# GEOPOLYMER CONCRETE MECHANICAL STUDY USING GGBS AND RHA ALGORITHMS

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**ABSTRACT**: AS the cement industry is responsible for 5-7 percent of global CO2 emissions in the production of concrete, the dose of cement is lowered by the use of minerals, and this strategy will help to the protection of the setting and energy conservation. This possibility is a geopolymer, which frequently comprises fly trash, a metallic element, or a hydrated oxide (NaOH or KOH), as well as sodium salt. The assembly of regular hydraulic cements and, as a result, the use of typical channel sand has increased as a result of concrete's interest in industrial development. The output of dioxide has increased throughout the cement manufacturing process. At constant time, thanks to MISBR mining of quick sand, the availability of water ways and has become progressively valuable and scarce. This mainly focuses on this analysis paper is to centre the ecological proximity of cement and waterway sand. The experiment was performed to represent the mechanical properties of geopolymer concrete. In this estimate various types of strengths in the geopolymer concrete. The materials used are ash, alkaline liquid, fine mixture, coarse mixture, GGBS, Rice husk ash, and Inter-sand.
**Keywords**: GGBS, RHA, M-Sand, Fly ash, Geopolymer, Protect Environment.

## 1. INTRODUCTION

Cement is widely used because of its incredible performance and bonding nature in two materials and easy to use and mix and place and apply to the structure. India is the one of an important leading role in the top three in cement production around the world. Cement production in China was 2.29 billion tons in 2013, followed by India with 270 million tons. Global cement demand is on an upward trend and is expected to increase by 4.5% in the next five years. Cement is a world-wide used material and global demand in 2019 is to be 5.19 billion metric tons of cement. Manufacturing of Cement is various for different processes. In this manufacturing, most of the materials are used the same such as limestone and clay, and so on, etc. in this process involves heating and cooling of materials at different stages. Now a day's lot of researches are going on cement for improving its performance and as well as durability too. This also focuses on the elimination of weakness problems subjected to the cement. One of the main disadvantages is the emission of gases during the manufacturing process. Which may lead to cause pollution to the environment? In this, some of the researchers explain that the production of 1tonofcement releases 1ton of around six percent of the emission of$CO_2$. The main problem of it is carbon emissions and footprint. After wood, concrete is the regularly utilized material by the network. After developing cement next is focuses on concrete material. Concrete material has a lot of limitations according to environmental conditions and so on etc.lot of researches is going on for developing concrete with suitable material. In this, we got a good solution in the name of geopolymer concrete.

## 2. LITERATUREWORK

**KRISHNAN L ET.AL (2014)** led considers and inferred that geopolymer innovation is appropriate. This author mainly explains the importance of geopolymer concrete and its uses in the industry sectors. Geopolymer fastener is ready by using waste materials and debris and GGBS with basic fluids sodium hydroxide and sodium silicate.

**ALIA.ALIABDOET. AL(2016)** utilized inventive mechanical waste fly debris as are placement of cement and the impact of little expansion of cement with fly debris is depicted in this work. The target of the investigation is to discover the compressive strength, split elasticity attributes of fly debris based geopolymer and with some expansion of cement. This paper additionally expects to discover the soluble arrangement resting time, restoring period, and relieving temperature on fly debris based geopolymer concrete.

**HARDIJITOET. AL(2008)** explains that geopolymer concrete and its mechanical properties. The author also explains the compositions of geopolymer concrete and its characteristics as well. We can get good compressive strength of geopolymer concrete with additionally demonstrated. The fluid proportion of mass is depending on the proportion of sodium silicate to sodium hydroxide. There is an expansion in compressive strength with the increment in restoring temperature. Longer restoring time likewise expanded the compressive strength.

**USHAET. AL(2015)** in this author explains the importance of geopolymer concrete and its uses in various civil engineering structures. In this investigation, fly debris was supplanted by various mineral ad mixtures

**SHANKAR SANNI ET.AL (2013)** led a test examination on geopolymer concrete and dependent on fly debris. The evaluations picked for the examinations are done for various mix proportions. The ant acid arrange mentutilized for the examination was the blend of two important solutions in the first one is sodium silicate, another important second solution is hydroxide arrangement, and used proportions are 2,2.50,3, and 3.50.

## 3. METHODOLOGY COARSE AGGREGATES

In these locally available materials are used mostly such as crushed granite and the size of stone aggregates are taken according to Indian code standard such as ten millimeters in size. These two important sieve pans are used for the classification of aggregates such as 10mm and 4.75mm. by using these sieves we can determine the type of aggregates and properties also according to IS.

## 4. MANUFACTUREDS AND RHA (RICEHUSKASH)

Rice husk is a natural material that is obtained from farming in agriculture. There are several usages increases now days. The main reason for that is locally available material and also very cheap compared to other materials. This is used as an ecological material for strengthening cementing material.

Fig 1.rice husk ash

| Sr. No. | Particulars | Properties |
|---|---|---|
| 1 | Colour | Gray |
| 2 | Shape Texture | Irregular |
| 3 | Mineralogy | Non Crystalline |
| 4 | Particle Size | < 45 micron |
| 5 | Odour | Odourless |
| 6 | Specific gravity | 2.3 |
| 7 | Appearance | Very fine |

Table 1. Properties of RHA

Artificial sand (M-Sand) can replace quick sand for concrete development. The artificial sand is sent out from the hard rock by crushing. The squashed sand particles are in the shape of a cube, and the edges are grounded. After cleaning and inspection, they can be used as developing materials. The size of artificial sand (M sand) is less than 4.75mm. Artificial sand is an alternative to quick sand. Due to the rapid industrial development, people's interest in the sand has greatly increased, which in most cases leads to insufficient sand for proper water ways.

| Properties | Type of sand | |
|---|---|---|
| | M-sand | River sand |
| 1. Textural composition (% by weight) | | |
| Coarse sand (4.75-2.00 mm)<br>Medium sand (2.00-0.425 mm)<br>Fine sand (0.425-0.075 mm) | 28.1<br>44.8<br>27.1 | 6.6<br>73.6<br>19.8 |
| 2. Specific gravity | 2.63 | 2.67 |
| 3. Bulk density (kN/m3) | 15.1 | 14.5 |
| 4. pH | 10.11 | 8.66 |
| 5. Chemical composition of M-sand | | |

Table 2. Types of sand and properties

## 5. GGBS

GGBS is gotten quickly chilling (extinguishing) liquid debris from the heater with the assistance of water. During this procedure, the slag gets divided and changed in to nebulous granules (glass), meeting the prerequisite of IS Code (fabricating particular for granulated slag utilized in Cement). The granulated slag is ground to wanted fineness for delivering GGBS. The substance creation of JSW's GGBS adds to the creation of unrivaled cement.


Fig 2 .GGBS

| Binder | L O I | Al2o3 | Fe2O3 | SiO2 | MgO | $SO_3$ | $Na_2O$ | Chlorides | Cao |
|---|---|---|---|---|---|---|---|---|---|
| Fly ash | .9 | 31.2 | 1.5 | 61.12 | .75 | .53 | 1.34 | .06 | 3.2 |

Table 3.Flyash & GGBS Properties

## 6. FLYASH

It is one of the important materials used in geopolymer concrete. In this Class, F type is Low calcium and fly ash obtained from En more thermal power station and it was analyzed as per IS:38121981having a specific gravity of 2.21 were used. ASTM-Fly ash came from the coal-burning power station.

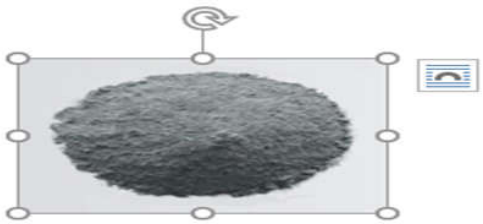

Fig 3 .Fly ash

## 7. EXPERIMENTAL RESULTS SLUMP CONETEST

It is one of the important types of tests used in concrete. This type of test gives a good resultfor the workability and properties of concrete as well. This is used to evaluate the performance of concrete. This test

is accurate and quantifies the function of the new concrete. More specifically, it is used to measures the consistency between groups. It is a simple and easy test and an easy-to-use method. This test is used to know the workability. In the given below showing a slump test with having various steps.

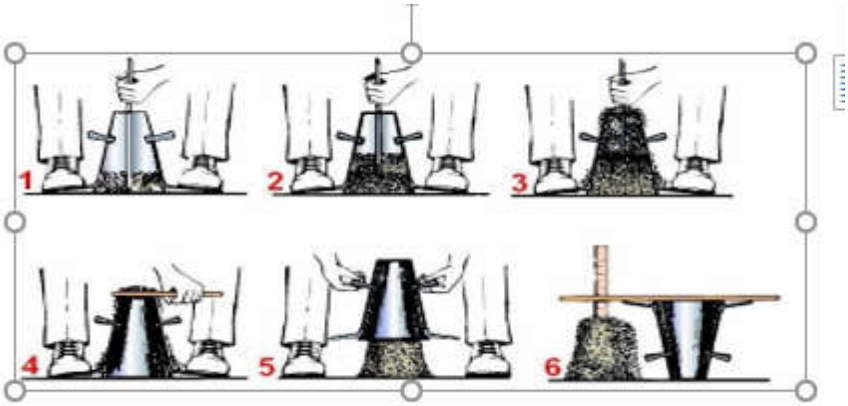


Fig 4. Showing Steps involved in the slump cone test.

## 8. SLUMP CONE TEST

| Sl. number | Physical properties | Observed values |
|---|---|---|
| 1 | Specific gravity | 2.51 |
| 2 | Initial setting time | 45 Min |
| 3 | Final setting time | 280 Min |
| 4 | Consistency | 35% |

| S.No | %GGBS+%RHA+%M-Sand | The slumpin mm forM40 Gradeconcrete |
|---|---|---|
| 1 | 0%GGBS+0%RHA+0%M-sand(Mo) | 56 |
| 2 | 2.5%GGBS+2.5%RHA+5%M-sand(M1) | 42 |
| 3 | 5%GGBS+5%RHA+10%M-sand(M2) | 36 |
| 4 | 7.5%GGBS+7.5%RHA+15%M-sand(M3) | 26 |
| 5 | 10%GGBS+10%RHA+20%M-sand(M4) | 22 |

Table 4. The slump in mm for M40 Grade concrete

## 9. COMPACTION FACTOR TEST

It is one of the important tests of concrete. In this test cylinder and trowel are used to level the concrete surface in the mould. This test gives a better result. It is used to know the workability. It consists of two cylindrical hoppers. Which are installed one another above one. Some times for better operation, we can use grease on the inner surface of the hoppers and the cylinder. We can take the weight of the empty cylinder. Place the cylinder below the hoppers and start the procedure. Observe the mix, if the color of the mixture is uniform, we can get good results. If the color of the mix is non-uniform repeat the process to get the uniform and homogeneous mix.

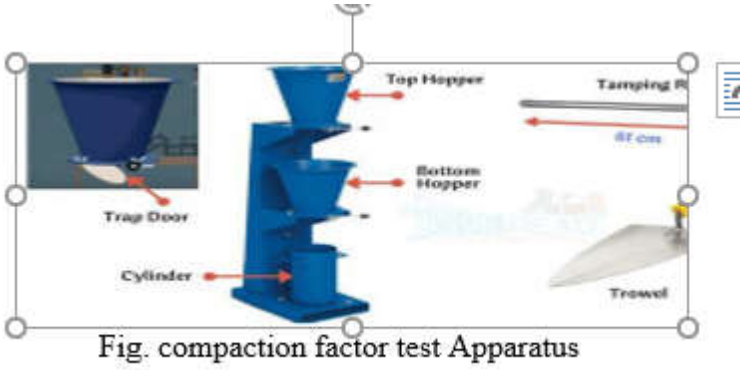


Fig 5. Compaction factor test Apparatus

**COMPACTION FACTOR TEST (C.F.)**

| S.No | %GGBS+%RHA+%M-Sand | C.F. forM40Concrete |
|---|---|---|
| 1 | 0%GGBS+0%RHA+0%M-s and (Mo) | .82 |
| 2 | 2.5%GGBS+2.5%RHA+5%M-sand(M1) | .84 |
| 3 | 5%GGBS+5%RHA+10%M-sand(M2) | .88 |
| 4 | 7.5%GGBS+7.5%RHA+15%M-sand(M3) | .92 |
| 5 | 10%GGBS+10%RHA+20%M-sand(M4) | .96 |

Table 5.CompactionfactorsforM40Gradeconcrete

## 10. COMPRESSIVE STRENGTH

It is one of a good test. In this one cube is placed between the testing equipment and then applies the load. The dial gauge shows the force reading in KN. By using these readings we can calculate the strength. The below figure clearly shows that cube and testing machine. The process of testing is very simple and easy to use in the laboratory.

Fig 6. Cube testing under Compressive strength

**COMPRESSIVE STRENGTH**

| S.NO. | %GGBS+%RHA+%M-Sand | 7 daysMpa | 14 daysMpa | 28 daysMpa |
|---|---|---|---|---|
| 1 | 0%GGBS+0%RHA+0%M sand(M0) | 26.1 | 35.5 | 39.3 |
| 2 | 2.5%GGBS+2.5%RHA+5%Msand(M1) | 26.95 | 36.11 | 39.87 |
| 3 | 5%GGBS+5%RHA+10%Msand(M2) | 27.31 | 36.95 | 40.21 |
| 4 | 7.5%GGBS+7.5%RHA+15%Msand(M3) | 26.81 | 36.43 | 39.71 |
| 5 | 10%GGBS+10%RHA+20%Msand(M4) | 26.35 | 35.81 | 39.31 |

Table 6. Results of the strength of cubes

## 11. SPLIT TENSILE STRENGTH

It is one of the important types of tests used in concrete. In this load are applied cylinders between the equipment. The next force is required to break the cylinder is noted in the dial gauge in KN. After the calculation often sile force, we can determine the tensile strength easily by using numerical formula. The sample is taken out from the curing tank and set for drying for 1to2hours. On either side of the cylinder of specimens draw the diametrical lines to make sure that the lines represent the same axial place. Place the plywood strips on the lower plate ofCTMandfixthecylinderoverit.AsperIS456-2000 thetensilecapacityofconcreteis0.7$\sqrt{fck}$.Splittensilestrength=PD/$\pi DL$

Fig. cylinder under Split tensile strength

Fig. cylinder under Split tensile strength

| S.No | %GGBS+%RHA+%M-Sand | 7 daysMpa | 14 daysMpa | 28 daysMpa |
|---|---|---|---|---|
| 1 | 0%GGBS+0%RHA+0%M-sand(Mo) | 2.55 | 2.97 | 3.13 |
| 2 | 2.5%GGBS+2.5%RHA+5%Msand(M1) | 2.5 | 3.03 | 3.19 |
| 3 | 5%GGBS+5%RHA+10%M-sand(M2) | 2.67 | 3.11 | 3.25 |
| 4 | 7.5%GGBS+7.5%RHA+15%Msand(M3) | 2.58 | 2.95 | 3.2 |

## CONCLUSIONS

Under normal operating room temperature, geopolymer concrete often does not show obvious physical changes, but can be observed under normal conditions. The complete Geopolymer concrete specimen placement process takes up to72 hours without hardening the surface. 5% GGBS +5% RHA+ 10% M-sand had a maximum compressive strength, split tensile and flexural strength. 8m can make good use of power, and the average strength can be increased by 8m. The higher the ratio of GGBS + RHA + M-Sand, the higher the durability of concrete caused by acid attack, alkali attack, and sulphate attack. As the best substitute for cementing materials, GGBS has the characteristics of high compressive strength, low heat of hydration, chemical corrosion resistance, better workability, durability, and high cost-effectiveness. The excess temperature in oven curing causing cracks on cubes Rice husk ask is also the reason for high compressive strength and its reason for avoiding chemical reactions. The acid solution has an obvious corrosiveeffectoncement-basedmaterials.Theaggressivesolutionincreasesastheacidconcentrationincreases.

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