

Study of Self Compacting Green Concrete- A Review

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Abstract

Self compacting concrete (SCC) is known for its two basic properties deformability or flowability and segregation resistance. Deformability and Segregation resistance in concrete is managed by introducing Superplasticizer and Viscosity Modifying Agent (VMA) in definite proportion. Use of self compacting concrete is increasing day by day because of better surface finish, less man power and easy handling. The use of Superplasticizer and VMA makes the SCC uneconomical than conventional concrete. The paper mainly focuses on the mix proportions by partial replacement of cement and fine aggregate by various eco friendly materials, non-biodegradable fines as VMA and to critically review the mechanical properties of self compacting concrete. It was observed that appropriate combination of fine materials, superplasticizer and water powder ratio gives better compressive strength as well as adoptable workability, flowability and passability. There is need to match requirement of Superplasticizer for given fine materials in mass of concrete.

Key Words

Deformability, Passability, Superplasticizer, Viscosity Modifying Agent (VMA) and Self Compacting Concrete (SCC), Fly Ash, Rice Husk Ash and Bagasse Ash.

1.Introduction

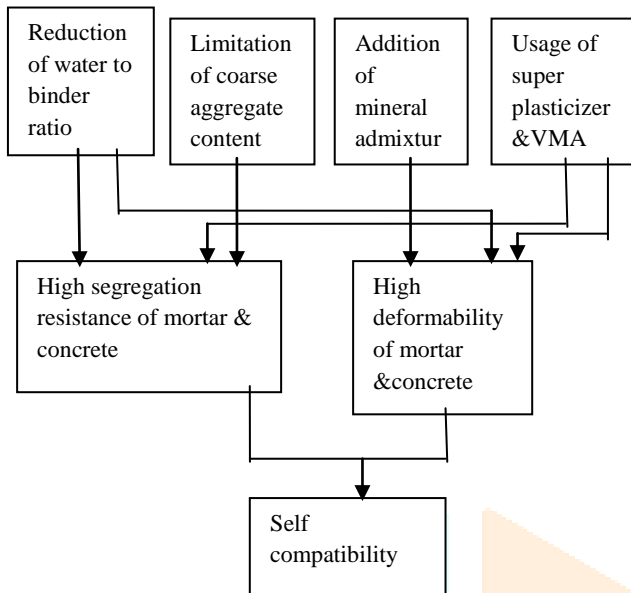
Self compacting green concrete is very often also cheap to produce, because, for example, waste products (*Fly Ash, Rice Husk Ash and Bagasse Ash.*) are utilized as partial substitute for cement, avoids the waste disposal fair, reduce energy consumption, and enhance durability. Self compacting green concrete doesn't require compacting using external sources such as an immersion vibrator; instead SSC is designed in such a way that it gets compacted using its own weight and characteristics. The self compacting property enables the concrete to fully cover the densely reinforced corners and spacing around the steel structures and completely fill the space within the framework. The property of self compactness is achieved without losing any kind of strength, stability, or change in its inherent properties. Use of self compacting concrete increase the speed of construction and reduce the noise pollution in environment. It is also referred as self-leveling concrete,

super workable concrete, self-consolidating concrete, highly flowable concrete, non-vibrating concrete, etc.

EFNRC Guidelines for SCC Achievement:

S. No.	METHOD	Unit	Typical Range Of Values	
			Min- mum	Maxi- mum
1.	Slump flow by Abrams cone	mm	650	800
2.	T50cmslump flow	sec	2	5
3.	J Ring	mm	0	10
4.	V Funnel	Sec	6	12
5.	Time increase, V-funnel at T5minutes	Sec	0	+3
6.	L Box	(h ₂ /h ₁)	0.8	1.0
7.	U Box	(h ₂ /h ₁) mm	0	30
8.	Fill Box	%	90	100
9.	GTM Screen stability test	%	0	15
10.	Orimet	sec	0	5

FLOW CHART FOR SCC ACHIEVEMENT



2.Literature Review:

Khalid B. Najim, Matthew R. Hall(2012):The main of the study is to experimently investigate the dynamic and mechanical property of self compacting Rubberized concrete(SCRC). Partial replacement of Fine Aggregate (FA) with crumb rubber scrap tyre is introduced, Coarse Aggregate (CA) and combined Fine and Coarse Aggregate (FCA) at 5, 10, and 15 wt% proportions. The Ultrasonic Pulse Velocity and Dynamic Modulus decreased as the proportion of rubber substitution was increased, however SCRC has superior vibration damping behaviour in all cases with up to 230% enhancement in damping ratio and damping coefficient for the CR 15 wt% mix.

M.Shahul Hameed and A.S.S Sekar(4 June 2009): Green concrete is introducing sustainable development by application of industrial wastes to reduce consumption scale of natural resources, energy and pollution of the environment. Marble sludge powder can be used as filler and helps to reduce the total voids content in concrete. Natural sand in many parts of the country is not graded properly and has excessive silt on other hand quarry rock dust does not contain silt or organic impurities and can be produced to meet desired gradation and fineness as per requirement. It is found that the compressive, split tensile strength and durability studies of concrete made of quarry rock dust are nearly 14 % more than the conventional concrete. The concrete resistance to sulphate attack was enhanced greatly. Application of green concrete is an effective way to reduce environment pollution and improve durability of concrete under severe conditions.

S.C.Kou,C.S Poon(February 2009): The effects of recycled glass (RG) cullet on fresh and hardened properties of self-compacting concrete (SCC) were investigated. RG was used to replace river sand (in proportions of 10%, 20% and 30%), and 10 mm granite (5%, 10% and 15%) in making the SCC concrete mixes. Fly ash was used in the concret mixes to suppress the potential alkali-silica reaction. The compressive strength, tensile splitting strength and static modulus of elasticity of the RG-SCC mixes were decreased with an increase in recycled glass aggregate content. Moreover, the resistance to chloride ion penetration increased and the drying shrinkage of the RG-SCC mixes decreased when the recycled glass content increased. The results showed that it is feasible to produce SCC with recycled glass cullet.

Tayyeb Akram Shazim Ali Memon,Humayun Obaid(February 2009):This research is aimed at evaluating the usage of bagasse ash as viscosity modifying agent in SCC, and to study the relative costs of the materials used in SCC. In this research, the main variables are the proportion of bagasse ash, dosage of superplasticizer for flowability and water/binder ratio. The parameters kept constant are the amount of cement and water content. The compressive strengths developed by the self compacting concrete mixes with bagasse ash at 28 days were comparable to the control concrete. Cost analysis showed that the cost of ingredients of specific self compacting concrete mix is 35.63% less than that of control concrete, both having compressive strength above 34 MPa.

Miao Liu(2011): This research investigated the feasibility of using ground glass in self-compacting concrete (SCC). The ground glass was used as a partial replacement for both the cement and fine aggregate. The results show that to keep the filling ability constant, the inclusion of ground glass would require an increase in water/powder ratio and a reduction in superplasticizer dosage. These did not change the passing ability, but degraded the consistence retention and hardened properties such as strength but not to a prohibitive extent. This research concludes that SCC with satisfactory fresh properties can be produced by incorporating up to 104 kg/m³ ground glass, replacing about 10% cement and 10% sand, without the need for viscosity modifying agent (VMA). The successful completion of this study can lead to the application of ground glass in SCC, thus widening the types of additions available for SCC, saving landfill and reducing CO₂ emissions by the use of less cement and sand.

Mustafa Sahmaran, Mohamed Lachemi, Tahir K. Erdem, Hasan Erhan Yucel (2011): In this study investigates whether SFS can successfully be used as a sand replacement material in cost-effective, green, self-consolidating concrete (SCC). In the study, SCC mixtures were developed to be even more inexpensive and environmentally friendly by incorporating Portland cement with fly ash (FA). Tests done on SCC mixtures to determine fresh properties (slump flow diameter, slump flow time, V-funnel flow time, yield stress, and relative viscosity), compressive strength, drying shrinkage and transport properties (rapid chloride permeability and volume of permeable pores) show that replacing up to 100% of sand with SFS and up to 70% Portland cement with FA enables the manufacture of green, lower cost SCC mixtures with proper fresh, mechanical and durability properties. The beneficial effects of FA compensate for some possible detrimental effects of SFS.

Shazim Ali Memon, Muhammed Ali Shaikh, Hassan Akbar (2010): This research is aimed at evaluating the usage of Rice Husk Ash (RHA) as viscosity modifying agent in SCC, and to study the relative costs of the materials used in SCC. In this research, the main variables are the proportion of RHA, dosage of superplasticizer for flowability and water/binder ratio. The parameters kept constant are the amount of cement, water, fine and coarse aggregate contents. Test results substantiate the feasibility to develop low cost SCC using RHA. In the fresh state of concrete, the different mixes of concrete have slump flow in the range of 595–795 mm, L-box ratio ranging from 0 (stuck) to 1 and flow time ranging from 2.2 to 29.3 s. Out of nine mixes, four mixes were found to satisfy the requirements suggested by European federation of national trade associations representing producers and applicators of specialist building products (EFNARC) guide for making SCC. The compressive strengths developed by the SCC mixes with RHA were comparable to the control concrete. Cost analysis showed that the cost of ingredients of specific SCC mix is 42.47% less than that of control concrete.

Samuel Demie, Muhd Fadhil Nuruddin, Nasir Shfiq (2013): This paper presents an experimental study of the influence of different superplasticizer dosage on compressive strength and micro-structure characteristics of interfacial transition zone (ITZ) prepared with fly ash based self-compacting geopolymer concrete (SCGC). The correlations between compressive strength development and microstructure of interfacial transition zone were also investigated. Concrete specimens were prepared with different superplasticizer (SP) dosage namely 3%, 4%, 5%, 6% and 7% and cured at 70 °C for

duration of 48 h. Field emission scanning electron microscope (FESEM) observations revealed that improved performance of concrete was found when the compressive strength increased through formation of dense ITZ between the aggregate and binder matrix at higher SP dosage. There are good correlations between compressive strength and micro-structure characteristics of interfacial transition zone. The FESEM analysis revealed that relatively a loose and porous interfacial zone was found between the binder and aggregate for low SP dosage and these loose and porous ITZ decreased the performance of concrete by lowering the compressive strength; however, a dense ITZ was found between the aggregate and binder matrix for higher SP dosage that enhanced the concrete performance by increasing the compressive strength.

Burak Felekoglu, Kamile Tosun, Bulent Baradan (2009): The aim of this study was to investigate the performance of two polymer based micro-fibres (polypropylene and polyvinyl alcohol) in different matrices (high strength and comparatively low strength with fly ash incorporation) which were designed to contain considerably high amounts of fibres (1% by volume) while maintaining their self-compactability. It was concluded that, a high strength matrix with a high strength fibre give the best performance from the view point of flexural strength and toughness performance. However, incorporation of fly ash did not cause a significant reduction in composite performance possibly due to its enhancing effect on matrix–fibre interface adhesion. The possibilities and suggestions to further improve the performance of the composites were also discussed.

Ferhat Bingol , Ilhan Tohumcu (2013): This paper presents the effect of air curing, water curing and steam curing on the compressive strength of Self Compacting Concrete (SCC). For experimental study, SCC is produced with using silica fume (SF) instead of cement by weight, by the ratios of 5%, 10% and 15%, and fly ash (FA) with the ratios of 25%, 40% and 55%. It is observed that mineral admixtures have positive effects on the self settlement properties. The highest compressive strength was observed in the concrete specimens with using 15% SF and for 28 days water curing. Air curing caused compressive strength losses in all groups. Relative strengths of concretes with mineral admixtures were determined higher than concretes without admixtures at steam curing condition.

3. Conclusion:

1. Better workability, compressive strength can be achieved by adding superplasticizer, VMA and powder content in definite proportion and matching the required quantity of water powder ratio.
2. SCC can be achieved without using VMA.
3. Industrial waste ashes (*Fly Ash, Rice Husk Ash and Bagasse Ash*) can be used as VMA for making SCC Economical.
4. Powder type VMA increases the fine content in SCC, makes it workable and at the same time keeps it segregation free.
5. Increase in quantity of super plasticizer admixture increases workability as well as strength of concrete.

4. References:

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