International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 03 | Mar 2019 www.irjet.net p-ISSN: 2395-0072

An Experimental Study on Strength of Concrete by using Partial Replacement of Cement with Coconut Shell Ash and Coarse Aggregate with Coconut Shell

P. Ashokkumar[1], M.S. Keerthivas[2], D. Naveenboobalan[3], R. Pravin[4]

[1]*Assistant Professor, Department of Civil Engineering, Sona College of Technology, Salem, Tamilnadu, India*
[2,3,4]*UG Students, Department of Civil Engineering, Sona College of Technology, Salem, Tamilnadu, India*

Abstract - *Cement is used as binder material in the production of concrete. It can be lead to a search for alternative material for replacement of cement. The Ordinary Portland cement emits large amount of co_2. Waste material production is increasing day by day. The cost of cement is increasing day by day. Thus need to find alternative binding materials that can be used as partial replacement of cement. Agricultural waste material, in the case, coconut shell, is an environmental pollutant, it should be collected. Using coconut shell (CS) as partial replacement should be urged as a priority in construction cost lowering measure. Aggregates sources are depleting very fast leading to significant increase in cost of construction. The coconut shell ash is used for the partial replacement of cement. The laboratory tests result carried out using coconut shell ash (CSA) as a partial replacement for cement used in concrete. In this particular study, M30 grade of concrete was prepared by replacing coconut shell for coarse aggregate and also replacing cement with coconut shell ash. Cement is replaced by 10%, 15%, and 20% of coconut shell ash in cement. Coarse aggregate is replaced by 10%, 15%, and 20% of coconut shell in conventional aggregate. Test were carried out to find the compressive strength, Split tensile strength and corrosion resistance test using cube and cylinder specimens respectively. The results show that usage of coconut shell and coconut shell ash as partial replacement in light weight concrete.*

Key Words: Coconut Shell Ash, Coconut Shell, Compressive Strength, Replacement, Aggregate, Corrosion resistance, Split tensile strength.

1. INTRODUCTION

Infrastructure development across created the world demands for building construction materials. Concrete is used to construct the various types of concrete structures. Cement is leading material in concrete structure. Cement sources are depleting very fast leading to increase in cost of construction. Aggregate sources are depleting very fast to significant increase cost. Agricultural wastes increasing day by day. Its disposal has real problem. The coconut shell becomes eco-friendly material. Coconut shell being hard and not easily degrades material. Coconut shell burned in high temperature it can be produce coconut shell ash and it should be used for partial replacement of cement. Crushed coconut shell (20mm) size can be used for partial replacement of coarse aggregate. Reduction in the construction cost and light weight concrete produced. This aim is to determining the strength of the concrete by using partial replacement of cement with coconut shell ash (CSA) and coarse aggregate with coconut shell (CS) in concrete.

2. REVIEW OF THE LITERATURE

1. Pravin V. Khandve, Shrikant M.Harle **In** this literature partial replacement of coarse aggregate with coconut shell in the concrete. It can be help to reduce the waste and pollution. The construction industries have replaced conventional aggregate to light weight aggregate. It can be used to reduce the size of the members in the structures. In this experimental setup percentage of increase coconut shell the strength increase in 7days also the strength increased in 28 days curing strength. Replacement of coconut shell as coarse aggregate increases as the workability Of concrete increases. Replacement of coarse aggregate with coconut shell increases will reduce the specific gravity of concrete. Density of concrete should not be less than 2000 Kg/cum.

2. Kulkarni Parag Pramod, Prashant Ganpat Chavan, Pagar Chetan Bhaskar

Crushed coconut shells are replaced in concrete. Coconut shells are easily available at low cost price in our country. In this experimental study light weight concrete can be prepared by using aggregate with coconut shells. Water absorption and moisture content of the crushed coconut shell is found to be 24% and 4.24% respectively. Normally coconut shell aggregates having high water absorption capacity because of higher porosity in structure. The specific gravity of crushed coconut shell is 1.05.

3. Shaik.Aliimran Tippu and Vr.Prasanth Kumar In this literature have conducted compressive strength and split tensile strength characteristics with complete replacement of coarse aggregate with coconut shell to produce light weight concrete. To replace cement by exploitation silica fume admixtures with completely replacing percentages 0%, 10%, 15%, 20%, 25%, and 30%. The mix proportion

1: 1.47: 0.65 the concrete 63 cubes and 63 cylinders are casted for conducting test.

3. MATERIALS

3.1 Cement

OPC-53 grade of Ordinary Portland cement confirming to IS: 12269:- 2013 are used in this project. The test results are tabulated in table 1

Table 1: Test Result of Cement.

S. No	Description	Results
1	Specific gravity	3.15
2	Fineness	8%
3	Consistency	36%
4	Initial setting time	32minutes

3.2 Fine Aggregate

Fine aggregate are basically sands won from the land or marine environment. It generally consists of natural sand or crushed stone with most particles passing through the 9.5mm sieve. As the coarse aggregate these can be from primary, secondary or recycled sources.

Table 2: Test Result of Fine Aggregate.

S. No	Description	Results
1	Specific gravity	2.44
2	Fineness modulus	2.52
3	Bulk density (partial compact)	1461kg/m^3
4	Bulk density (fully compact)	1635kg/m^3

3.3 Coarse Aggregate

Coarse aggregate of size 20mm was used and tested as per IS: 2386:-1983. The test of specific gravity, fineness modulus and bulk density of coarse aggregate were conducted. The test results of coarse aggregate are given below the table.

Table 3: Test Result of Coarse Aggregate.

S. No	Description	Results
1	Specific gravity	2.83
2	Fineness modulus	2.77
3	Bulk density	1805.6kg/m^3
4	Aggregate crushing value	23.4%
5	Impact value	28%
6	Water absorption	2.34%

3.4 Coconut Shell Ash (CSA)

Coconut shell is an agricultural waste material. Thus their effective, conductive and eco-friendly utilization has always been a challenge for scientific applications. Coconut shell ash is used as partial replacement with replacement levels of 10%, 15%, and 20%. Light weight concrete can be produced by using partial replacement of cement with coconut shell ash.

Table 4: Chemical Composition of Coconut Shell Ash

S. No	CSA Chemical Composition	% of CSA
1	Silica dioxide (SiO_2)	35.97
2	Alumina (AL_2O_3)	24.12
3	Iron (Fe_2O_3)	13.48
4	Calcium oxide (CaO)	10.12
5	Magnesium oxide (MgO)	1.98
6	Na_2O	0.95
7	K_2O	0.83
8	P_2O_5	0.43
9	SO_3	0.71
10	LOI	4.29

Fig. 1: Coconut Shell Ash.

Table 5: Test Result of Coconut Shell Ash.

S. No	Description	Results
1	Specific gravity	3.15
2	Fineness	8%

Table 6: Consistency and Initial Setting Time of Coconut Shell Ash.

S. No	% of Replacement	Consistency	Initial Setting Time
1	10% of CSA	36 minutes	37 minutes
2	15% of CSA	38 minutes	39 minutes
3	20% of CSA	38 minutes	42 minutes

3.5 Coconut Shell (CS)

Coconut shell is an agricultural waste material. Coconut shell has high water absorption capacity. Agricultural waste like coconut shell is used in concrete alternative sources for aggregate. Light weight concrete can produce by using partial replacement of coarse aggregate with coconut shell. The percentage replacement of coarse aggregate by coconut shell was 10%, 15%, and 20%.

Fig. 2: Coconut Shell (20mm).

Table 7: Test Result of Coconut Shell.

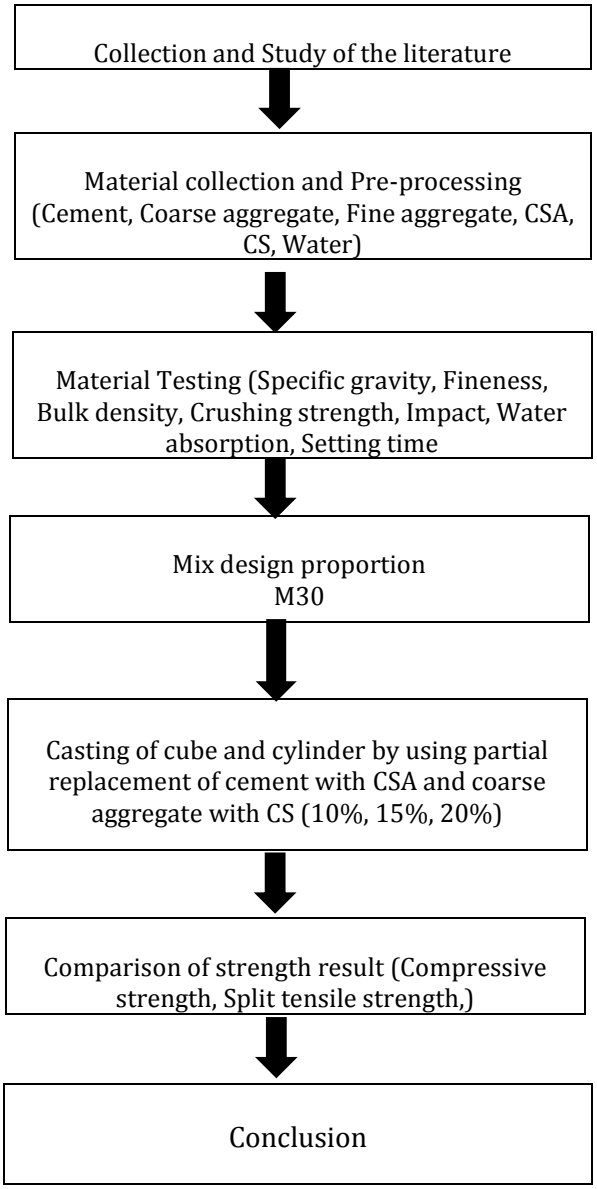
S. No	Description	Results
1	Specific gravity	1.28
2	Bulk density of	865kg/m^3
3	Aggregate crushing value	2.64%
4	Impact value	7.6%
5	Water absorption	23%

3.6 Water

Potable tap water available in laboratory with ph value of 7.0±1 and conforming to the requirement of IS 456-2000 was used for mixing concrete and curing the specimen as well.

4. EXPERIMENTAL WORK

4.1 Methodology



4.2 Concrete Mix Design

M30 grade of concrete was considered in this study of the project. Mix design was carried by using IS: 10262-2009 concrete mix proportioning first division code book. The mix ratio can be used in this experiment work is M30 grade (1: 1.26: 2.23: 0.4).

4.3 Mixing of Materials

Through mixing of materials is essential for the production of uniform coarse aggregate. The mixing should ensure that the mass becomes homogeneous, uniform in colour and consistency. The percentage replacement of cement with coconut shell ash were 10%, 15%, 20% and replacement of coarse aggregate with coconut shell were 10%, 15%, 20% are mixed.

Fig. 3: Mixing of Materials.

4.4 Casting of Specimen

After the sample has been remixed, immediately fill the cube moulds and cylinder moulds compact the concrete, either by hand or by vibration. Any air trapped in the concrete will reduce the strength of the cube and cylinder. To over compact the concrete as this may cause segregation of the aggregates and cement paste in the mix. Size of the cube (150mm x 150mm x 150mm)

Fig. 4: Casting of Cube.

Fig. 5: Casting of Cylinder.

4.5 Curing of Cubes and Cylinders

The concrete cubes and cylinders are kept wet a certain period after moulding so as to promote the hardening of cement. By proper curing, the durability of concrete are increased. By proper curing, shrinkage is reduced.

Fig. 6: Curing of Cubes and Cylinders.

5. SPECIMEN TESTING & RESULTS

5.1 Compressive Strength

Compressive strength is the applied pressure at which a given concrete sample fails. Compression test is the most common test conducted for concrete cube**.** Size of the concrete cube is 150mm x 150mm x 150mm. The cube specimen were cured and tested for 7days, 14 days, 28 days in compression testing machine. Compressive strength has been performed for 10%, 15%, 20% replacement of cement with coconut shell ash and coarse aggregate with coconut shell.

Compressive strength = (P/A) in N/mm^2

Fig. 7: Compressive Strength Test.

Table 8: Compressive Strength Result for 7th Day

S. No	Percentage Replacement of CSA and CS	7th Day Compressive strength in N/mm^2
1	10% of CSA and CS	21.06
2	15% of CSA and CS	24.03
3	20% of CSA and CS	21.51

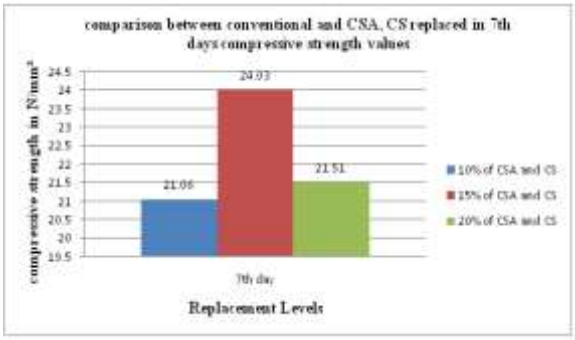


Chart -1: 7th Day Compressive Strength

Table 9: Compressive Strength Result for 14th Day

S. No	Percentage Replacement of CSA and CS	14th Day Compressive strength in N/mm²
1	10% of CSA and CS	28.63
2	15% of CSA and CS	31.12
3	20% of CSA and CS	28.03

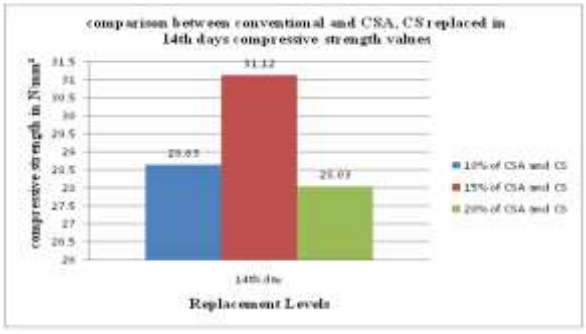


Chart -2: 14th Day Compressive Strength

Table 10: Compressive Strength Result for 28th Day

S. No	Percentage Replacement of CSA and CS	28th Day Compressive strength in N/mm²
1	10% of CSA and CS	32.12
2	15% of CSA and CS	37.24
3	20% of CSA and CS	31.46

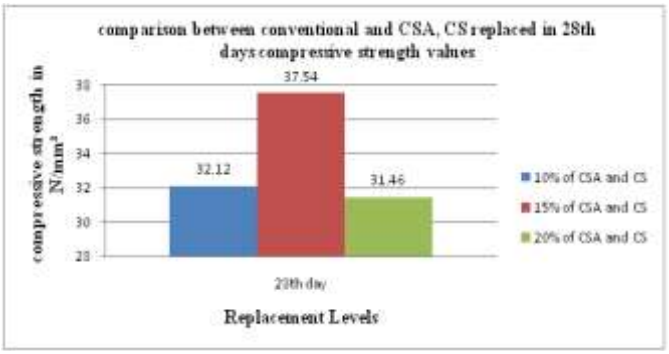


Chart -3: 28th Day Compressive Strength

5.2 Split Tensile Strength Test

Split tensile strength test on concrete cylinder is a method to determine the tensile strength of concrete. Split tensile strength test is conducted on compression testing machine. Split tensile strength was carried out on a cylinder specimen of dimensions 300mm height and 150mm diameter. The split tensile strength test specimen were cured and tested for 7days, 14 days, 28 days in compression testing machine.

Split tensile strength = $2P/\pi LD$ in N/mm^2

Fig. 8: Split Tensile Strength Test.

Table 11: Split Tensile Strength Result for 7th Day

S. No	Percentage Replacement of CSA and CS	7th Day Split Tensile strength in N/mm²
1	10% of CSA and CS	2.23
2	15% of CSA and CS	2.41
3	20% of CSA and CS	1.98

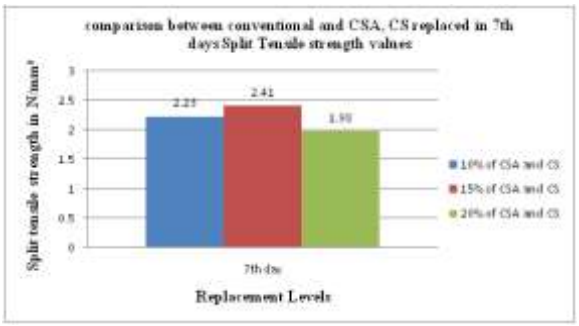


Chart -4: 7th Day Split Tensile Strength

Table 12: Split Tensile Strength Result for 14th Day

S. No	Percentage Replacement of CSA and CS	14th Day Split Tensile strength in N/mm²
1	10% of CSA and CS	2.81
2	15% of CSA and CS	2.90
3	20% of CSA and CS	2.53

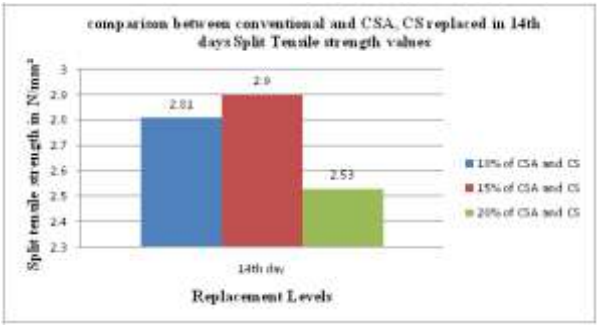


Chart -5: 14th Day Split Tensile Strength

Table 13: Split Tensile Strength Result for 28th Day

S. No	Percentage Replacement of CSA and CS	28th Day Split Tensile strength in N/mm²
1	10% of CSA and CS	3.02
2	15% of CSA and CS	3.12
3	20% of CSA and CS	2.90

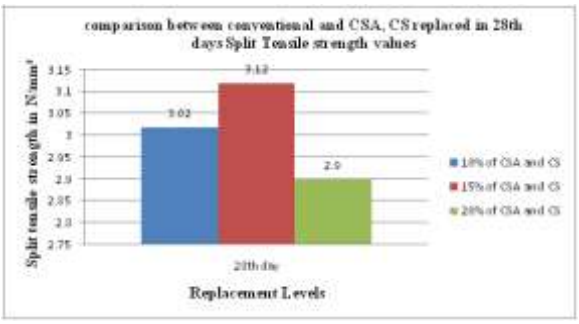


Chart -6: 28th Day Split Tensile Strength

6. CONCLUSION

The eco-friendly waste material coconut shell ash and coconut shell is used effectively for light concrete. The results obtained shows that coconut shell ash and coconut shell without any processing may replace by cement up to 15% by its weight. The required compressive strength is obtained from the 15% of replaced in light weight concrete. The required Split tensile strength is obtained from the 15% of replaced in light weight concrete.

REFERENCES

1. Dr. B. Rajeevan and Shamjith K M , "A Studyon the Utilization of Coconut Shell as Coarse Aggregate in Concrete" International Journal of Engineering Research & Technology (IJERT), July-2015, 4(7), 2278-0181.

2. G.Priyanga, K. Mohamed Rameez Raja, "Experimental Investigation of Partial Replacement of Coarse Aggregate by Using Coconut Shell and Fine Aggregate by Using M.Sand in Concrete" International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET), May 2018, Vol. 7, Issue 5, 2319-8753.

3. IS10262:2009, "Indian Standard for Concrete Mix Proportioning – Guidelines, Bureau of Indian Standard", New Delhi.

4. Shrikant Varpe, "Sustainable Concrete by Partially Replacing Coarse Aggregate Using Coconut Shell", Journal on Today's Ideas– Tomorrow's Technologies, June 2014, 2(1), 41-54.

5. IS 456:2000, "Indian Standard for Plain and Reinforced Concrete - Code of Practice, Bureau of Indian Standard", New Delhi.

6. Apeksha Kanojia, S.K. Jain, "Performance of Coconut Shell as Coarse Aggregate in Concrete", International Research Journal of Engineering and Technology (IRJET), July-2015, Volume: 02 Issue: 04.

7. Pravin Khanbve,IJPRET,2014, "Coconut shell as partial replacement of Coarse aggregate in concrete", International Journal of Pure and Applied Research in Engineering and Technology (IJPRET), June 2014; Volume 2 (9): 62-66.

8. Kabiru Usman Rogo, Selah Abu-Bakr, "Exploratory study of coconut shell as aggregate in concrete production", Journal of Engineering and Applied Sciences (JEAS), Dec 2010, Vol.2.

9. Utsev,J.T,Taku,J.K,2012, "Coconut shell ash as partial replacement of ordinary Portland cement in concrete production", International Journal of Scientific and Technology Research (IJSTR), September 2012, Vol.1,Issue 8, pp 86-89.

10. Amarnath Yerramala, Ramachandrudu C, "Properties of Concrete with Coconut Shells as Aggregate Replacement", International Journal of Engineering Inventions (IJEI), October2012, Volume 1, Issue 6, PP: 21-31.