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EXPERIMENTAL INVESTIGATION ON THE STRENGTH OF CONCRETE BY PARTIAL REPLACEMENT OF CEMENT USING BAGASSE ASH

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Abstract: *The utilization of industrial and agriculture waste products by Industrial process has been the force of waste reduction research for economic, environmental and technical reason. Sugar cane bagasse (SCB) is a fibrous waste product of sugar refining industry, along with ethanol vapor. This waste product (sugar cane bagasse ash) is already causing serious environmental pollution, which calls for urgent ways of handling the waste. Bagasse ash mainly contains aluminum ion and silica. In this paper, bagasse ash has been chemically and physically replaced in the ratio 0%, 20%, 30% and 40% by weight of Ordinary Portland Cement (OPC) in concrete. It is reduced the environmental impacts, improves the workability corrosion strength and long term strength of concrete but this replacement of SCBA in the ordinary Portland cement deviation its strength consequently. Fresh concrete tests like slump cone test and compaction factor test were undertaken was well as hardened concrete tests like compressive strength at the age of 7,14,28 days was obtained . The result shows that the strength of concrete increased as percentage of bagasse ash replacement increased.*

KEYWORDS: SCBA (SUGER CANE BAGASSE ASH),), compressive strength, split tensile strength, flexural strength.

1. INTRODUCTION

Bagasse is a byproduct of the sugar cane industry. Bagasse is the fibrous matter that remains after sugarcane or sorghum stalks are crushed to extract their juice. It is currently used as a bio fuel and in the manufacture of pulp and paper products and building materials. The application of sugar cane bagasse ash (SCBA), one of the main byproduct from the bagasse combustion, in concrete production provides an acceptable solution to some of the environmental concerns. 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 agriculture waste, as a source of raw materials for industry. This waste, utilization would not only be economical, but may also result in foreign exchanges earning and environmental pollution control. Industrial waste, such as blast furnace slag, fly ash and silica fume are being used as supplementary cement replacement material. . This paper analyzes the effect of SCBA in concrete by partial replacement of cement at the ratio of 0%, 20% and 25% by weight. The experimental study examines the workability and compressive strength of concrete. The main ingredients consist of ordinary Portland cement (OPC), SCBA, fine aggregate, coarse aggregate and water. After mixing, concrete specimens were casted and subsequently all test specimens were cured in water at 7, 14,28days.

2. BAGASSE ASH

A byproduct of sugarcane production, bagasse is the organic material which is left over after sugarcane is crushed. This is one of the most plentiful by products of the sugar production process, and for every ton of refined sugar produce, there are two tons of bagasse produce as well. Many sugar mills find themselves with mountains of this fibrous material, which at one time were simply taken out and burned in the field surrounding the sugar mill, pollution the environment and creating expense for the company. However, as natural resource become more and more scarce and global attention has been increasingly turned to the problems of conversing environmental resources, bagasse has come into its own most predominantly as an alternative fuel source, and as an environmental friendly substitute for paper and plastics.

Table-I: Properties of SCBA

Material	Density (kg/m^3)	Specific gravity	Fineness (μm)
SCBA	0.4	1.8	95

3. MATERIALS AND MIX PROPORTIONS

The materials used for the preparation of concrete mix are cement paste, coarse and fine aggregates, water, super plasticizers and water.

Mix design of M20 grade of concrete is designed using IS 10262:2009. A mix proportion of 1: 1.03: 1.973:0.45 (cement: fine aggregates: coarse aggregates 20mm: water) for M20grade was calculated. Portland cement of grade 53 was used confirming to IS

12269:2013; water cement ratio of 0.4 was maintained for all mixes. SCBA of dosages 0%, 20%, 30% by volume fraction of concrete.

Different dosages of basalt fiber is given below

M1- 0 % SCBA BASED Concrete.

M2- 20 % SCBA BASED Concrete.

M3- 30% SCBA BASED Concrete.

4. EXPERIMENTAL SETUP

Cube of mould size 150mm x 150mm x 150mm, cylinders of mould size 100mm x 200mm and beam mould of size 100mm x 150mm were cast and cured.

5. TESTS ON CONCRETE

5.1 Basic Tests on Materials

Specific gravity test was done on fine and coarse aggregates using pycnometer. The fineness modulus was calculated using sieve analysis test.

The impact test was done to determine the toughness using impact testing machine, abrasion test was done using Los Angels abrasion machine. The consistency of cement was found using Vicat's Apparatus. The results of these tests are tabulated in Table-III.

5.2ests on Fresh Concrete

The workability of fresh concrete is measured using the Vee Bee Consistometer apparatus. This test is used to measure the change in the concrete shape from slump cone to cylinder by mode of vibration.

5.3 Tests on Hardened Concrete

Compressive strength

Compressive strength tests were carried out on concrete cubes in Universal Testing Machine(UTM) of capacity 2000kN under 140kg/sq.cm/min loading rate, until the resistance of the specimen to the increasing load can be sustained. The results are shown in Table-IV. The compressive strength of concrete can be calculated using Equation (1).

$f_{cu} = P / A$ (N/mm^2) (1)

Where,

f_{cu} = compressive strength of concrete (N/mm^2)

P = load applied (N)

A = cross sectional area (mm^2)

Flexural strength

The flexural strength or modulus of rupture of concrete was determined for the beams cast. The results are shown in Table-V. The flexural strength of concrete can be calculated using Equation (2).

$f_{cr} = PL / bd^2$ (N/mm^2) (2)

Where,

f_{cr} = flexural strength of concrete (N/mm^2)

P = load applied (N)

L = effective span (mm)

b = breadth (mm)

d = depth (mm)

Split tensile strength

Cylindrical specimens were cast and cured to determine the split tensile strength of concrete. They were loaded in compression side along the diameter plane. The results of the split tensile strength are tabulated in Table-VI. the formula to calculate the split tensile strength is given in equation (3).

$f_t = 2P / \Pi DL$(N/mm^2) (3)

where,

f_t = split Stensile strength of concrete (N/mm^2)

P = load applied (N)

D = diameter (mm)

L = effective span (mm)

6. RESULTS AND DISCUSSION

- The Vee Bee times for plain concrete, M1, M2, M3 are 7s, 8s, 9.1s,12.5s.
- From the results it is seen that with increase in SCBA content the workability reduces i.e., the vee bee time increases.
- The results show that the SCBA in blended concrete had significantly higher compressive strength compare to the concrete without SCBA
- The flexural and the split tensile strengths of concrete increases with increase in SCBA.

- The results of the basic tests, compressive strength, flexural strength and split tensile strength are shown in Tables –II, III, and IV below.

A. BASIC TEST ON MTERIALS

Table-II: Basic tests on materials

S.NO	PROPERTIES	VALUE
1	Specific gravity of coarse aggregates	3.5
2	Specific gravity of fine aggregates	3.07
3	Fineness modulus	2.25
4	Impact value	14.9%
5	Abrasion value	34
6	Consistency of Cement	30%

B. COMPERSSIVE STRENGTH

Table-III: Compressive Strength value

COMPERSSIVE STRENGTH (N/mm^2)			
Mix Ratio	**7 days**	**14 days**	**28 days**
M1	17.35	21.90	23.95
M2	17.45	22.56	24.35
M3	17.65	23.15	24.55

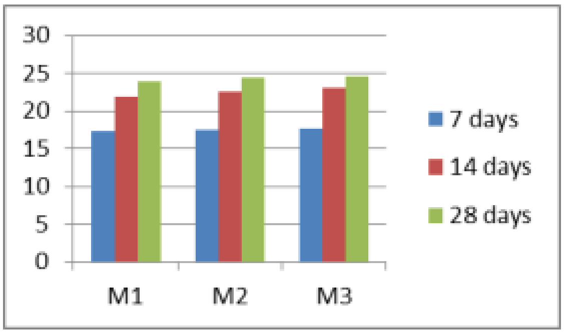

Chart- 1: Compressive Strength

C. FLEXURAL STRENGTH

Table-IV: Flexural Strength value

FLEXURAL STRENGTH (N/mm^2)			
Mix Ratio	7 days	14 days	28 days
M1	1.15	1.8	2.1
M2	1.20	1.95	2.25
M3	1.25	1.98	2.35

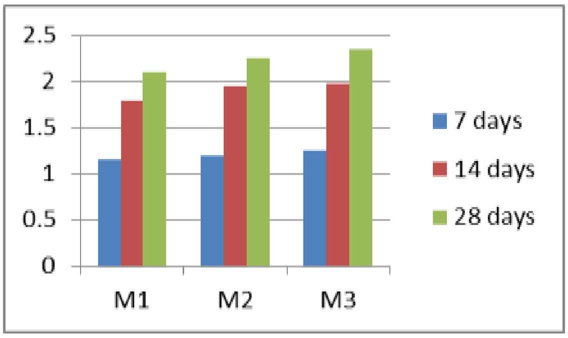

Chart- 2: Flexural Strength

D. SPLIT TENSILE STRENGTH

Table-V: Split tensile Strength value

SPLIT TENSILE STRENGTH (N/mm^2)			
Mix Ratio	7 days	14 days	28 days
M1	2.0	2.90	3.4
M2	2.10	2.98	3.75
M3	2.65	3.18	3.95

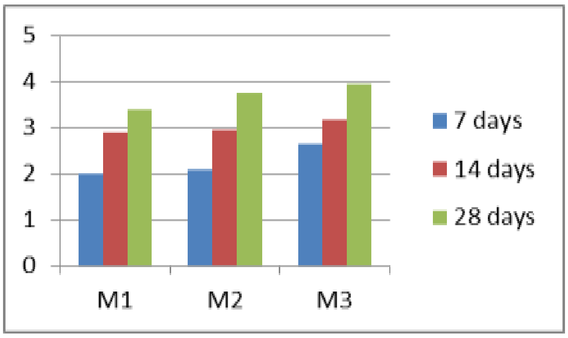

Chart- 3: Split Tensile Strength

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