Material Used

a) Ordinary Portland Cement

The cement used for the entire experiment is Ordinary Portland cement of 53 grade conforming to IS 12269. The cement was tested for fineness and specific gravity. The specific gravity of the cement obtained as per the test was 3.15. The cement used is fresh and without any lumps. It is the basic ingredient of concrete, mortar, and plaster.

b) Fine Aggregates

They are aggregate most of which passes 4.75mm IS Sieve. M Sand is used as the fine aggregate. Sieve analysis is carried out and as per sieve analysis; it comes under Zone-II. The limits for each zone as per IS: 383 – 1970.

c) Coarse Aggregates

Aggregate most of which is retained on 4.75mm IS Sieve and containing only so much finer material as is permitted for the various types described in this standard. As per IS: 10262 – 1982 clause 3.6 explaining the combination of different coarse aggregate fractions two different sizes, 20mm and 12.5mm size coarse aggregates were used which results in an overall grading conforming to Table 2 of IS: 383 - 1970.

d) Chemical Admixture (Super Plasticizer)

Super plasticizer (normal) 4% by the weight of cement is used in the concrete for improving the workability condition of the concrete.

e) Pumice stone powder

Pumice is a natural material of volcanic origin produced by the release of gases during the solidification of lava, and it has been used as the aggregate in the production of lightweight concrete in many countries around the world. So far, the use of pumice was dependent on the availability and limited to the countries where it is locally available or easily imported. The use of pumice as aggregate or mineral additive in the production of self-compacting concrete may be a good approach for the production of lightweight, easy workable, economic and environmentalist concrete.

f) Coconut shell

Coconut shell as partial replacement for coarse aggregate. The concrete with ground coconut shell was found to be durable in terms of its resistance in water, acidic, alkaline and salty. Density of coconut shell is in the range of 550 - 650 kg/m^3 and these are within the specified limits for lightweight aggregate.

2. METHODOLOGY

According to our project mix design, mix proportion for M20 grade of concrete is found to be 1:1.63:3.5, where we use chemical admixture as 4% weight of cement and 15% replacement of fine aggregate by fine pumice stone powder and using waste coconut shell as replacement of partial coarse aggregate by 5%, 10%, 15%, 20%, 25%, and 30% by weight.

3. TEST RESULT

Compressive Strength

The compressive strength were conducted on the concrete specimens with pumice stone powder as fine aggregate and coconut shell as a coarse aggregate. So we will replace coconut shell with the coarse aggregate in fix percentages such as 0%, 5%, 10%, 20%, 25% and 30%.

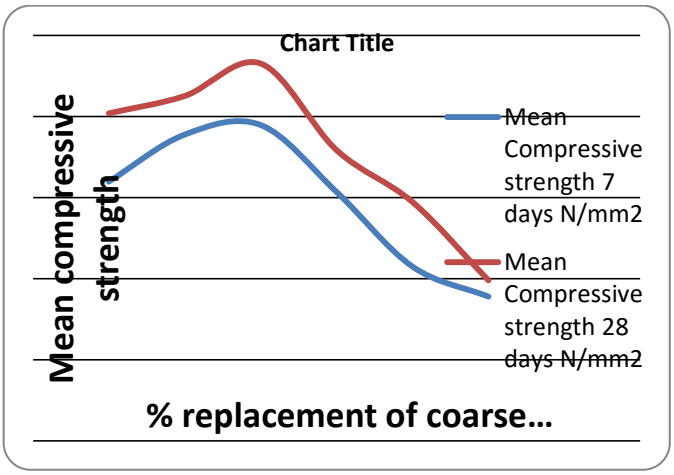
Table -1: Compressive strength of concrete with coarse aggregate partially replaced be coconut shell

% of replace of coarse aggregate by coconut shell	Mean Compressive strength		
	7 days N/mm^2	28 days N/mm^2	Percentage increment
5%	15.97	20.18	26.37 %
10%	18.87	21.25	12.61 %
15%	19.46	23.25	19.47 %
20%	15.33	17.91	16.82 %
25%	10.73	14.71	37.09 %
30%	8.88	9.88	11.26 %

Table -2 :- Density of coconut shell concrete

% of replace of coarse aggregate by coconut shell	Weight of cubes (kg)	Volume of cubes (m^3)	Density (kg/m^3)
5%	7.1	3.375×10^{-3}	2103.7
10%	6.9		2044
15%	6.4		1896.29
20%	6.1		1807.40
25%	5.9		1748.14
30%	5.7		1688.89

Chart -1: Graphical representation on compressive strength of concrete



4. CONCLUSIONS

1. In India there is large production of coconut shell accounting for 20 % of the world production in which creates environmental issue as it is not easily degradable so, from our result we conclude that coconut shell gives optimum strength

2. In our project we replace coarse aggregate with waste coconut shell and fine aggregate with pumice stone powder, where we obtained optimum strength at 15%.

3. The 28-day compressive strength of the concrete using coconut shell aggregate was found to be 23.21 N/mm^2 under full water curing and it satisfied for structural lightweight concrete.

4. The density of 28-day hardened coconut shell concrete was found to be in the range between 2103-1688 kg/m^3, that satisfy light weight concrete.

5. As there is increase in percentage replacement by coconut shell and pumice stone powder reduce the strength and density of concrete.

6. Using the coconut shell as coarse aggregate and pumice stone powder as fine aggregate can reduce material cost in construction because of economic in cost.

4. REFERENCES

1. Siti Aminah Bt Tukiman and Sabarudin Bin Mohd "Investigation the combination of coconut shell and grained palm kernel to replace aggregate in concrete: A technical review National Conference on Postgraduate Research (NCONPGR) 2009, UMP Conference Hall, Malaysia.

2. Olutoge F.A," Investigations on Sawdust and Palm Kernel Shells as Aggregate Replacement", ARPN Journal of Engineering and Applied Sciences VOL.5. NO.4, April 2010.

3. Abdulfatah Abubakar and Muhammed Saleh Abubakar**,** Exploratory Study of Coconut Shell as Coarse Aggregate in Concrete, Journal of Engineering & Applied sciences, vol.3, December 2011.

4. Maninder Kaur & Manpreet Kaur, Review On Utilization of Coconut Shell As Coarse Aggregates in Mass Concrete, International Journal of Applied Engineering Research, vol.7, Issue 11, 2012.

5. Daniel Yaw Osei, Experimental assessment on coconut shells as aggregate in concrete, International Journal of Engineering Science Invention, vol. 2, Issue 5, May 2013.

6. Parag S. Kambli and Sandhya R. Mathapati, Compressive Strength of Concrete by Using Coconut Shell, IOSR Journal of Engineering (IOSRJEN) www.iosrjen.org ISSN (e): 22503021, ISSN (p): 2278-8719 Vol. 04, Issue 04 (April. 2014).