RESEARCH PAPER | Engineering | Volume : 4 | Issue : 4 | Apr 2014 | ISSN - 2249-555X

Assesement of Concrete by Replacing Coarse Aggregate and Fine Aggregate to Coconut Shell and Glass Sand for Economical and Eco-Friendly Concrete

KEYWORDS: Coconut Shell(CS), Glass Sand(GS), Coarse Aggregate(CA), Fine Aggregate(FA)

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ABSTRACT *Concrete is most important construction material & made up of water, cement, sand and aggregate in proportion for desire strength. Water is very essential and has no substitute. Cement, sand and aggregate can have substitutes. Cement is binding material and being partially replaced with fly ash. Aggregate and sand is extracted from the Earth and river. The experiment proposes to replace aggregates by Waste Coconut Shell in different proportions. Coconut Shell is hard and light weight material. Study have replaced fine aggregate by Crush Glass Sand. It's significant contribution is to construction field where waste glass was reused for concrete production. The study concluded that Coconut Shell and waste Glass can be effectively used as coarse and fine aggregate replacement up to 20% without substantial change in strength. Produced concrete is relatively light weight than conventional concrete which is economical, eco-friendly and used in light weight structure.*

INTRODUCTION

In natural systems there is no such thing as waste. Everything flows in a natural cycle of use and reuse. Solid wastes are any discarded material which can be solid, liquid and semi-solid or containerized gaseous material. With the progress of civilization, the waste generated became of a more complex nature. The increase in population and urbanization was also largely responsible for the increase in solid waste. Presently in India, about 960 million tonnes of solid waste is being generated annually as by-products during industrial, mining, municipal, agricultural and other processes. Some effects of solid waste to environment are waste breaks down in landfills to form methane, a potent greenhouse gas, change in climate and destruction of ozone layer due to waste biodegradable, Littering due to waste pollutions, illegal dumping, Leaching: is a process by which solid waste enter soil and ground water and contaminating them.

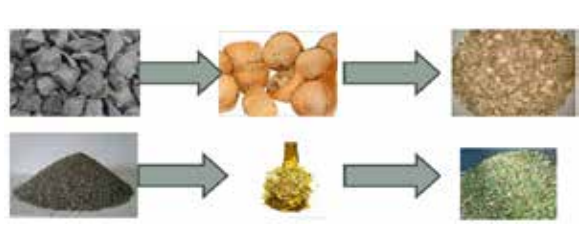
Coconut is found throughout the tropic and sub-tropic area. The coconut is known for its great versatility as seen in the many uses of its different parts. Coconut trees are among the most common sights throughout Kerala. Four southern states combined account for almost 92% of the total production in the country: Kerala (45.22%), Tamil Nadu (26.56%), Karnataka (10.85%), and Andhra Pradesh (8.93%). Other states, such as Goa, Maharashtra, Odisha, West Bengal, and those in the northeast (Tripura and Assam)

account for the remaining 8.44%.India produces 10,824,100 tonnes/year of Coconut.

Glass is basically sand; like the stuff you find on the beach, officially known as silicone dioxide. Glass is lightweight, impermeable to liquids, readily cleaned and reused, durable yet fragile. The use of recycled glass saves lot of energy and the increasing awareness of glass recycling speeds up focus on the use of waste glass with different forms in various fields. One of its significant contributions is the construction field where the waste glass was reused for concrete production. Most of the waste glasses have been dumped into landfill sites. The land filling of waste glasses is undesirable because it not biodegradable, which makes it environmentally less friendly. Ground waste glass was used as aggregate for mortar sand no reaction was detected with fine particle size, thus indicating the feasibility of the waste glass reuse as fine aggregate in mortars and concrete.

The advantage of using such waste materials (Coconut Shell and Glass Sand) provide generally low cost construction than using virgin aggregate and the elimination of the need for waste disposal in landfills. Utilization of these waste material in concrete leads to an effective solid waste management technique and will also be cost effective. The exploitation of available natural resources and raw materials required for the construction industries can also be reduced which in turn reduces the release of green house gases which causes global warming.

METHODOLOGY:-



Replacement Of Coarse And Fine Aggregate

I) METHODS AND MATERIALS

The raw materials used in this experimentation were locally available and these included Ordinary Portland Cement (O.P.C) as binding agent, waste glass sand as fine aggregate and coconut shell as coarse aggregate. Potable tap water

Volume : 4 | Issue : 4 | Apr 2014 | ISSN - 2249-555X

was used for mixing and curing throughout the entire investigation. The permissible and tolerance limits of water were checked as per the I.S 456-2000.

Cement:- Ordinary Portland cement grade 53, conforming to I.S 12269-2009 was used. Cement must develop appropriate strength.

SR NO.	PHYSICAL PROPERTY	TEST RESULT
1.	Standard Consistency	28 %
2.	Specific Gravity	3.15
3.	Fineness Of Cement (%)	3 %
4.	Initial Setting Time	102 min
5.	Final Setting Time	295 min

Coarse Aggregate And Coconut Shell :-
Coarse aggregate consists of 50% of self-weight of concrete and 70% of volume of concrete. Coconut shells were collected from temples to analyse the properties of coconut shell (2-7 mm thickness).

SR NO.	PROPERTIES	CA	CS
1.	Specific Gravity	2.92	1.19
2.	Bulk Density (kg/m ^{3})	1650	1190
3.	Water Absorption (%)	0.65	19

SR NO.	PROPERTIES	FA	GS
1.	Specific Gravity	2.86	2.39
2.	Bulk Density (kg/m ^{3})	2860	2390
3.	Water Absorption (%)	0.34 %	0.12 %

Fine Aggregate And Glass Sand :-

II) PREPARATION OF SPECIMEN

Concrete Mix Design:- M-30 grade of concrete was designed by I.S 10262-1982 method. The coarse aggregate and fine aggregate were replaced by coconut shell and glass sand as 0%, 15%, 20%, 25%.The test results were analysed and compared with theoretical values, obtained from various codes. Due to high water absorption of coconut shell, they were presoaked in water for 24 hours, prior to mixing.

Batching And Mixing:- Weigh Batching was practiced with the help of electronic weigh balance. Batching was done as per the mix proportions. Mixing was done in tilting mixer. It was mixed for 2-3 minutes, after addition of water.

Placing And Compaction:- Cubes are cleaned and oiled to prevent the formation of bond between concrete and moulds. Place the fresh concrete in cubes in 3 layers, tamping each layer 25 times. The entrapped air in concrete is removed by table vibrator. Anything kept on the table gets vibrated.

Demoulding:- After placing fresh concrete in moulds, it was allowed to set for 24 hours. It was marked with some permanent identification mark i.e. A1, A2, A3, etc. Concrete cubes are now kept in curing tank for 3, 7 and 28 days. After 28 days, concrete cubes were removed from curing tank to conduct tests on hardened concrete.

RESULTS AND DISCUSSION

Compressive Strength:- Cubes were placed in Compressive Testing Machine (C.T.M) and load was applied. The readings on dial gauge were recorded and compressive strength was calculated.

Calculations: Compressive Strength =

$$\frac{\text{Maximum Load}}{\text{Cross Sectional Area}} = \frac{P}{A}$$

CURING DAYS	0%	15%	20%	25%
03	17.21	07.5	14.91	13.98
07	23.89	18.44	21.43	20.45
28	33.76	26.53	31.61	26.76

Table 01. Compressive Strength of Coconut Shell And Glass Sand Concrete (N/mm2)

Tensile Strength:- Cylinder were placed in CTM, loads were applied and readings were recorded. The results are shown below in Table 02.

CURING DAYS	0%	15%	20%	25%
28	2.55	2.01	2.49	2.12

Table 02. Tensile Strength of Coconut Shell And Glass Sand Concrete Cylinder

Flexural Strength:- Beam were placed in UTM, loads were applied and following results were obtained.

CURING DAYS	0%	15%	20%	25%
28	6.03	5.23	5.89	4.74

Table 03. Flexure Strength of Coconut Shell And Glass Sand Concrete Beam

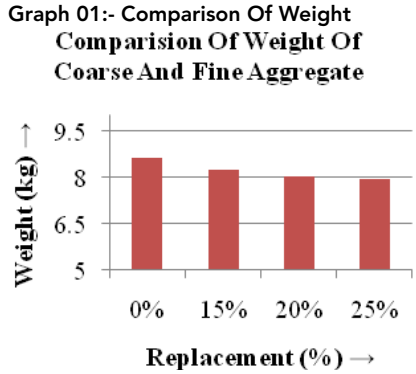
Weight Of Block:- Blocks were weighed after 28th day on electronic weighing machine and following results were obtained.

DAYS	0 %	15 %	20 %	25 %
28	8.64	8.223	8.015	7.953

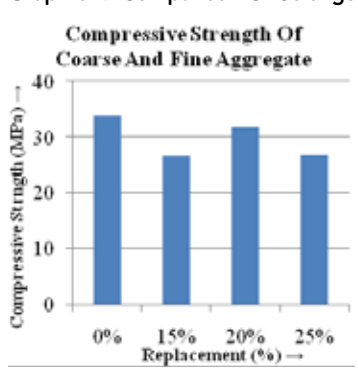
Table 04. Weight Of Blocks

GRAPHS

Graph 01:- Comparison Of Weight



Graph 02:- Comparison Of Strength



Volume : 4 | Issue : 4 | Apr 2014 | ISSN - 2249-555X

As per result, (as shown in Table 01, 02, 03, Graph 02), the strength obtained at 20% replacement is nearly equal to 0% replacement, and thereafter strength decreases as the percentage replacement increases. As the coconut shell increased, the surface area increased, thus requiring more cement for proper bonding. Since cement content was constant, there was no extra bonding and strength reduced.

As per Graph 01 and Table 04, weight of normal block is higher than replaced block, as the percentage of replacement increases weight of block decreases. Hence these blocks can said to be light weight.

CONCLUSION:-

The following conclusions may be made out of the study:

1. While using CS with coarse aggregate and GS with fine aggregate replacement, 28 d strength is found to marginally increase up to 20% replacement level.
2. Marginal decrease in strength is observed at 25% replacement level of CS and GS with coarse and fine aggregate respectively.

Economy of any project depend upon construction & it's advancement. Use of solid waste can achieve economy in construction. This study concludes an use of very economical & eco-friendly waste material in construction. Implementation of this study may take some time to suit for changing construction scenario. For eg. Introduction of fly ash in concrete has took manyyears.

- Experiment produces light weight concrete which is highly required where we have to minimize dead load.
- Coconut is sound absorbing up to certain extent hence study is helpful for sound absorbing structure.
- This experiment do not cause any huge damage to the people hence may use in earthquake prone zone as it is light weight concrete.
- Achieving economy in construction project as well as introducing new eco-friendly construction material.

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