International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 11 Issue 6 ǁ June 2023 ǁ PP. 257-265

Study on Effect of Alccofin & Fly Ash Addition in the Concrete

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ABSTRACT
In concrete, cement is a binding material, but cement is expensive due to excessive cost of transportation from manufacturing plant. Also large scale depletion of these sources creates environmental problems. In that case flyash which are obtain from thermal power plant as a waste product is best alternative material to cement, and alccofine can gives better bond strength which are having properties more than cement. However the gradual reduction in the numbers of skilled workers in construction industries has led to a similar reduction in the quality of construction works.
Infrastructural Development is at its peak all over the world and is a symbol of growth for any country. But, as every coin has two faces - Concrete is no exception. The negativity attached to construction industry is that concrete, the most popular constructionmaterial, involves use of cement which is responsible for 7% of total world's carbon dioxide emissions. Carbon dioxide is the main threat in causing global warming of the environment. Though attempts have been made to reduce CO_2 *emissions in environment by all possible means, but cement has not found a suitable replacement for it till date. so because of it we are replacing cement by flyash and alccofine in same percentage.*
Also disposal of unutilized fly ash causes severe ecological problems and is quiteexpensive. This study was undertaken to utilize large quantities of Class F fly ash produced in India, where utilization is in limited percent. So, this investigation explored the possibility of reducing the cement consumption in concrete with Class F fly ash in concrete.
We oriented that direction the study of experimental investigations on High performance concrete with partial replacement of cement by alccofine and flyash with various compositions and study its Compressive strength and slum, flow test etc.
Keywords: *- Cement, Alccofine, Flyash and High Performance Concrete.*

Date of Submission: 05-06-2023 Date of acceptance: 18-06-2023

I. INTRODUCTION

General Concrete is probably the most extensively used construction material in the world.However, when the high range water reducer or super plasticizer was invented and began to be used to decrease the water/cement (w/c) or water/binder (w/b) ratios rather than being exclusively used as fluid modifiers for normal-strength concretes, it was found that in addition to improvement in strength, concretes with very low w/c or w/b ratios also demonstrated other improved characteristics, such as higher fluidity, higher elastic modulus, higher flexural strength, lower permeability, improved abrasion resistance, and better durability. This fact led to the development of HPC. It has become more popular these days and is being used in many prestigious projects such as Nuclear power projects,flyovers, multistoried buildings etc.

High performance concrete (HPC) may be regarded as synonymous with high strength concrete (HSC). It is because lowering of water-to-cement ratio,which is needed to attain high strength, also generally improves other properties. However, it is now recognized that with the addition of mineral admixtures HPC can be achieved by further lowering water-to-cement ratio, but without its certain adverse effects on the properties of the material. environments. The addition of mineral admixture in cement has dramatically increased along with the development of concrete industry, due to the consideration of cost saving, energy saving, environmental protection and conservation of resources. However, environmental concerns both in terms ofcarbon dioxide emission during cement manufacture have brought pressures to reduce cement consumption by the use of supplementary materials.

Mineral admixtures such as fly ash, rice husk ash, silica fume etc are more commonly used in the development of HPC mixes. They help in obtaining both higher performance and economy.Concrete is considered as durable and strong material. Reinforced concrete is one of the most popular materials used for construction around the world. Reinforced concrete is exposed to deterioration in some regions especially in coastal regions. There for researchers around the world are directing their efforts towards developing a new material to overcome this problem. Invention of large construction plants and equipment's around the world added to the increased use of material.

1.1.2 ALCCOFIN

In high performance concrete applications, ALCCOFINE is generally proposed as the appropriate cement extender where high strength, low permeability are the prime requirements. Though ALCCOFINE is known to improve durability, its addition in concrete is often negated by the increase water and/or admixture dosage required to improve the workability and handling properties of the fresh concrete. Due to its unique chemistry and ultra fine particle size, ALCCOFINE provides reduced water demand for a given workability, even up to 70% replacement level as per requirement of concrete performance. ALCCOFINE can also be used as a high range water reducer to improve compressive strength or as a super workability aid to improve flow.

1.1.3 FLY ASH

Fly ash is the residue obtained from combustion of pulverized coal collected by the mechanical or electrostatics separators of the fuel gases of thermal power plants. Fly ash mainly consist mainly of spherical glassy particle ranging from 1 to 150 micrometers in diameter, out of which the bulk passes through a 45 micrometer sieve. The fly ash may be used in concrete either as a mineral admixture or in part replacement of cement. The pozzolanic activity is due to the presence of finally divided glassy silica and lime, which produce calcium silicates hydrate (C-S-H) responsible for strength development.

Due to the difference in densities of cement and fly ash, a part replacement by equal mass increase the volume of cementations materials; whereas replacement by equal volume reduces the mass in practice the replacement of cement by fly ash isusually on the mass basis.

1.1.4 COMPOSITION OF HIGH PERFORMANCE CONCRETE

The composition of HPC usually consists of cement, water, fine sand, superplasticizer, fly ash and alccofine. Sometimes, quartz flour and fibre are the components as well for HPC having ultra strength and ultra ductility, respectively.

II. LITERATURE REVIEW

2.1 GENERAL

The concrete industry, due to its large size, is the ideal home for economic and safe incorporation of millions of tones of industrial by-products such as fly ash. Therefore large-scale cement replacement in concrete by fly ash and alccofine will be highlyadvantageous from the standpoint of cost, economy, energy efficiency, durability, and overall ecological and environmental benefits.

2.2 LITERATURE SURVEY

Dale P. Bentz (1997) [1] have studied on mortar cubes compressive strengths with three variables of particle size distribution, volume of fly ash Content 20% to 65% and at six ages of strengths which show the significant influence on compressive strengths. Mixtures with 20% fly ash were able to develop compressive strengths exceeding those of the control mixture at all six testing ages. Mixtures with 35% fly ash approached, and in a few cases equaled, the performance of the control mix. Mixtures with either 50% or 65% fly ash provided compressive strengths that were significantly below those of the control mix at all testing ages.

Saíd Jalali (1998) [2] "durability of high-performance concrete with fly ash"**.** In this study they have mention that High-performance concrete (HPC) is usually produced using high quality materials. These high quality constituents drastically increase the initial cost of HPC, hence hindering its more widespread use.

C.S. Poon and L. Lam, Y.L. Wong, (1999) [3] have studied on high strength concrete prepared with large volumes of low calcium fly ash. The parameters studied included compressive strength, heat of hydration, chloride diffusivity, degree of hydration, and pore structures of fly ash/ cement concrete and corresponding pastes. The experimental results showed that concrete with a 28-day compressive strength of 80 MPa could be obtained with a water-to-binder (w/b) ratio of 0.24, with a fly ash content of 45%. Such concrete has lower heat of hydration and chloride diffusivity than the equivalent plain cement concrete or concrete prepared with lower fly ash contents.

Georg Dirk et al (2000) [4] have investigated that low lime Class F fly ashes, which according to ASTM C 618

have CaO content less than 10%. The paper briefly describes the benefits that can be imparted to the performance of concrete by using processed fly ash and how this performance of concrete can be further enhanced with increasing fineness of fly ash, in three aspects, namely in its (i) fresh state: mainly workability, stability and temperature rise, (ii) hardened state: mainly compressive strength and the associated engineering properties such as tensile strength and modulus of elasticity (iii) durability: mainly permeation properties and resistance to chloride ingress and therefore corrosion of steel reinforcement, sulfate attack and alkali – silica reaction.
Bouzoubaa et al (2001) [5] At CANMET Canada has done studies on the mechanical properties of concrete made with blended high volume fly ash cements.

properties of high volume fly ash cements and mortars have been also been studied. The use of the high volume fly ash cements improves the resistance of the concreteto the chloride ion penetration.
K. S. Kulkarni at al (2002) [6] has compared the two trial mixes of HPC whichwere designed to produce at least M80 grade concrete having pumpable workability. The two trial combinations attempted are named as HPC-O and HPC-M. HPC-O contains 100 % Ordinary Portland cement (OPC) and HPC-M contains 30% Micro Cement and 70% OPC.

permeability and hence the durability characteristics of HVFAC are far more superior to plain concrete. The setting time at DMRC project was unduly long while at MCD was quite like plain concrete suggesting the importance of choosing the correct type ofplasticizer.

III. METHODOLOGY & INVESTIGATION

To achieve the objective of present investigation, extensive and comprehensive experimental programmed has been planned. The entire investigation has been classified into various distinct phases of work for through and systematic approach. These phases ofwork are as follows:
The materials used for High performance concrete are selected from those by the conventional concrete industry. Typical materials used for High performance concrete are coarse aggregate, fine aggregate, cement, Fly ash, chemical admixtures and alccofine. High performance concrete can be designed and constructed using a broad range of normal concreting materials, and that this is essential for High performance concrete to gain popularity.
CEMENT: OPC 53 grade Ultratech Cement is used. Following test are performed:

a) Standard Consistency
b) Setting Time
c) Compressive Strength

These test are carried out as per the relevant IS code of practice. These testresult are presented in table no.3.2.1.1

TABLE 3.2.1.1 PROPERTIES OF CEMENT

Crushed stone sand (CSS) from Dindori source is used.
FINE AGGREGATE:

TESTS	RESULTS		
	10mm	20mm	CSS
Specific gravity	2.85	2.9	3.0
Water Absorption	2.5%	1.5%	2.72%
Bulk Density			
a) Un-compacted	1568Kg/m^3	1560Kg/m^3	1657Kg/m^3
b) Compacted	1687Kg/m^3	1684Kg/m^3	1792Kg/m^3
Elongation Index	25%	13.30%	

(Tests Above Are Determined In Accordance With B.S.812)

TABLE 3.2.2.1: PROPERTIES OF COURSE & FINE AGGREGATE

Sieve mm	Weight Retained (Cumulati ve)Kg	% Retain ed	% Passing	Limits
40 mm	0	0	100	100
20 mm	27	1.35	98.5	85-100
16 mm	765	38.65	61.75	
12.5 mm	1465	73.25	26.75	
10 mm	1923	6.15	3.85	0-20
4.75 mm	1999	99.95	0.05	0-10
2.36 mm	1999	99.95	0.05	0-5

TABLE 3.2.2.2: GRADING AND FINES CONTENT FOR 20MM

Sieve mm	Weight Retained (Cumulati ve)Kg	% Retained	% Passing	Limits
12.5 mm	0	0	100	100
10 mm	88	8.8	91.2	85-100
4.75 mm	969	96.9	3.1	0-20
2.36 mm	999	99.9	0.1	0-5

TABLE 3.2.2.3: GRADING AND FINES CONTENT FOR 10MM

Sieve mm	Weight Retained (Cumulat ive)Kg	% Retained	% Passing	Limits
10 mm	0	0	100	100
4.75 mm	8	1.6	98.4	90-100
2.36 mm	153	30.6	69.4	60-95
1.18 mm	276	55.2	44.8	30-70
600 µm	353	70.6	29.4	15-34
300 µm	396	79.2	20.8	0-10
150 µm	430	86	14	0-20
75 µm	430	92	8	0-15

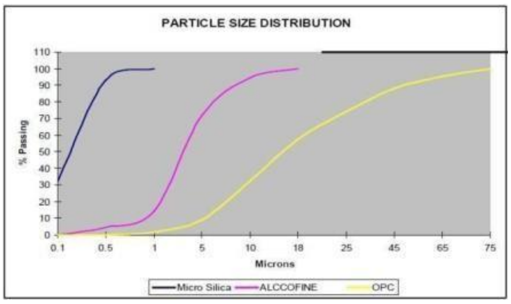
TABLE 3.2.2.4: Grading and fines content for C.S.S

Sr. No	Physical Properties	Pozzocrete - 60	Specification as per IS 3812-1981
1.	Color	Light grey	---
2.	Residue retained on 45 µm sieve	10.00%	34% max.
3.	Fineness	362 m^2/kg	320 m^2/kg

4 .	Specific gravity	2.3	---
5 .	Moisture content (Max.)	0.23%	2% max.

GRAPH 1: PARTICLE SIZE DISTRIBUTION

FLY ASH: Fly ash used is from bhusawal and its grade is P-60



The test results are described in the table no 3.2.3.1

TABLE 3.2.3.1: PHYSICAL PROPERTIES OF FLY ASH
3.2.4:
PROPERTIES OF ALCCOFINE

As can be seen in the chemical composition and physical characteristics listedin Table 1, ALCCOFINE has got the unique chemical composition mainly of CaO 31-33% and SiO2 33-35%. Physically the product is unique with regards to its particle size distribution.**CHEMIC ALANALYSIS**	**MAS S %**	**PHYSICA L ANALYSI S**	**RANG E**
CaO	32-34	Bulk Density	600-700 kg/m3
Al2O3	18-20	Surface Area	12000 cm2/gm
Fe2O3 SO3	1.8-2 0.3-0.7	Particle shape Particle Size, d10	Irregula r < 2 µ
MgO	8-10	d50	< 5µ
SiO2	33-35	d90	< 9 µ

Trial Mix procedure carried out by us in laboratory

4.1 RESULT AND DISCUSSION

In this phase the properties of HPC concrete mix with varying percentage of flyash and alccofine have been tested and their result compiled systematically in a tabular form. Their results are presented graphically for better understanding and to establish possible relationships.

Experimental observation: Table no. present the compressive strength for varying percentage of fly ash with and without alccofine and also pure OPC tested at 7days, 28 days with curing period of 28 days.

Relationship between strength of concrete for various percentage of fly ash and alccofine at 7 days, 28 days are presented in graph.

Concrete is the most popular construction material, with more than 11.1 billion tons of concrete consumed annually worldwide. The requirement of cement increases with time and it was estimated that each ton of cement produced generates an equal amount of carbon dioxide. The production of cement is responsible for 7% of global greenhouse gas emission created by human activities. Simultaneously, there has been enormous increase in the quantity of fly ash generated, the disposal of which pose serious problem due to shortage of dumping sites and steep rise in dumping cost.

In same construction of high rise buildings there is big problem of pumping of fresh concrete up to top floor of building during time of construction at that time HPC plays a very important role.

Therefore, incorporating sustainability concerns into the design of civil engineering materials is urgently needed.

4.1.1 Slum flow Test Result Table 14: Slum flow test

Designation	Flow(mm)	
	Set1	Set 2
OPC+PFA+ALCCOFINE	250	620
OPC+PFA	280	700
PURE OPC	180	350

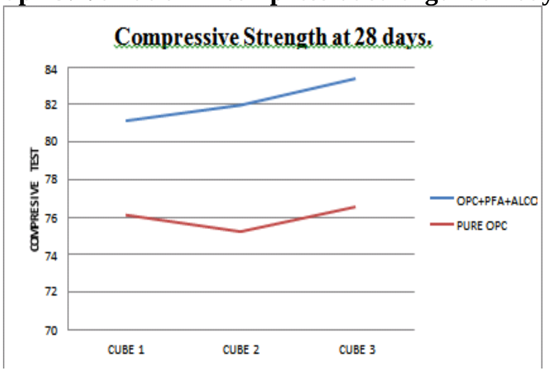
4.2 Table 15: Compressive strength after 7 day. Cube size: 100mmX100mmX100mm

DESINGNATION	GRE AD	CAS T DAT E	TES T DAT E	AG E AT TE ST	COMPRE SSIV STRENG TH N/MM^2	NOMI NAL DENSI TY KG/M^3
OPC+PFA+ALCOFINE	M60	13.01.20	20.01.20	7	53.90	2512
OPC+PFA+ALCOFINE	M60	13.01.20	20.01.20	7	54.67	2522
OPC+PFA+ALCOFINE	M60	13.01.20	20.01.20	7	55.67	2527
OPC+PFA	M60	13.01.20	20.01.20	7	DISCARDED	_
OPC+PFA	M60	13.01.20	20.01.20	7	DISCARDED	_
OPC+PFA	M60	13.01.20	20.01.20	7	DISCARDED	_
PURE OPC	M60	13.01.20	20.01.20	7	58.56	1387.0
PURE OPC	M60	13.01.20	20.01.20	7	60.10	1422.8
PURE OPC	M60	13.01.20	20.01.20	7	58.70	1408.5

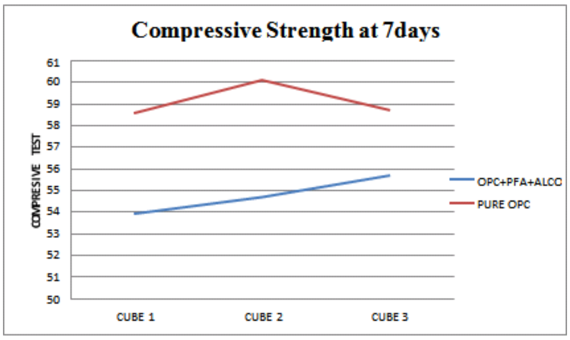
4.3 Table 16: Compressive strength after 28 day. Cube size: 100mmX100mmX100mm

DESINGNATIO N	GRE AD	CAST DAT E	TES T DAT E	AG E AT TES T	COMPR ESSIV STRENG TH N/MM^2	NOMIN AL DENSI TY KG/M^3
OPC+PFA+AL COFINE	M60	13.0 1.20	10.0 2.20	28	81.13	1212 .8
OPC+PFA+AL COFINE	M60	13.0 1.20	10.0 2.20	28	81.96	1236 .0
OPC+PFA+AL COFINE	M60	13.0 1.20	10.0 2.20	28	83.37	1252 .6
OPC+ PFA	M60	13.0 1.20	10.0 2.20	28	DISCA RDED	_
OPC+ PFA	M60	13.0 1.20	10.0 2.20	28	DISCA RDED	_
OPC+ PFA	M60	13.0 1.20	10.0 2.20	28	DISCA RDED	_
PURE OPC	M60	13.0 1.20	10.0 2.20	28	76.09	1712 .0
PURE OPC	M60	13.0 1.20	10.0 2.20	28	75.23	1692 .7
PURE OPC	M60	13.0 1.20	10.0 2.20	28	76.52	1721 .8

Graph 3: Variation in compressive strength at 7 days.

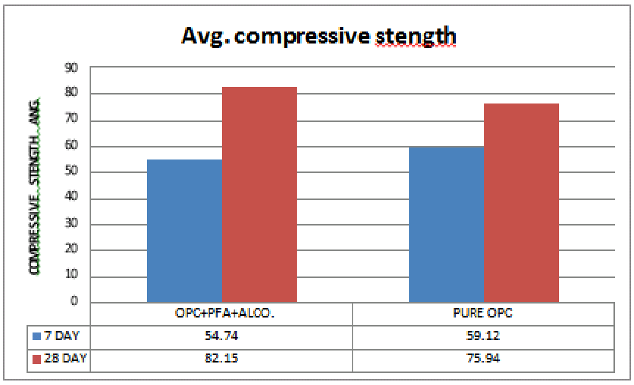


4.3.1 Graph 2: Variation in compressive strength at 28 days.

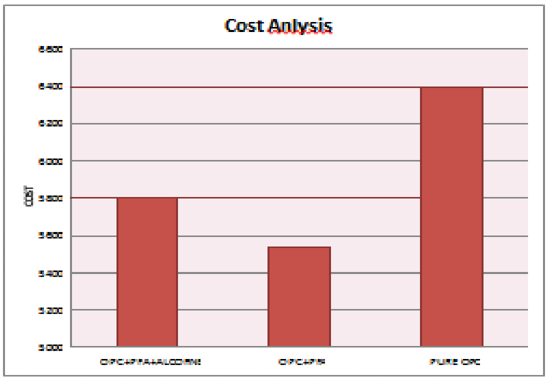


Graph 2: Variation in compressive strength at 7 days.

Sr. No.	Materials	Unit	Rate	OPC+PFA+ ALCCOFINE	OPC+PFA	PURE OPC
1	Cement	kg	7	3290	3150	4340
2	Fly ash	kg	1.67	167	290	00
3	alccofine	kg	10	500	00	00
4	Aggregate 20 mm	kg	0.5	148	150	150
5	Aggregate 10 mm	kg	0.5	345	350	345
6	Crush sand	kg	0.6	232	240	235
7	N. sand	kg	1.00	387	398	390
8	Admixture	kg	140	750	961	961
9	Water	lit	-	--	--	--
	Total Cost (Rs.)			5819	5539	6420



Graph 4: avg. compressive strength at 7 and 28 days.



Graph 5: cost comparison for 1 cubic meter concrete

4.4 Graph 5: cost comparison for 1 cubic meter concrete

5.1 CONCLUSION

After conducting the experiments we found that the compressive strength of concrete increases with increase alcofine and flyash content in HPC up to 15- 20 %. Following are the conclusions of the study.

- The compressive strength of concrete increases with increase alccofine and flyashcontent in HPC up to 15-20 %.
- But our 2nd trial was failed because it was not take proper initial strength; the flyash content which is used for this trial is up 30
%. So is code suggested that flyash is use up to 30-35% but it not in case of high performance concrete.
- High density of the mix was achieved and subsequently higher packing value.
- Cube failure pattern was dumb bell showing aggregate crushing dominantly.
- The trial has established compatibility of flyash and Alccofine to actsimultaneously in the mix.
- As far as cement is concerned, in case of high rise structure pumping of concreteis tedious work but by using HPC using alccofine this we can archive easily.
- The trial was made with the locally available materials and so their capability in aconcrete mix was also established.
- It will require less skill and effort to place.
- It will look better with no appearance defects.
- It will not require more skill at the batching plant.
- It is cost effective as compared to pure OPC.

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