ForestValue
StrongComposite

High-Strength Cellulose Composites

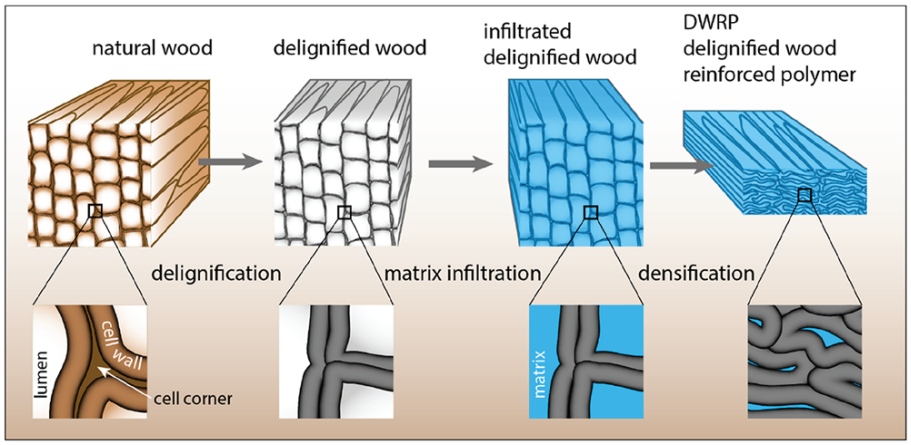

Figure 1. Manufacturing process of densified delignified wood-epoxy composites.

High-strength fiber composites, which allow to substitute less eco-friendly materials in various applications

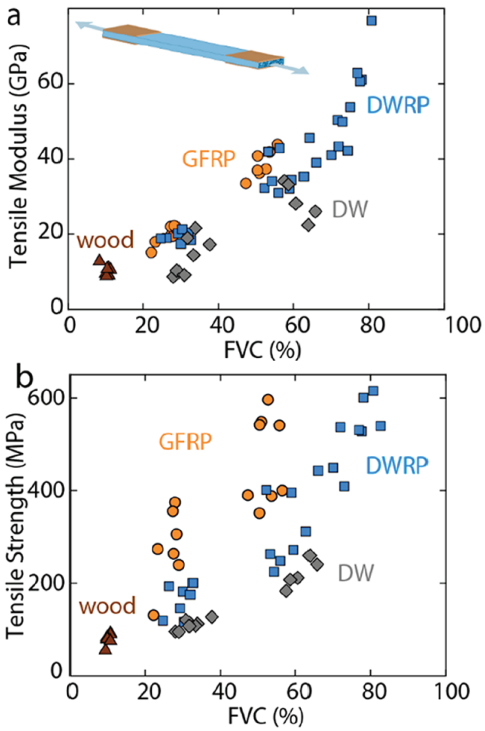

Figure 1. Tensile properties of densified delignified wood-epoxy composites.
GFRP = glass-fiber reinforced epoxy,
DW = delignified wood,
DWRP = delignified wood reinforced epoxy

For sustainable high-performance composites, wood was delignified in a structure-retaining process, infiltrated with an epoxy matrix, and subsequently densified (**Fig. 1**).
We utilized the continuous lumen channels of the delignified wood structure for vacuum-assisted matrix infiltration. Before matrix curing, the infiltrated delignified wood scaffold can be easily molded into complex shapes. Here, the material was densified to increase the fiber volume content, decrease porosity, and reduce density variations in the wood scaffold. As the delignified wood represents the reinforcing fibrous phase, it is desirable to achieve high fiber volume contents. Due to the decreased transverse rigidity of the cell walls of the delignified spruce wood fibers, composites with very high fiber volume contents of up to 80% could be produced. The exceptionally high tensile stiffness and strength values of up to 70 GPa and 600 MPa (**Fig. 2**) can be explained by enhanced stress transfer through mechanically interlocked fiber–fiber interfaces combined with the continuous epoxy matrix phase that connects adjacent cells via their pits. These novel high-strength and high-stiffness composites can be used as an alternative for glass fiber-reinforced or natural fiber composites.

Further information:

Frey et al. (2019). Delignified wood–polymer interpenetrating composites exceeding the rule of mixtures.
ACS applied materials & interfaces.

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