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BEHAVIOUR OF SILICA FUMES ON REINFORCED CONCRETE COLUMNS

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Abstract:

The new Concrete Society Publication, Cementitious Materials, CSTR74, covers the effects of cementitious materials - blast furnace slag (GGBS), fly ash (FA), limestone fines and silica fume (microsilica) on the properties of concrete. This paper focuses on the effects of silica fume on all the main properties of concrete in the fresh and hardened state as defined in the publication. Silica fume can be used either as a densified or undensified powder, a slurry, as a combination at the concrete mixer, or part of a factory-blended cement.

Keywords: GGBS, Slurry, Microsilica.

1. INTRODUCTION

Silica fume is a by-product of the manufacture of silicon metal and ferro-silicon alloys. The process involves the reduction of high purity quartz (SiO 2) in electric arc furnaces at temperatures in excess of 2,000°C. Silica fume is a very fine powder consisting mainly of spherical particles or microspheres of mean diameter about 0.15 microns, with a very high specific surface area (15,000–25,000 m 2/kg). Each microsphere is on average 100 times smaller than an average cement grain.

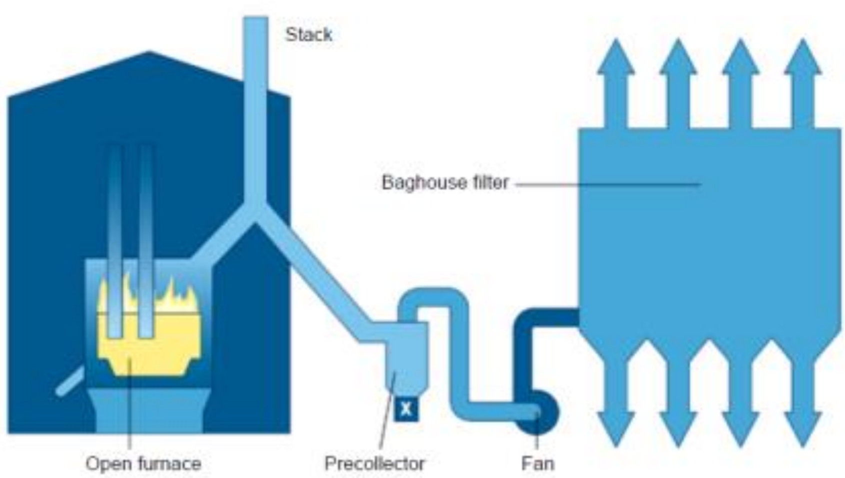

Fig.1.Basic Structure

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At a typical dosage of 10% by mass of cement, there will be 50,000–100,000 silica fume particles per cement grain. The materials differ in their chemical reactivity. GGBS is a latent hydraulic binder, i.e. when mixed with water, it slowly sets and hardens. With GGBS alone, the rate of hardening is relatively slow and for normal concrete applications, GGBS needs to be activated by combining it with CEM I. Fly ash and silica fume are pozzolanas, i.e. they do not react with water alone but do react chemically with the calcium hydroxide produced by the hydration of CEM I to form calcium silicate hydrates (C-S-H) which bind the concrete together. Limestone is chemically, relatively inert but limestone fines, because of their fine particle size, can contribute towards strength by a physical, void-filling mechanism. There is evidence that fine calcium carbonates act as nucleation sites, accelerating the hydration of CEM I, improving early strength development. The materials differ in their chemical reactivity. GGBS is a latent hydraulic binder, i.e. when mixed with water, it slowly sets and hardens. With GGBS alone, the rate of hardening is relatively slow and for normal concrete applications, GGBS needs to be activated by combining it with CEM I. Fly ash and silica fume are pozzolanas, i.e. they do not react with water alone but do react chemically with the calcium hydroxide produced by the hydration of CEM I to form calcium silicate hydrates (C-S-H) which bind the concrete together. Limestone is chemically, relatively inert but limestone fines, because of their fine particle size, can contribute towards strength by a physical, void-filling mechanism. There is evidence that fine calcium carbonates act as nucleation sites, accelerating the hydration of CEM I, improving early strength development.

2. RELATED WORK

Nowadays, Nano technology is widely used in entire line of work. Concrete is exhaustible material in construction industry and want to develop the properties of concrete. Nano particles are added to the concrete to enhance the mechanical properties of concrete than the conventional concrete. Nano silica is the first product that replaced the micro silica. Nano silica improves the bulk properties of concrete and reduces the setting time of concrete than the conventional concrete.

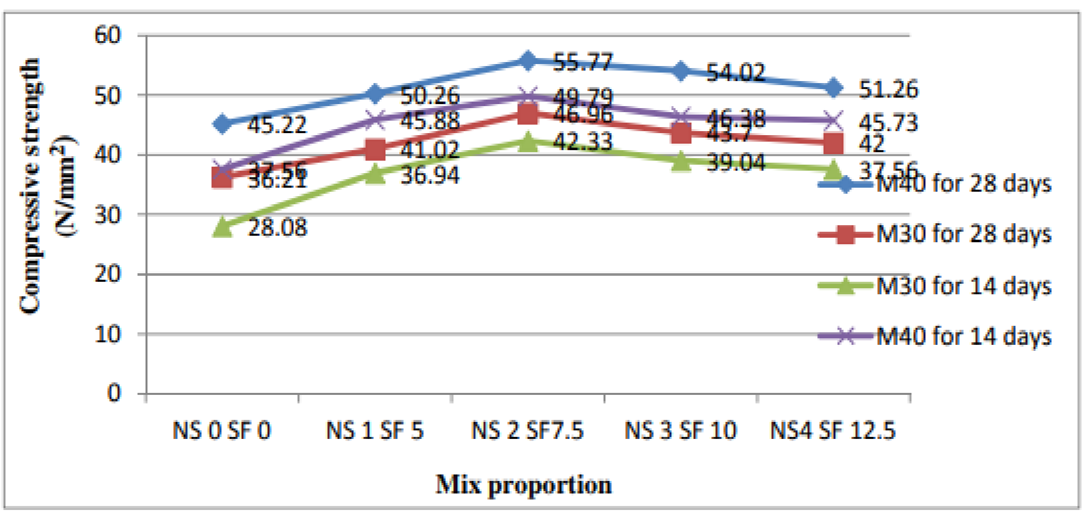

Fig.2.Mix proportion

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Nano silica has more pozzolanic nature. Nano silica is extremely fine particle than the silica fume and it reduces the pores of concrete and also to reduce the permeability of concrete therefore it leads to improvement in the durability of concrete. When Nano silica is added in to concrete, which protect the reinforcing steel from corrosion. Global consumption of silica fume exceeds 1 million tonnes per annum. Silica fume is generally dark grey to black or off-white in colour and can be supplied as a densified powder or slurry depending on the application and the available handling facilities. For use in the UK, it is normally supplied as slurry, consisting of 50% powder and 50% water. In powder form silica fume is available in bulk, large bags and small bags. If required in bags, these can be tailored to suit the customers' needs for handling and batch weight per cubic metre of concrete. Other applications include fibre cement, gypsum cement, refractory mortars and castables and in the use of specialised ultra high strength precast sections where strengths of over 200 N/mm 2 can be designed.

3. IMPLEMENTATION

To maximise the full strength producing potential of silica fume in concrete it is recommended that it should always be used with a dispersant admixture such as high range water reducing agent (HRWRA). The dosage will depend on the amount of silica fume and the type of admixture used; see Jahren. The dosage of air-entraining admixture to produce a required volume of air in concrete usually increases with the amount of silica fume. The amount of silica fume and the type of mixing were found to have no significant influence on the development and stability of the air-void system. The water demand of concrete containing silica fume increases with increasing amounts of silica fume, see Carette and Malhotra and Scali et al . This increase is caused primarily by the high surface area of the silica fume. To achieve a maximum improvement in strength and durability, silica-fume concrete should contain a high- range water reducing admixture. Fresh concrete containing silica fume is more cohesive and less prone to segregation than concrete without silica fume. Experience has shown that it is necessary to increase the initial slump of concrete with silica fume by approximately 50mm above that required for conventional CEM I concrete to maintain the same apparent workability , see Jahren. Silica fume addition has been used to assist in pumping long distances, especially vertically. Concrete was pumped in a single operation to a height of 601 metres at the Burj Khalifa project in Dubai; so far the world's tallest building. After concrete has been placed there is a tendency for the solids (aggregates and cementitious) to settle and displace the water, which is pushed upwards. If the process is excessive, the water appears as a layer on the surface. The tendency of a concrete to bleed is affected by the constituents and their proportions, particularly the grading of the fine aggregate, the water content and any admixtures. Excessive bleeding can produce a layer of weak laitance on the top of the concrete and may result in plastic settlement cracks but bleeding can also be beneficial in avoiding plastic shrinkage cracks.

4. ANALYSIS

A reduction in the early age temperature rise can reduce the risk of early-age thermal cracking and detailed guidance is provided in CIRIA Report C660, Early-age thermal crack control in concrete . However a slower release of heat can reduce the initial rate of strength gain. This may necessitate longer periods before striking formwork and/or removal of props especially when casting thin, exposed sections in winter conditions in cooler climates.

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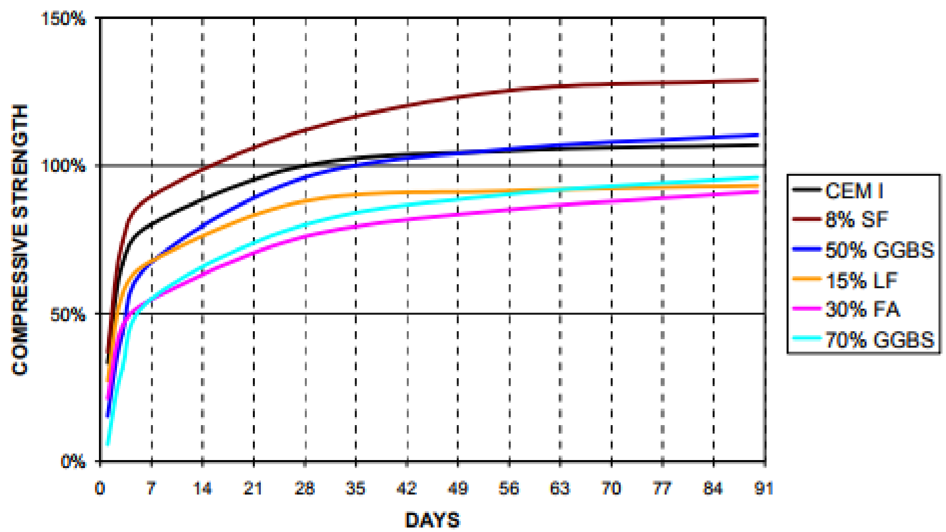

Fig.3.Analysis

CIRIA Report C660 suggests that silica fume should be considered equivalent to CEM I in regard to heat generation. It also points out that silica fume, when used with a high range water reducing admixture, can achieve equivalent strength with a reduced binder content (subject to any minimum limit on binder content) and thereby lower heat output. Papworth et al calculated theoretically the temperature rise for silica fume concrete and concluded that by reducing the total binder content of the mix, it can reduce the temperature rise. They then compare predicted temperature rises with those measured in practical situations. A solution to providing high early strength couple with low heat was demonstrated in massive silica fume concrete pours at the Hanford Nuclear Encapsulation facility in the USA.

Silica fume has frequently been combined with Portland cement and either fly ash or GGBS to produce ternary blends, such as that used in the Hong Kong, Tsing Ma Bridge as shown in. In ternary blends, the amount of silica fume is typically somewhat less than would be used without the fly ash or GGBS. Bleszynski, et al reported that ternary blend concrete exhibits greater overall durability performance than CEM I concrete and binary blends, with ternary blends giving better placing and finishing characteristics than binary silica fume blends. The paper also concludes that the incorporation of GGBS into silica fume concrete reduces the water demand.

CONCLUSION

From this study the replacement of cement with nano silica and silica fume increases the mechanical properties of concrete more than conventional concrete. The electrical resistivity of nano silica and silica fume concrete column is more, therefore the corrosion occur in the nano silica and silica fume concrete column is less. The electrical resistivity of conventional concrete column is less, therefore the corrosion occur in the conventional concrete column is more. While adding nano silica and silica fume in the concrete, increases the corrosion resistance in concrete than the conventional concrete and also to increases the durability of concrete than the conventional concrete.

REFERENCES

[1] Q.Ye, 2001. Comparison of pozzolanic activity between nano-sio2 and silica fume . Cement and concrete research , 128-136.

[2] Nili Eshani 2008 "Influence of nano silica and micro silica on concrete performance" second international conference of sustainable construction and technologies june 30 -2010

[3] R.Siddique and M. Iqbal Khan, Supplementary Cementing Material s, Engineering Materials, Springer-Verlag Berlin Heidelberg, 2011, pp.67-68.

[4] Verma Ajay, Chandak Rajeec and Yadav R.K. "Effect of micro silica on the strength of concrete with ordinary Portland cement" Reaserch journal of Engineering Science ISSN 2278-9472 vol.1(3), 1-4, sept (2012).

[5] Mohammad Reza Zamani Abyaneh, Alireza Mehran, Seyed Mohammad Mahdi Hoseini, (2013) "Effects of Nano-Silica on Permeability of Concrete and Steel Bars Reinforcement Corrosion" Australian Journal of Basic and Applied Sciences, 7(2): 464-467, 2013 ISSN 1991-8178.

[6] S.F Ahmed M.Maalej "Assesment of corrosion induced damage and its effect on the structural behaviour of rc beams containing supplementary cementitious Materials" progress in structural engineering and materials.8 (2)(2006),pp 69-77.