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EXPERIMENTAL INVESTIGATION ON EFFECTS OF PARTIAL REPLACEMENT OF COCONUT SHELL IN CONCRETE

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Abstract - Concrete is the mixture of different materials such as follows coarse aggregate, fine aggregate, cement & water content; all of them are mixed in various proportions to achieve various specific strength. Cement being the most important material which plays an important role as a binding material in concrete. Waste glass powder is in the form of fine aggregate which is used to increase the workability and time to consolidate concrete. Coconut shell as coarse aggregate can be used as filler material. Researches has investigated that glass powder possess pozzolana properties due to increase in silica content, so it can replace fine aggregate to certain degree and which is effectively increase the strength and also increase workability of concrete. The chemical composition of the coconut shell taken under study is almost similar to that of ordinary aggregate. In this experiment, the coconut shell is crushed into 25-30mm and replaced in following ratios 20%, 25%, 30%. The coconut shell plays major role as coarse aggregate in all the combination of concrete cubes and cylinders. The proportion of the mineral and mixtures are applied in testing for their workability, compressive strength and split tensile strength checks

***Key Words*:** Coconut shell, waste glass powder, workability, compressive strength and split tensile strength

1. INTRODUCTION

Concrete is generally most broadly utilized development material in India with yearly measure of utilized surpassing 100 million cubic meters. Concrete is the blend of coarse totals, fine totals, bond and water. Presently days there are shortage of regular asset is enormous issue. The measure of material of cement is constrained. So there is many waste material are utilized to supplant as a solid material. Coconut shells likewise one of the waste materials which can supplant as a totals in a solid. India is the third biggest maker of coconut on the planet. Coconut shell (CS) which is the loss from coconut is having huge transfer issue. It is accessible in vast amounts all through the waterfront part of India. It speaks to over 60% of the aggregate waste volume. Bamgboye and Jekayinfa lamented that 90% of coconut was disposed of as waste and either consumed in the outside or left to settle in squander lakes. This strategy the coconut preparing ventures squander as indicated by him delivering fundamentally to CO2 and methane outflows. The biggest accessibility of coconut shell makes it a reasonable and reliable option for total in concrete. This will have two preferred standpoint of waste administration and in addition contamination control. In another hand, Blended concrete is created by utilizing powdered glass and coconut can be use as substitution in concrete.

2. OBJECTIVES OF THE PROJECT

The main objective of the study is to use the waste materials (coconut shells and glass waste) in place of coarse and fine aggregates respectively in the various proportion to achieve certain properties of the concrete and also its effects on the strength in the construction industry. Further, the effects of concrete are to be determined by testing workability, tensile strength, compressive strength, durability, etc. of cement concrete. The main objectives of the study are summarized below;

1. To investigate the effect of partial replacement of coarse aggregates& fine aggregates with coconut shells and waste glass respectively and their properties of concrete.
2. To find better, sustainable and economical solution for high demand aggregate material in making concrete construction.
3. To prepare lightweight concrete by using coconut shell as coarse aggregate and waste glass as fine aggregate.

3. METHODOLOGY

The methodology which was followed in this project has shown in below.

a) The first and foremost process of methodology is to select the experimental project title.
b) The next and most important process of methodology is to select the appropriate literature review paper for further study.
c) The material collection should be taken as per the experiment contest and selected materials should be subjected to testing to gain their properties.
d) Then the materials are carried out on appropriate mix design and mixed into experimental specimens.
e) The experimental specimens are further subjected to testing and observation.
f) In this experimental project the main testing are to identify the compressive and spilt tensile strength of hardened concrete.
g) The results are to be obtained and recorded.
h) At least the recorded values are calculated and brought to conclusion.

4. MATERIALS USED

a. Cement

Cement is a fine grayish powder. Generally it is made from limestone and clay or shale. These raw materials are extracted from quarry where they are processed and blended to correct proportions. Cement is important ingredient which acts as binding material in concrete. Ordinary cement of grade 53 confirming to IS: 12269-1987, S.G of cement is found to be 3.15 which is used in this experimental programme.

Table-1: Chemical constituents of PPC

Lime (Cao)	60 to 67%
Silica (Sio_2)	17 to 25%
Alumina (Al_2O_3)	3 to 8%
Iron Oxide (Fe_2O_3)	0.5 to 6%
Magnesia (MgO)	0.1 to 4%
Sulphur Trioxide (SO_3)	1 to 3%
Soda and /or Potash ($Na_2O + K_2O$)	0.5 to 1.3%

b. Fine Aggregate

The aggregate which are passes through 4.75mm size IS sieve and the coarse grained materials as permitted by the above specifications are generalized as fine aggregate. M-sand used for experimental work which is locally procured and confirmed to grading. Fine aggregate passing through 4.75 mm IS sieve are used in this experiment programme. Sieve analysis, water absorption, specific gravity are monitored as per IS: 2386-1963(Part I & II)/IS: 383-1970.

c. Coarse Aggregate

Generally coarse aggregate is obtained from blasting in stone quarries or breaking them by manually or by crusher. Aggregate is called bound materials when it is mixed with cement and referred to as unbound material when used without cement. Aggregate makes up 60 to 80% of concrete. Coarse aggregate passing through 20mm sieve is used in experimental programme.

d. Water

Water is used for mixing and curing shall be clean and free from oils, acid, organic materials or other substances may cause defects to concrete and steel may corrode. Water controls the fresh and hardened properties in concrete.

e. Waste Glass Powder

Waste glass powder is a kind of reactive pozzolan inhibitor. It can enhance the properties of concrete with appropriate particle size and dosage. They act as admixture to increase workability and time to consolidation.

f. Coconut Shell

Coconut shell can be used in concrete as coarse aggregate. It is one of the disposable waste from farming activities. There are several characteristics such as workability, compressive strength, flexural tensile, water absorption are conducted. They contain high specific strength to weight ratio and low density less abrasion to machine.

Fig.1 Collection of Coconut shell

The physical of Coconut shell have been discussed in below table.

Table-2: Some physical properties of Coconut shell

S.NO	PROPERTIES	RESULTS
1	Specific gravity	1.65
2	Bulk density	750 kg/m^3
3	Impact value	8.45%

g. Glass Powder

Glass Powder is used in **Ceramic & Refractory Industries**. It is used as abrasives. Glass Powder reduces the quantity of cement to be used in concrete. Also glass powder is proved to be economical and is considered as environmental friendly construction material. While concrete is in its plastic phase, glass powder will increase its workability, so it requires less energy, cost and time to place and consolidate the concrete. While the concrete is in its hardened phase, concrete containing glass powder exhibits better strength, freeze-thaw resistance and sulfate resistance.

5. LABORATORY INVESTIGATIONS

a. Test on cement

Specific gravity test has been conducted on selected cement sample and the specific gravity of cement has been found as 3.12

Table-3: Laboratory test observations of Cement

DESCRIPTION	RECORD (in Kg)
Weight of empty vessel [W_1]	0.14
Weight of cement (1/3 of flask) [W_2]	0.206
Weight of cement (1/3) + kerosene (2/3) [W_3]	0.425
Weight of kerosene W_4	0.386
S.G=(W2-W1) / { (W2-W1) - (W3-W4) } X 0.79	3.12

b. Test on Fine Aggregate

Specific gravity test has been conducted on selected fine aggregate sample and the specific gravity of fine aggregate has been found as 2.74

Table -4: Laboratory test observations of Fine Aggregate

DESCRIPTION	RECORD (in Kg)
Weight of empty vessel [W_1]	0.672
Weight of aggregate (1/3 of flask) [W_2]	1.096
Weight of aggregate (1/3) + water (2/3) [W_3]	1.760004
Weight of water W_4	1.495
S.G=(W2-W1) / { (W2-W1) - (W3-W4) }	2.735

c. Test on Coarse Aggregate

Various tests were conducted on fine aggregate like Sieve analysis, specific gravity and fineness modulus, impact test and crushing strength test and their results as follows.

Table -5: Laboratory test results of Coarse Aggregate

Characteristics	Test value	Standard Value
Type	Crushed Stone	Crushed Stone
Specific Gravity	2.74	2.5-2.8
Maximum Size	20 mm	20 mm
Fineness modulus	3.33	2.9-3.5
Impact value	44%	<45%
Crushing value	42.2%	<45%

d. Slump test on Concrete

Slump test on concrete has been conducted on conventional M20 grade concrete and super absorbent polymer added concrete and the test result has shown in below table.

Table-6: Slump con test result

S. NO	Degree of Workability	% of SAP	Slump value
1	Slump Value (50 – 100) Medium	0.1	132
2		0.3	74
3		0.5	45

6. EXPERIMENTAL INVESTIGATION

a. Compressive Strength Test

As per IS: 516-1959 Compressive testing machine (2000KN), 15cm×15cm×15cm steel cube molds. Concrete gains maximum strength at 28days. Since in construction sector great amount of capital is at stake, so instead of checking strength at 28 days we can check strength in terms of concrete strength psi at 7 and 14 days to predict the target strength of construction work. Compressive strength is conducted to clarify the concreting is done properly or not. Compressive strength depends on many factors such as water cement ratio, cement strength, quality of the concrete material, quality control during casting of concrete and so on. The specimens are tested during the consequential days of 7^{th}, 14^{th}, and 28^{th} day. During the 7^{th} day of testing, we can gain the 64% to 70% of strength of 28 days strength. Before the testing in the machine the concrete should be get rid of moisture to acquire the maximum strength.

Fig.2 Compression strength test apparatus

Compressive strength with different proportions are discussed in below.

a. 20 % of Replacement of coconut shell and 15% of waste glass powder

Table-7: Compressive Strength test result of Cubes

S.NO	TESTS ON THE DAYS	COMPRESSIVE STRENGTH
1.	7^{th} DAY	12.35N/mm^2
2.	14^{th} DAY	17.09N/mm^2
3.	28^{th} DAY	18.74N/mm^2

b. 25 % of Replacement of coconut shell and 15% of waste glass powder

Table-8: Compressive Strength test result of Cubes

S.NO	TESTS ON THE DAYS	COMPRESSIVE STRENGTH
1.	7^{th} DAY	11.96N/mm^2
2.	14^{th} DAY	16.53N/mm^2
3.	28^{th} DAY	18.17N/mm^2

c. 30 % of Replacement of coconut shell and 15% of waste glass powder

Table-9: Compressive Strength test result of Cubes

S.NO	TESTS ON THE DAYS	COMPRESSIVE STRENGTH
1.	7^{th} DAY	11.72N/mm^2
2.	14^{th} DAY	16.23N/mm^2
3.	28^{th} DAY	17.86N/mm^2

The comparison test results of cubes have shown in below graph.

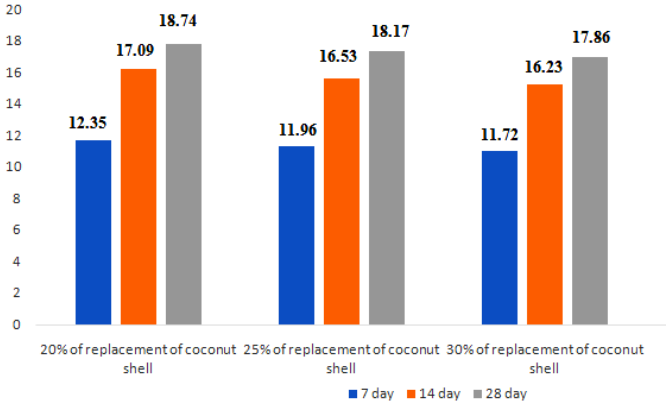

Fig.3 Comparison test results of cubes with coconut shell and glass powder

b. **Split Tensile Strength Test on Cylinder**

As per IS 5816: 1999 the splitting tensile strength test is performed on hardened concrete to determine its tensile strength. Marginal variations in water to cement ratio, ingredient proportioning, and increase in a slump, etc impacts the desired concrete strength. This in turn affects the strength and stability of structures. There are several tests to determine the strength of concrete. The unit of tensile strength is N/mm. The splitting test is easy to perform and we can get uniform results. It is a simple, reliable and convenient method to determine the strength of concrete.

Fig.4 Split tensile Strength test apparatus

Table-10: Compressive Strength test result of Cylinders

S.NO	REPLACEMENT %	SPLT TENSILE STRENGTH
1.	0%	3.45
2.	20%	4.68
3.	25%	5.57
4.	30%	6.01

The comparison test results have been clearly shown in below graph.

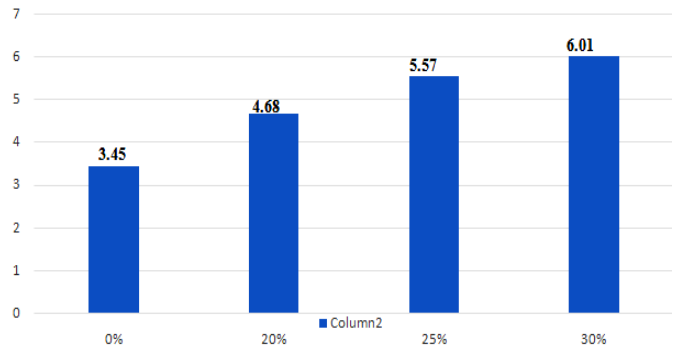

Fig.5 Comparison test results of cylinders with coconut shell and glass powder

7. CONCLUSION

The above experiment al result gives the following conclusions, The light weight concrete is generally used for constructions of bridges, decks, piers, precast constructions, and high-rise buildings. Coconut shell concrete shown better results when waste glass powder is added as additive. Partial replacement of coconut shell with waste glass powder in concrete results in increasing mechanical properties such as compressive strength and split tensile strength. Compare to coconut shell concrete, CSC with waste glass powder has increased compressive strength about (18.17 N/mm^2). Coconut acts as aggregate due to its high hardness and high carbon content. Waste glass powder in concrete increases the workability, has tends to remove porosity and provide excess required time for consolidation. Using the waste coconut shell by replacing fast depleting conventional aggregate source construction material and thereby getting the solution for social and environmental issues. For best constructional usage we can adopt 25% of replacement in concrete and the waste glass powder increase the compressive strength of the coconut shell concrete.

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