International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 03 | Mar 2020 www.irjet.net p-ISSN: 2395-0072

USE OF BRICK DUST, FLYASH AND CEMENT KILN DUST IN SCC – A REVIEW

Ali Mohd[a] , Ankit Mahajan[b]

[a] PG student, Department of Civil Engineering, Chandigarh University Mohali 140413
[b]Assistant Prof, Department of Civil Engineering, Chandigarh University Mohali 140413

Abstract;-*The concept of self-compacting concrete was proposed in (1986) by Professor Hajime Okamura but the prototype was first developed in 1988 in Japan, by Professor Ozawa at the University of Tokyo. Self-compacting concrete was developed at that time to improve the durability of concrete structures. Since then, various investigations have been carried out and SCC has been used in practical structures in Japan, mainly by large construction companies. Investigations for establishing a rational mix-design method and self-compact ability. Self-compacting concrete is a highly flow able, steady concrete which flows eagerly into places around packed reinforcement, filling formwork without any consolidation and major segregation. The hardened concrete is solid, uniform and has the same engineering properties and durability as that of conventional vibrated concrete. The use of SCC eliminates the need for compaction thereby saves time, reduces labour costs and save energy. Furthermore use of SCC enhances surface finish characteristics. Present work is an attempt to explore various strength parameters using tertiary combinations of waste materials.*

Keywords: Brick Dust, Fly ash, Cement kiln Dust and Self compacting concrete

1.0. INTRODUCTION

1. 1 SELF-COMPACTING CONCRETE

Self-compacting concrete is concrete which, without the effect of additional compaction energy, flows solely under the influence of the gravity, as well as completely fills the reinforcing spaces and the formwork. Its essential properties are high flow ability and good sedimentation stability. These properties can be achieved by the use of increased flour grain (flour corn type), by stabilizing additives (stabilizer type) or by their combination in combination with highly effective flow agents. The majority of the people might not know a lot about it or at least do not like it too much but, concrete is around us everywhere. If you do not live alone in the center of a desert or a sea, please just turn your head around and you will discover this fact. There is no doubt that the concrete is of special importance in the buildings and constructions. Among the other building and construction materials (i.e. steel, brick asphalt, timber etc.), it is still in the top rank according to its highest consumption compared to others worldwide. According to the Cement Sustainability Initiative, the consumption of the concrete is expected to be equal to 25 billion tons per year which means above 3.8 tons per person per year in the world. Concrete technology has made marvelous stride in the past decade. The expansion of specifying a concrete according to its performance requirements, slightly than the constituents and ingredients has opened numerous opportunities for producers of concrete and users to design concrete to go with their particular necessities. Growth of self-compacting concrete (SCC) is a wanted accomplishment in the construction industry in order to overcome problems associated with cast-in-place concrete. Self- compacting concrete is not affected by the skill of workers, the shape and amount of reinforcing bars or the arrangement of a structure and, due to its high-fluidity and resistance to segregation. It can be pumped longer distances.

1. 2. BRICK DUST

In developing countries bricks are still one of the most popular construction materials. India is the second largest producer of fired clay bricks after china. India is estimated to have more than 100,000 brick kilns, producing about 150-200 billion bricks annually, employing about 10 million workers and consuming about 25 million tons of coal annually. For brick making availability of good soil is crucial. Recently number of additives are added or are replaced with clay to increase the performance of bricks including fly ash, bagasse ash, rice husk ash etc. The utilization of waste from different industrial sector is appreciable for the environment and for the economy of the state also. The waste from the brick production facilities is also a cause of concern as the brick sector of India is unmanaged and has poor worker skill which causes high waste generation.

1. 3. FLY ASH

A waste material extracted from the gases emanating from coal fired furnaces, generally of a thermal power plant, is called fly ash. In many countries, coal is the primary fuel in thermal power plant and other industry. The fine residue from these plants which is collected in a field is known as fly ash and considered as a waste material. The fly ash is disposed of either in the dry form or mixed with water and discharged in slurry into locations called ash ponds. The quantity of fly ash produced worldwide is huge and keeps increasing every day. Four countries, namely, China, India, United State and Poland alone produce more than 270 million tons of fly ash every year. One of the chief usages of volcanic ashes in the ancient ages were the use of it as hydraulic cements, and fly ash bears close resemblance to these volcanic ashes. These ashes were believed to be one of the best pozzolans (binding agent) used in and around the globe. The demand of power supply has exponentially heightened these days due to increasing urbanization and industrialization phenomena. Subsequently, this growth has resulted in the increase in number of power supplying thermal power plants that use coal as a burning fuel to produce electricity. The mineral residue that is left behind after the burning of coal is the fly ash. The Electro Static Precipitators (ESP) of the power plants collect these fly ashes. Production of fly ash comes with two major concerns – safe disposal and management of fly ash. Because of the possession of complex characteristics of wasters which are generated from the industries, and their hazardous nature, these wastes pose a necessity of being disposed in a safe and effective way, so as to not disturb the ecological system, and not causing any sort of catastrophe to human life and nature. Environmental pollution is imminent unless these industrial wastes are pre-treated before their disposal or storage.

1.4. CEMENT KILN DUST

CKD is made within the oven throughout the assembly of cement clinker. Disposal of cement oven dirt is associate degree environmental drawback. the plain and best use of CKD is its reincorporation within the clinker production cycle. However, this will solely be done once the present restrictions on the alkalis and chloride concentrations in cement area unit revised. the employment of this material has received increasing attention as a result of it not solely solves a possible solid waste drawback however additionally provides another stabilising agent to be used in chemical stabilization of problematic soils and provides another construction material. Cement oven dirt isn't a venturous material underneath numerous environmental protection agency tips. Thus, the utilization of the cement oven dirt for chemical stabilization applications is also associate degree environmental answer of the issues related to its disposal method wherever a awfully large quantity of the cement oven dirt as by-product is daily made from the cement factories.

2.0. LITERATURE REVIEW

The widespread research and development of SCC in the past two decades has led to a substantial and increasing number of publications of all types. In this chapter those considered most relevant to the current study are reviewed and summarized here. A brief introduction to the fresh and hardened properties is followed by a discussion of test methods, constituent materials and mix designs. A detailed review of Fly ash & Brick dust and silica fume as additions to concrete and SCC is demonstrated. Because this project focuses on laboratory experiments, concrete production and site practice are only briefly mentioned.

S Girish (2010) presented the results of an experimental investigation carried out to find out the influence of paste and powder content on self-compacting concrete mixtures. Tests were conducted on 63 mixes with water content varying from 175 l/m^3 to 210 l/m^3 with three different paste contents. Slump flow, V funnel and J-ring tests were carried out to examine the performance of SCC. The results indicated that the flow properties of SCC increased with an increase in the paste volume. As powder content of SCC increased, slump flow of fresh SCC increased almost linearly and in a significant manner. They concluded that paste plays an important role in the flow properties of fresh SCC in addition to water content. The passing ability as indicated by J-ring improved as the paste content increased.

Paratibha Aggarwal (2008) presented a procedure for the design of self-compacting concrete mixes 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 results were found to be satisfactory, i.e. passing ability; filling ability and segregation resistance are well within the limits. SCC was developed without using VMA in this study. Further, compressive strength at the ages of 7, 28, and 90 days was also determined. By using the OPC 43 grade, normal strength of 25 MPa to 33 MPa at 28-days was obtained, keeping the cement content around 350 kg/m^3 to 414 kg/m^3

Felekoglu (2005) has done research on effect of w/c ratio on the fresh and hardened properties of SCC. According to the author adjustment of w/c ratio and super plasticizer dosage is one of the key properties in proportioning of SCC mixtures. In this research, fine mixtures with different combinations of w/c ratio and super plasticizer dosage levels were investigated. The results of this research show that the optimum w/c ratio for producing SCC is in the range of 0.84-1.07 by volume. The ratio above and below this range may cause blocking or segregation of the mixture.

Sri Ravindra rajah (2003) made an attempt to increase the stability of fresh concrete (cohesiveness) using increased amount of fine materials in the mixes. They reported about the 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 results of bleeding test and strength development with age were highlighted by them. The results showed that Fly ash & Brick dust could be used successfully in producing self-compacting high-strength concrete with reduced segregation potential. It was also reported that Fly ash & Brick dust in self-compacting concrete helps in improving the strength beyond 28 days. Self-Compacting Concrete.

Bouzoubaa and Lachemi (2001) carried out an experimental investigation to evaluate the performance of SCC made with high volumes of fly ash. Nine SCC mixtures and one control concrete were made during the study. The content of the cementations materials was maintained constant (400 kg/m^3), while the water/cementations 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 concrete such as compressive strength and drying shrinkage were also determined. The SCC mixes developed 28-day compressive strength ranging from 26 to 48 MPa. They reported that economical SCC mixes could be successfully developed by incorporating high volumes of Class F fly ash.

Nan Su (2001) proposed a new mix design method for self-compacting concrete. First, the amount of aggregates required was determined, and the paste of binders was then filled into the voids of aggregates to ensure that the concrete thus obtained has flow ability, self-compacting ability and other desired SCC properties. 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, and the results indicated that the proposed method could be used to produce successfully SCC of high quality.

Subramanian and Chattopadhyay (2002) Subramanian and Chattopadhyay (2002) are research and development engineers at the ECC Division of Larsen & Toubro Ltd (L&T), Chennai, India. They have over 10 years of experience on development of self-compacting concrete, underwater concrete with anti washout admixtures and proportioning of special concrete mixtures. Their research was concentrated on several trials carried out to arrive at an approximate mix proportion of self-compacting concrete, which would give the procedure for the selection of a viscosity modifying agent, a compatible superplasticizer and the determination of their dosages. In order to arrive at an acceptable combination of dosages of welan gum and super plasticizer, Subramanian and Chattopadhyay (2002)[9] ran several tests related to the tendency of the concrete to bleed and its ability to pass the U-tube test. They discovered that with a combination corresponding to 0.1 percent of welan gum and 0.53 percent by weight of water acrylic copolymer type superplasticizer, a satisfactory self-compacting mixture could be obtained.

Dehn (2000) have focused their research work on the time development of SCC compressive and splitting tensile strength and the bond behavior between the reinforcing bars and the self-compacting concrete compared to normal concrete. In order to ensure a good production of SCC, a mix design should be performed, so that the predefined properties of the fresh and hardened concrete would be reached for sure. All the components should be coordinated so that bleeding and segregation would be prevented. Because of these aspects, their mix design was based on experience from Japan, Netherlands, France, and Sweden. Due to the fact that the load bearing capacity of a reinforced concrete structure is considerably influenced by the bond behavior between the reinforcing bars and the concrete, the following items were taken into account: crack width control and lapped reinforcing bar

For this reason, investigations on the bond behavior between the re-bars and the SCC were necessary, especially considering the time development of the bond strength. These investigations showed, that the main parameters which influence the bond behavior are the surface of the re-bars, the number of load cycles, the mix design, the direction of concreting, as well as the geometry of the (pull-out) test specimens (Figure 2.4). The bond behavior was determined under uniform static loading using pullout specimens having a uniform concrete cover around the reinforcing bar. The bar diameter for the whole test series was 10 mm and the concrete cover around it had a diameter of 10 cm and a length of also 10 cm.

To avoid an unwanted force transfer between the reinforcing bar and the concrete in the unbounded area, the re-bars were encased with a plastic tube and sealed with a highly elastic silicone material. The re-bars were placed concentrically and the concrete was cast parallel to the loading direction. The tests were carried out in an electro mechanic testing machine where the specimens were loaded with a loading rate of 0.0008 mm/sec. The applied force of the machine was measured corresponding to the slip displacement of the reinforcing bar on the non-loaded side. The increase of the slip path was constantly monitored during the whole testing period. Experimental results showed higher compressive strengths (36%) and splitting tensile strengths (28%) of the SCC specimens compared to normal concrete specimens. Also, the bond behavior measured at 1, 3, 7 and 28 days after concreting was better for self-compacting concrete than that of normally vibrated concrete.

3.0. LITERATURE GAP

1. Various researchers have worked on use of these materials in SCC, however the research is limited to binomial materials only. The present research will emphasis on the use of tertiary combination of materials in SCC, the various mechanical properties as discussed above will be taken into consideration as well.
2. In addition the proportioning of materials used in previous papers are giving a broader / tentative results, in present research the interval of proportion will give more precise results.

4.0. CONCLUSION AND SCOPE

From the above literature gap, it has been concluded that need is to

1. To compare the mechanical properties of self-compacting and normal concrete specimens.
2. To Study the effect of various proportions of solo, binary and tertiary materials on the strength of SCC.
3. To predict the optimal proportion of mix for best possible outcomes.

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