International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.03, April 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

EXPERIMENTAL STUDY ON STRENGTH CHARACTERISTICS ON M20 CONCRETE WITH PARTIAL REPLACEMENTOF CEMENT WITH SILICA POWDER AND COARSE AGGREGATE WITH COCONUT SHELL

Shilpa Mahajan[1] , Aghav Manoj[2], Chavan Yogesh[3], Kale Abhishek[4], Kasangar Govinda[5], Keskar Anil[6], Kulkarni Aditya[7]

ABSTRACT

An attempt has been made to examine the suitability of replacing the 10% and 20% of silica powder with cement and simultaneously by replacing 10%, 20% of coconut shell as coarse aggregate for concrete of grade M20. Examine strength characteristics such as compressive strength, split tensile strength and flexural strength of concrete mix are found for 7 days, 14 days, 28 days of curing period and results are analyzed and compared with the regular (conventional) mix. Test for grade as per specified procedure of IS codes. The materials are proportioned by their weight. The water cement ratio is obtained by conducting workability tests. The results found were comparable with that of conventional mix.

Index Terms- Coarse aggregate, coconut shell, concrete, silica powder, cement, compressive strength split tensile strength, flexural strength.

I. INTRODUCTION

Infrastructure development across the world created demand for construction materials. Concrete is the premier civil engineering construction material. Concrete manufacturing involve consumption of ingredients, aggregates, water and admixture(s). Among all the ingredients, aggregates form the major part. Use of natural aggregate in such a rate leads to a question about the preservation of natural aggregates sources. In addition, operations associated with aggregate extraction and processing are the principal causes of environmental concerns. In light of this, in the contemporary civil engineering construction, using alternative materials in place of natural aggregate in concrete production makes concrete as sustainable and environmentally friendly construction material. Different alternative waste materials and industrial byproducts such as fly ash, bottom ash, recycled aggregates, foundry sand, china clay sand, crumb rubber, glass were replaced with natural aggregate and investigated properties of the concretes. Apart from above mentioned waste materials and industrial byproducts, few studies identified that coconut shells, the agricultural by product can also be used as aggregate in concrete.

According to a report, coconut is grown in more than 86 countries worldwide, with a total production of 54 billion nuts per annum. India occupies the premier position in the world with an annual production of 13 billion nuts, followed by Indonesia and the Philippines. Limited research has been conducted on mechanical properties of concrete with coconut shells as aggregate replacement. However, further research is needed for better understanding of the behavior of coconut shells as aggregate in concrete. Furthermore, there is no study available in the literature on the transport properties which determine durability of the concrete. Thus, the aim of this work is to provide more data on the strengths coconut shell concretes at different coconuts shells (CS) replacements and study the transport properties of concrete with CS as coarse aggregate replacement. Furthermore, in this study, the effect of fly ash as cement replacement and aggregate replacement on properties of the CS replaced concrete was also investigated. The high demand for concrete in the construction using normal weight aggregates such as gravel and granite drastically reduces the natural stone deposits and this has damaged the environment thereby causing ecological imbalance, there is a need to explore and to find out suitable replacement material to substitute the natural stone. In developed countries , many natural materials like Pumice ,Scoria and Volcanic debris and manmade materials like expanded blast-furnace slag, vermiculite and clinker are used in construction works as substitutes for natural stone aggregates. In India, commercial use of non- conventional aggregates in concrete construction has not yet started.

India is the third largest producer of coconut products in the world. Coconut trees are widely cultivated in the southern states of India, especially Kerala. Kerala is densely populated state and most of its population uses coconut or it's byproducts in their daily activities. Coconut shells thus get accumulated in the mainland without being degraded for 100 to 120 years. Disposal of these coconut shells is therefore a serious environmental issue. In this project , the study on use of coconut shells as a substitute or replacement for coarse aggregates in concrete is gaining importance in terms of possible reduction of waste products in the environment and finding a sustainable alternative for non renewable natural stone aggregates.

II.COCONUT SHELL AS COARSE AGREGATE

The concrete obtained using Coconut Shell aggregates satisfies the minimum necessities of concrete. Coconut Shell concrete has superior workability because of the smooth surface on one side of the shells. The impact resistance of Coconut Shell concrete is high when compared with conventional concrete. Moisture retaining and water absorbing capacity of Coconut Shell are more compared to conventional aggregate. The amount of cement content may be more when Coconut Shell are used as an aggregate in the production of concrete compared to conventional aggregate concrete. The presence of sugar in the CS as long as it is not in a free sugar form, will not affect the setting and strength of concrete. It is found that wood based materials, being hard and of organic.

III.OBJECTIVES

- To reduce the coconut waste generated.
- To prepare light weight concrete by using coconut shell as coarse aggregate partially.
- Coconut shell can be use as an economical civil engineering material.

IV. RESEARCH MATERIAL AND TESTING

4.1 MATERIALS

Research material are cement, natural fine aggregate, coarse aggregate, water and coconut shell.

4.1.1 COCONUT SHELL

Coconut shell is obtained from temples etc. they were sun dried for minimum 1 month before using crushed manually. The particle size of the coconut shell range from 5mm to 20mm. Cement- Ordinary Portland cement of 53 grade conforming to Indian Standard IS 12269-1987 9 was used throughout the experimental program.

4.1.2 FINE AGGREGATE

Naturally occurring fine aggregates are used.

4.1.3 COARSE AGGREGATE

Crushed hard basalt chips of maximum size 20 mm were used in the concrete mixes. The bulk density of aggregate was 1545 kg/m3 and specific gravity was found to be 2.77

4.1.4 WATER

Portable water conforming to IS 456-2000 was used for casting and curing.

V. TESTING METHODOLOGY

Test is carried out for finding compressive strength by using following experimental procedure.

Fig.1 Methodology

VI. CONCRETE MIX DESIGN

Mix design is the process of selecting appropriate ingredients of concrete and determining their qualified amounts with the objective of producing a concrete of the compulsory strength, durability and workability as economical as possible.

6.1 DESIGNS FOR M20 GRADE OF CONCRETE

1. As per IS 10262:2009 mix design of M20 grade concrete we have to taken for experimental work.
2. Sieve analysis is done for zone determination so as per IS 383-1970
3. Condition of exposure is moderate :as per IS 456-2000, page no. 20 Table no. 7 For M20 grade of concrete, minimum cement content =300kg/m3. Maximum free W/C ratio = 0.5.
4. As cement is OPC is considered.
5. Size of aggregate =4.76-12.5 mm (angular).
6. Workability of concrete: The concrete mix proportion chosen should be such that the concrete is of adequate workability for the placing condition of the concrete and can properly be compacted.
7. Degree of workability: medium.
8. Degree of supervision: Good

VII.SAMPLE CALCULATION FOR CONCRETE MIX

Standard cube are of 0.15mX0.15mX0.15m

No of Cubes= 36

Mix proportion for M20 grade cement=1:1.5:3

7.1 FOR M20 GRADE

For 12 cubes – Control Mix

12(0.15 X 0.15 X 0.15)=0.0404m3

Assume 50% Extra for mixing = 0.0404X1.5=0.06075 m3

Mix proportion:-1:1.5:3=5.5

Volume of cement=(0.06075)/(5.5)=11.05 X 10-3

Weight of cement=11.05 X 10-3 X 1428 kg/m3=15.77Kg

Cement =15.77kg =16kg

Sand=1.5 X 16=24 kg

Aggregate=3 X 16=48kg

7.1.1 FOR 10%-10% REPLACEMENT (90%CA+10% CS) (90%CE+10%SP)

For 9 cubes

$Cement_{+}$ = 11.82kg

Sand=1.5 X 11.82=17.73 kg

10% Coconut Shell = 35.46 Kg X (10/100)= 3.546kg

Coarse aggregate=35.46kg-3.546kg =31.92kg

10% Silica Powder=11.82Kg X (10/100) = 1.182Kg

Cement=11.82Kg-1.182=10.6Kg

7.1.2 FOR 10%-20% REPLACEMENT (90%CA+10% CS) (80%CE+20%SP)

For 9 cubes

Cement=11.82 kg

Sand=1.5 X 11.82=17.73kg

10% Coconut Shell = 35.46 Kg X (10/100)= 3.546 kg

Coarse aggregate=35.46kg -3.546kg =31.92kg

20% Silica Powder=11.82Kg X (20/100) = 2.364Kg

Cement=11.82Kg-2.364=9.456Kg

7.1.3 FOR 20%-10% REPLACEMENT (80%CA+20% CS) (90%CE+10%SP)

For 9 cubes

Cement=11.82 kg

Sand=1.5 X 11.82=17.73kg

20% Coconut Shell = 35.46 Kg X (20/100)= 7.09 kg

Coarse aggregate=35.46kg -7.09kg =28.37kg

10% Silica Powder=11.82Kg X (10/100) = 1.182Kg

Cement=11.82Kg-1.182=10.63Kg

7.1.4 FOR 20%-20% REPLACEMENT (80%CA+20% CS) (80%CE+20%SP)

For 9 cubes

Cement=11.82 kg

Sand=1.5 X 11.82=17.73kg

20% Coconut Shell = 35.46 Kg X (20/100)= 7.09 kg

Coarse aggregate=35.46kg -7.09kg =28.37kg

20% Silica Powder=11.82Kg X (20/100) = 2.364Kg

Cement=11.82Kg-2.364=9.456Kg

CA= Coarse Aggregate, CS= Coconut Shells, CE= Cement, SP= Silica Powder

Fig.2 Cube Casting Samples.

VIII.COMPRESSIVE STRENGTH RESULTS:-

Sr no	Coconut shell replaced (%)	Silica powder replaced (%)	Compressive strength (Mpa)		
			7days	14 days	28 days
1	10	10	12.95	16.70	-
2	20	10	14	19.43	-
3	10	20	12.68	20.12	-
4	20	20	11.22	16.47	-

Table 1:- Results

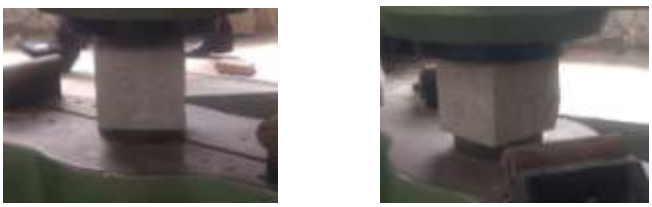

Fig.3 Testing On UTM

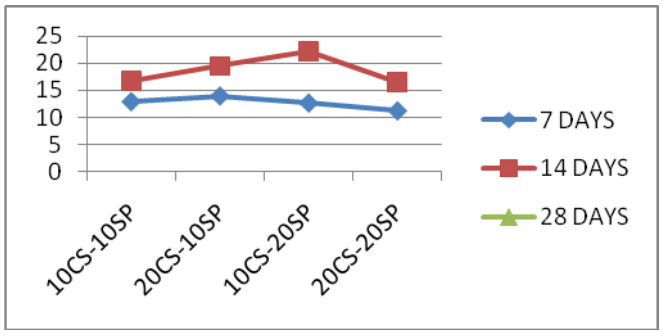

Fig.4 Testing Results

IX.RESULT DISCUSSION AND CONCLUSION

Overall cost of construction will reduced. The maximum compressive strength in control mix is 20.12 N/mm2 at 14 days, while the minimum strength at same days is 16.47 N/mm2. Thus compressive strength decreased as percentage of coconut shell is increased. Therefore coconut shell can be used where light weight concrete is required. Proper bonding between coconut shell and cement is not possible because of surface area of coconut shell aggregate.In future, we can increase strength of coconut shell concrete by adding admixtures.

REFERENCES

[1.] **J. P. Ries, J. Speck, (2010),** "Lightweight Aggregate Optimizes the Sustainability of Concrete", Concrete Sustainability Conference, National Ready Mixed Concrete Association.

[2.] **Vishwas P. Kukarni and Sanjay kumar B. Gaikwad**, Comparative Study on Coconut Shell Aggregate with Conventional Concrete, Journal of Engineering and Innovative Technology (IJEIT) Volume 2, Issue 12, June 2013.

[3.] **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): 2250-3021, ISSN (p): 2278-8719 Vol. 04, Issue 04 (April. 2014).

[4.] **Olanipekun, E.A., Olusola, K.O. and Ata, O**., "A comparative study of concrete properties using coconut shell and palm kernel shell as coarse aggregates". Building and Environment 41: 297-301,2006.

[5.] **Amarnath Yerramala Ramachandrudu C**, Properties of Concrete with Coconut Shells as Aggregate Replacement, International Journal of Engineering Inventions, vol.1, Issue 6, October 2012.

[6.] **Amarnath Yerramala Ramachandrudu C**, Properties of Concrete with Coconut Shells as Aggregate Replacement, International Journal of Engineering Inventions, vol.1, Issue 6, October 2012.