iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 2017 **Issue:** **Month of publication:** March 31, 2017

DOI:

Experimental Investigation of Partial Replacement of Fly Ash in Concrete by Varying Naoh Concentration

M. Aravindkumar[1], R. Prabakaran[1], V.Sriraman[2]
[1]*Student, B.E. Civil Engineering*
[2]*Assitant professor, Arjun College of Technology, Coimbatore, India*
[2]*Professor, Department of Civil Engineering, Arjun college of Technology, Coimbatore*

Abstract: ***Concrete can be extensively used in all building constructional activities and we make different in the concrete by using partial replacement of flyash (FA) with 3 different proportion from 10%,20%,30% and also decided to reduce the Co_2 in our concrete. The raw materials used in concrete Flyash , Cement ,Fine aggregate, Coarse aggregate and the chemicals (NaOH and Na_2sio_3)The concrete cost is less based on design calculation by the help of less usage of cement .The casting of cubes of 12 nos for different 7,14 and 28 days of curing of concrete and also we casted the beam of 4 nos with same stages of curing days of concrete. This report presents experimental study on strength parameters of partial replacement of cement by fly ash with NaOH and Na_2sio_3. To reduce the wastages produced by the industries and also make it into profitable materials. The fly ash as partially replaced at 10%, 20%, 30%, for cement. The compressive strength test is to be made for 7, 14 ,28 days of curing of concrete. The main objective of this experimental work is to be made a low cost concrete and also reduce the emission of Co_2 produced by concrete by using sodium hydroxide and sodium silicate and add the chemicals by 1M,2M,3M (1Molarity(M)=40 grams). Compression test and flexural strength can be tested for Cube and beam respectively***

I. INTRODUCTION

A. General

Concrete is a composite construction material composed primarily of aggregate, cement, and water. There are many formulations, which provide varied properties. The aggregate is generally coarse gravel or crushed rocks such as limestone, or granite, along with a fine aggregate such as sand. The cement, commonly Portland cement, and other cementitious materials such as fly ash and cement, serve as a binder for the aggregate.

B. Flyash

Presently about 105 million tons flyash is generated every year in India as a by-product of coal consumed in the thermal power plants. The thermal power plant is only the source to produce 65% of the total electricity produced in our country. Investigation on utilization of flyash in cement mortar is carried out in the literature. Several million tons of coal for generating the electricity is being consumed in India out of which 40% of coal is accounted for generating of flyash as a bye product. By the year 2010 more than 180 million tons of flyash would be generated every year. The type of flyash collected at the bottom of boiler furnace having lesser fineness & high carbon content is called bottom flyash.

C. Flyash concrete (fc)

Fly ash is a by-product of the combustion of pulverized coal in thermal power plants. It is removed by the dust collection system as a fine particulate residue from the combustion gases before they are discharged into the atmosphere. Fly ash particles are typically spherical, ranging in diameter from less than 1 micron to 150 micron, the majority being less than 45 micron. The range of particle sizes in any given fly ash is largely determined by the type of dust collection equipment used. The fly ash from boilers at some older plants, where mechanical collectors alone are employed, is coarser than from plants using electrostatic precipitators. The chemical composition of fly ash is determined by the types and relative amounts of incombustible matter in the coal used. More than *85%* of most fly ashes comprise chemical compounds and glasses formed from the elements of silicon, aluminum, iron, calcium and magnesium. Generally, fly ash from the combustion of sub-bituminous coals contains more calcium and less iron than fly ash from bituminous coal.

D. Cement replacement concrete

There has been a lot of research over using fly ash as additive in cement, admixture in concrete and cement replacement material in concrete. 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. But most of the research has been limited to few percentages of cement replacement or less grades of concrete. Hence, there borne a need to carry out an extensive research on compressive strength of different grades of concrete,different proportions of fly ash and different curing periods. Hence, a comparative study can be done and use of fly ash as a cement replacement in concrete can be analyzed and compared through various methods.

E. Chemical activity on flyash

The ability of fly ash and ground granulated blast furnace slag to react depends strongly on the alkali content and temperature of the ambient solution. They were dissolved in sodium hydroxide (NaOH) solutions of pOH 0.3, 0.6 and 1, and at various temperatures. The two fly ashes originate from two different power plants and have broad and mutually different particle size distributions. One power plant was a .wet-bottom. type plant that operates at 1800 oC (.EFA.); the other FA originates from a low NOx furnace plant (.LM.). For the dissolution experiments the particles were separated into a fraction of low density (cenospheres.) with a density smaller than 1400 kg/m3 and in a fraction of high density (.solid spheres.) with a density of 2300-2600 kg/m3. SEM images of polished sections of these fractions revealed that the cenospheres were hollow thin-walled spheres. The dissolution experiments were executed with the hollow cenospheres and the solid spheres, which differ in density about a factor of two. All dissolution experiments where executed with a sieved part of the fly ashes, the diameter lying between 38 μm and 50 μm. The fly ashes have also been ultrasonically vibrated to prevent agglomeration of small particles to large ones. As expected, dissolution rates (and related reaction rates as well) increased significantly with decreasing pOH (increasing pH) and temperature. The experiments revealed that for EFA and LM, Si, Al and K all congruently dissolve, implying bulk dissolution. Accordingly, the dissolution of one component, Si, represents an adequate measure forthe dissolution of the entire glass mass.

II. LITERATURE REVIEW

S. Gopala Krishnan, et al studied the effect of different percentages of replacement of cement, that of 15, 20, 25, 30% with fly ash for M80 concrete. W/(C+F) ratio and the quantity of C.A. were kept constant. The quantity of fine aggregate was suitable adjusted for different CRL (Concrete Replacement Levels) with fly ash. The reported that: incorporation of fly ash resulted in a marginal reduction in workability. But the mixes were more cohesive and free from any bleeding and aggregation. The finishing of the mix was also better.

S.S. Rehsi & S.K. Garg replaced 20% cement by weight with 27.5% fly ash by weight. Water requirement was kept at 8% less than the amount of water required to keep W/(C+F) ratio equal to W/C ratio of the corresponding plain cement concrete mix. The quality of sand was reduced and coarse aggregate increased by an amount equal to the weight of fly ash added.

Kraiwood Kiattikomal, et al reported that for class-F fly ash, it was the fineness, not the chemical composition that has significant effect on compressive strength of mortars. The mortars with finer fly ashes gained higher compressive strength than those with the coarser ones.

Dunstan, M.R.H in their studies at CANMET and university of Calgary, have indicated that structural concrete with 28days strength around 60MPa and of

adequate durability can be produced with Canadian fly ashes replacing up to 60% cement by weight and by incorporating high range water reducer and air entraining admixtures in concrete.

Rangan B.V. et al (2004), describes the effects of several factors on the properties of fly ash based on concrete, especially the compressive strength. The compressive strength of partial replacement concrete does not vary with the age of concrete. Commercially available Naphthalene based super plasticizer can be utilized to improve the workability of the fresh concrete without resulting in any segregation and degradation in the compressive strength up to 2% of this admixture by mass of fly ash. There is very little difference in compressive strength of specimens cured immediately after casting and those sent to curing 60 minutes after casting. Water content plays an important role in determining the compressive strength of partial replacement fly ash concrete as well as the workability of the fresh concrete. An increase in the curing temperature increases the concrete compressive strength, especially up to 75° C.

Cheak C.C. et al (2008), presented the study of partial replacement fly ash mortar cured in elevated temperature. Higher concentration of sodium hydroxide solution results in a higher compressive strength of partial replacement fly ash mortar. The activator to fly ash ratio, by mass of 0.40 produced the highest compressive strength of partial replacement fly ash concrete. As the ratio of water to solids by mass increases, the compressive strength of fly ash mortar decreases. The setting time of partial replacement fly ash mortar due to different curing temperature has been determined. The initial setting time and final setting time ranged from 129 minutes to 270 minutes.

Amol A. Patila, " Effect of curing condition on strength of partial replacement fly ash concrete "

This paper reports an experimental work conducted to investigate the effect of curing conditions on the compressive strength of partial replacement fly ash concrete prepared by using fly ash as base material and combination of sodium hydroxide and sodium silicate as alkaline activator. The partial replacement fly ash concrete aims at utilizing the maximum amount of fly ash and reduce CO2 emission in atmosphere by avoiding use of cement to making concrete.

III. METHODOLOGY

A. General

This chapter briefly explains the methodology adopts in this experimental work. From the literature review, it is decided as the use of sodium hydroxide and sodium silicate solution with the molar concentration of sodium hydroxide and sodium silicate as 1M, 2M and 3M.

The experiment investigation is conducted as detailed below. All the material tests were conducted in the laboratory as per relevant Indian Standard codes. Basic tests were conducted on fine aggregate, coarse aggregate, cement and water to check their suitability for control concrete making.

In the present study, two series of fly concrete specimens composing two different molar of sodium hydroxide (NaOH) and sodium silicate (Na2SiO3) which are 1M, 2M and 3M were adopted.

B. Methodology Adopted

This experimental study is restricted to 0.15 x 0.15x 0.15m cubes, and 1x0.15x0.25 m beams. Preliminary test were conducted on materials such as OPC53 grade cement, fine aggregate and coarse aggregate for finding the properties and by using these properties the mix ratio for M30 grade of concrete was calculated as per IS 10262:2009. Then compression test at 7 and 28 days and split tensile test and flexure test at 28 days were found.

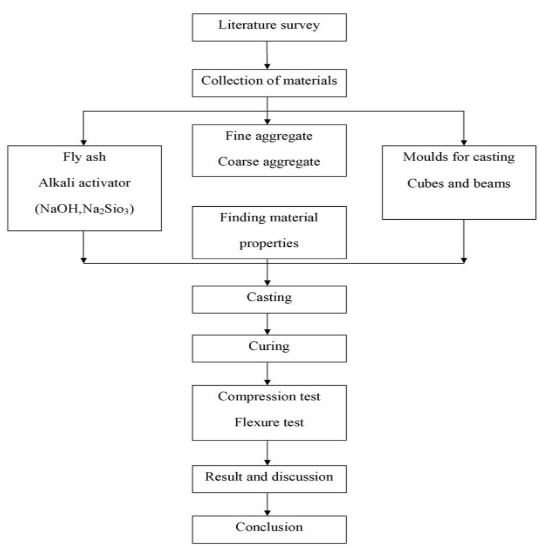

Figure 3.1 Methodology

C. Materials Used

1) Cemen
2) Coarse aggregate
3) Fine aggregate
4) Fly as
5) Sodium hydroxide
6) Sodium silicate
7) Super plasticizer

IV. EXPERIMENTAL INVESTIGATION

A. Cement

S.No	Properties	Test values
1.	Specific gravity	3.14
2.	Standard consistency	26%
3.	Initial setting time	40 min
4.	Final setting time	246 min
5.	fineness	3%

B. Fly ash

1) In this experimental investigation fly ash is used for partial replacement of cement.
2) The fly ash having the specific gravity of 2.35 obtained from Thermal Power Station located in Mettur.
3) It is used to replaced for cement at 10%,20%,30%.

C. Fine Aggregate

Locally available river sand passing through 4.75 mm and retained on 150 micron IS sieves is taken as fine aggregate conforming to zone II as per IS 383-1970.

S.No	Properties	Test values
1.	Specific gravity	2.72
2.	Fineness modulus	2.57
3.	Water absorption	0.75
4.	Bulk density (Kg/m^3)	1460

D. Coarse Aggregate

1) The coarse aggregate is obtained from local area and it is having the size less than 20 mm for this experimental work.

S.No	Properties	Test values
1.	Specific gravity	2.88
2.	Fineness modulus	3.44
3.	Water absorption	0.97
4.	Impact value	12.5
5.	Flakiness index	35.85
6.	Crushing value	12.4
7.	Elongation index	45.45

V. RESULT ANALYSIS

Compressive test values for 7days

S.No	% Of fly ash	Molarity (M)($NaOH \& Na_2Sio_3$)	Compressive strength (N/mm^2)
1	Control	-	17.79
2	10%	1M	16.82
3	20%	2M	17.54
4	30%	3M	18.23

Compressive test values for 28 days

S.No	% Of fly ash	Molarity (M)($NaOH \& Na_2Sio_3$)	Compressive strength (N/mm^2)
1	Control	-	32.89
2	10%	1M	31.25
3	20%	2M	32.27
4	30%	3M	32.97

VI. CONCLUSION BASED ON TEST RESULTS

The fly ash 30% replaced by cement and 3Molarity of NaOH is increased in the optimum compressive strength in 7 days and 28 days

REFERENCES

[1] Abdul Aleem M I (2012) "Fly ash concrete- A review" International Journal of Engineering Sciences & Emerging Technologies : 118-122

[2] Bakharev, T. (2005). "fly ash Materials Prepared Using Class F Fly Ash and Elevated Temperature Curing." Cement and Concrete Research: 1224-1232.

[3] B V Rangan, "FLY ASH CONCRETE : A REVIEW OF DEVELOPMENT AND OPPORTUNITIES" Concrete & Structures, August 2010

[4] Palomo, A., M. W. Grutzeck, et al. (1999). "Alkali-Activated Fly Ashes, A Cement for the Future." Cement and Concrete Research: 1323-1329.

[5] Is 10262:2009, "guidelines for concrete mix design" Bureau of Indian standards ,new Delhi, India.

[6] k.Aparnasrivastav international journals of new innovations in engineering and technology.

[7] Barbosa, V.F. F., K.J.D. MacKenzie, et al. (2000). "Synthesis and Characterisation of Materials Based on Inorganic Polymers of Alumina and Silica: Sodium Polysialate Polymers." International Journal of Inorganic Materials : 309-317