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Experimental Study on Determination of Compressive Strength of Ground Nut Shell Ash on Partial Replacement with Cement

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Abstract: ***Ground nut shell ash is one of the waste materials. It is used for replacement of cement. Ground nut shell contains of Cao, Sio_2, Al_2O_3 and Fe_2O_3. This experimental investigation was performed to evaluate the strength of concrete in which cement is replaced in different percentage like 0%, 10%, 20%, 30%, and 40% with ground nut shell ash. A total 90 cubes dimensions of 150*150*150 mm of GNSA/OPC concrete was cured for 3, 7, 14, 28, 56 and 91 days and compressive strength were casted for mix of M_{15} grade ratio (1;2;4). It was observed that 10% GNSA replacement was given the highest strength when comparing with remaining percentages. The water cement- ratios taken as 0.5.the effect of workability of fresh concrete were determined by the slump value test.***

Keywords: compressive strength, slump test, replacement, ground nut shell ash, water cement ratio

I. INTRODUCTION

Concrete is the most popular binding material that is being used for many years and is serving the purpose of binding very effectively. Concrete doesn't represent a single material. It is the combination of binding material, aggregates, and water. Concrete has many applications in design and construction industries. It has become indispensable and very popular because of its accessibility and ease of manufacturing. Even though numerous binding materials have been invented in the construction industry, the usage of this wonderful material has not decreased but has been increasing every day. But in the recent days, the manufacture of concrete ingredients is posing many problems. For example, the manufacturing of cement on a huge scale is increasing the environmental pollution. The concrete industry is trying constantly to find the alternate materials for cement. Fly ash has been used as the alternate material for their placement of cement for many years. Apart from these materials, for replacement, many innovative materials are also been used as replacement materials in the recent construction works. Some of the replacement materials are the rice-husk ash, silica fume, Ground Granulated Blast furnace Slag (GGBS) etc., These replacement materials are been used in case of high strength concrete also. In my study, I have used Groundnut shell Ash (GNSA) as a partial replacement of cement. The use of agricultural waste products such as groundnut shells as a replacement for cement could reduce the cost of construction and helps take care of energy and disposal problems.

A. About Ground Nut

Groundnut botanically belongs to Araches hypo Gaea Linn of a leguminous family. Groundnut is a self-pollinated; annual and herbaceous legume crop. The complete seed of groundnut is called pod and contains one to five kermis which develops underground in a needle like structure called peg which grows into the soil and then converts into a pod. Groundnut has tap root system which has many nodules, present in root and lateral roots. These nodules contain Rhizobium bacteria, which are symbiotic in nature and focus atmospheric nitrogen. The outer layer of groundnut is called groundnut shell: The shell constitutes about 25-35% of the pod. The seed accounts for the remaining portion (65-75%).

Andhra Pradesh is one of the foremost producers of groundnut in the India, producing up to about 1230 thousand tonnes and share (12.69%) in the year 2013-2014. Groundnut shell is found in large quantities as agricultural farm wastes in southern parts of Andhra Pradesh such as Anantapur, Kurnool, Chittoor, Cuddapah, Warangal, Nalgonda, Srikakulam, Visakhapatnam and Mahaboobnagar districts.

Over the years, groundnut shell constitutes common solid waste especially in the developing part of this States. It's potential as a useful engineering material has not been investigated. The utilization of Groundnut shell will promote waste management at little cost, reduce pollution by these wastes and increase the economic base of the farmer when such waste is sold thereby encouraging more production. 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.

II. MIX PROPORTIONING

Concrete mix design for M_{15}grade in this experiment was designed as per the guidelines specified in I.S. 10262-1982. The shows mix proportion of concrete.

A. Design Stipulations

1) *Characteristic Compressive Strength*: 15 N/mm^2 (Required in the field at 28 days)
2) *Maximum Size Of Aggregate:* 20 mm (angular)
3) *Degree of Workability:* 0.80
4) *Degree of Quality Control:* Good
5) *Type of Exposure:* Mild
6) *Type of Vibration:* vibration

B. Test Data for Materials

1) *Type of Cement or Grade of Cement:* OPC 53 grade
2) *Specific Gravity of Cement:* 3.12
3) *Specific Gravity of Coarse Aggregates :* 2.527
4) *Specific Gravity of Fine Aggregates:* 2.62

C. Design of Concrete Mix

1) *Target Mean Strength(f):* F_{ck}+1.65(s)= 15+1.65(3.5)=20.775N/mm^2
2) *Water Cement Ratio:* 0.6
3) *Water Content:* 186litres
4) *Cement Content per m^3 of Concrete:* 310 kg
5) *Percentage of Entrapped Air:* 2%
6) *Fine Aggregates Required:* 620 kg/m^3
7) *Coarse Aggregate Required:* 1240kg/m^3

D. Mix Proportions by Weight

TABLE -1 Mix ratio for plain cement concrete

cement	Fine aggregate	Coarse aggregate	w/c ratio
310	620	1240	186
1	2	4	0.6

III. PREPARATION OF TESTING SPECIMENS

A. Mixing Concrete

General -Mix concrete in a suitable mixer or by hand in batches of such size as to leave about 10% excess after moulding the test specimens. Hand mixing procedures are not applicable to air-entrained concrete or concrete with no measurable slump. Hand mixing should be limited to batches of 1/4 ft3 [0.007m3] volume or less. Mix the batch in a watertight, clean, damp, metal pan using the following procedures when aggregate have been prepared. Mix the cement, powdered insoluble admixture and fine aggregate without the addition of water until they are thoroughly blended. Add coarse aggregate and mix the entire batch without adding water until the coarse aggregate is uniformly distributed throughout the batch. Add water and the admixture solution if used, and mix the mass until the concrete is homogeneous in appearance and has the desired consistency is achieved which is then ready for casting. Before casting the specimen, slump cone test was done.

B. Casting of Specimens

The cast iron moulds are cleaned of dust particles and apply with mineral oil or grease on all sides before concrete is poured into the moulds. The moulds are placed on the level platform. The well mixed green concrete is filled into the moulds in three layers. Each mould was filled with three layers of the concrete and each layer was rammed 25 times with tamping rod. Excess concrete was removed with a trowel and the top surface is finished the level and smooth as per IS: 516-1969. The casting of test specimens is shown in fig.

C. Curing of Specimens

The specimens are left in the moulds undisturbed at room temperature for about 24 hours. Remove the specimens from the moulds 24 hours after casting. After removing the specimens immediately transferred to curing ponds containing clean and fresh water and cured for required time of period as per IS: 516-1969.

IV. RESULTS OF SPECIMENS

A. Compressive Strength

The results of the compressive strength test carried out are shown in the table and graph below. It shows that compressive strength increases as the days of cubes curing increase and decreases when the percentage of ground nut shells ash increase. At 0% ash and 100% cement that served as the control, compressive strength increased from 13.65 N/mm^{2}at 7 days to24 N/mm^2 at 91days.

Table- 2 Compressive test result for the concrete

ASH PERCENTAGE USED	COMPRESSIVE STRENGHT N/MM2					
	3DAYS	7DAYS	14DAYS	28DAYS	56DAYS	91DAYS
0%	7	13.65	14.9	17.35	20	24
10%	8.6	16	18	24	27.2	30
20%	8.9	16.53	14.65	16.32	19	21
30%	5.1	9.2	10.7	11.8	13	16
40%	4	5.2	6.3	7.9	9.2	10.4

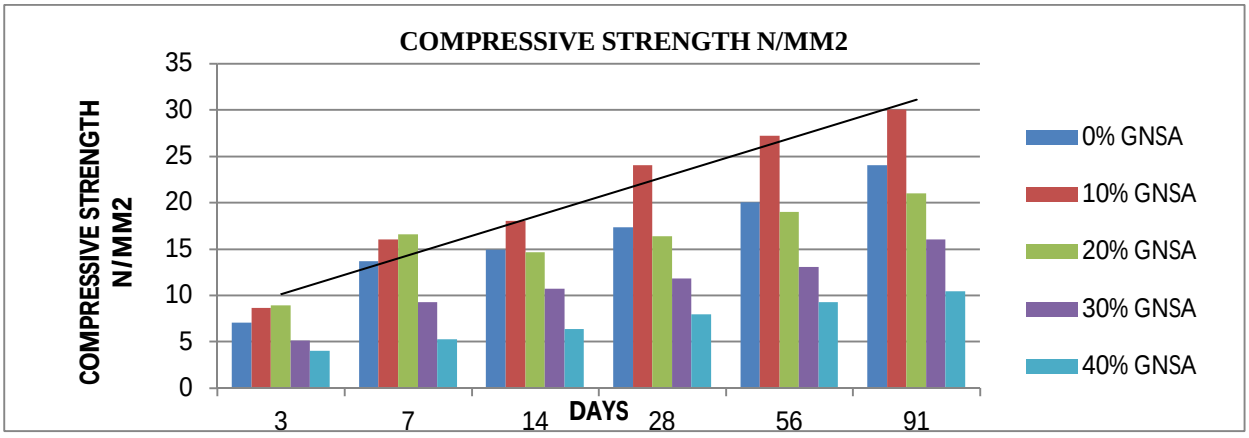

Fig 1: Graph for compressive strength

Compressive strength of 90:10% cement /ash increases from 8.6 N/mm^2 at 3days to 30 N/mm^2 at 91days. The compressive strength for 40% ash replacement were 5.2N/mm^2,6.32N/mm^2,7.92N/mm^2 9.2 N/mm^2 and 10.4 N/mm^2 for 7, 14, 28, 56 and 91days respectively

According to BS 8110 a grade 15 concrete of 1:2:4 without any mixing with cement should have acquired strength of 7N/mm^2 within 3 days of wet curing 24N/mm^2 within 91days based on the result obtained from this report work, OPC/GASH of 90:10% would be suitable for concrete. The results shows that their strength improves with age since pozzolanas react more slowly than cement due to variation in their constituent's composition. The pattern of this study was similar to they reported that cement blended

with pozzolanas would produce 65 to 95 % strength of OPC concrete in 28 days. As previous described by a percentage replacement of 10% with GSA will be adequate for good concrete work.

B. Slump Test

slump test is used to find the improper mixed batch. It measures the consistency of fresh concrete before its set. The inner portion of the mould and its base should be moistened at the beginning of every test. The slump value is indicated in table

TABLE 3: slump cone test values

slump test	0	10%	20%	30%	40%	30%	35%						
	25	24	23	22	21		20						

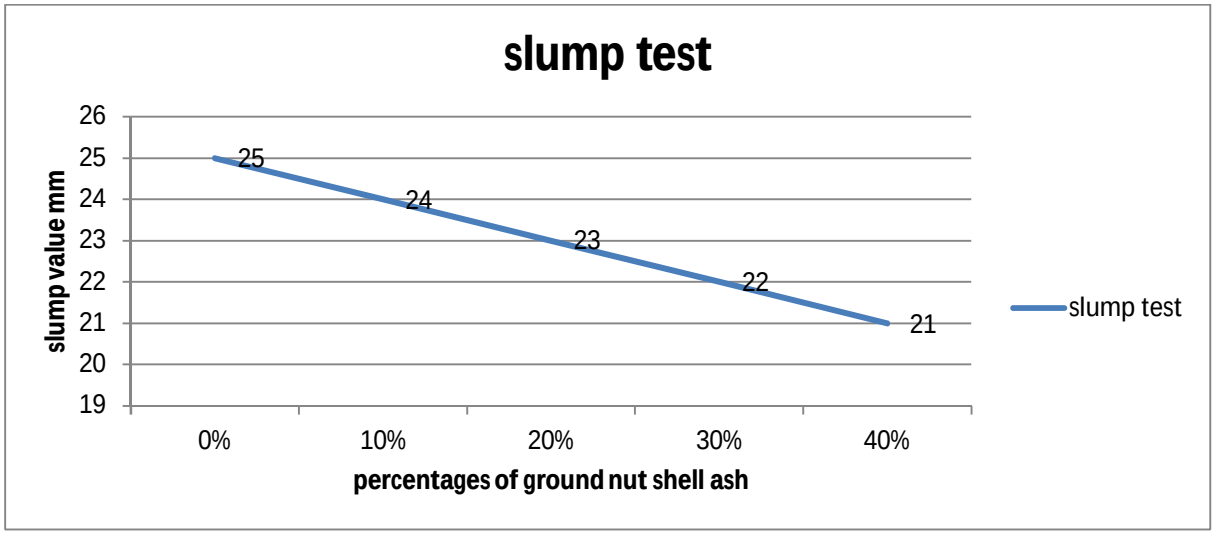

fig 2: graph for slump vale test

V. CONCLUSIONS

Based on experimental investigations by considering the compressive strength , split tensile strength and flexural strength of Concrete, the following observations are made:

A. The Compressive Strength of Concrete is increases when the replacement of Cement with groundnut shell ash up to 10% replaces by weight of Cement.

B. When W/C ratio is increase respectively, Compressive Strength of Concrete is increase.

C. Groundnut shell ash is a better innovative supplementary cementations' construction material which is used in concrete, so it can save the agriculture waste disposal costs and produce a greener" concrete for construction".

D. This research concludes that groundnut shell ash can be innovative supplementary cementations' Construction Material in Concrete but judicious decisions are to be taken by engineers.

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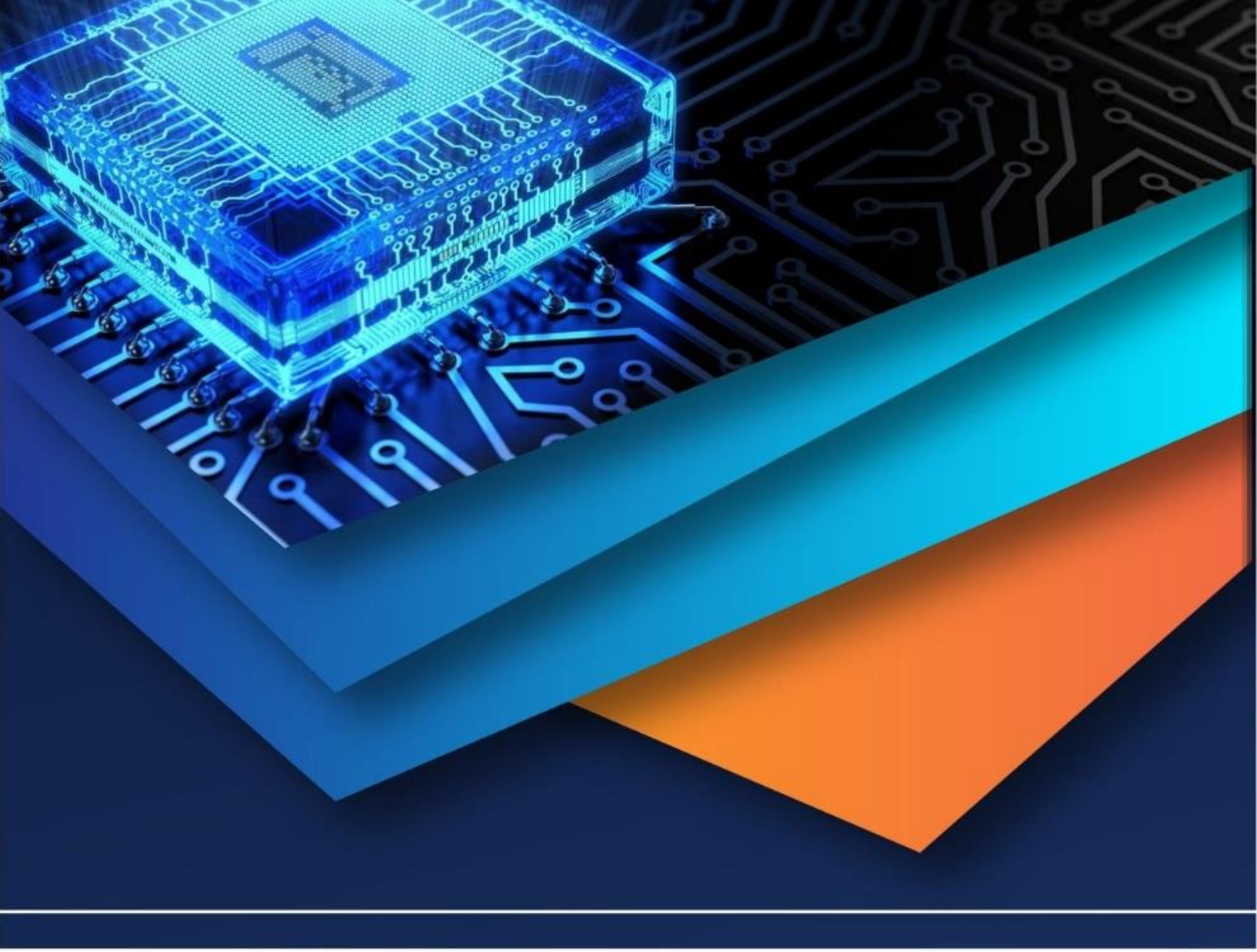

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