
Abstract

The extensive use of cellulose fibers has significantly improved the sustainability of fiber-cement products. The use of unbleached eucalyptus fibers represents a sustainable and innovative option to conventional reinforcing fibers, contributing to lower environmental impacts and increased utilization of renewable resources in the construction industry. Although the application of unbleached hardwood fibers has historically been restricted due to their recent availability and complex fiber-matrix interactions, this study successfully investigated the performance of SUZANO BIOPULP® (EUCANATURAL). As a new-generation unbleached eucalyptus pulp, the evaluation focused on its physical-mechanical behavior and solids retention efficiency in laboratory-produced fiber-cement composites, utilizing formulations representative of commercial flat and corrugated sheets. The performance of SUZANO BIOPULP® fibers was compared with conventional unbleached Pinus fibers and recycled textile fibers, maintaining a constant synthetic fiber (Polypropylene - PP) content across all formulations. Autoclaved flat-sheet formulations reinforced with 8 wt.% SUZANO BIOPULP® achieved a modulus of rupture of 14 MPa, outperforming those reinforced with 8 wt.% Pinus fibers and Pinus/recycled textile fiber blends. Under air curing, both flat- and corrugated-sheet formulations with 5 wt.% of eucalyptus fibers, either alone or combined with recycled textile fibers, exhibited mechanical performance comparable to conventional commercial formulations while exceeding the minimum ASTM requirements for exterior applications (~8.5 MPa). Additionally, all composites exhibited drying shrinkage within the limits established by relevant Standards. During processing, formulations reinforced exclusively with SUZANO BIOPULP® enabled approximately 10% higher fines retention efficiency, optimizing raw material yield. These higher solids retention indicates improved process efficiency and reduced reactive material losses during manufacturing. This superior performance is driven by the product's unique morphology, featuring a fiber population about three times higher than average conifer pulp. This characteristic provides a significantly larger contact surface and a more homogeneous distribution in the cement matrix, a behavior visually confirmed by Scanning Electron Microscopy (SEM) images, which showed excellent fiber-to-matrix adhesion. These findings prove that unbleached eucalyptus fiber is a highly competitive, sustainable innovation for the global fiber cement market. Furthermore, optimizing its refining process can significantly improve physical-mechanical properties with better energy efficiency and more efficient water drainage, strengthening its competitiveness.
