International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 03 | March - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Experimental Study on Properties of Concrete Incorporating Industrial Byproducts

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Abstract:

The increasing demand for sustainable construction materials has prompted investigations into the use of industrial byproducts as partial substitutes for traditional concrete ingredients. This experimental study examines the effects of incorporating various industrial byproducts, such as fly ash, crumbed rubber, and bagasse ash, on the properties of concrete. In this project, a quaternary mix of partially replaced cement concrete was created and tested. The research evaluates the workability of concrete mixes with different proportions of these byproducts. Tests were conducted to measure compressive strength, and the study also explores how curing conditions and the optimal percentage of byproduct replacement influence the overall properties of the concrete. The results indicate that when certain byproducts are incorporated in appropriate proportions, they can enhance the performance of concrete, resulting in improved strength, durability, and sustainability. These findings suggest that using industrial byproducts offers an effective method for waste utilization and helps reduce the carbon footprint of concrete production, presenting a promising solution for the future of green construction.

Introduction:

Concrete is vital in the construction industry due to its strength, durability, and versatility. However, producing concrete requires a substantial amount of energy and results in significant greenhouse gas emissions (CO2). As a result, experts are investigating cost-effective and environmentally friendly alternatives to traditional cement. So to reduce the the impact of this cement has been partially replaced with bagasse ash, fly ash, and crumbled rubber. The main objective of this project is to identify waste material that possesses desirable qualities when mixed with concrete, serving as an effective substitute for cement. If the strength of this newly developed eco-friendly cement surpasses that of conventional concrete, it could be a viable option for future construction applications. Using industrial by-products not only promotes sustainability but also enhances various properties of concrete. These materials can improve workability, reduce water demand, and increase strength and durability.

The objective of Research:

- To study the effects of industrial byproducts on fresh properties of concrete.
- To check the strength enhancement of concrete.

Importance of the study:

This project's significance lies in promoting environmental sustainability, enhancing waste management, and decreasing the carbon footprint associated with construction. By integrating industrial byproducts like fly ash, crumbed rubber, and bagasse ash as partial cement substitutes, the initiative encourages eco-friendly building practices while minimizing dependence on conventional cement, which is a major source of CO_2 emissions. The use of these waste materials not only aids in managing industrial byproducts effectively but also improves the concrete's properties, enhancing its workability, durability, and strength when used in proper proportions. Furthermore, employing these alternative materials provides a cost-efficient solution by reducing the overall concrete production costs. This research advocates for green construction techniques and offers a sustainable strategy for infrastructure development. If the newly formulated concrete displays equal or superior strength to standard concrete, it could present a credible alternative for future construction endeavours. By tackling both environmental and performance issues, this study offers a cutting-edge solution that furthers the development of sustainable construction materials.

Methodology:

The methodology involves a quaternary blend of concrete, which includes a combination of industrial byproducts: bagasse ash, crumbled rubber, and fly ash. Initially, these materials are collected and tested. Next, the appropriate concrete mix proportions are calculated to prepare the concrete. Once the mix is ready, cubes are cast and cured for periods of 7 days, 14 days, and 28 days. After the curing period, compressive strength testing is conducted for each timeframe. Finally, a comparison is made between the controlled concrete and the partially cement-replaced concrete.

Collection of Raw Material

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Test on Material

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Manufacturing of Concrete

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Test on Concrete

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Cube Casting and Curing

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Tests on Specimen

Observation:

Tests performed on material: -

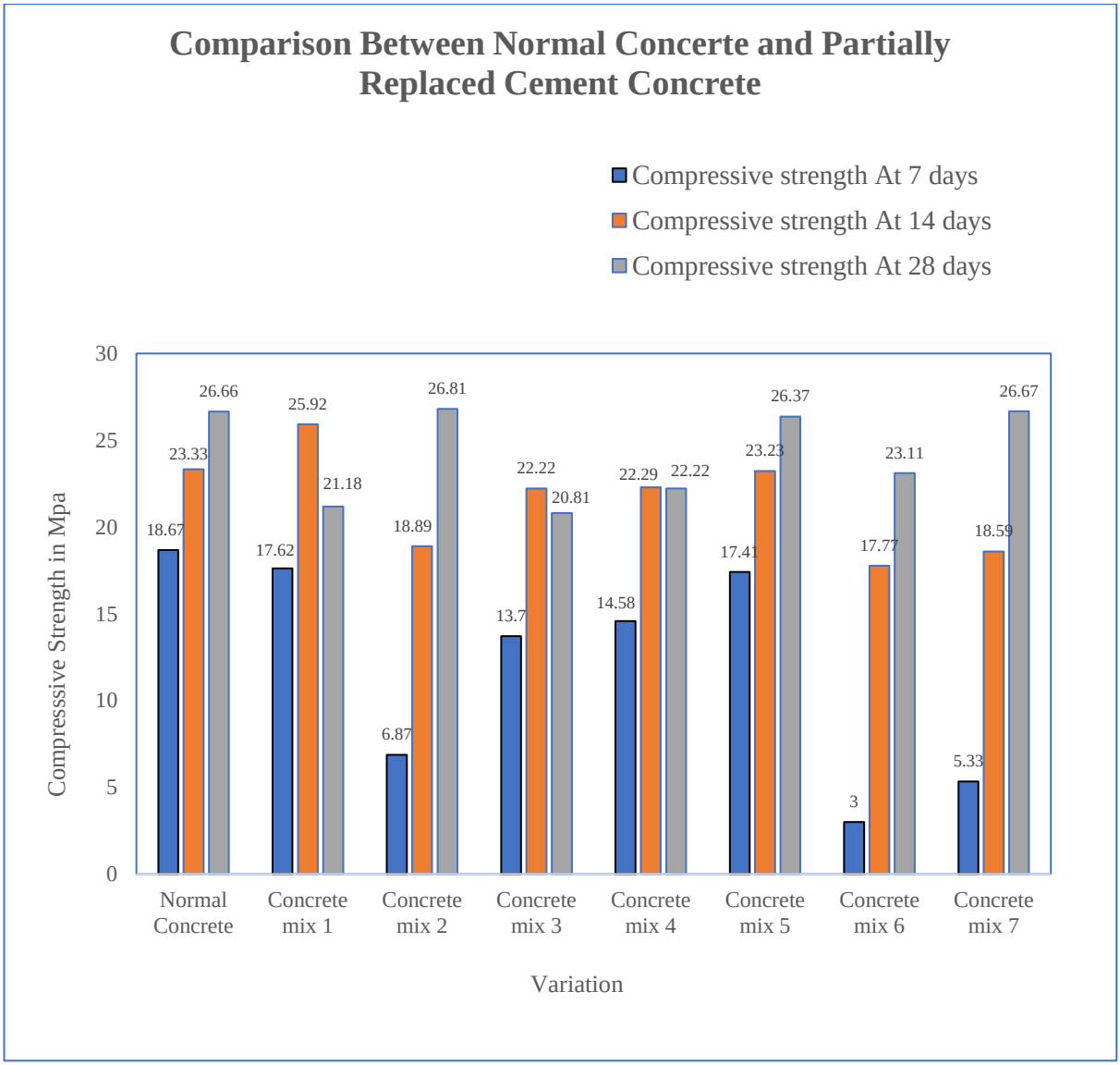
Sr. No.	Material	Test	Result	IS Code
1	Aggregate	Specific Gravity Test on Aggregate using Pycnometer.	G=2.95	IS 2386 (Part 3) 1963
2	cement	Setting time test on cement using Vicat apparatus		IS 12269: 2013
		1. initial setting time	38.33 min	
		2. Final setting time	420 min	
3.	Aggregate	Water absorption of aggregate	1.47	IS 2386 (Part 3) 1963
4.	Aggregate	Flakiness & elongation index test	13.88 %	IS 2386 (Part 1) 1963

Test performed on concrete:

1. Slump Cone Test – IS 1199

Sr. No.	Type Of Concrete	Slump Value (Mm)
1.	Normal Concrete	80
2.	Partially Replaced Cement Concrete	76

Results and discussion:



1.At 7 days Mix 2 i.e. Cement + Fly Ash+ Bagasse Ash + Crumbled Rubber

(60%) (20%) (12.5%) (7.5%)

is showing the lowest compressive strength with a decrease of 63%.

2. At 14 days Mix 1 i.e. Cement + Fly Ash+ Bagasse Ash + Crumbled Rubber

(60%) (20%) (10%) (10%)

is showing the optimum compressive strength with an increase of 11 %.

3. At 28 days Mix 2 i.e. Cement + Fly Ash+ Bagasse Ash + Crumbled Rubber

(60%) (20%) (12.5%) (7.5%)

is showing the optimum compressive strength with an increase of 0.56 %.

Conclusion:

The results indicate that incorporating bagasse ash and crumbled rubber into concrete influences its compressive strength in varying ways as time progresses. At the early curing stage (7 days), Mix 2 (Cement 60%, Fly Ash 20%, Bagasse Ash 12.5%, Crumbled Rubber 7.5%) exhibits the lowest compressive strength, implying that a higher proportion of bagasse ash and a lower amount of crumbled rubber hinder strength development. However, by the 14-day mark, Mix 1 (Cement 60%, Fly Ash 20%, Bagasse Ash 10%, Crumbled Rubber 10%) shows optimal strength with an 11% increase, indicating that a balanced mix of bagasse ash and crumbled rubber promotes early strength gain. At 28 days, Mix 2 reaches its peak strength with a minor increase of 0.56%, illustrating that although this mix weakens the concrete initially, it recovers over time. Overall, the findings suggest that mixtures with more crumbled rubber tend to gain strength more quickly, while those with higher bagasse ash content require more time to develop strength yet can achieve similar long-term results. Thus, the choice of an optimal mix should be based on the desired strength at different curing periods and the specific use of the concrete.

References:

1. Naraindas Bheel, Muneer Ali Jokhio, Javed Ahmed Abbasi, Hyder Bux Lashari, Muhammad Imran Qureshi, Abdul Salam Qureshi, “Rice husk ash and fly ash effects on the mechanical properties of concrete” ETASR (2020).
2. Anjaneya Babu Padavala, Malasani Potharaju, Venkata Ramesh Kode, “Mechanical properties of ternary blended mix concrete of fly ash and silica fume” ICSERET (2020)
3. A. Dhanalakshmi, J. Jeyaseela, S. Karthika, A. Leema Mrgret, “An experimental study on concrete with partial replacement of cement by rice husk ash and bagasse ash” ICSERET (2023)
4. Rafat Siddique, “Utilization of industrial by-products in concrete “ELSEVIER (2014)
5. Prof. Raj Bhosale, Anisha Nale, Prathamesh More, Digvijay Rajmane, “Partial replacement of cement by using rice husk ash and sugarcane bagasse ash” IJARSCT (2023)
6. Wegdan W. El-Nadoury, “Eco-friendly concrete using by-products as partial replacement of cement “FRONTIERS (2022)
7. Ahmed Minhajuddin, Dr Arijit Saha, “Performance Evaluation of Untreated Sugarcane Bagasse Ash as a Cement Alternative for Sustainable Concrete”(IRJAEH)2024

8. Laura Landa-Ruiz, Aldo Landa-Gómez, José M. Mendoza-Rangel, Abigail Landa-Sánchez, Hilda Ariza-Figueroa, Ce Tochtli Méndez-Ramírez, Griselda Santiago-Hurtado, Victor M. Moreno-Landeros, René Croche and Miguel Angel Baltazar-Zamora (Crystals 2021, 11,1012) Physical, Mechanical and Durability Properties of Ecofriendly Ternary Concrete Made with Sugar Cane Bagasse Ash and Silica Fume,2020

9. E.V. Prasad A, A.V. Phani Manoj, U. Surya Teja, Study on mechanical and durability properties of ternary blended concrete (Materials Today: Proceedings)2020