

“TO STUDY EFFECTS ON THE MECHANICAL PROPERTIES OF CONCRETE AFTER PARTIALLY REPLACING CEMENT BY SILICA FUME”

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Abstract – High strength Concrete is the homogenous mixer of Coarse aggregate, fine aggregate, cement water and chemical admixture. Artificial Concrete is widely used to built high-rise infrastructure. The main objective of this study is utilization of Silica fume as mineral admixture which is mixed in concrete as a partial replacement of Ordinary Portland Cement (OPC) of 43grade to investigate the influence of silica fume on M55 & M60 grade of concrete which are now being widely used for high rise building and pre stressed concrete. Total number of specimens of cubes, cylinders and beams were 50, 30 and 30 respectively, which were casted for testing to study influence of Silica fume on concrete. These Concrete specimens were deep cured in water under normal atmospheric temperature

and 56 days and splitting tensile strength of Cylinder at 7, 14, 28 and 56 days. A number of specimens for cubes, cylinders and beams were Casted respectively, which were casted for testing to study the influence of Silica fume on concrete. These Concrete specimens were deep cured in water under normal atmospheric temperature. The percentage of silica fume that have been replaced with cement was 0%, 10%, 15%, 20%, 25%^[1].

Key Words:-Concrete, Silica Fume, Workability, Compressive Strength, Flexural Strength, Splitting Tensile Strength.

Anil Kumar PM et.al (10 Oct. 2014) had studied on the experimental study for evaluation of durability characteristics of high performance concrete made from mixes using various percentages of fly ash and silica fume. Durability characteristics such as water absorption, permeability, sulphate attack resistance and abrasion resistance are low for the fly ash and silica fume replacing cement based concrete materials as compared with conventional high performance concrete.^[4]

1. INTRODUCTION

Concrete is a mixture of cement, natural sand, coarse aggregate and water. Its success lies in its proportions as can be designed to withstand harsh environment while taking on the most inspirational forms. Engineers and scientists are further trying to increase its limits with the help of innovative chemical admixtures as water reducer and mineral admixture i.e. various supplementary cementitious materials (SCMs) like fly ash, silica fume, GGBS, etc. Nowadays, most concrete mixture contains supplementary cementitious material which forms part of the cementitious component. These materials are by-products from other processes. The main benefits of SCMs are their ability to replace certain amount of cement and still able to display cementitious property, thus reducing the cost of using Portland cement. The fast growth in industrialization has resulted in tons and tons of by-product or waste materials, which can be used as SCMs such as Ground-granulated blast-furnace slag, fly ash, silica fume, steel slag etc.

AdarshUttarkar, et.al (2014) The percentage of Fly ash and Silica fumes in the mix will affects the Workability, Mechanical and Durability characteristics of Scathe P^H and Temperature Tests, helps us in better understanding of the Rheological characteristics of Scathe Compressive Strength, Split Tensile Strength & Flexural Strength is Maximum for mix proportion 25% Fly ash + 6% Silica fumes. The Acid Attack is at its peak for mix proportion 25% Fly ash + 6% Silica fumes.^[3]

A.A. Elsayed (December -2012) They were incorporated into concrete at the levels of 5%, 10%, and 15% for silica fume and 10%, 20%, 30% for fly ash, or super pozz by weight of cement. Water cement ratio of 0.40 was used and tests were carried out at 28 days. From the tests, the lowest measured water permeability was for the 10% super pozz and 10% silica fume or 20% fly ash mixes.

2. LITERATURE SURVEY

Rayees Ahmad Bhat et.al (Aug. 2018) had studied “Design Of High Performance Concrete By The Partial Replacement of Cement With Silica Fume using M60 Grade” This study investigates the performance of concrete under influence of silica fume in terms of slump, compressive strength at 7 days 14 days 28 and 56 days, flexural strength of beam at 7,14,28

3. EXPERIMENTAL STUDIES

3.1 Introduction

Concrete is a composite material which is prepared with mix of cement, fine aggregate, coarse aggregate and water. It can be widely used for any type of structure as per choice and demand and percentage constituents of concrete can be changed as per load and strength requirement of construction work. Concrete is economical as compared to

steel structure and it has also low cost of maintenance, easy mechanism for work.

3.2 Aggregates

As far as possible, flaky, scoriaceous and elongated pieces should be avoided. There are mainly two type of aggregate which are used for this study are given as follows

1 Coarse Aggregate

1 Fine Aggregate

3.3 Cement

A cement is a binder, a substance that sets and hardens and can bind other materials together Cements used in construction can be characterized as being either hydraulic or non-hydraulic, depending upon the ability of the cement to be used in the presence of water.

3.4 Silica Fume

Silica fume is a product resulting from reduction of high purity quartz with coal in an electric arc furnace in the manufacture of silicon or ferrosilicon alloy. It cools, condenses and is collected in cloth bags.

4. METHODOLOGY

Various test have been done to evaluate the mechanical properties of high strength concrete.

- Slum Test
- Density
- Split Tensile Test

Table -1: Slump on Replacement of OPC by Silica Fume for M55

Sl.No	%Mix(Cement + Silica Fume)	Slump (mm)
1.	OPC+ SF (100+0)	157
2.	OPC+ SF (97.5+2.5)	153
3.	OPC+ SF (95+5)	149
4.	OPC+ SF (92.5+7.5)	146
5.	OPC+ SF (90+10)	142

Table -2: Slump on Replacement of OPC by Silica Fume for M60

Sl.No	%Mix(Cement + Silica Fume)	Slump (mm)
1.	OPC+ SF (100+0)	169
2.	OPC+ SF (97.5+2.5)	164

Sl.No	%Mix(Cement + Silica Fume)	Slump (mm)
3.	OPC+ SF (95+5)	158
4.	OPC+ SF (92.5+7.5)	155
5.	OPC+ SF (90+10)	152

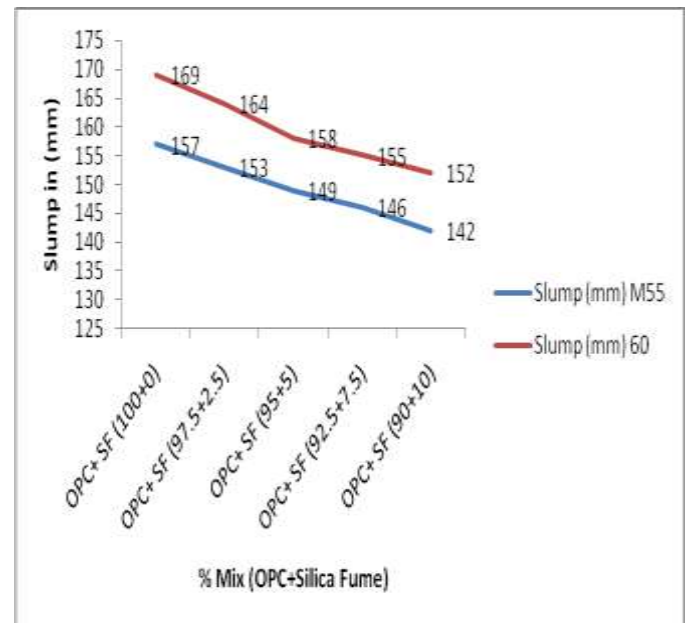


Fig.1 Comparative Analysis of Slump For Grade M55 & M60

Table -3: Density of hardened Concrete on Replacement of OPC by Silica Fume for M55

Sl.No	Percentage of Silica Fume	Density of Hardened Concrete (Kg/m ³)
1	0	2827.55
2	2.5	2878.66
3	5.0	2923.11
4	7.5	2954.66
5	10	2990.66

Table -4: Density of hardened Concrete on Replacement of OPC by Silica Fume for M55

Sl. No	Percentage of Silica Fume	Density of Hardened Concrete (Kg/m ³)
1	0	3127.11
2	2.5	3162.22
3	5.0	3204
4	7.5	3229.77
5	10	3289.77

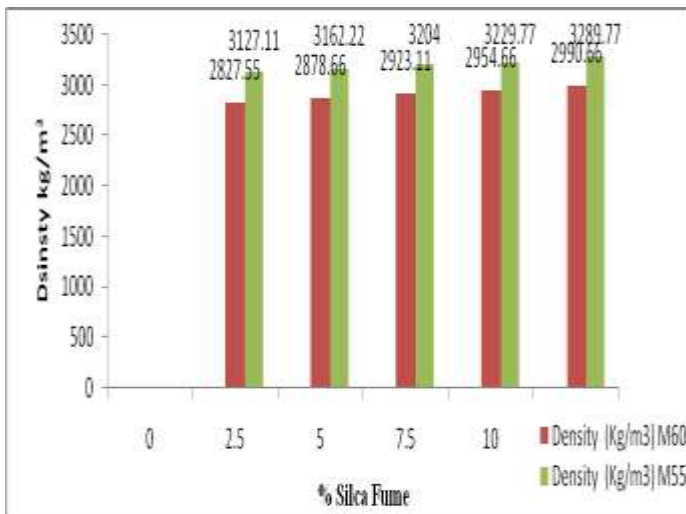


Fig.2 Comparative Analysis of Density For Garde M55 &M60

Table -5: Avg. Splitting Tensile Strength M55 (N/mm²)

Sl.No	%Mix (Cement + Silica Fume)	Avg. Splitting Tensile Strength M55 (N/mm ²)
1	OPC+ SF (100+0)	5.09
2	OPC+ SF (97.5+2.5)	5.18
3	OPC+ SF (95+5)	5.26
4	OPC+ SF (92.5+7.5)	5.32
5	OPC+ SF (90+10)	5.38

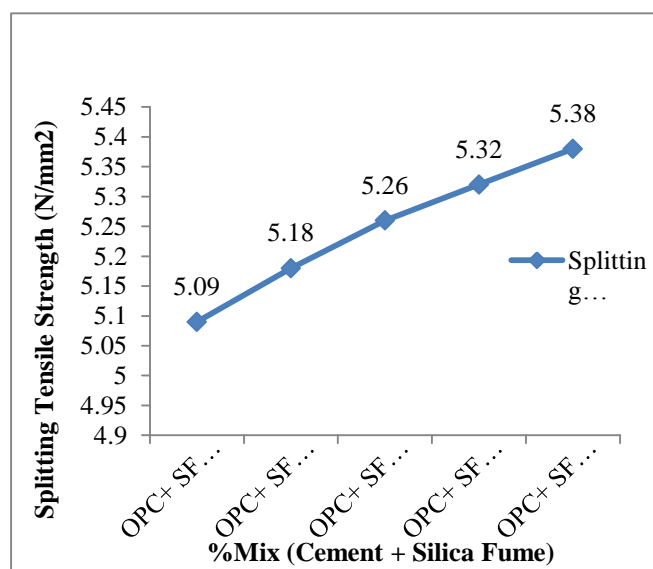


Fig.3 Effects of Silica fume on Concrete of M55 Grade on Replacement for 28 Days Splitting Tensile Strength of Cylinder

Table -6: Avg.28 days Splitting Tensile Strength M60 (N/mm²)

Sl. No	%Mix (Cement + Silica Fume)	Average For Splitting Tensile strength M60 (N/mm ²)
1	OPC+ SF (100+0)	5.63
2	OPC+ SF (97.5+2.5)	5.69
3	OPC+ SF (95+5)	5.77
4	OPC+ SF (92.5+7.5)	5.84
5	OPC+ SF (90+10)	5.92

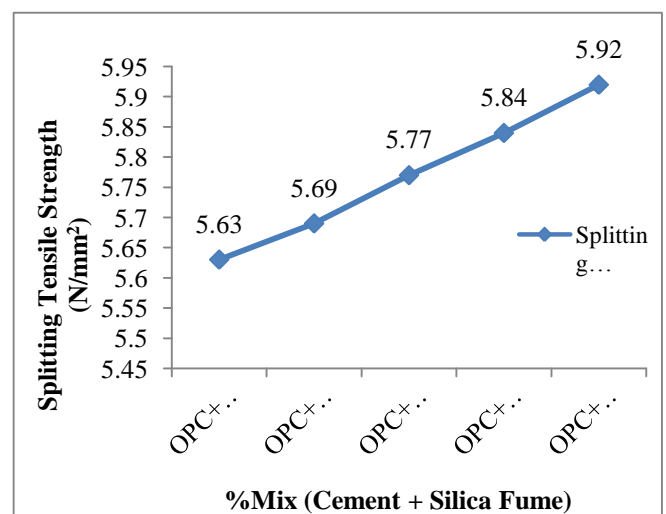


Fig.4 Effects of Silica fume on Concrete of M55 Grade on Replacement for 28 Days Splitting Tensile Strength of Cylinder

4. CONCLUSION

Higher slump was found as 157 mm in M55 (when 0% silica fume was replaced by weight of OPC). In case of M60 the slump value was 169 mm (when 0% silica fume was replaced by weight of OPC). Density of M55 & M60 grade concrete was higher compare to control mix M55 & M60 grade (when 10% silica fume was replaced by weight of OPC). Split tensile strength of concrete was increased in mixes M55 & M60, replacing OPC with 'silica fume (2.5% to 10% silica fume with increment of 2.5%), maximum split tensile strength observed in M55 grade was 5.38 N/mm²(when 10% silica fume was replaced by weight of OPC) which was 5.69% greater than control mix M55 and M60 grades and in case of M60, maximum split tensile strength observed was 5.92 N/mm²(when 10% silica fume was replaced by weight of OPC) which was 5.15% greater than control mix M60.

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