International Journal of Research (IJR)
e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 06, June 2015
Available at http://internationaljournalofresearch.org

CHARACTERISTICS OF HIGH VOLUME FLYASH IN CEMENT

K.Shyam Chamberlin**; r.syam Kumar *; v.taraka ram *; D.SAI * & ch.sai kalyan*
** (Faculty, Department of Civil Engineering, K.L.University, Andhra Pradesh, India)
*(Students, Department of civil Engineering, K.L.University, Andhra Pradesh, India)

ABSTRACT:

*The experimental study is based on the partial replacement of high volume fly ash in cement with different proportions. The utilization of fly ash is increasing now a days because the over usage of the cement can cause lot of increase in the carbon dioxide so that it effects the atmosphere. So it is better to use fly ash which is less pollutant. Many experiments have proved that cement has the strength to sustain any loads. But according to codal provisions' fly ash can resist up to 30 % when it is mixed with pozzolona Portland cement actually known as blended cement. So the fly ash is tested whether it can have the compressive strength when using the high volume flyash.The properties of cement like the standard consistency of the cement when replaced with fly ash in high volume is tested in this study and the compressive strength for 7, 28 days is tested by casting the cement mortar cubes of 7.07*7.07*7.07 cm. The class-F fly ash is used in preparing cement mortar cubes in a 1:3 ratio for the compressive strength are to be tested. Out of the various proportions the mortar mix of (1: 3 ratio is used) 30%, 40 %, 50%, 60 %, 70%, 80 % of fly ash is replaced.*

I .INTRODCUTION:

Fly ash is an industrial waste and a material of pozzolanic characteristic Portland due to burning the pulverized coal in the thermal power plants. **Fly ash**, also known as flue-ash, is one of the residues generated in combustion, and comprises the fine particles that rise with the flue gases. Ash that does not rise is called bottom ash. Fly ash is used as a supplementary cementitious material (SCM) in the production of Portland cement mortar. A pozzolan is defined as a siliceous or siliceous and aluminous material that in itself possesses little or no cementitious value, but that will, in finely divided form and in the presence of moisture, chemically reacts with calcium hydroxide at ordinary temperatures to form compounds having cementitious properties. The Supplementary Cementing Materials (SCM) most commonly used includes Fly ash, Silica fume and ground granulated blast furnace slag. Among these Fly ash is most suitable SCM to partially replace cement in fibre cement sheets. The benefits of SCM's are well known, proper enrichment of fly ash with calcium helps produce stronger and more durable. Fly ash is a waste product generated by thermal power stations; it is usually much cheaper than cement in India and hence offers saving in product cost. Most importantly replacing cement with fly ash reduces Green House Gas (GHG) emissions such as carbon dioxide. Production of one tonnage of cement emits one tonnage of CO2. Apart from this, cement substitution with fly ash saves natural resources such as limestone and coal, which are used for the manufacturing of cement. Fly ash in India contains low CaO (less than 10%) and is obtained by burning bituminous coal. Thus such a fly ash containing fibre cement sheets exhibits low early strength even at an optimal dosage of 10-20 %.

Two classes of fly ash are defined by **ASTM C618**: Class F fly ash and Class C fly ash. The chief difference between these classes is the amount of calcium, silica, alumina, and iron content in the ash. The chemical properties of the fly ash are largely influenced by the chemical content of the coal burned.

International Journal of Research
International Journal of Research (IJR)
e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 06, June 2015
Available at http://internationaljournalofresearch.org

Class F fly ash: The burning of harder, older anthracite and bituminous coal typically produces Class F fly ash. This fly ash is pozzalonic in nature, and contains less than 20% lime (CaO).

$$SiO2 + Al2O3 + Fe2O3 \geq 70\%$$

Class C fly ash: Fly ash produced from the burning of younger lignite or sub-bituminous coal, in addition to having pozzolanic properties, also has some self-cementing properties. In the presence of water, Class C fly ash hardens and gets stronger over time. Class C fly ash generally contains more than 20% lime (CaO).

$$SiO2 + Al2O3 + Fe2O3 \geq 50\%$$

Table 1 : Dosage Levels of Fly Ash

Level of Fly Ash % by mass of total cementitious material	Classification
<15	Low
15-30	Moderate
30-50	High
>50	Very High

Cement: Cement is a binder, a substance that sets and hardens and can bind other materials together. Cements used in construction can be characterized as being either hydraulic or non-hydraulic, depending upon the ability of the cement to be used in the presence of water.

Portland Pozzolana Cement (PPC) The Portland Pozzolana Cement is a kind of Blended Cement which is produced by either intergrinding of OPC clinker along with gypsum and pozzolanic materials in certain proportions or grinding the OPC clinker, gypsum and Pozzolanic materials separately and thoroughly blending them in certain proportions.

Pozzolana is a natural or artificial material containing silica in a reactive form. It may be further discussed as siliceous or siliceous and aluminous material which in itself possesses little, or no cementitious properties**.** In this experimental study we are using the pozzolana Portland cement.

II.EXPERIMENTAL INVESTIGATIONS

The methodology adopted for the experimental studies are fully been described by taking the cement mortar ratio as 1:3 (cement: fine aggregate). The cement of 200grams and 600 grams of fine aggregate are taken for preparing each mortar cube. The different proportions of flyash are taken as the replacement in the cement. As the Portland cement can replace upto 30% fly ash in it. The experimental works are done by replacing the fly ash from 30 % to 80 % in cement. The class F fly ash is used in this experiment. Many researchers indicated that low calcium flyash (class F fly ash) also improves the interfacial zone microstructure. Portland cement hydrates to produce calcium hydroxide as much as 20% to 25% by weight. This compound besides other alkali oxides like Na2O, K2O generates alkalinity.when the pozzolanic materials in the form of fly ash are added to the cements, the C-H of hydrated cement is consumed by the reactive SiO2 portion of these pozzolanas. This pozzolanic reaction improves microstructure of cement composites as additional C-S-H gel is formed and also the pore size refinement of the hydrated cement occurs. Hydration of tricalcium-aluminate in the ash provides one of the primary cementitious products in many ashes. The rapid rate at which hydration of the tri-calcium-aluminate results in the rapid set of these materials and is the reason why the delay in compaction result in lower strengths of the stabilized material. The standard consistency of

International Journal of Research (IJR)
e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 06, June 2015
Available at http://internationaljournalofresearch.org

the cement is by replacing the fly ash in cement from 30% to 80% so that the water content value can be found out by using the water content formula from **IS 4031.6.1988**.

Water content is (P/4+3) %

P is the Standard consistency of cement.

Three cubes samples were cast on the mould of size 7.07*7.07*7.07 cm for 1:3 cement mortars with partial replacement of cement with fly ash as 30%, 40%, 50%, 60%, 70%, 80%, and the w/c ratio as 0.6. In case of fly ash mortar,it was observed that certain specimens could not be taken out from the steel mould in 24h indicating that the rate of gain of strength was slower in first 2 days. After about 48h the specimens' were de-moulded and moist curing was continued till the respective specimens were tested after 28 days for compressive strength.

III. Compressive strength:

Compressive strength tests were performed on compression testing machine using cube samples. Three samples for each proportion were tested with the average strength values reported in this paper. The loading rate on the cube is 0.1mm/min. the comparative studies were made on their characteristics for 1:3 cement mortars with partial replacement of cement with fly ash as 30%, 40%, 50%, 60%, 70%, and 80%.

IV. RESULTS AND DISCUSSIONS:

The standard consistency of the cement with replacement of fly ash in it from Table 2. The fig 1 indicates that the standard consistency is increasing with the increase in the replacement of fly ash. The compressive strength for 7 days and 28 days is tested and the values are noted in Table 3 for 7 days and Table 4 for 28 days. The fig 2 indicates that the compressive strength is decreasing with the increase in the replacement of fly ash. The 28 days compressive strength also indicates the same that the compressive strength is reducing with the increase in the fly ash content in cement mortar.

Table 2: Standard consistency of cement with fly ash replacement

S.no	% fly ash in cement	Standard consistency
1	30%	33.5%
2	40%	35%
3	50%	36.5%
4	60%	38%
5	70%	41.5%
6	80%	42%

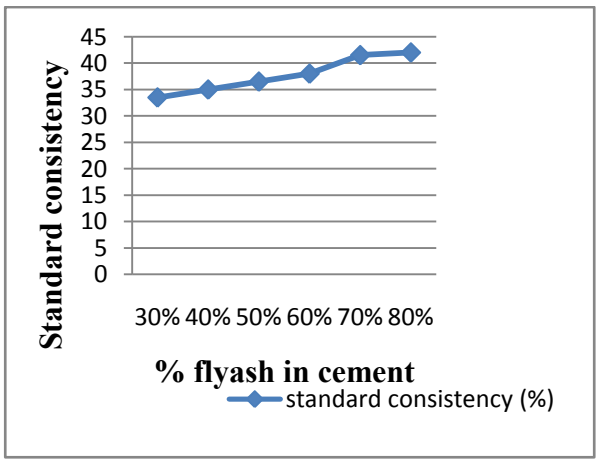

FIG 1: Standard consistency of fly ash replaced in cement

International Journal of Research (IJR)
e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 06, June 2015
Available at http://internationaljournalofresearch.org

TABLE 3: COMPRESSIVE STRENGTH FOR 7 DAYS

COMPOSITION (PPC+ FLY ASH)	COMPRESSIVE STRENGTH FOR 7 DAYS (N/MM2)			
	TRIAL 1	TRIAL 2	TRIAL 3	MEAN
70%+30%	18.24	27.4	23.04	22.89
60%+40%	21.86	25.59	14.41	20.62
50%+50%	10.68	18.63	22.45	17.25
40%+60%	9.31	16.27	20.39	15.32
30%+70%	10.98	6.57	3.13	6.89
20% + 80%	2.05	0.49	1.47	1.33

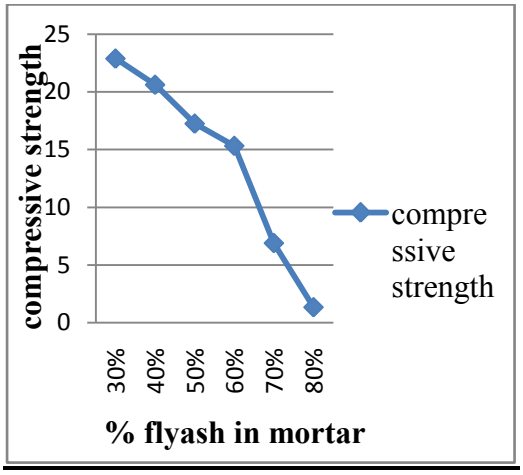

Fig 2: **COMPRESSIVE STRENGTH FOR 7 DAYS**

TABLE 4: COMPRESSIVE STRENGTH FOR 28 DAYS

COMPOSITION (PPC+ FLY ASH)	COMPRESSIVE STRENGTH FOR 28 DAYS N/MM2			
	TRIAL 1	TRIAL 2	TRIAL 3	MEAN
70%+30%	32.10	24.07	28.48	28.21
60%+40%	26.28	24.4	20.06	23.58
50%+50%	19.65	22.6	17.2	19.81
40%+60%	17.4	14.06	19.23	16.86
30%+70%	8.22	12.03	5.69	8.64
20%+80%	1.20	3.30	2.92	2.47

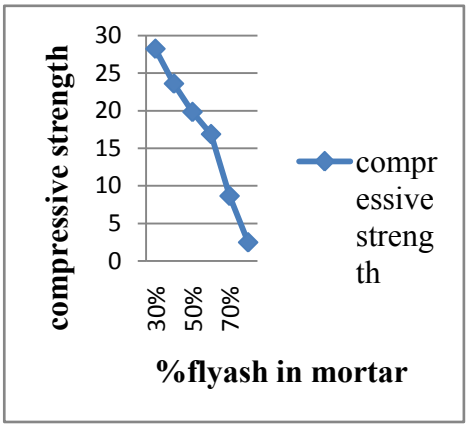

Fig 3 : **COMPRESSIVE STRENGTH FOR 28 DAYS**

V. Conclusion:

As the pollution is increasing day by day due to increase in the carbon content and decrease in the oxygen in the atmosphere**.** According to the International Energy Agency, cement production alone accounts for 7 % of total global CO2 emissions. Increasing of the cement production can result in the increase of the carbon dioxide in the environment so that it can affect the atmosphere. So by replacing the fly ash which is the waste material from thermal plants and cheap in cost. This does not emit atmospheric pollution gases so the fly ash can be environmental friendly and we can use it in the replacement of cement. The class F fly ash is used in this cement mortar and the compressive strength is found out for the different proportions of the fly ash in the cement by finding out the properties of the cement like the standard consistency of cement with the different proportion. From the experimental works conclusion can be that till 50 % usage of fly ash is safe in cement so that we can get an appropriate compressive strength. < 50% the strength is considerably reducing slowly. The usage of the 80% failure is not appropriate that the minimum strength is not achieved by the cement mortar cube. High volume of fly ash is cement can be recommended to certain

proportion (i.e.. till 50%) .Greater than 50%(<50%) the high volume of fly ash in mortar is not recommended and can cause damage due to less strength. These can also be used as a plastering the walls.

VI. REFERENCES:

[1]. High volume fly ash concrete (HVFC) L.K.crouch, Ryan Hewitt, ben byard.

[2]. Effects of fly ash fineness on the mechanical properties of concrete, Semsi yazici, Hasansahan arel.

[3]. Advantages of using fly ash as a supplementary cementing material in fibre cement sheets, Jagadesh, Sunku.

[4]. Use of fly ash as partial replacement of sand in cement mortar, Abhishek Jain1, Nazrul Islam.

[5]. Performance of Fly Ash and High Volume Fly Ash Concrete in Pavement Design
Yash Shrivastava and Ketan Bajaj.

[6]. Fly Ash Class F*:* Opportunities for Development of Low Cost Mortar, Rushabh A. Shah, and Jayeshkumar Pitroda.

[7] .Investigation on fly ash as a partial cement replacement in concrete, Faseyemi V.A.

[8].optimizing the usage of fly ash in concrete Michael Thomas, Ph.D., P.Eng. Professor of Civil Engineering, University of New Brunswick.

[9]. PhD thesis of Dr N Sanjeev, "Structural Appraisal of RCC Members with High Volume Fly Ash Concrete".