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Study on Mechanical Properties of Geo polymer Concrete

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Abstract: revolves around the eco-obliging perspectives. In this work, the mechanical properties of fly-ash based GPC which includes compressive strength, split tensile strength and non-destructive testing methods like UPV and rebound hammer tests results will be examined and analyzed based on the different mix limits for 8 mixes. The main varying limits of the mix are fundamental plan extent and concentration and folio degrees. Considering the ideal mix from 8 common GPC mixes, one mix will be concentrated under thegranitepowderreplacement.Thegranitepowderisutilizedforthepartial replacement of clasp for the 5%, 10%, 15%, and 20% of the binder volume. The concrete cube specimens are casted according to Indian standards and the seventh and 28th days strength are used for the analysis.

List Terms: Compressive strength, Geo polymer concrete, Granite powder.

1. Introduction

Being developed ventures, the Typical Portland Cement (OPC) Concrete has been utilized strikingly due to its virtuous mechanical and strength properties. Due to the industrial development of the last few decades, the utilization of OPC is enormous and that results in a rising in the level of CO2 in the atmosphere. In order to maintain the environment eco-obliging, there is a necessity for a legitimate choice for OPC. For such a sustainable eco-friendly environment, geo polymer concrete was made. Geo polymer Concretere defines the concreting technology by its lesser carbondioxide spread and utilization of present day waste such as fly-ash, GGBS and granite waste powder. Geo polymer Concrete is outlined by impelling the alumina and silica-rich materials by the dissolvable base activators. The Alumina and Silica from the folio materials answer with the activator plan to initiate the polymerization cycle. The activator solutions are contained salt bases like sodium or potassium. In this work Sodium Hydroxide (SH) and Sodium Silicate (SS)are used as salt activators. These activators have a huge impact on the strength like compressive and versatile strength and workability parameters.

Ghasan Fahim Huseien et al. investigated the effect of the kind of activator (mix of SS with SH, SS with water and SS alone) and calcium content on compressive strength, flexural strength, tensile strength and micro structure of GPC mixes. The usefulness and beginning setting time were reduced with calcium content. The activator sodium silicate alone gave good strengthresultsat60°C temperature[3].

UbollukRattanasakandPrinya Chadraprasirthave studied the effect of newly introduced long time mixing process for preparation geo polymer and compared with the normal mixing process. The limits considered are essential ratio(0.5,1,1.5and 2)and molarity variation (5,10and15M). The leaching test results showed good results for 10MNaOH. The newly proposed long-time mixing process gave some better results in compressive strength and infrared spectros copy [4]. KiatsudaSomnaetal. Have investigated the compressive strength and microstructure properties (using SEM, EDS and infrared spectros copy)on geopolymer pastes. Here, two types of flyash used one was ordinary flyash and another one ground flyash and activated with different concentrations of NaOH (4.5,7,9.5,12,14and16.5M).From the obtained results ground flyash mix

having an alkaline ratio in the range 9.5Mto14Mgavegood compressive strength increments. From the Micro structure study, it was cleared the ground flyash have higher polymerization compared to the ordinary one [5].

2. Materials and Methodology

A. Materials

The fundamental components for the encouraging the sustainable geo polymer concrete are fly trash, granite powder, ground granulated blastfurnaceslag(GGBS), sodium silicate solution (Na2SiO3) and sodium hydroxide (NaOH). Fly ash, GGBS and Granite powder were the supplementary cementitious materials (SCM) to encourage the restricting and bonding powers in the significant mix. The fly trash used for this work is of class F type and the properties are confirming to the Indian standards. GGBS is the slag material obtained from the steel manufacturing industry, which is the main source to cultivate the accelerated setting time of concrete. The stone waste is thefinelypowdereddustmaterialobtainedfromthequarrysiteinTamilnadu, India. It is obtained as a waste product during the sawing of the stone pieces. Primarily the work bases on the focus on stone waste. The genuine properties of the supplementary cementitious materials are analyzed in Table1.

Table1. Properties of SCM

Property	Fly ash	GGBS	Granite powder
Colour	Grey	Clear white	Grey
Form	Fine powder	Fine powder	Fine Powder
Specific gravity	2.21	2.75	2.64
Particle size	<90 microns	<75 microns	<90 microns
BulkDensity (kg/m^3)	1510	1290	1110

Table2.PropertiesofAggregates

Property	MSand	12mm aggregate	20mm aggregate
Specific Gravity	2.72	2.71	2.72
WaterAbsorption (%)	3.14	0.50	0.33
Crushing Value(%)	-	20.23	14.88
BulkDensity (kg/m^3)	1699	1461	1463

3. Methodology

Material	MixProportion(kg/m^3)			
	M1	M2	M3	M4
Flyash	331.03	331.03	331.03	331.03
GGBS	82.76	82.76	82.76	82.76
M-Sand	720.00	720.00	720.00	720.00
20mm aggregates	594.00	594.00	594.00	594.00
12mm aggregates	486.00	486.00	486.00	486.00
NaOH	74.48	74.48	74.48	62.07
NaOHMolarity	6 M	6 M	6 M	8M

The contemporary examples in the improvement of GPC are studied considering late issues and journals.

Considering the study the objectives are framed a long with the proper methodology. The works start with the finalizing the material utilization for the project and preliminary tests on the materials. This is followed by the preparation of mix design

4. Experimental Execution

For the strength assessment the compressive strength test, split tensile strength test, ultra sonic pulse velocity (UPV) test

MixID	7 days	28 days
M1	15.07	39.29
M2	22.78	46.68
M3	25.69	50.38
M4	17.45	35.22
M5	18.73	44.18
M6	24.97	49.37
M7	16.8	31.22
M8	15.69	31.89
M9	17.21	34.54
M9G1	19.52	35.62
M9G2	21.95	38.54
M9G3	22.62	35.48
M9G4	20.82	33.25

Table4.Compressive stress test results

From the compressive strength test results, it is clear that the extension in sodium hydroxide obsession results in higher compressive strength. Moreover, the lower the extent of sodium silicate to hydroxide higher will be the strength. Thealkalineratioof1.5and2.0yieldsalmostsimilarandmaximumstrength.Thecompressivestrengthforthemix M3exhibitsagreaterm aximumstrengthof50MPa.Almost50%ofthecompressivestrengthisachievedattheageof7daysforall mixes. The strength improvement at 7 days for the granite powder mixes are under 45%. This shows the granite powder gives less early strength when compared with normal GPC mixes. The 10% replacement of stone powder gives a maximum of 38.54 MPa compressive strain, which is 11.5%higherthanthenormalmixM9.Figure1showsthegraphicalvariationofcompressive stress for all mixes.

5. Results and Discussions

A. Compressive Strength Test

The compressive strength test is conducted at7thand28thdays.The results are shown in table 6.

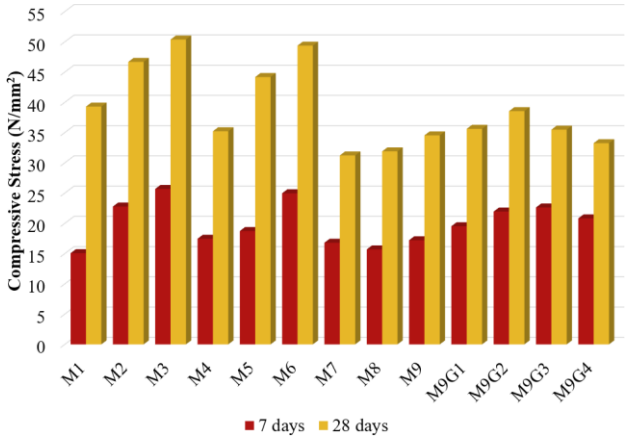

Fig1.CompressiveStressResults

B. Tensile Strength Test

The tensile strength test is conducted at 7th and 28 th days. The results are shown in table7.

Table7. Tensile stress test results

MixID	7 days	28 days
M1	2.66	3.85

M2	3.24	4.63
M3	3.34	4.79
M4	2.89	4.04
M5	2.88	4.45
M6	3.44	4.74

M7	2.78	3.93
M8	2.69	4.07
M9	2.84	4.12
M9G1	3.01	4.15
M9G2	3.22	4.53
M9G3	3.12	3.96
M9G4	3.01	3.88

6. Conclusion

1. Lower alkaline ratio and higher molarity have good mechanical properties for all mixes.
2. Forallmixes,40%ofthemechanicalstrengthisachieved at the age of7 days.
3. The 10% stone powder replacement is gotten as optimum replacement percentage.
4. The10%replacementofgranitepowdershowed11.5%increase in compressive strength at 28 years of age dayswhencomparedwiththeM9mix.Similarly,theM9G2mix with 10% superseded rock powder showed a 10%increase in split flexibility at 28 years of age days when compared withtheM9mix.

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