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Literature Review on Use of Calcite and Fly Ash for Manufacturing of Self Compacting Concrete

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Abstract: **-- Self-compacting concrete is an advanced concrete that does not require vibration for placing for placing and compacting. It set by its own weight and gravitational force. It used to avoid the concrete voids, develop uniform concrete strength, superior level of finish. The aim of this review is to summarize the previous research work related to utilization of material in self-compacting concrete. It is important to represent new research on concept and direction in their research. There are a lot of material used for rheological improvement in Self-compacting concrete. From these calcite and fly ash are used to improve powder content for flow ability, increase workability, compressive strength and durability of concrete. In conclusion, this paper will provide substantial idea and useful data for future study.**

I. INTRODUCTION

Self-Compacting Concrete (SCC) was introduced in 1980 in Japan. It was introduce by Okamura Hajime due to unavailability of manpower on site and resolve environmental issue such as noise reduction. SCC is the technology of concrete that makes use of concrete to flow and fill the void inside the formwork at every corner by it is own weight without vibration process. The fluidity and segregation resistance of SCC confirms a high level of homogeneity, minimal concrete voids and uniform concrete strength, providing the potential for a superior level of finish and durability to the structure. SCC is created with low water-cement ratio providing the potential for high early strength, earlier demolding and faster use of components and structures.

CHEMICAL ADMIXTURE

The need of use of plasticizers is mostly to fluidify the mix and improve the workability of concrete, mortar or grout. The use of plasticizer is for making of flowing, self-leveling, self-compacting tremie concrete and for making of high strength and high performance concrete. Plasticizer can produce at same water cement ratio much more workable concrete than plane ones, for the same workability it allows the use of lower water cement ratio, as a consequence of increase strength with lower water cement ratio, it also allows a reduction of cement content. The plasticizer makes a homogeneous, cohesive concrete generally without any tendency for segregation and bleeding.

MINERAL ADMIXTURE

- FLY ASH

Fly ash is a by-product of the burning of pulverized coal in thermal power plants. It is removed by the dust collection system form the exhaust gas of fossil fuel power plants as very fine predominantly spherical glassy particles from the combustion gases earlier they discharged into atmosphere. The size of particles is mostly depend on the on the type of dust collection. Diameter of fly ash particles ranges from 0.5 µm-300µm. The main constituents in fly ash are aluminum oxide, silica, ferrous oxide, calcium oxide.

• CALCITE

Calcium carbonate is a broadly available natural inorganic compound, also known as limestone, chalk or marble. Calcium carbonate is mainly obtained from its various natural mineral sources by mining. CaCO3 powder can also be produced from the reaction of carbon dioxide with calcium hydroxide.

$Ca(OH)2 + CO2 \square CaCO3$

The main applications of calcium carbonate are building materials, ceramic tiles, blackboard chalk and iron ore purification, oil well drilling fluids, paints, adhesives, and sealants. It has some medical uses such as antacid, calcium dietary supplement, pharmaceutical filler in tablets, and hemodialysis treatment.

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II. REVIEW OF LITERATURE

• Hajimi Okamura et. al. (April 2003)[1]
Self-compacting concrete was first developed in 1988 to achieve durable concrete structures. Since then, various investigations have been carried out and this type of concrete has been used in practical structures in Japan, mainly by large construction companies. Investigation for establishing a rotational mix-design method and self-compatibility testing methods have been carried out from the viewpoint of making self-compacting concrete a standard concrete.

• Nitish chalhotra (2011)[2]
This research consist of i) Development of suitable mix for self-compacting concrete that would satisfy the requirement of the plastic state. ii) Casting of concrete sample and testing them for compressive strength, shrinkage, water absorption, sulphate resistance and sorptivity. He use M25 grade of concrete. The conclusion he got for 35% fly ash for replacement to the properties observe were good as compare to 15% & 25% fly ash replacement. Hence if increase the fly ash replacement it better workable concrete. An increase of about 24% strength at 28 days and 30% at 56 days was observe with the decrease of fly ash content for 35%fly ash to 15% fly ash.35%fly ash replacement shoes 2 time less shrinkage in 20 days than that of 0% fly ash. Increase the amount of fly ash result seen the systematic reduction in sorptivity. Concrete mix with high pest contain are bound to have higher absorption value than concrete with lower paste contain as observe 35% fly ash replacement shoes higher absorption i.e. 2.7% at the age of 28 days and 2.59% at the age of 56 days than 15% fly ash replacement.

• Oladipupo S. Olafusi (2015) [3]
This paper compared the rheological properties and compressive strengths of self-compacting concrete (SCC) and conventional cement concrete. The flow ability and segregation resistance of freshly mixed concrete specimens were examined by the V-funnel apparatus, while the characteristics of passing ability were investigated with the L-box apparatus. The compressive strength results of hardened concrete showed that SCC gained strength slowly compared to the conventional cement concrete due to the presence of admixtures and its 28 days strength was lower than conventional cement concrete, but SCC eventually had potentials of higher strength beyond 90 days. Finally, the effect of water-cement ratio on the plastic properties of self-compacting concrete was quite negligible compared to conventional concrete.

• Oriyomi M Okeyinka et. al. (December 2014) [4]
This work investigates the influence of calcium carbonate as an admixture on the properties of wood ash cement concrete. The wood ashes which was scientifically and economically produced from saw dust was used to replace 0% to 50% of the cement content in the concrete mixes. . Compressive strength test was conducted on the hardened concrete cube specimens at their respective crushing ages. The chemical composition of the wood ash shows that, it satisfies the requirement for pozzolans and fall under the category of class F pozzolans, it exhibit a specific gravity of 2.13 and bulk density of 810kg/m3.The use of calcium carbonate as admixture increases appreciably the compressive strength of wood ash cement concrete at all levels of replacement. At 20% optimum replacement; 23.5%, 20.9%, 52.9% and 43.9% strength increase was observed at 7, 14, 21 and 28days curing age respectively. Therefore, the use of Calcium carbonate (CaCO3) in the correct proportions is capable of improving the strength of wood ash cement concrete.

• M. Lachemi et. al. (Mar. 2001) [5]
They made nine SCC mixtures and one control concrete were investigated in this study. The content of the cementitious materials was maintained constant (400 kg/m3), while the water/cementitious material ratios ranged from 0.35 to 0.45. The self-compacting mixtures had a cement replacement of 40, 50, and 60% by Class F fly ash. Tests were carried out on all mixtures to obtain the properties of fresh concrete in terms of viscosity and stability. The mechanical properties of hardened concretes such as compressive strength and drying shrinkage were also determined. The self-compacting concretes developed a 28-day compressive strengths ranging from 26 to 48 MPa. The results show that an economical self-compacting concrete could be successfully developed by incorporating high-volumes of Class F fly ash.

• Deepa Balakrishnan et. al. (2013)[6]
Advancements in technology demand many improved properties to the concrete like workability, flow ability, higher strength, durability etc. To overcome the difficulties like low workability and low flow ability, a new form of concrete designated as Self Compacting Concrete (SCC) was developed in 1988 by Okamura in Japan. Self-compaction is described as the ability of the fresh concrete to flow under its own weight over a distance without segregation and without using vibrators to achieve proper compaction. Sufficient number of investigations is necessary to get a clear idea about the factors affecting the

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strength, durability and long term behavior of SCC with additives like fly ash and dolomite powder. In this paper, high volume fly ash self-compacting concrete was produced with 12.5percent , 18.75percent , 25percent , and 37.5percent of the cement (by mass) replaced by fly ash and 6.25percent , 12.5percent and 25percent of the cement replaced by dolomite powder. For these mixtures compressive strength (cube) was studied at 7thday, 28th day and 90th days with same water powder ratio (0.33). The test results for acceptance characteristics of self-compacting concrete such as slump flow test, J-ring test, V-funnel test and L-box test are presented. The mixes were then tested for other mechanical properties like, cube compressive strength at 7th day, 28th day, and 90th day, cylinder compressive strength at 28th day, split tensile strength, and flexural strength at 28th day. For all levels of cement replacement concrete achieved superior performance in the fresh and mechanical tests compared with the reference mixture.

• K. Sathish Kumar et. al. (November 2015)[7]

Self-Compacting Concrete is an innovative concrete that does not require vibration for placing and compaction. It is able to flow under its own weight, completely filling formwork and achieving full compaction, even in the presence of congested reinforcement. One of the disadvantages of self-compacting concrete is its cost, associated with the use of high volumes of Portland cement and use of chemical admixtures. One alternative to reduce the cost of self-compacting concrete is the use of mineral admixtures such as fly ash, ground granulated blast furnace slag and micro silica, which is finely, divided materials added to concrete during mixture procedure. When these mineral admixtures replace a part of the Portland cement, the cost of self-compacting concrete will be reduced especially if the mineral admixtures are waste or industrial by-product. Moreover, the use of mineral admixtures in the production of self-compacting concrete not only provides economic benefits but also reduces heat of hydration. The incorporation of mineral admixtures also eliminates the need for viscosity-enhancing chemical admixtures. The lower water content of the concrete leads to higher durability, in addition to better mechanical integrity of the structure. This paper presents an experimental investigation on strength aspects like compressive, flexural and split tensile strength of self-compacting concrete containing different mineral admixtures and workability tests for different mineral admixtures are carried out. About 15% fly ash and 5% micro silica are used as a partial replacement for cement. The compressive and flexural values for SCC with mineral admixture (Fly ash and Micro silica) is good. So it is eco-friendly and cost efficient to use mineral admixtures in concrete.

• Anupam S. Hirapure et. al. (Feb 2016)[8]

The cement is continuously manufacture since from its discovery and become very popular due its bonding and durable nature. The raw material required for production of cement is mine every day; due to increase in demand of cement raw material they are in verge of exhaust which has direct impact on price of cement. The use supplementary cementitious material (SCMs) like Fly ash and Calcite can be the innovative approach to develop concrete without any side effect on its properties. Fly ash contain high amount of SiO2 and Calcite which is reach in CaCO3,experimental investigation shows that, it enhance the physical and mechanical properties of concrete. The workability of concrete found to be gradually increasing with the addition of Calcite and Fly ash in cement.

• Huseyin temiz et. al. (2014) [9]

They obtain a new building material by mixing limestone, calcite powder and fly ash in vaious ratios were used instead of mineral admixture. Mechanical and physical properties of sample were tested. Result showed that an increase which agree with the standard requirement was observed in setting time and volume expansion of paste sample with increasing amount of limestone and calcite powder. The conclusion they got were limestone and calcite powder does not cause an important increase in water involvement of admixture. There was not any difficulty in process ability.

• P. Dinakar et. al. (2013) [10]

The main objective is to investigate the influence of including fly ash (FA) on the properties of self-compacting concrete (SCC). Properties included were self-compatibility properties (slum flow, V-funnel time and L-box blocking ratio), mechanical properties (compressive strength, splitting tensile strength and elastic modulus), and durability properties (water absorption, water penetration depth and chloride permeability). For this they designed four SCC mixture in order to obtain different fresh-state properties. Four different mixes (SCC10, SCC30, SCC50 and SCC70) were employed to examine the influence of fly ash in SCCs on the fresh, mechanical and durability properties when PPC cement was used. In mixes SCC10, SCC30, SCC50 and SCC70 cement content was replaced with 10%, 30%, 50% and 70% fly ash. The water-binder ratio for all the mixes was kept constant at 0.30. This study discusses an experimental program carried out to investigate the effects of incorporation high volume fly ash replacement on the

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flow characteristics of SCC when PPC was used in the fresh state, and mechanical and durability properties in the hardened state. It can be observed that fly ash replacement of around 30-50% will be ideal for developing SCC when Portland pozzolana cement was used.

• Benabed B et. al. (2016)[11]

Self-compacting repair mortars (SCRM) are particularly desired for the rehabilitation and repair of reinforced concrete structures. The properties of SCRM can be improved by using chemical, mineral, polymer and fiber additives. In limestone quarries, considerable quantities of limestone fine powder are obtained during the process of crushing rock. These fine powders are being collected and their utilization is a big problem from the aspects of disposal, environmental pollution and health hazards. The introduction of limestone powder as cement and sand replacement present interesting possibilities to reduce the cement cost production, CO2 emission and the conservation of natural resources. The effects of limestone powder content in crushed sand on the properties of SCRM are not studied. An experimental study was undertaken to find out the effect of limestone powder content on fresh and hardened properties of SCRM. SCRM mixtures were prepared using crushed sand partially replaced with limestone powder at varying percentages up to 30%. Results indicate that the limestone powder as sand replacement significantly improves the fresh and hardened properties of SCRM with a content ranging from 10 to 15%. The use of limestone powder in repair mortar and concrete application would offer technical, economic and environmental advantages for concrete producers.

• N. Florea et. al. (2015)[12]

Self-compacting concrete (SCC) is an innovative construction material in construction industry. It is a highly fluid and stable concrete that flows under its own weight and fills completely the formwork. The flowability of SCC is achieved by increased paste content with employment of some mineral admixture in the form of limestone powder. The use of this type of filler increases the workability and the compressive strength for an optimal cement content replacement and also provides economic and environmental advantages by reducing Portland cement production and CO2 emissions.

III. CONCLUSION ON LITERATURE REVIEW

• Self-compacting concrete require considerable amount of powder content and fines for its cohesiveness and ability to flow without bleeding and segregation.

• By replacing the certain amount of mineral admixture with cement in self compacting concrete it increase strength, workability, durability.

• Use of fly ash with calcite in self compacting concrete reduces the carbon dioxide content.

• The effect of water cement ratio on the plastic properties of self-compacting was negligible.

• Self-compacting concrete is eco-friendly and cost effective with use of mineral admixture.

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