An Experimental Study on Self Compacting Geopolymer Concrete

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Abstract— Self-compacting geopolymer concrete (SCGC) holds promise as an eco-friendly and high - performance construction material with the potential to contribute to sustainable development. Self-compacting geopolymer concrete is a type of concrete that two innovative technologies. It is designed to have high followability and the ability to fill intricate and congested reinforcement within the need for external vibration or compaction. The constituents of SCGC are activated with various molarities of alkaline solution containing sodium hydroxide (NaOH) and sodium silicate (Na2SiO3) Ground granulated blast furnace slag, fly ash and superplasticizer. M30 grade concrete was prepared using trial and error process. The Durability of SCGC is based on the tests conducted such as water absorption, acid attack, sulphate attack, sorptivity. Mechanical properties such as flexural strength test evaluated. The comparison was established by preparing normal SCC and to test parametrically with superior properties of SCGC towards SCC.

Key words: SGCC, SCC, water absorption, acid attack, sulphate attack, sorptivity, sodium hydroxide (NaOH), sodium silicate (Na_2SiO_3), fine aggregate, coarse aggregate, cement, superplasticizer.

I. INTRODUCTION

Self-compacting geopolymer concrete (SCGC) is a novel material and a modern high- Performance concrete that Doesn't required ordinary Portland cement and additional compaction.

SCGC Was developed to overcome failure due to lack of adequate compaction. SCGC is a improved from of concrete that compacts under its own weight within the need for extra compaction. SCGC (self-compacting geo polymer concrete) is created to solve this problem. SCGC is made up of industrial by-products, with high alumina and silica composition, and uses super plasticizer as a binder for matrix formation and strength. It will flow and compacted by its self-weight. It was firstly introduced by Japanese researchers.

II. DURABILITY TEST

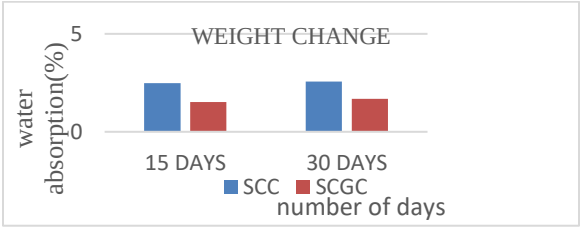
A.water absorption test

cubes of size 100mm were cast for two different mixes. All specimens were removed 24 hours after casting and subsequently water cured for 15 and 30 days. Samples were removed from water and wiped out any traces ofwater with damp cloth and difference in weight was measured.

FIG 1 water absorption test

TABLE 1water absorption for scc and scgc

Specimen	Age Of Concrete	Average Of Water Absorption(%)
SCC	15 days	2.48
	30 days	2.57
SCGC	15 days	1.52
	30 days	1.69



B. Acid attack test

The concrete cube specimens of various concrete mixtures of size 100 mmwere cast and cured and the

specimens were removed from the curing tank and allowed to dry for one day. The weights of concrete cube specimen were taken. The acid attack test on concrete cube was conducted by immersing the cubes in the acid water for the age of 15and 30 days. Hydrochloric acid (HCl) with 5% weight of water was added to water in which the concrete cubeswere stored.

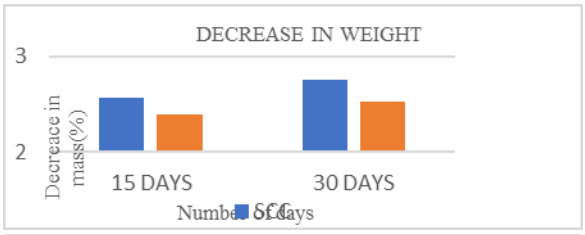
FIG 2 Acid attack test

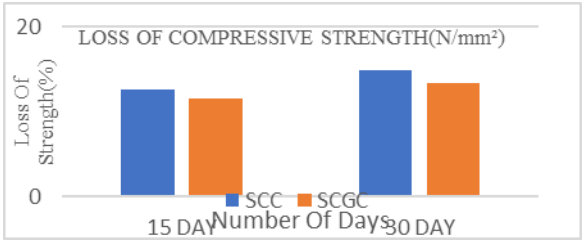
TABLE 2 Acid attack for scc and scgc

Specimen	Age Of Concrete	Average Decrease in weight (%)
SCC	15 days	2.38
	30 days	2.56
SCGC	15 days	2.27
	30 days	2.43

TABLE 3 Compressive strength in acid attack for scc and scgc

Specimen	Age of concrete	Decrease in strength after attack (N/mm²)	Residual strength (N/mm²)
SCC	15 days	12.58	87.415
	30 days	14.88	85.126
SCGC	15 days	11.47	88.124
	30 days	1.34	86.667





C. Sulphate attack test

The resistance of concrete to sulphate attacks was studied by determining the loss of compressive strength or variation in compressive strength of concrete cubes immersed in sulphate water having 5% of sodium sulphate (Na_2SO_4) by weight of water and those which are not immersed in sulphate water. The concretecubes of 100mm size were cured and dried for one day were immersed in 5% Na2SO4.The concentration of sulphate water was maintained throughout the period.

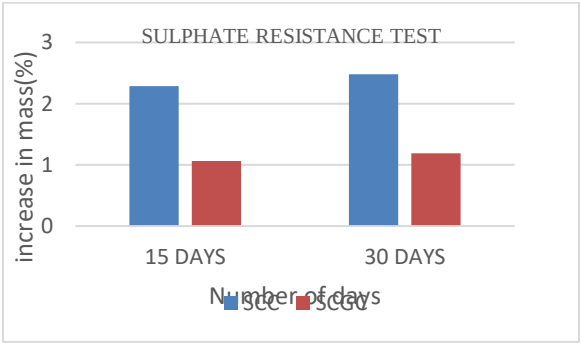
FIG 3 Sulphate attack test

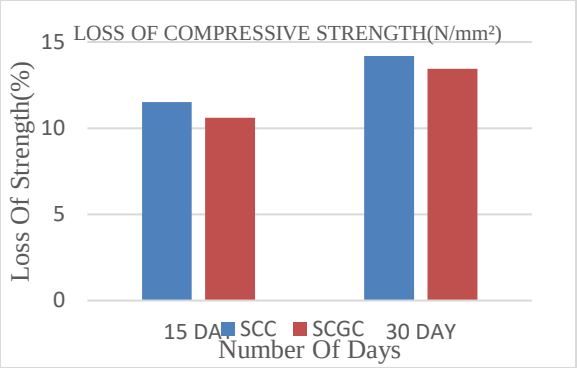
TABLE 4 sulphate attack for scc and scgc

Specimen	Age Of Concrete	Average Decrease in weight (%)
SCC	15 days	2.286
	30 days	2.482
SCGC	15 days	1.065
	30 days	1.194

TABLE 5 Compressive strength in sulphate attack for scc and scgc

Specimen	Age of concrete	Decrease in strength after attack (N/mm²)	Residual strength (N/mm²)
SCC	15 days	11.51	88.49
	30 days	14.19	85.81
SCGC	15 days	10.64	89.47
	30 days	13.45	86.55





D. Sorptivity test

sorptivity test for cylinder disc at 30 days for four specimens wereconducted as per ASTM C1585-13.

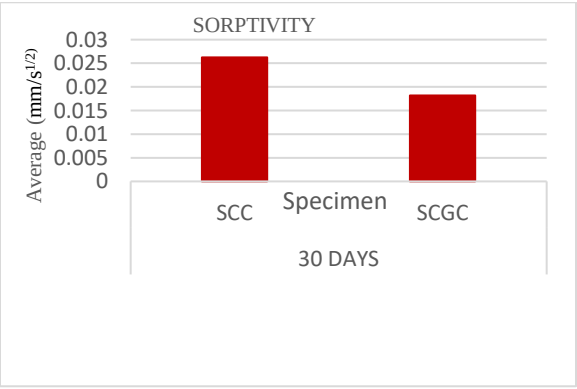
$S = I/t^{1/2.}$

Here S= sorptivity in mm,t = elapsed time in minutes I=Δw/Ad ; Δw = change in weight = W2-W1;A = surface area of the specimen referencethrough which water penetrated; d= density of water.

FIG 4 Sorptivity test

TABLE 6 sorptivity test for scc and scgc

Mix	Sorptivity ($mm/s^{1/2}$)	Sorptivity ($mm/s^{1/2}$)	Average ($mm/s^{1/2}$)
SCC	0.0215	0.0248	0.02625
SCGC	0.0197	0.0148	0.01815



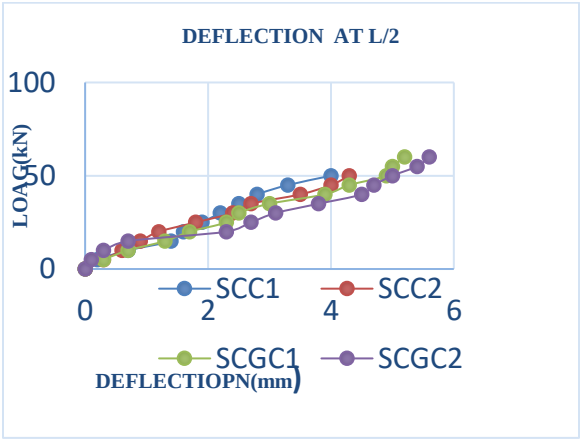
III FLEXURAL STRENGTH TEST

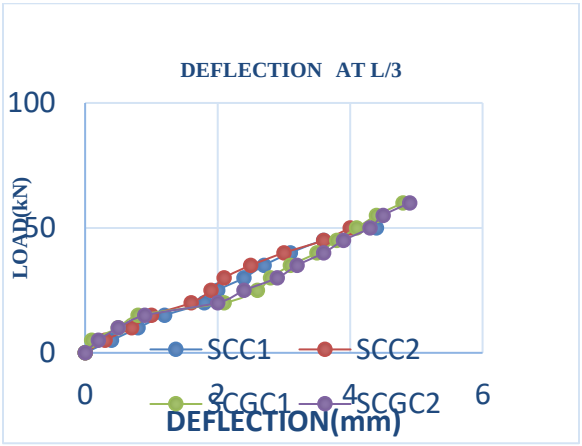
All the beam specimens were tested on actuator of capacity 250KN.The load was applied until complete failure took place. The support conditions were partially fixed on both the sides. Deflections were noted down at L/2 and L/3 ateach side of specimen with deflectometer. First crack is noted down. Then ultimate load and corresponding deflections were noted down. Then the load- deflection curve was plotted.

FIG 5 Crack Pattern on Scc & Scgc Beam

TABLE 7 Test Results For Scc & Scgc Beam

Specimen	Average of first crack load (kN)	Average of ultimate load (kN)	Average of max deflection (mm)
SCC	27.5	50	4.35
SCGC	35	60	5.4





IV. CONCLUSION

Self-compacting concrete and self-compacting geopolymer concrete has shown improvement in the strength parameters of concrete.

Water absorption decreases about 32% in SCGC when compared to SCC.

Acid resistance test Increase about 1.8% of compressive strength in SCGC when compared SCC.

When the SCGC specimen is immersed in sodium sulphate, the compressive strength also increased by 3.25% than the SCC.

Sorptivity results shows that concrete in which SCGC was found to have 45% less capillary rise than SCC.

The initial crack load arrived at SCC beam is comparatively less than the SCGC beam. The load obtained for an SCGC beam is **2.875** times the initial crack in SCC beam.

The ultimate load at failure were higher for Self-compacting geopolymer reinforced beam with self-compacting concrete.

SCGC beam shows better strength, flexural characteristics and less deflection than the SCC beam.

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