International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 03 | Mar-2016 www.irjet.net p-ISSN: 2395-0072

Effect of Silica fume, Rice Husk Ash and GGBS on Self Compacting Concrete: A Review

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Abstract - *This paper talks about the analysis of self-compacting concrete using different type of additives like Silica Fume, Rice Husk Ash and Ground granulated blast furnash slag (GGBS). All the studies are done to analyze the properties such as flowability and compressive strength of these pozzolanic materials on Self compacting concrete.*

Key Words: Self compacting concrete, silica fume, rice husk ash, ggbs, flowability, compressive strength.

1. INTRODUCTION

Self compacting concrete development began in Japan in the early 1980s because of concerns about concrete durability. In research it was found that not proper compaction of concrete mix results in rough quality of construction work. SCC is that type of concrete which consolidated by its own weight, there is no use of any vibration manually. It also reduces segggeregation problem and bleeding problem. Indeed some survey indicates that SCC work already had reached 40% of the total concrete placed in Japan. Compacting work applied to concrete placed in a structure plays a important role in attaining the initial strength also as well as the ultimate strength of the structure.

The use of SCC has many advantages such as: faster construction, removing the need for vibration, eliminating the noise pollution, improving durability and the filling capacity of heavy congested structural members. It is also beneficial in providing better surface finishes and also safe working environment. SCC consists of the same components as the normal vibrated concrete, which are cement, coarse aggregates, fine aggregates and water, with the addition of super plasticizer, and mineral admixtures in different proportions. The volume of the coarse aggregate should be restricted to avoid the possibility of blockage on passing through spaces between reinforced bars. This reduction necessitates the use of a higher volume of cement which causes a greater temperature rise and also increases in the cost of construction of the project. So incorporating high volumes of mineral admixtures like fly ash, rice husk ash, silica fume etc. to make it cost effective. However, the durability of such SCC needs to be proven. For concrete to be self-compacting it should have ability of filling, passing ability and resistance over the segregation property. These properties are gained by limiting the coarse aggregate content and using lower water/powder ratio together with super plasticizers.

Silica fume is also called micro silica fume. It's normally used as artificial pozzolanic admixture in concrete. It is a product obtained by reduction of high purity quartz with coal in an electric arc furnace in the manufacture of silicon or ferrosilicon alloy. Condensed silica fume is essentially silicon dioxide (more than 90%) which is present in non- crystalline form. It is extremely fine powder with particle size less than 1 micron and with an average diameter of about 0.1 micron, about 100 times smaller than average cement particles. Its having high surface area so its bond with cement and aggregate givers better result in strength.

Ground granulated blast furnish slag is obtained by quenching molten iron slag from a blast furnash in water or steam, to produce a glassy, granular product that is then dried and ground into a fine powder. It is having good pozzolanic property.

Rice husk ash is obtained by appropriate combustion of burning rice husk. It's used in concrete as a binder material. The factors which affect the properties of rice husk are the combustion time, chilling duration and as well as grinding.

For the SCC the test were carried out such as slump test, T_{50} test, V-funnel test, J-ring test, and L- box test. About SCC, its found that it is providing very good and acceptable results in construction of columns, foundation and walls, pre cast structures, piers, and pile caps etc. and all type of repairing work.

2. LITRATURE REVIEW

H Okamura and M Ouchi [1] discussed about development of SCC also named it "High Performance Concrete" and defined the three stages of concrete i.e. Fresh, Early age and after hardening. He mentioned mechanism for achieving self-compatibility, influence of coarse aggregate depending on spacing size, role of mortar as fluid in flowability of fresh concrete, role of mortar as solid particles, influence of coarse aggregate - content, shape & grading after that he concluded self-compacting concrete becomes so widely used that it will be seen as the "standard concrete" rather than as a "special

concrete," we will have succeeded in creating durable concrete structures requiring little maintenance work.

Bertil Persson [2] reported that on these mechanical properties, such as strength, creep, elastic modulus and shrinkage of self-compacting concrete and the corresponding properties of normal compacting concrete (NCC). The report included eight mix proportions of sealed or air-cured specimens. The water binder ratio which is used in this (w/b) varying between 0.24 and 0.80. Fifty percent of the mixes were SCC and rests were NCC. The time period at loading of the concrete mix in the creep studies varied between 2 and 90 days. The results indicated that elastic modulus, creep and shrinkage of SCC did not change significantly from the corresponding properties of NCC.

Ahmadi et.al [4] reported the development of Mechanical properties up to 180 days of self-compacting concrete and ordinary concrete mixes with rice-husk ash (RHA), from a rice paddy milling industry. Two different replacement percentages of cement by RHA, 10%, and 20%, and two different water/cementitious material ratios (0.40 and 0.35) were used for the self-compacting and normal concrete specimens. The results were compared with those of the self-compacting concrete without RHA. SCC mixes show higher compressive and flexural strength and lower modulus of elasticity rather than the normal concrete. Upto 20% replacement of cement with rice husk ash in matrix caused reduction in use of cement and expenditures, and also improved the quality of concrete at the time period of more than 60 days. It was said that RHA provides a good effect on the Mechanical properties after 60 days.

Krishna Murthy N. et.al [5] reported Self-compacting concrete possesses good qualities, productivity and working conditions due to removal of avoids. Designed for self-compacting concrete mix design with 29% of coarse aggregate, replacement of cement with Metakaolin and class F flyash, combinations of both and controlled SCC mix with 0.36 water/cement ratio and 388 liter/m^3 of cement paste volume. After that they introduced Metakaolin and class F flyash were user friendly for SCC design mix, and considered to be most promising building for the revolutionary changes on structures.

B. H. Venkataram Pai et.al [6] presented the results of an experimental study aimed at producing SCC mixes of M25 grade by using the Modified Nan Su method, incorporating Silica Fumes, Ground Granulated Blast Furnace Slag (GGBS), Rice Husk Ash as instead of cementing materials. These SCC mixes in terms of their properties like compressive, split tensile and flexural strength were also discussed. The fresh concrete properties are also included in the study. The SCC mix containing GGBS achieved greater strength could be because of the high pozzolonic activity of GGBS. The better strength of SCC mix was possibly due to silica fume providing micro filler effect, and also the quantity of silica fume was less which makes the mix richer in cement content.

S.S. Vivek et.al [7] in this paper examined the performance of Self Compacting Concrete (SCC) by replacing cement with varying the silica fume (SF). An attempt was made to check performance and properties of fresh concrete by slump flow test, T_{500} test and the hardened properties of concrete by compression test. There were four mixes of SCC made by replacement of cement with different percentages of silica fume from 5 to 20% with an increment of 5%. Tests were carried out to assess the compressive strength of concrete at different ages namely 7, 14 and 28 days. For SCC, super-plasticizer (Conplast SP430) was added in optimized dosage. It was found that replacement of cement by 10% of silica fume with a water to powder (w/p) ratio of 0.8 gave better results on fresh properties and compressive strength of admixed concrete. The replacement of cement by 15% of silica fume with a w/p ratio of 0.8 gave better results in Slump flow and T_{50test}. Whereas replacement of cement by 5% of silica fume with a w/p ratio of 0.8 gave better compressive strength at the time period of 7 and 14 days but it fails in flow properties and also the replacement of cement by 10% of silica fume with a w/p ratio of 0.8 gave better fresh concrete performance and compressive strength at the time of 28 days.

Yaghuob mohammadi et.al [8] studied that the effect of silica fumes on properties of self-compacting lightweight concrete (SCLC) containing perlite and leca. For this purpose, silica fume has been replaced by different contents. In this study, all mixtures total cementitious materials (cement + silica fume) were kept at 450 kg/m^3. Test was carried out such as Slum flow, L-box, U-box, V-funnel and J-ring. This research showed that mixtures without silica fume were not satisfactory.. For all tests added the silica fume demonstrated acceptable values. However, for the SCLC mixture containing 15% silica fume significant results were attained. Adding silica fume, compressive strength of samples increased.

3. CONCLUSIONS

1. Use of super plasticizer is helpful in flowability and segregation control.
2. Strength of self compacting concrete using silica fume increases upto 20% replacement.
3. The use of silica is also beneficial in flowability property.
4. Use of rice husk ash results good effect on compressive strength.
5. Use of these materials are environment friendly.
6. It's also cost effective.
7. Use of ggbs also gives the better on compressive strength.

ACKNOWLEDGEMENT

We would like to express our sincere thanks towards researchers who give us valuable information which is useful in proposed project.

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