GROUNDNUT SHELL ASH AS PARTIAL REPLACEMENT OF CEMENT IN CONCRETE

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ABSTRACT

Concrete is always valuable product in construction industry. The concrete ingredients are cement, coarse aggregate, and water. Nowadays there is a scarcity of concrete materials, so we are in need to find out the alternative materials to concrete. In this situation we should utilize the larger amount of waste products which is available. For example plastic wastages, agriculture wastages, rise husk ash etc.,

This experimental investigation was performed to evaluate the strength of concrete, in which cement was replaced from 0% to 10% percentage with ground nut shell ash (GSA).Test were conducted on Fresh concrete testes for M20 concrete using IS method.

I. INTRODUCTION

The continuous increase in the price of Portland cement is attributed to the insufficient production rate of the raw materials when compared with the demand rate in the construction industries. Due to increasing industrial and agricultural activities, tones of waste materials are deposited in the environment with little effective method of waste managing or recycling. Some of these deposits are not easily decomposed and the accumulation is a threat to the environment and people at large. Some of these waste materials are rice husks, maize combs, snail shells, palm-kennel shell, coconut shell, saw dust, groundnut shell etc.

Ground nut shell ash was partially used cement in concrete. Thus, the possible use of agriculture waste (such as Ground nut shell ash-GSA) will considerably reduce the cost of construction and as well as reduce or eliminate the environmental hazards caused by such waste.

An investigation was done by **Alabadan, B. A., et al.** (January-June 2005),the paper on partial replacement of ordinary Portland cement (Opc) with Bambara groundnut shell ash (Bgsa) in concrete. The ash contained 10.91% CaO, 2.16% Fe_2O_3, 4.72% MgO, 33.36% SiO_2, 1.75% Al_2O_3, 16.18% K_2O, 9.30% Na_2O, 6.40% SO_3, 6.02% CO_3 and 9.20% HCO_3. 10%, 20%, 30%, 40% 50% and 0% ash was used in the mix to replace cement. The strength of cement/ash concrete increased with curing period but decreased with increasing ash percentage. The highest strength was 31.24N/mm^2 and 20.68N/mm^2 at 28 days for 0% and 10% ash respectively. Substitution of cement with ash in concrete formation was relatively possible not exceeding 10%.Though the strength of OPC/BGSA concrete was lower than that of 100% cement; it can be used for light load bearing elements.

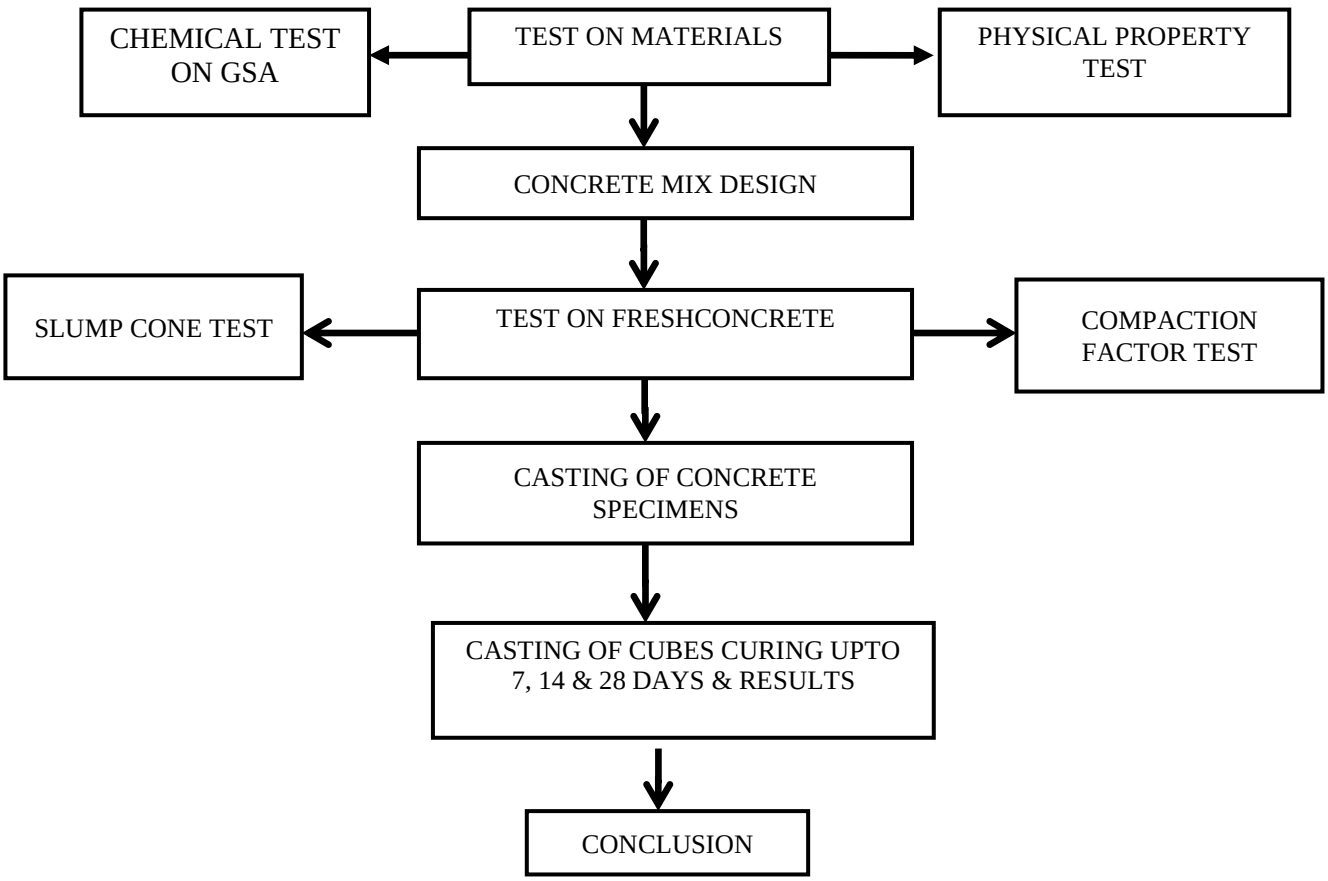
An investigation was done by **Nwofor, T.C., and Sule, S.,**(2012),based on the use of considerable volume of groundnut shell ash as the partial replacement for cement in concrete production. A total of 100 specimens of the GSA/OPC concrete were cured in cubes of 100mm dimension for 7, 14, 21 and 28 days and the compressive strength and density determined. The utilization of ground nut shell ash reduces the environmental problems and also replacement level of (0-40%) gives high compressive strength. A percentage replacement of 10% is suggested for sustainable construction, especially in mass concrete constructions.

An investigation was done by **Mahmoud,H.,**(November 2012), the production of sandcrete blocks using groundnut shell ash (GSA) as cement replacement was investigated. Six number sandcrete blocks were cast for each replacement levels (0, 10,20,30,40, and 50 percentage) with GSA. The blocks were cured and crushed at 7, 14, 21, and 28 days. The results show that the compressive strength ranges from 4.50 N/mm2 to 0.26N/mm2.The optimum replacement level was achieved at 20% with a corresponding strength of 3.58 N/mm2.

An investigation was done by **Sadaa,B.H., et al.**(March 2013),based on The suitability of groundnut shell as a constituent material in concrete was investigated by re-placing proportions by volume of fine aggregate (river sand) with groundnut shells. Groundnut shells were used to replace fine aggregate at 0, 5, 15, 25, 50 and 75% replacement levels. Compressive strengths values of the concrete cubes were evaluated at 28 days at different percentage replacement levels obtaining a range of values of 34.37, 40.59, 21.33, 17.78, 12.44, 7.56N/mm2.

II. METHODOLOGY

OVERVIEW METHODOLOGY



III. MATERIALS PROPERTIES, TESTS& MIXDESIGN

3.1.MATERIALS USED

3.1.1.CEMENT

In the present investigation OPC 53 Grade PENNA brand cement confirming to IS: 12269-(1987) was used and its properties are tabulated in Table 1.

Sl.No	Physical properties of cement	Results
1	Specific gravity	3.12
2	Standard consistency (%)	31%
3	Initial setting time (min)	50
4	Final setting time (min)	600

Table 3.1 Properties of cement

3.1.2.GSA (GROUNDNUT SHELL ASH)

Sl.No	Physical properties of cement	Results
1	Specific gravity	3.2
2	Standard consistency (%)	34%
3	Initial setting time (min)	135
4	Final setting time (min)	330

Table 3.2 Properties of GSA

3.1.3. FINE AGGREGATE

The fine aggregate used in this experimental investigation was natural river sand confirming to zone II as per IS: 383-1987. The properties of fine aggregate are shown in Table 2.

3.1.4. COARSE AGGREGATE

Crushed aggregates particles passing through 20mm and retained on 10mm I.S sieve was used as natural aggregates which met the grading requirements. The properties of coarse aggregate are shown in Table 2.

Properties of aggregates	Fine aggregates	Natural coarse aggregate
Specific gravity	2.62	2.91
Fineness modulus	3.3	7.2
Water absorption	0.9%	-
Impact value	_	16.73%
Grading of sand	Zone III	_

Table 3.3: Properties of Aggregates

3.1.5 MIX PROPORTIONING

Concrete mix design for M_{20} grade in this experiment was designed as per the guidelines specified in I.S. 10262-1982. The Table 4 shows mix proportion of concrete.

Design Stipulations

1. Characteristic compressive strength = 20 N/mm^2 (Required in the field at 28 days)
2. Maximum size of aggregate = 20 mm (angular)
3. Degree of workability = 0.90
4. Degree of quality control = Good
5. Type of exposure = Mild

Test Data For Materials

1. Specific gravity of cement = 3.12
2. Specific gravity of coarse aggregates = 2.97
3. Specific gravity of fine aggregates = 2.62
4. Waterabsorption: Fineaggregate = 0.9%
5. Sieve analysis of fine aggregate = Conforming to grading Zone III (with reference of IS 383-1970)

Water	Cement	Fine Aggregate	Coarse Aggregate
191.6 ml	383 kg	549 kg	1184 kg
0.5	1	1.43	3.09

Table3.4 Mix proportioning

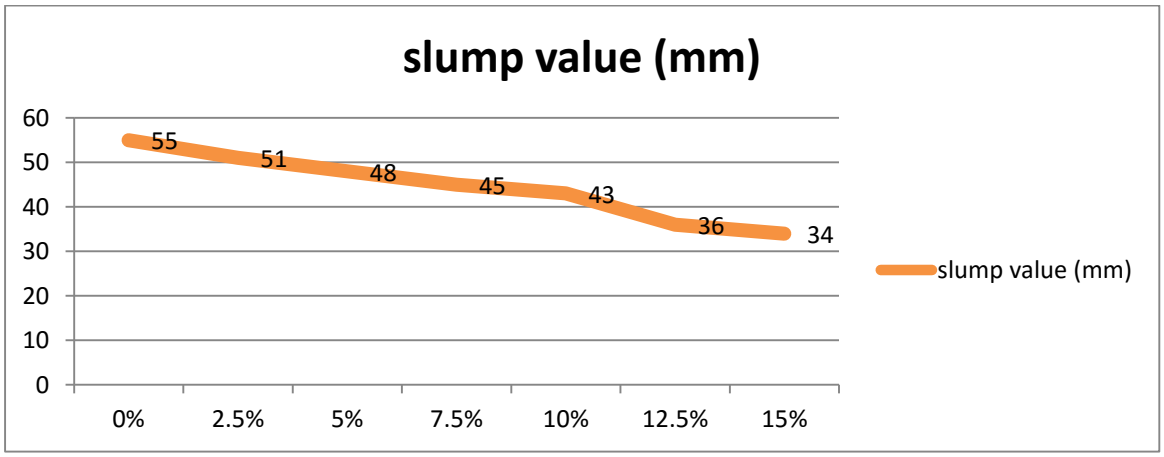
IV. FRESH CONCRETE TEST&RESULTS

4.1 SLUMP CONE TEST

The slump test is used to find the consistency of the fresh concrete. It measures the consistency or the wetness of concrete. The inside of the mould and its base should be moistened at the beginning of every test. The slump value is indicated in table

Slump value (mm)	0%	2.5%	5%	7.5%	10%	12.5%	15%
	55	51	48	45	43	36	34

Table 4.1Slump Values

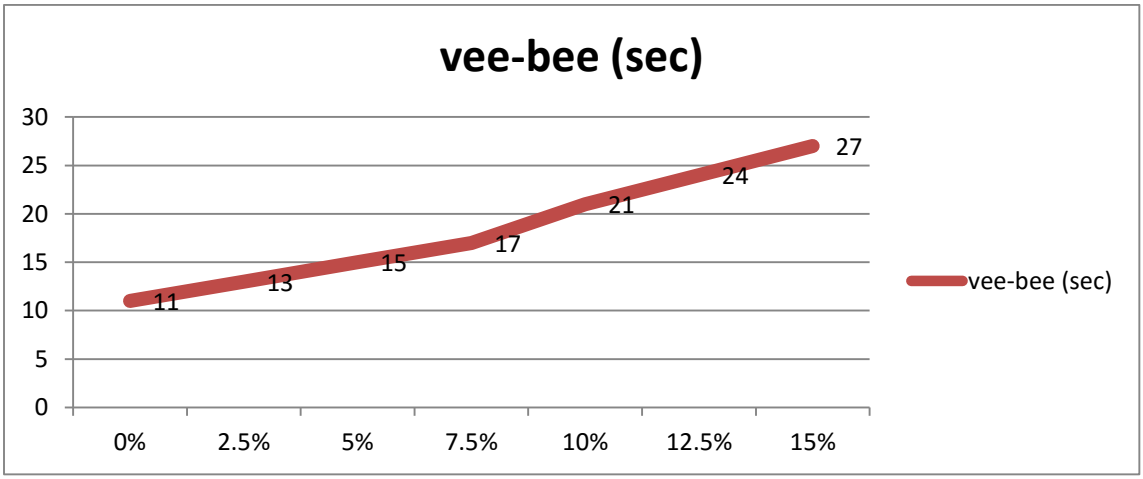


4.2 VEE- BEE CONSISTOMETER TEST

This test is used to find the compatibility of freshly mixed concrete. The test changes the shape of the concrete from cone to cylinder using vibration.

Vee Bee consistometer (secs)	**0%**	**2.5%**	**5%**	**7.5%**	**10%**	**12.5%**	**15%**
	11	13	15	17	21	24	27

Table 4.2 Vee Bee Consistometer Test

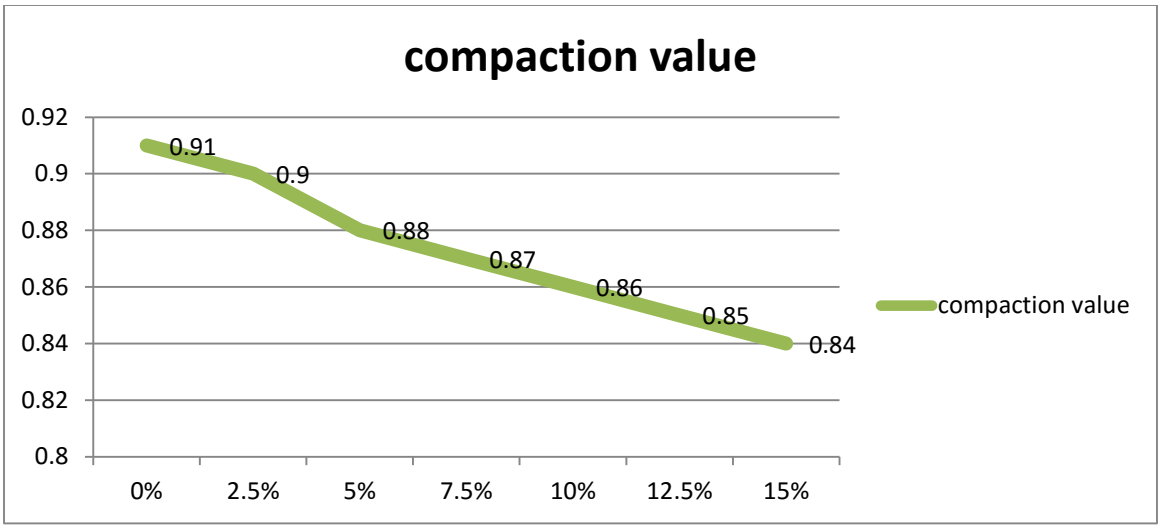


4.3 COMPACTION FACTOR TEST

It is also used for finding the consistency of the concrete. The upper and the lower moulds have to be cleaned and oiled for the easy flow of the concrete. The results indicate that the compaction factor is good for if there is a decrease in the groundnut shell ash. The compaction factor value is indicated in table.

Compaction factor	**0%**	**2.5%**	**5%**	**7.5%**	**10%**	**12.5%**	**15%**
	0.91	0.9	0.88	0.87	0.86	0.85	0.84

Table 4.3 Compaction Factor Test



IV. HARDEN COCRETE TESTE

4.1 Compressive strength Test

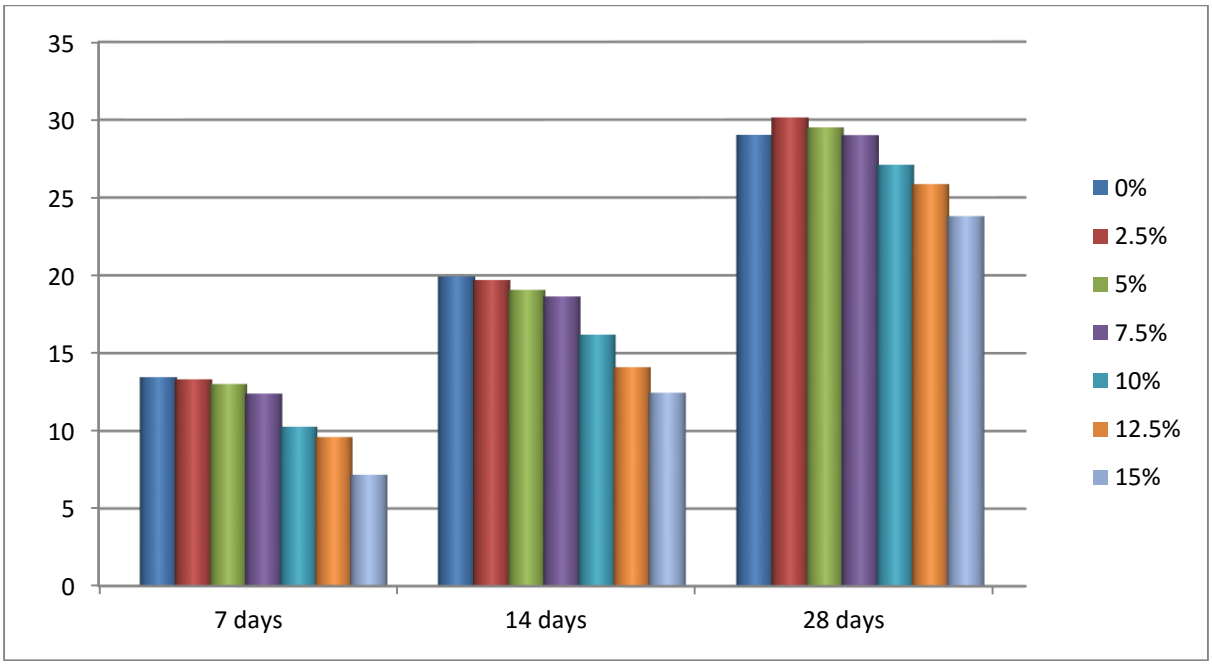
The cube moulds size of 150x150x150 mm as per the IS 10086-1982. Moulds were cleaned thoroughly using a waste cloth and then properly oiled the inner surfaces. Concrete is filled in to mould and then compacted using a standard tamping rod of 60 cm length having a cross sectional area of 25mm^2.

$$\text{Compressive strength (N/mm}^2\text{)} = \frac{\text{P in N}}{\text{A in mm}^2}$$

The specimens were immersed into water for curing up to 7, 14 and 28 days. Determine the compressive strength of the concrete for each set of cubes after 7th, 14th and 28th days of curing. The maximum load at failure was taken and the average compressive strength is calculated using the equation.

Replacement % of GSA	7 days (N/mm^2)	14 days(N/mm^2)	28 days(N/mm^2)
0%	13.46	19.92	29.02
2.5%	13.32	19.70	30.14
5%	13.02	19.07	29.50
7.5%	12.40	18.64	29.00
10%	10.27	16.19	27.10
12.5%	9.61	14.12	25.86
15%	7.18	12.46	23.80

Table 4.1 Compressive strength test



IV. CONCLUSION

In this project, aim to replacing groundnut shell ash as partial replacement of cement. In this, replaced groundnut shell ash in M_{20} concrete to percentage of 2.5%, 5%, 7.5%, 10%, 12.5% and 15% from which the compressive strength for normal concrete is 29.02N/mm^2. Whereas for 2.5% of replacement the compressive strength for groundnut shell ash is 30.14 N/mm^2 similarly for 5% and 7.5% of replacement the compressive strength is 29.5 N/mm^2 and 29.00 N/mm$^{2.}$ Results decrease in percentage of compressive strength in concrete that of normal concrete. The groundnut shell ash can be replaced at 2.5% of cement in concrete which is optimum value.