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"Effect of Silica Fume on Mechanical Properties of Hardened concrete as Partial Replacement of Cement for M-35 Concrete"

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Abstract—*To decrease the amount of cement in concrete supplementary material are used. For this purpose silica fume is replaced by 0%, 5%, 7.5%, 10%, 12.5%, 15% & 20% by the mass of cement. Water binder ratio is taken 0.42 for M-35 grade of concrete. Various tests were conducted in the research which showed the results of the same percentage at the different of 0% 5%, 7.5%, 10%,12.5%, 15%, & 20% for the time period of seven and twenty eight days curing as a substitution of cement by micro silica on compressive strength, bending strength, split tensile strength. The optimum strength occurred when when 12.5% replacement of cement with micro silica.*

Keywords: Silica Fume, water cement ratio, compressive strength, flexural strength, tensile strength

1. INTRODUCTION

Now a days Cement is becoming a limited supply in the entire world because of its rising demands day by day. The construction behavior have enlarged in more or less all the rising countries of the world. At present improving the superiority and standards of the property of concrete as a building material. Usually fly ash and micro silica or the mixture of mutually is added to concrete as a pozzolana material to improve the properties of concrete. The use of micro silica as a pozzolana material has enlarged in current years. They enhance the property of both fresh and hard concrete like durability, strength, permeability and compressive strength, bending strength and tensile strength. Micro silica has a property that it behave as a pozzolana as well as cementious material.. Due to huge surface area micro silica gets densed jam-packed in the adhesive of cement and NCA sinking the partition consequence in the changeover zone between the adhesive and aggregate. Micro silica increase the durability and strength of concrete

2. MATERIAL USED

2.1 Cement: Portland Pozzolana cement (PPC) is used in this research work.

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2.2 Sand: Sand is available near Narmada River. This sand is used for the above research work.

2.3 Natural aggregate: 20 mm natural coarse aggregate is used having a specific gravity of 2.72..

2.4 Silica Fume (Micro Silica): Micro silica is a result se of high-purity quartz with coke in stimulating arc furnaces in the manufacture of silicon and ferrosilicon alloys: Chemical Composition of micro silica is as follows

Table 1: Chemical composition of micro silica

Properties	Observed value
Silica oxide	91%-97%
Aluminium tri oxide	0.7 -3.1%
Ferrous Oxide	0.4-0.9%
Magnesium Oxide	0.5-1.2%
Calcium oxide	0.2-0.7%
Potassium Oxide	0.4-0.8%
Calcium	0.6-1.5%
Loss on Ignition	Maximum 1.6%

3. EXPERIMENTAL WORK AND TEST

3.1 Mix Design for M-35 Grade: The proportion of M-35 grade concrete is calculated as per IS 10262-2009 & IS 456-2000 is 1:2.05:3.20. Water binder ratio is taken as 0.42.

3.2 Compressive Strength Test: The mould is prepared for cubes used in the compression test having a size of 0.15mX0.15mX0.15m. After preparing cubes rest on the compression testing machine and load is applied. After applying load the value noted from the dial gauge. Compressive strength determine at 7 & 28 days.

3.3 Flexural Strength Test: The mould is prepared for beams used in the bending test having a size of 0.10mX0.10mX0.50m. After preparing beams rest on the flexural testing machine and load is applied. After applying load the value noted from the dial gauge. Bending strength determine at 7 & 28 days

3.4 Split Tensile Strength: The mould is prepared for cylinder used in the tensile test having a size of 0.15m diameter and 0.30m height. After preparing cylinder rest on the compression testing machine and load is applied. After applying load the value noted from the dial gauge. Tensile strength determine at 7 & 28 days

3.5 Workability test: In the workability test the slump value vary from 75 mm to 45 mm.

4. TEST RESULTS

4.1 Workability As shown in below table 2 for different percentage of micro silica slump value were calculated..

Table 2: Workability Result

Batches	% Silica Fume	Slump (mm)
Mix-01	0	75
Mix-02	5	72
Mix-03	7.5	65
Mix-04	10	61
Mix-05	12.5	55
Mix-06	15	52
Mix-07	20	45

4.2 Compressive Strength; The below table shows the compressive strength for different percentage of micro silica which is vary from 0%-20%..

Table 3: Compressive Strength Result

Mix Design	% Silica fume	7 days Compressive Strength	28 days Compressive Strength
Mix-01	0	25.97	42.95
Mix-02	5	26.85	44.22
Mix-03	7.5	27.03	44.81
Mix-04	10	27.75	45.70
Mix-05	12.5	29.85	47.18
Mix-06	15	26.18	43.88
Mix-07	20	25.85	43.02

4.3 Flexural Strength The below table shows the Bending strength for different percentage of micro silica which is vary from 0%-20%.

Table 4: Flexural Strength Result

Mix Design	% Silica fume	7 days Flexural Strength	28 days Flexural Strength
Mix-01	0	3.42	5.26
Mix-02	5	3.65	5.41
Mix-03	7.5	3.85	5.61
Mix-04	10	4.02	5.75
Mix-05	12.5	4.45	6.10
Mix-06	15	3.98	5.69
Mix-07	20	3.25	5.30

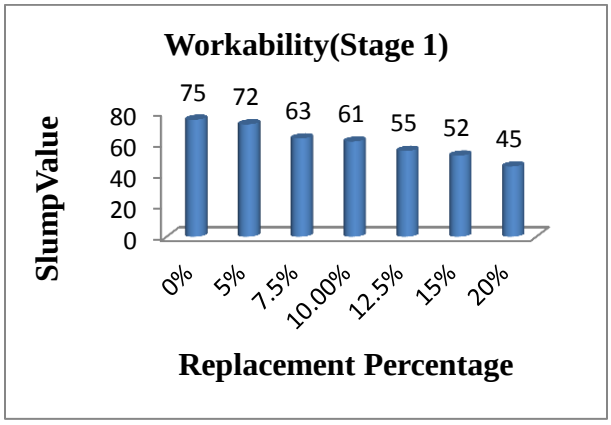
4.4 Split Tensile Strength The below table shows the tensile strength for different percentage of micro silica which is vary from 0%-20%.

Table 5: Tensile Strength Result

Mix Design	% Silica fume	7 days Split Tensile Strength	28 days Split Tensile Strength
Mix-01	0	2.29	4.48
Mix-02	5	2.46	4.70
Mix-03	7.5	2.69	5.10
Mix-04	10	2.87	5.26
Mix-05	12.5	3.33	5.64
Mix-06	15	2.48	4.60
Mix-07	20	2.23	4.18

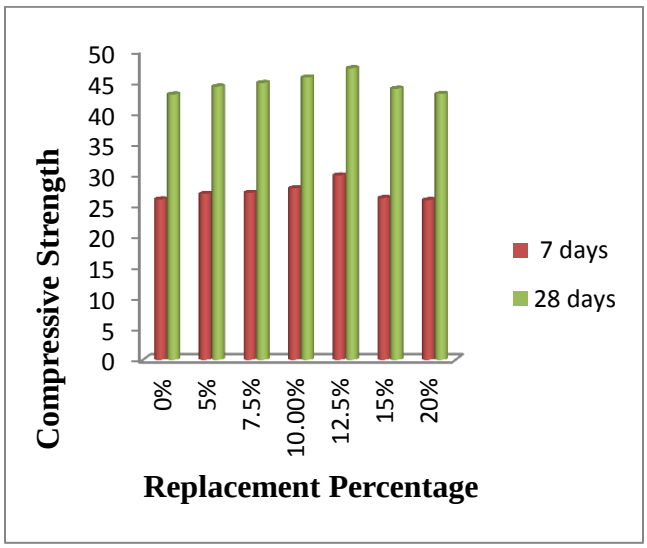
5. DISCUSSION ON TEST RESULTS

5.1 Workability: From the graph 1 the workability decreases when percentage of micro silica increases.



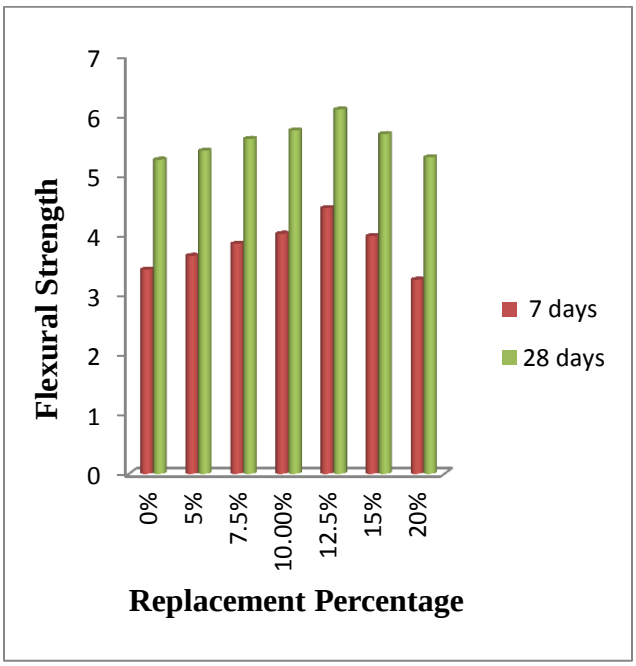
Graph 1: Slump Test for workability (mm)

5.2 Compressive Strength Test: From the graph 2 it is conclude that 7 & 28 days compressive strength 14.89% & 9.85% increases when percentage upto 12.5%. After that strength decreases when percentage of micro silica increases.



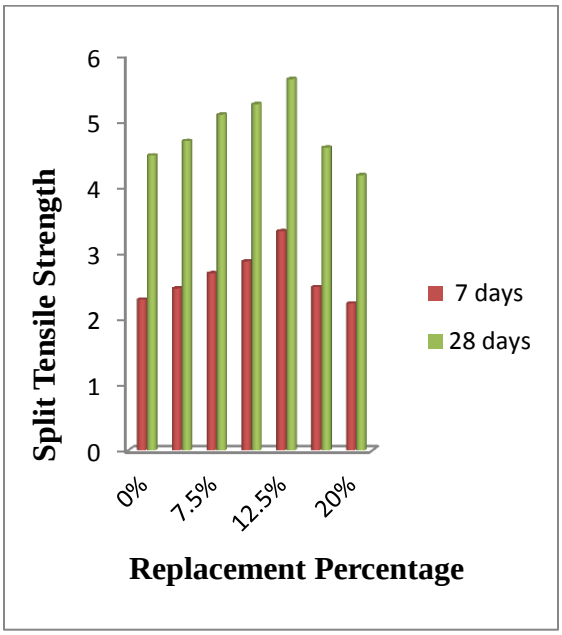
Graph: 2. Compressive Strength in N/mm2

5.3 Flexural Strength: It is conclude that 7 & 28 days bending strength 16.14% & 13.77% increases when percentage upto 12.5%. After that strength decreases when percentage of micro silica increases.



Graph:3 Flexural Strength in N/mm2

5.4 Split Tensile Strength: It is conclude that 7 & 28 days tensile strength 31.12% & 25.89% increases when percentage upto 12.5%. After that strength decreases when percentage of micro silica increases.



Graph 4: Split Tensile Strength in N/mm2

6. CONCLUSIONS:

From the above research work the conclusion are as follows:

1. Workability of concrete decreases as percentage of micro silica increases.
2. Optimum compressive strength observed when micro silica replacement is about 12.5%.
3. Optimum split tensile strength observed when micro silica replacement is about 12.5%.
4. Optimum bending strength was observed when micro silica replacement is about 12.5%.

REFERENCES

[1] Debabrata Pradhan, D. Dutt Influence of Silica Fume on Normal Concrete, Debabrata Pradhan et al. Int. Journal of Engineering Research and Applications Vol. 3, Issue 5, Sep-Oct 2013, pp.79-82

[2] N. K. Amudhavalli, Jeena Mathew, EFFECT OF SILICA FUME ON STRENGTH AND DURABILITY PARAMETERS OF CONCRETE International Journal of Engineering Sciences & Emerging Technologies, August 2012. ISSN: 2231 – 6604 Volume3, Issue 1, pp: 28-35 ©IJESET

[3] Dilip Kumar Singha Roy, Amitava Sil Effect of Partial Replacement of Cement by Silica Fume on Hardened Concrete International Journal of Emerging Technology and Advanced Engineering (ISSN 2250-2459, Volume 2, Issue 8, August 2012)

{4} Nasratullah Amarkhail EFFECTS OF SILICA FUME ON PROPERTIES OF HIGH-STRENGTH CONCRETE International Journal of Technical Research and Applications e-ISSN: 2320-8163 Special Issue 32 (September, 2015), PP. 13-19

[5] Pratik Patel Dr. Indrajit N. Patel Effect of Partial Replacement of Cement with Silica Fume and Cellulose Fibre on Workability & Compressive Strength of High Performance Concrete Volume : 3 | Issue : 7 | July 2013 | ISSN - 2249-555X

[6] Vikas Srivastava, V.C. Agarwal and Rakesh Kumar Effect of Silica fume on mechanical properties of Concrete J. Acad. Indus. Res. Vol. 1(4) September 2012 ISSN: 2278-5213

[7] Faseyemi Victor Ajileye, Investigations on Micro silica (Silica Fume) As Partial Cement Replacement in Concrete Global Journal of researches in engineering Civil And Structural engineering Volume 12 Issue 1 Version 1.0 January 2012 Type: Double Blind Peer Reviewed International Research Journal Publisher: Global Journals Inc. (USA) Online ISSN: 2249-4596 & Print ISSN: 0975-5861

[8]K. Perumal R. Sundararajan: Effect of partial replacement of cement with silica fume on the strength and durability characteristics of high performance concrete 29th conference on our world in concrete & structures: 25 - 26 August 2004, Singapore Article Online Id: 100029050

{9] Prof. Vishal S. Ghutke, Prof. Pranita S.Bhandari, Influence of silica fume on concrete IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
E-ISSN: 2278-1684, p-ISSN: 2320-334

{10} I. B. Muhit1, S. S. Ahmed2, M. M. Amin1 and M. T. Raihan1. Effects of Silica Fume and Fly Ash as Partial Replacement of Cement on Water Permeability and Strength of High Performance Concrete Proc. of Int. Conf. on Advances in Civil Engineering, AETACE 1Department of Civil Engineering, Chittagong University of Engineering & Technology, Chittagong-4349, Bangladesh

{11} Nadeem Pasha1 Mohammed Muqueem Ahmed2 Mohammed Azeemuddin3 Shaikh Minhajuddin4 Waseem Ali5: Study on Strength Characteristics of Silica Fume and Fly Ash as Partial Replacement of Cement. IJSRD - International Journal for Scientific Research & Development| Vol. 3, Issue 02, 2015 | ISSN (online): 2321-0613

{12} Hanumesh B M1, B K Varun2, Harish B A3: The Mechanical Properties of Concrete Incorporating Silica Fume as Partial Replacement of Cement International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 5, Issue 9, September 2015)

{13} Praveer Singh1, Mohd. Afaque Khan2, Abhishek Kumar3; the Effect on Concrete by Partial Replacement of Cement by Silica Fume: A Review e-ISSN: 2395 -0056 p-ISSN: 2395-0072

{24}H S Jadhav1 and R R Chavarekar2: Role of Fly Ash and Silica Fume on Compressive Strength Characteristics of High Performance Concrete ISSN 2319 – 6009 www.ijscer.com
Vol. 2, No. 1, February 2013 © 2013 IJSCER.

{25} 1,T.Shanmugapriya , 2,Dr.R.N.Uma: Experimental Investigation on Silica Fume aspartial Replacement of Cement in High Performance Concrete. The International Journal Of Engineering And Science (IJES) ||Volume||2 ||Issue|| 5 ||Pages|| 40-45||2013|| ISSN(e): 2319 – 1813 ISSN(p): 2319 – 1805

{26} S Sundararaman and S Azhagarsamy A Study on Performance of Concrete by Partial Replacement of Cement with Rice Husk Ash and Silica Fume ISSN: 2394 - 658X

{27} Alok Kumar1, Shubham Jain2* Shubham Gupta3,Sonaram4,Sanjay Merawat5 A Research Paper on Partial Replacement of Cement in M-30 Concrete from Silica Fume and Fly Ash

{28} Pranshu Saxena1 Experimental Study on Mechanical Properties of M30 Concrete with Partial Replacement of Cement and Fine Aggregate with Silica Fume. IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308

{29}H. Katkhuda*1, B. Hanayneh2 and N. Shatarat1: Influence of Silica Fume on High Strength Lightweight Concrete International Journal of Civil, Environmental, Structural, Construction and Architectural Engineering Vol: 3, No: 10, 2009

{30} Magudeaswaran P1, Eswaramoorthi P2; Experimental Investigations of Mechanical properties on Micro silica (Silica Fume) and Fly Ash as Partial Cement Replacement of High Performance Concrete IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 6, Issue 4 (May. - Jun. 2013)

{31} Manoj Kumar Poonia1, Vinesh Kumar2, Mukesh Kumar3: influence of silica fume and steel fiber on normal concrete. International Journal For Technological Research In Engineering
Volume 2, Issue 10, June-2015 ISSN (Online): 2347 – 4718

{32}Anurag Jain, P. Y. Pawade: Characteristics of Silica Fume Concrete International Journal of Computer Applications (0975 – 8887)

{33} 1AMAR DEVENDRA SHITOLE, 2SANDHYA MATHAPATI: The Use of Micro-Silica to Improve the Compressive and Flexural Strength of Concrete. International Journal of Mechanical And Production Engineering, ISSN: 2320-2092, Volume- 2, Issue-8, Aug.-2014