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Feasibility Analysis and Durability Comparative Study of Nanometer Fly Ash and Waste Rock Powder in Concrete

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Abstract: ***Now a day's using sand as a fine aggregate is becoming over exploiting due to heavy constructions. Due to this scarcity of sand occurs for the future generation. The concrete industries are facing the environmental impact of the cement production by the emission of carbon dioxide. Partial replacement of cement has been tried by low, medium and high volume with pozzolanic waste materials that include fly ash, silica fume, furnace slag having high silica and cementitious contents. Among all the replacement materials for cement, fly ash has been identified which is being produced in large quantities comparatively is recommended for use in concrete. [1] Most of them are confined to the utilisation of low calcium fly ash called class F fly ash, which is the waste, based on coal burning in thermal power stations. The production of cement poses environmental problems due to emission of gaseous pollutants, because the production of one ton of Portland cement emits approximately 1.0 tons of CO2 into the atmosphere. In the specification for concrete the grade of concrete quantity of cement to be used, aggregate quantities, consolidation are being mentioned now a days. [2,5]The depletion of natural materials for manufacture of cement and the drawbacks of OPC demand for a durable concrete. The day is not far away then the people demand for a concrete with specifications for mentioning the standards of Chloride permeability/resistance, Water permeability, Acid resistance, Alkaline, Sulphate resistance etc. To make concrete economical, there is a need to use the supplementary materials for imparting Strength and durability to cement/concrete. In order to reduce the environmental problem that are caused by the large scale production of OPC, there is a direct need to use supplementary cementing materials, which are locally available. [3,8,9]In the present study, Stone Powder Dust, which is rich in Calcium is used along with Nano Fly Ash to replace partially the cement in M_{30} grade concrete and an attempt is made to study the durability properties namely acid resistance, Chloride permeability and Water permeability. The OPC is replaced by stone powder dust from 5 to 15% and Fly Ash from 20 to 40% separately and the combination of these two materials.***

Keywords: Fly ash, stone powder dust, compressive strength, Rapid Chloride permeability, Acid attack, and Water permeability.

1. Introduction

Concrete is an extraordinary and key structural material in the human history. Increase in construction activities has lead to an increase in demand for various raw materials in concrete. Concrete's versatility, durability, sustainability, and economy have made it the world's most widely used construction material. The production of one tonne of cement consumes about 1.5 tonnes of raw materials, 80 units of electric power apart from one tone of CO_2 released into the atmosphere. Out of the total CO_2 emissions (from various sources) worldwide, cement industry contributes about 7% of CO_2 emissions. Annual cement production rate of the world is increasing very much year by year. The production can be reduced if demand is reduced. Demand can be reduced by using supplementary cementing materials and other material which reduce Portland cement content of concrete. The properties of concrete can also be increased by using by-products and natural wastes as supplementary cementing material. Lot of energy and cost can also be saved by using these natural wastes and industrial by-products as partial replacements to OPC and production of fly ash is nearly equal to the production of cement. [4,5]For effective utilization of fly ash and stone powder in cement in India, using stone powder and fly ash in Nano form as partial replacements to cement is very important than other usage of these supplementary cementing materials. There are both technical advantages and social benefits in using stone powder and fly ash in concrete. [2,17]Because SPD contains large amount of Calcium and fly ash contains large amount of silica and it is a pozzolonic material which behaves like cement in the presence of lime and water. In order to make the concrete more environmental friendly and greener there is a dire need to use SPD and Nano FA in concrete. After the selection of supplementary cementing materials for making of concrete, the other ingredients such as collected, aggregates were collected from the nearby quarries, 53 Grade Portland cement was used in all concrete mixtures. The concrete of its Flexibility, Durability, Sustainability, and Economy have made it the world's most widely used building material.

The fly ash is majorly used in the manufacture of cement. [9,20]For efficient consumption of ashes in cement in India, using cow dung ash and fly ash in the form as partial replacements of cement is very important than other usage complementary cementitious materials. There are both technical advantages and communal benefits in using Stone Powder Dust and fly ash in concrete. Because cow dung ash contains large amount of calcium potassium and phosphorus which is assimilate into the construction by absorption from the soil during the expansion of Stone Powder Dust and fly ash is a pozzolanic material which behaves like cement in presence of lime and water.

2. Literature Review

Abhisheck Jain (2013) et al have conducted experimental studies on mortar containing fly ash as a partial replacement of sand by weight as well as by volume were carried out to quantify its utilization. Both the types of pond and bottom fly ash in various ratios were used in preparing cement mortar and their strengths in compression and tension were tested. Out of the various proportions the mortar mix 1:2.5:2.5 (cement: coarse sand: pond fly ash) designed by method of volume is found satisfactory as for as the strength is concerned. The maximum utilization of fly ash almost 75% and cost saving about 58% were ascertained with the plain mortar of ratio 1:5 (cement : sand). The utilization of fly ash in mortar designed by weight provides 50% to 60% financial saving while 9% to 16% by method of volume. However, the fly ash mortar mix 1:1:5 (cement : fly ash : sand) by weight consumes about 20% less quantity of cement and overall consumption of fly ash is also less.

Yuvaraj Shanmugasundaram (2012) et al have found that the silica in nano form can easily react with cement particles which are normally in Nano scale initiate the CSH reaction and hence its tend to accelerate the compressive strength of concrete. Nano-silica consumes calcium hydroxide crystals, reduces the size of the crystals at the interface zone and transmute the calcium hydroxide feeble crystals to the C-S-H crystals, and improves the interface zone and cement paste structures. Corrosion resistance property of the nS added concrete iscomparatively higher than ordinary fly ash concrete. The corrosion resistance of optimum percentage replacement of fly ash is higher in nano concrete than the ordinary fly ash concrete. The average increases in compressive strength up to 7% than the compressive strength ordinary partially replaced fly ash concrete on 7 days cured concrete. But in the fourteen days cured cubes the increase in compressive strength is incrementally up by 13% percentages compared to the ordinary partially replaced fly ash concrete. The permeability of concrete attain by adding fly ash and Nano silica in the partial replacement of cement possess some significant higher strength.

Jemimah Carmichael.M (2012) et al have carried out and found that the effect of replacing cement with nanocement, nano-fly ash and nano-silica fume on the strength, consistency, initial and final setting times of cement mortar. It was found that replacement had insignificant effect on the consistency of cement paste. The initial and final setting times of cement mortar containing nano-cement was found to decrease with increase in the replacement percentage. Increase of replacement of cement with nano-flyash and nanosilica fume, the initial and final setting times were found to increase as the percentage replacement increases. From the strength point of view the optimal An experimental investigation has been carried at to find out at the effect of replacing cement with nanocement, nano-flyash and nano-silica fume on the strength, consistency, initial and final setting times of cement mortar. It was found that replacement had insignificant effect on the consistency of cement paste. The initial and final setting times of cement mortar containing nano-cement was found to decrease with increase in the replacement percentage. Increase of replacement of cement with nano-flyash and nanosilicafume, the initial and final setting times were found to increase as the percentage replacement increases. From the strength point of view the optimal

Er. Magudeaswaran. P (2013) et al have concluded that structural grade concrete can be produced by partial replacement (25%&12.5%, 30%& 15%, 35%&17.5%) of cement by fly ash and silica fume. The strength of the concrete and durability characteristics of the concrete is increased by using admixtures. Compression strength is increased by 31.6% for 35% & 17.5% replacement of fly ash and silica fume. Flexural strength of concrete is increased by 24.46% for 35% & 17.5% replacement of fly ash and silica fume. Spilt tensile strength of the concrete is increased. The pH value of the concrete decreases by 5.47%. The rate of absorption of the concrete is reduced by 0.24%. However, an acceptable strength and durability characteristics can be achieved by using a fly ash and silica fume. The use of fly ash and silica fume which are to cause environmental pollution when dumped as waste can be reused for strengthening the concrete gives a double fold advantage.

Sakshi Gupta (2013) et al have found that Nanotechnology has the potential to be the key to a brand new world in the field of construction and building materials. The role and application of the nano and micro silica particles with cementitious materials have been reviewed and discussed in details. It is evident from the literatures reviewed that none of the researchers have carried out extensive or comprehensive study of the properties of paste and mortar, with nano silica, micro silica and their simultaneous use. There is a limited knowledge about the mechanisms by which nano silica & micro silica affects the flow properties of cementitious mixes. In India, the research work on use of nano silica is still in elementary stage. Thus, a need arises to study extensively the various properties of paste, mortar, and concrete containing various percentages of nano silica, micro silica alone as partial replacement of cement and then studying their combined percentage effects. As the properties of nano-silica and micro-silica reported in literatures relate with those manufactured or exported from abroad, there is urgent need to study the effect of these materials (manufactured in India) on various properties of cement paste, mortar and concrete. Major parties in the construction materials industry should divert more funds to research work on incorporating nanotechnology in construction materials. Thus, the main motive is to provide practical information, regarding the strength, sustainability & durability properties of nano silica, micro-silica and their simultaneous use in paste, mortar and concrete. Also, the aim is to carry out the extensive studies to conceive the general purpose of testing new sustainable building processes and modern production systems, aimed at saving natural raw materials and reducing energy consumption. Taking advantage of nanostructure and microstructure characterization tools and materials, the simultaneous and also separate optimal use of micro-silica and nano-silica will create a new concrete mixture that will result in long lasting concrete structures in the future. Thus, there is a gap or room available for further research towards the fruitful application of especially nano-silica for construction with different nano structure characterization tools, which will be enable to understand many mysteries of concrete.

R.D. Padhye (2016) et al have Found that the potential for using fly ash as a supplementary cementitious material in concrete has been known almost since the start of the last century. Historically, fly ash has been used in concrete at levels ranging from 15% to 25% by mass of the cementitious material component. The actual amount used varies widely depending on the application, the properties of the fly ash, specification limits, and the geographic location and climate. There has been lot of research took place over using fly ash as additive in cement, admixture in concrete and cement replacement material in concrete. But most of the research has been limited to few percentages of cement replacement for concrete of fewer grades. An experimentation program is carried out to see the effect of fly-ash on compressive strength of different high grades concrete for different proportions of fly ash and different curing periods. Different grades of concrete mixes with varying percentage of fly ash content were prepared and the effects of fly ash on mechanical properties of fresh and hardened concrete have been investigated. The compressive strength of concrete was measured for 7, 28 and 45 days and compaction factor is taken as a measure of workability. A different comparative study is done consisting of rate and strength as parameters. Compressive strength of concrete at different proportions of cement being replaced by fly ash has been checked and results have been found effective and applicable. Hence, a comparative study is done and use of fly ash as a cement replacement in concrete can be analyzed and compared..

K. Rojaramani (2007) et al have carried out to study on replacement of sand with stone crusher waste at various replacements levels. Also it is well known that produce Portland cement consumes more natural resources and at the same time releases a large volume off CO2 into the atmosphere and causes greenhouse effect. In order to decrease cement production we are replacing cement with fly ash in different proportions. Along with these cement is also replaced by Kadapa stone powder. In this experimental work 20%, 40% and 60% of fly ash used in replacement of Ordinary Portland cement and for each these mixes 50%, 75% and 100% stone crusher waste is used as fine aggregate. For all these mixes 5% (by weight of cement) of Kadapa stone powder is used. Due to the time constraint, as a part of experimental work standard size cubes, cylinders and beams were cast and tested to evaluate only the 28 days Compressive, Split tensile and Flexural strengths of the above concrete mixes were found.

Subba Reddy. Singam (2017) et al have carried out and found that the study is to understand the behavior of concrete made with Black Stone Marble Waste Aggregate (BSMWA). The consumption of materials like coarse aggregate, fine aggregate, it will result the shortage the same in the future and also to environmental damage. Presently large quantum of Black Stone Marble Waste Aggregate is generated in marble and slab industry during the processing. Therefore, this study is to investigate the possibility of utalisation of the marble waste in concrete. The natural aggregate is replaced by the black stone marble waste with a proportion of 0, 25, 50, 75 and 100% and with addition of fiber 0, 1 and 2 percentages.

3. Materials and Experimentation

Materials Used

- Cement
- Aggregates : Fine aggregate and Coarse aggregate
- Water
- Nano Fly Ash
- Stone Powder Dust

Cement

Table 1: Physical properties of cement

S.No	Particulars	Results
1	Specific Gravity	3.15
2	Initial setting time	40 min
3	Final setting time	620 min
4	Fineness	225 m^2/kg

Aggregate

Properties of the fine aggregate

S. No	Particulars	Results
1	Type	Normal sand
2	Specific gravity	2.6
3	Grading size	4.75mm – 0.075mm
4	Water absorption	1%
5	Fineness modulus	2.28
6	Bulk density in Loose state Compacted state	1378.82 kg/m^3 1544.67 kg/m^3

Table 3: Sieve analysis of fine aggregate
Weight of the sample: 1 kg

Sieve size (mm)	Weight of the sample (kg)	Cumulative sample weight (kg)	Cumulative% of Weight retained (Kg)	Cumulative % of Weight passing (Kg)
4.75	0	0	0	100
2.36	0.03	0.03	3	97
1.18	0.25	0.28	28	72
600 µ	0.22	0.50	50	50
425 µ	0.030	0.53	53	47
300 µ	0.15	0.68	68	32
150 µ	0.22	0.86	86	14
Pan	0.14	1.000	-	0

$$\text{Fineness modulus} = \frac{\text{cumulative \% wt of material retained}}{100} = \frac{288}{100} = 2.88$$

Nano Fly Ash

The other supplementary cementing material used in this investigation is Nano FA. Fly ash used in this study contains more silica content and less calcium. The details of chemical compounds present in the fly ash are furnished in table no 7.

Figure 2: Nano Fly Ash

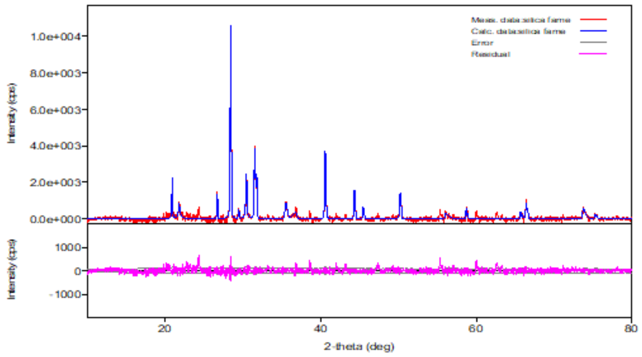


Figure 3: XRD analysis of Nano Flyash

Table 7: Properties of Nano fly ash

Major element	% by weight in the Nano fly ash	Requirement as per IS:3812-2003
SiO_2	58.80%	>35%
Al_2O_3	24.10%	-
Fe_2O_3	5.18%	-
TiO_2	6.14%	-
CaO	1.00%	-
MgO	0.38%	<5.0%
Na_2O	0.66%	<1.50%
K_2O	0.62%	<1.50%
P_2O_5	0.60%	-
SO_3	0.25%	<2.75%
Loss on iginition	6.25%	<12.00%

4. Experimental Investigation

4.1 Casting of Specimens

For casting specimens the concrete has been placed in the standard metallic moulds in three layers and compacted with tamping rod by giving 25 blows. Before placing the concrete in the moulds a thin coat of oil was applied for the walls of the mould inside for easy removal. Then moulds were placed on table vibrator for 30 seconds after thorough compaction the top surfaces of specimens were finished smoothly. The specimen details are presented in table no 8.

Table 8: Specimen Details

Mould type	Dimensions	No. of moulds		
		28 days	60 days	90 days
Cubes	150mm*150mm*150mm	3	3	3
RCPT moulds	100mm dia*50mm height	3	3	-
Water penetarion	200mm dia*125mm height	-	3	-

4.2 Curing of Specimens

The concrete specimens were air dried for 24 hours and then the specimens were demoulded and then kept for curing. Marking was done on the specimens to identify the percentage of Stone Powder Dust, Nano FA and their combinations. And then the specimens were placed in water tank for curing. All the specimens have been cured for desired age and then tested.

4.3 Testing of Specimen

For testing of specimen's compressive strength 2000KN capacity compression testing machine was used. For water permeability test, water permeability meter was used. For Rapid Chloride Permeability test, RCPT machine was used and results are tabulated.

4.4 Compressive Strength Test

Concrete cubes of sizes 150mm×150mm×150mm were tested for crushing strength. Compressive strength depends on many factors such as w/c ratio, cement strength, quality of concrete material and quality control during production of concrete.

Compression test on cube was conducted with 2000KN capacity compression testing machine available in concrete technology laboratory at SVEB, Kalavarai. The experimental arrangement is shown in figure no 4. The specimens were placed centrally on the base plate of the machine and the load was applied gradually at the constant rate of 140 kg/cm^2/min till the specimen failed. The maximum load applied was noted for each test. The specimen results were calculated at 28days and 60days and 90 days tabulated. The cube compressive strengths of various concrete mixtures are presented in graphical form. The crushing strength is the ratio of failure load to the area of cross section of specimen. The cube compressive strength can be calculated as follows:

If f_c is the cube compressive strength, then $f_c=\frac{P}{A}$ N/mm^2, Where P is an ultimate load in N, A is a cross sectional area of cube in mm^2.

Figure 4: Compressive strength

4.5 Acid Resistance Test

Concrete is not fully resistant to acids and its resistance depends upon the type and concentration of acid. Oxalic acid and phosphoric acids are harmless. The most vulnerable part of the cement hydrate is $Ca(OH)_2$, but C-S-H gel can also be attacked. Concrete can be attacked by liquids with PH value less than 6.5. For acid attack test, concrete cube of size 150×150×150 mm are prepared for various percentage combinations of Stone Powder Dust and Nano Fly Ash.

The specimen are casted and cured in mould for 24 hours, after 24 hours, all the specimen are demolded and the specimens are weighed and immersed in 5% of sulphuric acid (H_2SO_4) solution for 28days and 60 days. The pH value of the acidic media was 1. The pH value was periodically checked and maintained at 1. After 60-days of immersing in acid solution, the specimens are taken out and were washed in running water and kept in atmosphere for 2-day for constant weight. Subsequently the specimens are weighed and loss in weight and hence the percentage loss of weight and compressive strength was calculated.

4.6 Rapid Chloride Permeability Test

The rapid chloride permeability test for different concrete mixtures was carried out as per ASTM C-1202-97. This test method covers the determination of the electrical conductance of concrete to provide a rapid indication of its resistance to penetration of chloride ions.

Standard cylindrical disc specimens of size 100mm diameter and 50mm thick after 28 and 60 days water curing were used in this test. As per ASTMC 1202-97, specimens with other dimensions, when used for testing, the test result value of the total charge passed through, must e adjusted.

The apparatus consists of variable D.C. power supply which feeds constant stabilized voltage to the cells. The cells are made up of polymethyl methacrylate. The concrete specimens are kept in between the cells. The cells are connected to main instrument through 3 pin plug and socket for voltage feeding. The charge of current flowing through the specimen is measured using an accurate digital current meter. The cells have grooved recess on one face and closed at the other end. The specimen can be fit into the open faces of the cells. One of the cell is filled with sodium chloride (NaCl) solution (2.4M concentration and the other is filled with 0.3M sodium hydroxide (NaOH - 0.3M)) solution.

The cylindrical disc specimen are coated with quick setting epoxy on their curved faces and mounted in the open spaces of the two cells as shown in figure. After checking the leak proofness, a 60V potential difference is applied between the electrodes. The electro chemical cell in the assembly results in migration of chloride ions from sodium chloride solution to sodium hydroxide solution through the pores of the concrete specimen. The current passed was noted at every 30 minutes over a period of 6 hours and the total electric charge passed through the specimen is calculated using the expression

$$Q=900[I_0+I_{360}+2(I_{30}+I_{60}+I_{90}+I_{120}+I_{150}+I_{180}+I_{210}+I_{240}+I_{270}+I_{300}+I_{330})]$$

As per ASTMC-1202(5), the concrete resistance to chloride permeability is classified as follows.

Table 9: Permeability Classifications

Charge (coulombs)	Chloride Permeability
> 4000	High
2000-4000	Moderate
1000-2000	Low
100-1000	Very Low
< 100	Negligible

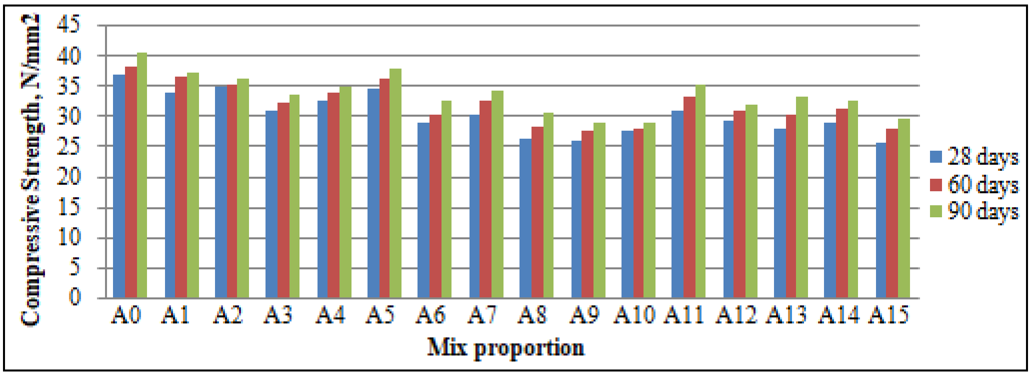
5. Experimental Results

Compressive Strength

The Compressive strength of M_{30} grade of concrete by replacing ordinary Portland cement with various percentage combinations of 5%, 10% and 15% SPD and 20%, 30% and 40% Nano Fly Ash. The results of compressive strength of A0, A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A13, A14 and A15 of concrete mixtures tested at 28days, 60days and 90 days are noted. The data is presented in the given below table no.11 and graphical representation of compressive strength shown in fig no.7.

Table 11: Compressive strength

Mix Proportions	Compressive strength N/mm^2		
	28 days	60 days	90 days
A0	37.1	38.4	40.8
A1	33.9	36.6	37.2
A2	34.9	35.5	36.4
A3	31.1	32.2	33.5
A4	32.6	33.9	35.1
A5	34.7	36.5	37.9
A6	28.8	30.2	32.5
A7	30.2	32.7	34.2
A8	26.4	28.4	30.6
A9	26.0	27.6	29.1
A10	27.5	28.1	28.9
A11	31.1	33.3	35.4
A12	29.4	30.9	32.1
A13	27.9	30.2	33.4
A14	29.1	31.4	32.5
A15	25.6	27.9	29.6



Acid Attack Test

Table 12: Acid Test

Mix Proportions	Compressive Strength, N/mm^2		% of Reduction in Strength	
	28 days	60 days	28 days	60 days
A0	34.2	31.5	10.9	22.8
A1	33.3	32.0	9.0	13.9
A2	31.8	30.4	10.4	16.4
A3	30.6	28.8	4.9	14.0
A4	31.3	29.5	7.6	15.9
A5	29.8	26.6	18.3	29.8
A6	29.5	25.4	2.3	21.8
A7	30.2	28.2	7.6	17.5
A8	26.6	24.3	6.3	20.5
A9	25.4	22.5	7.9	22.6
A10	26.2	24.8	6.7	14.1
A11	31.2	29.9	6.3	15.5
A12	29.8	26.6	13.2	17.1
A13	26.2	22.5	13.2	32.6
A14	28.5	26.5	9.2	18.4
A15	24.4	21.3	12.5	28.0

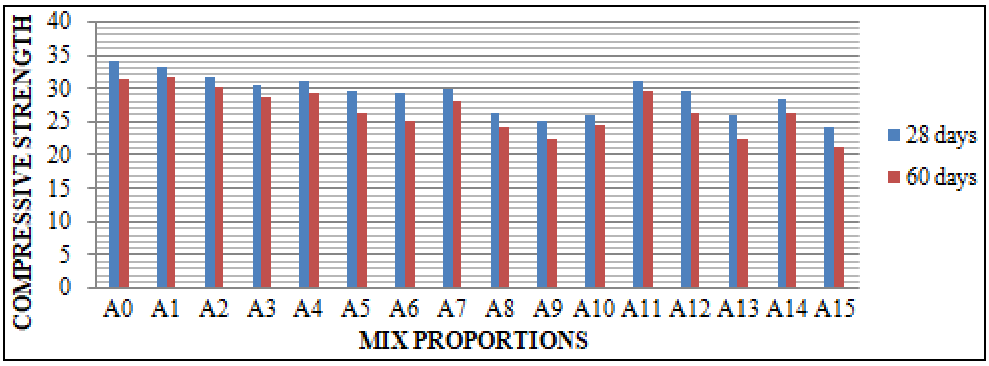


Figure 8: Acid test

Rapid Chloride Permeability Test

Table 13: Rapid chloride permeability Test

Mix Proportion	Chloride permeability in coloumbs	
	28 days	60 days
A0	2205.5	1753.6
A1	1523.5	1325.2
A2	1335.5	1320.5
A3	1128.8	1070.9
A4	642.4	594.4
A5	451.8	392
A6	337.2	303.1
A7	1088.9	966.6
A8	859.4	802.4
A9	654.5	578.9
A10	925.5	886.4
A11	785.2	707.4
A12	620.9	605.2
A13	882.4	792.8
A14	651.2	632.4
A15	489.3	335.8

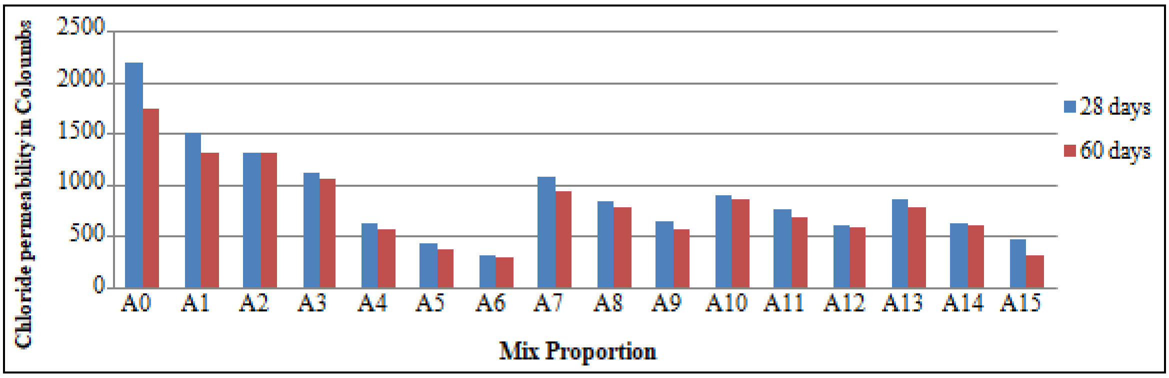


Figure 9: Rapid chloride permeability Test

5.6 Water Permeability Test

Table 14: Water Permeability Test

Mix Proportion	Weight gain (M in gm)	Depth of Penetration (d in cm)	Coefficient of permeability (K in m/sec)
A0	45	5.6	1.46×10^{-12}
A1	50	5.8	2.577×10^{-12}
A2	55	6.2	2.40×10^{-12}
A3	50	5.4	2.67×10^{-12}
A4	45	5.1	2.06×10^{-12}
A5	60	8.7	2.577×10^{-12}
A6	55	6.5	3.224×10^{-12}
A7	50	6.1	2.37×10^{-12}
A8	45	5.4	2.15×10^{-12}
A9	50	5.5	2.5×10^{-12}
A10	50	6.0	2.71×10^{-12}
A11	55	5.2	3.15×10^{-12}
A12	65	7.0	4.1×10^{-12}
A13	60	6.7	3.63×10^{-12}
A14	55	6.3	3.12×10^{-12}
A15	55	7.5	3.72×10^{-12}

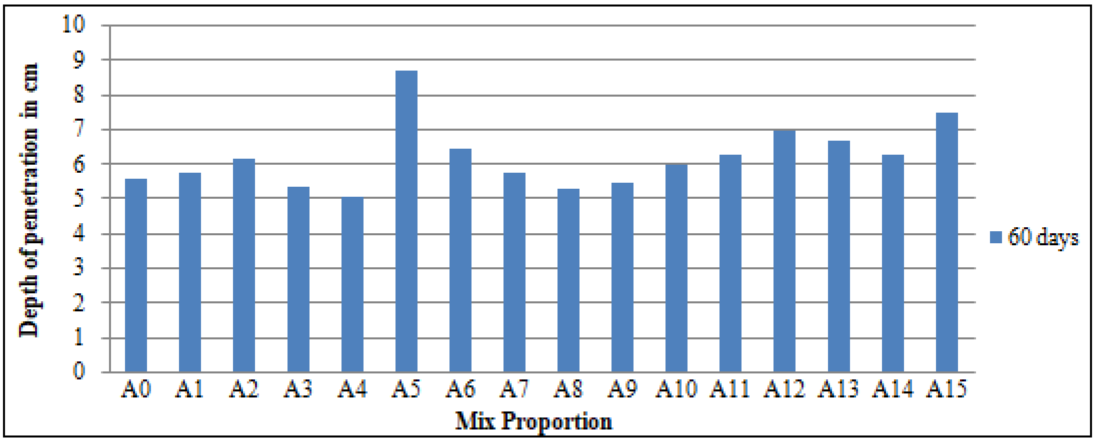


Figure 10: Water permeability Test

6. Conclusions and Suggestions for Future Study

1) The Durability properties of M_{30} concrete with replacement of OPC by Nano Fly Ash and Stone Powder Dust separately and the combination of Nano Fly Ash and Stone Powder dust can be improved.
2) The Acid resistance of M_{30} conventional concrete reduces 10.9 and 22.8% strength at 28 and 60 days of immersion in Acid water and replacement of OPC by 15% stone powder dust (i.e.,A_3), reduces 4.9% and 14% strength at 28 and 60 days, replacing of OPC by 20% Nano Fly ash (i.e.,A_7), reduces 7.6 and 15.9% strength at 28 and 60 days and replacing of OPC by combination of 30% Nano Fly ash and 10% Stone Powder Dust(i.e., A_{11}), reduces 6.3 and 15.5% at 28 and 60 days. Hence, Fly ash and Stone Powder Dust can be used to improve the acid resistance of conventional concrete.
3) The Chloride permeability of M_{30} concrete having 15% Stone Powder Dust and 85% cement (i.e.,A_3), 40% Nano Fly ash and 60%cement(i.e.,A_6), combination of

40% Nano Fly ash and 15%Stone Powder Dust (i.e.,A_{15}) have shown highest resistance to Chloride permeability. The total charge passed through the above specimen are 1128 coulombs (Low), 337 coulombs (Very low), 489 coulombs (Very low), at 28 days and 1070.9 coulombs (Low), 303.1 coulombs (Very low), 335.8 coulombs (Very low) at 60 days respectively.

4) The Water permeability of M_{30} concrete having 15% Stone Powder Dust and 85% cement (i.e., A_3) has shown in least penetration among the samples in which OPC is replaced by Stone Powder dust. And replacing OPC by 20% Nano Fly ash (i.e., A_4) has shown least water penetration among the concrete in which cement is replaced by Nano Flyash. And replacing OPC by Combination of 30% Nano Fly ash and 10% Stone Powder dust (i.e., A_{11}) has shown highest resistance to water penetration.
5) The use of Nano Fly Ash and Stone Powder dust makes conventional concrete not only durable but also economical.
6) Use of Stone Powder dust in R.C.C can be studied.
7) The properties of concrete with combination of high volume Nano Flyash and stone Powder dust can be studied.
8) Use of Stone Powder dust for lean concrete mixes can be studied.
9) The properties of Stone Powder Dust concrete using super plasticizer can be studied.
10) Usage of Stone Powder Dust for self-compacting concrete can be studied.

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