

Valorization of Rice Straw Residue: Diffusion of Rice Straw Ash in the Indian Construction Sector as a Sustainable Supplementary Cementitious Material

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Abstract:

This study looks at how rice straw ash (RSA) can be used in the Indian construction industry to create more eco-friendly and sustainable building materials. With growing concerns about pollution, waste, and the rising cost of construction, it is important to find new materials that are both affordable and better for the environment. The research begins with a detailed analysis of RSA's chemical and physical properties to evaluate its effectiveness as a supplementary cementitious material (SCM). This includes assessing its silica content, pozzolanic activity, and compatibility with conventional cementitious systems. Additionally, the study examines the thermal and mechanical properties of RSA-modified concrete to determine its feasibility for large-scale applications in infrastructure projects and whether it can be used in real construction projects. The study also looks at the bigger picture—how different social, economic, and policy factors affect the use of RSA in India. Using a structured approach called the Multi-Level Perspective (MLP), it examines challenges like the demand for infrastructure, government rules, and market conditions that may impact RSA adoption. A SWOT analysis is also done to identify its strengths (such as being eco-friendly and cost-effective), weaknesses (such as lack of awareness and inconsistent quality), opportunities (such as new policies supporting green materials), and threats (such as competition from regular cement and other materials). Another important part of the study is understanding the role of different social groups in adopting RSA. Farmers who produce rice straw, construction workers who handle the materials, government officials who set rules, and builders who decide what to use—all play a role in whether RSA becomes widely accepted. The research looks at how these groups influence the spread of RSA and whether they see its benefits. The study also highlights how RSA supports the idea of a circular bioeconomy—where waste from farming

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is turned into useful materials instead of being burned or thrown away. The findings contribute to the broader discourse on sustainable construction materials, highlighting the role of RSA in reducing cement consumption, lowering carbon footprints, and promoting waste-to-resource strategies in India.

Keywords:

Rice Straw Ash (RSA), Circular Bioeconomy, Sustainable Construction Materials, Supplementary Cementitious Material (SCM), Valorization of Agricultural Residues.