iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VI **Month of publication:** June 2021

DOI: https://doi.org/10.22214/ijraset.2021.34845

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VI June 2021- Available at www.ijraset.com

Effects of Micro Silica & Fly ash on Strength & Durability Parameters of High Strength Concrete

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Abstract: ***High strength concrete is a term used to describe concrete with special properties not attributed to normal concrete. High-performance means that the concrete has one or more of the following properties: low shrinkage, low permeability, a high modulus of elasticity, or high strength. The application of nanotechnology in concrete has added a new dimension to the efforts to improve properties of High strength concrete. Nano materials, by virtue of their very small particle size can affect the concrete properties by altering the microstructure. Concrete can deteriorate for a variety of reasons, and concrete damage is often as result of combination of factors. This causes stresses in the concrete, which can eventually have resulted in cracking, delamination, and spalling. Concrete resists weathering action, chemical attack, and abrasion while maintaining its desired engineering properties throughout its lifespan. Different concretes require different degrees of durability depending on the exposure of environment and the properties desired. Durable concrete will retain its original form, quality and serviceability when exposed to its environment. The main characteristics influencing the durability of concrete is its permeability to the ingress of water, oxygen, carbon dioxide, chloride, sulphate and other deleterious substances. It became necessary to impart knowledge about durability of concrete and factors affecting durability to the society, as the wide use of concrete as a material in the constructions. This study concerns with the use of Nano silica of size 12 nm in M60 grade of concrete to improve the compressive strength of concrete and study on various durability parameters of High strength concrete. An experimental investigation is planned to carry out with different amount of Fly ash as 15% ,20%, 25%,30% and Micro silica as 5.5%,7%,8.5%,10% in concrete by weight of concrete. have been planned to carry out are workability, compressive test, flexural test, split tensile test. To study durability parameters of High strength concrete with nano silica Rapid chloride penetration test (RCPT), Water Sorptivity test, Acid attack test, Sulphate attack test are conduct. In this study it was observed that t the durability, strength and workability are increase as the percentage of fly ash & micro silica increses.***

I. INTRODUCTION

Concrete is the material of present as well as future. The wide use of it in structures, from buildings to factories, from bridges to airports, makes it one of the most investigated materials of the 21st century. Due to the rapid population explosion and the technology boom to cater to these needs, there is an urgent need to improve the strength and durability of concrete. Out of the various materials used in the production of concrete, cement plays a major role due its size and adhesive property. So, to produce concrete with improved properties, the mechanism of cement hydration has to be studied properly and better substitutes to it have to be suggested. Different materials known as supplementary cementitious materials or SCMs are added to concrete improve its properties. Some of these are fly ash, blast furnace slag, rice husk, silica fumes and even bacteria. Of the various technologies in use, nano-technology looks to be a promising approach in improving the properties of concrete

II. IMPORTANCE OF STUDY

To study effect of fly ash and micro silica on strength and durability parameters of high strength concrete. Tostudy durability Indices of high strength concrete with use of fly ash and micro silica. ,Scope of work: - The study purpose to prepare various concrete mix with high strength M60 and M70 with various amount of fly ash and micro Silica as an ingredient and then to perform different tests.

Work flow defined is as under : -Prepare M60 & M70 concrete mixes with various fly ash & micro silica content .Conduct durability tests -Rapid Chloride Permeability Test (RCPT),Water Sorptivity Test, Acid attack test, Sulphate attack test Conduct strength tests-Compressive strength test, Flexural strength test ,Tensile strength test .Analysis of results and reporting the outcomes. Nanomaterials are very small sized materials with particle size in nanometres.

These materials are very effective in changing the properties of concrete at the ultrafine level by the virtue of their very small size. The small size of the particles also means a greater surface area. Since the rate of a pozzolanic reaction is proportional to the surface area available, a faster reaction can be achieved.

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Only a small percentage of cement can be replaced to achieve the desired results. These nanomaterials improve the strength and permeability of concrete by filling up the minute voids and pores in the microstructure. The use of Micro silica in concrete mix has shown results of increase in the compressive, tensile and flexural strength of concrete. It sets early and hence generally requires admixtures during mix design. Nano-silica mixed cement can generate nano-crystals of C-S-H gel after hydration. These nano-crystals accommodate in the micro pores of the cement concrete, hence improving the permeability and strength of concrete.

For this study Nano silica is purchased from Astrra Chemicals, Chennai. Table 4.9 shows the properties of nano silicawhich is based on test results of companies and Geo test house, Junagadh.Fly ash is a fine powder which is a by-product from burning pulverized coal in electric generation power plants. Fly ash is a pozzolan, a substance containing aluminous and siliceous material that forms cement in the presence of water. When mixed with lime and water it forms a compound similar to Portland cement.The fly ash produced by coal-fired power plants provide an excellent prime material used in blended cement, mosaic tiles, and hollow blocks among others.Fly ash can be an expensive replacement for Portland cement in concrete although using it improves strength, segregation, and ease of pumping concrete. The most commonly utilized pozzolanic waste material and has the biggest potential to use in concrete is the Fly ash (also known as pulverized fuel ash). In coal based power plants fly ash is the waste product.

III.EXPERIMENTAL PROGRAMS & STUDY

Table I (M-60)

Sr. No.	% of fly ash	% of micro silica	Slump Value in MM	Compressive strength (28 days)	Split tensile strength (28 days)	Flexural strength (28 days)	R.C.P.T. in Coulombs (c)	Sulphate attack test	Acid attack test
1	0%	0%	96	58.2	7.08	8.99	2130	7.4	7.2
2	15%	5.50%	103	60.4	7.19	9.15	1990	7	6.7
3	20%	5.50%	122	61.9	7.2	9.19	1841	6.5	6.2
4	25%	5.50%	132	64.3	7.28	9.25	1836	6.1	5.9
5	30%	5.50%	135	67.5	7.31	9.43	1825	6	6.4
6	15%	7%	136	70.5	7.38	9.51	1804	6.6	6.1
7	20%	7%	138	75.6	7.5	9.61	1740	5.7	5.5
8	25%	7%	135	73.7	7.45	9.53	1769	6.4	6.8
9	30%	7%	133	71.3	7.21	9.44	1802	6.8	6.5
10	15%	8.50%	136	69.2	7.14	9.28	1796	7.1	6.1
11	20%	8.50%	128	74.4	7.36	9.56	1822	7.5	7.3
12	25%	8.50%	133	68.6	7.42	9.37	1922	6.8	6.9
13	30%	8.50%	130	65.1	7.02	9.06	2005	7.2	7.8
14	15%	10%	127	62.1	7.26	8.92	1896	7.6	7.2
15	20%	10%	131	59.6	7.31	9.18	2009	7.9	7.5
16	25%	10%	122	57.9	6.98	8.96	1882	8.1	7.1
17	30%	10%	125	55.2	6.87	8.23	2015	8.7	7.8

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Table II (M-70)

Sr. No.	% of fly ash	% of micro silica	Slump Value in MM	Compressive strength (28 days)	Split tensile strength (28 days)	Flexural strength (28 days)	R.C.P.T. in Coulombs (c)	Sulphate attack test	Acid attack test
1	0%	0%	100	59.4	7.6	9.03	2086	7.4	7.8
2	15%	5.50%	109	61.4	7.65	9.14	1995	7	7.5
3	20%	5.50%	118	63.5	7.68	9.11	1975	6.5	7.1
4	25%	5.50%	122	65.9	7.71	9.15	1981	6.1	7.8
5	30%	5.50%	130	68.3	7.76	9.18	1985	6	7.9
6	15%	7%	145	70.4	7.8	9.22	1996	6.6	7.7
7	20%	7%	152	73.3	7.82	9.27	1805	5.7	7.5
8	25%	7%	155	80.4	7.96	9.5	1782	6.4	7.6
9	30%	7%	158	79.4	7.93	9.41	1826	6.8	7.8
10	15%	8.50%	156	78.2	7.98	9.58	1781	7.1	7.7
11	20%	8.50%	158	81.4	8	9.64	1796	7.5	6.9
12	25%	8.50%	161	87.1	8.25	9.82	1709	6.8	6.1
13	30%	8.50%	158	82.3	8.14	9.69	2002	7.2	6.5
14	15%	10%	153	79.4	8.19	9.62	1824	7.6	7.1
15	20%	10%	156	73.2	8.09	9.38	1809	7.9	7.4
16	25%	10%	148	67.5	7.68	9.09	1944	8.1	7.8
17	30%	10%	142	66.3	7.55	8.93	2010	8.7	8.2

IV. CONCLUSIONS

A. Slump value for M60 is 138mm for 20% flyash and 7% micro Silica. and for M70 161mm for 25% flyash and 8.5% micro silica. So, as the increase of Nano silica in mixes it help to increase the Slump (Workability).

B. The experimental results of compressive strength show that for 20% flyash and 7 % micro slica in M60 and for 25% flyash and 8.5% microsilica in M70 helps to increase the cube compressive strength measured at 28 days while further increase with concrete reduces strength.

C. The experimental results of Split tensile strength show that for 20% flyash and 7 % micro slica in M60 and for 25% flyash and 8.5% microsilica in M70 helps to increase the Split tensile strength strength measured at 28 days while further increase with concrete reduces strength.

D. From the experiment results of compressive strength, split tensile strength and flexural strength the optimum percentage of M60 20% flyash and 7 % micro slica and for M70 25% flyash and 8.5%

E. Water Sorptivity value decrease as the Nano Silica are added and concrete which shows better performance in terms of permeability of the concrete. The performance in terms of permeability is better in M60 grade than M70 grade.

F. Rapid Chloride permeability test Results show that the chloride ion permeability of all mixes falls in good category (moderate and low). Further charge passed decreases with the increase in percentage of Nano Silica in M60 and M70 mixes.

G. The experimental results of Acid attack and Sulphate attack test show that for all mixes of Nano Silica in M60 and M70 grade give better results in terms of percentage of decrease of compressive strength and there are no major changes in the results of flyash and micro Silica for acid attack and sulphate attack.

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V. ACKNOWLEDGMENT

I express my deep sense of gratitude to my college, Noble Group of Institutions, Junagadh & Gujarat Technological University for giving me a great opportunity to carry out this dissertation. I would like to thank our Head of Department Civil Engineering, Prof. Kishan Vekariya for allowing me to take up this project & for his precious help & guidance which always motivate me with technical guidance throughout this semester period. I humbly express thanks to my respected guide Asst. Prof. Kishan Vekariya of Department of Civil Engineering, Noble Group of Institutions Junagadh for his valuable time and continuous help given to me. I am grateful to him for his prolonged interest in my work and excellent guidance. He has been a constant source of motivation for me. By his uncompromising demand for quality and his insistence for meeting the deadlines, I could do such an excellent work. He has shown me a way to pursue excellence. His tactics of what to learn and how to learn have helped me stepping into professional world as well as to be a better person. Also I would like to thank all other respected faculties of Department of Civil Engineering for their unmatchable help Most importantly, I would like to thank my Parents, for everything that they have done for me throughout my life and the joy they have brought to me for just having their support. Much of my success has been because of their love & encouragement.

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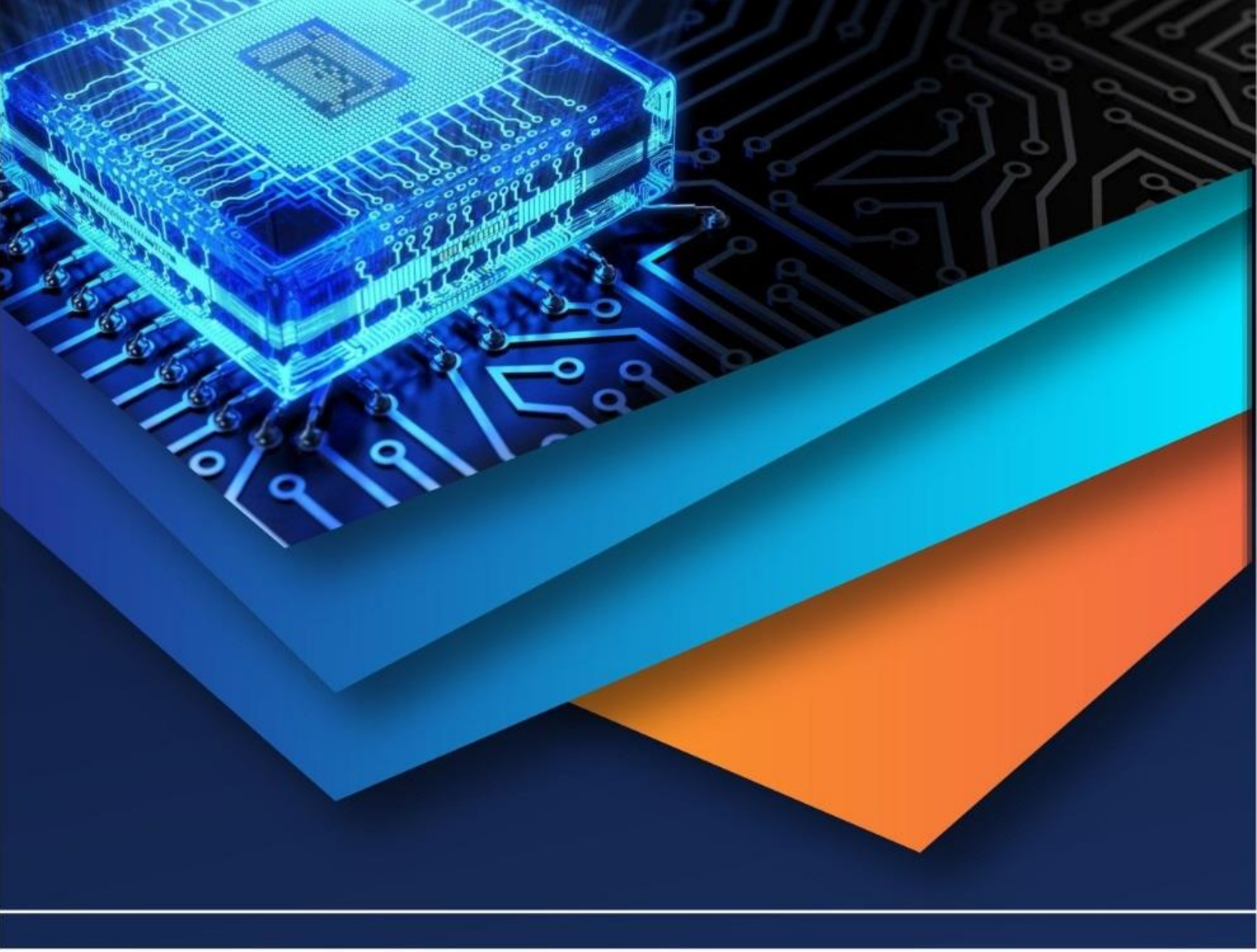

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