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THE STUDY OF EFFECT OF SILICA FUME ON STEEL SLAG CONCRETE

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ABSTRACT

Concrete is the most versatile construction material as it can be designed to withstand the harshest environments while maintaining the most inspiring looks. Engineers are constantly pushing the boundaries to improve its performance with the help of innovative chemical blends and complementary cementitious materials. Nowadays, most concrete mixes contain supplementary cementitious materials that form part of the cementitious component. These materials are mostly byproducts of other processes. The main advantage of SCMs is their ability to replace a certain amount of cement and still exhibit cementitious properties, thereby reducing the cost of using portland cement. The rapid increase in industrialization has resulted in the generation of tons and tons of byproducts or waste materials that can be used as SCM such as fly ash, silica fume, ground granular blast furnace slag, steel slag, etc. The use of these by-products not only helps utilize these waste materials, but also enhances the properties of the concrete in its fresh and hydrated state. Slag cement and fly ash are the two most common SCMs used in concrete. Most concrete produced today contains one or both of these ingredients. For this reason their properties are often compared to each other by mix designers wishing to optimize concrete mixes.

Key Words:- Cementitious Component, sand, versatile construction, chemical admixtures, fly ash, silica fume, ground granulated blast furnace slag etc.

INTRODUCTION:

Concrete is a mixture of cement, sand, coarse aggregate and water. Its success lies in its versatility as it can be designed to withstand the harshest environments while maintaining the most inspiring looks. Engineers and scientists are trying to extend its limits further with the help of innovative chemical blends and various supplementary cementitious materials SCM.

SUPPLEMENTARY CEMENTITIOUS MATERIAL:

Recently, stricter environmental-pollution controls and regulations have led to an increase in industrial wastes and sub-classified by-products that can be used as SCM, such as fly ash, silica fume, ground granulated blast furnace slag, etc. . The use of SCM in concrete manufacturing not only prevents these materials from delaminating but also enhances the properties of concrete in its fresh and hydrated state.

STEEL SLAG:

Steel slag, a byproduct of steelmaking, is produced during the separation of molten steel from impurities in steelmaking furnaces. It can be used as aggregate in concrete. Steel slag aggregates generally exhibit a tendency to expand due to the presence of free lime and magnesium oxides that have not reacted with the silicate structure and which can become hydrated and expanded in humid environments. This potentially expansive nature (10 percent or more change in volume due to hydration of calcium and magnesium oxides) can cause difficulties with products containing steel slag, and is one reason why steel slag aggregates are not used in concrete construction. is done. Steel slag is currently used as aggregate in hot mix asphalt surface applications, but work remains to determine the feasibility of using this industrial by-product more intelligently as a replacement for both fine and coarse aggregates in conventional concrete mixes. Requires some additional work.

LITERATURE SURVEY:

Much work has been done to explore the benefits of using pozzolanic materials in creating and enhancing the properties of concrete. MDA Thomas, M.H.Shehata1 et al. Ternary cementitious blends of portland cement, silica fume, and fly ash have been studied that provide significant advantages over binary blends and even greater enhancements over plain portland cement. Sandor Popovics2 has studied the portland cement-fly ash-silica fume system in concrete and concluded several beneficial effects of adding silica fume to fly ash cement mortar in terms of strength, workability, and ultra sonic velocity test results. Jan Bijn3 has studied the benefits of slag and fly ash added to concrete made from OPC in the context of alkali-silica reaction, sulphate attack. l. Lam, Y.L. Wong, and C.S. Poon4 in his study titled Effect of fly ash and silica fume on compression and fracture behavior of concrete had concluded the increase in strength properties of concrete by adding different percentages of fly ash and silica fume. Tahir Gonen and Salih Yazikioglu5 studied the effect of binary and ternary mixing of mineral admixtures on short- and long-term performance of concrete and concluded several improved concrete properties in fresh and hardened state. Mateusz Radliński, Jan Olek and Tommy Nantung 6 in their experimental work entitled Effect of Mixture Composition and Initial Curing Conditions on Scaling Resistance of Ternary Concrete explored the effect of different proportions of ingredients of ternary mixture to binder on the scaling resistance of reduced concrete. have put. temperature.

MATERIALS AND METHODOLOGY

MATERIALS

Silica Fume

Silica fume is a by-product in the reduction of high-purity quartz with coke in electric arc furnaces in the production of silicon and ferrosilicon alloys. Silica fume contains fine particles with a surface area of 215,280 ft^2/lb (20,000 m^2/kg) when measured by nitrogen absorption techniques, with particles approximately one-hundredth the size of average cement due to its extreme fineness and high silica content. The material, silica fume is a very effective pozzolanic material particle.

SLAG CEMENT

Slag cement has been used in concrete projects in the United States for more than a century. The first use of slag cement in Europe and elsewhere showed that long-term concrete performance was enhanced in several ways. Based on these early experiences, modern designers have found that these improved durability characteristics help reduce life-cycle costs, reduce maintenance costs, and make concrete more durable. For more information on how slag cement is manufactured and how it increases the durability and stability of concrete.

SAND

Sand is a naturally occurring granular substance composed of finely divided rock and mineral particles. The most common component of sand in inland continental settings and non-tropical coastal settings is silica (silicon dioxide, or SiO_2), usually in the form of quartz, which, due to its chemical inertness and considerable hardness, is the most common mineral in weathering. resistant to. It is used as fine aggregate in concrete.

METHODOLOGY TEST PROCEDURE:

The Experimental programme was carried out in two stages

Stage 1: Experimental work were conducted on mortar mixes by using different binder mix modified with different percentages of silica fume.

Stage2: Experimental works were conducted on steel slag concrete mixes by using different binder mix modified with different percentages of silica fume.

A: DETERMINATION OF STRENGTH OF CONCRETE OF 1:1.5:3 MIX PROPORTION BY USING FLY ASH CEMENT + SILICA FUME AS BINDER MIX ,SAND AS FINE AGGREGATE AND STEEL SLAG AS COARSE AGGREGATE.

In this stage concrete of mix ratio 1:1.5:3 is prepared using fly ash cement + silica fume with different proportions of silica fume as binder mixture, sand as fine aggregate and steel slag as coarse aggregate. Will be done. Different proportions of silica fume in the concrete mix will vary from 0%, 10% and 20%. The concrete mix shall be tested for the following strengths.Compressive strength after 7 days,28 days, 56 days

- Flexural strength after 28 days, 56 days
- Porosity test after 28 days and 56 days
- Capillary absorption test after 28 days and 56 days.
- Wet - dry test after 26 days and 56 days

- Compressive strength by Rebound hammer method.

B: DETERMINATION OF STRENGTH OF CONCRETE OF 1:1.5:3 MIX PROPORTION BY USING SLAG CEMENT+SILICA FUME AS BINDER,SAND AS FINE AGGREGATE AND STEEL SLAG AS COARSE AGGREGATE

In this step concrete of mix ratio 1:1.5:3 was prepared using slag cement + silica fume as binder mixture with different proportions of silica fume, sand as fine aggregate and steel slag as coarse aggregate. Will go. The proportion of silica fume in the concrete mix will vary from 0%, 10% and 20% of the mix. The concrete mix shall be tested for the following strengths.Compressive strength after 7 days,28 days, 56 days

- Flexural strength after 28 days, 56 days
- Compressive strength by Rebound hammer method.
- Porosity test after 28 days and 56 days
- Capillary absorption test after 28 days and 56 days
- Wet - dry test after 28 days and 56 days.

C: DETERMINATION OF STRENGTH OF CONCRETE OF 1:1.5:3 MIX PROPORTION BY USING FLY ASH CEMENT+SLAG CEMENT + SILICA FUME AS BINDER MIX ,SAND AS FINE AGGREGATE AND STEEL SLAG AS COARSE AGGREGATE.

In this stage the mix ratio is 1:1.5:3 for concrete fly ash cement + slag cement + silica fume with different proportions of silica fume as binder mixture, sand as fine aggregate and steel slag as coarse aggregate. Will be prepared using. Different proportions of silica fume in the concrete mix will vary from 0%, 10% and 20%. The concrete mix shall be tested for the following strengths.Compressive strength after 7 days,28 days, 56 days

- Flexural strength after 28 days, 56 days
- Porosity test after 28 days and 56 days
- Capillary absorption test after 28 days and 56 days
- Wet - dry test after 26 days and 56 days
- Compressive strength by Rebound hammer method.

LABORATORY TEST CONDUCTED:

Compressive Strength Test

Six standard cubes were cast to determine the compressive strength at 7 days, 28 days and 56 days after curing for each set. Also number nine. To know the compressive strength of concrete, a cube was cast. The size of the cube is as per IS 10086 – 1982.

Capillary Absorption Test

Two cube samples for both (mortar and concrete cube) were poured to determine the capillary absorption coefficient after 7 days, 28 days and 56 days of curing. This test is conducted to check the capillary absorption of different binder mix mortar matrices which indirectly measures the durability of different mortar matrices.

Procedure:

1) The specimen was dried in oven at about 105^0C until constant mass was obtained.
2) Specimen was cool down to room temperature for 6hr.
3) The sides of the specimen was coated with paraffin to achieve unidirectional flow.
4) The specimen was exposed to water on one face by placing it on slightly raised seat (about 5 mm) on a pan filled with water.
5) The water on the pan was maintained about 5mm above the base of the specimen during the experiment as shown in the figure below.
6) The weight of the specimen was measured at 15 min and 30 min. intervals.
7) The capillary absorption coefficient (k) was calculated by using formula: k=Q/A* sqrt (t) where Q is amount of water absorbed A is cross sectional area in contact with water t is time.

RESULTS AND DISCUSSIONS

EXPERIMENTAL STUDY ON MORTAR.

Here we prepared the mortar from different types of cement in the ratio of 1:3 + sand as silica fume replacement and fine aggregate as binder mixture. Then its physical properties such as capillary absorption stability, compressive strength and porosity were predicted.

EXPERIMENTAL STUDY ON CONCRETE CUBE.

Here we prepared concrete with different types of cement in the ratio of 1:1.5:3 + silica fume replacement as binder mixture, sand as fine aggregate and steel slag as coarse aggregate. Then its physical properties such as capillary absorption, water/cement ratio, compressive strength, porosity, flexural strength and wet-dry test were predicted.

CONCLUSION:

From the present study the following conclusions are drawn:

1. The addition of silica fume improves the strength of various types of binder mixtures by making them more dense.
2. Addition of silica fume improves the early age strength of fly ash cement while it increases the late age strength of slag cement.
3. Uniform mixing of slag and fly ash cement improves overall strength development at any level.
4. Addition of silica fume to any binder mixture reduces capillary absorption and porosity as the fine particles of silica fume react with the lime present in the cement and form hydrates and crystalline in the structure.
5. Capillary absorption and porosity decreases with increase in dosage up to 20% replacement of silica fume for mortar.
6. Addition of silica fume to concrete containing steel slag in the form of coarse aggregate reduces the strength of the concrete at any age.
7. This vibration is caused by the formation of voids in the table during mixing and compacting the concrete mix because silica fume makes the mix stickier or more cohesive which does not allow the trapped air to escape. Using a needle vibrator can help reduce this problem.

REFERENCES

1. Thanongsak, N., Watcharapong, W., and Chaipanich. A., (2009), “Utilization of fly ash with silica fume and properties of Portland cement–fly ash–silica fume concrete”. Fuel, Volume 89, Issue 3, March 2010, Pages 768-774.
2. Patel, A, Singh, S.P, Murmoo, M. (2009), “Evaluation of strength characteristics of steel slag hydrated matrix” Proceedings of Civil Engineering Conference-Innovation without limits (CEC-09), 18th - 19th September‟ 2009.
3. Li Yun-feng, Yao Yan, Wang Ling, “Recycling of industrial waste and performance of steel slag green concrete”, J. Cent. South Univ. Technol.(2009) 16: 8−0773, DOI: 10.1007/s11771-009-0128-x.
4. Velosa, A.L, and Cachim, P.B.,” Hydraulic lime based concrete: Strength development using a pozzolanic addition and different curing conditions” ,Construction and Building Materials ,Vol.23,Issue5,May2009,pp.2107-2111.
5. Barbhuiya S.A., Gbagbo, J.K., Russeli, M.I., Basheer, P.A.M. “Properties of fly ash concrete modified with hydrated lime and silica fume”, aCentre for Built Environment Research, School of Planning, Architecture and Civil Engineering, Queen‟s University Belfast, Northern Ireland BT7 1NN, United Kingdom Received 28 January 2009; revised 1 June 2009; accepted 3 June 2009. Available online 15 July 2009.
6. Gonen,T. and Yazicioglu,S. “ The influence of mineral admixtures on the short and long term performances of concrete” department of construction education, Firat University, Elazig 23119, Turkey.2009.
7. Mateusz R.J. O. and Tommy N. “ Effect of composition and Initial Curing Conditions of Scaling Resistance of Ternary(OPC/FA/SF) concrete”, Journal of Materials in Civil Engineering © ASCE/October 2008, PP 668-677.