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ENVIRONMENTALLY FRIENDLY COMPOSITES AND SURFACE TREATMENTS FOR METAL-TO-COMPOSITE HYBRID JOINTS FOR MARINE APPLICATION

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Since early 1960s the marine industry has experienced an increasing use of composites from small boats to submarines. Traditional marine composites are woven glass/carbon reinforced thermosetting polyester/vinyl ester resins produced by hand lay-up, but the development of low-styrene emission resins, the vacuum resin infusion process and stitched fabrics have all contributed to improve composite quality. However, over recent years there have been some significant changes in both the materials and their applications. For example, increasing concern about environmental impact has favoured a move towards bio-sourced and recyclable matrix polymers and fibres. In the framework of the THALASSA project, collaboration among universities, research centres and companies is striving to develop greener alternatives to traditional composites and surface treatments for joining dissimilar materials. The present work is focused on the development and mechanical characterization of composite laminates reinforced with natural basalt and flax fibres while exploiting innovative recyclable and bio-based epoxy formulations suitable to resin infusion based on bio-based epoxy monomers and a cleavable ammine. In an attempt to providing access to recyclable materials with existing manufacturing technology, comparisons are also provided with Elium™ acrylic resins that can be infused like vinyl ester but then react to form thermoplastics, which can subsequently be recycled. In addition, an alternative anodizing process based on environmentally friendly chromium-free electrolytes has been developed to enhance the bonding strength of adhesive co-cured joints in double-strap configurations for nautical applications. Joint strengths have been evaluated under quasi-static loading, under transverse normal impact load at different temperatures and after an artificial salt fog ageing to assess their durability in marine environments. Results showed that the application of recyclable materials in the marine sector is of particular interest and due to their intrinsic characteristics, can lead to the solution of many problems and to improved performance.

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