



Analysis of Suitability of Composite Materials under Marine Conditions

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Marine vessels operate under highly demanding environmental conditions, where exposure to saltwater, humidity, and continuous mechanical loading accelerates material degradation. Traditional construction and repair materials such as wood, steel, aluminium, and conventional fiberglass often suffer from corrosion, rot, and fatigue, resulting in high maintenance requirements and reduced service life. To address these limitations, this study investigates the development and evaluation of composite materials specifically designed for marine applications, aiming to enhance the durability, strength, and long-term performance of structures. Two synthetic reinforcements, Chopped Strand Mat (CSM) and Woven Roving Mat (WRM), and two natural fibers, Coir and Pineapple Leaf Fibre (PALF), were mixed with epoxy resin as the matrix phase to fabricate composite panels. Four composite structures were prepared: CSM, WRM, CSM and Coir (1:1), and WRM and PALF (3:1), using the hand lay-up method. Mechanical properties of developed composites, including tensile strength, flexural strength, impact resistance, hardness, and water absorption, were evaluated according to ASTM standards before and after immersion in seawater for one month. Results show that WRM-based composites exhibited the best performance, achieving tensile strength of 133.98 MPa, flexural strength of 484.72 MPa, and impact resistance of 134 kJ/m², attributed to their continuous fibre structure and reduced void formation. In comparison, natural fibre hybrids showed poor mechanical properties, while the CSM-Coir composite demonstrated the highest water absorption (up to 4.22%), indicating reduced suitability for prolonged exposure to wet environments. Seawater immersion resulted in approximately 30% reduction in tensile strength and around 10% reduction in flexural strength across all samples due to moisture diffusion and fibre-matrix debonding. Overall, the study confirms that glass-fibre-reinforced composites are highly suitable for structural marine applications due to their strength, durability, and low water absorption. Natural fibre hybrid composites, while less mechanically robust, demonstrate potential for non-structural marine components where sustainability and cost-efficiency are priorities.

Keywords: Composite materials, Marine conditions, Synthetic fibers, Natural fibers, Hybrid composite