International Journal of Engineering Research-Online
A Peer Reviewed International Journal
Articles available online http://www.ijoer.in

Vol.3., Issue.4., 2015
(July-Aug)

RESEARCH ARTICLE

ISSN: 2321-7758

BEHAVIOR OF SELF-COMPACTING CONCRETE USING MINERAL ADMIXTURE-A REVIEW

PUJA SAIKIA[1], ESWAR SUDHARSAN.C[2]
[1]Student, [2]Assistant professor
[1,2]Department of civil engineering, Aarupadaiveedu institute of technology
Chennai, India

ABSTRACT
Concrete is a homogeneous material used in construction with the combination of binding agent, fine aggregate, coarse aggregate and water. Concrete is normally used in the frame structure like construction of slab, column, beam etc, with some limitations like compaction, surface finishes, maintains strength at congested area. Because of all this restrictions we are demanding to manufacture self-compacting concrete with partial replacement of mineral admixtures to make it economical and ecofriendly in nature. SCC is concrete that can be placed and compacted under its own weight without any external vibration for compaction, assuring complete filling of formwork even when it is densely reinforced. The main objective of this study is to make use of mineral admixtures as a partial replacement of cement and understand its effects on concrete in fresh and harden state. The review also proposed to quantify the amount of mineral admixture to be added and also the workability and compressive strength of self-compacted concrete is erratic as content of mineral admixtures increased.

Keyword: Self-compacting Concrete; mineral admixture; super plasticizer; viscosity modify agent; workability; compressive strength; durability.

I. INTRODUCTION

Self-compacting concrete, as the name proposes, it achieves full compaction without any external vibration. It offers us many welfares and rewards over conventional concrete like, increase the speed of construction, reduce site man power, uniform and complete consolidation, better surface finish, improve durability, reduce cost of construction, freedom in design, reduce noise, safe work environment. The mix design of Self-compacting Concrete mixes includes substantial proportions of fine-grained inorganic materials and this gives potentials for utilization of mineral admixtures, which are currently waste products with no practical applications. However, SCC is a sensitive mix because it has to possess high flow ability together with high segregation resistance. This balance is made possible by the addition of super plasticizers (HRWR) combined with cohesiveness produced by the high concentration of fine particles.

II.LITERATURE REVIEW

1.P.SashaPhani et al(2013):- has carried out the study of durability properties of self-compacting concrete using mineral admixtures which gives the optimum strength for M100 grade after mixing of self-compacting concrete with 5% of micro silica and 25% of fly ash. The acid attack test of high self-compacting concrete is determine by immersing test specimen of size 100×100×100mm cubes in 10% H2SO4 solution and 10% of HCL solution respectively. Higher the durability factor higher will be the resistance to the acid and sulphate attacks.

2.Mr.Dhruv Kumar H. Patel et al(2014):-carried out a literature review which presented a procedure for the design of self-compacting concrete mixed based on an experimental investigation. At the water/powder ratio of 1.180 to 1.215,slump flow test, V-funnel test and L-box test were found to be satisfactory. By using the OPC 43grade,normal strength of 25MPa to 33MPa at 28days was obtained, keeping the cement content around 350 kg/m^3 to 414 kg/m^3.

3.Saurabh Kumar Singh et al(2014):-aimed to study to investigate the effect of fine materials on the hardened properties of self-compacting concrete and also use the slump test, V funnel test ,flexural strength on self-compacting concrete. It shows that 15% to 20% replacement of cement with silica fume and 15% of marble powder improves the properties of self-compacting concrete. Adding the powdery materials 10% to 15% increased the 28 days strength of concrete and adding plasticizers increase the slump by 40% and reduce the water consumption by 20% per cubic meter.

4. Prof. Shriram H. Mahure et al(2013)*:-*this experimental study carried out for M30 normal grade of self-compacting concrete with CKD(Cement Kiln Dust) as partial replacement of cement with a fraction of 0%,10%,20%, 30%. Up to 20% addition of CKD,the compressivestrength, flexural strength was same. After the addition of 20%CKD, compressive strengthresults found in decreasing order. The compressive strength of M30 grade of concrete monitored for 91 days and it showed an increase in strength from 1 to 2% over its 28 days strength.

5.Darshan H R et al(2014):-has carried out the design of self-compacting concrete with ground granulated blast furnace for percentage replacement varying between 20-80%. The result shows 60 MPa at 60% replacement of GGBS given the strength at 28 days. Compressive strength of self-compacting concrete with GGBS is increased up to 10% replacement of cement with GGBS and also mineral admixtures replacement have better workable concrete.

6. Ahmed Fathi et al(2013):- experimentally found that addition of glass fibre to self-compacting concrete lead to enhance the peak strain at 85% of ultimate strength. Concrete containing class F-fly ashes showed higher early age (1 to 14days) and less bleeding that of concrete containing class F fly ashes.

7. P.A Ganeshwaran et al(2013):- has experimentally show that water absorption increases because of the inert behavior of fly ash. After fly ash reaction, mechanism takes place under water absorption at 28 days and at 56 days. Increase in amount of fly ash reduces shrinkage.

8. ZineEddineAbib et al(2012):-has experimentally tested that WCB powder were used as addition of 5% to 15% by weight of concrete. The sand fines of 2.7 with a volume of sand variesbetween 0.72 to 0.76. Thepozzolana activity index of variants are above 0.9 and the variant of the mortar at 5% of WCB higher than 1 during 28 days. Reduction of sand ratio from 0.8-0.67 achieved by the use of brick waste in self compacting concrete.

9.HocineSiad et al(2015):-has studied the assessment of magnesium sulphate attack on SCC containing fine aggregate,rice husk ash(RHA) and GGBS with cement replacement of 5 to 15%. Compressive strength,length change and mass loss were investigated over 118 days. The amount of super plasticizer is as selected to obtain a slump flow as 670±20mm. the SCCLF presented the large loss in the 30MPa,12% compared to SCC 30PZ and SCC 30FA. The sulpher displaced a maximum concentration of about 4% and a depth of 7 .5mm.

10. J.M.Srishaila et al(2014)*:-*has experimentally carried out that the compressive strength,split tensile strength and flexural strength is minimum for mix proportion 25% of fly ash ,±6% silica fumes. The acid attack is at peak for mix proportion 25% fly ash ±6% silica fumes. It will be noticeable that the limitation of self-compacting concrete that an uncontrolled variation of 1% moisture content in the fine aggregate will have a much bigger impact on the rheology of self-compacting concrete at very low w/c (~0.3) ratio.

***11. Mohammed Kamran et al(2014)*:-** has experimentally carried out that the mix with least fly ash gained maximum strength which was desired as per 67% of total characteristics strength. The effect on strength of self compacting concrete,more % of fly ash mixed by replacing the quantity of cement by 15%,25%, and 35%.

***12. DeepthyRajagopal et al(2014)*:-** has experimentally studied that the compressive strength of cubes immersed in sodium chloride solution decreases as the strength of the solution increases. Master Glenium sky 8233 was used as super plasticizer. Soil is used of 0.5M, so 0.25,0.5 and 0.75M was used.

***13. R. Vasusmitha et al(2013)*:-**has experimentally studied that percentage increase in compressive strength , tensile strength and flexural strength are 3.26,3.81, and 3.59 at 56 days with respect to 28 days strength. Percentage increase in weight loss of concrete specimen immersed in 5% Na2SO4 solution is varying from 0.77 to 3.39% from 28 to 180 days. Percentage increase in weight loss of concrete specimen immersed in 5% H2SO4 solution is varying from 4.59 to 13.37% from 28 days to 180 days.

***14. S.Thanayalakshmi et al(2015)*:-**This study is carried out for the different combination of mineral admixtures and the effect of these admixtures in hardened and fresh properties of concrete. The content of mineral admixtures, bottom ash 15% and silica fume 10% gives a maximum compressive strength of 45MPa and split tensile strength of 5.7MPa at the age of 28 days. The workability were maximum for bottom ash 15% and silica fume 7.5% with the optimum super -plasticizer dosage of 60% by weight of binder. The addition of viscosity modifying agent can be carried out to improve the properties of concrete in fresh state.

15. BathamGeeta et al(2013):-This study showed that the hardened properties of self compacting concrete containing QDP,FA and SF and their combination. The maximum compressive strength was reordered 81.17%MPa that resulted from replacing the cement by 70% slag. The contact point decreases, for mix M-2(with 60% FAC) whereas for M-3(50% FAC +10% SF) value of contact points increases by 32%. The maximum increase in contact point was found to be 90% and 89% for M-5(50% FAC+30% SL+ 10% SF) and M-4 (70% SL) respectively. The maximum compressive strength was found to be 5MPa for self-compacting concrete with 15% SF. The mix M-2 showed highest flexural strength and M-5 showed lowest flexural strength. Using steel fibre to produce higher strength, ultra-high strengthand SCC.

16.E. Todorova et al(2013):- experimentally carried out that the strength pressure of concrete mixture with metakaolinite and viscocrete 5370 ,the highest value showed sample with admixtures 1.25% and 1.5%,where the strength reaches 71 and 76,7MPa. Mixtures with stone flour and 1,2% viscocrete 5370 and viscocrete 5800, strength indicates to 65,1 and 63,3MPa. The cement used for the fabrication of the test specimens was CEB –M 42.5R. The limestone aggregate included two gravels with fraction 4-8mm and 4-16mm and sand 0-2mm. Metakaolinite(MK) is a pozzolanicmaterial,obtained by dehydroxylation of lignite crystals. The particle size of MK is much fine than cement and prevent the aggregation.

17. Amir Juma et al(2012):- in this review indicates that rich husks are the shells produced during the dehusking of paddy rice. 1000kg of rice can produce 200 kg of husk. The U-box test indicates the degree of compactibilityinterms of filling height,difference of height of concrete attained in two compartments of U-box. In other hand Orimet test is able to simulate the flow of fresh concrete during actual placing of sites. The different pozzolona materials meant as the partial replacement of cement such as rice husk,flyash,red mud was found to have a high percentage of silicon dioxide than in the remaining partial replacement of cement materials. The microstructure properties of fly ash mortar replaced shows a high percentage of permeability and effective porosity compared to rice husk ash.

18. B. H.VenkataramPai et al(2014):- has experimentally found that the compressive strength on hardened concrete ,the self-compacting concrete mix containing GGBS has more strength as compared to the mixes containing other powders for curing days of 7 days,14 days and 28 days. The compressive strength of SCC mix containing GGBS is 28.89%, 10.95%, 12.84% and 19.66% more than that of SCC mixes containing fly ash, silica fumes, RHA and shell lime powder respectively for a curing period of 28 days. The split tensile strength of SCC mix containing GGBS is 3.21% more than that of SCC mixes containing fly ash and silica fume and it is 1.55% and 2.40%. The flexural strength of self compacting concrete mix containing GGBS 17.86%, 23.89% and 9.65% more than that of SCC mixes containing fly ash, silica fumes, RHA ,shell lime powder respectively for

a curing period of 28 days. The mix design was carried out for M25 grade concrete and is based on modified Nan Su method.

19. K. S. John sirani et al(2013):- This study experimental investigation study carried out of SCC with fine aggregate(sand) replacement of a Quarry Dust(QD) (0%,25%,50%,75%,,100%) and addition of admixtures. This investigation is to determine the suitable percentage of quarry dust replacement of influence of different proportioning of super plasticizers in SCC that gives the highest value of concrete compressive strength. The self-compacting concrete of 25% series has shown the best performances at 3 days, 7 days and 28 days. In the case of replacement of 100% of quarry dust will be highly decrease in compressive strength. Polycarboxylate ether(PCE) based super plasticizers represent a major back through in concrete technology as they can produce the water requirements by 40% and impart very high workability that can be extend upto 60meters for good flowability.

20. MD NOR ATAN et al(2011):-This study investigates the compressive and flexural strengths of self- compacting concrete incorporating raw rice husk ash, individually and in combination with other types of mineral additives, as partial cement replacement. Test results show that 15% replacement of cement using raw rice husk ash produced grade 40 concrete.Rice husk ash (RHA) is an agricultural by-product obtained from burning of the husk under controlled temperature of below 800 ºC. The process produces about 25% ash containing 85% to 90% amorphous silica plus about 5% alumina, which makes it highly pozzolanic. In order to higher level of replacement, RRHA is blended with fine limestone powder (LP), pulverized fuel ash (FA) and silica fume (SF).Therefore, the study investigates the effects of raw rice husk ash on compressive and flexural strengths of self-compacting concrete; when used in binary blend with ordinary Portland cement and in ternary and quaternary blends with ordinary Portland cement, fine limestone powder, pulverized fuel ash and silica fume. . The control mix requires 185 L/m³ of mixing water and 10.5 L/m³ of SP dosage, while the binary mix C/RRHA (BM) requires 255 L/m³ of mixing water and 10.5 L/m³ of SP dosage to produce 640 mm slump-flow. This shows that 15% replacement of OPC with RRHA causes an increase in mixing water requirement by around 38% while the SP requirement .30% replacement of OPC with RRHA in combination with equal mass of LP, FA and SF is shown. The binary mix (C/RRHA) exhibits moderate early strength of 22.7 MPa (in compression) and 3.2 MPa (in flexure). Strength development increases at high rate from 7 days to 28 days (compressive strength case) and from 7 days to 60 days (flexural strength case). One of the functions of mineral additive such as RRHA is to regulate the cement content so as to reduce heat of hydration. This study shows that raw rice husk ash can be used to replace cement in self- compacting concrete. 15% replacement of OPC with RRHA, 30% replacement with two mineral additive components (LP/RRHA) and 45% replacement with three mineral additive components (LP/SF/RRHA) produce comparable compressive strength as the control mix and improved flexural strength. 30% replacement of OPC with two mineral additive components (FA/RRHA) and 45% replacement with three mineral additive components (FA/SF/RRHA) produce comparable compressive and flexural strengths as the control mix. In general, RRHA addition exhibits better performance in flexure as compared to its performance in compression.

III. CONCLUSION

- To raise the stability of fresh concrete (cohesiveness) using increased amount of fines in the mixes.
- To development of self-compacting concrete with reduced segregation potential.
- The systematic experimental approach showed that partial replacement of coarse and fine aggregate with finer materials could produce self-compacting concrete with low segregation potential as assessed by the V-Funnel test.
- The amount of aggregates, binders and mixing water, as well as type and dosage of super plasticizer to be used are the major factors influencing the properties of SCC.
- Slump flow, V-funnel, L-flow, U-box and compressive strength tests were carried out to examine the performance of SCC. If we

add the mineral admixture replacement for we can have a better workable concrete.

- It has been verified, by using the slump flow, T50 cm slump flow J-ring test, L-box test and U-tube tests, that self-compacting concrete (SCC) achieved consistency and self-compatibility under its own weight, without any external vibration or compaction. SCC with mineral admixture exhibited satisfactory results in workability, because of small particle size and more surface area.

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