IMPACT: International Journal of Research in Engineering & Technology (IMPACT: IJRET)
ISSN(E): 2321-8843; ISSN(P): 2347-4599
Vol. 2, Issue 9, Sep 2014, 45-50

DURABILITY STUDY OF SELF-COMPACTING CONCRETE USING MANUFACTURED SAND

DEEPTHY RAJAGOPAL[1] & MATHEWS M PAUL[2]

[1]Post- Graduate Scholar, Mar Athanasius College of Engineering, Kothamangalam, Kerala, India

[2]Professor, Department of Civil Engineering, Mar Athanasius College of Engineering, Kothamangalam, Kerala, India

ABSTRACT

Self-Compacting Concrete (SCC) is an innovative concrete that does not require vibration for placing and compaction. Self-Compacting Concrete is extensively applied in many construction projects due to its excellent fresh and hardened properties. In this study M35 mix is used. Master Glenium Sky 8233 is used as the chemical admixture. The main aim of the project is to design the mix using fly ash as additive. Then sulphate attack and chloride attack of the specimens were determined. Different proportions of solution are used for durability study.

KEYWORDS: Self-Compacting Concrete, Durability, Fresh Properties, Hardened Properties

INTRODUCTION

Concrete technology has made tremendous strides in the past decade. The development of specifying a concrete according to its performance requirements, rather than the constituents and ingredients has opened innumerable opportunities for producers of concrete and users to design concrete to suit their specific requirements. One of the most outstanding advances in the concrete technology over the last decade is "Self Compacting Concrete" (SCC). Self Compacting Concrete is an innovative concrete that does not require vibration for placing and compaction. It is able to flow under its own weight, completely filling formwork and achieving full compaction, even in the presence of congested reinforcement. The improved construction practice and performance, combined with the health and safety benefits, make self compacting concrete a very attractive solution for civil engineering construction.

In this study, a mix was designed using fly ash as additive. Using this mix cubes were casted and sulphate and chloride attack were determined. Also fresh and hardened properties of SCC were determined. The fresh properties were determined by Slump flow, V-funnel and L-Box test.

EXPERIMENTAL INVESTIGATIONS

Materials

Grade-53 Ordinary Portland Cement was used. Manufactured sand was used as fine aggregate. Blended aggregate of size 12.5mm and 6mm were used as coarse aggregate. Specific gravity of fly ash used was 2.1. Master Glenium Sky 8233 was used as super plasticizer. The various properties of fine and coarse aggregate was shown in Table 1 and Table 2.

Table 1: Physical Properties of Coarse Aggregate

Properties	Values
Specific Gravity	2.72

Table 2: Physical Properties of Fine Aggregate

Properties	Values
Specific Gravity	2.65
Fineness Modulus	3.12

Mix Proportion

Table 3 presents the quantities of ingredients required for one cubic meter of SCC.

Table 3: Mix Proportion for $1m^3$ SCC

Cement	Fine Aggregate	Coarse Aggregate	Fly Ash	Water	Admixture
376 Kg	514.14 Kg	649.9 Kg	505.7 Kg	203 *l*	6 Kg

Tests on Fresh Properties of Concrete

In order to study the fresh properties of SCC various tests were done like Slump flow, T_{500}, L-box test and V-funnel test. The values obtained doing this test were tabulated in Table 4 and it conform to the range of SCC.

Table 4: Fresh Properties of Concrete

Slump (mm)	T_{500} (s)	Passing Ratio	V-Funnel (s)
720	1.9	0.98	24

Durability Study

Its ability to resist weathering action, chemical attack, abrasion or any other process of deterioration. In order to study the durability charecteristics, that is, the sulphate attack and chloride attack the SCC cubes were immersed in sodium chloride and Magnesium sulphate solutions. The cubes were demoulded and dipped in the respective solutions. Then the cubes were taken from the solutions after 7, 14, 28, 56, 90 days and their corresponding compressive strengths were noted. Sodium chloride solution of three different strengths were used. Salt content of soil is 0.5M so 0.25, 0.5 and 0.75M was used. Similarly Magnesium sulphate solution was also of three different strengths. They are 4% $MgSO_4$, 5% $MgSO_4$, 6% $MgSO_4$ were used.

RESULTS AND DISCUSSIONS

The compressive strength values of specimen immersed in chloride and sulphate solution were tabulated in Table 5 and Table 6. From the result we can seen that the compressive strength of the specimen decreases as the strength of the solution increases.

Table 5: Compressive Strength of Cube Immersed in Chloride Solution

Solution	Average Compressive Strength (MPa)			
	7^{th} Day	14^{th} Day	28^{th} Day	56^{th} Day
Control Concrete(water curing)	46.65	54.51	67.70	69.18
NaCl 0.25M	43.55	50.51	60.40	61.23
NaCl 0.5M	40.42	46.82	56.21	57.30
NaCl 0.75M	37.32	43.21	52.32	53.02

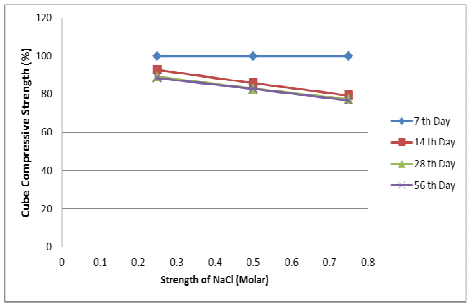

Figure 1: Percentage Reduction in Compressive Strength of Cube Immersed in NaCl with Respect to Strength of NaCl Solution (Molar)

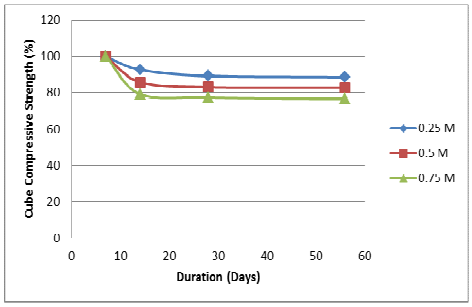

Figure 2: Percentage Reduction in Compressive Strength of Cube Immersed in NaCl with Respect to Duration

Table 6: Compressive Strength of Cube Immersed in Sulphate Solution

Solution	Average Compressive Strength (MPa)			
	7th Day	14th Day	28th Day	56th Day
Control Concrete (water curing)	46.65	54.51	67.70	69.18
4% $MgSO_4$	45.46	51.56	60.00	60.89
5% $MgSO_4$	43.56	49.16	58.20	57.24
6% $MgSO_4$	42.52	47.26	56.80	55.45

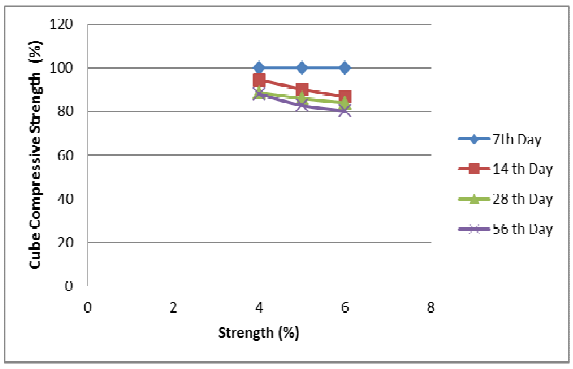

Figure 3: Percentage Reduction in Compressive Strength of Cube Immersed in $MgSO_4$ with Respect to Strength of $MgSO_4$ Solution (Percentage)

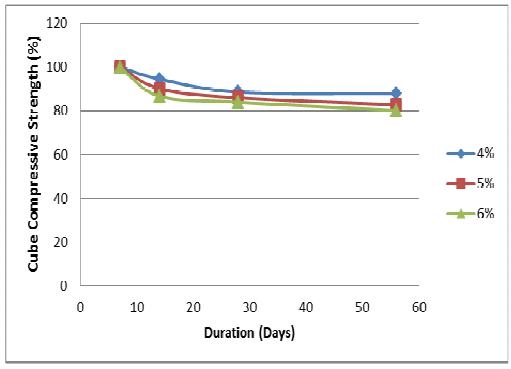

Figure 4: Percentage Reduction in Compressive Strength of Cube Immersed in $MgSO_4$ with Respect to Duration

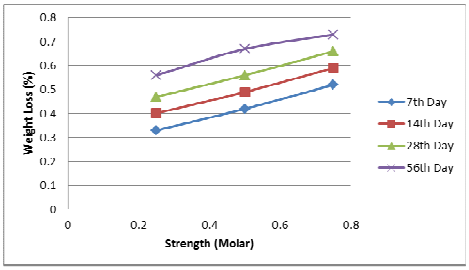

Figure 5: Weight Loss (in %) of Cube Immersed in Sodium Chloride Solution

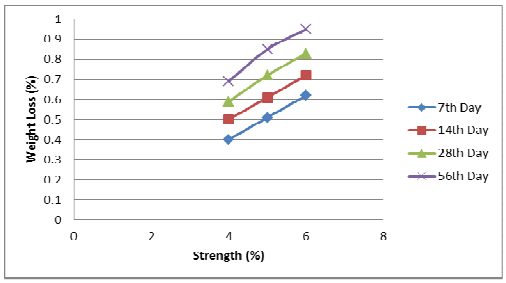

Figure 6: Weight Loss (in %) of Cube Immersed in Magnesium Sulphate Solution

CONCLUSIONS

Based on the results presented in this paper, the following conclusions can be drawn:

- The various properties of the mix such as slump flow +$T_{500,}$ filling ability, passing ability etc are verified and its

meets the European standard of SCC. So the use of SCC using M-sand developed is recommended according to the European guide lines.

- The compressive strength of cubes immersed in sodium chloride solution decreases as the strength of the solution increases.
- The compressive strength of cubes immersed in magnesium sulphate solution decreases as the strength of the solution increases
- The weight loss of the specimen immersed in sulphate and chloride solution increases as exposure day increases. This is due to deterioration of concrete

ACKNOWLEDGEMENTS

The author would like to thank all persons who ensured the good running of experiments in the laboratory of construction materials.

REFERENCES

1. Burak Felekoglu, Selcuk Turkel and Bulent Baradan, [2007], "*Effect of Water/Cement Ratio on the Fresh and Hardened Properties of Self- Compacting Concrete*", Building and Environment 42, pp. 1795-1802.
2. O. Gencel, C. Ozel, W. Brostow and G. Martınez-Barrera, [2011], "*Mechanical properties of self-compacting concrete reinforced with polypropylene fibres",* Materials Research Innovations, vol 15 no 3.
3. R. Preetha, G. V. V. S. R Kishore, C. S. Pillai, S. C. Chetal, [2011], "*Self Compacting Concrete with Flyash for Nuclear Power Plant Structures*", International Journal of Earth Sciences and Engineering, Volume 04, No 06, pp. 945-948.
4. Prakash Nanthagopalan and Manu Santhanam, [2011], "*Fresh and Hardened Properties of Self- Compacting Concrete produced with M- sand*", Cement and Concrete Composites 33, pp. 353-358.
5. P. A. Ganeshwaran, S. Deepashri, [2012], "*Evaluvation of Mechanical Properties of Self- Compacting Concrete with M- sand and Fly ash*", International Journal of Civil Engineering and Technology, Volume 3, Issue 2.
6. Benchaa Benabed, El- Hadi Kadri, Lakhdar Azzouz and Said Kenai, [2012], "*Properties of Self-Compacting Mortar made with various types of sand* ", Cement and Concrete Composites 34, pp. 1167-1173.
7. Leila Zeghichi, Zeid Benghazi and Laid Baali, [2012], *"Comparative Study of Self-Compacting Concrete with Manufactured and Dune Sand",* Journal of Civil Engineering and Architecture, ISSN 1934-7359, Volume 6, No. 10 (Serial No. 59), pp. 1429–1434.
8. P. A. Ganeshwaran, Dr. D. Suji, [2013]*, "Behavioural Studies on Potential Aspects of Self Compacting Concrete with M- Sand and Fly Ash"*, International Journal of Emerging Technology and Advanced Engineering, Volume 3, Issue 11.

9. Prof. Mathews M. Paul and George Mathew [2012], "*Mix Design Methdology For Laterized Self Compacting Concrete and its Behaviour at Elevated Temperature'* Construction And Building Materials.
10. EFNRC, *Specifications and Guide lines for Self Compacting Concrete*, European Federations and Contractors of Specialists products for Structures (EFNRC) [2002].
11. IS: 12269-1989, *Specification for Ordinary Portland cement 53 grade*, Bureau of Indian Standards, New Delhi.
12. IS: 383-1970, *Specification for Coarse and Fine Aggregate from natural sources for Concrete*, Bureau of Indian Standards, New Delhi.
13. IS: 2386-1963 *Methods of test for Aggregate of concrete part 1, 2, 3 and 4*, Bureau of Indian Standards, New Delhi.
14. Shetty M. S, Concrete *Technology theory and Practice*, S. Chand and Company Ltd, New Delhi.
15. IS: 516-1959, *Methods of test for Strength of concrete*, Bureau of Indian Standards, New Delhi.
16. Nan Su, Kung-Chung Hsu and Hi-Wen Chai, *A simple mix design method for self-compacting concrete,* Cement and Concrete Research, Vol. 31, 2001, pp. 1799–1807.