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Effects of Self Compacting Concrete (SCC) With Nanomaterials

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Abstract

Self Compacting Concrete (SCC)[8],[19] is a easily flowable concrete under its own weight and without the need of any vibration, the most advantageous property of SCC is to maintaining homogeneity. The highly fluid nature make it placing at confined sections with reinforcement. The other advantages of SCC is that less time required to place in large sections. Mixture proportions for SCC differ from those of ordinary concrete. The SCC has more powder content and less coarse aggregate. Rounded aggregates would provide a better flowability and less blocking potential for a given water-to-binder ratio, compared to angular, semi-rounded aggregates and the presence of flaky and elongated particles causes of blocking problems in confined areas, and also increase the minimum yield stress. Various type of pozzolanic materials[1],[12], 14] like Fly ash(FA)[3], Metakeolin(MK)[8],Silica fume(SF)[6],Rise Husk Ash(RHA)[14], Ground Granulated Blust Furnace Slag(GGBFS)[2] etc. are added for partial replacement with dry weight of Ordinary Portland Cement(OPC) to enhance the strength, durability, workability of concrete.

Keywords: *Homogeneity, Nanomaterials, OPC, Pozzolanic Material, SCC, w/b ratio etc*

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1. INTRODUCTION

Self-compacting concrete (SCC) has been described as "the most revolutionary development in concrete Construction for several decades". Originally it has developed for growing shortage of skilled labor, and other beneficial economically as-- reduction of manpower, better working environment, better surface finish, Easier to placing at confined sections with reinforcement, improved durability, greater freedom in design , absence of vibration . Due to the tiny size, the Pozzolanic materials are compared with artificially created nanomaterials. The Pozzolanic materials are used as partial replacement with dry weight of Ordinary Portland Cement(OPC) to enhance the strength, durability, workability of concrete.

2. NANOMATERIALS

Nanoscience[4],[5],[9] and nanotechnology primarily deals with the synthesis, characterization, exploration, and exploitation of nanostructured materials[5]. These materials are characterized by at least one external dimension is in the size range from 1-100 nm. 1nm is equal to 10−9 m. A nanometer is one millionth of a millimetre. Approximately one lace times smaller than the diameter of a human hair. Scientists are also unable to established a proper definition of nanomaterials but they agreed about their tiny size. Most nanoscales materials are too small to be seen with the necked eye and even with conventional lab microscope also. They can be seen with powerful microscope like Atomic Force Microscope(AFM), or Scanning Tunnelling Microscope(STM), or X-ray Diffraction(XRD) etc. Nanomaterials can be created both naturally and artificially. Naturally created nanomaterials are zeolite, burned clay, volcanic ash etc. and artificially created nanomaterials are FA(fly ash), RHA(Rise husk ash), GGBS(Ground granulated blust furnace slag)(it is simply called a slag), SF(Silica fume), MK (Metakeolin) etc.

The physical and chemical properties of nanomaterials can differ significantly from those of the bulk materials of the same composition. For an example when MK(Metakeolin) is used as partial replacement of OPC, it reacts with calcium hydroxide[Ca(OH)2] to form supplementary Calcium Silicate Hydrate(C-S-H) which is similar with the composition and structure to those obtained from OPC. The nano-materials are of two fold : one is the bottom-up approach, that is, the miniaturization of the components, as articulated by Richard P.

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Feynman, who stated lectured at the California Institute of Technology in 1959 that "there is plenty of room at the bottom" ; and the other is the self-assembly of molecular components, where each nano structured component becomes part of a superstructure. The prediction of Feynman to a large extend have been realised today as we celebrated the golden jubilee of nanotechnology on Dec. 29, 2009. Nanotechnology have effectively applied in plain and reinforced concrete structure due to the overall improvement of various properties of concrete like flow ability, compression, tension and torsion. Concrete is a composite material of aggregates and binders where the binding materials are OPC, pozzolanic materials and water.

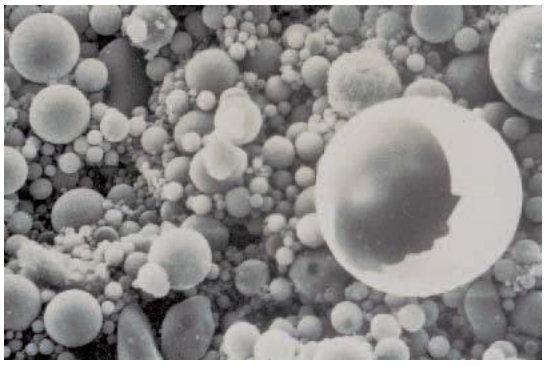


Fig. 1: Fly Ash (FA) particles observing in Scanning Tunnelling Microscope (STM)

3. VISCOSITY MODIFYING AGENTS (VMA)

The conventional method of improving the stability of flowing SCC is to increase the fines content by using a large amount of filler. However, attempts are being made to reduce the fines content and paste content to the levels of normal concrete(in doing so, reducing the potential for creep and shrinkage) and use viscosity modifying agents(VMAs)[20],[21]. To improve the stability, current research shows that SCC produced with low powder content and VMA had similar fresh concrete properties as SCC with high powder contents produced without VMA. They were mainly used for underwater concreting in the past, but are now also used in SCC. Most VMAs have polysaccharides as active ingredient. However, some starches could also be appropriate for control of viscosity in SCC. The sequence of addition of VMA and superplasticizer into the concrete mixture is important. If VMA is added before the superplasticizer, it swells in water and it becomes difficult to produce flowing concrete. To avoid this problem, VMA should be added after the superplasticizer has come into contact with the cement particles. Another method of addition is to

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disperse the superplasticizer in mixing water, and then add VMA to this mixture.

4. SUPER PLASTICIZER

The admixtures are principally surface reaction agent. It increase the workability, so as to easily placing in proper location. The concretes with up to 250 mm slump were manufactured without bleeding **(Fig.2)**, provided that an adequate cement factor was used.

5. HIGH RANGE WATER REDUCING AD MIXTURE (HRWRA)

HRWRA are principally surface reactive agents. It produced negative charges into individual cement particles also its hydrated particles dispersed and suspended into inner part repulsion. Thus it conform high mobility to the particles. The HRWRA helps in achieving excellent flow at low water contents and VMA reduces bleeding and improves the stability of the concrete mixture. HRWRA is based on polycarboxylate ethers and typically used plasticize in the mix. It is chemically different from normal plasticizers and it permits 30% reduction of water without reducing the workability. By using of super plasticizers, SCC having high strength and high performance. The following polymers are commonly used as super plasticizers.

i) Sulphonated Melamine Formaldehyde Condensates (SMF)

ii) Sulphonated Napththalane Formaldehyde Condensates(SNF)

iii) Polycarbonate Ester

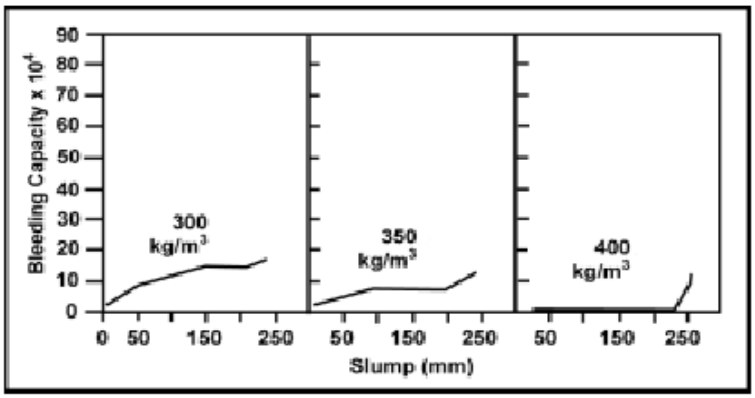


Fig.2: Bleeding capacity as a function of concretes containing superplasticisers

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6. MIXING OF CONCRETE

Before starting production, the employees involved must be informed about SCC and taught how to handle this new type of concrete. Most common mixers can be used for producing SCC. Both forced action mixers, such as paddle-mixers, and gravity mixers, such as free-fall-mixers, are suitable. Different mixing orders have been investigated and found to work, e.g. by adding all material at the beginning of mixing or by adding super plasticiser and or water after a while. Consequently, suppliers have to find their own most suitable mixing order for the concrete mix chosen. SCC is more sensitive to the water content in the mix than traditional vibrated concrete and because of this it is necessary to measure the moisture content in the aggregates and to take into account the water content in the admixtures before the remaining water is added.

CONCLIUSION

To enhance the strength of SCC only binary effect is not yet sufficient but it needs the ternary blends effect and the test result will proceed successively in the next journal.

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