IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

GROUNDNUT SHELL ASH AND SILICA GEL AS PARTIAL CEMENT REPLACEMENT IN CONCRETE

[1]Saurav Kumar Nidhi,[2]Mohit Sahu

[1]UG Scholar, [2]Assistant Professor

[1] Department of Civil Engineering

[1]Sagar institute of Science and Technology, Gandhi Nagar, Bhopal, India

Abstract: This experimental study has been done to investigate the behavior of the concrete when cement is replaced by some Percentage of the groundnut shell ash and silica gel. To overcome the huge demand for cement we should not have to be more reliable on the old constituents of the cement. We have to find some new sources of cement constituents in that one of the important agro-waste come into the list due to the presence of the silica in abundant amounts. In this experiment, we have done a broad analysis of workability and compressive strength. The Study is done at the constant water-cement ratio of 0.5. Partial replacement is done by weight of the Cement by 5% and 10 % by ground nutshell ash (GNSA) and 0.0%, 0.2%, 0.3%, and 0.4% of silica gel (SG) in the concrete mixture. We found that compressive strength increase approximately by 38% than normal concrete of M20 at 5%GNSA+0.3% SG Replacement.

***Index Terms*– Partial Replacement, Groundnut shell ash (GNSA), Silica Gel (SG), Workability, Compressive strength.**

I. Introduction

Modern technology took place in the field of concrete. Concrete is a composite mixture of cement, Fine Aggregate, coarse aggregate, water, Admixture, and superplasticizers. When the composite matrix Casts informs and is cured, it Hardens into a rock-like material by a chemical reaction between water and binder material[1] due to the massive demand for infrastructure. There is also a massive demand for Concrete because concrete is used in High quantities in making the building and other engineering structures work. Cement plays a vital role in the form of a binder in the concrete as we know that the main constituents of cement are lime, Alumina, silica, magnesia-and gypsum. All these are quarried from the Earth mines, and in the quarry, we will produce large amounts of toxic gases like CO_2, CH_4, and e.t.c in nature. To save energy and to earn carbon credit is very much essential as per the humanitarian[2]. The usage of groundnut shell ash decreases the environmental pollution caused by the cement industries. Today, our researchers and scientists find that cement replacement was used from the 19th century, and today is the 21st century. We see something that will not affect environmental conditions. Due to changes in such environmental conditions, our natural things are getting damaged as like glaciers, the rise of temperature of the earth, and many more things. In this experiment: we use the groundnuts shell partial Replacement of the PPC cement and the silica gel. Both of these contains silica oxide in high amount So the consequences of Strength and durability does not get affected.Therefore, using the Pozzolanas available from are natural Resources as gnsa, Marble dust, Rice Husk, Paper sludge, coal powder, flyash, etc. These Helps to reduce the more reliability of the cement industry.The replacement level in gnsa is from 0% to 35%, and silica gel (0.1%-0.4%) in comparing the compressive strength with the normal concrete. At 10%, Replacement by GNSA gives higher compressive strength and at 0.3%silica gel gives more compressive strength than others[2][3].

II. Materials and methods

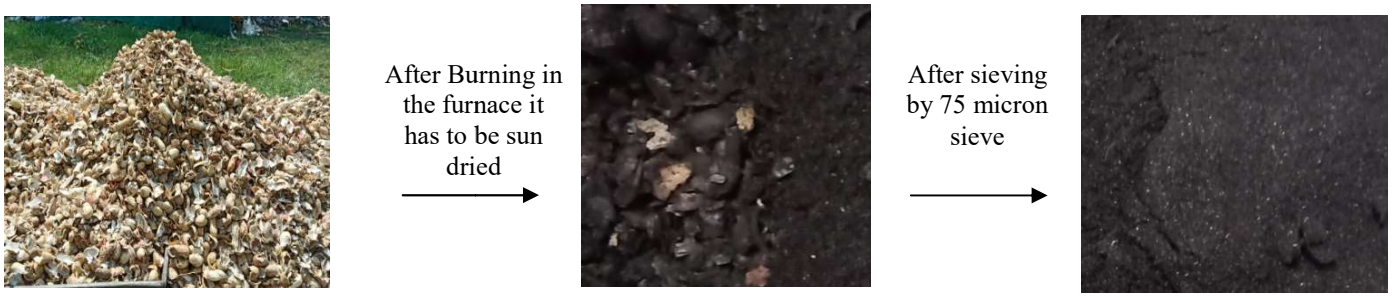

Figure 1 Transformation of groundnut shell to its ash

II.I Cement

Fly ash-based Ultratech PPC cement is manufactured by Aditya Birla Pvt ltd. and cement is obtained from the local market of Gandhi Nagar, Bhopal was used in the experiment. The Physical test is done as per is 4031:1988, and results are shown in Table 1.

II.II Fine Aggregate

Naturally, occurring River sand is obtained from the Narmada River and obtained from the local market of Gandhi Nagar, Bhopal. Sieve analysis is done as per 4.75 BS sieve, and the physical properties are shown in Table 1.

II.III Coarse Aggregate

Crushed stones of size 20 mm are brought from the local market of Gandhi, Bhopal. The results of the physical tests are shown in Table 1.

II.IV Groundnut shell ash (GNSA)

Groundnut shells are obtained from Shree DhanukaAgro Pvt ltd, Neemuch, Madhya Pradesh .it is dried in the sun and then burnt in the furnace at 300-500 degreesCelsius. The groundnut shell ash contains oxides that match the pozzolanic properties[4]. The results of the physicals test are shown in the table1.

II.V Silica gel

It is used in the form of hard crystals.

II.VI Water

Water used in this experiment is clear tap water and is free from impurities obtained from the Department of Civil Engineering laboratory. SISTec Gandhi Nagar. The specification requirement for water that PH of the water should not be less than 6 according to the IS 456:2000 [5]and BS 3148.

II.VII Preparation and casting of Concrete

Batching is done by the weight approach in this experiment. A mix ratio of 1:1.5:3, (cement: fine Aggregate: Coarse aggregate) at a constant water concentration of 0.5 and target mean Strength is 26.6 N/mm²[6]. The Partial Replacement of cement. by ground nutshell ash by 0% ,5% and 10%.with silica gel by the variation of 0%,0.2%,0.3%and0.4%.
100%C+0%GNSA+0%SG,95%C+5%GNSA+0%SG,95%C+5%GNSA+0.2%SG,95%C+5%GNSA+0.3%SG,95%C+5%GNSA+0.4%SG,and90%C+10%GNSA+0%SGareconstituents are used in this investigation. 100%C+0%GNSA+0%SG is the Nominal mix. Total 72 cube Specimen are Prepared of size 150mm x 150mm x 150mm at room temperature. After 24 hours of casting, the concrete is ready for the specimen to be de moulded from the mould and is cured for 7 days, 14 days, 28 days, and 56days for calculation of the compressive strength.

Table 1 Physical Properties Materials Used

Materials	Properties	Specifications
Cement	Consistency =0.33 Setting time : Initial setting time: 47 minutes Final setting time : 13hours	0.30-0.35[7] 30 minutes [8] 10 hours
Fine aggregate	Bulk density = 1503.21 kg/m^3	
Coarse aggregate	Bulk density = 1600 kg/m^3	
Groundnut shell ash	Bulk Density = 251.32 kg/m^3	
Water	Bulk Density =1000 kg/m^3	

III. Results and Discussion

III.I.Workability

After freshly prepared concrete workability of concrete is calculated by two methods: slump cone and compaction factor for accurate workability. The calculation is done as per is 1199-1959[9].

III.I.I Slump cone

The slump value is a maximum of 110mm at the nominal mix and after partial replacement of the cement; slump varies as Shown in table 2 and figure 2.

III.I.II.Compaction factor

For knowing the accurate workability, we calculated the compaction factor. The maximum compaction value is at 0.945 and varies not more or less than a nominal sample. The compaction factor is shown in table 2 and figure 3.

Table 2 slump cone values and compaction factors

Composition	Slump (mm)	Compaction Factor
100%(C)+00%(GNSA)+00%(SG)	110	0.945
95%(C)+05(GNSA)+00%(SG)	40	0.854
94.8%(C)+05%(GNSA)+0.2%(SG)	46	0.873
94.7%(C)+05%(GNSA)+0.3%(SG)	25	0.827
94.6%(C)+05%(GNSA)+0.4%(SG)	28	0.828
90%(C)+10%(GNSA)+00%(SG)	20	0.808

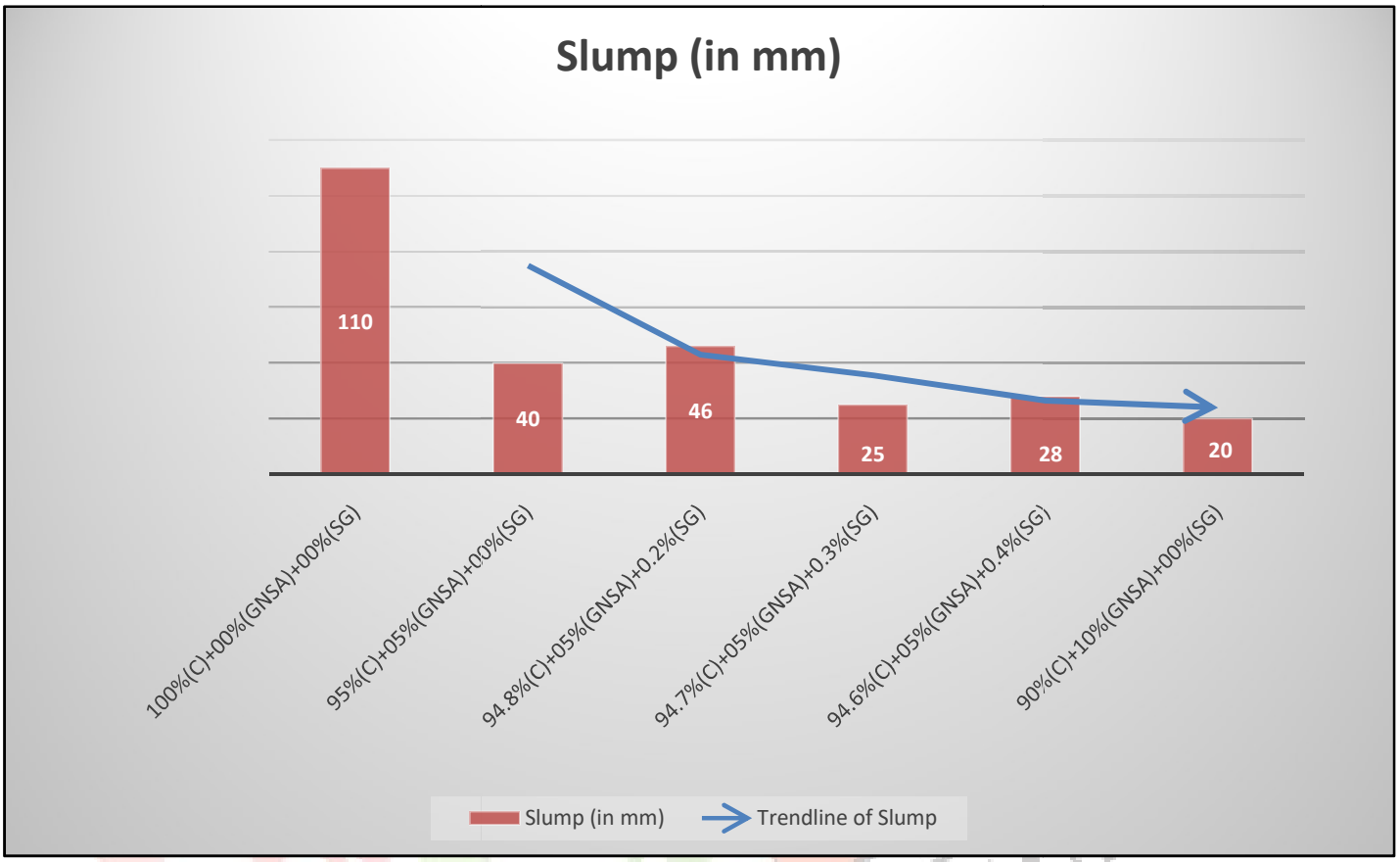

Figure 2 slump

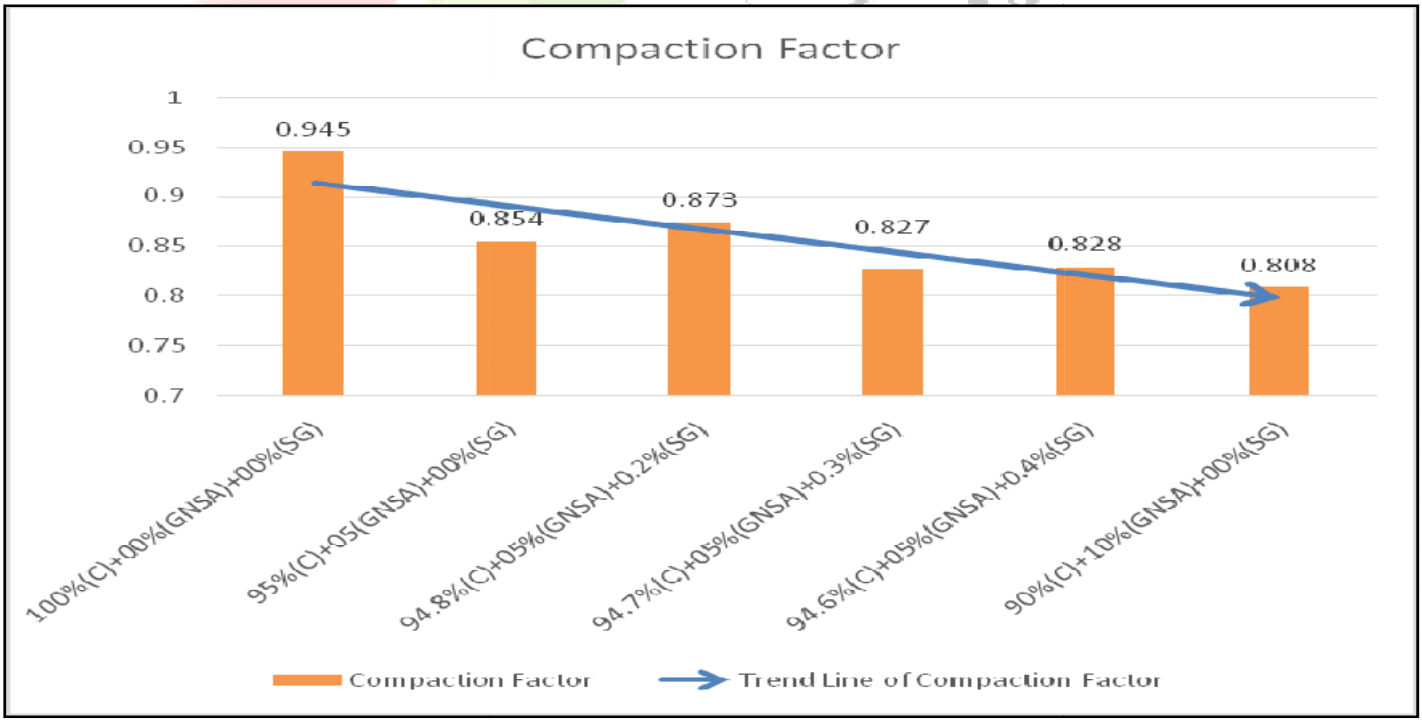

Figure 3 Compaction factor

III.II.Compressive strength

The Compressive strength is done by the compressive testing machine situated at the laboratory of the department of civil engineering as per the is 516:1959[10]. The compressive strength results of all 72 specimens are shown in table 3, and Average Compressive strength is shown in table 4. The graphical variation is shown in figure 4. 100%C+0% GNSA+0%sg is the nominal mix, compressive strength increases from 14.796 N/mm^2 at 7 days to 22.445 N/mm^2 at 28 days and 22.829 N/mm^2 at 56 days. Compressive strength of 94.6%C+5%GNSA+0.4%sg give 19.259 N/mm^2,26.592 N/mm^2,28.607 N/mm^2,29.199 N/mm^2 at 7,14,28 and 56 days respectively and at 90%C+10%GNSA+0%SG Compressive strength are 17.896 N/mm^2,24.059 N/mm^2,26.311 N/mm^2,26.667 N/mm^2 at 7,14,28,56 respectively. As per IS 456:2000, a grade of M20 of mix ratio 1:1.5:3 without mixing with the cement compressive strength at 28 days should be 20 N/mm^2.Based on other studies at 5-10%.Replacement of GNSA gives more compressive strength, and at 0.3%, SG gives more compressive strength[2][3].

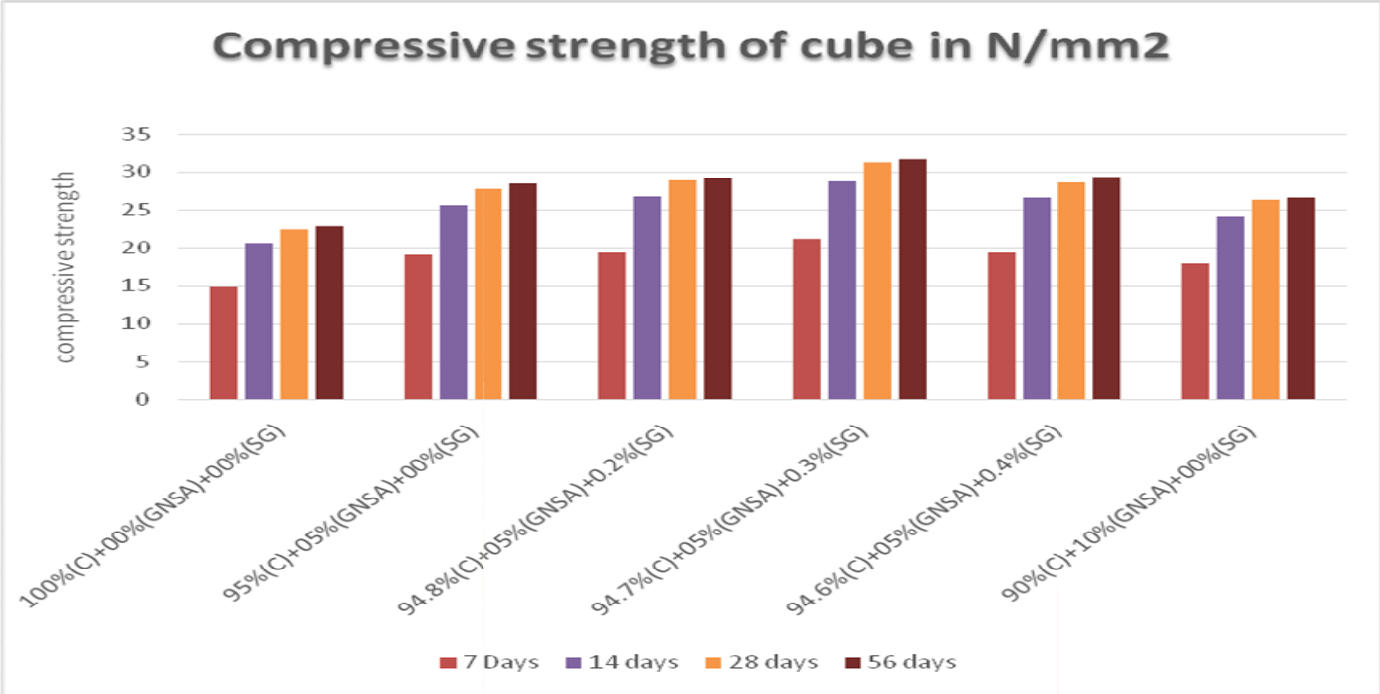

Figure 4 Averages of Compressive Strength

Table 3 compressive strength of all 72 specimens

S.No	Mix Composition of concrete			Compressive strength at different days in N/mm^2			
	Cement (%)	Gnsa (%)	Silica (%)	7 Days	14 Days	28 Days	56 Days
1.	100.0	00	0.0	14.044	19.511	21.156	21.689
				17.067	23.422	25.467	25.467
				13.289	18.844	20.711	21.333
2.	95.0	05	0.0	15.289	20.844	22.267	23.067
				20.667	28.044	30.133	30.978
				21.067	28.133	30.756	31.067
3.	94.8	05	0.2	21.956	30	32.267	32.533
				16.356	22.578	24.533	24.889
				19.556	27.6	29.689	30
4.	94.7	05	0.3	21.867	29.911	32.622	33.156
				17.156	23.467	25.422	26
				24.311	32.667	35.467	35.822
5.	94.6	05	0.4	17.111	23.733	25.467	26.222
				22.978	32.267	34.489	34.933
				17.689	23.778	25.867	26.444
6.	90.0	10	0.0	17.911	24.311	26.533	26.8
				20.178	26.578	29.422	29.644
				15.6	21.289	22.978	23.556

Table 4 Average Compressive Strength Of all the Specimens

S.no	Mix Composition of concrete			Compressive strength at different days in N/mm^2			
	Cement (%)	GNSA (%)	SilicaGel (%)	7 Days	14 Days	28 Days	56 Days
1.	100.00	00	00	14.796	20.592	22.445	22.829
2.	95.00	05	00	19.007	25.673	27.718	28.370
3.	94.80	05	0.2	19.289	26.726	28.829	29.141
4.	94.70	05	0.3	21.112	28.681	31.171	31.659
5.	94.60	05	0.4	19.259	26.592	28.607	29.199
6.	90.00	10	0	17.896	24.059	26.311	26.667

IV Conclusion

It is based on the above study by considering the workability and compressive strength. The following observation is written below:-

- The workability of the concrete starts decreasing with the increase in the percentage of replacement of the cement by GNSA and Silica Gel.
- The compressive strength increases by approximately 38% at the replacement of 5%GNSA +0.3% SG by the total Weight of the Cement.
- The replacement of cement by GNSA and SG will help to reduce environmental pollution. And due to Pozzolanic properties, it can be used in the construction industry, but the decision is on the engineers.

V References

[1] H. T. Kimeng, O. O. Ekundayo, M. Sani, and K. Frederick, "Feasibility study of the use of Groundnut Shells as Fine Aggregates in Lightweight Concrete Construction," *Int. J. Adv. Res. Eng.*, vol. 1, no. 1, p. 13, 2015, doi: 10.24178/ijare.2015.1.1.13.

[2] N. V. Lakshmi and P. S. Sagar, "Study on partial replacement of groundnut shell ash with cement," *Chall. J. Concr. Res. Lett.*, vol. 8, no. 3, p. 84, 2017, DOI: 10.20528/cjcrl.2017.03.002.

[3] V. Sumitha, P. T. Ravichandran, and K. Divya Krishnan, "Study on behaviour of Self-Healing Concrete using Silica gel," *Int. J. Eng. Technol.*, vol. 7, pp. 411–414, 2018, doi: 10.14419/ijet.v7i2.12.11507.

[4] A. B. Albert, C. F. Njoku, and M. O. Yusuf, "The Potentials of Groundnut Shell Ash as Concrete Admixture," *Agric. Eng. Int. CIGR Ejournal*, vol. VIII, no. April, pp. 1–8, 2015.

[5] IS 456, "Concrete, Plain and Reinforced," *Bur. Indian Stand. Dehli*, pp. 1–114, 2000.

[6] IS 10262 (2009), "Guidelines for concrete mix design proportioning (CED 2: Cement and Concrete)," *Bur. Indian Stand. New Delhi*, p. New Delhi, India, 2009.

[7] IS 4031- Part IV, "Methods of physical tests for hydraulic cement. Part IV- Determination of consistency of standard cement paste," *Bur. Indian Stand. New Delhi*, p. Reaffirmed in 2005, 1988.

[8] M. Kisan, S. Sangathan, J. Nehru, and S. G. Pitroda, IS4031-Part V,"म □ नक ," 1988.

[9] IS 1199 : 1959, "IS : 1199-1959: Indian Standard Methods of sampling and analysis of concrete," *Indian Stand.*, pp. 1199–1959, 2004.

[10] IS 516:2014, "Method of Tests for Strength of Concrete," *IS 516 - 1959 (Reaffirmed 2004)*, p. New Delhi, India, 2004.