

Research Article

Strength Characteristics of Fly Ash Concrete with Varying Fly Ash Content For Water to Binder Ratio Of 0.5

S. Sarangi

School of Civil Engineering, KIIT University, Bhubaneswar-751024, Odisha, India

***Corresponding author**

Sunita Sarangi

Email: sunita_srng55@gmail.com

Abstract: Cylindrical and cubical concrete blocks are prepared with 0%, 10% & 20% fly ash content and cured for various time periods. The compressive strength is determined according to ASTM C837 standard. It is found that there is a decrease in strength with increase in fly ash content and as the curing time increases the strength also increases for each of the case. The maximum value of compressive strength is found for the controlled concrete mixture with 0% fly ash i.e., 19MPa for the cylindrical specimen.

Keywords: compressive strength, fly ash, concrete

INTRODUCTION

Fly ash affects the plastic properties of concrete by improving workability, reducing water demand, reducing segregation and bleeding, and lowering heat of hydration. Fly ash increases strength, reduces permeability, reduces corrosion of reinforcing steel, increases sulphate resistance, and reduces alkali-aggregate reaction [1]. Possessing pozzolanic properties, the glassy silica and alumina of Class F fly ash requires a cementing agent, such as Portland cement, quicklime, or hydrated lime, with the presence of water in order to react and produce cementitious compounds [2]. Low calcium fly ash (ASTM Class F) has been widely used as a replacement of cement in normal and high strength concrete. In normal strength concrete, the replacement level can be more than 50% while in high strength concrete, the replacement level is usually limited to $15 \pm 25\%$. The main objectives of using fly ash in high strength concrete are to reduce heat generation and to obtain better durability properties [3]. Gesoglu et.al [4] studied the shrinkage cracking performance by preparing lightweight concrete mixtures with varying water to cementitious material ratio & with varying volume ratio of cold-bonded fly ash and natural sand. The compressive strength was reported to be decreasing with increase in amount of lightweight fly ash aggregate which is a weaker than the matrix, however with the strength value obtained they suggested that the mixtures prepared can be used for structural application. Concretes of medium and low strength values can be manufactured by the addition of fly ash in a concrete mixture in any form i.e., either replacement of cement by some volume percentage or by preparing aggregates of different volume percentage.

The compressive strength reduces with the increase in amount of fly ash and with increase in curing period compressive strength increases as compared to control concrete mixture [5-9].

In this study attempt was made to study the strength response towards the addition of different volume percentage of fly ash in a concrete mixture and curing at different time period.

EXPERIMENTAL DETAILS

Materials & test blocks

Commercially available Portland cement conforming to ASTM type I along with low calcium ASTM class F fly ash is used for preparing the test blocks. Fly ash is added to cement at 0%, 10% & 20% wt% of the total mixture for each of the cylindrical and cubical test blocks. The water to binder ratio is maintained 0.5 for each of the case. The test blocks are cured in water at ambient temperature after demoulding after 24hrs.

Compression test

The compressive strength of the cubical and cylindrical test blocks for respective specimens of concrete and fly ash composition was tested with a compression machine at the loading rate of $0.2 \pm 0.4 \text{ N/mm}^2/\text{s}$.

RESULTS AND DISCUSSIONS

The compressive strength of the cubical and cylindrical test blocks are presented in Fig. 1 and Fig.2 respectively. It is observed that the compressive strength for both the concrete mixture cubes and cylinders are decreasing with increasing in fly ash

content with respect to concrete having 0% fly ash and showed an increasing trend with increase in curing time. Same trend for concrete having 25% fly ash with water to binder ratio 0.5 was also reported in a study by Lam et.al [10] & Shanmugasundaram et.al [11] that used fly ash as coarse and fine aggregates in cement fly ash concrete mixture with proportions varying from 10:90 to 22.5:77.5. Highest compressive strength was found for 0% fly ash concrete cylinders after 28 days of curing i.e., 18.67MPa and the lowest value was 3.60MPa for the cylinder with 20% fly ash after 3 days of curing. This kind of phenomena was also observed by Joseph and Ramamurthy [12], who attributed the result to the slow pozzolanic reaction between cement and fly ash.

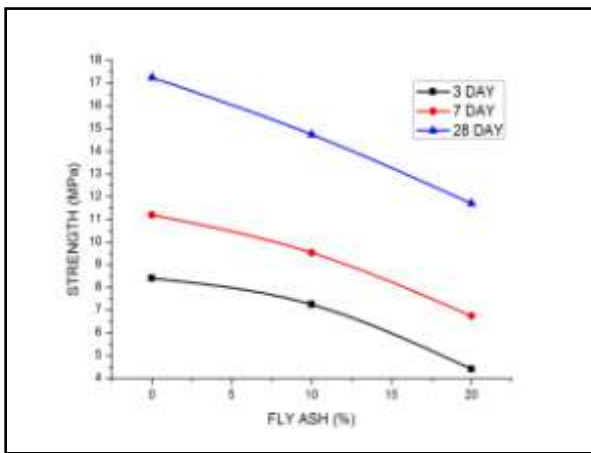


Fig-1(a): Compressive strength of cubes

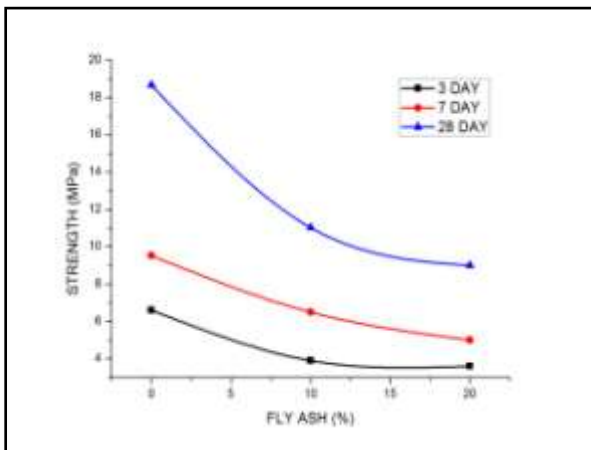


Fig-1(b): Compressive strength of cylinders

CONCLUSION

In order to study the effect of fly ash as admixture concrete columns are prepared with 0%, 10% & 20% fly ash content and subjected to compression test. Conclusions of the current study are presented below.

- Compressive strength of concrete decreases with increase in fly ash content.
- With increase in curing time strength of the concrete increased in each of the case.

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