Partial Replacement of Coconut Shell as Coarse aggregate; A Review

P.Madhu Bala
Student, TRP engineering college (SRM groups) Trichy
Swathi Arivalagan
Student, TRP engineering college (SRM groups) Trichy
Naveen Kumar. R
Assistant Professor, TRP engineering college (SRM groups) Trichy

***Abstract*—Environmental pollution is drastically increasing nowadays. On considering the factors eco-friendly and reducing the cost of concrete, the coarse aggregate had been replaced by Coconut shell. Coconut is grown in more than 93 countries. India is the third largest, having cultivation on an area of about 1.78 million hectares for coconut production. Annual production is about 7562 million nuts with an average of 4248 nuts per hectare. Approximately the coconut shell is produced about 3.18 million tonnes [6]. In this study the coarse aggregate is replaced by coconut shell in M15, M20, and M25 grades of concrete of 16%, 18.5%, and 20% each and compressive strength have been found out. From the results it have been concluded that coconut shell can be used as structural concrete and it leads to sustainable development.**

***Index Terms*—Coarse aggregate, Coconut Shell, Compressive Strength, Structural Concrete.**

I. INTRODUCTION

Concrete is widely used as a construction material. Concrete consists of cement and natural aggregates such as gravel and crushed rock. The aggregates occupy larger volume in the concrete. Depletion of natural aggregate for making concrete is high and it will not lead to sustainable development. There are many researches were undergoing for replacing the coarse aggregate to control depletion and ecological imbalance. Many of the non-decaying waste material will remain in the earth for thousands of years. By making non-decaying waste as sustainable use, its impact can be reduced. Hence Coconut Shell is utilized as a replacing material in concrete.

II. MATERIALS AND METHODS

The materials used for producing concrete in this study were Portland cement of 53 grade, zone II fine aggregates, and Course aggregates of fineness modulus.The coconut shells are obtained from a local coconut field. They are sun dried for 1 month before being crushed manually. The crushed materials are later transported to the laboratory where they were washed and allowed to dry under ambient temperature for another 1 month. The particle sizes of the coconut shell range from 5 to 20 mm as shown in fig 2. The surface texture of the shell was fairly smooth on concave and rough on convex faces [7].

Fig.1

Fig.2

*Concrete Mix Design***:** The control mix for M15, M20, M25 grades are produced and molded as cube as per IS recommendation and tested for compressive strength at 3rd, 7th, 14th and 28th days. Similarly the concrete is tested by replacing Blue metal (coarse aggregate) by coconut shell of 16%, 18.5% and 20%.

*Batching and Mixing***:** Weigh Batching was practiced with the help of electronic weigh balance. Batching was done as per the mix proportions. Mixing was done in tilting drum mixer. It was mixed for 2-3 minutes, after addition of water.

*Placing and Compaction***:** Cubes of size 150mm X 150mm X 150mm is used. The cubes are cleaned and oiled to prevent the formation of bond between concrete and moulds and for easy removal of hardened concrete. The fresh concrete is placed in cubes in 3 layers and tamp each layer for 25 times using tamping rod. The fresh concrete is vibrated using vibrating machine to remove the entrapped air from concrete.

*Demoulding***:** After placing fresh concrete in moulds , it was allowed to set for 24 hours. It was marked with some permanent identification mark. Concrete cubes are now kept in curing tank for 3, 7, 14 and 28 days.

Testing: After 3rd, 7th, 14th and 28th day, concrete cubes were removed from curing tank to conduct tests on hardened concrete in compression testing machine and compressive strength of hardened concrete is noted.

III. TEST RESULT

In the table **'P'** denotes ultimate load given to hardened concrete and **'σ'** denotes the maximum compressive strength of hardened concrete at failure.

Table 1: Summary of Result for M15 grade

DAYS	CONTROL MIX		COCONUT SHELL MIX					
			16% OF REPLACEMENT		18.5%OF REPLACEMENT		20% OF REPLACEMENT	
	P (KN)	σ (N/mm^2)	P (KN)	σ (N/mm^2)	P (KN)	σ (N/mm^2)	P (KN)	σ (N/mm^2)
3	77.5	3.4	72	3.2	69	3.1	66.7	2.9
7	150	6.6	144	6.4	140.5	6.2	130.5	5.8
14	232	10.3	220.5	9.8	216	9.6	202	8.9
28	419.5	18.6	409.5	18.2	393.5	17.4	365.5	16.2

Table.1 represents the 3rd, 7th, 14th and 28th day Compressive Strength of Cube of M 15 grade control mix and coconut shell concrete with the replacement of 16%, 18.5% and 20% by coarse aggregate

By testing the concrete cubes, at 28th day 16% replacement of coarse aggregate by coconut shell shows that the strength of the coconut shell concrete was decreased by 2.15% from control mix. Similarly for 18.5% and 20% replacement the strength get decreased by 6.75 % and 12.9 % respectively.

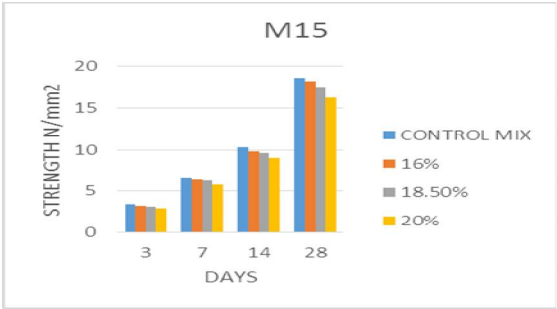

Fig.3

Fig .3 is the graph drawn between Days in X axis and Strength in Y axis. It represents the variation in strength of coconut shell concrete with 16%, 18.5% and 20% replacement which are compared with control mix in M 20 grade concrete.

Table 2: Summary of Result for M20 grade

DAYS	CONTROL MIX		COCONUT SHELL MIX					
			16% OF REPLACEMENT		18.5%OF REPLACEMENT		20% OF REPLACEMENT	
	P (KN)	σ (N/mm^2)	P (KN)	σ (N/mm^2)	P (KN)	σ (N/mm^2)	P (KN)	σ (N/mm^2)
3	119.5	5.31	116	5.16	112	4.97	103	4.57
7	240	10.67	233.5	10.37	225	10	208	9.24
14	364	16.18	354	15.73	342	15.2	316	14.04
28	590	26.2	570	25.33	551.5	24.5	507.5	22.55

Table.2 represents the 3rd, 7th, 14th and 28th day Compressive Strength of Cube of M 20 grade control mix and coconut shell concrete with the replacement of 16%, 18.5% and 20% by coarse aggregate.

By testing the concrete cubes, at 28th day 16% replacement of coarse aggregate by coconut shell shows that the strength of the coconut shell concrete was decreased by 3.3% from control mix. Similarly for 18.5% and 20% replacement the strength get decreased by 6.49 % and 13.93% respectively.

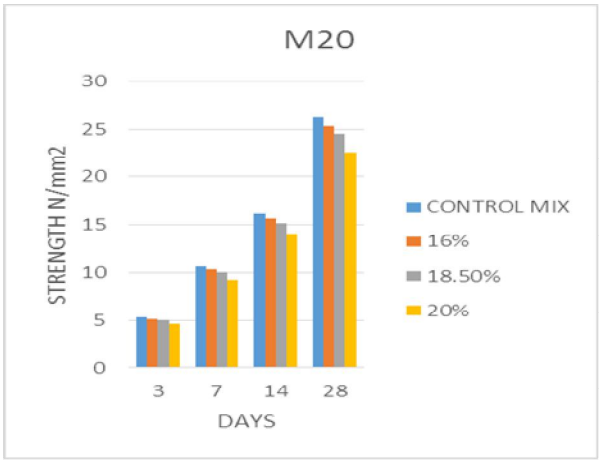

Fig.4

Fig. 4 represents the variation in strength of coconut shell concrete with 16%, 18.5% and 20% replacement which are compared with control mix in M 20 grade concrete.

Table 3: Summary of Result for M25 grade

DAYS	CONTROL MIX		COCONUT SHELL MIX					
			16% OF REPLACEMENT		18.5%OF REPLACEMENT		20% OF REPLACEMENT	
	P (KN)	σ (N/mm^2)	P (KN)	σ (N/mm^2)	P (KN)	σ (N/mm^2)	P (KN)	σ (N/mm^2)

3	145	6.44	140	6.22	136	6.04	126	5.6
7	291.5	12.96	281	12.18	274	12.17	254	11.28
14	470	20.89	455	20.2	441	19.6	409	18.17
28	715	31.78	688	30.5	667	29.4	626	27.82

Table.3 represents the 3rd, 7th, 14th and 28th day Compressive Strength of Cube of M 25 grade control mix and coconut shell concrete with the replacement of 16%, 18.5% and 20% by coarse aggregate

By testing the concrete cubes, at 28th day 16% replacement of coarse aggregate by coconut shell shows that the strength of the coconut shell concrete was decreased by 4.02% from control mix. Similarly for 18.5% and 20% replacement the strength get decreased by 7.48 % and 12.46 % respectively.

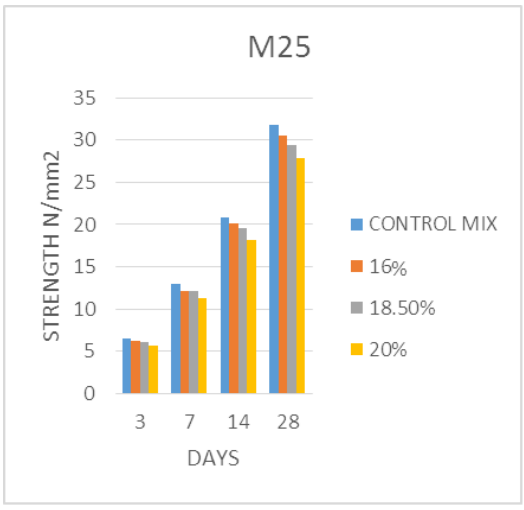

Fig.3 represents the variation in strength of coconut shell concrete with16%, 18.5% and 20% replacement which are compared with control mix in M 20 grade concrete.

From the graph it is clearly understood that the strength of the coconut shell concrete has been gradually decreased by increasing the percentage of replacement up to 18.5%.Even strength of concrete has been gradually reduced, the coconut shell concrete can be used in structure up to 18.5%.Above 18.5% the strength has been decreased drastically by increasing the percentage of replacement. So it is conclude that above 20% of replacement it cannot be used as the structural concrete

IV. Conclusion

From the research findings, Coconut Shell has used as replacement of Coarse Aggregate in concrete and categorized as light weight Aggregate. It is found that the strength of the coconut shell concrete almost achieved the strength of conventional concrete. Thus it can be used as structural concrete for mix ratio M15, M20, M25. Due to surface texture of coconut shell, the bond strength is higher. And also due to its light weight, it helps in reduction of dead load, increase the progress of building and lowest haulage and handling cost. The weight of a building on the foundation is an important factor in design particularly in the case of weak soil and tall structure. In the framed structure the beams and the columns have to carry loads of floors and walls. If the floors and walls made up of light weight concrete, consequently the cross sectional area of the structure get reduced and leads to economy. So it reduces the cost about 30% comparing to conventional concrete. The Coconut shell concrete has low thermal conductivity, a property which improves with decrease in density. So it can be used in extreme climatic condition and also in case of building where air conditioning is to be installed. Therefore Coconut Shell concrete leads to sustainable environment.

REFERENCES

[1] Shetty M.S, *Concrete Technology Theory and Practice*, 3rd ed. S.Chand Company Limited, New Delhi.
[2] Specifications for 53 grade Ordinary Portland Cement ;I.S 12269-1987
[3] Specifications for coarse and fine aggregates; I.S 383-1970
[4] Indian Standard : Plain and Reinforced Cement Concrete" Code of practice; I.S 456-2000
[5] Recommended guidelines for concrete mix design; I.S 10262-1982
[6] Apeksha Kanojia, S.K. Jain, "Performance of Coconut Shell as Coarse Aggregate in Concrete: A Review",2015, International Research Journal of Engineering and Technology (IRJET),Vol.2,Issue 04.
[7] Maninder Kaur, Manpreet Kaur, "A Review on Utilization of Coconut Shell as Coarse Aggregates in Mass Concrete",2012, International Journal of Applied Engineering Research, ISSN 0973-4562 Vol. 7 No.11, http://www.ripublication.com/ijaer.htm
[8] J.M.Crow,"The Concrete Conundrum",2006, ww.chemistryworld.com
[9] Daniel Y.O, (2013) "Experimental Assessment on Coconut Shell as aggregate in concrete", International Journal of Engineering Science Invention, Vol.2, Issue 5, pp 07-11
[10] Maninder Kaur, Manpreet Kaur,(2012) "A review on utilization of coconut shell as coarse aggregate in mass concrete", International Journal of Applied Engineering Research, Vol. 7, No.11, pp 05-08
[11] Kulkarni V.P, Kumar .S, (2013), "Comparative study on coconut shell aggregate with conventional concrete", Vol.2, Issue 12, pp 67-70.
[12] Kabiru Usman Rogo, Selah Abu-Bakr (2010) "Exploratory study of coconut shell as aggregate in concrete production", Journal of Engineering and Applied Sciences, Vol.2.