An Experimental Study on Improving Strength of Concrete by Partial Replacement of Cement with Fly Ash using River Sand

L Bhanu[1] B Chandra Sekhar Babu[2] S Ashok Kumar[3]
[1,2]Assistant Professor [3]Associate Professor
[1,2,3]Department of Civill Engineering
[1,2,3]Kakinada Institute of Technology & Science, Divili

Abstract— The purpose of this experiment is to reduce the cost of construction to certain extent without compromising with strength and durability. To improve the strength of concrete by partial replacement of cement with industrial waste materials such as fly ash, instead of using standard in proportion for cement mixture By preparing concrete mix with these modified materials (cement, coarse aggregate, sand and fly ash) cubes of standard sizes (15x15x15)cm are casted and tests are performed on workability, compressive strength of concrete. By this concrete strength is calculated and compared with nominal mix strength and found that partial replacement of cement with fly ash is suitable for the construction work

Key words: Concrete, River Sand

I. INTRODUCTION

Concrete is a composite construction material consisting of water, cement, fine aggregate (sand) and coarse aggregate. Concrete is in general, cement-based concrete.

Now a days the cost of concrete is increased since the cost of Cement is increased. To reduce the requirements and cost of concrete some alternative materials are needed to replace the Cement. Cement is the most cost and energy intensive component of concrete. Accordingly, replacement of cement by fly ash reduces the unit cost of the concrete and conserves energy.

The main objective of the present work is to improve the strength of concrete by partial replacement of cement with fly ash is 0%, 10%,20%, and 30%.

Fly ash also has high fineness, which decreases the porosity and pore size and increases the compressive strength. Fly ash is the most widely used pozzolanic material in all over the world.

In this experimental study the river sand is used. The study is carried out a mix proportion of M_{20} (1:1.5:3) with water cement ratio of 0.5 respectively.

II. MATERIAL DESCRIPTION

In present day concrete, cement is a mixture of lime stone and clay heated in a kiln to 1400-1600c.The types of cement permitted by IS: 1343-1980(clause 4.1) for pre-stressed applications are the following .The information is revised as per IS: 456-2000, plain and Reinforced-concrete code of practice.

33 Grade of ordinary Portland cement conforming to IS 269-1989

43 Grade of ordinary Portland cement conforming to IS 8112

Portland slag cement conforming to IS: 455-1989, Portland slag cement specifications, but not more than 50% slag cement.

According to IS 456:2000 the cement 43Grade Ordinary Portland Cement conforming to IS 8112

A. Aggregates:

Aggregates, which account for 70 - 80% of the total volume of concrete. Aggregates are divided into two distinct categories.

i) Fine Aggregate
ii) Coarse Aggregate.

Gravel aggregates are stones that have nominal size larger than *4.75mm is called as* Coarse Aggregate. Nominal size is less than 4.75mm is fine aggregate. Coarse aggregate can be obtained from natural sources or synthetic .Generally river sand is preferable for fine aggregate.

Average specific gravity of rocks vary from 2.6 to2.8.

Fineness modulus 2.2-2.6 is Fine sand, 2.6-2.9 is Medium sand and 2.9-3.2 is Coarse sand.

B. Water:

Water is an important ingredient of concrete as it actively participates in the chemical reaction with cement.

The amount of water is mix in pounds compared with the amount of cement is called water cement ratio. The lower the water cement ratio, the stronger the concrete (higher strength, less permeability).

SL.NO	SIEVE mm	WEIGH RETAINED	% OF WEIGHT RETAINED	CUMULATIVE % RETAINED	CUMULTIVE % RETAINED
1	80	0	0	0	100
2	40	0	0	0	100
3	22.4	1.943	1.943	38.86	61.14
4	19	1.319	3.262	65.24	34.76
5	13.2	1.679	4.941	98.82	1.18
6	10	0.056	4.997	99.94	0.06
7	6.3	0.003	5.0	100	0
∑ cumulative % retained = 402.86					

Table 1:

Water used for making concrete should be clean. It activates the hydration of cement and forms plastic mass. As it sets completely concrete becomes hard mass. However excess water reduces the strength of concrete. To achieve required workability and at the same time good strength a water cement ratio of 0.4 to 0.45 is used, in case of machine mixing and water cement ratio of 0.5 to 0.6 is used for hand mixing. PH value shall not be less than 6.

C. Fly ash:

Fly ash is finely divided residue resulting from the combustion of powdered coal and transported by the flue gases and collected by electrostatic precipitator.

Fly ash was first used in large scale in the construction of Hungry Horse dam in America.

In India ,Fly ash was used in Rihand dam construction replacing cement up to about 15%. In India, the total production of fly ash is nearly as that of cement (75 million tons).

But our utilization of fly ash is only about 5% of the production.

Classes

- ASTM C618 Defines two classes of fly ash:
- Class C
- between Class F
- Primary difference Class C and Class F fly ash is the amount of the amount of calcium, silica, alumina, and iron content in the ash
- ASTM C618 requirements:
- Loss of Ignition (LOI) < 4%
- 75% of ash must have fineness of 45 µm or less

Physical test	Results obtained	IS: 8112-1989 (15) specifications
Fineness (retained on 90 sieve)	2.55	10max
Standard consistency	31%	-
Initial setting time	30min	30min
Final setting time	10 hours	600max
Specific gravity	3.25	-

Table 2:

III. Experimental Program

A. *Cubes casting procedure:*

- Clean the moulds and apply oil. Fill the concrete in the moulds in 3 layers.
- Compact each layer with not less than 25 strokes per layer using a tamping rod. (steel bar 16mm dia and 60cm long , bullet pointed at lower end)
- level the top surface and smoothen it with a trowel.
- Cube date and grade is marked on the cube after initial or final set by paint. The test specimens are stored in moist air for 24 hours.
- After 24 hours cubes removed from the moulds and kept submerged in clear fresh water until it is taken out for testing.
- water is changed to reduce the temperature and available fresh water having good oxygen value.
- The Values for slump cone test The cubes are cured in water like 3,7,14 and 28 days etc...

B. *Compressive Strength of Concrete:*

A compression test determines behavior of materials under crushing loads. The specimen is compressed and deformation at various loads is recorded.

The test was conducted on test specimens at the periods of 3, 7and 28 days after proper curing till the day of test.

IV. Results and Discussions

A. *Slump Cone Test Results:*

Water/Cement Ratio	Height of the cone 0%	Height of the cone 10%	Height of the cone 20%	Height of the cone 30%
0.5	30	30	30	30
0.5	28	27	29	28
0.5	26	25	27	27.5

Table 3: Slump Cone Test Results

B. *Compressive Strength test Results N/mm^2:*

Days	Ordinary Mix 0% M_{20} (1:1.5:3)	10% replacement of cement with fly ash.	20% replacement of cement with fly ash.	30% replacement of cement with fly ash.
3	26.44	26.22	26	19.22
7	36.66	38.88	37.66	26.33
28	45.55	46.22	45.11	33.22

Table 4: Compressive Strength test Results N/mm2

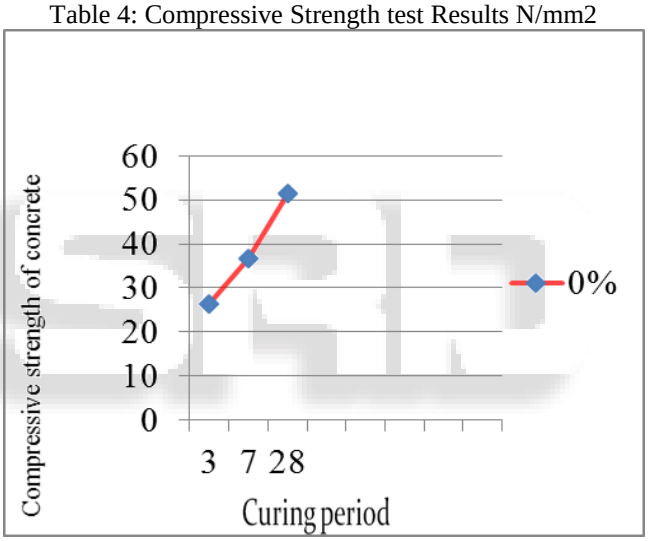

Fig. 1:

Graph Shows 0% sample M_{20} (1:1.5:3)

V. Conclusion

- The Maximum Compressive strength of sample M_{20} (1:1.5:3) grade concrete specimen is 45.55 N/mm^2 at 28 days.
- The Maximum Compressive strength for 10% replacement of cement with fly ash is 46.22 N/mm^2 at 28 days.
- The Maximum Compressive strength for 20% replacement of cement with fly ash is 45.11N/mm^2 at 28 days.
- The Maximum Compressive strength for 30% replacement of cement with fly ash is 33.66 N/mm^2 at 28 days.
- 10% and 20% are increasing strength as well as ordinary sample. But 30% of sample is doesn't meet the requirements of ordinary sample.
- According to the test a result of the fly ash is used to replace the cement up to 20% is suitable for constructions works.

REFERENCES

[1] S. Yuvaraj, Dr.Sujimohankumar, N.Dinesh, C. Karthic, Volume 2, Issue 6, June (2012)"Experimental research on improvement of concrete strength and enhancing the resisting properly of corrosion and permeability by the use of Nano-Silica Flyash concrete"
[2] C.Marthon*, T.P.Agrawal, Vol. 2, Issue4, July-August (2012), pp.1986-1991 "Effect ofFly Ash Additive on Concrete Properties"
[3] G.Quercia,H.J.H.Brouwers, June 20 – 23, (2010)"Application of nano-silica (nS) in concrete mixtures"
[4] IS : 516-1959, Method of Tests for Strength of Concrete.
[5] IS : 456-2000, Code of Practice for Plain and Reinforced Concrete.

