International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 10 | Oct - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

SUGAR CANE BAGASSE ASH IN CONCRETE: A REVIEW

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Abstract:
Sugarcane bagasse ash (SCBA), a by product of sugarcane processing, has shown great potential as a supplementary material in concrete production. A review of its application in concrete highlights its benefits, including improved mechanical properties, durability, and sustainability. SCBA contains high levels of silica, which can act as a pozzolanic material, enhancing the compressive strength and reducing the permeability of concrete. Incorporating SCBA also lowers the carbon footprint of concrete, contributing to greener construction practices by partially replacing cement. However, challenges remain, such as the variability in ash quality, proper ash treatment, and optimal blending ratios. Ongoing research focuses on refining these aspects to maximize the benefits of the SCBA in concrete, making it a promising alternative in the construction industry for sustainable development.

Keyword - Sugarcane bagasse ash, Compression strength, Percentage strength, Sugarcane Workability, Slump test.

INTRODUCATION:

Concrete, is a pivotal component of the construction sector, serves as the cornerstone of infrastructural development nationwide. Consequently, Ordinary Portland Cement (OPC), its primary constituent, is universally recognized as a vital construction material. The response to escalating cement costs and dwindling river sand reserves, researchers globally are exploring the incorporation of industrial and agricultural waste in construction. This initiative aims to develop sustainable, cost-effective alternatives.
Supplementary cement replacement materials, including the blast furnace slag, rice husk ash, fly ash, and silica fume, have garnered significant attention. Recently, sugarcane bagasse ash (SCBA), a fibrous residue generated during sugar juice extraction, has been investigated as a potential cement substitute in concrete. The controlled combustion of bagasse yields an ash rich in unburned matter, silicon, and aluminum oxides, rendering it suitable for cement replacement.

The abundance of bagasse ash, derived from approximately 1500 Mt of sugarcane produced annually worldwide (yielding 40-45% bagasse post-juice extraction), presents a valuable opportunity for waste reuse in concrete.

Currently, sugarcane straw is often incinerated in open landfills, contributing to environmental degradation and pollution. The resultant ash (3-5% of initial residues) poses significant in disposal challenges.

In India, the second-largest cement producer globally, the copious generation of bagasse ash from sugar industry cogeneration processes presents a compelling opportunity. Bagasse ash reactive silica content makes it an ideal supplementary cementing material for blended cement manufacture. The primary objective is to develop high-performance, sustainable materials at reasonable costs, minimizing environmental impacts. By harnessing bagasse ash, the construction industry can mitigate waste disposal issues while promoting eco-friendly practices."

"Concrete, is a critical construction component, necessitates innovative, sustainable solutions. Sugarcane bagasse ash (SCBA), generated abundantly worldwide, offers potential as a cement substitute. Its reactive silica content and availability make it an attractive supplementary cementing material. By utilizing SCBA, in the construction industry can reduce waste, environmental impacts, and costs, while promoting eco-friendly practices."

1. Advantages of Sugar Cane Bagasse Ash:

- It is well available within the field.
- These composites may be recycled.
- It is high tensile strength.
- It improved structural Efficiency.
- It is High impact strength.
- It improved Constructability.

2. Disadvantages:

- The flow spread decreased with an increasing amount of SCBA within the material.

METHODOLOGY:

On the basis of literature survey, it is found that, the minimum study has been carried out on Sugar Cane Bagasse

Ash (SCBA) concrete. It is also found that there is no comparative study has been done on conventional and Modified concrete.
The materials used in this study are as follows:

- Sugar Cane Bagasse Ash (SCBA)
- Aggregates (Coarse and fine)
- Super plasticizer.

There are some specific tests for aggregates which are as follows:

- Crushing Test
- Impact Test
- Abrasion Test
- Specific Gravity

Several test methods will be used to complete this project, these are:

- Workability
- Compressive strength
- Tensile strength

1. M. Sivakumar, Dr. N. Mahendran, Architects and engineers have increasingly recognized the benefits of partially replacing cement with waste materials like bagasse ash, known as its pozzolanic properties in cement and cement products. Bagasse ash, when used in concrete mixtures, not only provides strength comparable to conventional concrete. They conducted various tests like specific gravity, and setting time to examine the physical and chemical properties of bagasse ash in cement product. Concrete samples with different proportions of bagasse ash replacing cement were cast to evaluate their performance. When the utilizing bagasse ash helps mitigate industrial waste disposal issues, offering an environmentally friendly solution by reducing waste.
Conclusion: Based on the experimental results are as following: 20% replacement of cement by the Bagasse ash results (i.e.) the strength is almost equal to the nominal strength of the concrete. It is cost effective too as it mitigates the cost by 12% for 1 m^3 of concrete.

2. K. Ganesan, K. Rajagopal, K. Thangavel, The incorporation of waste materials in concrete production offers a viable solution to addressing environmental challenges and waste management issues. Agricultural by-products, such as rice husk ash, wheat straw ash, hazel nutshell ash, and sugarcane bagasse ash, are utilized as pozzolanic materials in the formulation of blended cements. The investigation covers a range of properties, including compressive strength, splitting tensile strength, water absorption, permeability.The findings reveal that BA functions effectively as a mineral admixture, with an optimal replacement ratio of 20%. Ordinary Portland cement can be optimally replaced with well-burnt bagasse ash up to a level of 20%, without negatively impacting the desired properties of concrete. The development of higher early strength in the concrete.

3. M. Ganesh Babu, G. Shiny Priyanka,The utilization of industrial and agricultural waste generated by production processes has become a primary focus in waste reduction, and technical reasons. Sugarcane bagasse, a fibrous by-product of the sugar refining industry, is one such waste. Bagasse ash is predominantly composed of silica and alumina. In this study, the chemical and physical properties of bagasse ash are analyzed, and it was incorporated into concrete. Tests on fresh concrete, such as the compaction factor and slump cone tests, including compressive strength, flexural strength, and modulus of elasticity at 7 and 28 days. Conclusion: The results indicate that incorporating sugarcane bagasse ash (SCBA) into blended concrete significantly enhances compressive strength, tensile strength, and flexural strength compared to concrete without SCBA. It was observed that cement can be effectively replaced with SCBA, with a maximum replacement limit of 10%.The SCBA content increases, the density of the concrete decreases, leading to the production of lightweight concrete using waste materials.

4. Bahurudeen, Manu Santhanam, are study the Sugarcane bagasse ash, a by-product derived from cogeneration combustion boilers in sugar industries, has been recognized for its potential as a supplementary cementitious material in concrete, with studies improvements in concrete properties. However, the use of bagasse ash has been limited due to an insufficient understanding of its properties and the lack of efficient processing techniques for large-scale application.
A comprehensive examination of the pozzolanic activity was conducted, taking into account various processing techniques, including burning, grinding, sieving to remove coarse fibrous particles, and combinations of these methods. Conclusion: The raw bagasse ash collected for this study exhibited pozzolanic activity below the minimum standard requirement of 75%. The microstructural analysis of the raw sugarcane bagasse ash revealed a mixture of fully burnt fine particles alongside fibrous coarse particles. The observation are made by using the advanced techniques, highlighting the complex morphology of the raw material.

5. Study made by this authors, A.E. Souza , S.R. Teixeira are use a Sugarcane bagasse ash (SCBA) is a by-product from burning bagasse in boilers in the sugar and alcohol industry. SCBA contains a high amount of silica along with smaller amounts of aluminum, iron, alkalis, and alkaline earth oxides. In this study, the SCBA properties of ceramic materials were tested by adding different amounts of SCBA, replacing some of the non-plastic material used in making roof tiles. Tests showed that the addition of ash did not significantly affect the ceramic properties up to 1000°C. Results 1000°C, but at higher temperatures, SCBA contributed to sintering and phase the formation.
Conclusion: When the incorporation of sugarcane bagasse ash (SCBA) inhibits the formation of mullite during the sintering of clay-based materials, (SCBA) act as the non-plastic material, reducing the linear shrinkage of ceramics during both the drying and firing stages. The temperature of 1000°C serves as the critical threshold for the alterations in

sintering process. In this temperature, the ceramic properties are minimally impacted by varying concentrations of ash, at the temperature of exceeding 1000°C, SCBA actively participates in the formation of a liquid phase.

6. Study made by this authors, Guilherme Chagas Cordeiro , Romildo Dias are use Sugar cane bagasse ash, as the byproduct from sugar and alcohol production, has potential as a pozzolanic material. However, the effective utilization of the mortar and concrete necessitates controlled grinding and classification processes to achieve the required fineness and homogeneity for industry standards. This study examines the influence of mill type and grinding circuit configuration on particle size, specific surface area, and pozzolanic activity at both laboratory and pilot plant scales. However, prolonged grinding times enabled the achievement of values exceeding 100%.
Conclusion: General, the grinding of D80 values below approximately 60 μm and achieving Blaine specific surface areas above 300 m²/kg yield products classified as pozzolans. The particle size, characterized by the 80% passing size, and Blaine specific surface area exhibit a strong correlation with the pozzolanic.The use of ultra-finely ground SCBA via vibratory grinding enables the production of high-performance concrete, achieving equivalent mechanical properties with up to 20% SCBA replacement compared to concrete made solely with Portland cement.

7. K. Ganesan, K. Rajagopal are use the SCBA as a waste by product incorporation of waste materials into concrete production presents an effective strategy for addressing environmental challenges linked to waste management. Agro-wastes, such as rice husk ash, wheat straw ash, and sugarcane bagasse ash, serve as pozzolanic materials in the formulation of blended cements. However, limited research has focused specifically on the utilization of bagasse ash (BA) as a partial cement replacement in cement mortars. This study investigates the impact of varying BA content on the physical and mechanical properties of hardened concrete. The properties assessed include compressive strength, splitting tensile strength, water absorption, permeability characteristics, chloride diffusion, and resistance to chloride ion penetration.
Conclusion: Present investigation yields the conclusion that up to 20% of ordinary Portland cement can be effectively substituted with well-burnt bagasse ash without compromising the desirable properties of concrete. The specific benefits of this substitution include: Enhanced early strength development, Reduce the water permeability.

8. S.Sanchana sri1, Mr.T.Ramesh is study the Bagasse,is a byproduct of sugarcane processing, serves as a fuel source in sugar mills, producting sugarcane bagasse ash (SCBA) during combustion. SCBA is offers the potential as a partial cement replacement, addressing economic and environmental concrete. The combustion of bagasse produces sugarcane bagasse ash (SCBA), characterized by solid black particles. The utilization of SCBA as a partial cement replacement in concrete addresses various economic and environmental challenges associated with waste management
Conclusion: Demonstrates significant pozzolanic activity, establishing its potential as a substitute cementitious material (SCM). It has observed that finer SCBA particles correlate are increased pozzolanic actively, leading to a recommendation for utilizing grain sizes less than 0.015 mm to optimize strength in mortars. Such research outcomes could facilitate the promotion of industrial SCBAs as SCMs, contingent upon the application of finer particles that enhance both the filler and pozzolanic effects within concrete mixtures.

9. Study made by the authors, Nuntachai Chusilp, Chai Jaturapitakkul, and Kraiwood Kiattikomol, had examine the physical properties of concrete that incorporated ground bagasse ash (BA) as a partial replacement for Type I Portland cement. Ground bagasse ash was sourced from a sugar factory and processed to ensure that less than 5 wt% of particles were retained on a No. 325 sieve. The study involved replacing cement with BA at levels of 10%, 20%, and 30% by weight, while maintaining a constant water-to-binder (W/B) ratio of 0.50 and a binder content of 350 kg/m³.

Key findings by the authors are include:

1. **Compressive Strength**: At 28 days, concrete samples with 10% to 30% ground bagasse ash exhibited higher compressive strengths compared to the control concrete. Notably, the 20% replacement achieved the highest compressive strength, measuring 113% of the control.
2. **Water Permeability**: The inclusion of up to 30% ground bagasse ash resulted in reduced water permeability compared to the control concrete at both 28 and 90 days.
3. **Optimal Replacement Level**: The study identified 20% BA as the optimal replacement level, balancing strength and permeability benefits. Increasing the replacement to 30% improved water permeability but did not yield the same strength advantages.
4. Ground bagasse ash can be effectively utilized in concrete to enhance both compressive strength and water resistance, with 20% being the most beneficial replacement level.

10. Architects and engineers have increasingly recognized the value of partially replacing cement with waste materials like bagasse ash, a byproduct of sugarcane processing, which exhibits pozzolanic properties when used in mortar and cement. Bagasse ash, when mixed with cement, provides structural strength equivalent to the nominal strength of concrete, while also reducing costs on a large scale.
Various tests were conducted to assess the physical and chemical properties of bagasse ash, including fineness, specific gravity, and both initial and final setting times.

Moulds were created using different ratios of cement to bagasse ash to determine the optimal replacement percentage. Specimens were then tested for compressive strength, and the most favorable mix was identified.
Conclusion: Based on the experimental findings, the following conclusions emerge:
- A *20% replacement* of cement with bagasse ash achieves strength comparable to the nominal strength of conventional concrete.
- This substitution proves to be *cost-effective, reducing expenses by approximately **12%* per cubic meter of concrete.
- Consequently, *cheaper concrete* can be produced using industrial waste, while maintaining the structural integrity and strength required for construction.
- The integration of bagasse ash in concrete addresses the issue of waste disposal, transforming an industrial byproduct into a valuable resource, thus contributing to *environmental sustainability*

CONCLUSION:

- Sugarcane bagasse ash is will not harmful for environment. It is very cost effective
- Increasing the durability of concrete. Also increasing the workability.
- Bagasse ash are used only 20% to 30% in concrete.

The use of Sugar Cane Bagasse Ash (SCBA) in concrete has shown different advantages. It increases the strength of concrete and also reduces the dependence on cement. The sugar cone is the one type of eco waste they not harm the environment. The use of sugar cane bagasse ash (SCBA) in metropolitan cities services to reduce air pollution form the environment.

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