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Strength Characteristics Of Fly Ash Activated Concrete

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Abstract— Concrete is used in most of the Civil Construction work in the world. However high-energy requirement and pollution involved in the production of cement hampers the image of concrete as a sustainable material. Efforts are continuously being made to make concrete environment friendly. Fly ash activated cement concrete is a new development in the world of concrete in which cement is partially replaced by fly ash and activated by alkaline liquid to act as a binder in the concrete mix. Experimental investigation has been carried out to study effect of concentration of sodium hydroxide on compressive strength. Water and cement plus fly ash ratio of 0.45 by mass was maintained in the experimental work. The concentration of sodium hydroxide solution is varied. Cement fly ash concrete cubes of 150mm sides were cast. The curing is done for 3days, 7days, 28days, 56days and 90days at room temperature. Test result shows that the compressive strength increases with increase in concentration of sodium hydroxide, however beyond optimum concentration of sodium hydroxide compressive strength decreases.

Keywords—Concrete, Ordinary Portland Cement, Fly Ash, NaOH, Replacement, Compressive Strength, Curing, Activation

Introduction—Production of Portland cement is increasing due to the increasing demand of construction industries. Therefore the rate of production of carbon dioxide released to the atmosphere during the production of Portland cement is also increasing. Generally for each ton of Portland cement production, releases a ton of carbon dioxide to the atmosphere. The green house gas emission from the production of Portland cement is about 1.35 billion tons annually, which is about 7% of the total greenhouse gas emissions. Therefore to reduce the pollution, it is necessary to reduce or to replace the cement from concrete by other cementatious materials like fly ash, blast furnace slag, rice husk ash. Fly ash can be considered as the world's fifth largest raw material resource. An estimated 25% of fly ash in India is used for cement production, construction of roads and brick manufacture. Processed fly ash which is obtained by converting an industrial by-product into a resource material, as a component of cement, its uses helps to reduce $C0_2$ emission associated with concrete construction. Fly ash based concrete possesses high compressive strength, undergoes very little drying shrinkage and moderately low creep, and shows excellent resistance to sulphate and acid attack. They are not suffering from alkali-aggregate reaction and possess excellent fire resistant.

System Development— Materials used are as follows

The material used for making fly ash cement concrete specimen are low calcium dry fly ash as the source material, aggregate, cement and water. The type cement used is ordinary Portland cement of 53 grade. The ash used in this study was low calcium (ASTM class F) dry fly ash from Dirk India Pvt. Ltd. Nasik. Fly ash (P10, P63,) were obtained during the period of this study.

Fly Ash P10-Pozzocerte10 is filler ingredient, obtained by selection and processing of fly ash produced as a by-product at coal-fired electricity generating power stations. It is subjected to strict quality control.

General Information

Presentation	Coarse light weight powder
Colour	Dark grey
Bulk Weight	1.0 tonne/m^3
Fineness	60 to 85% retained on 45 micron Sieve
Package	30 kg paper bags and bulk tankers

Fly Ash P63-Pozzocrete 63 is a high efficiency class F pozzolanic material obtained by selection and processing of power station fly ashes resulting from the combustion of pulverized coal. Pozzocrete 63 is subjected to strict quality control.

General Information

Presentation	Finely divided dry powder
Colour	Light grey
Bulk Weight	Aprox. 0,90 metric ton per cubic meter
Specific density	Aprox. 2,30 metric ton per cubic meter
Size	90% < 45 micron
Particle shape	Spherical
Package	30 kg paper bags, 1 metric ton big-bags and bulk tankers

Aggregates-Local aggregate 20 mm and 12.5mm are coarse aggregate in saturated surface dry condition, were used. The coarse aggregate were crushed ballast type aggregate which are found in Deccan trap region. The fineness modulus of combined aggregate was 4.81. These size fractions are combined in fixed proportion to maintain grading complying with as per IS650: 1991.

Sand-Locally available river sand is used as fine aggregate. The sand is sieved using sieves of sizes 4.75 mm, 2.36 mm, 1.18 mm, 600 micron, 300 micron and 150 micron. The fineness modulus of combined aggregate was 3.43.

Table 3.1: Properties of Aggregates

Properties	C A I	C A II	FA(sand)
Type	Crushed angular	Crushed angular	Spherical (River sand)
Maximum Size	20mm	12.5 mm	4.75 mm
Specific Gravity	2.632	2.629	2.559
Grading	Confirming to combination of CA-I : CA-II 65 : 35		Confirming to grading zone-III
Material finer than 75 micron	Nil	Nil	1.25 %
Water Absorption	0.63%	0.804%	1.63%
Moisture Content	Nil	Nil	Nil

Manufacture Of Test Specimens

The concrete mix is prepared of proportion M (l: 1.5:3) as follows:

l) Material is taken on weight basis.

2) First aggregate is weighted to nearest gram and placed in mixing tray then sand is weighted and placed uniformly over aggregate. In the same way cement and fly ash is weighted and placed over mix of sand and aggregate.

3) Water cement ratio taken is 0.45. Water is then measured accurately in measuring cylinder and is uniformly poured in the mixture of cement, sand and aggregate. Care should be taken that uniformly mixing should be carried out and have uniform color.

4) When NaOH is used in the mix it is first mixed with water in required proportion and then it is uniformly poured in the mixture of cement, sand and aggregate.

Compressive Strength Test

Size Of Test Specimen-Test specimen cubical in shape shall be 15x15x15cm. The mould shall be 150mm size. In assembling the mould for use, the joints between the sections of mould shall be thinly coated with mould oil and a similar coating of mould oil shall be applied between the contact surfaces of the bottom of the mould and the base plate in order to ensure that no water escapes during the filling. The interior surfaces of the assembled mould shall be thinly coated with mould oil to prevent adhesion of the concrete.

Compaction-The test specimens shall be made as soon as practicable after mixing, and in such a way as to produce full compaction of the concrete with neither segregation nor excessive laitance. The concrete shall be filled into the mould in layers approximately 5 cm deep. In placing each scoopful of concrete, the scoop shall be moved around the top edge of the mould as the concrete slides from it, in order to ensure a symmetrical distribution of the concrete within the mould. Each layer shall be compacted by hand. When compacting by hand, the tamping bar shall be used and the strokes of the bar shall be distributed in a uniform manner over the cross-section of the mould. The number of strokes per layer required to produce specified conditions for cubical specimens, in no case shall the concrete be subjected to less than 35 strokes per layer for 15 cm cubes. After the top layer has been compacted, the surface of the concrete shall be finished level with the top of the mould, using a trowel, and covered with a metal plate to prevent evaporation. **Curing-**The test specimens shall be stored in the laboratory at a place free from vibration, under damp matting, for 24 hours ± ½ hour from the time of adding the water to the other ingredients. The temperature of the place of storage shall be maintained within the range of 22° to 32°C. After the period of 24 hours, they shall be marked for later identification, removed from the moulds and, unless required for testing within 24 hours, stored in clean water at a temperature of 24° to 30°C until they are transported to the testing.

Testing-Tests shall be made at the 3, 7, 28, 56, & 90 day's ages of the specimen. At least three specimens shall be made for testing at each selected age.

Procedure-Specimens stored in water shall be tested immediately on removal from the water and while they are still in the wet condition. Surface water and grit shall be wiped off the specimens and any projecting fins removed.The bearing surfaces of the testing machine shall be wiped clean and any loose sand or other material removed from the surfaces of the specimen which are to be in contact with the compression platens. In the case of cubes, the specimen shall be placed in the machine in such a manner that the load shall be applied to opposite sides of the cubes as cast, that is, not to the top and bottom. The axis of the specimen shall be carefully aligned with the centre of thrust of the spherically seated platen. No packing shall be used between the faces of the test specimen and the steel platen of the testing machine. The load shall be applied without shock and increased continuously at a rate of approximately 140 kg/sq cm/min until the resistance of the specimen to the increasing load breaks down and no greater load can be sustained. The maximum load applied to the specimen shall then be recorded and the appearance of the concrete shall be noted.The measured compressive strength of the specimen shall be calculated by dividing the maximum load applied to the specimen during the test by the cross-sectional area, calculated from the mean dimensions of the section (150X150X150mm) and shall be expressed to the nearest N per sq mm. Average of three values shall be taken as the representative of the batch provided.

Result- The details are given below

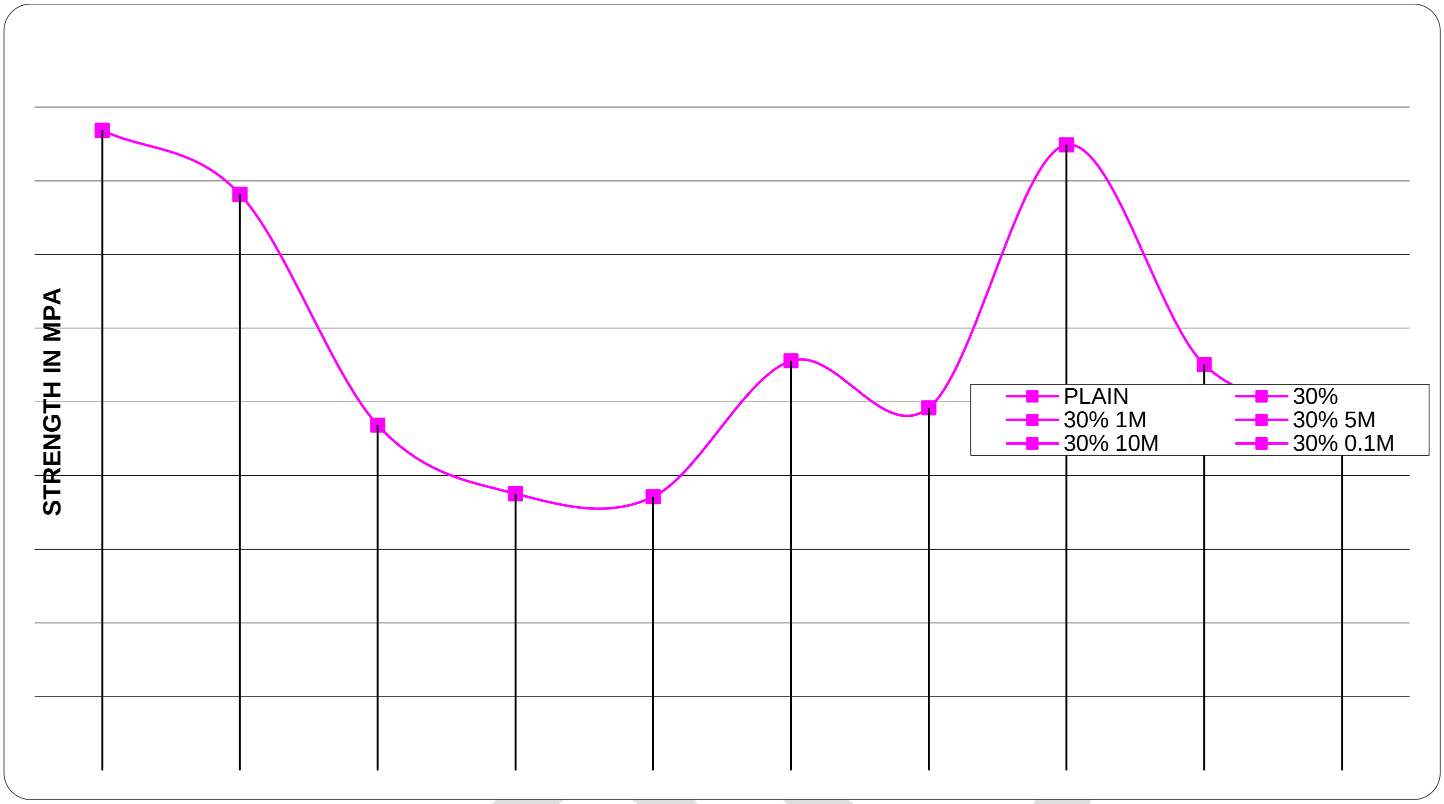

Fig.No.1. Comparison of 30% replacement of cement by P63 fly ash on Compressive strength at W/C=0.45 and varying concentration of NaOH

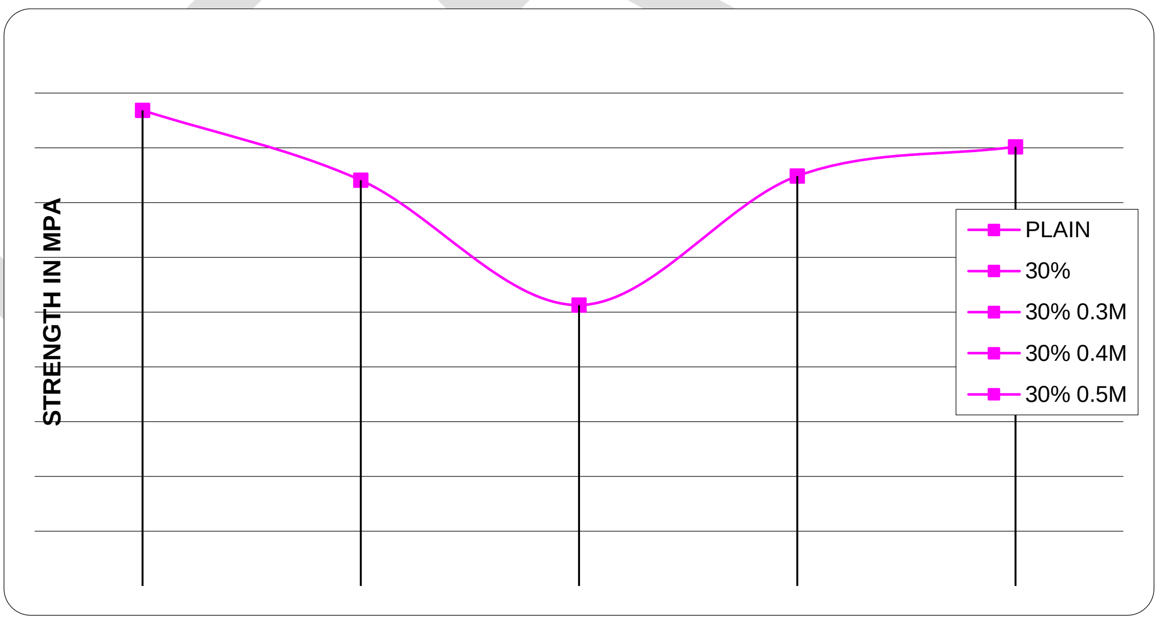

Fig.No.2 Comparison of 30% replacement of cement by P10 fly ash on Compressive strength at W/C=0.45 and varying concentration of NaOH

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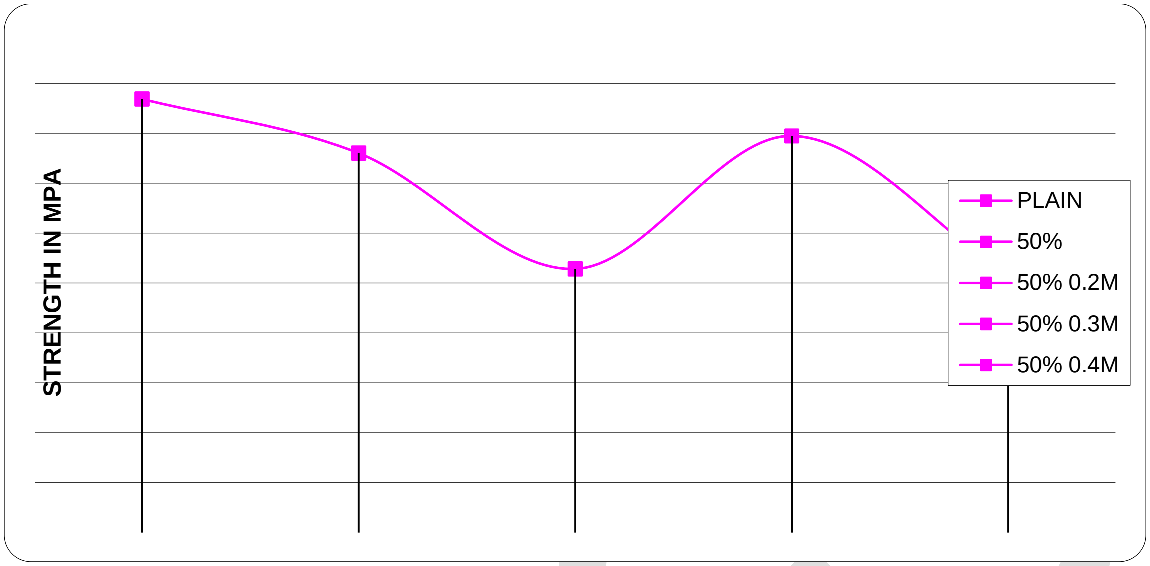

Fig.No.3 Comparison of 50% replacement of cement by P63 fly ash on Compressive strength at W/C=0.45 and varying concentration of NaOH

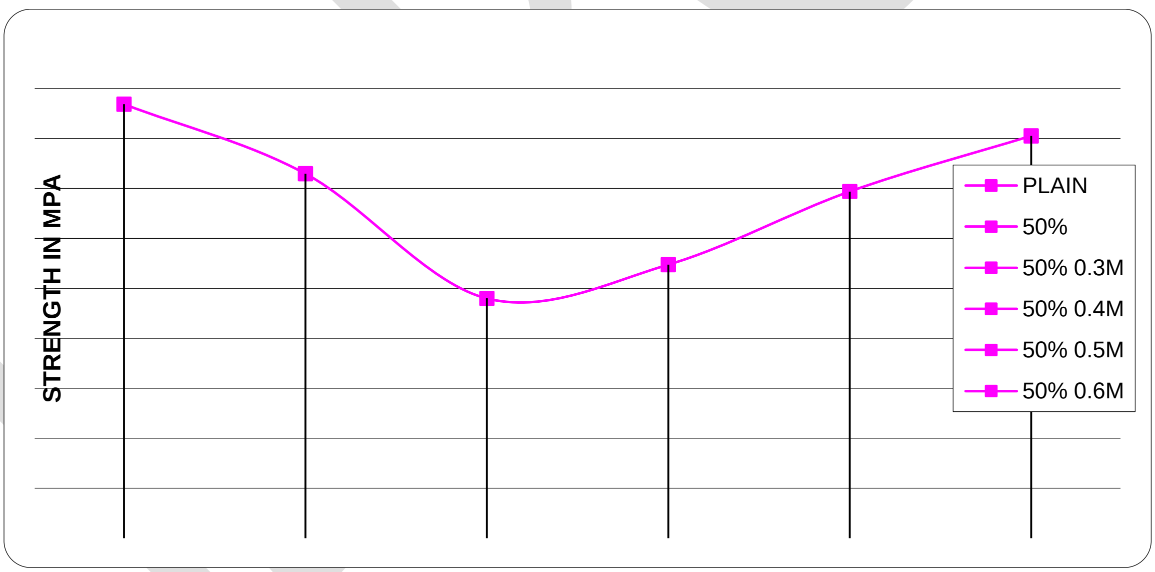

Fig.No.4. Comparison of 50% replacement of cement by P10 fly ash on Compressive strength at W/C=0.45 and varying concentration of NaOH

CONCLUSION

The conclusions drawn are summarized as follows,

1. It is observed that compressive strength decreases for P63 and P10 fly ash at 30% and 50% replacement of cement at 28 days of curing as compared to plain concrete.
2. Compressive strength for 30% replacement of cement by P63 fly ash at 56 days of curing is equal to 28 days strength of plain concrete.
3. It is observed that compressive strength for P63 and P10 fly ash at 30% and 50% replacement of cement at 28 days of curing increases with increase in concentration of NaOH upto certain level and then decreases.
4. Compressive strength for 30% replacement of cement by P63 fly ash at 28 days of curing is maximum at 0.3M NaOH and equal to 28 days strength of plain concrete.
5. Compressive strength for 50% replacement of cement by P63 fly ash at 28 days of curing is maximum at 0.3M NaOH as compared to plain concrete.
6. Compressive strength for 30% replacement of cement by P10 fly ash at 28 days of curing is maximum at 0.5M NaOH as compared to plain concrete.
7. Compressive strength for 50% replacement of cement by P10 fly ash at 28 days of curing is maximum at 0.6M NaOH as compared to plain concrete.

Conclusion must be short and precise and should reflect the work or research work you have gone through. It must have same as above in introduction paper adjustment

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