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Eco-Innovation for Enhancing the Performance of Metal Roofing Sheets

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Abstract

The demand for metal roofing sheets has declined due to issues such as excessive heat and noise generation. An eco-friendly roofing layer is made from environmentally sustainable materials, contributing to a more comfortable living environment. The objective of this study is to utilize natural materials to develop a roofing layer as an eco-innovative solution to mitigate the excessive temperature and noise, ultimately enhancing industrial performance. To implement the proposed eco-innovative concept, Deluxe roofing sheets was selected as the target industry due to its relevance and suitability for sustainable material integration. A performance evaluation was conducted using four treatments, including a control. The experimental treatments consisted of natural materials: *Caryota urens* fiber, coir dust, *Agave sisalana* fiber. Each treatment, including the control, was tested using three replicates to ensure reliability and statistical validity. Each roofing material layer was attached to the Deluxe roofing sheet using rubber latex as a binding agent ensuring proper adhesion. Each treatment unit (76.2×76.2 cm^2) was prepared by first applying a thin coat of coagulated rubber latex onto a Deluxe roofing sheet. Different fibre layers were then placed individually on the coated surface, followed by a second latex coating and compression to achieve a thickness of 10 mm. A uniform layer of sawdust was subsequently applied to fill surface gaps, and the composite was pressed again to obtain a final thickness of 15 mm. The performance of composite roofing layers was assessed based on key parameters such as thermal insulation and noise reduction capabilities. The outdoor temperature was maintained between 70 °C and 80 °C, and the indoor temperature was measured at a distance of 125 cm from the sheet using a dual-laser video IR thermometer. The audible sound level was measured at three distances from the sheet (15,30 and, 45 cm) using a sound level meter under standardized testing conditions. All collected data were statistically analyzed using SAS Software and Dunnett's t test was employed to compare each treatment against the control. According to the changes in indoor temperature values and sound intensity levels, all three fiber based treatments showed a significant difference (40% reduction in indoor temperature and 10.5% reduction in sound level) compared with control test. All three treatments resulted in lower temperature and lower audible sound intensity level than control, indicating their effectiveness in temperature and sound insulation. Fiber from *C. urens* and *A. sisalana* showed better results compared to coir dust for temperature and sound insulation. These findings suggest that all three materials are suitable for use as a layering material on Delux roofing sheets.

Keywords: *Eco innovation, Excessive heat, Excessive noise, Metal sheets, Roofing layer*