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Review Paper –Effect of Calcite and Fly Ash on Self-Compacting Concrete in Fresh and Hardened State

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***Abstract:*— Self-compacting Concrete (SCC) is special type of concrete that rapidly spread into congested place such as congested reinforcement. Huge sections of concrete can be easily placed using SCC. Problems such as noise pollution on the worksite that is induced by vibration of concrete is drastically reduced by SCC and the number of workers required at the construction site are reduced. In recent years the usage of SCC raised swiftly. The objective of this paper is to develop SCC mixes with different filling material (calcite) and mineral admixture (fly ash).Slump flow, V-funnel time and L-box blocking ratio are the self compacting properties to be included. Also the mechanical properties such as compressive strength, splitting tensile strength is included.**

***Key word:*-- Calcite, Fly ash, Self-compacting concrete (SCC) , Super-plasticizer.**

I. INTRODUCTION

No matter how good the mix design is or how well it has been produced, ultimate performance of concrete cannot be achieved with improper compaction. Vibrators are usually used to compact concrete which are often operated by untrained labour. Prof. Okamura and his team originally developed SCC at the University of Tokyo, Japan during the year 1986 to improve the quality of construction. Also the problems of defective workmanship were greatly reduced. Till now a good amount of work has been performed in the field of SCC to give confidence in the general behavior of SCC. SCC consists the same components as normal vibrated concrete i.e. cement aggregates, and water with addition of various admixtures. Self-compacting concrete must follow these basic principles filling ability, passing ability, segregation ability.

One of the major problems faced in reinforced concrete construction practices is compaction and placement of the fresh concrete through congested reinforcement. The benefit of Self compacting concrete is that it can settle into the heavily reinforced, narrow and deep sections by its own weight to completely fill the formwork without any mechanical vibration. However, fresh SCC mix must be provided with stability and segregation resistance without loss of uniformity. When the environmental aspects are taken into consideration the excessive use of cement is undesirable. This situation leads to the use of replacement powders, such as fly ash, limestone powder, and calcite. Generally, for Self-compacting concrete it is important to use superplasticizer for achieving high mobility. Most fly ash is pozzolanic, which means it's a siliceous or siliceous-and-aluminous material that reacts with calcium hydroxide to form a cement. The primary objective of the research in this paper is to evaluate and explore the possibility of using locally available fly ash and calcite in the production of SCC. The effects of varying the mix proportions of these materials on both the fresh and the hardened properties of SCC. Also comparing the properties of conventional concrete and Self compacting concrete is included.

II. OBJECTIVES

The aim of work is to check the behavior of concrete with calcite blended cement to its mechanical and physical properties. The study involves an effective use of calcite as the partial replacement of cement.

The objectives are:

1. To study the effectiveness of calcite as a concrete ingredient.
2. To study the optimum mixes of concrete by using calcite and fly-ash in concrete.
3. To study mechanical behavior of concrete by using calcite and fly-ash in concrete.

III. LITERATURE REVIEW

N. Bouzoubaâ* and M. Lachemib (3, Mar. 2001) presented the research on the initial results of an experimental program aimed at producing and evaluating SCC made with high-volumes of fly ash. In this they investigated the study on the nine SCC mixture sand one control concrete. They maintained the cementitious materials constant (400 kg/m3), while the water/cementitious material ratios ranged from 0.35 to 0.45. From the observation it was conclude that a cement replacement of 40, 50, and 60% by Class F fly ash in the self-compacting mixtures. They carried out tests on all mixtures to obtain the properties of fresh concrete in terms of viscosity and stability. Also determined the mechanical properties of hardened concretes such as compressive strength and drying shrinkage. For the 28 day the compressive strength ranging from 26 to 48 MPa in the SCC. They concluded that the high volume class F fly ash is most an economical in the self compacting concrete.

Hajimi Okamura and Masahiro Ouchi (2003) for the making self-compacting concrete a standard concrete the various investigation for establishing a rotational mix-design method and self-compatibility testing methods have been carried out. Since they concluded that when self-compacting concrete becomes so widely used that it is seen as the, “standard concrete”, rather than a, “special concrete”. And they succeeded in creating durable and reliable concrete structures.

P.L. Domone (2007) collected data from more than 70 recent studies then analyzed co-related and compared the hardened mechanical properties of self-compacting concrete (SCC) normally vibrated concrete (NVC). Results showed that limestone powder, added in SCC, contributes significantly to strength at ages up to at least 28 days. The analysis has shown that sufficient data have been obtained to give confidence in the general behavior of SCC.

Burak Felekoglu (2007) have worked on the use of a quarry dust limestone powder in self-compacting paste and investigated its concrete applications. He divided his work in two parts- 1. The physical and mechanical properties of cement pastes incorporating quarry waste limestone powder (QLP) and a powder produced by direct grinding of limestone (PLP) were compared. 2. Performance of quarry waste limestone powder in SCC applications were tested and discussed. It was found that normal strength SCC (~30MPa) mixtures that contain approximately 300–310 kg of cement per cubic meter can be successfully prepared by employing high amounts of QLP. Higher strength classes of SCCs (~45–50MPa) can be achieved but the cement dosage should be increased (i.e. 470 kg/m3).

Binu Sukuma et al.(2008) investigated, replacement of powder content with high volume fly ash based on a rational mix design method developed by the authors. For this they divided mix in two series (A-series and B-series). A-series is obtained by using fly ash alone as mineral admixture. B-series using quarry dust as inert filler along with fly ash. All required rheological characteristics such as flow ability, filling ability, passing ability and segregation resistance were found out for different grades. It was observed that the strength gain at early ages of curing of SCC is better than conventional concrete of the same grades.

Halit Yazıcı (2008) has replaced cement with a Class C fly ash (FA) in various proportions from 30% to 60%. Freezing and thawing, and chloride penetration resistance have been investigated to find durability properties of various self-compacting concrete (SCC) mixtures along with mechanical properties. Test results indicate that SCC could be obtained with a high-volume FA. Moreover, these mixtures have also great environmental and economic benefits.

Salim Barbhuiya (2011) studied the use of an alternative material i.e. dolomite powder, instead of limestone powder, for the production of SCC. For this he prepared five concrete mixes with different proportions of fly ash and dolomite powder (Mix 1 100% FA, Mix 2 75%FA + 25%DP, Mix 3 50%FA + 50%DP, Mix 4 25%FA + 75%DP, Mix 5 100%DP), each having the same water cement ratio of 0.38 were tested in this study. He concluded that it is possible to manufacture self-compacting concrete using fly ash and dolomite powder with acceptable fresh and hardened properties.

Krishna Murthy. N, et. al (September 2012) for the mix design of self compacting concrete (SCC) with 29% of coarse aggregate, replacement of cement with Metakaolin and class F fly ash, and also the combinations of both. They controlled water/cementitious ratio in SCC mix with 0.36 (by weight) and 388 liter/m3 of cement paste volume.

P. Dinakar et al. (2013) investigated the influence of fly ash (FA) on the properties of self-compacting concrete (SCC). For this they designed 4 SCC mixtures in order to obtain different fresh-state properties. In mixes SCC10, SCC30, SCC50 and SCC70 cement content was replaced with 10%, 30%, 50% and 70% fly ash. Properties included were self-compactibility properties (slump flow, V-funnel time and L-box blocking ratio) mechanical properties (compressive strength, splitting tensile strength). It was observed that fly ash replacements of around 30–50% will be ideal for developing SCCs when Portland pozzolana cement was used.

B. H. Venkataram Pai1, et. al (2014) presented an experimental study on SCC mixes of M25 grade, with five mineral admixtures, viz., Fly Ash, Blast Furnace Slag

(GGBS), Silica Fumes, Rice Husk Ash, and Shell Lime powder as supplementary cementing materials. From the result they have concluded that the compressive strength on hardened concrete in SCC 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. It is also observed from the results that 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 other powders for a curing period of 28 days.

A.Tamilarasan, Dr.S.Sankaran (2015) determined properties of fine aggregates, coarse aggregates (R – sand) & (M-sand) cement and fly ash for M40 grade mix design and worked out with the different percentage of fly ash (15%, 20% & 25%). As compared to other percentages, the 15% fly ash addition in SCC shows good compressive strength. While in tensile test the 15% of fly ash addition in SCC showed good results as compared to others. Also in the flexural strength 15% of fly ash addition in SCC shows the good strength. Thus they concluded that in SCC with 15% replacement of cement with Fly Ash showed good results both in compression and tension. From the experimental investigation it is observed that Cement can be replaced with 15% Fly Ash effectively in SCC.

Bidyadhar Basa (July-August 2016) from the tests results it can be concluded that the Fly Ash Light Weight Aggregate (FALWA) has the flow characteristics in self compacting concrete. In the case of Conventional Concrete (CC) the corresponding result of the strength is obtained at 30% to 50% replacement and in the case of Self Compacting Concrete (SCC) at 30% replacement. He concluded that with the use of Fly Ash Light Weight Aggregate (FALWA) the great reduction in the weight of concrete can serve as a better structural material for both conventional as well as self compacting concrete.

IV. CONCLUSION

Self-compacting concrete (SCC) demands large amount of powder content and fines for its cohesiveness and ability to flow without bleeding and segregation. The effect of mineral admixtures on admixture requirements is significantly dependent on their particle size distribution as well as particle shape and surface characteristics. The flow properties of self-compacting concrete depend heavily on powder particle size, shape, surface morphology, and internal porosity in addition to factors such as , sequence of admixture addition, and water/ superplasticizer content. Independent of the fact that SCC consists the same components as normal vibrated concrete, there exist clear differences regarding the concrete composition in order to achieve the desired ‘‘self-compacting properties’’. To produce a homogeneous and cohesive mix, self-compacting concrete demands a large amount of powder content compared to conventional vibrated concrete.

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