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Comparative Study on Conventional Concrete and Fly-Ash Aggregate Concrete

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***Abstract*—Fly-ash in finely divided residue resulting from the combustion of powdered coal and transported by the flue gases and collected by electrostatic precipitator. Fly-ash is the most widely used pozzolanic material all over the world. In India, the total production of fly-ash is nearly as much as that of cement (85 million tons), from 85 existing coal based thermal power plant in India. But our utilization of fly-ash is only 5% of production. The use of fly-ash must be popularized for more than one reason.**

In this experimental investigation strength aspects of fly ash aggregates concrete were studied, by preparing aggregates with cement and fly ash in the ratio of 12:88, 14:86 and 16:84. The tests have been conducted on concrete in order to study the strength characteristics such as compressive strength and spilt tensile strength.

Keywords— Fly ash aggregate, superplasticizer, light weight concrete, compressive strength and split tensile strength.

I. INTRODUCTION

The environmental impacts of crushed stone aggregate, extraction is of increasing concern in many parts of the country. The impact includes loss of forest, noise, dust, blasting vibration and pollution hazards unplanned exploitation of rocks may lead to landslides of weak and steep hill slopes. Now days due to industrialization there is a scarcity of electricity thought India. In India having 85thermal power plants are there for generation of electricity. In each thermal plant due to generation of electricity 85 million tones per annum. Major challenge in complete usage of fly-ash as an aggregate in construction industry. Hence fly ash can be used in making artificial light weight coarse aggregate. The aggregate so prepared are known as fly ash aggregates, the method is called as PELLETISATION. These aggregates can be manufactured in different proportion of fly ash, cement; the aggregate which is thus manufactured is light weight aggregate.

Design and construction by this type of concrete containing light weight aggregates are economical; due to nature that light weight reduce the self-weight. It involves initially dry mixing of cement and fly ash by adopting some amount of water to the mixing of these constituents in a mixer to from aggregates. In conventional concrete, weight of concrete is one of the parameters to compare with weight of fly ash aggregate concrete. Normally density of concrete is in the order of 2200 to 2600 kg/m^3.this heavy self-weight makes it as uneconomical structural material compared to low self-weight of fly ash aggregate concrete. In order to produce of desired density to suit the required application, the self-weight of structural and non- structural members are to reduced. Hence economy is achieved in the design of supporting structural elements which lead to the development of light weight concrete. Light-weight concrete is defined as concrete that has been made lighter than the conventional concrete by changing material composition or production method. Light weight aggregate concrete is made by replacing the usual material aggregate by light aggregate. Though light-weight concrete can't always substitute normal concrete for its strength potential, it has its own advantages like reduced dead load and thus economic structures and enhanced seismic resistance, high sound absorption and good fire resistance.

II. LITERATURE REVIEW

Priyadharshini.P, Mohan Ganesh.G et al: This paper mainly focuses on manufacturing process of light weight aggregates using pelletizer and curing has been done in cold bonded technique. The properties of these fly ash aggregates have been tested and compared with natural gravel and the study shows that cold bonded fly ash aggregates can be used as an aggregate replacement material in concrete. The strength property and density of concrete made with artificial fly ash aggregates and natural gravel were also studied which confirms that introduction of fly ash aggregates in concrete reduces the compressive strength but meets the required strength to be used as a structural material.

Biswaroop Ghosh and Dr.A.k.Rath: This study is aimed to develop a technique for producing an aggregate with the fly-ash and use it in the in replacement of normal coarse aggregate. The properties of fly-ash were experimentally checked whether it is of type-C or of type-F by chemical analysis of the fly-ash. Batches of fly-ash aggregates were manufactured using cold bonded technique using disc pelletizer. Based on the crushing value, water absorption and impact value test results of their properties, fly-ash aggregates were selected. Using the fly-ash aggregates prepared from the cold bonded technique, there properties were tested. These pellets will be light in weight having specific gravity (1.63,1.89) less than that of gravel (2.67) and will have high impact value (32.52, 28.54) than that of gravel (20.12). At the same time, they will also address some of the environmental problems such as disposing the industrial waste which is being generated from thermal waste.

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III. METHADOLOGY

A. Preparation of fly ash aggregate:

- Fly ash and ordinary Portland cement 53 grade were selected in different proportions like [fly ash; cement] 10:90, 12:88, 14:86 as shown in fig:1.
- These proportions are thoroughly dry mixes in concrete mixer.
- After dry mix in a mixer start sprinkling the water until formation fly ash aggregate.
- The contents were thoroughly mixed in concrete mixer until the formation of fly ash aggregates. Method of formation is called palletisation.
- Once the aggregates formed from the mixer allowed to dry for a day.
- Dried aggregates kept for 7 days water curing and one day of sun light curing is carried. As shown in fig 2 and fig 3

Fig 1: pellets

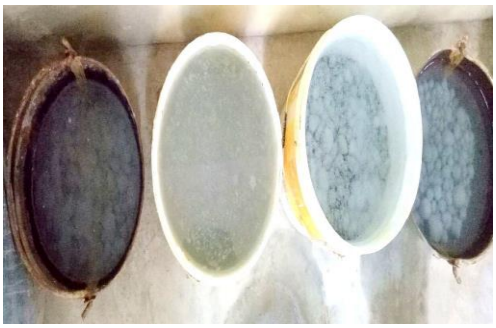

Fig 2: water curing

Fig 3: sun light curing

B. Segregation of fly ash aggregates:

- After curing, fly ash aggregates were segregated into fine and coarse aggregates based on size of the pellets
- The aggregates passing through 4.75mm sieve are fine aggregates.
- The aggregates retained on 4.75mm sieve are coarse aggregates.

C. MIX DESIGN

Total quantities of materials for $1m^3$ fly ash aggregate concrete:

- Cement content = $394kg/m^3$
- Water content = 157.6 litres
- Fine aggregate = $529.83 kg/m^3$
- Coarse aggregate = $817.92 kg/m^3$
- Chemical admixture =6.304kg/m3
- w/c =0.4
- Mix ratio = C: FA: CA: W/C
  = **1:1.34:2.07:0.4**

D. Preparation of Concrete specimens

- The weighed materials of cement, fly ash fine aggregates and fly ash coarse aggregates, were then placed on a large mixing tray which is clean and free from impurities.
- The ingredients were then mixed to obtain a uniform mix.
- The concrete mix is then placed in to the cube mould of 150mm X 150mm X 150mm and in cylindrical mould of 100mm X 200 mm in three successive layers with 25 blows each layer, with the help of a tamping rod the top surface is then smoothened.
- The concrete mould is then placed in a safe location for 24 hours after which the specimens are placed in curing tank for a specified period of time.

Fig 4: Specimen

IV . TESTS

- Compressive strength test
- Spilt tensile strength test

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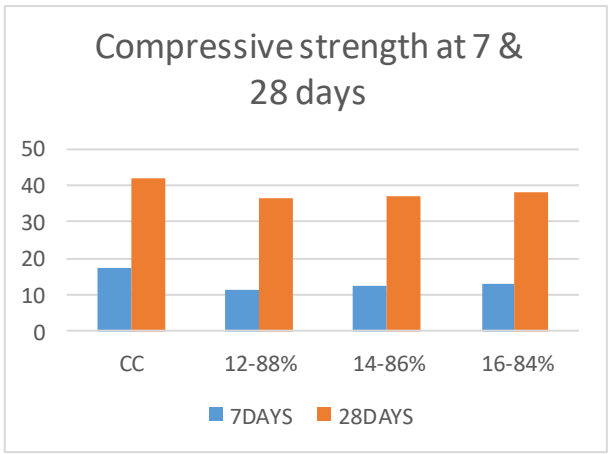
Figure 4: Testing of cube under CTM

Figure 5: Testing of cylinder under CTM

V . RESULTS

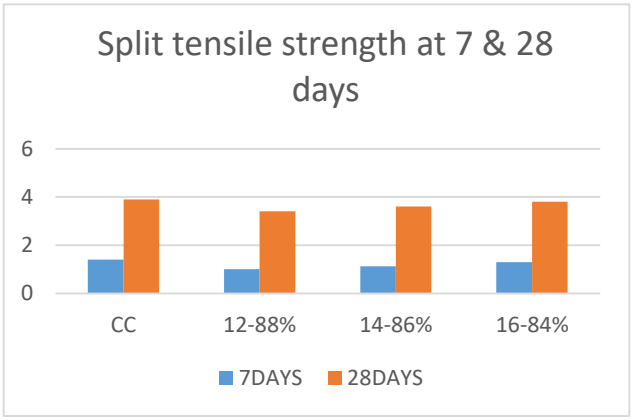
Results for Compressive strength at 7 and 28 days of concrete mix

Sl .no	Aggregate ratios	Compressive strength for 7days in n/mm^2	Compressive strength for 28days in n/mm^2
1.	12:88	11.31	36.71
2.	14:86	12.46	37.22
3.	16:84	12.91	37.90
4.	CC	18.04	41.72



Result for split tensile strength at 7 and 28 days concrete mix

Sl .no	Aggregate ratio's	Split tensile strength for 7days in n/mm^2	Split tensile strength for 28days in n/mm^2
1.	12:88	1.0	3.4
2.	14:86	1.12	3.6
3.	16:84	1.3	3.8
4.	CC	1.8	3.9



VI . CONCLUSION

The following conclusion can be drawn from above experimental investigation:

- The fly-ash aggregates produced by cement and fly-ash in the ratios of 12:88, 14:86, and 16:84 have specific gravity of fly-ash coarse aggregates 2, and fine aggregates have obtained 1.67.
- The aggregates produced from cement and fly-ash which are in rounded in shape which give better workability then that of natural aggregates.
- Use of light-weight fly-ash aggregates will reduce the dead load of structure.
- The compressive strength and split tensile strength of fly-ash aggregates concrete obtained are less than that of conventional concrete.
- This method can be implemented where the load sustainability is less.

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