A Review: Green Concrete by Replacing Cement by Fly Ash and Silica Fume

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Abstract:
This paper presents a review on the use of Silica Fume and Fly ash as a mineral admixture in the concrete. Distinctive outcome from several researches have been demonstrated here, particularly accentuating on the fresh and hardened properties of concrete when blended with Silica Fume and Fly ash. The results showed a substantial enrichment in the mechanical properties of concrete when cement replaced with SF and FA. The review also presented a brief idea of percentage replacement of SF and FA for high-strength concrete. A decreasing trend in workability and increasing trend on water absorption has been identified when there is an increase in percentage replacement of SF and FA. It can be concluded that the optimal percentage of replacement with SF and FA gives better compressive strength than ordinary Portland cement. The study also demonstrates the effect of silica fume and fly ash on durability parameters like water absorption, permeability, sulphate attack.

Keywords: Green Concrete, Fly Ash, Silica Fume, Workability, Compressive Strength, Split Tensile Strength, Flexural Strength, Durability Test.

I. INTRODUCTION

Green concrete is a concept of thinking about environment while considering the concrete considering every facet from raw materials, mixture design to structural design, construction, and service life. Green concrete is very often also cheap to produce, because the waste products from industries are used as a partial auxiliary for cement, extra cost incurred for the disposal of waste are evaded, energy consumption in production is minimal, and durability is superior. In India, there is an excessive production of fly ash as it is used in the production of electricity in nuclear power plants, For example NTPC. Silica fume is also an industrial waste containing heavy metals in it constitutes. By shrewd use of available materials for concrete making and their right proportion, concrete mixes are produced to have the better compressive strength, split tensile strength, flexural strength and Durability properties in the fresh and hardened state. Waste can be used in construction industry to be used as admixtures so that natural sources will be preserved for the future generation and the environment will not pollute from waste deposits. To avoid the pollution and reuse the waste material, the present study is carried out. As the properties are as good as the cement, the Class F fly ash (coal fly ash) and silica fume is used as fine partial replacement in the cement concrete because they possess pozzolanic properties.

II. LITREATURE REVIEW

The background needs for the development of the alternative materials to increase the mechanical strength of the concrete by using fly ash and silica fume in concrete the available published literature on replacement of cement by silica fume and fly ash is briefly reviewed:

Poon et al. (1999) studied the effect of class F fly ash on the flexible pavement concrete and concluded that concrete prepared in large volume with Class F fly ash was economical as compared to conventional flexible pavement. In concrete 50% of hydration process was completed at the age of 7 days and after that up to 90 days, the increase in hydration process was not substantial.

Sasikumar (2016) studied on Properties of Silica Fumes as a Partial Replacement of Cement. Main parameter investigated was compressive strength. In this research M30 grade concrete was used and partial replacement of cement by silica fume was done in 25%, 30%, 40% and 50%. The consistency was increased about 40% when silica fume added to 25% in concrete. The optimum compressive strength had been obtained at 25% silica fume replacement level. Also the optimal split tensile strength reached at 25% silica fume replacement for cement.

Amarkhail (2015) studied the replacement of cement by silica fume on mechanical properties of High-Strength Concrete. In this research, the cement was replaced by silica fume by 10%, it showed no decrease in the workability of the matrix also it achieved the maximum compressive strength when cement was replaced by silica fume by 15%. With 15% silica fume maximum flexural strength was achieved. He concluded that 10% and 15% silica fume as replacement of cement were found to be the optimum amount for the enhancement of compressive strength and flexural strength respectively.

Chindaprasirt, et al. (2005) this research was based on class F Fly Ash of having different kind of fineness, the fly ash was taken from Mae Moh Power plant in north of Thailand and in research they replaced the cement by fly ash by 20% and 40% by weight of cement. They observed that the compressive strength of classified fly ash was higher than the original fly ash cement past and the replacement of cement by ordinary fly ash increased the porosity and decreased the pore size of the matrix. They concluded, to achieve maximum strength it is very much necessary to reduce pores in cement paste. The blain fineness test of ordinary fly ash and classified...
fly ash was taken as 300 and 510 m²/kg, and the specific gravities of these samples were 2.33, 2.54 respectively.

Berndt (2009) In this study, the concrete was prepared by using waste materials from industries, Class f fly ash, blast furnace slag and recycled aggregate from demolitions. He concluded, there was an increase in compressive strength and durability of the concrete when blast furnace slag was used in 50% in the concrete.

Jain & Pawade (2015) In this study silica fume was used. They prepared the high strength concrete by replacing cement by silica fume and adopted different methods of curing and compared it with the standard values. In research they replaced the cement by silica fume by 5%, 10%, 15%, 20%, and 25%. They created the matrix with and without the superplasticizers. To test the durability of silica fume mortar was tested in sulphate compounds, ammonium nitrate, calcium chlorides.

Hanumesh, Varun & Harish (2015) in this study, M20 grade of concrete was prepared by partial replacement of cement by silica fume in 5%, 10%, 15% and 20%. They tested it for mechanical properties of the hardened concrete and concluded that the compressive strength of concrete was increased by the replacement of cement by silica fume by 10% and furthermore, increase in the percentage of silica fume decreased in compressive strength and the same results were shown by tensile strength up to 10% replacement of cement, it showed maximum tensile strength and thereafter increase causes decrease in the split tensile strength. They concluded 10% is the optimal percentage replacement of cement.

Skripkiunas et al. (2002) In this study, different percentage of super plasticizers were used and they concluded that optimal percentage of naphthalene formaldehyde super-plasticizer in matrix was 1-1.5%. Silica fumes increased the rate of hydration and decreased calcium hydroxide quantity in the concrete.

Turk et al. (2012) In this research different proportion of silica fume were used and found that the water absorption values of cubes decreased with the addition of silica fume in the matrix by 5% to 20%. In contrast, the water absorption value of cubes with fly ash increased with the addition of fly ash in the matrix up to 25% to 40%.

Muhit et al. (2013) In this study high performance concrete was prepared and found that replacement of cement by fly ash or silica fume the water permeability will be increased and the strength of the specimens also increased. When the cement was replaced by fly ash by 20% the water absorption was 15mm.

III. CONCLUSION
1. By using Class F fly ash in concrete the 50% of the hydration process completes at 7 days.
2. By replacing cement by silica fume at 25%, the consistency, compressive strength and split tensile strength increases.
3. In High strength concrete, silica fume can be replaced by 10% to 15% to achieve maximum compressive strength and flexural strength.
4. With the use of silica fume the water absorption of the cubes decreased.
5. With the use of fly ash the water absorption of the cubes were increased.

6. The mechanical strength of the specimens were increased and also durability of the concrete with replacement of fly ash and silica fume.
7. Both silica fume and fly ash can be used in the concrete as a partial replacement.

IV. REFERENCES