

# International Journal of Innovative Research in Science, Engineering and Technology

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## Durability Studies of Sugarcane Bagasse Ash Concrete

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**ABSTRACT:** This paper presents the use of Sugarcane Bagasse ash as a cement replacement in concrete, which is a good solution to environment concerns that we are facing now. The effect of bagasse ash as a partial replacement of concrete has been investigated on the durability of concrete to sulphate attack and acid attack, the cement was replaced with 10% of bagasse ash. The sulphate resistance and acid attack was assessed by conducting ultrasonic pulse velocity test and compressive strength loss. The results indicate that bagasse ash is an effective material for the replacement of 10% of cement, which gives 80-85 % compressive strength compared to normal concrete.

**KEYWORDS:** Sugarcane Bagasse ash, Partial replacement, Ultrasonic pulse velocity.

### I. INTRODUCTION

Cement, the most important construction material in the world. However the environmental impact of cement has become a growing concern, as cement is one of the primary producers of carbon dioxides and major greenhouse gases. One effective way to reduce the environmental impact is to replace the cement content from the concrete. Utilization of agro – industrial waste as a partial replacement of cement in concrete, which will have the potential to reduce costs, minimization of waste and conserve energy. Bagasse is the waste produced after juice extraction in sugarcane industry, which is usually used as a fuel for boilers in the sugar mills which produce high amount of ash annually.

### II. OBJECTIVES

The purpose of the work is to study and compare the strength and durability of concrete with partial replacement of cement using bagasse ash.

### III. METHODOLOGY

The required materials like bagasse ash, cement, coarse and fine aggregate were collected. Aggregates were graded according to the Indian standard code. Material properties were determined for cement, coarse aggregate and fine aggregate to carry out the mix design for various mix proportion such as M20, M30, M40. Mix design for M20, M30 and M40 mixes was prepared using IS: 10262 - 2009 method. After 28 days of curing various strength tests such as compressive test, splitting tensile strength, modulus of elasticity and flexural strength was conducted by replacing the cement of fresh concrete with sugarcane bagasse ash and a comparison was made for different mix proportions. Durability aspect was also tested for both SCBA and normal concrete by conducting various tests for Sulphate, Acid attack, UPV and Sorptivity test and its quality was assured.

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## IV. MATERIALS

Materials used are

- a) Cement: Ordinary Portland cement was used. Specific gravity of cement was obtained as 3.15.
- b) Fine aggregate: Fine aggregate used for the study is M sand. It is properly graded to obtain minimum void ratio and is free from deleterious materials like clay, silt content and chloride concentration. Specific gravity of fine aggregate was found using pycnometer as per IS 2386 (Part 3) 19633. Specific gravity of fine aggregate is obtained as 2.66.
- c) Coarse aggregate: The coarse aggregates are granular materials obtained from rocks and crushed stones. The physical properties of coarse aggregates like specific gravity was conducted in accordance with IS:2386. Specific gravity is obtained as 2.78. The maximum size of coarse aggregate used is 20mm.
- d) Bagasse ash: Bagasse is a major by-product of the sugar industry, which is utilized in the same industry as an energy source for sugar production. Sugarcane contains 25–30% bagasse; whereas industry recovered sugar is about 10%. Approximately 70 sugar mills produce an estimated 14 million tons of bagasse annually, which is mainly used as an energy source. Burning bagasse leaves 3% ash, which has no use other than landfill. Bagasse ash is mainly composed of reactive silica and can be used as pozzolanic material in concrete. Raw bagasse ash is composed of mainly silica (60-75%), CaO, K<sub>2</sub>O and other minor oxides including Al<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub> and SO<sub>3</sub>. In this the bagasse ash was collected.
- e) Water: Water available in the college campus conforming to the requirements of water as per IS 456: 2009.

## V. EXPERIMENTAL WORK

In this work, total of 24 concrete specimens were casted for durability analysis. The mix design of concrete specimens for M20, M30 and M40 was done according to Indian Standard guidelines. About 10% of SCBA was replaced by weight of cement. The influence of SCBA on the durability performance of concrete is discussed in this paper. Durability performance was investigated by using Ultrasonic Pulse Velocity Test. The concrete specimens were casted and are dipped in solutions of sodium sulphate, magnesium sulphate and sulphuric acid after 28 days of curing for a period of 90 days. Durability tests were conducted after a period of 30, 60 and 90 days.

## VI. EXPERIMENTAL RESULTS

Durability of concrete depends upon the severity of the environment in which they are located and it also depends upon the nature of concrete construction. Normal concrete and BAC concrete cubes were immersed in different solutions of sulphate such as magnesium sulphate, sodium sulphate and sulphuric acid after 28 days of curing. Figs. 1, 2, 3 shows the variation of UPV values of BAC and NC cubes immersed in different sulphate and acid solutions.

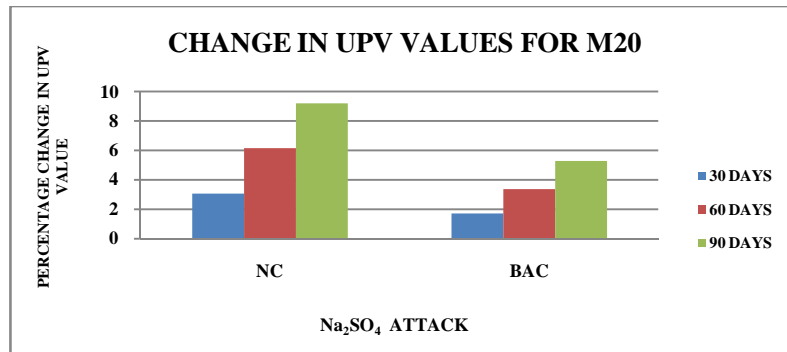
- a) Sulphate attack
  - Sodium sulphate

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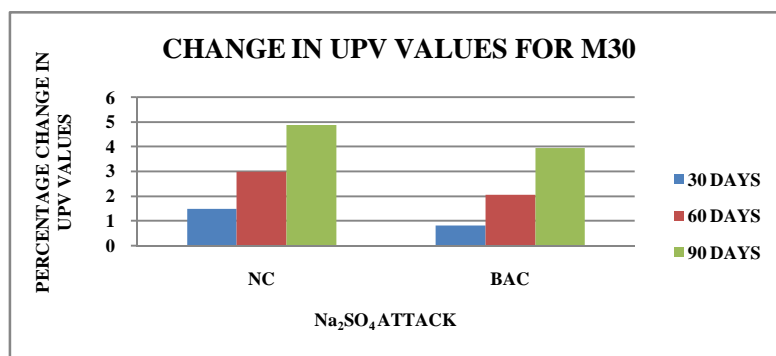
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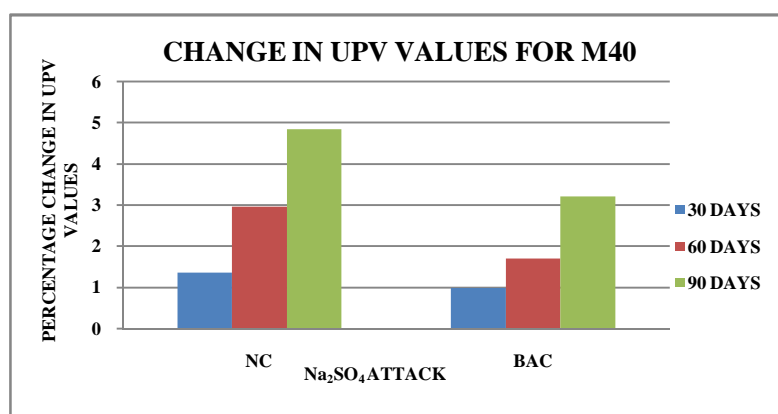
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(a)



(b)



(c)

Fig 1: Change in UPV values for specimens dipped in Na<sub>2</sub>SO<sub>4</sub> solution.

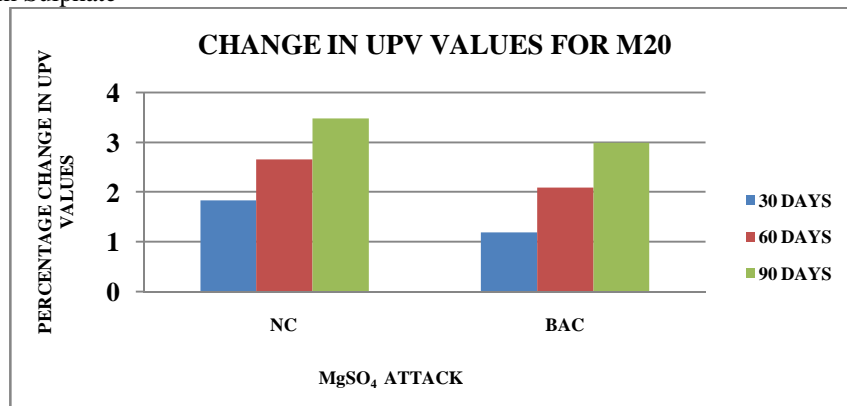
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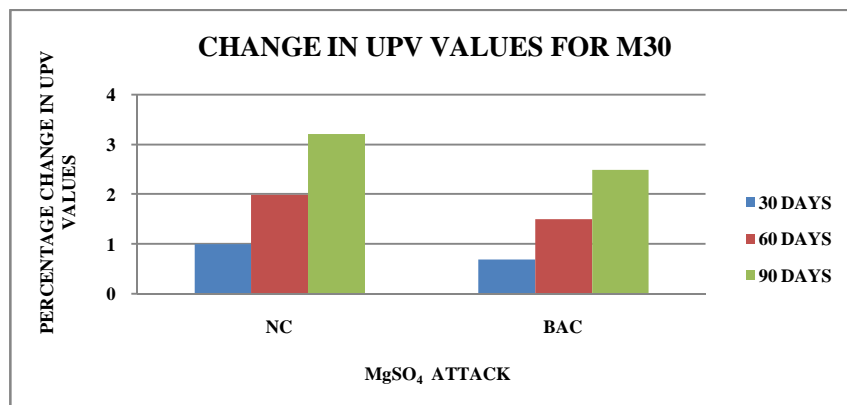
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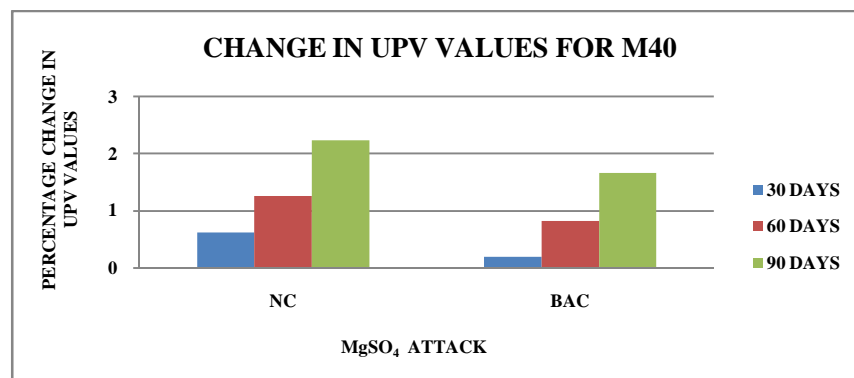
- Magnesium Sulphate



(a)



(b)



(c)

Fig 2: Change in UPV values for specimens dipped in  $Mg_2SO_4$  solution.

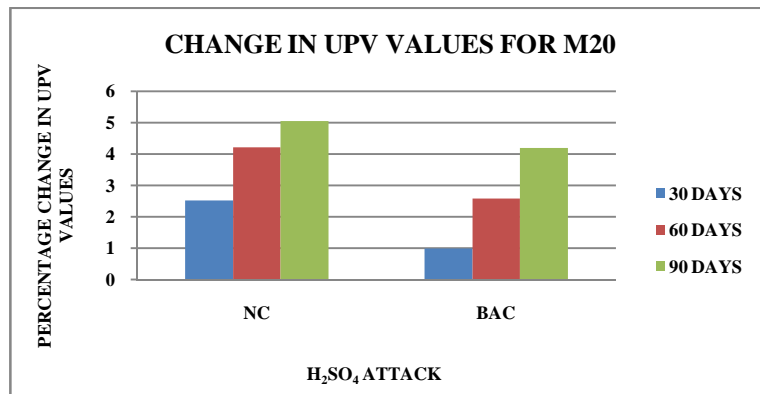
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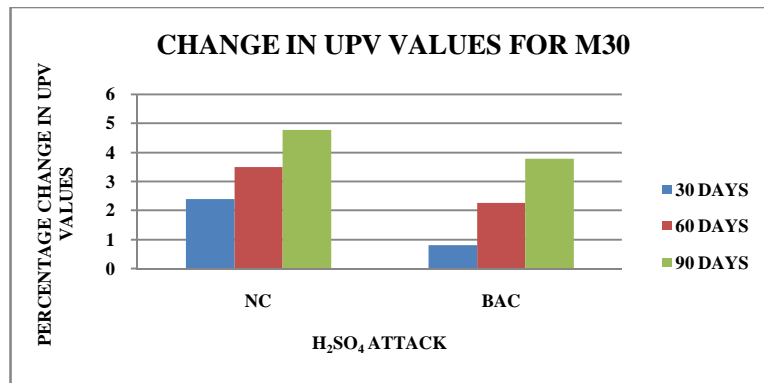
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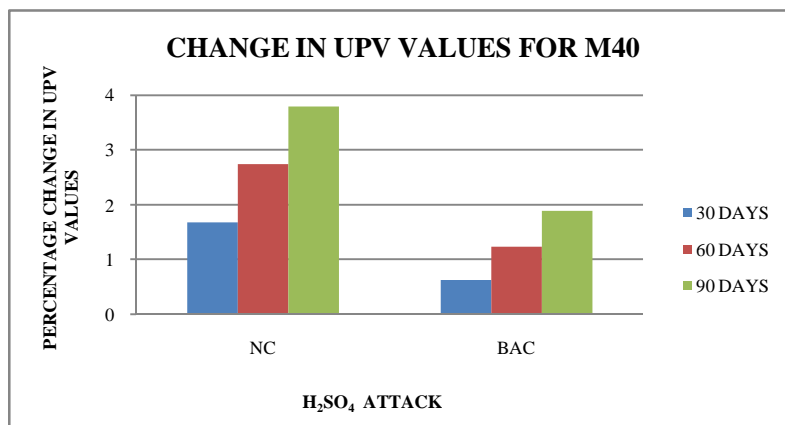
b) Sulphuric Acid



(a)



(b)



(c)

Fig 3: Change in UPV values for specimens dipped in H<sub>2</sub>SO<sub>4</sub> solution.

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## VII. CONCLUSION

Durability of concrete made with BAC under sulphate and acid attack is higher to that of conventional concrete made with NC. The improvement in sulphate resistance is attributed to the consumption of calcium hydroxide in the pozzolanic reaction which prevented the formation of gypsum.

The main idea of using this waste was not only the cost effectiveness but also improving the properties of concrete, especially the durability and protection of habitat. Hence it can be concluded that bagasse ash is an effective replacement material in the preparation of concrete.

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