

Study on Adhesion of Recycled Polypropylene Skin and PVC Foam Core Sandwich Composite

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Structured Abstract

Background: Sandwich composites are widely used in various applications such as flood barriers, transportation and marine structure. However, the bonding quality between the skin and core plays a vital role on the overall mechanical and durability performance. This study focuses on developing an eco-friendly sandwich composite by using recycled polypropylene (rPP) as the skin and PVC foam as the core. Different types of adhesive were used, which is polyurethane (PU) and epoxy adhesive to evaluate the effect of mechanical, structural and physical properties of the sandwich composite.

Methods: The sandwich composites were fabricated by using hand lay-up method and compression moulding methods. The skin used was made of a plain woven recycled polypropylene while the core used is PVC foam. Polyethylene (PE) resin was used to bond 2 layers of rPP before the two adhesives, PU and epoxy were used for 2 separate samples to bond the skin and core. Mechanical testing included impact and flexural tests. Fourier Transform Infrared Spectroscopy (FTIR) and Scanning Electron Microscopy (SEM) were used to analyze the chemical and interfacial bonding. Water absorption and thickness swelling tests were also conducted to evaluate the durability of sandwich composite under moisture exposure.

Results: PU adhesive resulted to have a higher flexural strength but lower flexural modulus which indicates better energy absorption but reduced in stiffness. Epoxy adhesive showed a higher flexural modulus but is brittle. FTIR confirms the presence of functional groups for the adhesive while SEM analysis revealed fewer voids in PU-bonded samples compared to epoxy that has more voids due to the thin application of adhesive. Water absorption of PU was higher most likely due to the porous structure and both adhesives showed acceptable thickness swelling values after a 24 hours immersion.

Conclusion: Results show that selection of adhesive strongly influences the performance of sandwich composite. PU is suitable for general use that requires high energy absorption while epoxy is better for structural rigidity applications. The use of rPP and appropriate adhesives supports the sustainable development approach for lightweight structural uses.

Keywords: Adhesion, Sandwich Composite, Polymer Composite

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