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A Literature Review on Study of Silica Fume as Partial Replacement of Cement in Concrete

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Abstract **- India is a developing country. Many construction projects are going on and many projects are proposed in near future. If we evaluate some of the projects in past, we find that they cannot sustained due to lack of enough considerations towards the sustainability of these projects during the planning stage. This is about the sustainability of individual projects. In broad context the construction sector consumes lot of natural resources in the form of material and fuel. This has adverse effect on the environment and ecology. The emission of CO2 in production processes contributes to global warming. Use of alternative materials, production processes, reuse and recycling of waste materials will help in preserving the natural resources. In recent study, there has been a considerableattempts for improving the properties of a concrete with respect to a strength and durability, especially in aggressive environments. High performance concrete is appears to be a better choice for the strong and durable structure. A large amount of the by-product or a wastes such as fly-ash, copper slag& silica fume etc. are generated by industries, which causes environmental as well as health problems due to dumping and disposal.Proper introduction of the silica fume in the concrete improves both the mechanical and durability characteristics of the concrete.**

Keywords- **CO2 Silica fume, Cement, pozzolanic.**

I. INTRODUCTION

Leaving the waste materials to a environment directly can cause the environmental problems. Hence the reuse of a waste material from the Industries has been a emphasized. Waste can be a used to the produce new products or can be a used as a admixtures so that natural resources are a used as a more efficiently and the environment is protected from waste. These industrial wastes are dumped in a nearby land and the natural fertility of the soil is a spoiled.

Silica fume is also known as micro silica or condensed silica fume, is used as an artificial pozzolanic admixture. It is the material is a resulting from the reduction of quartz with the coal in an the electric arc furnace in the manufacture of a silicon or a ferrosilicon alloy. Chemical composition of a silica fume are a Contains more than the 90 percent silicon dioxide& Other constituents are carbon, Sulphur and oxides of aluminium, iron, calcium, magnesium, sodium and potassium. The physical composition of the silica fume Diameter is about a 0.1 micron to 0.2 microns, surface area about 30,000 m^2/kg and Density varies from 150 to 700 kg/m^3.

II. REVIEWS OF ARTICLES

Amudhavalli & Mathew (2012) studied the Effect of silicafume on the strength and durability characteristics of concrete. The main parameter investigated in this study is M35 grade concrete with partial replacement of cement by silica fume by 0, 5, 10,15and by 20%. a detailed experimental study in Compressive strength, split tensile strength, flexural strength at age of 7 and28 day was carried out. Results Shows that Silica fume in concrete has improved the performance of concrete in strength as well as in durability aspect. [1]

Perumal& Sundararajan (2004) observe theEffect of partial replacement of cement with silica fume on the strength and durability properties of high-grade concrete. Strength and durability properties for M60, M70 and M11 0 grades of HPC trial mixes and to arrive at the maximum levels of replacement of cement with Silica fume, investigations were taken. The strength and durability characteristics of these mixes are compared with the mixes without SF. Compressive strengths of 60 N/mm2, 70 N/mm2 and 110 N/mm2 at 28days were obtained by using 10 percent replacement of cement with SF. The results also show that the SF concretes possess superior durability properties. [2]

Kumar & Dhaka (2016) write a Review paper onpartial replacement of cement with silica fume and its effects on

concrete properties. The main parameter investigated in this study M-35 concrete mix with partial replacement by silica fume with varying 0, 5, 9, 12 and 15% by weight of cement the paper presents a detailed experimental study on compressive strength, flexural strength and split tensile strength for 7 days and 28 days respectively. The results of experimental investigation indicate that the use of silica fume in concrete has increased the strength and durability at all ages when compared to normal concrete.[3]

Ghutke& Bhandari (2014) examine the Influenceof silica fume on concrete. Results showed that the silica fume is a good replacement of cement. The rate of strength gain in silica fume concrete is high. Workability of concrete decreases as increase with % of silica fume. The optimum value of compressive strength can be achieved in 10% replacement of silica fume. As strength of 15% replacement of cement by silica fume is more than normal concrete. The optimum silica fume replacement percentage varies from 10 % to 15 % replacement level. [4]

Hanumesh, Varun & Harish (2015) observes theMechanical Properties of Concrete Incorporating Silica Fume as Partial Replacement of Cement. The main aim of this work is to study the mechanical properties of M20 grade control concrete and silica fume concrete with different percentages (5, 10, 15 and 20%) of silica fume as a partial replacement of cement. The result showed that the compressive strength of concrete is increased by the use of silica fume up to 10% replacement of cement. From 10% there is a decrease in compressive strength and the split tensile strength of concrete is increased by the use of silica fume up to 10% replacement of cement. From 10% there is a decrease in split tensile strength. The optimum percentage of replacement of cement by silica fume is 10% for M20 grade of concrete. [5]

Shanmugapriya& Uma (2013) carried anExperimental Investigation on Silica Fume as a partial Replacement of Cement in High Performance Concrete. The concrete used in this investigation was proportioned to target a mean strength of 60 MPa and designed as per A The water cement ratio (W/C) adopted was 0.32 and the Super Plasticizer used was CONPLAST SP 430.Specimens such as cubes, beams and cylinders were cast for various mix proportions and tested at the age of 7,14and 28 days CI 211.4R-08.The investigation revealed that the partial replacement of cement by silica fume will develop sufficient compressive strength, flexure strength and split tensile strength for construction purposes. The optimum dosage of silica fume found to be 7.5% (by weight), when used as partial replacement of ordinary Portland cement. [6]

Alok (2016) write A Research Paper on PartialReplacement of Cement in M-30 Concrete from Silica Fume and Fly Ash. Replacement levels of OPC by Silica Fume were 0%, 2.5%, 5%and 7.5% where replacement levels of Ordinary Portland cement by Fly Ash were 0%, 5%, 10% and 15% by weight. 1% super-plasticizer was used in all the test specimens for better workability at lower water cement ratio and to identify the sharp effects of Silica Fume and Fly Ash on the properties of concrete. Water-cement ratio was kept 0.43 in all cases.43.1 N/mm2 was the maximum compressive strength which was obtained at replacement level of 7.5% by weight of SF and 20% by weight of FA with cement.6.47 N/mm2 was the maximum flexural strength which was obtained at replacement level of 7.5% by weight of SF and 20% by weight of FA with cement.2.573 N/mm2 was the maximum split tensile strength which was obtained at replacement level of 7.5% by weight of SF and 20% by weight of FA with cement. [7]

Jain &. Pawade (2015) studied the Characteristicsof Silica Fume Concrete. The physical properties of high strength silica fume concretes and their sensitivity to curing procedures were evaluated and compared with reference Portland cement concretes, having either the same concrete content as the silica fume concrete or the same water to cementitious materials ratio. The experimental program comprised six levels of silica-fume contents (as partial replacement of cement by weight) at 0% (control mix), 5%, 10%, 15%, 20%, and 25%, with and without superplasticizer. It also included two mixes with15% silica fume added to cement in normal concrete. Durability of silica-fume mortar was tested in chemical environments of sulphate compounds, ammonium nitrate, calcium chloride, and various kinds of acids. [8]

Roy &Sil (2012) Studied the Effect of PartialReplacement of Cement by Silica Fume on Hardened Concrete. From the study it has been observed that maximum compressive strength (both cube and cylinder) is noted for 10% replacement of cement with silica fume and the values are higher (by 19.6% and 16.82% respectively) than those of the normal concrete (for cube and cylinder) whereas split tensile strength and flexural strength of the SF concrete (3.61N/mm2 and 4.93N/mm2 respectively) are increased by about 38.58% and 21.13% respectively over those (2.6 N/mm2 and 4.07 N/mm2 respectively) of the normal concrete when 10% of cement is replaced by SF.[9]

Amarkhail (2015) observed Effects of SilicaFume on Properties of High-Strength Concrete. He found that up to 10% cement may be replaced by silica fume without harming the concrete workability. Concrete containing 10% silica fume replacement achieved the highest compressive strength followed by 15% silica fume replacement with a small difference. Concrete with 15% silica fume content achieved the highest flexural strength.10% and 15% silica fume content as replacement

of cement were found to be the optimum amount for significantly enhancement of compressive strength and flexural strength respectively. [10]

Sasikumar & Tamilvanan (2016) Performed anExperimental Investigation on Properties of Silica Fumes as a Partial Replacement of Cement. Main parameter investigated in this study is M30 grade concrete with partial replacement of cement by silica fume0%, 25%, 30%, 40% and 50%. The normal consistency increases about 40% when silica fume percentage increases from 0% to 25%. The optimum 7 and 28-day compressive strength has been obtained in the 25 % silica fume replacement level. Also, the split tensile strength is high when using 25% silica fume replacement for cement. [11]

Ajileye (2012) Cement replacement up to 10%with silica fume leads to increase in compressive strength for M30 grade of concrete. From 15% there is a decrease in compressive strength for 3, 7, 14- and 28-days curing period. Compressive strength of M30 grade of concrete was increased from 16.15% to 29.24% and decrease from 23.98% to 20.22%. [12]

Sharma &Seema (2012) examined the effect ofpartial replacement of cement with silica fume on compressive strength of concrete.M20 grade of concrete with W/C ratio as 0.5 and percentage replacement was 0%,10%,20%. The optimum compressive strength is obtained at 20% cement replacement by a Silica Fume at all age levels (i.e. 24 hours,7& 28 days). The 28 days' compressive strength at 20% replacement was found to be 32.29 MPa with a slump value of 21 mm. [13]

Pradhan and Dutta (2013) investigated theeffects of silica fume on conventional concrete the optimum compressive strength was obtained at 20% cement replacement by silica fume at 24 hours, 7days and 28 days. Higher compressive strength resembles that the concrete incorporated with silica fume was high strength concrete. [14]

Srivastava (2012) worked out the workability ofconcrete on optimum replacement of silica fume by cement. Workability reduces with the addition of silica fume. However, in some cases improved workability was observed. With the addition and variation of replacement levels of silica fume the compressive strength significantly increased by (6-57%). There was no change observed in the tensile and flexural strength of the concrete as compared to the conventional concrete. [15]

III. CONCLUSION

In this review paper earlier studies related to the partial replacement of a Cement with the Silica fume of a reveals that there is a significant of a change in the strength properties of a concrete such as a compressive strength, flexural strength&split tensile strength. These experiments were are carried out in a various grade of concrete to be find out the result. From the above literature reviews of a optimum percentage of a Silica Fume is varies from 5% to 15%. Up to these Percentage Replacement of a improvement in the strength of the concrete has been observed in the terms of a Compressive Strength, Flexural Strength and the Tensile Strength on a partial replacement of a Cement with Silica fume. Previous studied also be shows that Silica Fume concretes possess superior durability properties.

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