International Journal of Civil Engineering and Technology (IJCIET)
Volume 9, Issue 7, July 2018, pp. 1678–1684, Article ID: IJCIET_09_07_180
Available online at http://www.iaeme.com/ijciet/issues.asp?JType=IJCIET&VType=9&IType=7
ISSN Print: 0976-6308 and ISSN Online: 0976-6316

STUDY ON THE PERFORMANCE OF WHITE CRYSTAL STONE WITH FINE AGGREGATE FLYASH BASED SCC OF GRADE M30

P. Sivakumar
Research scholar, Karpagam Academy of Higher Education, Coimbatore, Tamilnadu India

Dr. N. Balasundaram
Professor and HOD, Karpagam Academy of Higher Education, Coimbatore, Tamilnadu, India

K. Vivek
Assistant Professor, Paavai Engineering College, Namakkal, Tamilnadu, India

ABSTRACT

Generally, Stones are classified as building stones, dimension and ornamental stones. They are naturally available rocks of igneous, sedimentary or metamorphic origin. A building stone will be chosen based on the various parameters like durability, economy, workability, bonding strength, attractiveness, etc., In this study, white crystal stones were partially replaced with the fine aggregate in the production of fly-ash based self-compacting concrete (SCC). To check the possibility of using white crystal stones in fly-ash based SCC of grade M30 many tests were conducted. The white crystal stone was replaced with river sand at 0%, 10%, 20%, 30%, 40%. It is identified that as increasing the percentage replacement of white crystal stone with fine aggregate, its workability does not get affected, while the crystal stone provides better mechanical properties of concrete.

Key words: Fly-ash based SCC, White Crystal stone, Mechanical properties.

Cite this Article: P. Sivakumar, Dr. N. Balasundaram, K. Vivek, Study on the Performance of White Crystal Stone with Fine Aggregate Flyash Based SCC of Grade M30. *International Journal of Civil Engineering and Technology*, 9(7), 2018, pp. 1678-1684.
http://www.iaeme.com/IJCIET/issues.asp?JType=IJCIET&VType=9&IType=7

1. INTRODUCTION

In recent times, Self-compacting concrete (SCC) made a notable impact in the field of construction due to its greater flexibility. Usage of SCC has tremendous advantages like shortening of the construction period, improved productivity, better quality and strength of concrete. In other terms, concrete which utilizes waste products as a partial substitution material for cement or aggregate is known as green concrete.

In present days, natural river sand is very expensive construction material. Due to scarcity and restrictions, cost of river sand is increasing rapidly. Large-scale depletion of these resources destroys the stability of river banks and creates various environmental problems. To avoid such situations and to meet the demand, we have to consider a useful alternative or replacement material for natural river sand. Some of the conventional options are crushed rock material, sea sand, fly-ash, marble dust powder, etc., In this study, white crystal stone of varying percentage was used to replace the natural river sand used in the fly-ash based SCC.

Cement is the major constitution which controls the bonding of substances, hydration process, setting of concrete but it is very costlier to produce than the other components of concrete. While the production of cement, enormous amount of Carbon dioxide (CO_2) was emitted to the environment which cause variety of problems. So, a replacement material for cement is fly ash which has the same pozzolanic properties like cement. Fly-ash is an waste material from power plants and shows that excellent alternative material to the Portland cement.

2. EXPERIMENTAL PROCEDURES

2.1. Materials Used

In this experimental study cement, fly-ash, fine aggregate, white crystal stone, coarse aggregate, super plasticizer are to be used.

Cement: Commercially available OPC was used

Table 1 Properties of Cement

Properties	Value
Type of Cement	OPC 53
Initial and final setting time	38 min and 568 min
Specific gravity	3.18
Standard consistency	32%

Fly-ash: Pulverized fine-grained fly ash collected from the nearby power plant was used in the entire study as per IS 3812:2003.

Table 1 Properties of Fly-Ash

Properties	Value
Color	Dark gray
Specific gravity	2.48
Fineness	4826 2/g

Fine aggregate: Locally available Clean and Dry River sand of Zone II was used.

White crystal stone: Locally available crystal stones taken from the nearby quarries. The properties were mentioned in table 3. SiO_2 and CaO are the main constituents in the white crystal stones. The details of sieve analysis were given in table 4.

Figure 1 white crystal stones

Coarse aggregate: Locally available, rounded aggregate passing through 20 mm sieve and retained on 4.75 mm sieve was used.

Table 3 Properties of Aggregates

Parameter	Fine aggregate	Coarse aggregate	White crystal stones
Specific gravity	2.52	2.74	2.41
Water absorption	6.6%	2.5%	5.6%
Fineness modulus	2.89	-	2.84

Water: Potable water of pH value 6.7 was used in the preparation of all specimens.

Super plasticizers: Commercially available super plasticizer of Master Glenium SKY 8233 was used in the preparation of SCC.

Table 4 Sieve Analysis Results

Sieve designation	Percentage passing in Zone II		Grading limits for Zone II (IS 383)
	Natural river sand	White crystal stones	
4.75mm	94.25	91.25	90-100
2.36mm	87.50	82.30	75-100
1.18mm	71.70	69.40	55-90
600micron	43.50	37.50	35-59
300micron	12.25	11.75	8-30
150micron	2.25	3.20	0-10

2.2. Mix Proportion

Mix design has been adopted as per the guidelines are given from IS 10262:2009 to design the M30 grade of concrete. Specimens were prepared as one conventional grade SCC and fly-ash based SCC with varying percentage of fine aggregate by white crystal stone. Replacement of fine aggregate ranges from 0%, 10%, 20%, 30% and 40%. The details of mix proportion were mentioned in table 5.

Table 5 Mix Proportion For SCC

Concrete Mix	Cement	Fly-ash	Sand	Coarse aggregates	Water
Conventional	521.28	-	765.23	788.24	198.45
Proportion	1	-	1.47	1.51	0.38
Fly-ash based	-	525.11	764.18	790.19	199.24
Proportion	-	1	1.46	1.50	0.38

3. EXPERIMENTAL INVESTIGATION

3.1. Test Specimens

Conventional and Fly-ash based self-compacting concrete was prepared for the above mix proportion shown in table 5.

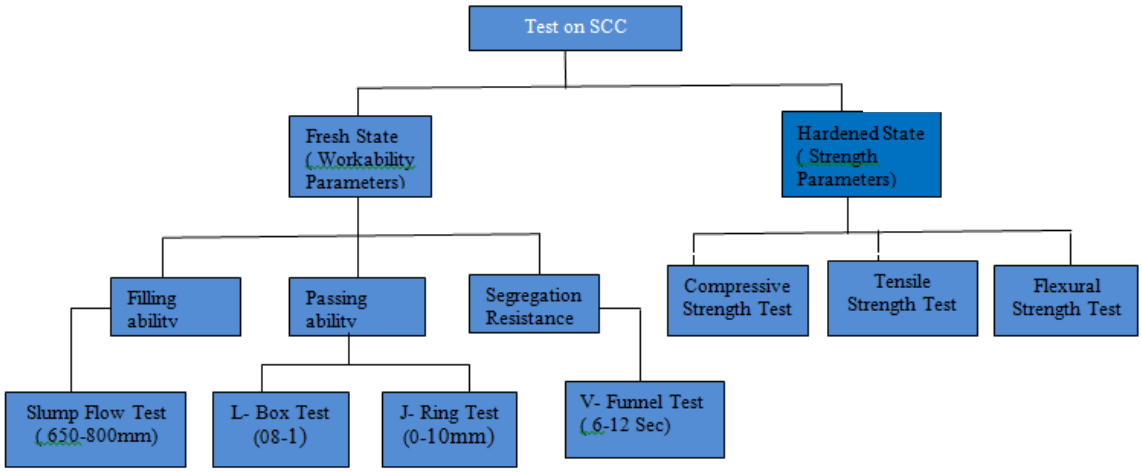

Figure 2 Testing on SCC

Table 6 Test on Fresh SCC Concrete

Concrete mix	Slump flow test	L-Box test	J ring test	V-Funnel test
CC-SCC	720	0.8	3.5	7.5
FA-SCC-0%S	725	0.85	4	6.5
FA-SCC-10%S	715	0.9	4	7
FA-SCC-20%S	705	0.95	3.5	7.3
FA-SCC-30%S	695	0.95	2	8.5
FA-SCC-40%S	680	1	1.5	12

3.2. Test on hardened state of SCC

Table 7 Specimen Details

Type of concrete specimen	Size of specimen
Concrete Cubes	150 x 150 x 150 mm
Concrete Cylinders	150 mm Dia x 300 mm Length
Concrete Prisms	100 x 100 x 500 mm

After the process of demolding, the specimens were immersed in water where they are allowed to cure for 3, 14, 28 and 56 days. Testing on specimens were steered as per the guiding principles specified in IS 516-1964.

Table 8 Compressive Test

Concrete mix	Compressive strength (N/mm2)			
	3 days	14 days	28 days	56 days
CC-SCC	18.56	29.22	35.76	40.15
FA-SCC-0%S	16.67	28.68	34.67	42.03
FA-SCC-10%S	16.79	28.14	35.11	43.85
FA-SCC-20%S	17.84	29.06	36.95	44.63
FA-SCC-30%S	19.58	29.93	38.16	49.81
FA-SCC-40%S	18.26	27.28	36.31	43.59

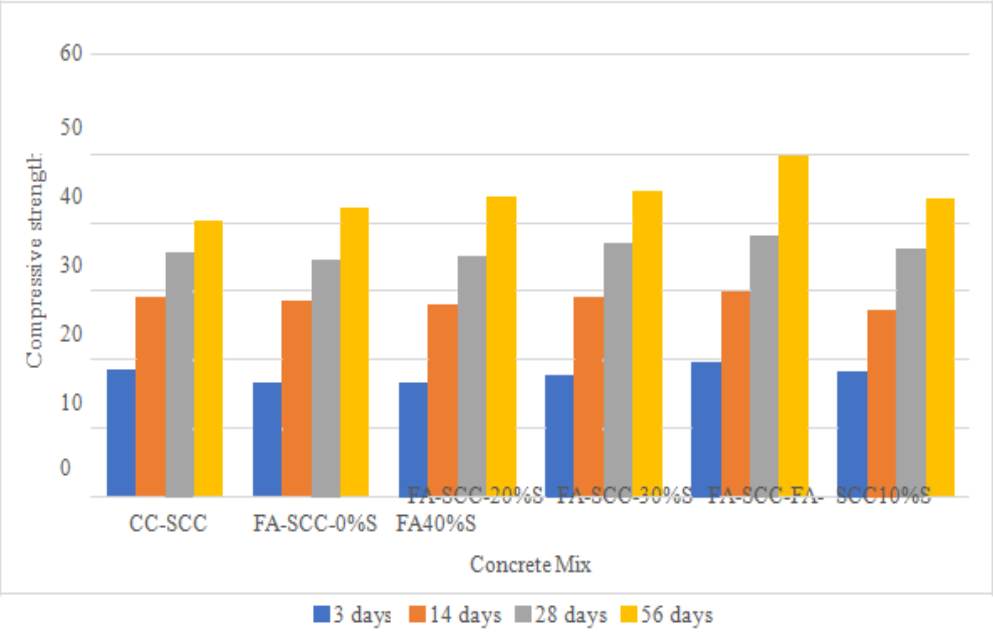

Figure 3 compressive strength test results

Table 8 Split Tensile Strength Test

Concrete mix	Split tensile strength (N/mm2)			
	3 days	14 days	28 days	56 days
CC-SCC	2.86	3.21	3.59	4.27
FA-SCC-0%S	2.68	3.53	3.91	4.58
FA-SCC-10%S	2.71	3.85	4.22	4.89
FA-SCC-20%S	2.86	3.88	4.76	5.06
FA-SCC-30%S	2.98	4.42	4.81	5.36
FA-SCC-40%S	2.63	3.91	4.27	4.73

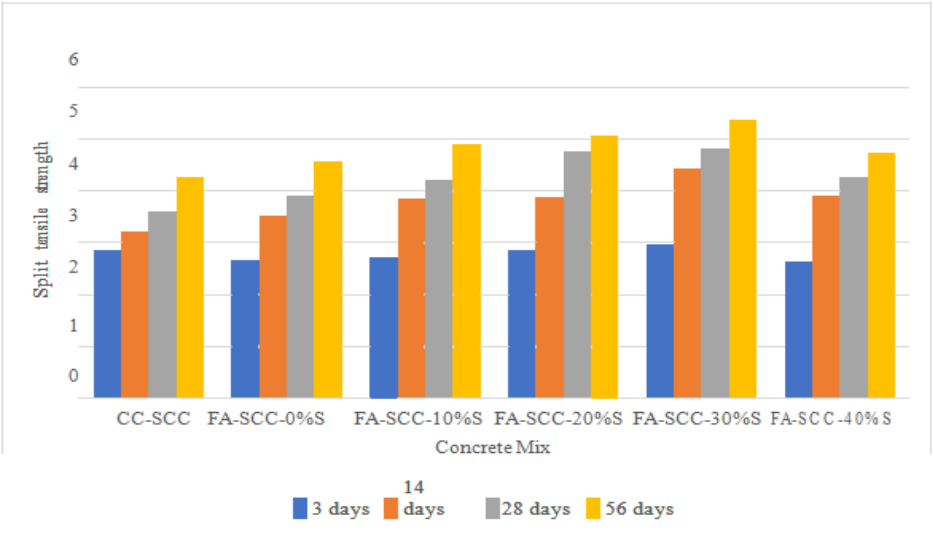

Figure 4 split tensile strength test results

Table 10 Flexural Strength Test Results

Concrete mix	Flexural strength (N/mm2)			
	3 days	14 days	28 days	56 days
CC-SCC	3.67	4.28	4.68	5.17
FA-SCC-0%S	3.80	4.43	4.97	5.23
FA-SCC-10%S	3.98	4.59	5.25	5.29
FA-SCC-20%S	4.83	5.64	6.23	6.40
FA-SCC-30%S	5.65	6.19	6.51	7.29
FA-SCC-40%S	3.92	4.38	5.61	6.19

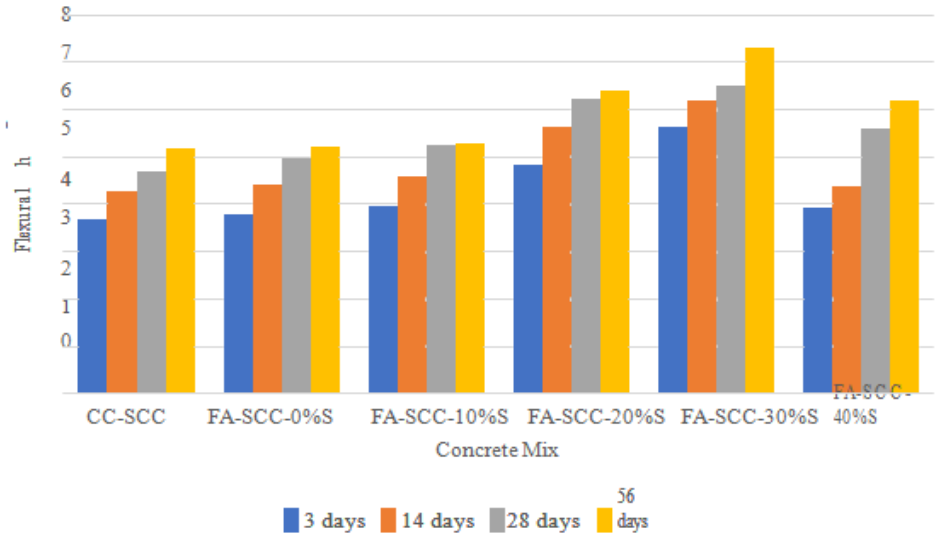

Figure 5 Flexural Strength Test Results

4. CONCLUSIONS

This study was helpful in determination of feasibility of white crystal stones in a fly-ash based self-compacting concrete. Hundred percent replacement of fly-ash in SCC, decreases the various environmental problems and the 30% partial replacement of white crystal stones with fine aggregate shows improved results. Compressive, split tensile and flexural strengths were increased by 24.06%, 25.53% and 41% respectively at the optimum percentage of replacement than conventional SCC.

REFERENCES

[1] P. Aggarwal, Y. Aggarwal, S.M. Gupta, 2007 “Effect of Bottom Ash as Replacement of Fine Aggregates in Concrete”, Asian Journal of Civil Engineering (Building and Housing), Vol. 8(1), pp. 49-62,

[2] IS: 8112:1989. Grade 43 ordinary Portland cement – specification. New Delhi: Bureau of Indian Standards.

[3] IS 2386(Part 1):1963. Methods of test for aggregates for concrete: Part 1 Particle size and shape. New Delhi: Bureau of Indian Standards.

[4] T. Celik, K. Marar, 1996 “Effects of crushed stone dust on some properties of concrete” Turkey, Cement and Concrete Research. 26 (7) (1996) 1121–1130.

[5] R. Ilangovana, N. Mahendrana, K. Nagamanib,2008 “Strength and durability properties of concrete containing quarry rock dust as fine aggregate”. India, ARPN Journal of Engineering and Applied Sciences 3 (5) 20–26.

[6] H. Donza, O. Cabrera, E.F. Irassar, 2002 “High-strength concrete with different fine aggregate”. Argentina, Cement and Concrete Research. 32 1755–1761.

[7] K. Shi-Cong, P. Chi-Sun,2009, “Properties of concrete prepared with crushed fine stone, furnace bottom ash and fine recycled aggregate as fine aggregates. China, Construction and Building Materials 23 , 2877–2886.

[8] Alyamaç, K.E., Ince R.A, 2009 “Preliminary concrete mix design for SCC with marble powders”. Construction and Building Materials. 23, 1201–1210.

[9] Elyamany, H. E., Elmoaty Abd. M., Elmoaty Abd., Basma, M., (2014). “Effect of filler types on physical, mechanical and microstructure of self-compacting concrete and Flow-able concrete”. Alexandria Engineering Journal. 3(2), 295–307.

[10] Siddique, R. 2004 “Performance characteristics of high-volume Class F fly ash concrete. Cement and Concrete Research 34 (3), 487–493.

[11] Persson B. 2001 “A comparison between mechanical properties of self-compacting concrete and the corresponding properties of normal concrete. Cement and Concrete Research 31:193–8.

[12] Bouzoubaa N, Lachemi M. 2001 “Self-compacting concrete incorporating high volumes of class F fly ash – Preliminary results”. Cement and Concrete Research 31:413–20.

[13] Akbulut, H, Gürer, C., 2007 “Use of aggregates produced from marble quarry waste in asphalt pavements”. Building and Environment 42, 1921–1930.

[14] Ch. Sai Bhavagna and G. Lalitha , Experimental Study on Concrete (M30) by Partial Replacement of Fine Aggregate with Copper Slag . International Journal of Civil Engineering and Technology , 8(1), 2017, pp. 1031 –1038.