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A STUDY ON COMPRESSIVE STRENGTH OF CONVENTIONAL CONCRETE BY REPLACING WITH FLYASH AND SUGARCANE ASH

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ABSTRACT

The problem gets compounded with million tons of waste being generated worldwide inform of demolished waste from natural and technological disasters. There is a growing concern to limit the amount of waste by recycling which will provide opportunities for saving energy, time and resources. The utilization of by-products in the production of concrete has gained considerable interest among concrete technologists in the recent years. Mineral admixtures like sugar cane bagasse ash is the most common type of by-product. That are usually incorporated into concrete mixes to produce concrete with exception properties. The conventional concrete used cement, fine aggregate, coarse aggregate and water. The cost of the convention materials like cement is increasing spirally, hence they can be reduced sugarcane bagasse ash, which is industrial wastes available at low cost. As not much of literature is available for this aspect of utilization, the trial and error procedure has been adopted for selection of water cement ratio. Finally, from the above investigations, it is observed that structural properties like Compressive Strength, workability of concrete with the replacement of cement by Sugarcane Bagasse Ash and Fly Ash which are close to the strength of conventional concrete. Test results indicate that the strength results of conventional mix close to the strength of concrete which is replace by 10% sugar cane bagasse ash and Fly Ash can be replaced in cement which gives results equal to the normal concrete.

Key words: Compressive strength, Workability, Flyash, Sugarcane ash, Ordinary Portland- Cement

INTRODUCTION

Every year millions of tons of ash are generated from thermal power plants. In addition to this a large quantity of agriculture waste like rice husk ash, sugarcane bagasse ash is also produced. The problem gets compounded with million tons of waste being generated worldwide inform of demolished waste from natural and technological disasters. There is a growing concern to limit the amount of waste by recycling which will provide opportunities for saving energy, time and resources. The utilization of by-products in the production of concrete has gained considerable interest among concrete technologists in the recent years. Mineral admixtures like sugarcane bagasse ash are the most common type of by-product. That is usually incorporated into concrete mixes to produce concrete with exception properties. The conventional concrete used cement, fine aggregate, coarse aggregate and water. The cost of the convention materials like cement is increasing spirally; hence they can be reduced sugarcane bagasse ash, which are industrial wastes available at low cost. As not much of literature is available for this aspect of utilization, the trial and error procedure has been adopted for selection of water cement ratio.

Sugarcane Ash

Sugarcane bagasse is an industrial waste is used worldwide as fuel in the same sugar cane industry. The combustion yields ashes containing high amounts of unburned matter, silicon and aluminum oxides as main components. These sugar cane bagasse ashes (SCBA) have been chemically, physically and miner logically characterized in order to evaluate the possibility of their use as cement – replacing material in the concrete industry, are given in table no 3. Ganesan etal stated that 1 ton of sugar cane generates 280 Kgs of bagasse, and that based on economics as well as environmental related issues, enormous bagasse management issues i.e., utilization, storage and disposal. The bagasse used in this work was obtained from zongo area of zaria in kaduna state of Nigeria. The sugarcane bagasse consists of approximately 50% of cellulose, 25% of hemicellulose and 25% of lignin. Each ton of sugarcane generates approximately 26% of bagasse (at a moisture content of 50%) and 0.62% of residual ash. The residue after combustion presents a chemical composition dominates by silicon dioxide (SiO_2). In spite of being a material of hard degradation and that presents few nutrients, the ash on the farms as a fertilizer in the sugarcane harvests.

Flyash

Fly ash obtained from ash silos of Vijayawada Thermal power station (VTPS) is used for the current study, Fly ash is a by-product of the combustion of pulverized coal in thermal power plants. It is Removed by mechanical collector or electrostatic precipitators as a fine particulate residue from the combustion gases. One of the most important uses of fly ash as shown in fig1.1 making cement and concrete. As fly ash is available almost free of cost, there is considerable saving in making concrete by addition of fly ash. However, each fly ash is different. Its quality depends upon quality of coal used and type of collection. The reactivity of fly ash depends on its chemical composition, fineness and particle shape. Therefore, before using a particular fly ash, research on its cement properties need to be done. IS 3812 specifies the properties of fly ash suitable for use in concrete.

Fig1.1: Sample of Flyash

Compressive Strength Test

Concrete specimens are removed from curing pond and wiped clean. Then they are placed under 400 KN capacity compression testing machine as shown in fig 1.2 then load is applied continuously. The load is increased until the specimen fails and the maximum load is recorded for each specimen and the compressive strength is calculated by using following formula.

Compressive Strength = Applied Load / Area of cross section.

Fig1.2: Compressive Testing Machine

1. OBJECTIVES

Ordinary Portland cement is recognized as a major construction material throughout the world. Researchers all over the world today are focusing on ways of utilizing either industrial or agricultural waste, as a source of raw materials for industry. This waste, utilization would not only be economical, but may also result in foreign exchange earnings and environmental pollution control. Industrial wastes, such as blast furnace slag, fly ash and silica fume are being used as supplementary cement replacement materials.

To observe the variation in compressive strength of concreate cube of size (150mm x 150mm x 150mm) by replacing the Cement with Flyash and Sugarcane Ash.

METHODOLOGY

The various tests performed for the study are mentioned below as per the standard codes, the tests include, index tests for soil classification, sieve analysis of sand and Aggregate impact test for fine and coarse aggregates, graphs results were given in following table no 1& 2.

Materials Used:

- Cement 43 grade
- Flyash
- Sugarcane ash
- Fine aggregates
- Coarse aggregates
- Water

Tests conducted for fine & coarse aggregate

- Sieve Analysis :(IS:2720(Part IV) -1985)
- Specific Gravity
- Bulk Density
- Aggregate impact test

Mix Proportions as per (IS:456-2000):

- Grade designation: M20
- Type of cement: OPC 43 grade,
- Max. nominal size of aggregates: 25 mm
- Minimum cement content: 340 kg/m3
- Maximum water cement ratio 0.57
- Workability: 75 mm (slump)
- Exposure condition: Mild
- Degree of supervision: Good
- Maximum cement content: 480 kg/m3
- Chemical admixture: Not used

Test procedure

Firstly, the required quantities of Cement, Fly ash, Sugarcane Bagasse ash, fine aggregate and Coarse aggregate were taken by weighing, then measured quantities of fine aggregate and coarse aggregate were spread out over dry mix of cement and Sugarcane Bagasse ash or fly ash and mixed thoroughly in dry state until uniformity of color was achieved. Water is applied in a measured quantity to the dry mix and it was thoroughly mixed to obtain homogeneous concrete. For the test purpose the mould with size of 150 x 150 x 150 mm is chosen and cleaned thoroughly, then inner side and bottom of the mould were coated with waste oil for easy removal of mould after casting. The mix was placed in three layers. Each layer was compacted using a tamping rod of 600 mm in length and 16 mm diameter with 25 blows then after appropriate time gap all moulds were removed and the blocks allowed for curing.

Fig3.1: Crushing Test

First the grade of cement ordinary Portland cement(OPC) 43, used in this investigation is M20 without use of Sugar cane bagasse ash and Fly Ash. The mix design is based in strength criteria and durability criteria used in moderate environment conditions and the ratios by weight of cement, fine aggregate and aggregate is obtained using the equations from IS 10262-2009 and proportions are maintained strictly as per standards throughout the casting and all the cubes allowed for curing and in between the curing days Cubes were tested for compressive strength by using compressive testing machine as shown in fig1.2 after 7 Days and 14 days and 28 Days curing**.**

Fig3.2: Slump cone test

In the very first blocks are constructed with conventional concreate and then same conventional concreate is replaced with fly ash and sugarcane ash by 10%,20%,30% of weight of cement. Before that the basic tests were conducted to the concreate mix like slump cone test as shown in fig 3.2 and compaction factor test as shown in fig3.4 for finding the workability. and for aggregate the aggregate crushing test is conducted as shown in fig3.1 and for fine aggregates sieve analysis test conducted then samples passing from 4.75mm sieve as used for the present study and the variation is observed in compressive strength same are given in tables no 1 & 2 and graph 1 & 2.

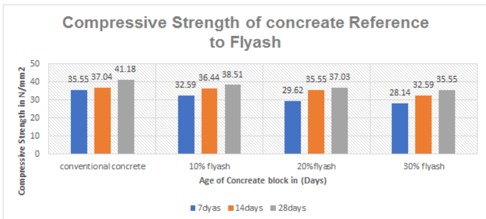
Fig3.4: Compaction factor test

2. RESULTS AND ANALYSIS

The Result analysis and obtained from the various tests and same as given in following tables

Table 1: compressive strength variation with Reference to time

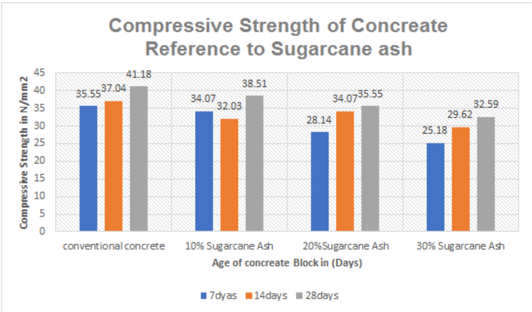
	compressive strength in (N/mm^2)			
s.no	concreate type	7dyas	14days	28days
1	conventional concrete (or) 0% flyash	35.55	37.04	41.18
2	10% Sugarcane Ash	32.59	36.44	38.51
3	20%Sugarcane Ash	29.62	35.55	37.03
4	30% Sugarcane Ash	28.14	32.59	35.55



Graph1: Compressive strength variation with Reference to Flyash

Table2: Compressive Strength Variation with Reference to Time

	compressive strength in (N/mm²)			
s.no	**concreate type**	**7dyas**	**14days**	**28days**
1	conventional concrete (or) Sugarcane ash	35.55	37.04	41.18
2	10% Sugarcane Ash	34.07	32.03	38.51
3	20%Sugarcane Ash	28.14	34.07	35.55
4	30% Sugarcane Ash	25.18	29.62	32.59



Graph 2: Compressive Strength Variation with Reference to Sugarcane Ash

Table 3: Chemical Composition of Bagasse in (mass%)

COMPONENT	Mass in %
SiO_2	78.34
Al_2	8.55
Fe_2O	3.61
CaO	2.15
Na_2O	0.12
K_2O	3.46
MnO	0.13
TiO_2	0.5
BaO	<0.16
P_2O_5	1.07
LOSS OF IGNITION	0.42

3. CONCLUSION

From the above investigations, it has been observed that the structural properties like Compressive Strength, workability of concrete with the replacement of cement by Sugarcane Bagasse Ash and Fly Ash which are close to the strength of conventional concrete. Test results indicate that the strength results of conventional mix close to the strength of concrete which is replace by 10% sugar cane bagasse ash and Fly Ash can be replaced in cement which gives results equal to the normal concrete. The utilization of by-products in the production of concrete has gained considerable interest among concrete technologists in the recent years. Mineral admixtures like sugar cane bagasse ash are the most common type of by-product. The cost of the conventional materials like cement is increasing gradually, by the economical consideration, sugar cane bagasse ash and Fly-ash which are industrial wastes available at low cost. A proper mix design and use of plasticizers can further improve the acceptable quality of cement concrete for construction. When compared to the other waste materials it is very economical.

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