Use of Sugarcane Bagasse Ash as a Fine Aggregate in Cement Concrete

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Ali Aizaz Dayo[1], Dr. Aneel Kumar[2], Anees Raja[3], Naraindas Bheel[4*], Zubair Hussain Shaikh[5]

[1,2,3,5]*Department of Civil Engineering Mehran University of Engineering and Technology Jamshoro*
[4]*Department of Civil Engineering Hyderabad College of Science & Technology Hyderabad*

Abstract: In this experimental study, Sugarcane bagasse ash (SCBA) was used as a partial simulation for fine aggregate in concrete to reduce its cost, and different processing methods using agricultural/industrial waste were formed. The main focus of this research work was to examine the fresh property and mechanical (compressive strength and splitting tensile strength) concrete properties by replacing 0%, 10%, 20%, 30% and 40% of SCBA by dry weight of fine aggregates. A total of 60 concrete cylinders were prepared with 1:2:4 proportion with 0.50 water-cement ratio and immerged in water on 7 and 28 days. Finally, these concrete cylinders were tested on UTM. Three concrete samples were cast for each proportion and ultimately the average of the three concrete samples was taken as the final result. The slump value of concrete decreased with increases in the amount of SCBA in cement concrete. The results analyzed that the compressive and tensile strength of the concrete samples increased by 7.90 % and 14% at 10% of SCBA as sand substitute materials in cement concrete after 28 days.

Keywords: *Sugarcane bagasse ash; fine replacement material; improved strength; reduced construction cost.*

1. Introduction

Due to the huge demand for the construction materials industry, particularly in the last era, because of this an increase in population leads to prolonged less availability of building materials, Civil engineers have been faced problems to transformation of industrial waste into beneficial building structure ingredients [1]. The task for the administration is to decrease the dangerous effects of waste on the health and well-being Environment [2]. The concrete production is mainly significant because it is responsible not only for the consumption of expected assets and energy but also for the absorption of other wastes related to industrial areas and consequences [3]. It is observed that a concrete batching plant can yield from 8 to 10 tons of fresh concrete waste per day with a daily capacity of 1000 cubic meters of concrete [4]. The choice of polymers is significant, and their value shows an important part: they not only bound the strength of concrete but also because of their properties distress the stability and characteristics of concrete [5].

A fine aggregate (FA), The global intake of sand in the construction of concrete is very high and emerging countries have faced roughly pressure on the resource of natural sand in mandate fulfill the growing demand for infrastructure development in recent ages [6]. Therefore, the production industry has a great mandate for different ingredients for sand. To incredulous the pressure and claim for river sand, scholars have recognized about sand substitutes, such as RHA [7, 8], SCBA, millet husk ash [9] tile powder [10], marble powder, maize cob ash [11], wheat husk ash, and silica fume [12].

Eco-friendly Supervision in developing countries is suffering from the difficult problems due to environmental issues inevitably linked to public and economic features, which must be measured in developing any environmental plan or directive [13]. There is so many waste problem existed in all over the world, especially in densely populated areas [14]. Reuse of solid industrial wastes as sand substitute material in the construction works not only save a dump site but also reduce the need for the abstraction of natural raw materials [15]. Thus, the purpose of this study, sugar cane bagasse ash is to replace with sand in the making of cement concrete.

Bagasse is the main derivative of energy source and sugar mill for sugar making in the same industry [16], while industrially processed sugar. Sugarcane (SC) consists of 25 to 30% bagasse makes up about 10%. As a raw material for paper production bagasse is used due to its fibrous texture and from one ton of bagasse can produce about 0.3 tons of paper [17]. In Pakistan, around seventy sugar factories create about 14 million tons of bagasse per year, mostly burning bagasse leaves 3% ash used as energy source, no other uses than landfill [18, 19].

With free lime Silica content in pozzolana responds unconstrained in the process of cement hydration and produces additional (CSH) acts as a new hydration product [20], which improves the hardened properties of concrete. The ash generated during the burning of agricultural waste at a controlled temperature of less than 700 ° C for 1 hour converting the silica content in the ashes to the amorphous phase [21], the specific surface area of the ash is linearly related to the reactivity of amorphous silica.

The characteristics of aggregates and SCBA were considered in detail. Concrete M15 is intended for a different percentage of SCBA, Found indirect splitting tensile strength and compressive strength of concrete.

2. Methodology

The research study was conducted on the mechanical and fresh properties of concrete by using 0%, 10%, 20%, 30% and 40% of SCBA as fine aggregates in concrete. A total of 60 concrete cylinders (200 mm x 100 mm) were prepared of 0.5 water/cement ratios with 1:2:4 mix proportion and curing ages were 7 and 28 days. In this study, concrete

Corresponding author Email address: *naraindas04@gmail.com*

cylinders were cast for hardened properties i-e splitting tensile strength and compressive strength of concrete by obeying the ASTM code procedure. Three concrete specimens were cast for each proportion and finally, the mean value of the three cylinders was taken as the ending result [22].

Table 01: Various Mix Proportion of Concrete

S. No.	Mix Ratio	Water-cement Ratio (%)	Cement (%)	Coarse Aggregates (%)	Sugarcane Bagasse Ash (%)	Fine Aggregates (%)
01	1:2:4	0.50	100	100	0	100
02	1:2:4	0.50	100	100	10	90
03	1:2:4	0.50	100	100	20	80
04	1:2:4	0.50	100	100	30	70
05	1:2:4	0.50	100	100	40	60

2.1 Material Used

2.1.1 Cement

The Ordinary Portland Cement was used locally available in the market under the trademark name "Lucky cement".

Table 02: Tests of Cement

S.No	Tests	Results
01	Normal consistency	32%
02	Initial setting time	48 min
03	Final setting time	230 min

2.1.2 Fine Aggregates (F.A)

Locally available near the river bed and free of debris sand was utilized as fine aggregate ingredient which passed through #4 sieves. The various physical properties of fine aggregates are mention in table 01.

2.1.3 Coarse Aggregates (C.A)

The crushed aggregates were used of 20 mm in size which is locally available in the region of Jamshoro. The preliminary tests were performed on coarse aggregates as tabulated in Table 01.

Table 03: Tests of Aggregates (Fine and Coarse)

S.No	Properties	Fine Aggregates	Coarse Aggregates
01	Fineness Modulus	2.21	---
02	Water Absorption	1.60%	1.0%
03	Specific Gravity	2.64	2.61
04	Bulk Density	118 lb/ft^3	96 lb/ft^3

2.1.4 Sugarcane Bagasse Ash (SCBA)

Ash was used in this work collected from Matiari Sugar mill. It contains various un-burnt matters, which was sieved through 350-micron sieve to obtain desirable ash that was used as fine aggregates in the production of concrete.

2.1.5 Water

The clean and drinkable water was used in this experimental work.

3. Results and Discussion

3.1 Workability of Fresh Concrete

The fresh property of concrete i-e workability was conducted by slump cone. The maximum value of slump concrete was measured by 52 mm while using 0% SCBA and the minimum value of slump was recorded by 16 mm at 40% of SCBA as fine aggregate replacement in concrete. It was advocated that the flow of fresh concrete was reduced with increases in the amount of SCBA as shown in Fig. 01.

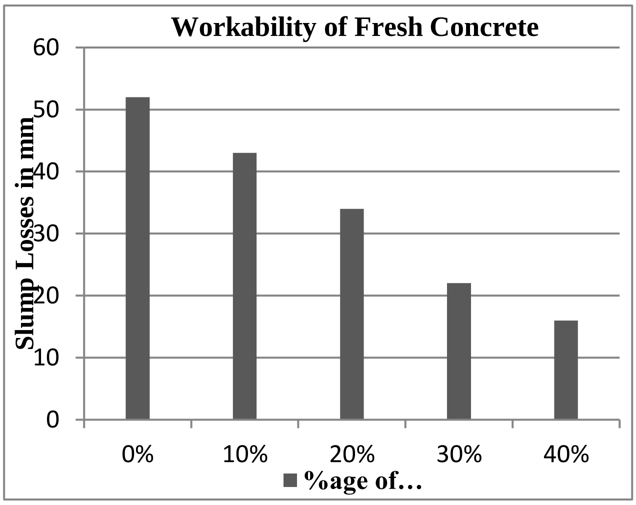

Figure.1. Workability of Fresh Concrete

3.1.2 Compressive Strength of Concrete

The test of Compressive strength was experimented on cylinders (100mm×200mm) by using different amounts of SCBA. Three specimens were cast for each proportion and finally, the average value of these three concrete samples was taken as the final result. The compressive strength was enhanced by 4.20% and 7.90 at 10% of SCBA used as fine substituent material in concrete after 7 and 28 days correspondingly. Similarly, the lowest value of compressive strength was decreased by 30.4% and 25% at

40% of SCBA as a fine substitute in concrete on 7 and 28 days as shown in Fig 02.

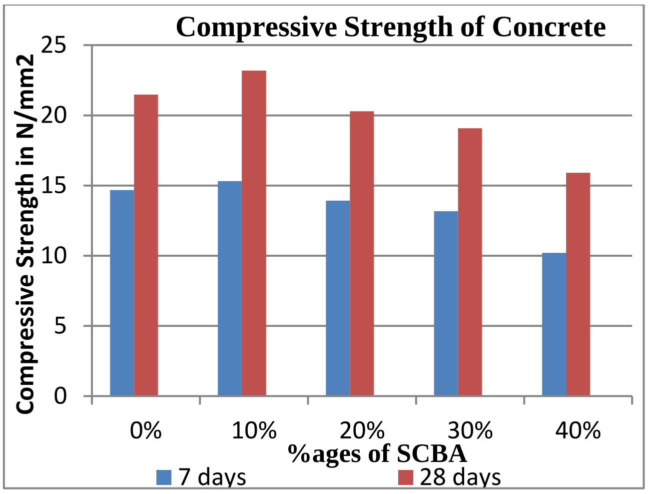

Figure.2. Compressive Strength of Concrete

3.1.3 Splitting Tensile Strength of Concrete

Splitting tensile strength tests were performed on cylinders (200mm×100mm) of various SCBA proportions of 0%, 10%, 20%, 30% and 40% by the weight of fine aggregates. In this experimental work, three concrete samples were cast for each proportion and an average was taken as the final results. The maximum splitting tensile strength was noted by 8.10% and 14% at 10% SCBA as a fine aggregate replacement level at various days of curing correspondingly. Similarly, the minimum t tensile strength decreased by 48.10% and 26.20% at 10% SCBA as a sand substitute material in concrete on 7 and 28 days as shown in Fig 03.

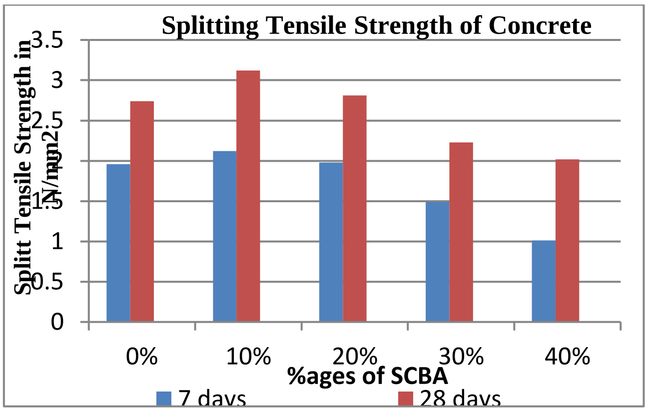

Figure.3. Splitting Tensile Strength of Concrete

5. Conclusion

- The maximum value of slump concrete was measured by 52 mm while using 0% SCBA and the minimum value of slump was recorded by 16 mm at 40% of SCBA as fine replacement level of aggregate in concrete. It was advocated that the slump value of concrete was reduced with increases in the amount of SCBA in concrete.
- The compressive strength was enhanced by 4.20% and 7.90 at 10% of SCBA used as fine substituent material in concrete at the age of (7 and 28). Similarly, the minimum value of compressive strength was decreased by 30.4% and 25% at 40% of SCBA as an FA in concrete at the age of (7 and 28).
- The split tensile strength (STS) was maximum, noted by 8.10% and 14% at 10% SCBA as a fine aggregate replacement material in concrete at the age of (7 and 28). Similarly, the minimum splitting tensile strength decreased by 48.10% and 26.20% at 10% SCBA as a sand replacement material in concrete on 7 and 28 days.

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About Authors

1. **Ali Aizaz Dayo** is a student of Master of Engineering in Structural Engineering from the Department of Civil Engineering, Mehran UET Jamshoro, Sindh, Pakistan. His research interest is in concrete Technology, sand and cements replacement material in concrete.

2. **Dr. Aneel Kumar** is the Professor and Chairman of the Department of Civil Engineering, Mehran UET Jamshoro, Sindh, Pakistan. His research interest is in the Mechanical and Chemical Soil Stabilization, Shallow and Deep Foundation Design, etc.

3. **Anees Raja** is a Lecturer in the Department of Civil Engineering, Mehran UET Jamshoro, Sindh, Pakistan. His research interest is in Geotechnical and Highway Engineering.

4. **Naraindas Bheel** is a Lecturer in the Department of Civil Engineering, Hyderabad College of Science & Technology Hyderabad, Sindh, Pakistan. His research interest is in concrete Technology, Pozzolana, sand replacement material, cement replacement material, and Fiber Reinforcement materials in concrete.

5. **Zubair Hussain Shaikh** is a student of Master of Engineering in Structural Engineering from the Department of Civil Engineering, Mehran UET Jamshoro, Sindh, Pakistan. His research interest is in concrete Technology, sand and cements replacement material in concrete.