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EXPERIMENTAL STUDY ON PARTIAL REPLACEMENT OF COARSE AGGREGATE BY USING COCONUT SHELL AND CEMENT WITH FLYASH

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Abstract - *In our paper we reviewed the practicability of using partial coconut shell on the coarse aggregate in order to mitigate the availability affordability quality and pollution issues and partial replacement of fly ash with cement. Solid cubes, cylinders and prism of M20 grade were casted by replacing coarse aggregate to coconut shell by weight at 5%,10%,15% and fly ash to cement. Specimen were completed for testing once one and two weeks activity in water present as the control .strength testing was included (compressive, flexure and split tensile).comparing the strength of natural concrete with our replaced mix .River sand will be used in traditional concrete but we are replaced it with m-sand to reduce the cost. Due to reasons like large-scale coconut farming in coastal regions like Andhra Pradesh, Goa, Tamil Nadu and kerala, etc. In this areas coconuts are producing more, so coconut shells waste are more in this area.*

Key Words: Coconut shell, fly ash, compression strength, split tensile, flexural strength

1. INTRODUCTION

Civil engineers are the backbone of any developing country's development of in structures. Today due to the development of the infrastructure the need of concrete has been increased at high rate. Concrete is important construction materials that have been widely used all over the world. The use of concrete has been increasing day by day. Due to this some negative impacts are there in production of concrete such as coarse aggregate extraction from natural resources, scarcity of river sand it leads to depletion of materials and ecological imbalance. Various researches have been found that replacement for coarse aggregate. The use of plastic ,paper and pulp industry waste, textile waste, rice ash, recycled rubber tyres, broken bricks are some examples for replacing aggregate in concrete. Coconut shell is an agricultural by product which can be used as coarse aggregate in concrete. According to report made in 2016 India is the third largest coconut producers in world. India produces of about 119million tones of coconut every year. The coconut shells are accumulated in land and get degraded around 100-120years. Due to this, a serious environment problem of disposal of coconut shells occurs. So to minimize this coconut shell can be used as aggregate in concrete. The main aim of this project is to study the strength of coconut shell concrete with different replacement precent. Also to attempt has been made to study the suitability of fly ash in concrete.

1.1 AIM AND OBJECTIVE

- The aim of study is to evaluate the performance and suitability of coconut shell in concrete with as alternative for coarse aggregate.
- To evaluate the compressive strength, split tensile strength, and flexural strength of concrete with replacement of cement and coarse aggregate with fly ash and coconut shell.
- Study on strength characteristics of M20 grade concrete with replacement of 5%, 10%, and 15% of coarse aggregate by coconut shell with flyash of 5% constant replacement.
- To determine the strength of concrete at 14, 28days with admixture is used to minimum the water cement ratio and to achieve the workability.

2. MATERIALS USED

2.1CEMENT

Cement is a binder, a substance used for construction that sets, hardens, and adheres to other materials to bind them together. Cement is seldom used on its own, but rather to bind sand and gravel (aggregate) together

Fig 2.1: Cement

2.2 FINE AGGREGATE

Aggregate is the granular material used to produce concrete or mortar and when the particles of the granular material are so fine that they pass through a 4.75mm sieve, it is called fine aggregate. Fine aggregates are usually sand or crushed stone that are less than 9.55mm in diameter. Typically the most common size of aggregate used in construction is 20mm**.**

Table -1: Properties of Fine Aggregate

PROPERTIES	RESULTS
Specific gravity	2.67
Water absorption	1.34%
Maximum size	4.75mm

2.3 COURSE AGGREGATE

Coarse aggregates are a construction component made of rock quarried from ground deposits. Examples of these kinds of ground deposits include river gravel, crushed stone from rock quarries, and previously used concrete. Coarse aggregates are generally categorized as rock larger than a standard No.

Table -2: Properties of Course Aggregate

PROPERTIES	RESULTS
Specific gravity	2.70
Water absorption	0.29%
Maximum size	20mm
Minimum Size	12.5mm
Impact value	15.65
Crushing Value	6.52

2.4 COCONUT SHELL

Coconut shell is an agricultural waste and is available in plentiful quantities throughout tropical countries worldwide. In many countries, coconut shell is subjected to open burning which contributes significantly to CO2 and methane emissions. Coconut shell is widely used for making charcoal

Fig 2.1: Coconut Shell

2.4 FLY ASH

Class F fly ash from RMC Ready Mix Plant at Erode. Fly ash conforms to requirements of IS3812 part1.The use of fly ash as a partial replacement for Portland cement will usually reduce water demand. Usually strength development is very slow due to pozzolanic reaction of fly ash. Later age strength is higher. Class F fly ash reduces alkali -silica reactivity because of the dense structure and hence expansion is reduced which increases durability. The pozzolanic reaction between fly ash and lime generates less heat, resulting in reduced thermal cracking when fly ash is used to replace a percentage of Portland cement.

3.0 MIX DESIGN

Concrete mix of M20 grade was designed by conforming to IS 10262-1982 method. The coarse aggregate were replaced with coconut shell by 5% 10% and 15 of fly ash with cement. 0.50 water cement ratio was kept constant.

Table -3: Mix Calculation

	cement	Fine aggregate	Coarse aggregate	Water cement ratio
Ratio	1	1.4	2.7	0.50
Mass req for cube	1.28kg	2.75kg	3.46kg	640ml

4. CASTING, CURING AND TESTING OF SPECIMEN

Cement, fine aggregate and coarse aggregate of mix proportion 1:1.4:2.7 were taken corresponding to M20 grade concrete. Coconut shell as partial replacement of coarse aggregate and fly ash has cement were used. Batching of materials as per mix design is done by weigh batching .All ingredients are first dried mixed then water and super plasticizers added .Machine mix is done to get homogenous mixture. Then the mixture is poured into specimens. Vibrators are used for compaction. After vibration the surface of specimen is leveled using trowel. Specimens are kept for drying for 24 hours and then specimen were demoded. Specimens are then kept for curing. Curing is done 14, 28days Testing of specimen: The 9 cubes for each proportions were tested for compressive strength of size 150 × 150 × 150 mm. 6 cylinders for each proportions of size 150mm diameter and 300mm length were casted and used for testing split tensile strength and 6 beams for each proportions of size 500mm length, 100mm width and 100mm depth were casted and used for testing flexural strength at 7, 14, 28 days curing.

4.1 COMPRESSIVE STRENGTH

Specimens of size 150 × 150 × 150 mm were casted for all the proportions and tested in compression testing machine. Capacity of machine is 2000KN.Compressive strength calculated by using equation,

$$F=P/A$$

Table -4: Compressive Test Values

Percentage Replacement of Coconut shell	Flyash	14 DAYS	28 DAYS	AVERAGE
0%	**5%**	18.4 17.5 18.1	31.50 31.35 31.45	**31.43**
5%		15.20 15.45 15.00	30.50 30.35 30.45	**30.43**
10%		13.25 13.10 13.00	29.25 29.15 29.20	**29.2**
15%		15.50 10.60 12.70	28.50 28.80 28.70	**28.60**

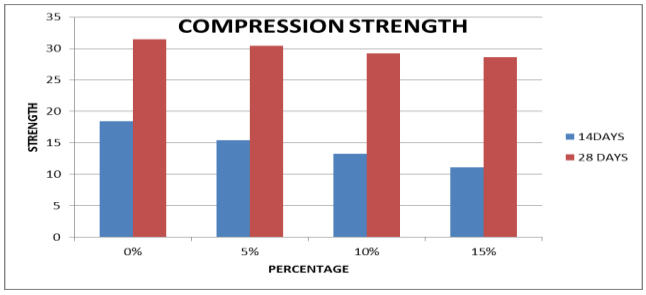

Chart -1: Compression Test Value

4.2 SPLIT TENSILE STRENGTH

Specimen of size 150mm diameters and 300mm length were casted. The test was conducted on the Compression Testing Machine. Cylinder specimens were placed under the Compression Testing Machine in a horizontal direction perpendicular to the direction in which they are casted .The tensile strength was found by using equation, Split tensile strength test concrete cylinder is a method to determined tensile strength of concrete.

T=2P\3.14LD

Percentage Replacement of Coconut shell	Flyash	14 DAYS	28 DAYS	AVERAGE
0%	5%	2.27 2.24 2.25	2.45 2.43 2.45	2.44
5%		1.72 1.70 1.73	2.30 2.20 2.25	2.25
10%		1.80 1.70 1.60	1.95 1.85 1.90	1.90
15%		1.83 1.85 1.81	1.50 1.45 1.50	1.48

Table -4: Split Tensile Test Values

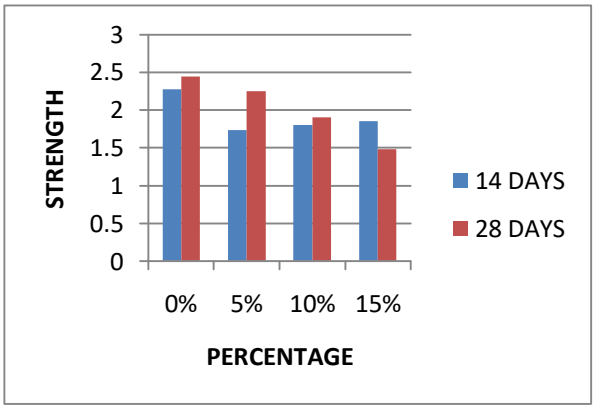

Chart -2: Split Tensile Test Values

4.3 FLEXURAL STRENGTH TEST

Flexural strength, also known as modulus of rupture, or bend strength, or transverse rupture strength is a material property, defined as the stress in a material just before it yields in a flexure test .The transverse bending test is most frequently employed, in which a specimen having either a circular or rectangular cross-section is bent until fracture or yielding using a three point flexural test technique. The flexural strength represents the highest stress experienced within the material at its moment of yield.

$$F = PL/bd^2$$

Table -5: Flexural Strength Values

Percentage Replacement of Coconut shell	Flyash	14 DAYS	28 DAYS	AVERAGE
0%	5%	4.58 4.56 4.60	6.2 6.7 6.8	6.7
5%		5.76 5.80 5.74	5.5 5.6 5.9	5.6
10%		6.41 6.48 6.50	5.3 5.4 5.5	5.4
15%		7.79 7.75 7.80	4.7 4.8 4.6	4.7

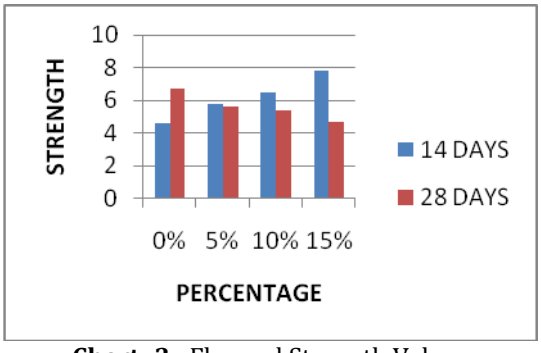

Chart -3: Flexural Strength Values

5. CONCLUSION

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 India, commercial use of non-conventional aggregates in concrete construction is not practiced yet. 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 and Tamil Nadu. Coconut shells as a substitute for coarse aggregates in concrete and fly ash are substitute for fine aggregates is gaining importance especially in this region in terms of reduction of waste products in the environment and finding a sustainable alternative for non-renewable natural stone aggregates. The properties of concrete using crushed coconut shell as coarse aggregate and fly ash as fine aggregates were investigated in an experimental study. From the experimental analysis, it is an evident that at age of 14, 28 days shows the compressive strength, split tensile strength and flexural strength increases as a percentage of coconut shell is increased. For the further increases of coconut shell the strength decreased. Optimum strength obtained at 5% replacement of coconut shell as coarse aggregate

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