ISSN : 2348 - 9065 (Online)
ISSN : 2349 - 3143 (Print)
Vol. 3, Issue 1 Jan. - Mar. 2016
International Journal of Research in Electronics and Communication Technology (IJRECT 2016)

Comparison of Normal and High Volume Fly Ash Concrete

[I]Tapeshwar Kalra, [II]Ravi Kumar
[I]M.Tech Student, Dept. of Civil Engineering, SDDIET, Barwala, Haryana, India
[II]Associate Professor, Dept. of Civil Engineering, SDDIET, Barwala, Haryana, India

Abstract
The era of infrastructure increased in recent year, so the advancement of concrete technology exaggerated day by day in life. Use of concrete exaggerated the consumption of natural resources and energy sources. In recent years inordinate measure of fly ash generated in thermal industries. The previous couple of years, some cement firms have started mistreatment ash in producing cement called hydraulic cement, however, the utilization of ash remains terribly low. There's intolerably opportunity for the fly ash in cement likewise as in concrete.
This work describes the use of Non-conventional artifact (Fly ash) that is definitely our there. During this work cement has been replaced by fly ash consequently within the range of 0% (without fly ash), 25%, 40%, 50% and 60% by weight of cement for M-25 Mix Concrete mixtures were moulded, tested and compared in terms of compressive ,split and flexural strength.

Key Words
Fly ash, flexural strength, thermal properties, aggregates, compressive strength.

I. Introduction

Concrete, typically composed of gravel, sand, water, and Portland cement, is an extremely versatile building material that is used extensively worldwide. Reinforced concrete is very strong and can be cast in nearly any desired shape. Unfortunately, significant environmental problems result from the manufacture of Portland cement. Worldwide, the manufacture of Portland cement accounts for 6-7% of the total carbon dioxide (CO2) produced by humans, adding the greenhouse gas equivalent of 330 million cars driving 12,500 miles per year

Fortunately, a waste product Fly Ash can be substituted for large portions of Portland cement, significantly improving concrete's environmental characteristics. Fly Ash, consisting mostly of silica, alumina, and iron, forms a compound similar to Portland cement when mixed with lime and water. Fly ash is a non- combusted by-product of coal-fired power plants and generally ends up in a landfill. However, when high volumes are used in concrete (displacing more than 25% of the cement), it creates a stronger, more durable product and reduces concrete's environmentalimpact considerably. Due to its strength and lower water content, cracking is reduced.

In the HVFAC mechanism, physical and chemical factors combines at all ages to density and bind the paste. In the early age of concrete, the important factors of strength development are

(i) Physical effect - fine particles of fly ash act as micro aggregates and density the mass
(ii) Chemical contribution of the formation of ettringite or related sulpho-aluproduction.

In the later age hydration reaction dominate in the strength development process as additional binders are generated by reaction involving fly ash. Any concrete that uses more fly ash than 25% (weight of cement) would be considered high volume fly ash concrete. With high volume fly ash concrete, you will see less early age strength, but the long term strength is about the same as with normal concrete.

II. Objectives

1) Design of M40 concrete mix to obtain the ratio of different components of concrete.
2) By using the above calculated ratio samples for compressive and flexural strength test for 28%, 50%, 70% replacement of cement by fly ash is to be made.
3) Compressive strength of 3,7 and 28 days is to be calculated by casting cubes for M40 mix at 28%, 50% and 70% fly ash replacement by cement.
4) Flexural strength of 28 and 56 days is to be calculated by casting beam shaped samples of M40 mix at 28%, 50% and 70% fly ash replacement by cement.
5) Comparison of the compressive and the flexural strength obtained at different percentages of fly ash is to be made.
6) Cost comparison of 28%, 50% and 70% fly ash concrete is to be made.

III. Materials and Methodlogy

Water

As perIS-456-2000, portable water is considered for satisfactory mixing and curing of concrete. The water should be clean and free from harmful impuritiessuch as oil, alkali, acidetc. In general the water is fit for drinking is used for making concrete. The water cement ratio (w/c) of 0.46 has been used.

Concrete

The concrete mix design is done in accordance with IS 10262(2009). The cement content used in the mix design is taken as 380 kg/ m3 which satisfies minimum requirement of 300 kg./m3 in order to avoid the balling affect. Good stone aggregate and Natural River sand of Zone-II were used as coarse and fine aggregate respectively. Size of coarse aggregate was 20mm and 10mm. A sieve analysis conforming to IS 383-1970 was carried out for both the fine and coarse aggregates.

Admixture

Master Gilenium Sky 8233 admixture was used during the present study.

Fly Ash

Fly ash is a fairly divided residue which results from the combustion of powdered bituminous coal or sub bituminous coal like lignite. It is a by product of many thermal power stations. Fly ash resembles pozzolana i.e. a substance which although not cementitious itself contains constituents which combine with lime to form a material having cementitious properties. It is acidic in nature and its main constituents are silica, alluminium oxide and ferrous oxide. In the

ISSN : 2348 - 9065 (Online)
ISSN : 2349 - 3143 (Print)

present work the fly ash is obtained from Panipat thermal power plant I (Haryana). The Physical and Chemical Properties of fly ash along with PPC (Pozzolana Portland Cement) are given

Physical Properties	PPC
Specific gravity	2.67
Mean grain size (µm)	21.5
Specific area (cm2/gm)	3770
Colour	Grey

Chemical Composition (%)

	PPC	Fly Ash
Silicon dioxide (SiO2)+ Aluminium oxide (Al2O3) + Iron Oxide (Fe2O3)	-	95.5
Silicon dioxide (SiO2)	-	60.5
Sulphur trioxide (SO3)	2.12(3% max.)	0.2
Reactive Silica (SiO2)	-	33.4
Chlorides (C1)	0.011(0.1% Max.)	0.01
Magnesium oxide (MgO)	2.5 (6% max.)	0.6
Loss on Ignition	1.74 (5% max.)	1.1
Sodium oxide (Na2O)	-	0.1
Insoluble Residue	24.28	-

IV. Mix Design

Design of M25 Concrete Mix

The concrete mix was designed as per code IS 10262-1982 and SP: 23-1983

1. Characteristic strength of concrete at 28 days (f_{ck}) -25N/mm2
2. Maximum size of crushed aggregate -20 mm
3. Degree-workability -Low
4. statistical coefficient (K) -1.65
5. Value(S) -4.00
6. exposure –Moderate

Fig.1:freshly compacted and placed concrete mixes

Sl.no	Mix	Cement	FA	Water	CA1	CA2	Fly ash
1	Control	398	599	183	388	878	0
2	(1) - 25%	298.5	599	183	388	878	99.5
3	(2)40%	238.8	599	183	388	878	159.2
4	(3)50%	199	599	183	388	878	199
5	(4)60%	159.2	599	183	388	878	238.5

Fig. 2 : Curing of specimens

IV. Results/Conclusion

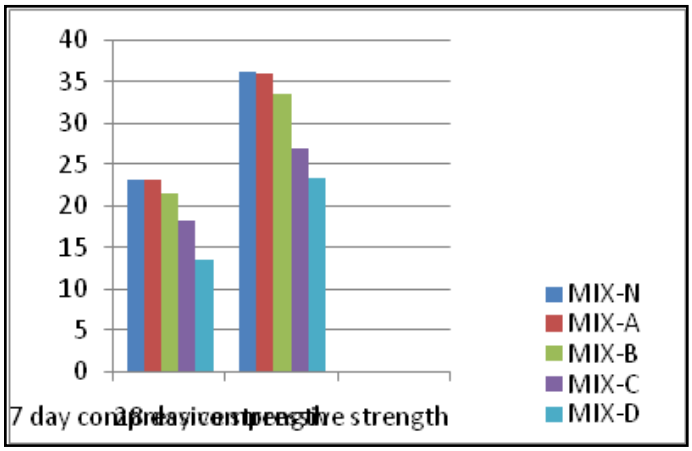

Fig. 5.1: Comparison of Different Mixes of Compressive Strength after 7 & 28 Days

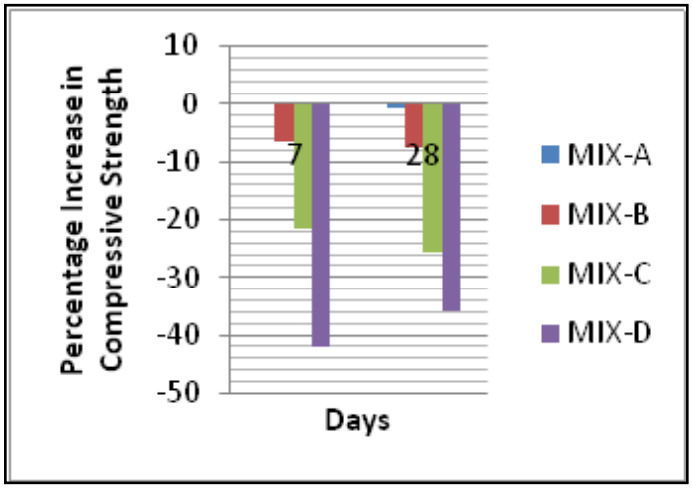

Fig. 3 : Percentage (%) increase in Compressive Strength

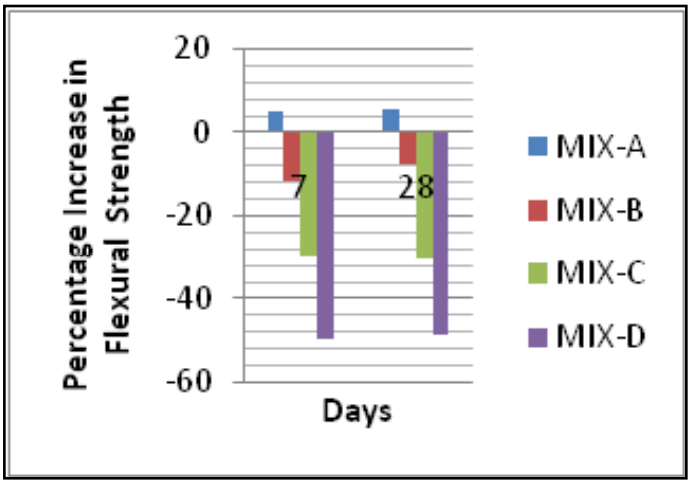

Fig. 4: Percentage (%) changes in Flexural Strength

The compressive strength of 28 days of 50% fly ash concrete is only 12% less than the 28% fly ash concrete. The compressive strength of 28 days of 70% fly ash concrete is much low (43%) than the 28% fly ash concrete.The flexural strength at 28 and 56 days for 50% fly ash concrete is 18% and 10% respectively less than the 28% fly ash concrete. This shows fly ash gives less early age strength but increases the latter age strength.The flexural strength of 28 and 56 days of 70% fly ash concrete is 66% and 50% respectively less than the 28% fly ash concrete. This is a huge difference and is not accepted. Results obtained of 28% and 50% fly ash concrete are good and acceptable.The results obtained of 70% fly ash concrete are comparable to M25 concrete.The compressive strength of fly ash concrete up to 25% replacement level is slightly equal to referral concrete at 7 &28 days. Optimum replacement level of fly ash is 25%, at 25% replacement level increase in strength at 7and 28 days is 0.561% & 0.61%. The compressive strength of fly ash concrete at 60% replacement level decreased in strength with referral concrete is 41.90% and 35.81% at 7 & 28 days. The Flexural strength of fly ash concrete up to 25% replacement level is slightly equal to referral concrete at 7 &28 days. Optimum replacement level of fly ash is 25%, at 25% replacement level increase in strength at 7and 28 days is 5.08% & .5.86 %.

The flexural strength of fly ash concrete at 50% replacement level increased in strength with referral concrete is 30.16% 30.65% at 7 & 28 days but whereas at 60% replacement level decrease in strength with referral concrete is 49.83% to48.69% at 7 & 28 day

References

[1]. *Rubenstein, M (2013): "Emission From The Cement Industry", State of The Planet Blogs From The Earth Institute, Columbia University, pp. 1-2.*
[2]. *Alam, J, Akhtar, M.N (2011): "Fly Ash Utilization in Different Sectors in Indian Scenario", International Journal of Emerging Trends in Engineering and Development, Issue 1, Vol. (1), pp. 2-3.*
[3]. *NTPC Ltd. (2007): "Fly Ash for Cement" , Ash Utilization Department, pp. 32-33.*
[4]. *Brown, J.H. (1982): "The strength and workability of concrete with PFA substitution", In: Proceedings International Symposium on the Use of PFA in Concrete, pp. 151–161.*
[5]. *Gebler, S. H., Klieger, P. (1983): "Effect of fly ash on the air-void stability of concrete (No. RD085. 01T)", Portland Cement Association.*
[6]. *Owens, P. L. (1979): "Fly ash and its usage in concrete", Concrete International, 13(7), pp 45-50.*
[7]. *Sivasundaram, V., Carette, G. G. &Malhotra, V. M. (1990): "Selected properties of high volume fly ash concretes", Concrete International, 12(10), pp. 47-50.*
[8]. *Carette, G. G., Malhotra, V. M. (1984): "Characterization of Canadian fly ashes and their performance in concrete", Division Report, MRP/MSL, pp. 84-137.*
[9]. *Joshi, R. C., Lohtia, R. P. (1993): "Effects of premature freezing temperatures on compressive strength, elasticity and microstructure of high volume fly ash concrete", Third Canadian Symposium on Cement and Concrete, Ottawa, Canada.*
[10]. *Lohtia, R. P., Nautiyal, B. D. & Jain, O. P. (1976): "Creep af Fly Ash Concrete" In ACI Journal Proceedings (Vol. 73, No. 8).ACI.*
[11]. *Haque, M.N., Langan, B.W. & Ward, M.A. (1998): "High fly ash concretes", ACI Material.8(1), pp. 54–60*
[12]. *Saraswathy, V., Muralidharan, S., Thangavel, K. &Srinivasan, S. (2003): "Influence of activated fly ash on corrosion-resistance and strength of concrete", Cement and Concrete Composites, 25(7), pp. 673-680.*