

An Experimental Investigation of Mechanical Properties of Geo-Polymer Concrete by Using Ggbs, Granite Powder, Marble Powder

Butcha Meenakshi, T.Chandrasekhar Yadav, Bejji Someswararao

¹P.G Student, Department of Civil Engineering, Gokul institute of technology, piridi, Bobbili, Vizianagaram, Andhra Pradesh, India, ²Assistant Professor, Department of Civil Engineering, , Gokul institute of technology, piridi, Bobbili, Vizianagaram, Andhra Pradesh, India, ³Assistant Professor, Department of Civil Engineering, Sri Sivani College, Chilakapalem, Srikakulam, Andhra Pradesh, India.

ABSTRACT

The usage of concrete is increasing day by day. In concrete, Cement is a binding material, now it is time to search for alternative sustainable materials to use all sorts of indigenous waste products byproducts and cheaply available minerals in the concrete. The new generation concrete has been developed such as geo-polymer concrete, amorphous alumina silicates cementations material which uses waste products of industries, and also alkaline solutions such as sodium silicate(Na_2SiO_3), sodium hydroxide (Naoh) as their binding material .In this study Geo -polymer concrete with Granite powder, Marble powder,GGBS are chosen. Mechanical and durability properties are investigated through compressive and tensile strength tests after 7 and 28 days. RCPT test only 28 days.

Keywords- GGBS, Marble powder, Granite powder, Sodium silicate(Na_2SiO_3), Sodium hydroxide (NaOh).

Date of Submission: 01-09-2024

Date of acceptance: 10-09-2024

I. INTRODUCTION

1.1 GENERAL:

Cement plays a vital role in the construction industry, a binding material which binds all other ingredients of concrete in presence of water. However, it was estimated that about one ton of cement production generates approximately one ton of CO_2 which is objectionable to the environment. In order to reduce the utilization of cement concrete the special concrete called geo-polymer concrete consists of fly ash and alkaline solution as their binding material. In these GGBS and granite and marble powder these are totally waste of materials and cheaply available. It will be comes nature. So main purpose of these materials usage of low cost and gives to good strength.

1.2 HISTORY OF CONCRETE:

600 BC-Rome: Although the ancient romans weren't the first to create concrete they were first to utilize this material widespread. By 200 BC, the romans successfully implemented the use of concrete in the majority of their construction. They was used to a mixture of volcanic ash, lime, and sea water to form the mix. The time period during which concrete was first invented depends on how one interprets the term concrete. Ancient materials

were crude cements made by crushing and burning gypsum or limestone. Lime also refers to crushed, burned limestone. When sand and water were added to these cements, they became mortar, which was a plaster like material used to adhere stones to each other. Today's concrete is made using Portland cement, coarse and fine aggregates of stone and sand, water. Admixtures are chemicals added to the concrete mix to control its setting properties and are used primarily when placing concrete during environmental extremes, such as high or low temperatures, windy conditions, etc.

EARLY USE OF CONCRETE:

The first concrete like structures were built by the Nabataea traders or Bedouins who occupied and controlled a series of a series of oases and developed a small empire in the regions of southern syria and northern Jordan in around 6500 BC. In making concrete, the Nabataea understood the need to keep the mix as dry or low slump as possible, as excess water introduces voids and weaknesses into the concrete. Their building practices included tamping the freshly placed concrete with special tools.

1.3 NEED OF THE PRESENT INVESTIGATION:

Concrete is the most commonly used construction material; Its usage by the communities across the globe is second only to water. Cement production is also highly energy intensive, after steel and aluminium. On the other hand, coal burning power generation plants produce huge quantities of GGBS and some of the materials which byproducts. Present prepare of geo polymer concrete adding of GGBS, Granite powder, Marble powder, Sodium silicate, Sodium hydroxide polymers. The geo polymer concrete prepares totally wastage of industrial material. These materials are cheaply, nearly available. The main content of geopolymer concrete is reduce to CO₂ compares to normal concrete, geopolymer concrete gives to good and early increasing strength. Its early setting time compares to normal concrete. But the geopolymer concrete is no usage to RCC, Constructions, other works. Because this is very costly and early setting.

II. LITERATURE REVIEW

PRASS.PITHADIYA.ABHAYV.NAKUM(2015) has examined the experimental study on geopolymer concrete by using ggbs as a replacement of fly ash up to 100%. The fresh and hardened properties of concrete were examined. Results showed that replacement of fly ash increases the strength gradually. It has been observed that geopolymer concrete requires oven curing about 100% and concluded that ggbs makes significant impact on mechanical properties of geo-polymer concrete.

Ajay Takekar, GR Palli (2017) has studied by Experimental study on mechanical properties of fly ash and GGBS based on geopolymer concrete. The present investigation aims at studying the mechanical properties of fly ash and ggbs based on GPM. In this study fly ash replaced (0%, 25%, 50%, 100%) by ggbs. The compressive strength, split tensile strength, flexural strength 3, 7, 28, days compared to with normal OPC M25 grade of concrete and oven curing studied. Geopolymer concrete shows better results than normal conventional concrete. This geopolymer concrete is more advantageous, economical and eco friendly.

DR.G.Prince Arulraj, Mr.A.Adin and Mr.T.Suresh kannan (2013) Has studied by experimental investigation of granite powder. Granite powder belongs to igneous rock of family. The density of granite between 2.65 to 2.75 and compressive strength will be greater than 200 MPa. It is will be mixes of M30 Grade of concrete designed for Indian standard 10262 and specimens were caste. The present study of granite powder replaced by fine aggregate and this powder added 0, 5, 10, 15, 20, and 25% of fine

aggregate. After casting cubes and cylinders were air cured. Finally the replacement of fine aggregate with granite powder is found to improve the strength of concrete.

III. MATERIALS AND METHODOLOGY

3.1 MATERIALS

The materials used in this study are

- GGBS
- Granite Powder
- Marble Powder
- Fine Aggregate
- Coarse Aggregate
- Sodium Hydroxide (NaOH)
- Sodium Silicate (Na₂SiO₃)
- Water

Table 1: Physical properties of GGBS

PROPERTIES	VALUES
Particle size	0.1 micron
Specific surface area	400-600m ² /kg
Relative density	2.85 -2.95
Ph (T= 20 degree C)	1.0-1.1Tonnes/m ³
Specific gravity	2.92

Table 2: Physical properties of Granite powder

CHARACTERISTICS	VALUE
Density of granite powder	2.65 to2.75
Specific gravity of granite powder	2.53
Fineness	2.4

Table 3: Properties of marble powder

CHARACTERISTICS	VALUE
Specific gravity of marble powder	2.842
Fineness	24.4%

Table 4: Properties of fine aggregate

CHARACTERISTICS	VALUE
Zone	2
Specific gravity	2.64
Density	14 Kn\m ³
Water absorption	2.1%

Table 5: Properties of coarse aggregate

CHARACTERISTICS	VALUE
Nominal size	20mm
Specific gravity	2.84
Density	1625.8Kg\m ³
Water absorption	2.4%

Table 6: Properties of sodium hydroxide

PROPERTY	VALUE
Color	Pellets/white
Boiling point	102 ⁰ C for 40% aqueous solution
Molecular weight	39.997 g/mol
Specific gravity	1.5

Table 7: Properties of sodium silicate

PROPERTY	VALUE
Density	40.4 -42 ⁰
Dry matter	37.50-39.50%
Weight ratio	3.20-3.40
SiO ₂	29.50%
Na ₂ O	9%
Specific gravity	1.6

IV EXPERIMENTAL RESULTS AND DISCUSSION

Compression strength test results:

The cubes were casted in the concrete technology laboratory and were tested on 14,28 days and the results obtained were as follows.

Mix Proportions by Weight

Cement(kgs)	Fine Aggregate(kgs)	Coarse Aggregate (kgs)	w/c ratio (lt)
425.73	676.15	1186.77	191.58
1	1.588	2.79	0.45

Table 1: Compressive strength test results @ GGBS +G.P

MIX	14 Days	28 Days
GGBS 100%	37.77	62.95
GGBS 90% +G.P10%	37.59	62.65
GGBS 80% +G.P20%	32.97	54.95
GGBS 70% +G.P30%	34.77	57.95
GGBS 60% +G.P40%	26.43	44.05
GGBS 50% +G.P50%	29.52	49.2

Table 2: Compressive strength test results @ GGBS + M.P

MIX	14 Days	28 Days
GGBS 100%	37.77	62.95
GGBS 90% +M.P10%	38.64	64.4
GGBS 80% +M.P20%	37.05	61.75
GGBS 70% +M.P30%	26.37	43.95
GGBS 60% +M.P40%	25.05	41.75
GGBS 50% +M.P50%	17.01	28.35

Table 3: Compressive strength test results @ GGBS+G.P 20% (C)+M.P

MIX	14 Days	28 Days
G 70%+G.P20%+M.P10%	25.98	43.3
G 60%+G.P20%+M.P20%	28.95	48.25
G 50%+G.P20%+M.P30%	17.1	28.5

Table 4: Compressive strength test results @ GGBS+M.P 20% (C)+G.P

MIX	14 Days	28 Days
G 70%+M.P20%+G.P10%	29.52	49.2
G 60%+M.P20%+G.P20%	24.9	41.5
G 50%+M.P20%+G.P30%	17.76	29.6

Split Tensile Strength Test:

Table 1: Split Tensile Strength Test Results @GGBS+M.P20%(C) + G.P

MIX	14 Days	28 Days
G 70%+G.P10%+M.P20%	2.04	3.4
G 60%+G.P20%+M.P20%	2.13	3.55
G 50%+G.P30%+M.P20%	1.35	2.25

Table 2: Split Tensile Strength Test Results @GGBS+G.P20%(C) + M.P

MIX	14 Days	28 Days
G 70%+G.P20%+M.P10%	1.53	2.55
G 60%+G.P20%+M.P20%	1.62	2.7
G 50%+G.P20%+M.P30%	2.01	3.35

V CONCLUSION

1. Replacement of fly ash increases the strength gradually.
2. It can be concluded that usage of constructional waste with GGBS in conventional concrete may improve mechanical properties, and is economical and eco friendly to use such materials as a replacement of normal concrete ingredients.
3. It has been shown that reactive MGO can act as an effective alkali activator for GGBS paste, higher strength up to 33mpa at 28 days.
4. In order to achieve the scope of this study, the following are the conclusions we drawn.
5. In the present experimental investigation of 100%GGBS,90%GGBS+10%G.P,80%GGBS+20%G.P,70%GGBS+30%G.P,60%GGBS+40%G.P50%GGBS+50%G.P.These proportions using prepared geo polymer concrete and prepared cubes
6. In the present experimental investigation of 100%GGBS,90%GGBS+10%M.P,80%GGBS+20%M.P,70%GGBS+30%M.P,60%GGBS+40%M.P,50%GGBS+50%M.P.These proportions using prepared geopolymer concrete and prepared cubes.

7. In the present experimental investigation of 70% GGBS+20% G.P+10% M.P, 60% GGBS+20% G.P +20% M.P, 50% GGBS+20% G.P+30% M.P

8. These proportions using prepared geo polymer concrete and prepared cubes. In this 20% G.P is constant

9. The influence of combined applications of GGBS, Granite powder, Marble powder, Polymers on compressive strength, split tensile strength, flexural strength of M30 grade of concrete is investigated.

10. the present experimental investigation of 70% GGBS+20% M.P+10% G.P, 60% GGBS+20% M.P+20% G.P, 50% GGBS+20% M.P+30% G.P. These proportions using prepared geo polymer concrete and prepared cylinders, beams. In this 20% M.P is constant

11. In the present experimental investigation of 70% GGBS+20% G.P+10% M.P, 60% GGBS+20% G.P+20% M.P, 50% GGBS+20% G.P+30% M.P

12. These proportions using prepared by geo polymer concrete, casting cylinders, beams. In this 20% G.P is constant.

13. Curing was In the present experimental investigation of 70% GGBS+20% G.P+10% M.P, 60% GGBS+20% G.P +20% M.P, 50% GGBS+20% G.P+30% M.P

14. These proportions using prepared geo polymer concrete and prepared cubes. In this 20% G.P is constants.

15. This work continues with testing of concrete specimen in addition of GGBS, Granite powder, Marble powder and polymers were added.

REFERENCES

- [1]. ISSN:2319-1163, pISSN:2321-7308: PARAS S. PITHADIYA, ABHAY V. NAKUM "EXPERIMENTAL STUDY ON GEO-POLYMER CONCRETE BY USING GGBS
- [2]. ISSN:2231-6604, VOL.1: M.I.ABDUL ALEEM, P.D.ARUMAIRAJ (2012) GEO POLYMER CONCRETE.
- [3]. ISSN:5107-5113, VOL.2: P.N.RAO (2010) HIGH PERFORMANCE CONCRETE WITH GGBS AND ROBO SAND. .
- [4]. VOL.2020: E.RABIA, R.A.S MOHAMED (2020) DEVELOPING GEO POLYMER CONCRETE PROPERTIES BY USING NANOMATERIALS AND STEEL FIBERS.
- [5]. ISSN:210-219, VOL.51: PRAKASH, R.VORA (2012) PARAMETRIC STUDIES ON COMPRESSIVE STRENGTH OF GEO POLYMER CONCRETE.
- [6]. ISSN:735-746, VOL.3: DHAVAMANI DOSS, SAKTHI DOSS (2019) STUDY ON HIGH STRENGTH GEO POLYMER CONCRETE WITH ALUMINA AND SILICA MATERIALS USING MANUFACTURING SAND
- [7]. VOL.31: LIANYANG ZHANG (2019) EXPERIMENTAL STUDY OF GEO POLYMER CONCRETE PRODUCED FROM WASTE CONCRETE.
- [8]. ISSN:18-23, VOL.4: AJAY TAKEKAR, GR PATIL (2017) HAS STUDIED BY EXPERIMENTAL STUDY ON MECHANICAL PROPERTIES OF FLY ASH AND GGBS BASED ON GEO POLYMER CONCRETE.
- [9]. ISSN:133-137, VOL.28: B.VIJAYA RANGAN AND HARDIITO (2015) STUDIED ON FLY ASH BASED GEOPOLYMER CONCRETE
- [10]. D.BONDAR (2013) STUDIED ON GEO POLYMER CONCRETE
- [11]. ISSN:210-219, VOL.51: PRAKASH (2013) STUDIED BY PARAMETRIC STUDIED ON COMPRESSIVE STRENGTH OF GEO POLYMER CONCRETE
- [12]. VOL.31: LIANYANG ZHANG (2019) STUDIED BY EXPERIMENTAL STUDY OF GEO POLYMER CONCRETE PRODUCED FROM WASTE CONCRETE.
- [13]. ISSN:193-198, VOL.3: DR.G.PRINCE ARULRAJ, MR.A.ADIN AND MR.T.SURESH KANNAN (2013) HAS STUDIED BY EXPERIMENTAL INVESTIGATION OF GRANITE POWDER
- [14]. ISSN:183-204: MARKANDEYA RAJU PONNADA, S SIVA PRASAD (2016) STUDIED BY COMPRESSIVE STRENGTH OF CONCRETE WITH PARTIAL REPLACEMENT OF AGGREGATE WITH GRANITE POWDER AND COCKLE SHELL.
- [15]. ISSN:1808-2018: VOL.8: ELYAS ASADI SHAMSABADI, MANSOUR GHALEHNOVI (2018) HAS STUDIED BY PERFORMANCE OF CONCRETE WITH WASTE GRANITE POWDER ; THE EFFECT OF SUPERPLASTICIZERS ISSN:0976-4399, VOL.1 : BABOO RAI, KHAN NAUSHAD, ABHISHEK, DUGGAL, TABIN RUSHAD (2011) HAS STUDIED INFLUENCE OF MARBLE POWDER / GRANULES IN CONCRETE MIX.
- [17]. PII:S2352-7102: MANPREET SINGH, KAILASH CHAUDHARY, ANSHUMAN SRIVASTAVA, DIPENDU BHUNIA (2017) HAS STUDIED BY A STUDY ON ENVIRONMENTAL AND ECONOMIC IMPACTS OF USING WASTE MARBLE POWDER CONCRETE.
- [18]. ISSN:1819-6608, VOL.8: V.M. SOUNDARARAJAN AND A.SIVAKUMAR (2013). HAS STUDIED BY EFFECT OF THE LIME

CONTENT IN MARBLE POWDER FOR
PRODUCING HIGH STRENGTH CONCRETE.

- [19]. VOL.5: BEDERINA MADANI,LAMRA
MOHAMMED (2019)HAS STUDIED BY EFFECT
OF MARBLE POWDER ON THE PROPERTIES OF
SELF COMPACTING SAND CONCRETE.
- [20]. ISSN:1964-8189,VOL.20:MEHMET S.KIRGIZ
(2016)HAS STUDIED BY FRESH AND
HARDENED PROPERTIES OF GREEN BINDER
CONCRETE CONTAINING MARBLE POWDER
AND BRICK POWDER.