Journal of Civil Engineering and Environmental Technology
p-ISSN: 2349-8404; e-ISSN: 2349-879X; Volume 5, Issue 6; July-September, 2018, pp. 402-404

http://www.krishisanskriti.org/Publication.html

Development of Self Compacting Geopolymer Concrete at Ambient Curing Conditions

Srikanth[1] and Dr. B. Narendra Kumar[2]

[1]PG Student, VNRVJIET, Hyderabad, Telangana State, India
[2]Professor of Civil Engineering, VNRVJIET, Hyderabad, Telangana State, India
E-mail: [1]patangasrikanth1990@gmail.com, [2]narendrakumar_b@vnrvjiet.in

Abstract—To present experimental work aims to study rheological and mechanical properties of Quartz sand based self compacting geopolymer concrete (SCGPC) cured at ambient curing conditions. SCGPC is developed by replacing river sand with quartz sand and partial replacement of fly ash with ground granulated blast furnace slag (GGBS) ranging from 0% to 60% with an interval of 20% of flyash. Results indicate a nominal increase in flexural strength, split tensile strength and compressive strength.

1. INTRODUCTION

Geopolymer was the name coined by Daidovits in 1978 to materials which are characterized by inorganic molecules. Geo polymer cement concrete is made from utilization of these geopolymers. Fly ash is the byproduct from thermal power plant whereas ground granulates blast furnace slag from steel plant. These two materials are processed and used for concrete to form geopolymer concrete. Geopolymer concrete reduces carbon emissions which are significant from usage of Portland pozzolona cement.

Both concepts of geopolymers and self compatibility are brought together to develop a hybrid concrete i.e., self-compacting geopolymer concrete. This concrete shows both self-compacting and geopolymer concrete properties. Development of SCGPC at ambient curing conditions has scope to study. In this paper, we have examined rheological and mechanical properties of quartz sand based SCGPC at ambient curing conditions.

2. LITERATURE REVIEW

P. Dinakar(2013) concluded using earlier studies that GGBS based self compacting concretes of strengths at various replacement levels ranging from 20% to 80% can be developed.

R. Krishneswar(2016) states 50% replacement of GGBS with flyash has satisfied rheological properties of SCGPC as per EFNRC guidelines with adequate strength properties.

Venu Malagavelli(2010) stated GGBS can be used as a choice to replace cement as binder material and 50% replacement has given better results.

***E. Divya** stated 50% replacement of GGBS with fine aggregate has shown* favourable effects of the mechanical properties concrete.

3. EXPERIMENTAL PROGRAM

This experiment studies the strength characteristic of self compacting geopolymer concrete that contains quartz sand and coarse aggregates. The studies were carried out using different mix proportions for self-compacting, geopolymer cubes, beams and cylinders with different strength Compressive strength, flexural strength, split tensile strength were conducted for 7 days and 28 days.

Mix Designation	Fly ash (kg/m^3)	GGBS (kg/m3)	Quartz Sand (kg/m^3)	Coarse aggregate (kg/m^3)	Sodium hydroxide solution (kg/m^3)	Sodium Silicate solution (kg/m^3)	SP % of powder content	Extra water
MIX 1	500	---	925	805	50	125	2	12 %
MIX 2	400	100	925	805	50	125	2	12 %
MIX 3	250	250	925	805	50	125	2	12 %
MIX 4	200	300	925	805	50	125	2	12 %

4. MATERIALS

1. Fly ash

Fly ash is residue attained after combustion of coal. Fly ash used in the study is ASTM Class F sourced from RDC CC plant Bachupally in Hyderabad. The specific gravity of fly ash used was 1.79. Class F fly ashes are produced from bituminous and sub bituminous coals and contain alumina and silicate as active components. In this experimental work flyash is taken as binder.

TABLE 1

Properties of Fly Ash and GGBS

Property	Fly-ash	GGBS
Specific gravity	1.79	2.58
Bulk density (Kg/m^3)	500-800	1100
Appearance	Grey	White
Particle size	30 microns	25 microns
Fineness (m^2/kg)	350	380

2. Ground Granulated Blast Furnace Slag (GGBS)-

GGBS is a by-product from the blast-furnaces used to make iron. GGBS is a glassy, granular, non-metallic material consisting essentially of silicates and aluminates of calcium and other bases. The specific gravity of GGBS is 2.58. In this experimental work GGBS was assumed as binder.

3. Coarse Aggregates-

Natural aggregates were used as the coarse aggregates in the concrete mixtures. Locally available crushed cubes cylinders of medium size 12mm was used as the natural coarse aggregate.

TABLE 2

Properties Of Coarse Aggregates

Property	Value
Size	12mm
Shape	Irregular
Specific gravity	2.71
Abrrasion	27.58%
Water Absorption	0.50%
Crushing value	14.22%

4. Quartz sand-

Quartz is the silica rich mineral. Pure Quartz is colourless and transparent. It occurs mostly in igneous rocks and practically in all metamorphic and sedimentary rocks. It is highly resistant to both mechanical and chemical weathering.

TABLE 4: Properties Of Quartz sand

Property	Value
Size	4.75mm
Bulk Density	1591 kg/m3
Specific gravity	2.7
Fineness modulus	3.33
Water Absorption	1.20%

TEST RESULTS

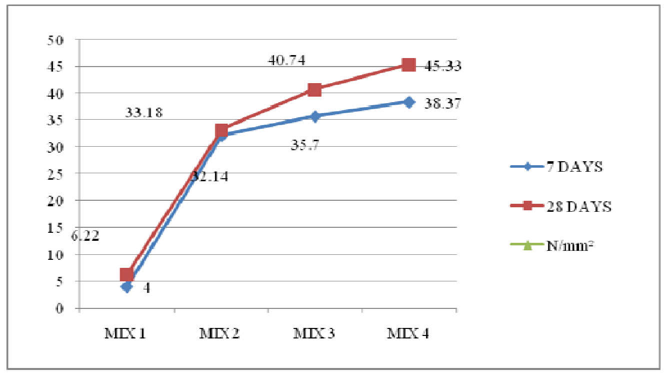
Rheological properties

Rheological properties such as flow table test, V-funnel test and L- box test are performed according to EFNRC guidelines.

Mix	Flow Table		V Funnel	
	T_{50} (sec)	Diameter (mm)	T_f (sec)	L- box
SCGPC 1	3	775	6	0.98
SCGPC 2	3	740	8	0.95
SCGPC 3	4	690	9	0.89
SCGPC 4	5	650	11	0.84

Compressive Strength: units (N/mm^2):

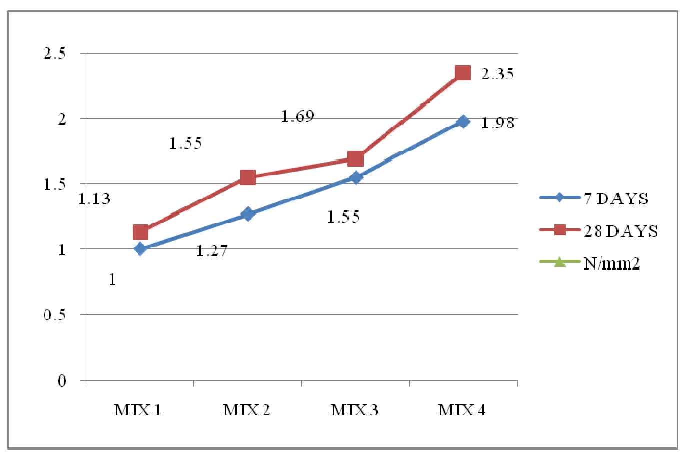
Compressive strength is the tendency of structure to resist loads, tending to reduce size, as counter to tensile strength, which supports loads tending to expand. In present trends, compressive strength resists compression. Cubes of size 150mm X 150mm X150 mm are casted and tested.



Split Tensile Strength: units (N/mm^2):

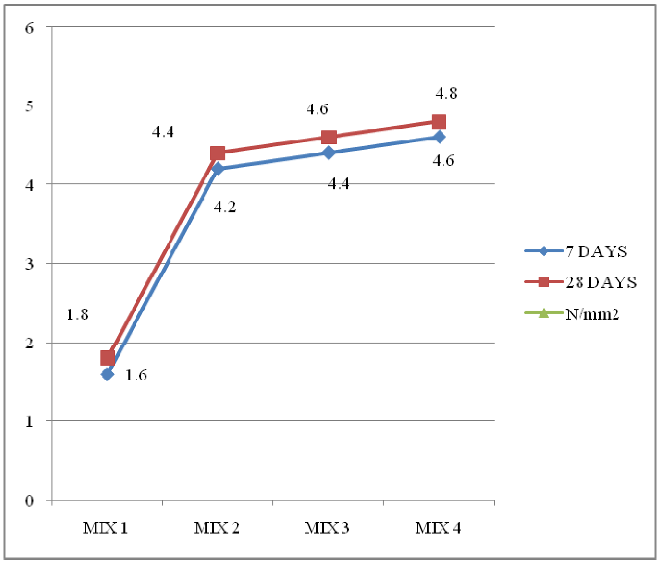
The spilt tensile strength of geopolymer concrete is also an important property. Geoploymeric concrete casted cylinders are used to determine the tensile strength of geopolymer concrete. The gepolymer concrete is slightly weak in tension due to its brittleness nature and is not dreamt to resist the tension directly.

Cylinders of 150mm diameter and 300mm length are casted and tested.



Flexural Strength:

Flexural strength is one measure of the bending strength of geopolymer concrete. It is a measure of an unreinforced concrete beam or slab to resist rupture in bending. It is measured by loading (**100x100x500mm**) concrete beams with a span length of at least three times the depth.



5. CONCLUSIONS

Increase in 55.5% is observed in 28 days compressive strength when compared with 7 days compressive strength of nominal mix (mix 1).

Increase in 18.13% is observed in 28 days compressive strength when compared with 7 days compressive strength of optimum mix (mix 4).

Increase in 18.68% is observed in 28 days compressive strength when compared with 7 days split tensile strength of optimum mix (mix 4).

Increase in 4.34% is observed in 28 days compressive strength when compared with 7 days flexural strength of optimum mix (mix 4).

Mix 4 is considered as optimum mix with maximum mechanical properties and maximum increase of these parameters.

Optimum mix also satisfies all rheological properties under EFNRC guidelines.

REFERENCES

[1] Design of self-compacting concrete with ground granulated blast furnace slag. By P.Dinakar Kali Prasanna Sethy Umesh C.Sahoo, ELSEVIER . Journal of Scientific & Industrial Research Vol. 66, January 2013, pp. 161-169.

[2] Venu Malagavelli et. al. / International Journal of Engineering Science and Technology Vol. 2(10), 2010, 5107-5113.

[3] E.divya. Study On Behaviour Of Concrete Partially Replacing Quartz Sand As Fine Aggregate Posted in Concrete Engineering, Research Papers.

[4] EFNARC, 2002.

[5] American Society for Testing and Materials. Standard Test Method for Density, Relative Density, Absorption of Coarse Aggregate, ASTM C127, Annual Book of ASTM Standard, 2012.

[6] American Society for Testing and Materials. Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates, ASTM C136, Annual Book of ASTM Standard, 2006.

ABOUT THE AUTHORS

P. Srikanth is currently pursuing Post-graduation (M.Tech.) in Structural Engineering at VNRVJIET, Hyderabad.

Dr. B. Narendra Kumar (DEAN) is currently working as Professor of Civil Engineering at VNRVJIET, Hyderabad.