International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-8 Issue-3S, February 2019

Method of Proportioning Silica Fume Concrete

M. Dinesh Vijay Kumar, Joe Paulson

***Abstract:** This report work deals with the increased use of silica fume as a supplementary cementations material numerous efforts are made to optimise the extent of replacement in the previous modules extensive work were done to find the optimised extent of replacement of cement with silica fume as 13%. Test of this optimum replacement were also done on beams and short columns to confirm the result. Production of silica fume concrete is done on case-to-case basis depending upon the specific requirement with regard to any parameter of importance or consideration. An attempt in made to define a comprehensive method of proportioning silica fume concrete. The method is also tested for only one parameter that is compressive strength.*

I. INTRODUCTION

Silica fume concrete (SFC) is used for concrete mixtures, which possess workability, strength, high density, low permeability and resistance to chemical attack. The addition of Silica fume (SF) has proved to improve both the compressive strength and durability of concrete. From the earlier research, they found the optimum percentage of silica fumes to replace cement is 13% which used in this work. Silica fume is one of the by-products of silicon metal (or) it also knows as silicon alloy metal factories. The silica fume was considered as the waste industrial materials. Silica fume is also called as the condensed silica fume, micro silica and Volatilized silica. Due to its very active and high pozzolanic property it became the most valuable by-product among the pozzolanic materials. It is used in the concrete to improve its properties and it also increases the compressive strength. The color of silica fume is either premium white (or) premium grey. Silica fume (SF) is generated by the silicon metal or by ferrosilicon that which producing by industry. The compressive strength of each concrete decreases water–cement material ratio increases Silica fume improves the long-term corrosion resistance and alkali silica expansion, but also increases the carbonation of depth. The silica fumes also significantly and increases the no evaporable water content of the paste and later ages due to its pozzolanic activity. The results that which indicate the optimum percentage of silica fume replacement are not constant at all the water–cement ratios but are dependent up on the water content of the mix. Silica fume has been recognized as the one of The most effective supplementary cementations materials (SCMs) that which contributes to the concrete durability that which improvement through pozzolanic reactions. SF is one of the very fine amorphous silica powders at which produced in electric arc furnaces as the by-product of the manufacture that which alloys the silicon or elemental silicon. Silica fume is normally utilized (or) used as the substitute for cement and concrete. The basis of 28-days of curing and testing strength results of modified strength of water-cementations material and the relationships ratio have been proposed for the concrete containing cement and the supplementary cementations material in silica fume are consider. Abrams' law mainly known as Abrams' water- cements ratio law. This law mainly deals with the strength of concrete mix and is inversely related between the mass ration of water and to cement. In the history of concrete technology in 1918 the Abrams law is the water-cement ratio law and it is the strength of concrete. The originally formulated of Abrams' law in which that conventional concrete containing cement.

Manuscript published on 28 February 2019.
***** Correspondence Author (s)
M. Dinesh Vijay Kumar, M-Tech Structural engineering, Department of Civil Engineering, Karunya Institute of Technology and Sciences, Coimbatore, India.
Joe Paulson, Assistant professor, Department of Civil Engineering, Karunya Institute of Technology and Sciences, Coimbatore, India.

II. METHODOLOGY

A. MATERIALS

1) Cement
2) Fine aggregate
3) Coarse aggregate
4) Water
5) Silica fume

III. PROPERTIES OF SILICA FUME

A. PHYSICAL PROPERTIES

1) More than 95% of the Silica fume (SF) particles are finer than 1mm.
2) Silica fume was used initially for cement replacement, along with the water-reducing admixtures
3) Silica fume is affected by the carbon content and several aspects having to do with the manufacturing process, such as the use of wood chips versus coal, wood chip composition, furnace temperature, furnace exhaust temperature, and the kind of product (metal alloy) being produced.

B. CHEMICAL COMPOSITION

1) The amorphous silicon dioxide has a very high content in silica fume and a very fine spherical particles are consists. Iron, magnesium and alkali oxides are considered as small amounts.
2) Silica fume is not a crystalline material will not dissolve in concrete, which must occur before the material can react. Don't forget that there is a crystalline material in concrete that is chemically similar to silica fume. That material is sand, while sand is essentially silicon dioxide ($SiO2$), it does not react because of its crystalline nature.

3) The silica fume based upon the metal being produced in the smelter from which is the fume was recovered. Usually these materials have no impact on the performance of silica fume in concrete.

C. THE ADVANTAGES OF USING SILICA FUME ARE AS FOLLOWS

A) Early compressive strength is high
B) Tensile, flexural strength and modulus of elasticity are high
C) Toughness increases
D) Bond strength is high
E) Durability enhanced
F) Permeability to chloride and water intrusion is very low.
G) Abrasion resistance increases.
H) Electrical resistivity is high and permeability is low.

D. THE APPLICATIONS OF SILICA FUME ARE

A) Repair products silica fume is used in a variety of cementations
B) Silica fume is used for high-way bridges, parking deck, marine structures and bridge deck overlays containing High performance concrete (HPC)
C) Silica fume for greater design flexibility enhanced with High-strength concrete
D) The usage in rock stabilization, mine tunnel linings and rehabilitation of deteriorating bridge and marine columns and piles are concrete by silica-fume

IV. METHODOLOGY

The intend to take this methodology:

- Module – I: To develop a relationship between water cement ratio and compressive strength of concrete for various grades;
- Module – II: To develop the work on other parameters like workability, water content, setting time etc. which is related with proportioning of concrete mixes;
- Module – III: Develop a comprehensive method of proportioning of concrete and testing on few samples.

V. OBJECTIVE & RESULTS

The prime objective of this study is to develop a comprehensive method of proportioning a silica fume method for this optimized replacement levels. For this, we are planning to conduct experiments in concrete – 150mm cube testing alone.

Fig 1. Casting Cubes

Fig 2. Casted Cubes

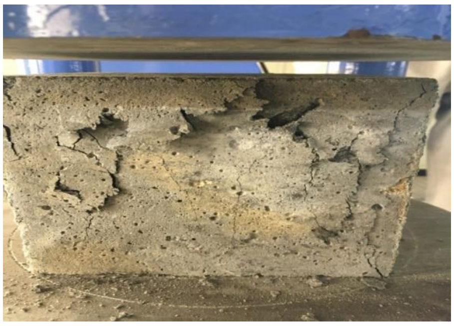

Fig 3. Compression Test

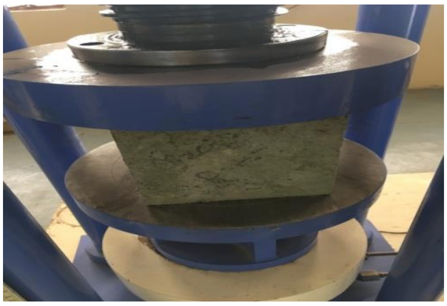

Fig 4. Compression Test

Table 1: 28 days compressive strength for M20 and M25

Water cement ratio	Compressive Strength (MPa)	
	M20	M25
0.6	17.84	21.36
0.55	29.64	23.17
0.5	32.22	27.54
0.45	34.21	29.95

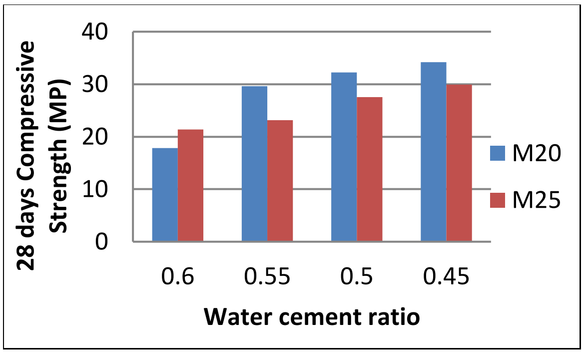

Fig 5. 28 days compressive strength for M20 and M25

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Table 2: 7 and 28 days compressive strength for M30, M35 and M40

Water cement ratio	Compressive Strength (MPa)					
	M30		M35		M40	
	7 Days	28 Days	7 Days	28 Days	7 Days	28 Days
0.6W	12.27	17.78	13.6	18.89	15	20.55
0.55W	13.38	19.11	13.84	19.22	18.07	24.75
0.5W	15.71	22.13	17.85	24.44	21.5	29.13
0.45W	19.52	27.11	21.54	29.11	24.5	32.67

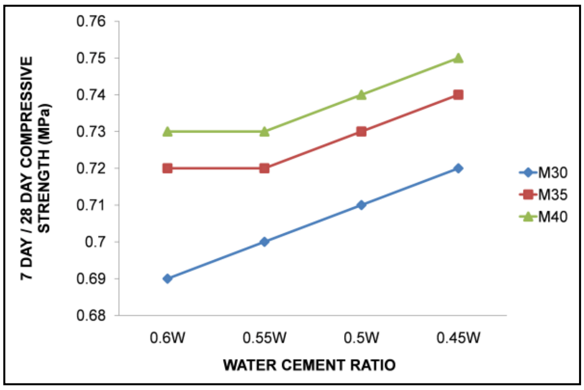

Fig 6. 7 and 28 days compressive strength for M30, M35 and M40

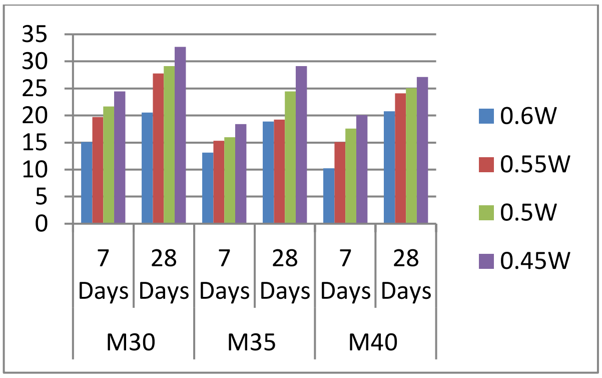

Fig 7. 7 and 28 days compressive strength for M30, M35 and M40

VI. CONCLUSION

All experiments that are necessary to correlate between concrete compressive strength and water cementitious materials ratio was completed.

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