

# Replacement of Cement by Bagasse Ash with Admixture

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**Abstract:** As the increase in demand and due to scarcity of construction material such as cement researchers have started focusing on finding the solution as Eco-friendly alternatives or substitutes of cement. Their main focus is on utilizing industrial or agricultural waste materials as a raw material in cement. On the other hand, Sugar cane bagasse ash is a fibrous waste product of the sugar industry. This waste product is already causing serious environmental pollution, which calls for urgent ways of handling the waste. Bagasse ash is mainly contains aluminum ion and silica which can be used as an alternative binding material. Along with bagasse ash another hazardous waste and non-degradable material that is thermocol polluting the environment is being selected to utilize it in concrete effectively. Thermocol is a type of polystyrene used for packaging. After use it is thrown away as "waste plastic". Thermocol is the commercial name for the expanded polystyrene (EPS) and is produced from a mixture of about 90-95% polystyrene and 5-10% gaseous blowing agent, most commonly pentane or carbon dioxide. This is one of the highest consumed polymers produced due to its versatile application in different fields particularly in packaging. Due to its non-biodegradability and high volume it constitutes a major fraction in municipality waste stream. In this segment the bagasse ash powder obtained is partially replaced with (ordinary Portland cement) in concrete along with admixture made by thermocol solution used in various proportion. Test conducted along with compressive strength, initial & final setting time was also taken.

**Keywords:** Concrete blocks, Ordinary Portland cement, Thermocol solution (As Admixture), bagasse ash powder

## 1. Introduction

Sugarcane bagasse ash is a by-product of sugar factories found after burning of sugarcane bagasse which itself is found after the extraction of all economical sugar from sugarcane. The disposal of this material is already causing environmental problems around the sugar factories. For each ten tones of sugarcane crushed, a sugar factory produces nearly three tones wet bagasse ash. When bagasse waste is burned under the controlled manner it also gives ash having amorphous silica, which has pozzolanic properties. The combustion yields ashes containing high amounts of unburned matter like silica and alumina oxides. Sugarcane bagasse ash used as cement replacement material to improve quality and reduce the quantity of cement.

India alone generates approximately 90 million of bagasse as a solid waste from the sugarcane industry. Disposal of solid waste generated from industrial production activity is the other serious problem. The accumulation of wastes is not only a burden to the industry, but also affects the environment adversely.

Ordinary Portland cement is the most extensively used construction material in the world. Since the early 1980's, there has been an enormous demand for the mineral admixture and in future this demand is expected to increase even more. Also in this modern age every structure has its own intended purpose and hence to meet this purpose modification in traditional cement concrete has become essential. This situation has led to the extensive research on concrete resulting in mineral admixture to be partly used as cement replacement to increase workability in most structural application. If some of raw material having similar composition can be

replaced by weight of cement in concrete then cost could be reduced without affecting its quality. A few studies have been carried out on the ashes obtained directly from the industries to study pozzolanic activity and their suitability as binders, partially replacing cement.

**Table 1:** Different % of cement Ingredients

Description of properties	Percentage (%)
Silica (SiO <sub>2</sub> )	66.89
Alumina (Al <sub>2</sub> O <sub>3</sub> )	29.18
Ferric oxide (Fe <sub>2</sub> O <sub>3</sub> )	29.18
Calcium Oxide (CaO)	1.92
Magnesium Oxide (MgO)	0.83
Sulphur tri Oxide (SO <sub>3</sub> )	0.56
Loss of Ignition	0.72
Chloride	-

Along with sugarcane bagasse ash another material was taken which is hazardous waste and non degradable contains lots of pollution to environment. Thermocol is a type of polystyrene used for packaging. After use it is thrown away as "waste plastic". Thermocol is the commercial name for the expanded polystyrene (EPS) and is produced from a mixture of about 90-95% polystyrene and 5-10% gaseous blowing agent, most commonly pentane or carbon dioxide. This is one of the highest consumed polymers produced due to its versatile application in different fields particularly in packaging. Due to its non biodegradability and high volume it constitutes a major fraction in municipality waste stream.

## 2. Objective of Study

Firstly, to study about the characteristics, properties detail knowledge about replacement of cements concrete by using sugarcane bagasse ash (SCBA). After completion of

above segment study of initial and final setting time and strength of concrete. This testing is needed to know whether the strength can be acceptable or not when follow mix design standard. Secondly, this research was to know the effectiveness of the admixture which was used. Along with compressive test of various proportion of replacement of cement by Sugarcane Bagasse ash, compressive strength of addition of admixture were also taken in different percentage of admixture added in concrete and also the relative properties of concrete by replacing cement by sugarcane bagasse ash and adding admixture.



**Figure 1:** Bagasse ash Powder

**Table 2:** Chemical composition of Bagasse ash powder

Sr. No	Description of properties	Percentage (%)
1	Silica	65.43
2	Magnesium	0.753
3	Calcium	10.6
4	Iron	4.58
5	Sodium	1.07
6	Potassium	3.56
7	Alumina	11.47

Key points of objective of our segment are summed as follows.

- 1) To partially replace the cement by using of sugar cane bagasse ash.
- 2) To find the Solution for disposal of Bagasse Ash and Thermocol waste.
- 3) By addition of bagasse ash it helps to reduce the quantity of cement.
- 4) To modify the cement from its originality and enhance the property of cement.
- 5) Addition of bagasse ash and thermocol solution in concrete to modify the setting time of concrete.

### 3. Materials

#### 3.1 Cement

Ordinary Portland cement of 53 grades from a single batch was used for the entire work. The cement used is fresh and without any lumps. The cement procured was tested for physical requirements in accordance with IS: 12269-1987 and for chemical requirements in accordance with IS: 4032-1977.

#### 3.2 Sugarcane Bagasse Ash

In this project, sugarcane bagasse ash was collected from Purti Power Plant (BELA), Nagpur. Sugarcane bagasse consists of approximately 50% of cellulose, 25% of hemicelluloses 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 dominated by silicon dioxide (SiO<sub>2</sub>). In spite of being a material of hard degradation and that presents few nutrients, the ash is used on the farms as a fertilizer in the sugarcane harvests. For this study, fresh SBA taken from the furnace was used. It was cooled in air by applying a small quantity of water. The ash was dumped near the plant in large amount.

### 3.3 ADMIXTURE

Admixture used here was Thermocol and thinner solution which is a waste material after its use. So, it is better to know the progress by utilization of thermocol in various research papers. Some research papers based on utilization of thermocol are as followed which deals with various applications and variety of its utility in along with its physical and chemical properties.

Narendra B. Selukar, Chaitanya V. Lande, Chetankumar G. Ingole (2014)<sup>[4]</sup> Studied on, “Waste Thermocol to Adhesive for Better Environment”. From experiment it is observed that petrol and toluene is able to give good quality of adhesive than that of other solvents. Hence this technique is eco-friendly. From the experimental study it is observed that petrol and toluene able to form good quality of adhesive. Thus, it is conclude that conversion of waste thermocol to adhesive is an economical, eco-friendly and efficient technique.

### 4. Performed Test

#### 4.1 Consistency test

The basic aim is to find out the water content required to produce a cement paste of standard consistency as specified by the **IS: 4031 (Part 4) – 1988**.

#### 4.2 Initial and final setting time

**IS: 4031- (part 5) - 1988**. By using Vicat apparatus, we have done initial setting time for different % thermocol solution in cement as well as with different % of bagasse ash in cement.

- 1) Weighing 400gm cement to perform test.
- 2) Weighing varying amount of weight of used replacement materials as shown in table below.
- 3) Water is used of determined consistency which kept constant throughout the segment etc.

#### 4.3 Compressive strength test for concrete

IS code used for determining fineness is **IS: 516-1959**. Compressive test were carried out for bagasse ash replacement, addition of admixture as well as both combination in concrete.

#### Concrete Preparation

- 1) Mixing of cement sand and aggregate for M25 mix proportion that is in the ratio 1:1:2 with addition of water in ratio of **0.4** by weight of cement.

- 2) Bagasse ash used of passed sieve 125u.
- 3) The type of curing selected is Immersion curing.
- 4) Average of the result is taken for 7 days, 14 days as well as 28 days.

## 5. Results

**5.1 Table 3**

**Table 3: Initial and setting time result**

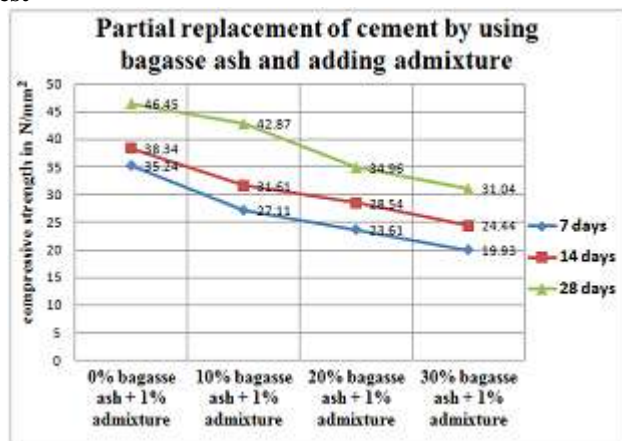
Sr. No.	Replacement% of bagasse ash and add. of admixture	Initial setting time (min)	Final setting time (min)
1	0%SBCA+1% Admixture	145	256
2	10%SBCA+1% Admixture	125	230
3	20%SBCA+1% Admixture	92	204
4	30%SBCA+1% Admixture	75	182

**5.2 Table 4**

**Table 4: Compressive strength test result**

Sr. No	Replacement% of bagasse ash and add. of admixture	Compressive strength (N/mm <sup>2</sup> )		
		7 days	14 days	28 days
1	0%SBCA+1% Admixture	35.25	38.35	46.45
2	10%SBCA+1% Admixture	27.11	31.61	42.87
3	20%SBCA+1% Admixture	23.61	28.54	34.96
4	30%SBCA+1% Admixture	19.93	24.44	31.04

### 5.3.1 Graphical representation of compressive strength test



## 6. Conclusion

- 1) Here in this segment there is decrease in initial and final setting time after increasing in % of bagasse ash and thermocol solution.
- 2) There is only slight decrease in compressive strength after increase in % of replicable materials, but for up to 2% addition in admixture, the strength goes on increasing hence 2% of addition of admixture is beneficial to add according to result obtained.
- 3) It forms a protective layer around MS bar hence it prevents MS bar from contacting in water in concrete, so it protect MS bar from corrosion.
- 4) As thermocol is waste the cost of admixture is very less as compare to other admixture which is highly costly.

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