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A Study on Compressive Strength of Concrete with Bagasse Ash as Supplementary Cementitious Material on Various Curing Methods

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Abstract - A number of researchers today are focusing on ways of utilizing industrial and agricultural waste as a source of raw materials for production of construction products. Presence of silica in Sugarcane Bagasse Ash(SCBA) contributes to improved pozzolanic activity. The main objective of this research was to characterize the compressive strength of concrete for M30 grade by replacing cement with 15% Sugarcane Bagasse ash which is heated at 1100ºc for one hour and also subjected to varying curing methods. In this study three different types of curing methods are adopted namely conventional curing, steam curing and curing agent. In conventional curing specimens are tested after 28days of pond curing. In steam curing the strength enhancement depend on steam curing cycle, the parameters involved are Delay period, Curing temperature and Curing period. Cerapolycure is an acrylic resin based curing agent forms a seamless film and prevents the evaporation of water when applied on a concrete surface. A comparative study between three different curing methods was carried out. From the results it is observed that the steam curing and curing agent develops increased compressive strength.

Key words: Bagasse ash, steam curing, cerapolycure.

I. INTRODUCTION

Ordinary Portland is the most common type of cement in general use around the world. Researchers all today are focusing on ways of utilizing waste, as a source of raw materials for industry. Nowadays bagasse ash, residue from sugar industry has been used in large amount. When this waste is burned under controlled conditions, it gives ash, which has pozzolanic properties. A few studies have been carried out to study pozzolanic activity and their suitability as binders, partially replacing cement. Therefore it is possible to use sugarcane bagasse ash (SCBA) as replacing material for cement. The bagasse is burned in various temperatures to prepare the ash properties for the development of composition, which shows the percentage weight of SiO2 is increased and it is rich in silicon oxides. The main aim is to develop composites by Bagasse ash (BA), which has higher weight percentage of Silica and it will be helps in increasing strength of aluminum materials while it used as reinforced material which is burned at 1100ºC for 1 hour. hydration characteristics of bagasse ash blended Portland cement was investigated in previous literatures and it was concluded that 15% replacement of cement was optimum for better performance and three different curing systems were adopted to find the strength properties.

II. LITERATURE REVIEW

A. Imran and Anwar (2017) says that the fibres were burnt at different intervals of temperature 1100°C with 1,3,5 hours. Parameters studies carried out on grain size and percentage variation of chemical composition and also effect of temperature on weight and density variation in different hours are investigated. And they observed that length of particle size is decreased with increasing in time at constant temperature. The EDS says that BA were found, Si is rich and increases with increasing in time at constant temperature. These results indicated that the oxides will help to increase the strength of materials

B. Mazen et al., (2016) explained that research is to investigate the performance of concrete under adverse and normal curing condition. Tests include water absorption, compressive strength, and microscopic analysis. Wax-based curing compound when accompanied with the waterproofing material enhanced strength levels. Increase in internal cracks of concrete are due to liquid curing agent with higher water cement ratio. Water based curing agent has 43% increase in strength where wax based curing has 34% increase in strength for the same period.

C. Manoj kumaret al.,(2016) explained to study the Concrete cubes, cylinder and prism were cast and tested. This study is carried out to evaluate fresh properties and

mechanical properties of hardened concrete replaced by bagasse ash. They observed that the specimen with 15% of bagasse ash and 0.5% SP shows good results in mechanical Properties. It shows that partial replacement of cement as SCBA can be effectively used due to its pozzolanic properties. These results indicated that the load carrying capacities of bagasse ash concrete cubes are higher than the conventional concrete.

D. Bahurudeen et al.,(2015) studied that the experimental investigation has been carried out on the test specimens to study the strength properties in terms of compressive strength, heat of hydration, drying shrinkage and durability. This study analyzes that use of sugarcane bagasse ash in concrete prominently enhances its performance. It is found that Resistance of concrete against chloride and gas penetration significantly increased with increase in bagasse ash replacement. Surface resistivity of SCBA replaced concretes was found to be higher compared to control concrete due to excellent pozzolanic performance of SCBA.

E. Ramezanianpour and khazali (2013) investigated the Effect of steam curing cycles on strength and durability of SCC. To study the effects of 36 steam cured concrete on the compressive strength Compressive strength measurements indicated that increase in precuring period leads to lower immediate compressive strength values. Immediate compressive strength are also due to increased temperature and total cycle time that means higher energy and time consumption. This could be due to the accelerated hydration reactions and rapid formation of Calcium–Silica–Hydrate (C–S–H gel).

III. PROBLEM DEFINITION

The main aim is to develop the composite by using Bagasse ash (BA), which shows higher weight percentage of Silica and it will be helps in increasing strength of aluminium materials while it is used as reinforced material. In present scope of work sugarcane bagasse ash will be prepared at constant temperature of 1100ºC for one hour in a furnace and to incorporate bagasse ash as an alternative construction material as cement in concrete and three different curing conditions are adopted to study the strength properties of incorporated concrete.

TABLE I
Physical characteristics of SCBA blended cements

CHARACTERISTICS	OPC	15% PPC
Specific gravity	3.16	2.97
Fineness (m^2/kg)	310	313
Soundness, expansion (mm)	1.61	1.10
Consistency (%)	30	40
Initial setting time (min)	125	180
Final setting time (min)	165	280

IV. BAGASSE ASH PREPERATION

The sugarcane mineral is extracted and fibered waste is milled makes as small fibres known as bagasse. Bagasse is burned in furnance at various temperature the final product is Bagasse Ash, the bagasse ash is prepared at temperature of 1100˚C for the duration of one hour.

Fig 1: Untreated Bagasse Ash

Fig 2: Treated Bagasse Ash

V. EXPERIMENTAL INVESTIGATION

This experimental perform through a cube size of 150 × 150 × 150 was casted. To obtain the strength of concrete, bagasse ash replaced with cement at 15 percentages.

VI. PREPARATION OF CUBE

All the materials were first mixed in dry condition. To the dry mix calculated quantity of water was added and thoroughly mixed to get a uniform mix by using mixer machine. Oil was applied on the inner surfaces of the moulds and concrete was poured in three layer and each layer was compacted then the specimen were demoulded next day and curing for required period in curing tank.

A. Curing systems

Three different curing systems were adopted in this research work as explained below

1) Pond curing

Pond curing is one of the commonly used curing methods for concrete. The concrete specimens were demoulded and the specimens were kept in the pond and were immersed in water for 28 days. After 28 days of curing the specimens were tested. During this curing period there is no chance for the concrete to become dry since it was hydrated all the time.

2) Steam curing

In order to study the effects of different steam curing cycles on the hardened concrete. Three parameters were selected as variables

- ***Delay period*:** delay period of 2 hours and 4 hours were chosen for investigation such that the effect of delay period before and after setting time can be determined.
- ***Curing temperature*:** based on the literature, the experimental investigations were carried out for temperatures of 60º
- ***Curing period*:** it was decided to have a curing period of 6 hours and 8 hours, followed by a cooling period of 2 hours such that the total steam curing cycle was less than 18 hours.

3) Curing agent

In this type curing agent, Cera-polycure is used which is an acrylic resin based curing compound which when applied on concrete, forms a seamless film and prevents the evaporation of water from the capillaries of concrete to ensure proper hydration process.

TABLE 2
Specimen Lablling

S.NO	SPECIMEN ID	CURING METHODS
1	BGA	Conventional curing
2	BGAC	Curing agent
3	T60-2-6	Steam curing
4	T60-2-8	Steam curing
5	T60-4-6	Steam curing
6	T60-4-8	Steam curing

VII. COMPRESSIVE STRENGTH

Compression strength of concrete with bagasse ash was conducted. The compression test was conducted as per IS 516 – 1959. The specimens (cube) of size 150 mm x 150 mm x 150 mm were kept in water for curing for 28 days and specimen was tested. The load was applied without shock and increased continuously at a rate of approximately 95 kg/sq mm/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 was then recorded and the appearance of the concrete for any unusual features in the type of failure was noted. Average of three values was taken as the representatives of the compressive strength of the sample as noted.

TABLE 3
Ultimate Strength of the Specimens

The U1ltimate strength of cubes under different curing condition are as follows

SPECIMEN TYPE	NO. OF DAYS	AVERAGE COMPRESSIVE STRENGTH (N/mm²)	
		Treated ash	Conventional concrete
BGA	28	34.2	37.5
BGAC	28	33.1	35.5
T60-2-6	28	33.48	37.1
T60-2-8	28	31.99	33.5
T60-4-6	28	28.70	31
T60-4-8	28	39.7	42
BGA	56	50.5	45.6
BGAC	56	45.8	40.2
T60-2-6	56	43.6	42.6
T60-2-8	56	48.4	43.6
T60-4-6	56	40.1	39.5
T60-4-8	56	49	44.3

VIII. CONCLUSIONS

- In this experimental investigation, concrete mix M30 has been designed. The concrete with bagasse ash as a partial replacement of cement

for 15% are used and results have been evaluated for various curing methods.

- Incorporation of treated bagasse ash improves the compressive strength in conventional curing method.
- All concrete specimens subjected to steam curing developed higher compressive strength.
- For 60°C temperature, increasing the curing period has a beneficial effect on the initial compressive strength and also delay period of the steam curing cycle has a significant effect on initial compressive strength.
- A compressive strength was increased in concrete treated with the water based curing agent- cera polycure.

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