Bio-Based Textile Reinforcements for Water-Based Waterproofing Membranes for Flat and Walkable Roofs

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Abstract

The use of flat roof systems in buildings has increased in recent years, and solutions incorporating this system are therefore expected to grow further. In parallel, innovative technologies are contributing to the evolution of modern roofing systems, particularly within the context of sustainable construction and improved durability. Despite these advancements, current roof waterproofing solutions still present inherent limitations, including cracking and subsequent water infiltration.
In the case of water-based waterproofing membranes, although their use remains limited compared with prefabricated sheet systems and solvent-based alternatives, higher performance is required due to the critical demands of waterproofing effectiveness and durability. In addition, these systems offer improved environmental sustainability. Their performance depends on several factors, including mechanical behaviour, application conditions, membrane thickness, and the treatment of critical details. Reinforcement structures play a key role in enhancing the performance of waterproofing membranes for flat and walkable roofs, particularly by reducing cracking and improving long-term durability.

To address these challenges, the present project focuses on the development of sustainable textile reinforcement systems based on natural fibres such as flax (linen) and hemp, as well as recycled polypropylene, for use in water-based polymeric membranes, aiming to achieve an optimised and more sustainable waterproofing solution.

Beyond improving the mechanical performance and durability of the waterproofing system, the use of natural fibre reinforcements provides an additional environmental benefit by avoiding the release of microplastics associated with conventional synthetic textile reinforcements.

The performance of these systems is strongly dependent on the compatibility between the waterproofing membrane and the textile reinforcement, with implications at mechanical, physical, and chemical levels. The results indicate that linen, hemp, and recycled polypropylene reinforcements exhibit high tear resistance performance. Good retention of this property

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is also observed after prolonged exposure to a water-based polyurethane membrane under accelerated ageing conditions.

The focus of this work is the development and optimisation of textile reinforcement systems designed to enhance mechanical performance, delay degradation processes, and extend the service life of water-based roof waterproofing membranes.
This study also enables correlation between laboratory-induced ageing and in situ exposure conditions, supporting a more reliable understanding of long-term behaviour in real applications.

Keywords: Flat roofs, Sustainable construction, Water, based membranes, Textile reinforcement, Natural fibre composites, Flax fibres, Hemp fibres, Recycled polypropylene, Mechanical resistance, Durability, Lightweight construction