

ADDITION OF STEEL FIBER AND FLYASH TO INCREASE COMPRESSIVE STRENGTH OF SELF COMPACTING CONCRETE

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ABSTRACT

One of the most popular composite materials in contemporary building is reinforced concrete (RC). Concrete is a rather brittle substance that is more robust when compressed but less so when stretched. Many constructions are not suited for plain, unreinforced concrete because of its inadequate ability to bear stresses caused by vibrations, wind loads, and other factors. Concrete can be strengthened by embedding steel rods, wires, mesh, or cables before it solidifies. This reinforcement, often known as rebar, resists tensile forces. In Present Investigation with cement block with different admixtures i.e. fly ash and steel fiber mixed together as a admixture in a cement block with a percentage of 15%, 20%, 25% for fly ash and steel fiber of diameter 1, 2 and 3mm , the compression test were perform on 36 block and found that the concrete block of M20 with a proportion of mixture 15% of fly ash and 20% of steel fiber exhibits optimum compressive strength with steel fiber of 1mm diamter, thus this results obtained are evaluated in Taguchi optimization with L9 orthogonal array with signal to noise ratio and found the optimum result in compressive strength of cement block compared to other admixture cube samples.

Keywords: Compressive Strength, Cement, Fly Ash, Steel Fiber, Taguchi, Signal To Noise Ratio.

1. INTRODUCTION

The fact that the raw materials needed to make cement are limited and non-renewable and must be preserved for future generations is becoming more widely recognized. At some time in the industry, there is a strong tendency toward the faster usage of admixtures in concrete as a means of achieving sustainable building. Millions of tonnes of mineral admixtures are created as waste products of industrial processes, and disposing of them is a significant concern [1]. One such waste that is widely available in India's exclusive regions is ash from coal-based power plants. Concrete has a remarkable potential for using fly ash and might be the safest place for it to be used. Due to financial and technological assistance, fly ash, also known as pulverized gasoline ash, a commercial byproduct of coal-based thermal energy plants, contains finely split spherical silicate glass particles that have been replaced with iron and aluminum. It may be utilized in concrete. The characteristics of concrete are widely improved by the addition of fly ash.

A. Fly Ash

The waste from burning pulverized coal that is gathered by mechanical dust collectors, electrostatic precipitators, or separators from the fuel gases of thermal strength flowers is known as fly ash or Pulverized Fuel Ash (PFA). The type of gasoline burned, the boiler's load, and the type of separators all affect its composition. Fly ash contains calcium, aluminum, and silicon oxides, however there is a far less amount of calcium oxide. The fly ash's silica concentration should be as high as is practical, while its carbon content should be as low as is practical.



Figure 1: Fly Ash (Source Internet)

B. Advantages of Fly Ash

- Fly Ash improves concrete workability and reduces water demand
- Fly Ash generally exhibits less bleeding and segregation than plain concretes.

- Sulfate and alkali aggregate resistance.
- Fly Ash has lower heat of hydration.
- Fly Ash generally reduces the permeability and absorption of concrete.

C. Objectives

- The objective of this study is “Optimization of fly ash and steel fiber composition in cement”. This requires following specific objectives:
- A study on Utilization of fly ash and steel fiber.
- Fly ash and steel fiber Strength Analysis.
- Characterization of fly ash and steel fiber on their physical and chemical properties.

2. METHODOLOGY AND EXPERIMENT ANALYSIS

A. Material Used

The basic ingredients of concrete block which were used in this research work are OPC (ultra tech cement), fly ash, copper slag and Natural Fine aggregate (sand), Water (fresh drinkable water).

B. Ordinary Portland Cement

The ordinary Portland cement of 53grade manufactured by the ULTRATECH Cement Company was used in the study, which is in accordance with IS 12269:1987. Having design strength for 28 days being a minimum of 53 MPa or 530 kg/sqcm with baine of fly ash 353.6 m²/Kg.

Table 1: Chemical Composition of Fly Ash

Chemical Composition of Fly Ash						
LOI	Silica	CaO	Al ₂ O ₃	Fe ₂ O ₃	MgO	Chloride
1.34	59.67	3.21	28.08	4.68	0.98	0.018

Table 2: Physical Composition of Fly Ash

Physical Composition of Fly Ash				
	Blaine, M2/kg			353.6
	Residue, %			
	45μ			12.48
	19μ			

Table 3: Chemical Composition of Steel fiber

C	Fe	Mn	P	S	Cr	Cu	Ni
0.34	0.60	0.44	0.21	0.03	4.78	0.08	0.15

Table 4: Portland Composite Cement

Portland Composite Cement					
Materials			Fly ash%	Steel Fiber %	Total %
Standard Composition%			15-35	35-50	
Keeping Fly Ash only Variable			15	45	100
			20	40	100
			25	35	100



Figure 2: Batching of materials



Figure 3: Breaking of cube sample during compression test.



Figure 4: Broken cube after experimentation.

3. RESULT ANALYSIS AND DISCUSSION

A. Experimental Investigation Results for compressive strength test of cement cube with different percentage of admixture

Table 5:

No. of Experiment	Blaine of Flyash	Input Parameters		Results O/P			
		Fly Ash %	Steel fiber (Dia)	Compressive Strength (Mpa)			
				1 day	3 days	7 days	28days
1	353.6 M ² /Kg	15	1	10	19	28	38
2		15	2	11	22	31	43
3		15	3	13	26	35	46
4		20	1	6	16	24	31
5		20	2	7	17	26	35
6		20	3	10	21	31.5	42
7		25	1	6	14	21	30
8		25	2	7	16	22	28
9		25	3	9	18	26	33

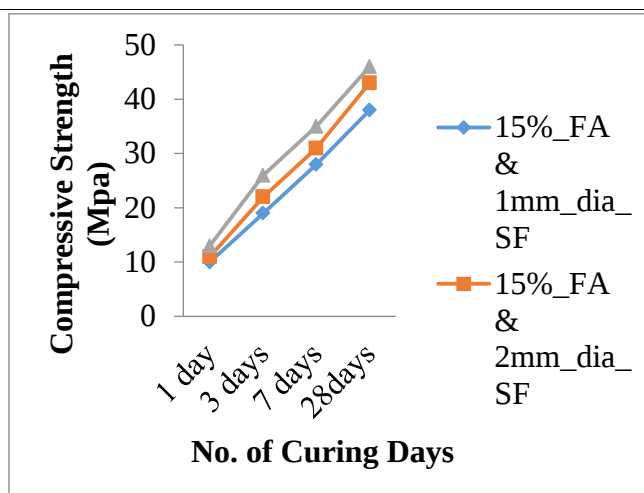


Figure 5: Graph shows Results of compressive strength test of cement cube of no. of day cured sample with different percentage of fly ash and steel fiber.

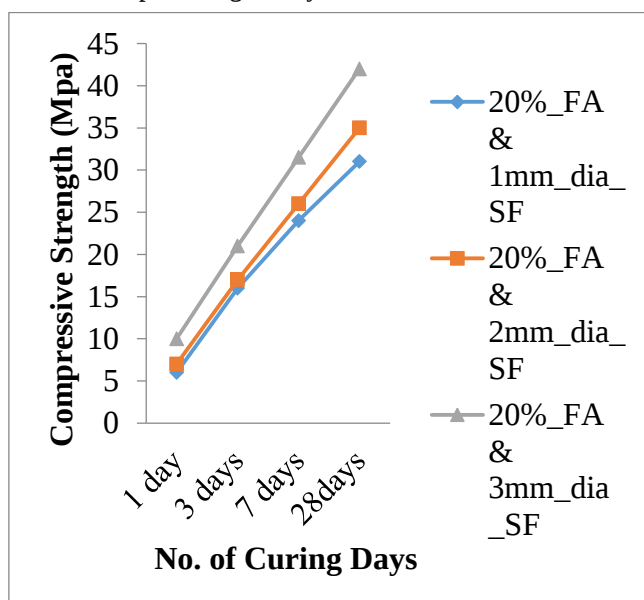


Figure 6: Graph shows of Result of Compressive Strength of cement cube with 3 days cured sample.

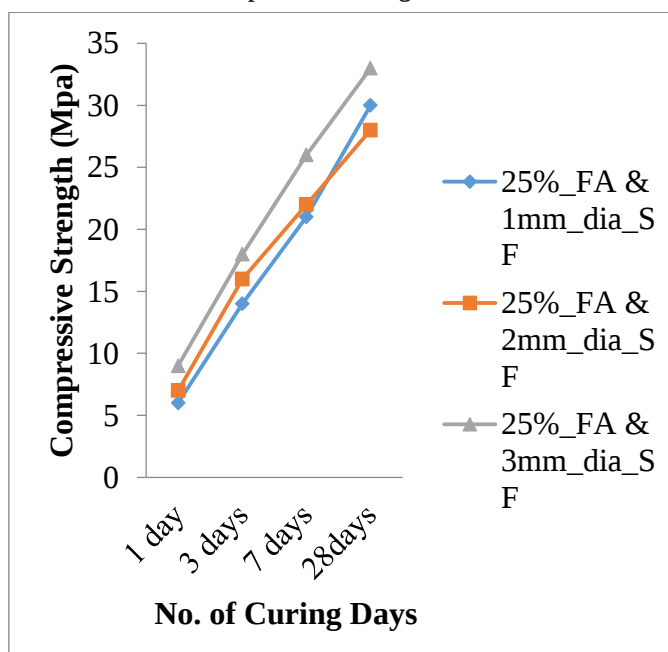


Figure 7: Graph shows of Result of Compressive Strength of cement cube with 7 days cured sample.

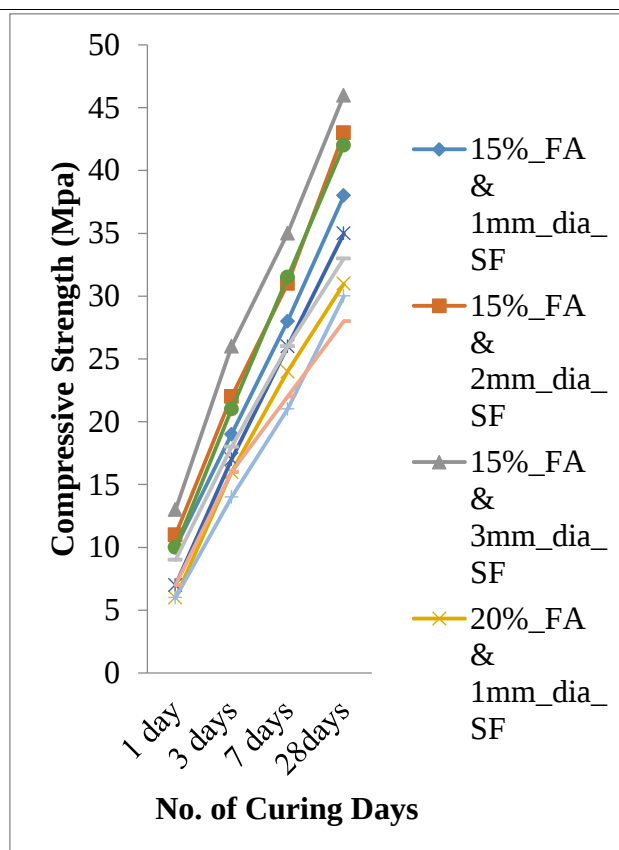


Figure 8: Results of compressive strength test of overall comparison for different admixture.

4. CONCLUSION

- According to interaction plot of mean (Taguchi) it can be seen that graph are nearby parallel which means that is not much interaction between steel fiber and fly ash.
- The compressive strength also depends upon the type of coal used in power plant if the class C and F type of fly ash shows different impact on strength.
- Total no. of trails can be upto 27 but with the help of Taguchi design of experiment method. The optimum results are achieved in trails.

The compressive strength in composition where fly ash is 15% and steel fiber of diameter 3mm is best in comparison with other trails. This composition shows better strength between 1 to 28 no. of days.

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