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Experimental Investigation of Partial Replacement of Coarse Aggregate by Using Coconut Shell and Fine Aggregate by Using M.Sand in Concrete

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ABSTRACT: The high cost of conventional construction material affects economy of structure. With increasing concern over the excessive exploitation of natural aggregates, synthetic lightweight aggregate produced from environmental waste is a viable new source of structural aggregate material. It is also help in reducing the cost of concrete manufacturing. In the present work coconut shell as partial replacement for coarse aggregate and manufactured sand as partial replacement for fine aggregate in concrete is used. Density of coconut shell is in the range of 550-650 kg/m³ and these are within the specified limits for light weight aggregate. Water used for mixing of concrete is potable water. Cube will be casted and the compressive strength and workability will be evaluated at 7, 14 and 28 days. Its utilization is cost effective and eco-friendly.

KEYWORDS: coconut shell, manufactured sand, fine and coarse aggregate

I. INTRODUCTION

The concrete is world's most widely used construction material. The utilization of concrete is increasing at a higher rate due to development in infrastructure and construction activities all around the world. Increasing demand of natural aggregate show that crushed stone demand will be 2050 million metric tonnes in 2020. However there are some negative impacts of more production of concrete like continuous extensive extraction of aggregate from natural resources will lead to its depletion and ecological imbalance. Researchers are in search of replacing coarse aggregate to make concrete less expensive and to lead sustainable development. This environmental reason has generated a lot of concern in the construction world. The use of sugarcane bagasse, wooden chips, plastic waste, textile waste, polyethylene, rice husk ash, rubber tyres, vegetable fibers, paper and pulp industry waste, groundnut shell, waste glass, broken bricks are some examples of replacing aggregates in concrete.

SCOPE AND OBJECTIVE:

- To find economical solution for high cost construction material.
- To prepare lightweight concrete by using coconut shell as course aggregate.
- Reducing pollution by using a waste material
- It promotes green construction
- Coconut shell resist towards crushing, impact and abrasion
- There is no need of treating coconut shell before usage.

II. METHODOLOGY

COCONUT SHELL

- Replacement of coarse aggregate was done with coconut shell. Waste coconut shell available in hotels were collected and used as a coarse aggregate.

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 7, Issue 5, May 2018

• These coconut shells were oven dried for 1 day at a temperature of 50°C. After taken out from the oven the surface of the shells were thoroughly cleaned by removing the coconut coir and ashes.

- Then the shells were broken into pieces. The pieces were sieved through the 12mm IS sieve.
- The shells retained in the IS sieve 12mm is used for the replacement.



Fig1.coconut shell and coconut shell aggregate

M.SAND

- The M sand was manufactured from the quarry dust and gravel dust.
- The specific gravity of M sand was found as 2.84
- For producing the stone particles about 40 -60 % dusts or wastes created.
- The M sand has a fineness modulus as 2.67.
- The water could be observed by the M sand as 5.6% than the natural river sand.
- The bulk density of manufactured sand was 1860 Kg/m³.

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Vol. 7, Issue 5, May 2018



Fig2.M sand

S.No	IS Sieves	Natural River Sand (%)	M Sand (%)	Remarks
1.	4.75mm	96	93	ZONE –II
2.	2.36mm	88	85	
3.	1.18mm	74	71	
4.	600micron	49	46	
5.	300micron	17	18	
6.	150micron	3	3	

1. Sieve Analysis Report of Fine Aggregate

COARSEAGGREGATE

- Crushed granite of size 20mm is used as a coarse aggregate.

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Vol. 7, Issue 5, May 2018

- The coarse aggregate is having dust particles and so it could be cleaned well by washing and removing the dust particles.
- The sieve analysis of fine and coarse aggregates is confirmed to IS10262.

FINE AGGREGATE

- Sand used for the experimental program was locally procured and confirmed to Indian standard Specifications IS: 383-1970.
- The sand was sieved through BIS 4.75mm sieve to remove any particles greater than 4.75 mm and then was washed to remove the dust.
- Fine aggregate was test as per IS 2386-1963.
- The specific gravity of fine aggregate was 2.65

S.No	Properties	Observed value
1.	Fineness Modulus	2.23
2.	Specific gravity	2.65
3.	Water absorption	0.96 %

2.Properties of Fine Aggregate

CEMENT:

- The cement used was ordinary Portland cement (43 grade).
- It is a basic ingredient of concrete, mortar and plaster.
- It consists of the mixture of oxides of calcium, silicon and aluminum.
- Portland cement are made by heating limestone with clay and grinding this product with source of sulphate.
- Specific gravity of cement measured as 3.15.
- Fineness of cement is measured as 90%

Portland cement is manufactured by crushing, milling and proportioning the following materials:

- Lime or calcium oxide, CaO: from limestone, chalk, shells, shale or calcareous rock
- Silica, SiO₂: from sand, old bottles, clay or argillaceous rock; Alumina, Al₂O₃: from bauxite, recycled aluminum, clay
- Iron, Fe₂O₃: from clay, iron ore, scrap iron and fly ash Gypsum, CaSO₄.2H₂O: found together with limestone

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Vol. 7, Issue 5, May 2018

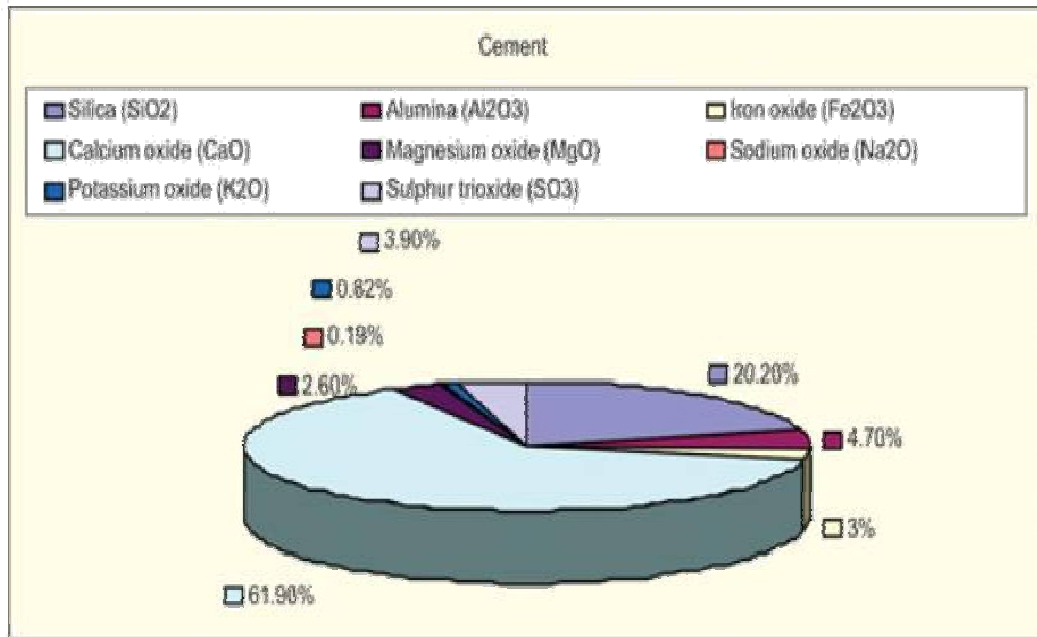


Fig3.chemical composition of cement

III. MIX DESIGN AND MIX PROPORTION

- The concrete mix design was proposed by using Indian Standard for control concrete.
- The grade was M20.
- Hand mixing and weight batching is used.
- The mix proportion of concrete was arrived using IS 10262-2009.

Cement : Fine aggregate : Coarse aggregate
1.00 : 1.50 : 3.00

The w/c ratio could be assumed as 0.50.



Fig4.Hand mixing

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Vol. 7, Issue 5, May 2018

MATERIALS	MIX 1(%)	MIX 2(%)	MIX 3(%)	MIX3(%)
Coarse aggregate	90	85	80	75
Coconut shell	10	15	20	25
Fine aggregate	80	60	40	20
Manufactured sand	20	40	60	80

3.Mix proportion of concrete

MOULDING

- Cube size - 150X150X150mm
- 20 specimens to be casted for 4 type of mix to determine the compressive strength.
- Cylinder size - 150mm diameter and 300mm height –
- 20 specimen to be casted for 4 type of mix to determine the split tension strength.



Fig5.Moulding of cube and cylinder

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Vol. 7, Issue 5, May 2018

DEMOULDING

The specimen will be de-moulded after 24 hours of casting.



Fig6.De-moulded cube and cylinder

CURING AND TESTING

After demoulding, the specimen will be cured for 28 days. Compressive strength will be calculated in 7 days, 14 days and 28 days. Split tension test will be tested after 28 days of curing of concrete.



Fig7. Curing of Cubes and cylinders

CUBE COMPRESSIVE STRENGTH

For cube specimens testing of concrete, 150mm x 150mm x 150mm size cubes were used. All the cubes were tested in saturated condition, after wiping out the surface moisture. The cubes were tested by using Universal testing machine of 400KN capacity at the age of 7, 14 and 28 days of curing.

The tests were carried out at a uniform stress of 10 kg/cm²/minute after the specimen has been centered in the testing machine. Loading was continued till the readings were reversed from the incremented values. The reversal in the reading value indicates that the specimen was failed. The machine was stopped and the reading at that instant was noted

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Vol. 7, Issue 5, May 2018

which was the ultimate load divided by the cross sectional area of the specimen is equal to the ultimate compressive strength of concrete.

$$\text{Compressive strength} = P / A$$

Where, P = Maximum load

A = Area of specimen



Fig8. Testing of cubes

CURING DAYS	COMPRESSIVE STRENGTH IN N/mm ² for various mix				
	0%	c.s(10%) m.s(20%)	c.s(15%) M.s (40%)	c.s(20%) m.s(60%)	c.s(25%) m.s(80%)
7 DAYS	15.09	14.47	14.08	13.95	13.60

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Vol. 7, Issue 5, May 2018

14 DAYS	18.63	17.40	16.96	15.02	14.01
28 DAYS	20.27	18.91	17.89	16.88	15.48

4. Compressive strength of various mix

SPLIT TENSILE STRENGTH

For split tensile strength of concrete, 150mm dia. and 300mm height cylinders were used. The split tensile strength on cylinder was conducted on a Universal testing machine of capacity 400 KN. The method covers the determination of the splitting tensile strength of cylindrical concrete specimens. This method consists of applying a diametric compressive force along the length of a cylindrical specimen. This loading includes tensile stresses on the plane containing the applied load. Tensile failure occurs rather than compressive failure.

Split tension test is obtained by the maximum load is divided by appropriate geometrical factors to obtain the split tensile strength of concrete.

$$\text{Split tensile strength} = \frac{P}{Ld}$$

P = maximum load in Newton's applied to the specimen

l = length of the specimen

s

d = cross sectional diameter of the specimen

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 5, May 2018



Fig9. Testing of cylinders

CURING DAYS	TENSILE STRENGTH in N/mm ²				
	0%	c.s(10%) m.s(20%)	c.s(15%) m.s(40%)	c.s(20%) m.s(60%)	c.s(25%) m.s(80%)
28 DAYS	3.39	3.16	2.94	2.76	1.86

5. Tensile strength of various mix

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Vol. 7, Issue 5, May 2018

III. CONCLUSION

In this experiment coconut shell was used as a partial replacement of coarse aggregate and M sand was used as a partial replacement of fine aggregate in concrete. The concrete was prepared under various mix combinations of materials. The compressive and tensile strength were found. This experiment is mainly for giving economic as well as eco-friendly concrete.

The following conclusions were drawn

- It is observed that the utilization of supplementary coarse and fine aggregate materials is well accepted because of the several improvements possible in composite and due to overall economy.
- It improves the consistency and workability of fresh concrete because an additional volume of fine and coarse aggregate is added to the mixture. These materials modify the microstructure of concrete and reduce its permeability thereby reducing the penetration of water.
- The of M Sand and coconut shell replacement in concrete

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