A Review on use of Industrial Waste in Self Compacting Concrete

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ABSTRACT

In current scenario various large and complex structures are constructed, which often leads to difficult concreting conditions under the heavy reinforcement. It is difficult to ensure fully compacted concrete without voids or honeycombing. Also the problem of the durability of concrete structures has been a major topic of interest in Japan around the1980s as proper compaction was not happening due to shortage of skilled labours. This leads to the development of self compacting concrete (SCC) around the 1988. In which concrete get compacted by its own weight without the requirement of vibration. This type of concrete flows easily around the reinforcement and fill all the corners of the formwork. Initially Self compacting concrete was known as Self-consolidating Concrete or Self Compacting High Performance Concrete. This type of concrete mixes does not require any compaction which saves the energy, time, need of skill labours and noise pollutions. This review paper explains the utilization of High volume fly ash as replacement of cement in the Self Compacting Concrete.

Keywords: Industrial Waste, Self Compacting Concrete, Fly ash, Slump Flow

I. INTRODUCTION

Self-compacting concrete (SCC) is one of the recent innovations in the concrete technology. Self compacting concrete is does not involve compaction of concrete. It is able to set under its own load without any compaction and completely fill the formwork achieve the full compaction, even in the occurrence of congested reinforcement. The self compacted hardened concrete is dense, uniform and it has the same harden property and durability properties as normal vibrated concrete have.

Constructing concrete structure without compaction has been done in the past throughout the world. Like placement of concrete underwater by the use of tremix without compaction. The production of such concrete mixesrequires expensive admixtures and very large quantity of cement but the drawback of such concrete was lower strength. This leads to the development of Self Compacting Concrete (SCC) mix in 1980s.This concept was developed in University of Japan. Self Compacting Concrete was also known as high performance concrete. Self compacting concrete consolidates under its own self-weight and adequately fills the formworks without voids, without segregation and excessive bleeding or any other separation of materials. Also it sets in the formwork without the need of any mechanical consolidation. To check the self compacting concrete is workable or not its filling ability, passing ability and resistance to segregation are checked. Filling ability helps SCC to flow through the formwork and completely fill all the spaces within it. Passing ability of mix is the property by which it flows without any blocking. The benefit of resistance to segregation imparts the advantage to the concrete in maintaining a uniform composition hence the paste and the aggregate bind together. The application of SCC aims at obtaining a concrete of high performance, better and more reliable, improved durability, high strength and faster construction. For SCC it is generally important to use superplasticizers in order to obtain high flowability. Some volume of powdered materials such as silica fume, fly ash, glass filler, stone powder, etc. can be used in development of Self compacting concrete. Self-compacting concrete has been successfully used in Japan, U.S., Europe etc. SCC is widely accepted because of its enhanced properties of self consolidation. Also it reduces noise pollution, reduce time, reduce skill labour requirement and save energy.

Literature Review/

Elinwa et al. has assessed the properties of fresh properties of self compacting concrete containing sawdust ash. Sawdust ash is a waste product obtained from thermally activated timber wastes at temperatures between 400º C and 600º C and it has certain binding properties. The melamine sulphate (MS) and naphthalene sulphonate (NS) superplastisizer were used to prepare SCC. Different mortar mixes were prepared with increasing replacement of cement by sawdust ash. Saturation was achieved at w/c ratio of 0.60 and 0.42 and super-plasticizer's dosage of 2.5% and 2.0% for MS and NS super-plasticizer respectively. This shows that there was no segregation. The evaluation of the self compactibility of the SCC mix using the U-boxes and L-boxes showed that good compactibility could be achieved. SCC microstructure and homogeneity was found better. This was because of lower void ratio of SCC in the interfacial transition zone between cement paste & aggregate and the pores were distributed much more evenly compared to control mix. Result indicates that sawdust ash could be used as powder material with cement and super-plasticizers to produce flowable concrete.

Khatib J. M. has investigated the influence of fly ash on the properties of self compacting concrete. Portland cement was replaced by 0 to 80% fly ash. The water to binder ratio was maintained at 0.36 for all mixes. Portland cement, fly ash, fine aggregate and 10 mm crushed coarse aggregates were used for preparing concrete mixes. Different 8 mixes were prepared including three control mixes in which fly ash was not used and only quantities of admixture (super plasticiser) were changed. In the remaining mixes cement was partially replaced with 20%, 40%, 60% and 80% fly ash by mass of binder. Properties like workability, compressive strength, ultrasonic pulse velocity (V), absorption and shrinkage were observed. Concrete mixes containing fly ash had increase in workability and constant water to binder ratio. The control mixes, which has increased admixture content resulted in an increase in density. This was attributed to the better compaction and reduction in voids in concrete due to the higher flow obtained. By keeping the same admixture content, the addition of increasing amounts of fly ash in concrete caused a systematic reduction in density. It was found that the density values of SCC were similar to those of traditional vibrated concrete, which helps in good compaction of SCC. The water absorption values of control mixes was minimum for optimum dose of admixture, and was increased for lower and higher doses of admixture. There was a systematic increase in water absorption with increase in fly ash content. However, after eight weeks all mixes containing fly ash, water absorption values were less than or equal to 2%, which is considered to be a low water absorption. Control mix having optimum dose of admixture showed maximum compressive strength, whereas use of low or high dosage of admixture reduces the compressive strength. The constant addition of admixture showed that concrete containing 40% fly ash shows higher compressive strength after eight weeks than the other fly ash mixes. There was strength reduction for concretes containing fly ash at the same water to binder ratio, as compared to that of the control mix. Correlation between compressive strength and water absorption showed that there was sharp decreased in strength as the absorption of water increased from 1% to 2%. The trend in ultrasonic pulse velocity (V) was similar to that of compressive strength. Medium dosage of admixture in control mix caused an increase in ultrasonic pulse velocity as compared with low and high dosage of admixture. Also the 40% fly ash mix showed the largest value of ultrasonic pulse velocity compared with other fly ash mixes for the same admixture addition. The results of shrinkage test showed that low admixture dosage increased shrinkage, whereas a decrease in shrinkage occurred at high admixture content. A substantial increase in shrinkage took place during the first 28 days of hydration and after that there was little change in shrinkage. Also increasing the amounts of fly ash resulted in a systematic reduction in shrinkage. It was concluded that high volume of fly ash could be used in self compacting concrete to produce high strength and low shrinkage concrete.

Mehta P. has made study on the large amount of fly ash in high performance concrete, as consumption of coal going up day by day in thermal power stations and disposal cost of fly ash also increased. Researcher observed that dosage of 15% to 20% of fly ash by mass of the total cementitious material has a beneficial effect on the workability and cost economy of concrete, but it may not be enough to improve the durability to sulphate attack, alkali-silica expansion, and thermal cracking. For this purpose, large amounts of fly ash use recommended, in order of 25% to 35% by different researcher, but this was not enough to classify the mixtures as high volume fly ash (HVFA) concrete according to the definition proposed by CANMET. From theoretical considerations and practical experience the author has recommended 50% or more cement replacement by fly ash. It is possible to produce high performance concrete mixtures having high workability, high ultimate strength and high durability. The High-volume fly ash concrete system can overcome problem of low early strength to a great extent by a drastic reduction in the water-cementitious materials ratio by use of combination methods, such as use of the super plasticizers in large proportion. The properly cured high-volume fly ash concrete shows the very homogenous in microstructure, virtually crack-free. There is a direct link between durability and resource productivity, the increasing use of high volume fly ash concrete will help to enhance the sustainability of the concrete industry.

K. M. A. Hossain et al. has investigated volcanic ash replacement in the proportion of 20% to 50% of cement powder content used in mix. Drying shrinkage for VASCC was ranging between 484 to 572 micro strains at age of 224 days, while for 0% VASCC mix it was ranging between 536 to 585 micro strains. It was observed that drying shrinkage increased with age for lower w/p mix, and high VA exhibit lower drying shrinkage. It was also observed that drying shrinkage increased with increase in w/p ratio in range of 0.35 to 0.45, and decreases with increase in total aggregate to powder ratio in range of 4.1 to 4.2. Rapid Chloride Permeability test of VASSC mixtures showed low in range of 900 to 1,540 C, in comparison to 1100 C of 0% VASCC. Researcher found that RCP was found to increase again with the increase in percentage of VA for w/p more than 0.4. It showed the improvements in chloride ion resistance of VASSCs.

Conclusion

A review study conducted on the Self compacting concrete. After critical review of various researches following conclusion are drawn.

- The use of fly ash as replacement of cement has increased the workability of fresh concrete.
- The use of fly ash in self-compacting concrete reduced segregation.
- The systematic experimental approach shows the partial replacement of coarse and fine aggregate with finer materials could produce self-compacting concrete with low segregation and the same is assessed by the V-Funnel test.

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