GLASS FIBRE REINFORCED M40 GRADE LIGHT WEIGHT AGGREGATE CONCRETE

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Abstract : In this study, the properties of concrete with light weight aggregate and with addition of Glass fibers is investigated. Coarse aggregate in concrete is partially replaced with 10,20,30 percentages coconut shell and 0.5,1,1.5 percentage fibres were added to M40 grade of concrete. A total of 90 cubes were casted and their properties such as workability, compressive strength, impact strength, density of concrete were evaluated and the results were analyzed and compared with the conventional concrete. The results showed that the tensile strength of coconut shell and Glass fibre mix concrete existed to be more or less equivalent to the conventional concrete. The aim behind the use of coconut shell as partial replacement for conventional aggregates is to make eco-friendly light weight structure. Glass fibres were added for strengthening of concrete.

IndexTerms **- Coconut shell Aggregate, Glass fibres, Compressive strength, Tensile Strength**

I. INTRODUCTION

Concrete is the world's most widely used construction material. The utilization of concrete is increasing at higher rate due to development in infrastructure and construction activities. Yet, there are some negative impacts due to more production of concrete such as continuous extraction of aggregates from natural resources which will lead to the depletion of aggregate resources, ecological imbalance and environmental degradation. For its suitability and adaptability with respect to the changing environment, the concrete must be such that it can conserve resources, protect the environment, economize and lead to proper utilization of energy. The utilization of reusable materials such as pumice, perlite, clay, coconut shell, rice husk, pumice, straw, coal slag, oil palm shells etc., in aggregates is particularly very promising as nearly 70-80% of concrete is made of aggregates. With increasing concern over the excessive exploitation of natural aggregates, lightweight aggregates which are produced from environment waste are viable new sources of structural aggregates material with its application in concrete considerably reduces the self- load of the structure and can be particularly used in areas where light weight concrete is required for non-load bearing walls, non-structural floors, and strip footing.

II. MATERIALS, SPECIFICATION AND PROPERTIES

In the experimental work ordinary Portland cement of 53 grade is used with specific gravity of 3.1.Fine aggregate used is river sand with specific gravity of 2.54 and maximum size of 4.75 mm .Based on sieve analysis according to IS 383:1970 fine aggregate confirming to Zone II is used .Sub rounded coarse aggregate with nominal size of 20mm with a specific gravity of 2.78 and impact value of 28.77 are used in this work. Coconut shell aggregate of size between 8mm to 16mm is used as partial replacement for the coarse aggregate. Specific gravity of coconut shell is 1.28.Glass fibre of 1mm length is used and 2.5g/cc specific gravity is added .

Table 1: Specifications of materials

Materials	Specification	Properties	Test Results
Cement	Grade 53-OP	Specific Gravity	3.1
Fine Aggregate	River Sand, Zone II	Specific Gravity	2.54
Coarse Aggregate	Sub rounded, Nominal size 20mm	Specific Gravity	2.78
		Impact Value	28.77
Coconut shell	8 to 16mm	Specific Gravity	1.28

Table 2:Properties of glass fibre

S.NO	Characteristics	Observation
1.	Moisture content %	< 0.20
2.	Combustible matter content %	0.8 – 2.0
3.	Tensile breaking strength %	> 0.25
4.	Length	12 mm
5.	Specific gravity	2.5 gm/cc

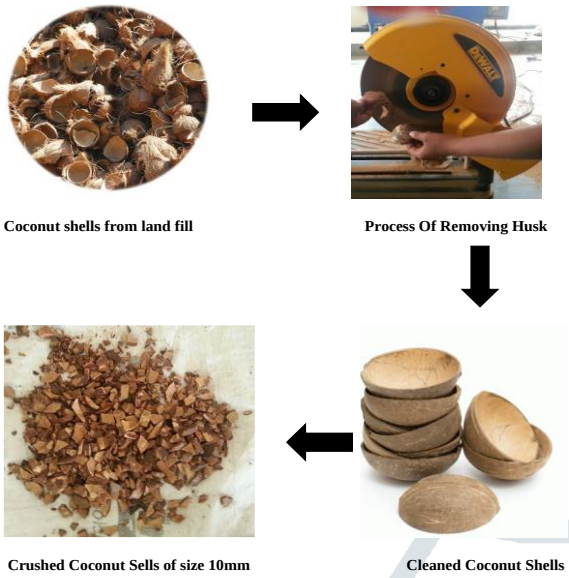

Figure 1: Coconut shell Aggregate

Figure 2: Properties of Glass Fibre

III. MIX DESIGN

Mix design is carried out as per IS 10262 -2019 for grades M40 for Nominal concrete. Concrete is then replaced with 10%, 20%, 30% coarse aggregates with coconut shell aggregate and 0.5%,1%,2% fibers are added.. Mix Id is assigned for different percentage replacements. For each mix Id 9 cubes are casted to test 7, 14 and 28 days strength.

Table 3:Mix Design

Mix Id	Fiber percentage	Replacement of coarse aggregate with coconut shell	Cement (Kg)	FA(Kg)	CA(Kg)	SF(Kg)
CC	0%	0%	372	645	1152	0
LWC1	0.5%	10%	372	645	1037	115
LWC2		20%	372	645	922	230
LWC3		30%	372	645	807	345
LWC4	1%	10%	372	645	1037	115
LWC5		20%	372	645	922	230
LWC6		30%	372	645	807	345
LWC7	1.5%	10%	372	645	1037	115
LWC8		20%	372	645	922	230
LWC9		30%	372	645	807	345

IV. EXPERIMENTAL METHOD

Initially preliminary investigation to identify the properties of materials is to be done. Mix design for M40 is done as per the IS 10262:2019 and final mix proportion is selected within the specified water limits. Concrete cubes are casted for both control mix and 10,20, 30 percentage partially replaced coconut shell aggregate with addition of fibers. Cubes are water cured and tested for compressive strength and density to determine light weight concrete. Cylinders of standard size 150 x 300 mm are casted to determine the tensile strength.. Batching was done as per the obtained mix design for M40 and M50 grades and mixing was done

in the tilting mixture for 1-2 min after addition of water. The concrete was casted in a pre-oiled cast iron moulds in 3 layers by tamping each layer with 25 blows. Then the tamped moulds were placed on the vibrator for compaction and surface finished neat and allowed to set for 24 hours. Later the cubes were kept in curing tank for 7, 14 and 28 days and the compressive strength for the respective days were tested. Impact test is conducted on coarse aggregate and coconut shell according to IS 283-1970 .The impact value of coconut shell aggregate is 9.3.

Table 4: Impact Test Values For Coarse Aggregates & Coconut Shells

Aggregate Type	Wt of Empty Mould (gms)	Wt of Mould + Aggregates (gms)	Impact Value = Difference in wts / Initial wt x 100
Coarse Aggregate	1908	2457	28.77
Coconut shells	1908	2087	9.3

V. RESULTS AND DISCUSSION

5.1 Test results on Fresh concrete

Workability of the fresh concrete is done through slump cone test for different percentage replacement of the coconut shell and fiber reinforced and control concrete. From the results tabulated workability decreased with percentage increase in replacement of coarse aggregate with coconut shell as well as with percentage increase in addition of fiber content. The workability decreased from 40mm for control concrete to 5mm for concrete with 30% coconut shell aggregate replacement and 1.5% fibre addition..

Table 5: Slump Values Of Concrete Mixes For Various Percentages Of Coconut shell Replacement and addition of fibers

Mix Id	CC	LWC1	LWC2	LWC3	LWC4	LWC5	LWC6	LWC7	LWC8	LWC9
Slump	40	40	30	28	38	27	26	36	28	25

5.2 Test results on Hardened concrete

For determining the compressive strengths, the specimens are cleaned and surface dried before placing in the Compression Testing Machine .The platen was lowered and touched the top surface of the specimen.The test is conducted as per IS 516-1959. The test results from table 6 shows the strength of concrete increased from 7 days to 28 days for all the mixes. The strength at 7 days is found to be 70 to75% of strength at days for all mixes

Table 6: Compressive Strength Of different mixes

Mix Id	Fiber percentage	Replacement of coarse aggregate with coconut shell	**7 days Strength (Mpa)**	**14 days Strength (Mpa)**	**28 days Strength (Mpa)**
CC	0%	0%	38.67	41.44	52.79
LWC1	0.5%	10%	26.44	29.35	35.99
LWC2		20%	20.17	25	28.53
LWC3		30%	16.23	22.15	23

LWC4	1%	10%	28.61	32.27	37.56
LWC5		20%	25.31	26.17	32.26
LWC6		30%	21.53	23.34	27.23
LWC7	1.5%	10%	31.86	33.78	39.15
LWC8		20%	27.24	30.27	38.12
LWC9		30%	22	28.12	32

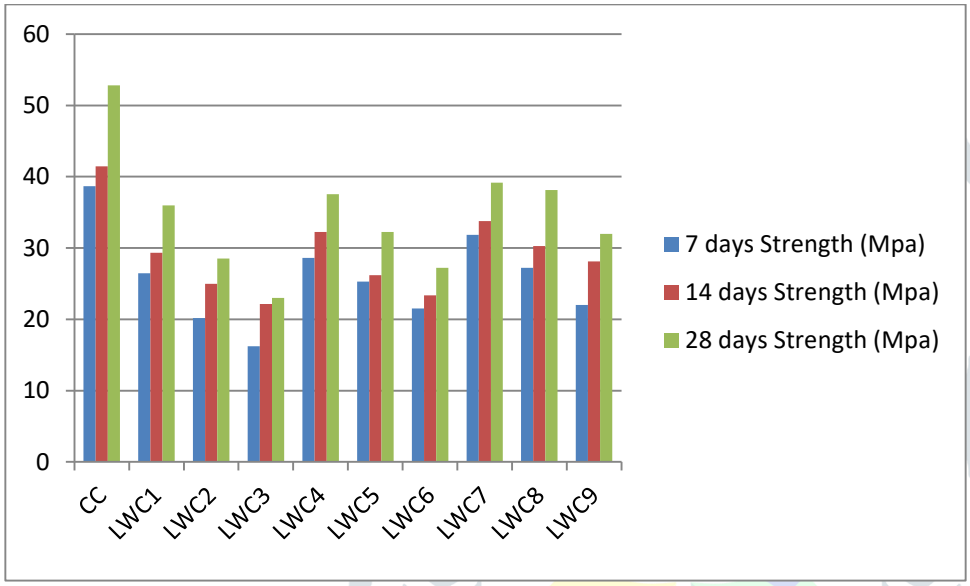

Figure 3 :Compressive Strength of different mixes

The trend in the graph shows the compressive strength for all the replacements with coconut shell decreased compared to the compressive strength of control concrete .The trend also shows irrespective of fibre content compressive strength of concrete decreased with increase in coconut shell aggregate. The trend of graph in the Fig: 3 shows the compressive strength of concrete partially replaced with 10% coconut shell aggregate decreased by 31.82% for 0.5% fibre addition ,29% for 1% fibre addition and 25% for 1.5% fibre addition to the concrete .With increase in fibre content from 0.5% to 1.5% the compressive strength increased by 5 to 10%. Among all the mixes the maximum compressive strength is obtained for 10% replacement with coconut shell and 1.5% addition of fibre.

Specimen are tested as per IS 5816:1999 to get split tensile strength. Maximum tensile strength is obtained for concrete partially replaced with 10% coconut shell aggregate and 1.5% addition of fibres is 4.22 Mpa. With addition of 1% and 1.5% fibre content and 10% coconut shell aggregate the tensile strength is almost near to the control concrete which is 4.12 Mpa.

Table 6 :Split Tensile strength of different mixes

Mix Id	CC	LWC1	LWC2	LWC3	LWC4	LWC5	LWC6	LWC7	LWC8	LWC9
Tensile Strength(Mpa)	4.12	3.91	3.72	3.31	4.11	3.82	3.6	4.22	4.0	3.8

From table the density of concrete is decreasing with increase in percentage replacement of coarse aggregate with coconut shell aggregate. The lowest density of concrete is 1714 kg/m^3 for 30% replacement with coconut shell.

Table 7: Density of concrete for various percentages of coconut shell aggregate

Type Of mix **Grade**	Nominal Mix	10% Replacement	20% Replacement	30% Replacement
Density(Kg/m^3)	2414	2190	1980	1714

VI. CONCLUSION

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- The maximum compressive strength is attained at 10% replacement with coconut shell aggregate with 1.5 % addition of fibre.
- The compressive strength attained at 10% replacement are greater than 30 Mpa, hence this concrete partially replaced with coconut shell can also be used as a structural light weight concrete as per ACI 318
- The strength attained at 1.5% fibre addition is greaterthan 30 Mpa, hence this concrete partially replaced with coconut shell can also be used as a structural light weight concrete as per ACI 318.
- The tensile strength of concrete decreased with increase in percentage of coconut shell aggregate.
- .Density of concrete decreased with increase in percentage of coconut shell with lowest density of 1714 Kg/m3
- The impact value of coconut shells obtained was less than 10% which can be used for wearing surfaces as per IS 283-1970

REFERENCES

[1] Experimental study on partial replacement of cement with egg shell powder and silica fume April 2017,Rasayan Journal of Chemistry 10(2):442-449
[2] Properties of concrete with eggshell powder as cement replacement,October 2014,Indian Concrete Journal 88(10):94-105

[3] Environmental impact and quality assessment of using eggshell powder incorporated in lightweight foamed concrete Hock Yong Tiong, Siong Kang Lim ⇑ , Yee Ling Lee, Chuan Fang Ong, Ming Kun Yew Lee Kong Chian Faculty of Engineering & Science, Universiti Tunku Abdul Rahman, Malaysia
[4] Olanipekun E.A. , A comparative study of concrete properties using coconut shell and palm kernel shell as coarse aggregates, International Journal of Building and Environment, 41(2006), pp. 297-301.
[5] Pravin V.Khandve, Shrikant M. Harle, Coconut shell as partial replacement of course aggregate on concrete, Prof. Ram, Megha College of Engineering, Amaravati.
[6] IS 456:2000. Plain and Reinforced Concrete- Code of Practice. Bureau of Indian.
[7] IS 383:1970. Specification for coarse and fine Aggregates from natural sources for concrete. Bureau of Indian Standards.
[8] IS 10262: 2009. Guidelines for Concrete Mix Design Proportioning. Bureau of Indian Standards.