CelluWood

Co-funded by the Eco-innovation Initiative of the European Union

Laminated Strong Eco-Material for Building Construction Made of Cellulose-Strengthened Wood

Project Final Outcomes

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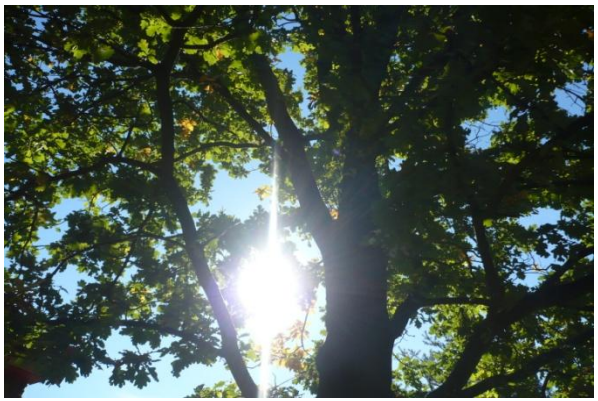

Project objectives (1)

The **CELLUWOOD** project aimed at developing a new range of structural elements for construction made of wood by introducing innovative technologies. The project developed the fit for purposes nanocellulose and lignin bio-resins and their novel applications in the laminated wood production (glulam products) instead of synthetic resins made from petrochemicals.

The ultimate outcomes are new glulam construction re-engineering elements, namely **eco-beam and eco-columns.**

Project objectives (2)

The project objective is achieved through:

- Introduction of (new) technologies from other sectors (e.g. cellulose velvet, bio-composite reinforcement and bioresin) for innovative uses in the lamination, defect removal and repairing of strong building materials

- Innovation in the use of nano/micro cellulose and bioresin technologies in timber re-engineering.

Project results/products

The project results/products can be classified into two groups:

New adhesive, bonding and structural components:

- Lignin-based gluing system;
- Nanocellulose epoxy and casein resins for eco-beams;
- Inorganic core material for eco-columns.

Structural construction products:

- Eco-beams and eco-columns.

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Lignin-based gluing system

CELLUWOOD developed lignin base adhesive with a “greener” character, in which the use of the phenol component was partially replaced by modified lignin.

The produced adhesive is capable of setting in cold pressing in order to be used as binder for glulam building materials in small and medium sized companies.

Characteristics:

- Lower phenol-formaldehyde emission
- Easy to apply
- Relatively cheap to be produced (becaues of the low lignin prices)
- Performances equivalent to commercial glue (e.g. eco-beams fabricated with the modified PF resin showed better mechanical properties than commercially available beams)

Restriction of use:

- Darker colour

The application can be suitable for outdoor constructions and situations where colour effect does not jeopardize the design idea.

Lignin based gluing system

Innovative aspect and comparative advantages:

- **Cold press PF lignin modified bio-adhesive and corresponding hardener with superior mechanical performances (phenolic component replaced up to 50%).**
- **The system can be effectively used in the production of glulam beams and columns with performance comparable to the products produced with conventional gluing systems.**
- **Easy to apply, cheaper and low formaldehidye emisson.**
- **The eco-beams produced from lignin bio-resins have been developed for the first time within the framework of the CELLUWOOD project but are not available on the market yet.**

Conclusion

- **The developed lignin-based PF resin gluing system showed a clear environmental improvement compared to commercial available glues: 74% vs. MUF and 86% vs. PU resins. Besides the environmental advantages, the lower cost and better technical performance make the lignin-based gluing system as real eco-innovation and a great success for the CELLUWOOD project.**

Nanocellulose epoxy resin for eco-beams

Nanocellulose based materials are characterised by high strength and low weight.

Two types of nanocellulose based wood adhesives have been produced:
- nanocellulose reinforced epoxy,
- nanocellulose reinforced casein.

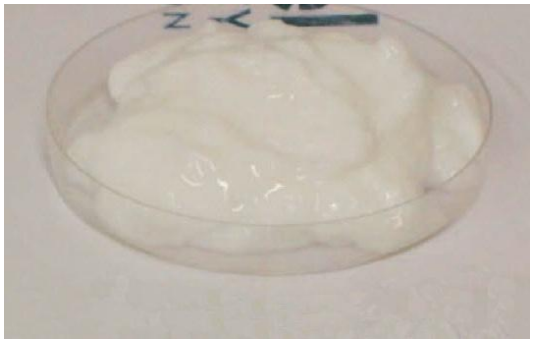
Both adhesives can be used and cured at the room temperature under a low pressure, and display high performance.
The shear strength of the epoxy resin increased by more than 50%, (dosage of nanocellulose in a range of 1-5%).

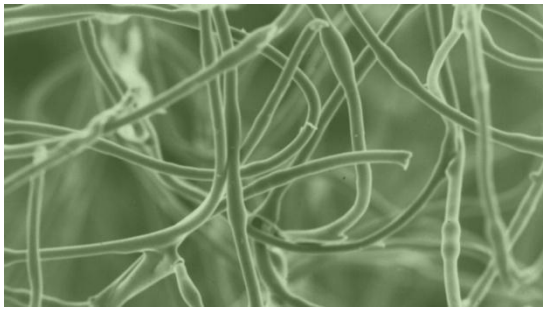
- **Nanocellulose has the potential to replace current used MUF and epoxy resins, and provide much efficient and high strength resin systems for laminated timber industries.**

Nanocellulose epoxy resin for eco-beams

Innovative aspect and comparative advantages:

- **The first successful research on nanocellulose dispersion in hydrophobic resin without using organic solvents.**
- **The first successful research on epoxy reinforcement with nanocellulose.**





Conclusion

- **Nanocellulose has the potential to replace current used MUF and epoxy resins, and provide more efficient and high strength resin systems for laminated timber industries.**

- **Nanocellulose reinforeced gluing systems have a higher environmental impact compared to the commercial glues. The main reason is high environmental impact of the adhesion system used as a base component for reinforced adhesives and the nature of the data used for the LCA (only laboratory testing data were available). It is expected that in optimised industrial production the impact will be much lower. Further research about this aspect is recommended, and reinforcement of other gluing systems with lower environmental impact in order to make the nanocellulose adhesives environmentally competitive with commercial glues.**

Inorganic core material for eco-column (ICM)

Another novelty concept developed in CELLUWOOD project has been the Inorganic Core Material (ICM) for eco columns. The idea was to use wood residues from timber beam and column production as core material for the eco columns.

- **Key component: Modified formulation of a sawdust and gypsum mixture which increases stiffness and gives better compressive strength to the components.**

Characteristics:

- Use of abundant raw material easy process and the good performance,
- ICM composite columns can potentially be commercialised to use wood residues and reduce raw material costs for the column production

Inorganic core material for eco-column (ICM)

Innovative aspect and comparative advantages:

- **New concept for ICM development for timber column.**
- **New technology of enhancing the strength of gypsum based composite.**
- **ICM is a versatile product. This light weight composite can be used as brick or core material for columns.**
- **ICM is cheaper than solid timber.**

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Conclusion

- **It is envisaged that once the interface between the ICM and enclose lumber is improved, the ICM composite columns can potentially be commercialised to use wood residues and reduce raw material costs for the column production.**

- **The novel ICM concept using a gypsum and sawdust mixture as core material for columns can find its place in the wood construction market, in particular in the wall building and column manufacturing sector.**

Structural construction products: eco-beams and eco-columns

The developed eco-beams and eco-columns are strong re-engineered timber products bonded by a natural bio-resin system.

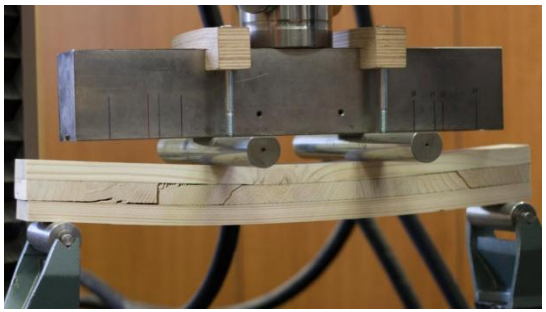
The developed natural binding systems have been applied to both eco-beams and eco-columns.

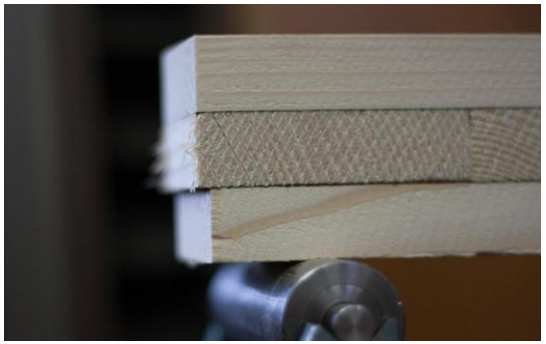
- **The processing technologies have been tailored with the application of the natural bioresin systems. This could be done with the conventional production facilities and gluing lines in the companies.**
- **No extra investment where required to apply the developed resins and gluing systems.**

Structural construction products: eco-beams and eco-columns

Innovative aspect and comparative advantages:

- **it has not yet been possible to make natural fibre composites reliably strong enough for incorporation in building structures.**
- **it has not yet been possible to laminate wood without recourse to use of strong, water-resistant glue made from almost the whole petro-chemical feedstock.**





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Conclusion

- **Eco-beams fabricated with the lignin modified PF resin showed better mechanical properties than commercially available Melamine Urea Formaldehyde (MUF) resin beams.**
- **Excellent dimensional stability.**
- **CELLUWOOD beams are appropriate for outdoor use.**
- **Their production is convenient for small and medium companies. Does not demand any extra investment.**

PROJECT CONSORTIUM

The project involves seven partners (six SMEs and one university), representing industrial research, manufacturing, design and dissemination.

- **InWood Development Ltd (UK)**
- **Tecnifusta Enginyera SL (Spain)**
- **CBD d.o.o (Slovenia)**
- **Chimar Hellas SA (Greece)**
- **AIDIMA (Spain)**
- **Brunel University (UK)**
- **InnovaWood (Belgium)**

Thank you

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