Utilization Of Industrial Wastes In Mortar (Silica Fume & Flyash)

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ABSTRACT

This paper presents an Experimental investigation on the effect of silica fume and flyash on mechanical Properties and durability. Including compressive strength ,water absorption Consistency by using flow table test of mortar is reported in this paper. the variables of the study are percentage replacement of cement with silica fume & Flyash. The test results indicate that the mechanical properties of silica fume and flyash modified mortar are improved to a great extent. whereas the water absorption is reduced of modified mortar as compared to that of plain mortar. it is Also interesting to note that partial replacement of cement by $M_{5,5}$, $M_{5,10}$, $M_{10,5}$, $M_{10,10}$.(M-Mix of silica fume & flyash %) improve both mechanical and durability Of modified mortar. The silica fume and fly ash is varied from 0 to 10% by weight of cement.

KEYWORDS: -. *Silica fume, fly ash , compressive strength, water absorption, Consistency.*

1. INTRODUCTION

In recent times, signification development have been observed in concrete technology. Among them is the evolution of high performance concrete,in which Use of low water-cement ratio and industrial and chemical admixtures has become a common practice such admixtures usually include silica fume, flyash that can react the hydrates of cement in concrete and mortar. The use of additional cementitious materials due to economic, technical and environmental considerations has become very common in modern concrete construction A number of studies have been conducted on the durability and strength of concrete made with mineral admixtures.

Fly ash (FA) is waste materials from the thermal power plant; it is separated from the flue gas of the power station burning pulverized coal. there are two basic types of FA: Class F (low-calcium FA) and Class C (high-calcium FA). Its physical and chemical properties depend exclusively on the quality of coal used and on technological conditions of burning. FA is added to Portland cement (PC) or directly to mortars or concretes.The use of FA as a replacement addition to cement in production is useful for a number of purposes. FA use partially displaces production of other concrete ingredients, resulting in significant energy savings, reductions in CO2 emission and conserving resources. FA makes substantial contributions to workability and chemical resistance. It is widely accepted that, they reduce the hydration heat, and block the alkali-silica reactions .FA, when used as mineral admixtures in high performance concrete, can improve both the strength and durability properties of the concrete and mortar.

Silica fume (SF) is a by-product resulting from the reduction of high-purity quartz with coal in electric arc furnaces in the manufacture of ferrosilicon alloys and silicon metal. It has been shown that in some cases, the presence of such particles can reduce the positive effect of the SF on the microstructure and mechanical properties of the pastes. The use of SF decreases the permeability, thereby increasing the resistance of concrete against corrosion , improving its strength and durability.

2.Purpose and scope

The experimental research program outline in this paper is design to investigate the influence of silica fume and flyash on consistency , compressive strength ,water absorption of modified mortar. (modified by partial replacement of silica fume and flyash) Silica fume and flyash partial replace from $M_{0\%}$. $M_{5\%5\%}$, $M_{5\%10\%}$, $M_{10\%5\%}$, $M_{10\%10\%}$ By weight of cement.

3.Objectives of this study:

- To analyze important mechanical properties of micro-silica & flyash mortar.
- Utilization of Silica fume, as a pozzolanic admixture, in order to improve the performance of cement mortar.
- Reduction in environmental pollution involving production of cement and a contribution to the economy as well.

4. Material

Comparison of Chemical and Physical Characteristics --Silica Fume, Fly Ash and Cement

	Silica Fume	Fly Ash	Cement
SiO^2Content(%)	85- 97	35 - 48	20 -25
Surface Area sqm/kg	17,000 - 30,000	400 - 700	300 - 500
Pozzolanic Activity (withcement,%)	120 - 210	85 - 110	n/a
Pozzolanic Activity (withlime(MPa)	8.3 - 11.4	5.5 - 6.9	n/a

4. PREPARATION OF MIXES

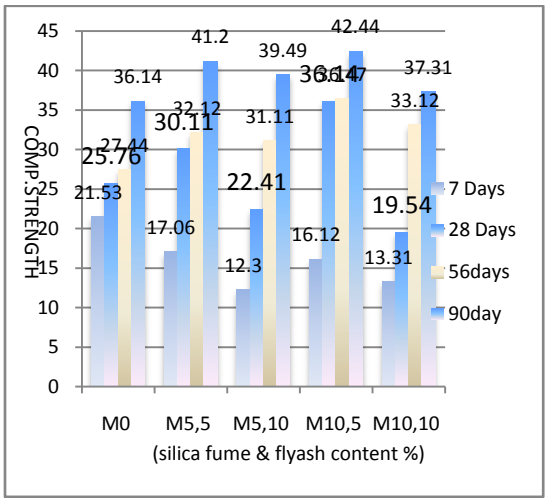
Prepared a mix of cement mortar by using Silica fume and flyash partially, Using binder-sand ratio of 1:3, prepared various mix $M_{0\%}$. $M_{5\%5\%}$, $M_{5\%10\%}$, $M_{10\%5\%}$, $M_{10\%10\%}$.

Table No. 1- Mix proportion of Cement Sand mortar

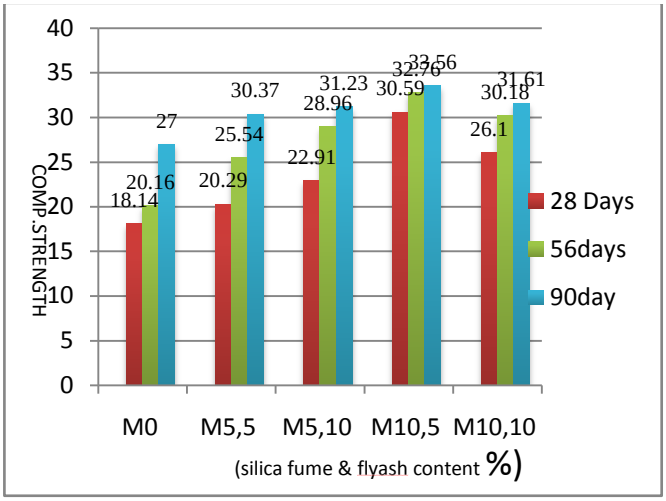
Constituent	Water (P/4+3	Cement	sand
Proportion	11%	1	3
	11%	1	6

Table No. 2- Mix proportion of silica fume & flyash

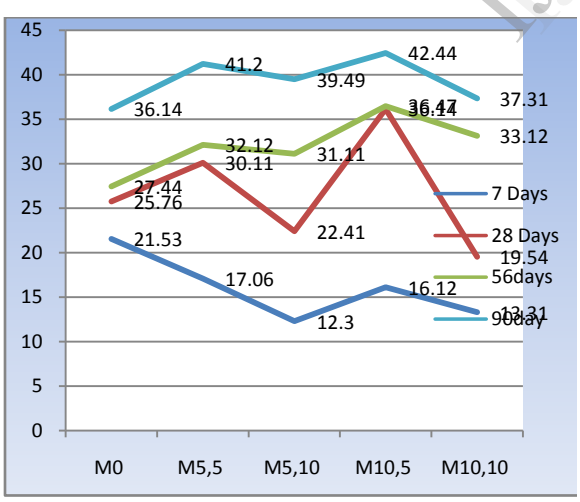
MIX	Silica fume & flyash (by % weight of cement)
M_0	0
$M_{5,5}$	5SF 5FA
$M_{5,10}$	5SF 5FA
$M_{10,5}$	10SF 5FA
$M_{10,10}$	10SF 5FA



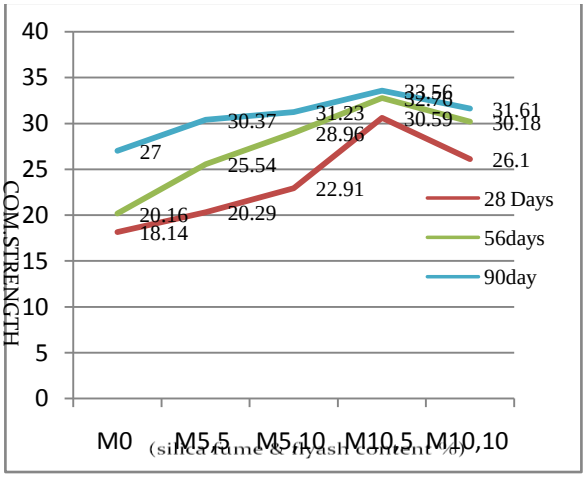
Compressive strength (Mpa) of mortar (Bar Chart 1:3)



Compressive strength (Mpa) of mortar (Bar Chart 1:6)



Compressive strength (Mpa) of mortar (Line graph 1:3)



Compressive strength (Mpa) of mortar (line graph1:6)

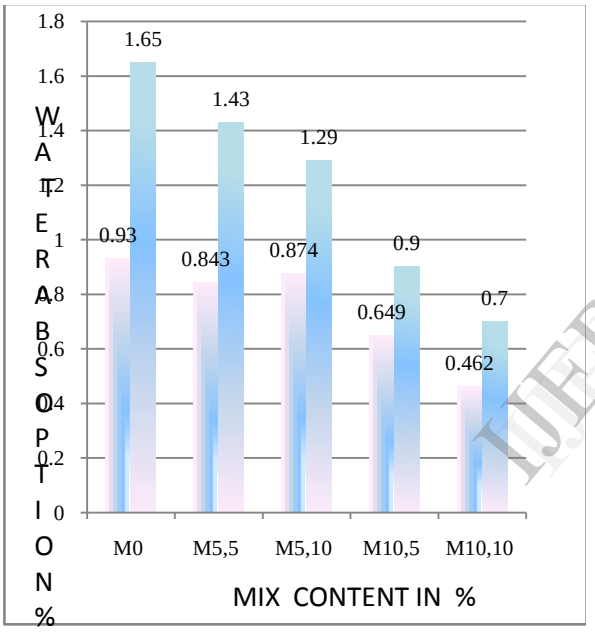
Water absorption test (1:3 & 1:6)

Rate of water absorption of different mixes after 28 days of curing are Tabulated in Table. And calculated by following formula.

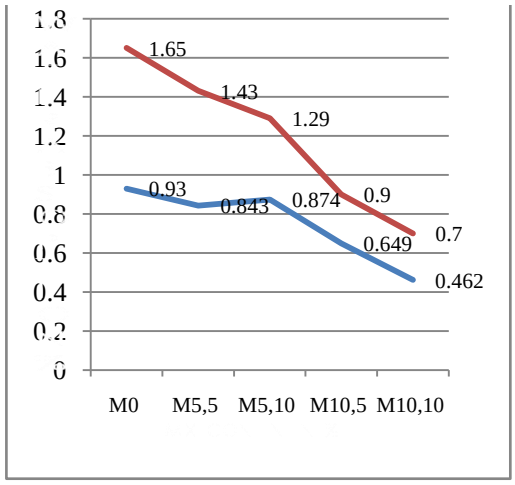
Water absorption (%) = $(W_1 - W_0)/W_0 \times 100$

W_1 - dry wt of mortar in gms

W_0 - wet wt of mortar in gms



Water absorption test (1:3 & 1:6)(bar chart)



Water absorption test (line graph 1:3 & 1:6)

Analysis of Results

It is observed that up to 10% replacement of cement with silica Fume & 5% of flyash the Compressive strength increases with increasing dose of silica Fume and then reduces slightly.

The increase in strength from 7 to 28 days curing is varying in the range of 20% to 55%. For 1:3

The increase in strength from 28 to 56 days curing is varying in the range of 10% to 20%.for 1:6

The maximum increase in characteristic strength is observed for 10% of silica fume & 5% of flyash replacement.

For this dose, the relative increase in compressive strength is found to be up to 55.39%.

We can conclude that water absorption decreases with increase in percentage of replacement by silica fume & flyash.

The reason could be the inclusion of silica fume & flyash to the mortar actually forms denser matrices thereby improving resistance of the matrices against water ingress which is one of the most important reasons that increases the deterioration of mortar.

Water absorption coefficient decreases with increasing % of silica fume up to 10% & flyash up to 10% replacement.

This shows that there is a reduction in the size of capillary pores as stated theoretically. Hence, silica fume & flyash mortar is less susceptible to deterioration and hence more durable.

Conclusions

By using micro-silica, the mortar matrix gets a denser composition filling even the micro-voids thus enhancing the impermeability of mortar. Better Impermeability may ensure better crack-resistance and corrosion resistance as well as less prone to chemical attack.

The properties shown by micro-silica & flyash mortar are much better than plain cement mortar. It is desirable to use micro-silica in high performance mortar in spite of the increased cost (approximately 30% higher for optimum proportion) keeping in mind the increased strength and enhanced durability that micro-silica &flyash mortar has to offer.

Silica fume and flyash leads to improvement of both mechanical properties and durability of partial replaced mortar. The employment of 10% of silica fume and 5% of flyash in cement mortar to improvement of compressive strength. The addition of 10% of silica fume and 10% flyash reduces the water absorption. it is clear that from bar chart, if curing span will be increase strength will be in The properties shown by micro-silica concrete are much better than plain cement concrete. It is desirable to use micro-silica in high performance and high grade concretes in spite of the increased cost (approximately 30% higher for optimum proportion) keeping in mind the increased strength and enhanced durability that micro-silica concrete has to offer.

Sufficient trial mixes and various tests should be carried out with the on-site mortar ingredients to get the desired properties for a particular constructional application. The percent of micro-silica and flyash to be replaced should be assessed on the basis of the property of mortar to be enhanced in particular.

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