International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 07 | July 2022 www.irjet.net p-ISSN: 2395-0072

EXPERIMENTAL STUDY ON THE BEHAVIOR OF CONCRETE BY PARTIAL REPLACEMENT OF CEMENT WITH GROUNDNUT SHELL ASH AND FINE AGGREGATE BY GRANITE POWDER

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Abstract - Concrete is a vital part of the construction industry. The expansion in population has placed a massive want for more and more infrastructure and it keeps growing. The result of this demand is that the increase in production of cement. The worldwide production of cement is around 4.1 billion metric tons and is predicted to rise to 4.83 billion metric tons in 2030. This has in turn led to exploitation of natural resources in addition as emission of pollutants that cause damage to our environment. Huge quantity of waste materials and by-products are made by manufacturing enterprises like rice husk ash, silica fumes and mineral slag and so on. As a result, waste management has become an enormous problem for our environment. Groundnut has tap root system which has many nodules, present in root and lateral roots. Granite powder which are the by-product created while cutting large granite rocks in granite factories to their desired shapes. The waste generated by the industry has accumulated over the years, and it's been dumped immorally leading to environmental problem. The research work here deals with the partial replacement of cement by mass with GSA and Fine aggregate with Granite Powder together. After mixing, casting and curing the characteristic strength of this new concrete are compared with standard concrete of M30 grade. The experimental investigations are administered for compressive strength Split Strength and flexural strength for curing period of 3, 14 and 28 days. The experimental results show that the for a combined replacement percentage of 32% GSA and 24% GP, is show positive results. Workability reduces with increasing % age of GSA and Granite Powder. The maximum proportion of replacement has been found by conducting the following strength tests: Compressive strength test, Flexural strength test and Split Tensile Strength Test.

Keywords: Groundnut shell ash (GSA), Granite Powder (GP), Pozzolanic material, Compressive strength, Flexural strength and Split tensile strength

1. INTRODUCTION

Global consumption of concrete is second solely to water. As the demand for concrete increases, thus will the demand for Portland cement. Cement has been in use since the nineteenth century to make concrete. The demand for concrete is growing with the growing demand for infrastructure, energy and resources. However, there are some problems with cement production, that isn't just one of the most powerful materials employed in construction, however it's additionally accountable for some carbon dioxide (CO2) emissions, which are common in global warming. Additional gas Carbon dioxide accounts for 65% of global warming. In India, marble and granite stone process is one in all the most rising effects of changing marble dust content on recent and up-to-date physical and mechanical properties. Concrete technology will scale back the utilization of natural and energy resources to pollute the burden on the environment. As we all know that now a days the price of construction materials is rising. Waste disposal will increase massively, quickly reduce dumping sites, increase rapidly in transportation and dumping cost will result on} the environment, preventing property development.

1.2 GRANITE POWDER

Granite belongs to the igneous rock family. The granite Density is between 2.65 to 2.75 g / cm3 also the compression strength is greater than 200MPa. Granite powder obtained from cooling units and structures was found. Since granite powder was good, hydrometer analysis was performed to determine the particle size distribution of granite powder. From the hydrometer analysis it was established that the coefficient of curvature was 1.95 while the coefficient of uniformity was 7.82. The gravitational strength of granite powder was found to be 2.5.

1.3 GROUNDNUT SHELL ASH

Utilization of these agro-wastes for formulation of white ware body will bring about reduction in the use of natural raw materials, reduces production cost, energy consumption as well as serving as a means of safe disposal of these agro-wastes. White wares are usually manufactured by using different raw materials such as sodium or potassium feldspar, ceramics frits together with clay, kaolin and silica sand. In spite of the fact that groundnut shells are produced in large quantity in Nigeria and other parts of the world, insufficient attention has been devoted to characterizing this

waste material as alternative raw material for white ware bodies.

2. LITERATURE REVIEW

K. Chiranjeevi Reddy et. al. 2015 In this paper entitled as "Experimental Study on Concrete with Waste Granite Powder as an Admixture" Granite fines are used as a filler material within the concrete, replacing the fine aggregate which can help in filling up the pores within the concrete. Granite fines resulted in an increase in compression strength in both 7 & 28 days to 33.14 & 43.40 N / mm2 compared to 23.26 & 39.41 N / mm2 of ordinary concrete. Tensile strength also follows the same pattern with a 7.5% rotation and granite fines that increase the grip strength for 7 & 28 days to 2.87 & 4.19 N / mm2 compared to 2.4 & 3.4 N / mm2 of standard concrete. However the flexible strength at a good gradient conversion of 7.5% showed a significant improvement in the flexibility for 28 days to 6.34 N / mm2 compared to 3.35 N / mm2 of conventional concrete.

B.A. Alabadan 2015 Pozzolanic materials have long demonstrated their effectiveness in producing high-performance Concrete. Artificial pozzolanas such as rice husk ash have gained acceptance as supplementary cementing materials in many parts of the world. This work evaluates the potentials of groundnut shell ash (GSA) as a partial replacement for ordinary Portland cement (OPC) in concrete. Chemical analysis of the ash was carried out to ascertain whether it possesses pozzolanic or cementing properties and the partial replacement of OPC by GSA was varied from 0% to 70% in the concrete. The compressive strengths of the control and those of other combinations increased with curing age but decreased with increased ashPercentage. Though, the strength of the control was higher, replacement of cement with ash up to 30% would be more suitable than others.

H. Mahmoud et. al. 2012 In This research paper entitled as "The production of sandcrete blocks using groundnut shell ash (GSA) as cement replacement was investigated. 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. The strength at the optimum level was within the recommended limit of the Nigerian Industrial Standard (NIS) 87:2000. The results also showed that the strength decreases with increase of cement above 20% replacement.

3. MATERIAL

3.1 CEMENT

Any variation in their quantity affects the compressive strength of the concrete mix. Portland cement (Ordinary Portland Cement) is a very important type of cement and a fine powder produced to grind Portland cement clinker. The OPC is divided into three phases, namely Grade 33, Grade 43 and Grade 53 depending on the strength of 28 days. OPC of grade 53 conforming to IS 12269 from a single lot was used throughout the course of the investigation. It was fresh and without any lumps.

3.2 FINE AGGREGATE

According to size, the fine aggregate may be described as coarse, medium and fine sands. IS: 383-1970 has divided fine aggregate into 4 grading's which become gradually finer from grading zone I to IV. The fine aggregate used in this research was clean river sand collected. Whose maximum size was 4.75 mm, conforming to IS 383 1987 grading zone II.

3.3 COARSE AGGREGATE

The particles retained on a 4.75mm sieve are termed coarse aggregate. For making a good concrete mix, coarse aggregated must be hard, clean, and free from any chemical coating of clay and dust on the surface. Crushed stone makes the majority of the particle of coarse aggregate. Coarse aggregates angular in shape are used in this research work that is obtained from the local crusher. Grading of coarse aggregate was done according to IS:383-1970. Aggregates of Nominal size 20mm & 10mm to form a graded aggregate. The concerned lab provided the properties of coarse aggregate.

3.4 GROUNDNUT SHELL ASH

Table -1 Chemical composition of GSA

S.no	Elemental Oxide	GSA (% by mass)
1.	Calcium Oxide (CaO)	14.3
2.	Silicon Dioxide (SiO_2)	62.7
3.	Aluminum Oxide (Al_2O_3)	12.42
4.	Magnesium Oxide (MgO)	2.0
5.	Ferric Oxide (Fe_2O_3)	14.0
6.	Potassium Oxide (K_2O)	15.46
7.	Manganese dioxide (MnO_2)	2.0

3.5 GRANITE POWDER

Table -2 Chemical composition of GP

S.no	Compound	% weight
1	Silica	70-77
2	Alumina	11-13
3	Potassium Oxide	3-5
4	Soda	3-5
5	Lime	1
6	Iron	2-3
7	Magnesia & Titania	Less than 1

4. METHODOLOGY

4.1 MIXING CONCRETE

Thorough mixing of the materials is essential to produce uniform concrete. The mixing should make sure that the mass become homogeneous, uniform in consistency and colour. There are two methods adopting for mixing concrete one is hand mixing and other is machine mixing.

4.2 CURING

Before removing the mould, it is dried for 24 hours, and then specimens are placed in a water tank made to cure specimens. The specimens must be marked for identification so that there must not be any error. The specimens are removed from the tank and dried before putting in the testing machine. The specimens are kept in the tank for 3,7,28 days.

4.3 WORKABILITY TEST

It can be used in site as well as in lab. This test is not applicable for very low and very high workability concrete. It consists of a mould that is in the form of frustum having top diameter of 10cm, bottom diameter of 20cm and height of 30cm. The concrete to be tested if fitted in the mould in four layers. The each is compacted 25 times with the help of tamping rod. After the mould is completely filled it is lifted immediately in the vertically upward direction which causes the concrete to subside.

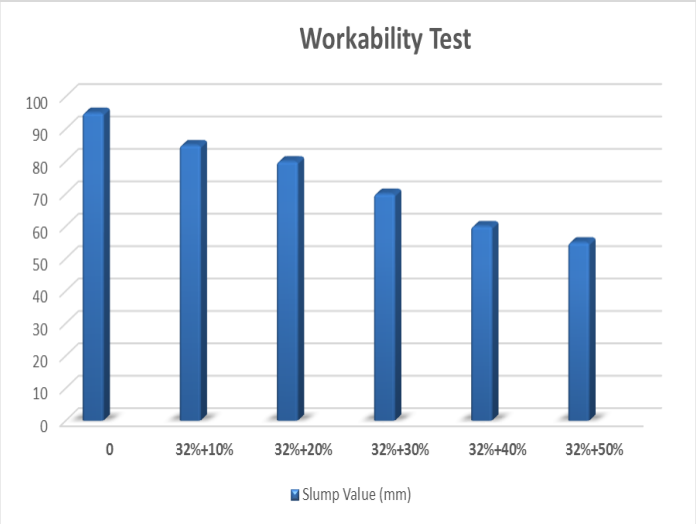


Fig -1: SLUMP CONE TEST

4.4 COMPRESSIVE STRENGTH TEST

Then fresh concrete is filled in mould in 4 layers and after filling each layer tamping should be done 35 times in case of cube and 25 times in case of cylinder by using standard tamping rod. Once the mould is filled then leveled top surface of concrete with trowel. After the day the mould will removed and specimen are dropped in the curing tank under standard temperature of 27±2° c. After 3,14 days and 28 days in this research.

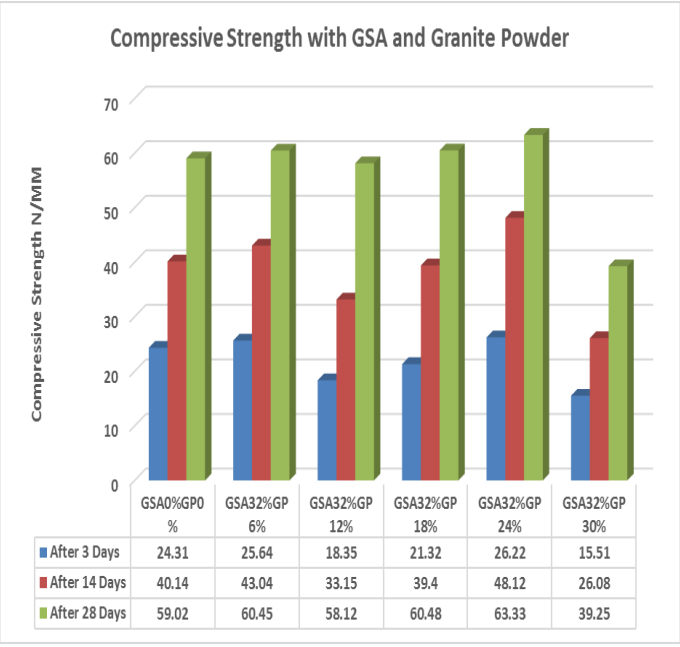
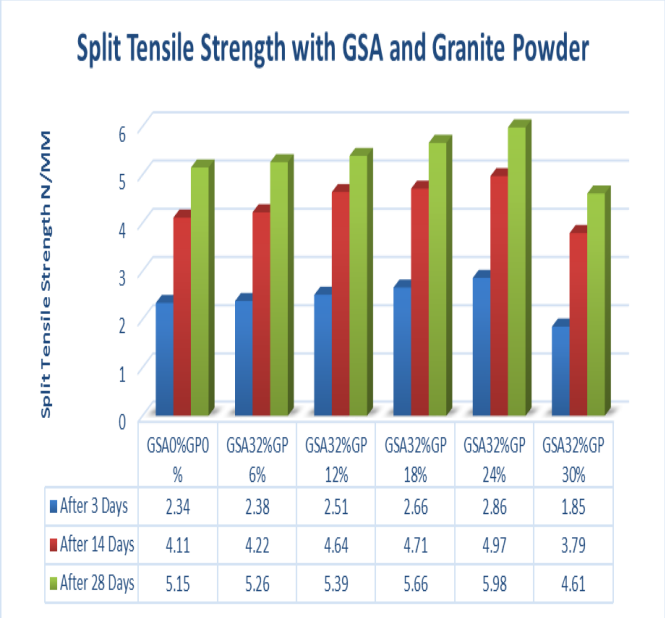


Fig -2: COMPRESSIVE STRENGTH TEST 3, 14, 28 DAYS

4.5 SPLIT TENSILE STRENGTH TEST

The specimen used for this test is cylindrical and its dimension is 150 mm in diameter and 300mm in length. The instrument used for this testing is universal testing machine. The fresh concrete is prepared in according to the required grades and respective mix proportion. The fresh concrete is filled in mould in layers and each layer is tamping with standard tamping rod with 25 blows for each layer. After the day the mould is removed and specimen is placed in the curing tank for 3,14 days and 28 days in this research at the temperature 27+ 2°c. Then draw the line on the specimen.

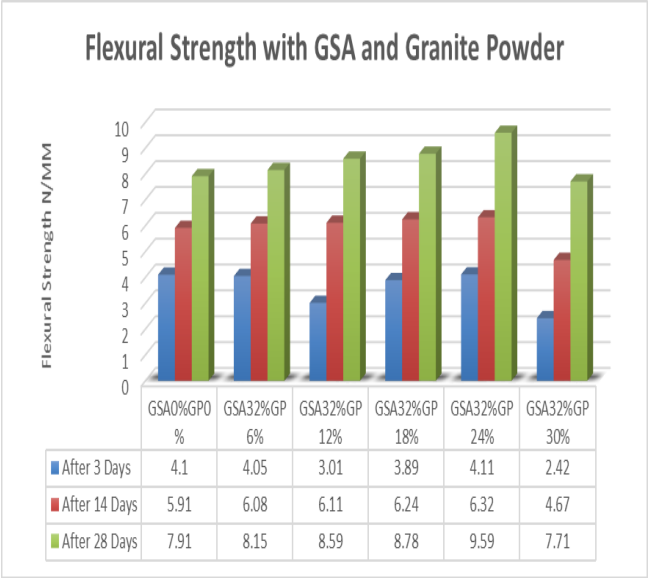


	GSA0%GP0 %	GSA32%GP 6%	GSA32%GP 12%	GSA32%GP 18%	GSA32%GP 24%	GSA32%GP 30%
After 3 Days	2.34	2.38	2.51	2.66	2.86	1.85
After 14 Days	4.11	4.22	4.64	4.71	4.97	3.79
After 28 Days	5.15	5.26	5.39	5.66	5.98	4.61

Fig -3 SPLIT TENSILE STRENGTH 3, 14, 28 DAYS

4.6 FLEXURAL STRENGTH TEST

The concrete is prepared at required rate of mass element the mould is filled with concrete in layers and blows 25 times with standard tamping rod. After the day or we can say 24 hours the mould is removed and specimen placed in the water tank for curing at a temperature of 27 + 2 C. Depending upon the requirement the test specimen is removed from the water tank and wipe it properly for 3,14 and 28 days for testing.



	GSA0%GP0 %	GSA32%GP 6%	GSA32%GP 12%	GSA32%GP 18%	GSA32%GP 24%	GSA32%GP 30%
After 3 Days	4.1	4.05	3.01	3.89	4.11	2.42
After 14 Days	5.91	6.08	6.11	6.24	6.32	4.67
After 28 Days	7.91	8.15	8.59	8.78	9.59	7.71

Fig -4 FLEXURAL STRENGTH 7,14,28 DAYS

5. CONCLUSION

• The use of Groundnut shell ash and Granite powder as partial replacement of cement and Fine Aggregate respectively should be taken up for acceptable and environmentally friendly construction.

• By using these easily available left overs and agricultural waste materials in construction, we can greatly decrease the cost of construction up to a certain level and also not compromising much on the quality while also overcoming the environmental hazards.

• In general, it was also observed in the experiment that the workability of concrete decreases with the increase in the percentage of Groundnut shell ash and Granite Powder the concrete was less workable.

• This investigation has also established that the use of Groundnut shell ash and Granite Powder by a certain percentage can produce positive results when cement and fine aggregate. Thus can be used in construction purpose.

• It is observed that by replacement of cement with Groundnut shell ash up to 32% by weight of cement, there is an increase in compressive strength, Flexural strength and Split tensile strength of concrete after which there is a drastic decline in the strength of concrete.

• The max compressive strength is achieved by replacement of fine aggregate with Granite powder and replacement of Cement with Groundnut shell ash in combination on 28th day as 63.33 Mpa.

• In the case of replacement of fine aggregate with Granite powder and replacement of Cement with Groundnut shell

ash in combination, it is found out that there is an increase in all the three strengths compressive, split tensile and flexural. The increase is up to a percentage replacement of 32% of Groundnut shell ash and 24% of Granite Powder in combination by weight of cement and fine aggregate respectively.

• The max split tensile strength is achieved by replacement of fine aggregate with Granite powder and replacement of Cement with Groundnut shell ash in combination on 28th day as 5.43 Mpa.

• As it was observed that Groundnut shell ash overall gains strength in the later days due to its pozzolanic activity and hence is a good enough material as the replacement material of cement.

• The max flexural strength is achieved by replacement of fine aggregate with Granite powder and replacement of Cement with Groundnut shell ash in combination on 28th day as 9.59 Mpa.

• The investigation also showed that granite powder is an excellent material for replacement in concrete for river sand thus can help save the environment and also reduce the expenses.

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