

The wood revolution: how a new technique opens doors in construction

A study published in March 2025 describes a self-densified wood with exceptional mechanical properties. At PAPIK Group we assess its real reach for timber-frame construction.

Construction with natural materials such as timber advances at the pace of materials science. In March 2025 the **Journal of Bioresources and Bioproducts** published a study by Chinese researchers describing a self-densified wood with mechanical properties that, until now, seemed beyond the reach of a naturally derived material. At PAPIK Group we follow these developments with technical interest and, at the same time, with the judgement needed to tell a laboratory finding from a mature construction solution.

What densified wood is and what self-densification adds

Timber has been used for millennia to raise every kind of structure, yet it has well-known mechanical limits. However good its properties, natural wood does not compete with steel or light alloys where very high strength is required. To move past that barrier, the industry has developed successive densification methods over decades.

- Polymer-infiltrated compressed wood (PICW), studied since 1965.
- Thermo-mechanically compressed wood (TMCW), since 2008.
- Delignified compressed wood (DCW), since 2018.
- Delignified compressed wood with partial surface dissolution of the fibre (D&PSDCW), since 2019.
- Resin-infiltrated delignified compressed wood (DRICW), since 2020.

The new study substantially improves on these results with a system the authors call self-densification.

The key lies in the microstructure

The technique reorganises the wood's internal microstructure in two steps. First, a partial delignification removes some of the lignin, the natural substance that binds the fibres together, so the cellulose fibres gain freedom of movement. Then a solution based on lithium chloride (LiCl) and N,N-dimethylacetamide (DMAc) draws those fibres toward the interior of the trunk. Drying with dry air completes the process, and the wood self-densifies uniformly across its entire cross-section.

The result is a wood almost three times denser than natural timber, which keeps its original shape along the growth direction. This densification yields notable strength in both tension and bending, with impact and compression behaviour that natural wood does not reach.

Why it matters for timber-frame construction

Strength

Self-densified wood reaches a tensile strength of up to 496 MPa, nine times that of conventional timber. Within a timber structure, each piece of this material could offer strength comparable to metal elements, without giving up the ecological and aesthetic qualities that belong to wood.

Uniformity

Compression densification methods tend to produce anisotropic wood, with strength that varies according to the direction of the load. Self-densification produces a uniform microstructure, so the material responds evenly in all directions. This isotropy is especially valuable wherever robustness and a visually clean finish are both required.

Sustainability

Improving mechanical properties without adding synthetic materials or energy-intensive processes helps reduce the carbon footprint of construction. Wood is a renewable resource that fixes CO₂, so a material able to replace high-impact metal structures aligns with standards such as Passivhaus, a core commitment of our construction with the Eskimohaus system.

Practical applications

The study points to concrete uses. Tests with nails made from this material have shown they can bear loads higher than those of metal nails, with no need for pre-drilling. A possibility of this kind could reshape traditional fixing and assembly practices for timber structures.

The transformation process, without the jargon

A log contains thousands of aligned filaments bound by lignin, a natural adhesive that is essential to the tree yet limits the mobility of the fibres. A treatment with mild solutions removes part of that adhesive and frees the fibres. A second solution draws them inward, and the natural evaporation of water brings them closer still, creating numerous additional bonding points. The result is a denser, stronger and more uniform wood, obtained without complex machinery or energy-heavy treatments.

What it means for those committed to sustainable homes

For a builder of efficient homes, the technique opens several paths for the future.

- **Material saving.** A lightweight wood with properties comparable to, or greater than, some metals would allow structures with the same safety using less material, which could simplify structures and reduce their cost in material and labour.

- **Strength and durability.** Timber houses already meet the requirements of the Technical Building Code. A stronger material could change structural calculations, allowing greater height with less material or reducing reinforcement in exceptional cases.
- **Environmental innovation.** Replacing materials that emit large amounts of CO₂ during manufacture with a material that fixes more than it emits would be a step toward decarbonising the sector.

What remains to be researched

Every scientific advance raises new questions. This process uses two groups of substances. For lignin removal it employs sodium hydroxide (NaOH) and sodium sulfite (Na₂SO₃); with correct use, these pose no relevant environmental risk and their effects do not persist in the wood. By contrast, the lithium chloride (LiCl) and N,N-dimethylacetamide (DMAc) involved in self-densification are toxic and do not disappear easily.

As builders attentive to indoor comfort and wellbeing, we believe research should explore how to minimise these risks, seeking alternative mechanisms or materials that deliver the same benefits without the associated drawbacks. The industry still has room to turn this finding into a real product for sustainable construction.

The advance shows that the timber house is not a passing trend but the result of advanced research combining science and tradition. These discoveries still sit within the laboratory, and a long road remains before real applications appear, yet they confirm the direction. To explore this logic of natural materials further, you can also read our article on the [ecological footprint](#) of construction.

Wood has ceased to be a technical limitation and has become a field of research. Our task is to follow this evolution closely and adopt it once it is mature enough to guarantee safety, health and durability.