

Sustainable Design and Mechanical Evaluation of Al-Based Bio-composite for Structural Applications

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Abstract : In the face of growing global environmental concerns and the urgent need for sustainable material methods, the use of bio-composites has emerged as a promising solution. Bio-composites, which integrate natural fibers or agricultural wastes, offer several advantages, such as easy disposal, fewer health hazards, and reduced energy consumption during manufacturing. They also contribute to weight reduction in products, leading to lower carbon emissions and energy savings. This study focuses on the development and characterization of bio-composites using recycled aluminum, eggshell carbonized powder (ECP), and date seed powder (DSP) for engineering applications. The research will investigate the mechanical and corrosion characteristics of the bio-composites and assess their feasibility for practical use in various engineering fields. Recycled aluminum and agro-waste materials are utilized to enhance sustainability, reduce environmental impact, and promote a circular economy. The study will highlight the potential of these eco-friendly materials in improving mechanical and corrosion properties, making them suitable for a wide range of engineering applications. The fabrication process will involve sourcing materials from local sources, cleaning, processing, and fabricating composites using a stir casting technique. Statistical analysis using ANNOVA will be done to compare the amount of variation of organic reinforcement (ECP / DSP) between groups with the amount of variation within groups. Characterization methods include tensile testing, Vickers macro-hardness testing, SEM analysis, and corrosion testing. This research will contribute to the development of sustainable engineering materials and support the global and local efforts towards environmentally conscious practices.

Keywords : bio-composites, sustainability, recycled aluminum, eggshell carbonized powder (ECP), date seed powder (DSP)

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