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A REVIEW ON EFFECT OF MINERAL ADMIXTURE ON SELF COMPACTING CONCRETE

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ABSTRACT

Self compacting concrete (SCC) flows into place Fresh self-compacting concrete and around obstructions under its own weight. Self-compacting concrete decreases construction time, labour and equipment uses on construction,, and helps in achieving use without applying vibration in congested reinforced concrete structures characterized by difficult casting conditions. However, because it usually requires a larger content of binder and chemical admixtures compared to ordinary concrete, its material cost is generally 20–50% higher, which has been a major hindrance to a wider implementation of its use. The fresh concrete properties and compressive strength at 1, 7 and 28 days of such SCC mixtures were measured. The parameters considered in the study were the contents of cement, water- cement ratio (0.35 to 0.45), water-to-powder) ratio (W/P), fly ash and dosage of SP (super plastizers). The responses of concrete are recorded from slump flow, fluidity loss, Orimet time, V-funnel time, L-box, J Ring, rheological parameters, segregation and compressive strength at 7and 28 days. Lastly, both carbonation and chloride penetration tests were carried out to assess durability behaviour of this concrete mixture.

KEYWORDS: Self Compacting Concrete, Rheological Parameters, Fly Ash, Workability, Strength Properties

INTRODUCTION

In recent years, many quite important studies about SCC have been made. The most important difference between SCC and ordinary concrete is the existence of filler material in the SCC mixture.

Thus, there are also many studies about the effects of filler materials on the properties of SCC. According to the conclusions of these studies, the benefit of filler material usage in SCC can be said as improved workability with reduced cement content. By this way, low heat of hydration and decreased shrinkage cracking can also be obtained.

Moreover, since cement is the most expensive component of concrete, reducing cement content can be said as an economic solution. Besides, the pores between aggregates are fulfilled and impermeable concrete can be produced. Therefore, the durability of concrete is also increased. Industrial by-products such as fly ash (FA), stone dust, silica fume and blast furnaceslag are generally used as filler materials in SCC. Thereby, the workability of SCC is improved and the usage amount of by products can be increased at the same time. In addition, such usages of by-products in cement or concrete provide economical benefits and prevent environmental pollution.SSC is also one of the concrete technologies contributing the sustainable development by using filler materials such as limestone powder. The fresh rheological characteristics, strength and durability of SCC can be improved with the addition of powders which can be separated into two groups as inert or pozzolanic. The usage amount and the type of cementations or inert powders depend on the physical and physico-chemical properties of these powders which affect the performance of fresh paste such as particle shape, surface texture, surface porosity and rate of super plasticizer adsorption, finest fraction content and particle size distribution. There are no accepted standards for the effects of these factors due to the complex influence of the combination of these factors.

In this study, it is aimed to investigate the effect of Fly Ash as fine material on the fresh and hardened properties of SCC. Fresh concrete tests such as slump-flow, V-funnel, L-box, unit weight, air content and hardened concrete tests such as compressive strength, flexural strength, and compactness were attempted to make this objective achieved and determine the optimum fly ash replacement ratio in SCC.

REVIEW OF LITERATURE

Mohammed Sonebi (2004) developed medium strength self-compacting concrete by using pulverised fuel ash (PFA) with a minimum amount of super plasticizer. A factorial design was carried out to mathematically model the influence of key parameters on filling ability, passing ability, segregation resistance and compressive strength, which are important for the successful development of medium strength self-compacting concrete incorporating PFA. The parameters considered in the study were the contents of cement and PFA, water-to-powder (cement + PFA) ratio (W/P) and dosage of SP. The responses of the derived statistical models are slump flow, fluidity loss, Orimet time, V-funnel time, L-box, rheological parameters, segregation resistance and compressive strength at 7, 28 and 90 days. Twenty-one mixes were prepared to derive the statistical models, and five were used for the verification and the accuracy of the developed models. The models are valid for mixes made with 0.38 to 0.72 W/P, 60 to 216 kg/m3 of cement content, 183 to 317 kg/m3 of PFA and 0% to 1% of SP, by mass of powder. The influences of W/P, cement and PFA contents, and the dosage of SP were characterised and analysed using polynomial regression equations, which can identify the primary factors and their interactions on the measured properties. The results showed that MS-SCC can be achieved with a 28-day compressive strength of 30 to 35 MPa by using up to 210 kg/m3 of PFA.

Caijun Shi et al (2005) carried out the design and properties of self-consolidating light weight concrete. Self-consolidating lightweight concrete is designed using a combination of the least void volume for a binary aggregate mixture, excessive paste theory, and ACI standard practice for selecting proportions for structural lightweight concrete. Glass powders and ASTM Class F fly ash are added to produce excessive paste to increase the flow ability and segregation resistance of the concrete. The five designed concrete mixtures exhibit good flow ability and segregation resistance. Compared with the fly ash, the use of ground glass powder decreases setting times and increases chloride migration resistance, the strength and drying shrinkage of the concrete. The designed self-consolidating light weight concretes have good freezing-and-thawing resistance. When expanded shale or clay is used as coarse aggregate, the concrete containing glass powder does not exhibit deleterious expansion, even if alkali-reactive sand is used as fine aggregate of the concrete.

Burak Felekoglu (2006) studied self- compacting concrete (SCC) as a special concrete, has practical advantages due to its mechanical performance and application easiness. However, a more careful study is needed at the stage of mixture proportioning. In order to produce SCC, a more voluminous but also a more viscous matrix is needed compared to concrete of normal workability. This may be achieved by using additional fillers with pozzolanic or inert nature. The employment of sands rich in fines may be a second alternative source of filler. However, the physical properties of sands rich in fines affect the performance of SCC in dual ways. In this study, the effects of the changes in the physical properties of sands (in particular the fine material content and type), on concrete performance were investigated. SCC mixtures containing four different sands (washed natural (WN) sand, washed crushed limestone (WCL) sand, crushed limestone sand with silt powder (CLS) and crushed limestone sand with clay powder (CLC)) were produced and the admixture requirements for each type of SCCs were determined. Test results suggest that, in order to produce SCC with the same consistency, admixture requirement may change with the physical properties of sands used. When compared to SCCs prepared with washed sand (poor in fines), approximately similar compressive strengths have been obtained by using CLS sand. On the other hand, CLC sand caused strength loss and increased the admixture demand for a targeted slump-flow of SCC. Due to the increased admixture content, setting times of SCCs prepared with CLC sand were also lengthened. The methylene blue adsorption value is a good indicator of clay content of sand. This test method was efficiently used for the selection of appropriate sand type incorporating high volumes of fine materials. Additionally, micro structural studies revealed some clues about the poor performance of SCCs prepared with CLC sand.

Mustafa Sahmaran et al (2006) evaluated the effectiveness of various mineral additives and chemical admixtures in producing self-compacting mortars (SCM). For this purpose, four mineral additives (fly ash, brick powder, limestone powder and kaolinite), three super plasticizers and two viscosity modifying admixtures were used. Within the scope of the experimental program, 43 mixtures of SCM were prepared keeping the amount of mixing water and total powder content (portland cement and mineral additives) constant. Workability of the fresh mortar was determined using mini V-funnel and mini slump flow tests. The setting time of the mortars, was also determined. The hardened properties that were determined included ultrasonic pulse velocity and strength at 28th and 56th days. It was concluded that among the mineral additives used, fly ash and limestone powder significantly increased the workability of SCMs. On the other hand, especially fly ash significantly increased the setting time of the mortars, which can be eliminated through the use of ternary mixtures, such as mixing fly ash with limestone powder. The two polycarboxyl based SPs yield approximately the same workability and the melamine formaldehyde based SP was not as effective like other SPs.

Binu Sukumar et al (2007) replaced high volume fly ash in the powder, based on a rational mix design method to develop self-compacting concrete (SCC). High fly ash content necessitated the study on the development of strength at early ages of curing which is a significant factor for the removal of formwork. Rate of gain of strength at different periods of curing such as 12 h, 18 h, 1 day, 3 days, 7 days, 21 days and 28 days were studied for various grades of different SCC mixes and suitable relations were established for the gain in strength at the early ages in comparison to the conventional concrete of same grades. Relations were also formulated for the compressive strength and the split tensile strength for different grades of SCC mixes. It was observed that the rate of gain in strength for different grades of SCC was slightly more than the expected strength of conventional concrete of the same grades.

Ibrahim Turkmen and Abdulhamit Kantarcı (2006) studied, Fresh self-compacting concrete (SCC) flows to place and around obstructions under its own weight to fill the formwork completely and is self-compact, without any segregation. This article outlines compressive strength, apparent porosity and capillarity coefficient of SCC including mixture of expanded perlite aggregate (EPA) and natural aggregates (NA) at different curing conditions. The binder (cement and silica fume) dosage was held constant at 450 kg=m3 throughout this study. Super plasticizer 2% by weight of Portland cement (PC) was used to reduce water/binder (w/cm) ratios. It was found that the capillarity coefficient and apparent porosity of concrete is increased by using EPA and that the compressive strength of EPA concrete generally decreases with increasing EPA ratios. Another experimental finding was that, at the cured in air (CC2) curing conditions, SCC shows both the highest capillarity coefficient and the apparent porosity and lowest compressive strength after 28 days.

Burak Felekoglu and Hasan Sarıkahya (2007) synthesized three Poly Carboxylate (PC) based super plasticizers by using radical polymerisation techniques. The effect of these admixtures on setting time of cement pastes, time dependent workability and strength development of SCC was investigated. Test results showed that, from the viewpoint of chemical structure, workability retention performance of PC-based Super Plasticizers could be manipulated by modifying the bond structure between main backbone and side-chain of copolymer. PC-based SPs with ester bonding were found to be ineffective in maintaining the workability of fresh concrete workability due to the alkali attack vulnerability of this bond structure. It was also reported that, by directly bonding the polyoxyethy lene side-chain to the backbone of copolymer, the workability of fresh can be effectively maintained at least for a period of 2 h. It was found that, in addition to the types of SP, water/powder ratio of SCC mixtures were also responsible for the long workability retention performances. Best results were derived from mixtures incorporating 2.3 weight % of SP.

Mustafa Sahmaran, and I. Ozgur Yaman (2007) presented a study on the fresh and mechanical properties of a fiber reinforced self-compacting concrete incorporating high-volume fly ash that does not meet the fineness requirements of ASTM C 618. A polycarboxylic-based super plasticizer was used in combination with a viscosity modifying admixture. In mixtures containing fly ash, 50% of cement by weight was replaced with flyash. Two different types of steel fibers were used in combination, keeping the total fiber content constant at 60 kg/m3. Slump flow time and diameter, V-funnel, and air content were performed to assess the fresh properties of the concrete. Compressive strength, splitting tensile strength, and ultrasonic pulse velocity of the concrete were determined for the hardened properties. The results indicated that high-volume coarse fly ash can be used to produce fiber reinforced self-compacting concrete, even though there is some reduction in the concrete strength because of the use of high-volume coarse fly ash.

Andreas Leemann and Frank Winnefeld (2007) studied the influence of different viscosity modifying agents on the flow properties and the rheology of self-compacting mortars. Additionally, their effect on the early hydration of cement pastes and on the development of strength of concrete was determined. Inorganic VMA micro silica (MS), nano silica slurry (NS), organic VMA based on high molecular ethylene oxide derivate (EO), natural polysaccharide (PS) and starch derivate (ST) were used. The different VMAs were combined with a super plasticizer (SP). At constant water-to-binder ratio (w/b), the addition of VMA caused a decrease of mortar flow and an increase of flow time (V-funnel test). At a constant dosage of super plasticizer (SP) mixtures with VMA require a higher w/b to keep the same flow properties as the reference mixtures without VMA. In spite of the higher w/b flow time and plastic viscosity respectively are only slightly reduced. This property is especially beneficial for the production of stabilizer-type self-compacting concrete where the amount of fines can be reduced with the use of VMA. However, only the use of VMA PS and ST leads to smaller changes of flow when w/b is changed. The organic VMA show almost no influence on early cement hydration and the development of compressive strength. However, the inorganic VMA caused an acceleration of hydration and higher compressive strength at the age of 1 day.

Ilker Bekir Topcu et al (2007) carried out the study on the utilization of the waste MD in self-compacting concrete (SCC), as filler material, is the main objective of this study. Besides, the MD is used directly without attempting any additional process. Thus, this would be another advantage for this objective. For this purpose, MD has replaced binder of SCC at certain contents of 0, 50, 100, 150, 200, 250 and 300 kg/m3. After then, slump-flow test, L-box test and

V-funnel test are conducted on fresh concrete. Furthermore, compressive strength, flexural strength, ultrasonic velocity, porosity and compactness are determined at the end of 28 days for the hardened concrete specimens. The effect of waste MD usage as filler material on capillarity properties of SCC is also investigated. According to the test results, it is concluded that the workability of fresh SCC has not been affected up to 200 kg/m3 MD content. However, the mechanical properties of hardened SCC have decreased by using MD, especially just above 200 kg/m3 content.

Halit Yazıcı (2007) carried out the study on replacement of cement with a Class C fly ash (FA) in various proportions from 30% to 60%. Durability properties of various self-compacting concrete (SCC) mixtures such as, freezing and thawing, and chloride penetration resistance have been investigated besides mechanical properties within the scope of this study. Similar tests were carried out with the incorporation of 10% silica fume (SF) to the same mixtures. Test results indicate that SCC could be obtained with a high-volume FA. Ten percent SF additions to the system positively affected both the fresh and hardened properties of high-performance high-volume FA SCC. Although there is a little cement content, these mixtures have good mechanical properties, freeze–thaw and chloride penetration resistance.

E. Roziere et al (2007) designed Self-compacting concrete (SCC) mixtures with higher volumes of paste than vibrated concrete mixtures. The results reported in this paper come from a study of nine SCC concrete mixtures. Volume of paste was varied between 291 and457 -l/m3. One of the mixtures had already been used in a large scale test, and the others were designed by varying several parameters of the reference concrete mixture. Mechanical properties, shrinkage, fracture parameters and fracture process zone (FPZ) size were measured. Fracture behaviour was characterized by means of three-point bending tests and acoustic emission analysis. From the experimental results, increasing the volume of paste has a restricted effect on strength, unless water content varies. Strength, elastic modulus and fracture resistance slightly decrease with an increase in paste content. Volume of paste causes an increase in shrinkage and cracking due to shrinkage. Fracture and acoustic emission analysis show that increasing the volume of paste tends to make SCC more brittle.

Binu Sukumar et al (2007) investigated on Self-compacting concrete (SCC) demands large amount of powder content and fines for its cohesiveness and ability to flow without bleeding and segregation. In the investigation, part of this powder is replaced with high volume fly ash based on a rational mix design method developed by the authors. Because of high fly ash content, it is essential to study the development of strength at early ages of curing which may prove to be a significant factor for the removal of formwork. Rate of gain in strength at different periods of curing such as 12 h, 18 h, 1 day, 3 days, 7 days, 21 days and 28 days are studied for various grades of different SCC mixes and suitable relations have been established for the gain in strength at the early ages in comparison to the conventional concrete of same grades. Relations have also been formulated for compressive strength and split tensile strength for different grades of SCC mixes.

P. Dinakar et al (2008) presented an experimental study on the durability properties of self compacting concretes(SCCs) with high volume replacements of fly ash. Eight fly ash self compacting concretes of various strength grades were designed at desired fly ash percentages of 0, 10, 30, 50, 70 and 85%, in comparison with five different mixtures of normal vibrated concretes (NCs) at equivalent strength grades. The durability properties were studied through the measurement of permeable voids, water absorption, acid attack and chloride permeation. The results indicated that the SCCs showed higher permeable voids and water absorption than the vibrated normal concretes of the same strength grades. However, in acid attack and chloride diffusion studies the high volume fly ash SCCs had significantly lower weight losses and chloride ion diffusion.

Khatib (2008) investigated the influence of including fly ash (FA) on the properties of self-compacting concrete. Portland cement was partially replaced with 0–80% FA. The water to binder ratio was maintained at 0.36 for all mixes. Properties like workability, compressive strength, ultrasonic pulse velocity, absorption and shrinkage were found. The results indicated that high volume FA can be used to produce high strength and low shrinkage SCC. Replacing 40% of Portland cement with FA resulted in a strength of more than 65 N/mm2 at 56 days. High absorption values were obtained with increasing amount of FA. There is a systematic reduction in shrinkage as the FA content increases and at 80% FA content, the shrinkage at 56 days reduced by two third compared with the control. A linear relationship existed between the 56th day shrinkage and FA content. Increasing the admixture content beyond a certain level led to a reduction in strength and increase in absorption. The correlation between strength and absorption indicated a sharp decrease in strength as absorption increased from 1 to 2%. Beyond 2% absorption, the reduction in the strength was found to be at a slower rate.

A. Turatsinze and M. Garros (2008) focused on Cement-based materials suffer from low tensile strength and poor strain capacity. They are brittle and highly sensitive to cracking, notably to shrinkage cracking, which is particularly detrimental for large surface areas. This paper focuses on the properties of a Self-Compacting Concrete (SCC) incorporating rubber aggregates, obtained by grinding end-of-life tyres, as a partial replacement for natural aggregates.

Results show that the new cementitious material goes against some governing principles of mechanical behaviour of ordinary cement-based concrete. In particular, the modulus of elasticity of rubberized SCC is reduced and its variation with rubber aggregate content does not obey the conventional empirical relationship of modulus of elasticity with compressive strength. The strain capacity of SCC was quantified through flexural bending tests, which demonstrated hat strain capacity increased when rubber aggregates were incorporated in concrete. This response is interpreted as a result of the ability of rubber aggregates to reduce the stress singularity at the first crack tips running into the rubber/cement–matrix interface, a mechanism slowing the cracking kinetics and delaying macro crack localization. In such conditions, rubberized SCC is expected to be suitable when resistance to the cracking due to imposed deformation is a priority. This type of composite with low modulus of elasticity is also suitable for Controlled Modulus Columns (CMC) foundations, the ultimate solution for improving very soft soils subjected to settle mentor stability problems caused by insufficient bearing capacity. Incidentally, the use of rubber aggregates in SCC provides an opportunity to recycle non-reusable end of-life tyres.

Ilker Bekir Topcu and Turhan Bilir (2008) studied the usage of ground elastic wastes such as rubber in SCC is investigated. Rubber has replaced aggregates at the contents of 60, 120 and 180 kg/m3 in SCC by weight. Four different mixture proportions have been prepared. Moreover, 24 series have been produced by using six different viscosity agents in both SCC and rubberized self-compacted concrete (RSCC). By using these agents, it is attempted to see the effects of them on the properties of RSCC. Fly ash (FA) is used as filler material. The slump–flow, V-funnel, compressive strength, high temperature and freezing–thawing resistances of RSCC have been compared to the properties of ordinary SCC. At the end, it is observed that increase in RA content leads to increase in fresh properties of RSCC such as workability because of the existence of viscosity agents in mixtures. It decreases the hardened properties such as compressive strength and durability. However, the different viscosity agents can provide appropriate results for RSCC containing the same rubber aggregate

(RA) content and the hardened properties of RSCC are better than the properties of ordinary concrete even if they are lower than the ones of SCC.

Paratibha Aggarwal et al (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/m3 to 414 kg/m3.

Mehmet Gesoglu et al (2008) carried the experimental study was conducted to investigate properties of SCCs with mineral admixtures. Moreover, durability based multi-objective optimization of the mixtures were performed to achieve an optimal concrete mixture proportioning. A total of 22 concrete mixtures were designed having a constant water/binder ratio of 0.44 and a total binder content of 450 kg/m3. The control mixture included only a Portland cement (PC) as the binder while the remaining mixtures incorporated binary, ternary, and quaternary cementitious blends of PC, fly ash (FA), ground granulated blast furnace slag(S), and silica fume (SF). Fresh properties of the SCCs were tested for slump flow diameter, slump flow time, L-box height ratio, and V-funnel flow time. Furthermore, the hardened properties of the concretes were tested for sorptivity, water permeability, chloride permeability, electrical resistivity, drying shrinkage, compressive strength, and ultrasonic pulse velocity. The results indicated that when the durability properties of the concretes were taken into account, the ternary use of S and SF provided the best performance.

Al-Feel and Al-Saffar (2009) carried out an experimental investigation to study the effect of curing methods on the compressive, splitting, and flexural strengths (modulus of rupture) of self- compacting concrete and compared the same with that of normal concrete. The self-compacting concrete was made with Portland cement, limestone powder, sand, gravel and super-plasticizer. The specimens were cured in the air and water, for the period of 7, 14, and 28 days. Three specimens were tested for each point of each property. It is reported that the compressive strength, splitting tensile strength and flexural strength of the water cured specimens were 11%, 10% and 11% respectively more than that of the specimens cured in air. From the failed specimens it was found that there was no segregation and the bond between aggregate and matrix was good.

M. Hunger et al (2009) experimented In order to come to a sustainable built environment the construction industry requires new energy saving concepts. One concept is to use Phase Change Materials (PCM), which have the ability to absorb and to release thermal energy at a specific temperature. This paper presents a set of experiments using different amounts of PCM in self-compacting concrete mixes. The study focuses on the direct mixing of microencapsulated PCM with concrete and its influence on the material properties. Therefore, the fresh concrete properties and the hardened properties are investigated. The hardened properties comprise strength tests and a thorough assessment of the thermal properties. It will be shown that increasing PCM amounts lead to lower thermal conductivity and increased heat capacity, which both significantly improve the thermal performance of concrete and therefore save energy. On the other hand a significant loss in strength and micro-structural analysis both indicate that a large part of the capsules is destroyed during the mixing process and releases its paraffin wax filling into the surrounding matrix. However, the compressive strength of our specimens still satisfies the demands of most structural applications.

G. Heirman et al (2009) studied the of mineral additions and chemical admixtures on the shear thickening flow behaviour of powder type self-compacting concrete (SCC) is studied by means of a wide-gap concentric cylinder rheo meter. The Couette inverse problem is treated by means of the integration method in order to derive the flow curve $\tau(\gamma)$

from the torque measurements. According to the experimental results, the shear thickening effect is found to be strongly influenced by the addition of the chemical admixture (a polycarboxylate ether based super plasticizer), whereas mineral additions were found to modify the intensity of shear thickening. The limestone, quartzite and fly ash addition used in this research project, respectively increase, unalter and decrease the shear thickening intensity. The powder volume and the available amount of free water proved to have a major impact on the viscosity of the powder type SCC mixes. Increasing the powder volume or decreasing the amount of free water results in an increased viscosity of the SCC mix. The flow behaviour of fresh SCC is mostly characterized by empirical test methods like slump-flow, V-funnel, L-box, sieve stability, etc.

Venkateswara Rao et al (2010) developed standard and high strength self-compacting concrete with different sizes of aggregate based on Nansu's mix design procedure. The results indicated that Self Compacting Concrete can be developed with all sizes of graded aggregate satisfying the SCC characteristics. The mechanical properties such as compressive strength, flexural strength and split tensile strengths were found at the end of 3, 7 and 28 days for standard and high strength SCC with different sizes of aggregate. The optimum size of aggregate was found to be 10mm for standard self-compacting concrete (M30), while it was 16mm for high strength self-compacting concrete (M70) though all other sizes also could develop properties satisfying the criteria for SCC. A comparison of M30 and M70 grade concrete confirmed that the filling ability, passing ability and segregation resistance were better for higher grade concrete for the same size of aggregate. This is due to the higher fines content in M70 concrete. It was noted that 10mm size aggregate and 52% fly ash resulted in highest mechanical properties in standard SCC, whereas 16 mm size aggregate with 31% fly ash content resulted in highest strength in case of high strength SCC.

Mucteba Uysal and Kemalettin Yilmaz (2011) studied the benefits of using limestone powder (LP), basalt powder (BP) and marble powder (MP) as partial replacement of Portland cement to develop the self-compacting concrete. Furthermore, LP, BP and MP were used directly without any additional processing in the production of self-compacting concrete (SCC). The water to binder ratio was maintained at 0.33 for all mixtures. The examined properties include workability, air content, compressive strength, ultrasonic pulse velocity, static and dynamic elastic moduli. Workability of the fresh concrete was determined by using both the slump-flow test and the L-box test. The results proved that it is possible to successfully utilize waste LP, BP and MP as mineral admixtures in producing SCC. It was reported that the employment of waste mineral admixtures improved the economical feasibility of SCC production.

John J. Myers et al (2012) Carried out an experimental investigation involving the hardened properties of SCC that affect structural performance (*e.g.*, bond, shear, pre stress losses) and durability (*e.g.*, freeze thaw resistance, permeability), particularly the role of local aggregates and sensitivity in the mix designs.

Sensitivity involves the impact that relatively small changes in the mix design have on the performance of the material, which is critical for a construction material such as concrete. Furthermore, to establish a solid background for the study, the investigators also reviewed literature on SCC related to fresh properties, workability, stability, admixtures and mix design methods.

P. Dinakar et al (2013) investigated the influence of fly ash (FA) on the properties of self-compacting concrete (SCC).Portland pozzolana cement (PPC) was partially replaced with 10–70% fly ash. The water to binder ratio was maintained constant at 0.30 for all mixes. Properties included were self-compactibility properties (slump 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). The results indicate that fly ash along with PPC can be used in SCC to produce high strength high performance concretes. Replacing 30% of PPC with FA resulted in strength of nearly 100 MPa at 56 days. Splitting tensile strength and elastic modulus values have also followed the same trend. High absorption values were obtained with increasing amount of FA, however, all the SCC sexhibited initial absorption values of less than 3%. The water penetration depths in SCCs were lower at10% and 30% replacements of fly ash but remained higher at 50% and 70% replacements. There is a systematic reduction in the chloride permeability of SCCs at 30% replacement of fly ash.

Ramin Vafaei Pour Sorkhabi et al (2013) Study the Strength of Self Compacting *Concrete* According to the Ratio of Plasticizers and Slump Flow Using Experimental Method. The use of self compacting *concrete in the* concrete structures increasingly has become prevalent in recent years. In this regard, the use of admixtures in this type of concrete and determining the proportion of them will be important. In this study they aimed to, by taking the ratio of powdery materials and plasticizers and the main materials f ormed concrete mixing, during tests conducted in 4 groups, in laboratory of Islamic Azad University of Tabriz, they observed adding the powdery materials, 10% to 15%, increased the 28-day strength of concrete. Also results showed that adding plasticizers increase *t*he slump by 40% and reduce water consumption by 20% per cubic meter.

Chockalingam. M (2014) carried out an experimental investigation to evaluate about Self-Compacting concrete which gets compacted under its self-weight. In this experimental work different percentages of marble powder (MP) and silica fume (SF) are added. Experiments are carried out for the effective replacement of cement with silica fume (0%, 15%, 20%, 25%, 30%) and Marble powder (15%). Several tests such as slump flow, V-funnel, L-box, U-box are carried out to determine optimum parameters for the self-compact ability of mixtures. Test on Compressive strength, flexural strength and deformation characteristics of the specimens are studied. The results obtained from these tests are compared with conventional concrete specimens. The load deflection curves are also drawn. The results show that 15% to 20% replacement of cement with silica fume and 15% marble powder improves the properties of SCC.

CONCLUSIONS

The elimination of vibrating equipment improves the environment protection near construction sites where concrete is being placed, also reducing the exposure of workers to noise and vibration. The improved construction practice and performance, combined with the health and safety benefits, make SCC a very attractive solution for civil engineering construction. Fifteen case studies on the development of self compacting concrete were analysed. From the literatures it can be seen that various properties of materials and mix proportions makes SCC to behave differently in its fresh and hardened state when it is used. Case studies have confirmed that, there are currently no standardized tests or limits for the specification of SCC. Considerable scope exists for the optimization of SCC mixes with efficiency and economy for the benefit of construction industry in the future.

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