International Journal of Current Trends in Engineering & Technology
ISSN: 2395-3152
Volume: 03, Issue: 04 (JULY-AUGUST, 2017)

Improve the Strength of Concrete by Using Different Types of Binders

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ABSTRACT: **-** Concrete can withstand the severest environments while taking on the most encouraging forms. Engineers are constantly trying to improve its performance with the aid of modern admixtures and supplementary cementations materials (SCMs). Currently, concrete mixtures include different supplementary cementations material which produces part of the cementations constituent. The major advantage of SCM is capacity to substitute cement partially in concrete and still presenting the cementations property. The use of waste material as SCM helps to consume these waste materials and also improves the properties of concrete in fresh and hydrated states. Most significant SCMs which are used very frequently are fly ash and silica fume as they enhance both compressive strength and durability of concrete. In the present research a series of experiments had been performed to make comparative study of various mechanical properties of concrete mixes prepared by Portland cement, Fly ash cement and their blend (in 1:0.5 and 1:1 proportion). Concrete mixes were modified by 5%, 10%, 15% and 20% of silica fume in replacement. The ingredients are mixed in 1: 1.5: 3 proportions. The compressive strengths, workability and porosity properties were studied after 3 days, 14 days and 28 days. Inclusion of silica fume improves the strength of different types of binder mix by making them denser.

Keywords: **-** Cement, Concrete, Blending, Silica fume, Strength, workability.

I. INTRODUCTION

Concrete is a mixture of binder, fine aggregate, coarse aggregate and water. It can be usually designed to resist harsh exposure conditions. Researchers are trying to enhance its properties with the help of new additives and several supplementary cementations materials (SCM).In the past SCM were considered to be natural and readily available such as volcanic ash or diatomaceous earth. Nowadays, most concrete mixture contains SCM which are mainly by-products or waste materials from other industrial processes. As there is vast increase in the commercial and residential wastes and industry by products such as fly ash, silica fume, ground granulated blast furnace slag etc. The use of these materials in concrete constructions is recommended to minimize the pollution but also to improve the properties of concrete. The SCM can be categorized on the basis of reaction- hydraulic and pozzolanic. Hydraulic materials can react with water to make cementations compound like ground granulated blast furnace Slag (GGBS). Pozzolanic materials are not having any cementations property, however, when used with cement or lime can form products possessing cementations prosperities.

1.1 Definition and grouping

Fly ash is pozzalanic SC material one of the residues produced in the combustion of coal. Fly ash is generally confined from the chimneys of power plants. Relying upon the source of the coal being burned, the components of fly ash vary considerably, but all fly ash includes substantial Since the worldwide production of Portland cement is expected to reach nearly 2 billion tons by 2010, replacement of any large portion of this cement by fly ash could significantly reduce carbon emissions associated with construction It has been experimentally proved to replace Portland cement up to 30% by mass, without harmfully affecting the strength and durability of concrete. Several laboratory and field investigations have reported to reveal excellent strength and durability properties. However, the strength development occurs only at later period. Due to the spherical shape of fly ash particles, it can also increase workability of cement while reducing water demand. To compare and determine various mechanical properties of concrete mixes prepared by blending Portland cement and Fly ash cement in equal proportions [1]. To determine the effect on properties of concrete mixes which are modified by adding 5%, 10%, 15% and 20% silica fume as partial replacement of binder material formed by blending. To study the variation of properties when ingredients are mixed in 1: 1.5: 3 proportions. The compressive strengths, workability and porosity properties were studied after 3 days, 14days and 28days [2].

II. MATERIALS AND METHODOLOGY

Fly ash, which is mainly made up of silicon dioxide and calcium oxide, can be used as a alternate for Portland cement, or as a add-on to it.

The materials which build up fly ash are pozzolanic; hence, they can be used to bind cement materials together.

The laboratory experiments have been conducted as follows – Experimental works were conducted on mortar mixes by using different binder mix modified with different percentages of silica fume. Present experimental investigation has been carried out for three different combinations of silica fume and fly ash cement [3]. Four different proportion of silica fume had been used to investigate the properties of concrete.

Chemical Compound	Fly Ash Cement (%)
SiO2	6
CaO2	49
MgO2	0.66
Fe2O3	15
Al2O3	16

III. RESULTS AND DISCUSSION

3.1 Experimental Study on Mortar

Mortar with ratio 1:3 has been prepared from different types of cement and silica fume replacement as binder mix and sand as fine aggregate. Then its physical properties like consistency, compressive strength have been investigated. These test results both in tabular form and graphical presentation are given below.

3.1.1 Normal Consistency for Mortar

Normal consistency of different binder mixes has been determined using the procedure as given by IS 4031: part 4 (1988). Two types of blended mix with cement and fly ash ration 1:0.5 (CF1) and 1:1 (CF2) has been prepared. In these two types of concrete mix, silica fume (SF) in different proportions has been mixed 300gm of sample coarser than 150 micron sieve has been considered. Optimum quantity of water has been mixed to the sample and blended comprehensively for 2-3 minutes. Cement paste has been placed in the Vicat's apparatus and tested under the needles of Vicat's apparatus between 5 to 7 mm. The percentage of water which satisfies the above condition is normal consistency. It has been found that – Early or 3 days strength and 14 days strength increased rapidly with increase in percentage of replacement by silica fume.

Table 1 Normal consistency of different binder

Mix	Description	Cement + fly ash	Silica fume	Consistency
		Grams	Grams	%
M1	CF1	300	00	31.5
M2	CF1 +5%SF	285	15	35
M3	CF1 +10%SF	270	30	37.5
M4	CF1 +15%SF	255	45	40
M5	CF1 +20%SF	240	60	41.5
M6	CF2	300	00	34
M7	CF2 +5%SF	240	60	36.5
M8	CF2 +10%SF	240	60	39.5
M9	CF2 +15%SF	240	60	42.5
M10	CF2 +20%SF	240	60	45.5

Table 2 show Number of Days for Process

Type of Cement	% of SF	3 Days	14 Days	28 Days
Ordinary Portland Concrete	0	954	15.91	19.43
	5	10.82	17.2	20.84
	10	11.65	17.97	21.09
	15	12.35	18.54	22.85
	20	13.05	19.13	23.12
Fly Ash Cement blend (1:0.5)	0	8.87	14.82	18.57
	5	9.58	15.71	19.50
	10	1.35	16.65	20.47
	15	11.17	17.65	21.50
	20	12.07	18.71	22.57
Fly Ash Cement blend (1:1)	0	8.22	13.73	17.87
	5	9.21	15.10	19.30
	10	10.31	16.61	20.84
	15	11.55	18.27	22.51
	20	12.93	20.10	24.31

1. Early gain of strength is more in case of fly ash cement with 1:1 blend and gain of strength at later stages is more in case of ordinary Portland cement. The major explanation for early gain of strength in fly ash and cement blend could be rapid reaction among fly ash and silica fume particles due to fine particles.

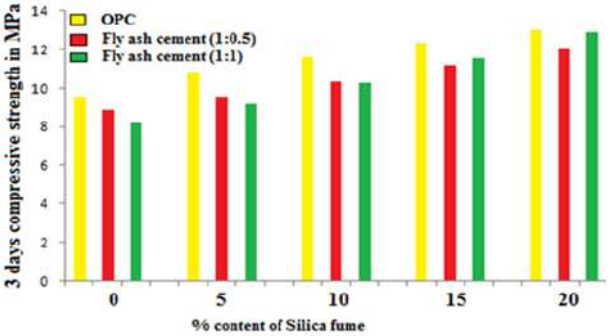

Figure1 Compressive strength after 3 days

2. As cement particles are coarser than silica fume particles,

reaction rate is relatively sluggish so, gain of early strength is relatively low in Ordinary Portland cement concrete but at later stages gain of strength is higher. For all mixes it has been observed that up to 20% replacement of cement with silica fume the compressive strength increased with increasing the content of silica Fume as partial replacement of cement.

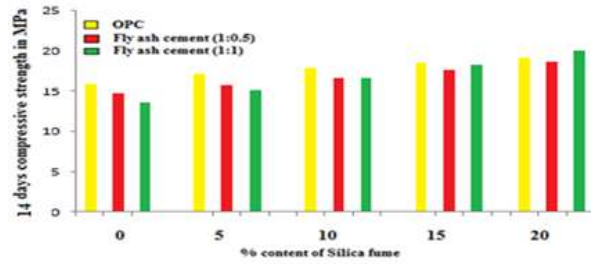

Figure 2 Compressive strength after 14 days

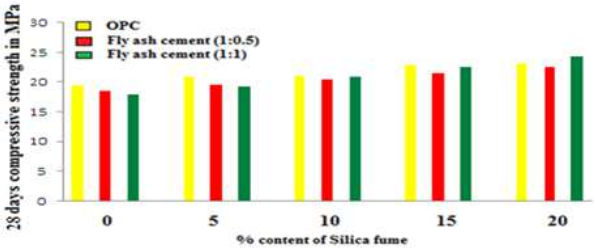

Figure3 Compressive strength after 28 days

IV. CONCLUSION

Inclusion of silica fume increases the water requirement of binder mixes to make paste of normal consistency. Water requirement increases with increasing dose of silica fume. Early gain of strength is more in case of fly ash cement with 1:1 blend and gain of strength at later stages is more in case of ordinary Portland cement. Inclusion of silica fume improves the strength of different types of binder mix by making them denser. Addition of silica fume improves the early strength gain of fly ash cement whereas it increases the later age strength of OP cement. The equal blend of fly ash and cement improves overall strength development at any stage. Few more properties for comparing the performance of concrete composed by blending fly ash and other materials in different proportions need to be investigated. Materials other than silica fume are required to be considered. Monitoring the effect of several waste materials over the different physical and chemical properties of concrete is needed to be investigated.

REFERENCES

[1]. Thomas, M. D. A. and Shehata, M. H. "Use of ternary cementations systems containing silica fume and fly ash in concrete "; Cement and Concrete Research 29 (1999).

[2]. Sandor, P. "Portland Cement- Fly ash- Silica fume Systems in concrete "Department of Civil and Architectural Engineering, Drexel University, Philadelphia, Pennsylvania, 1993.

[3]. Bijen, J. " Benefits of slag and fly ash " Construction and Building Materials , 10 (5): 309-314, 1996

[4]. Lam, L, Wong, Y. L., and Poon, C. S. " Effect of fly ash and silica fume on compressive and fracture behaviors of concrete " Cement and Concrete research, 28 (2) 271-283, 1988.

[5]. Gonen, T. and Yazicioglu, S. "The influence of mineral admixtures on the short and long term performances of concrete" Department of Construction Education, Firat University, Elazig 23119, Turkey.2009.

[6]. Mateusz R.J. O. and Tommy N. " Effect of Composition and Initial Curing Conditions of Scaling Resistance of Ternary(OPC/FA/SF) concrete", Journal of Materials in Civil Engineering ©ASCE/October 2008, PP 668-677.

[7]. Barbhuiya S.A., Gbagbo, J.K., Russeli, M.I., Basheer, P.A.M. "Properties of fly ash concrete modified with hydrated lime and silica

[8]. J.G. Cabrera, and Linsdale, C.J," A new gas parameter for measuring the permeability of mortar and concrete". Journal of Concrete Research (1988) (40), pp. 177-182. View record in Scopus| cited by in Scopus (29).

[9]. Jigar P. Patel, "Broader use of steel slag aggregates in concrete", M. Tech. thesis, Cleveland State University, December, 2008.

[10]. Thanongsak, N., Watcharapong, W., and Chaipanich. A., (2009), "Utilization of fly ash with silica fume and properties of Portland cement–fly ash–silica fume concrete". *Fuel*,89 (3):768-774 2010

[11]. Patel, A, Singh, S.P, Murmoo, M. (2009), "Evaluation of strength characteristics of steel slag hydrated matrix" Proceedings of Civil Engineering Conference-Innovation without limits (CEC-09), 18th - 19th September" 2009.

[12]. Li Yun-feng, Yao Yan, Wang Ling, "Recycling of industrial waste and performance of steel slag green concrete", J. Cent. South Univ. Technol. (2009) 16: 8−0773.