CHIMAR.

Cellulosic Materials In Adhesive Systems For Wood-based Panels

MANOS KARAGIANNIDIS

CHIMAR HELLAS SA

nano texnology

Objectives

- Introduce cellulose, a natural material, into adhesive systems which are applied in the production of wood-based panels
  - Current study → Adhesive = Urea-Formaldehyde (UF) resin
    Application (panel) = Particleboard (PB)
- Investigate the optimum path of introduction of cellulose in the adhesive system

Target

- Enhance the functionality of such adhesive systems
- Improve the performance of the final product (panels)
- Reduce utilization of petrochemical substances
- Decrease the carbon foot-print of the final product

Cellulose types

Micro-fibrillated Cellulose (MFC)

MFC 2% suspension

MFC 10% paste

Micro-crystalline Cellulose (MCC) / Nano-crystalline Cellulose (NCC) – Supplied by the Dept. of Chemistry, Aristotle U. of Thessaloniki (CELL4GLUE Project)

MCC Powder

Sonication or high shear blending

MCC/NCC 1% & 2% suspension

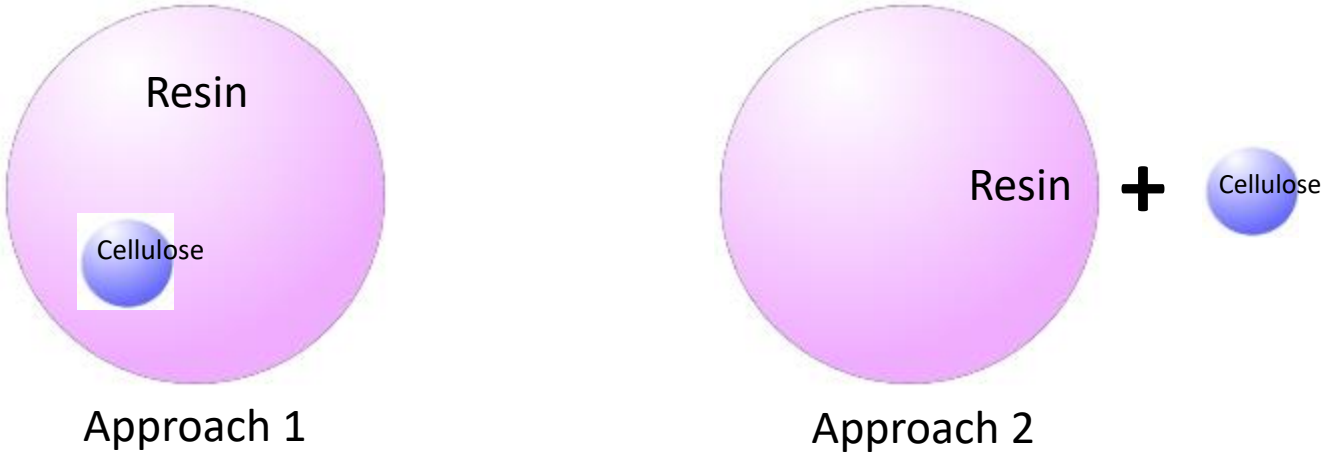
Cellulosic Materials Characteristics and Advantages

MFC	MCC / NCC
Mechanical and/or chemical treatment	Chemical treatment
Long and thin fibers with crystal and amorphous regions	Rod-like, short fibers at highly crystalline form
High viscosity and yield stress	Low viscosity and yield stress
Shear thinning	
High water holding capacity	Poor water holding capacity
Thickening and shear thinning effect on the resin	Prolonged stability of the resin

Approaches

Introduce Cellulosic material in the resin during its synthesis (Approach 1)

Admix Cellulosic material with the resin after its synthesis (Approach 2)



Results – Resin/Adhesive system

CHIMAR.

MFC impact on resin viscosity

- MFC 2% suspension in the resin during synthesis

Formulation	0.0% MFC	0.22% MFC
Viscosity, cP	275	325

- Slight increase of viscosity

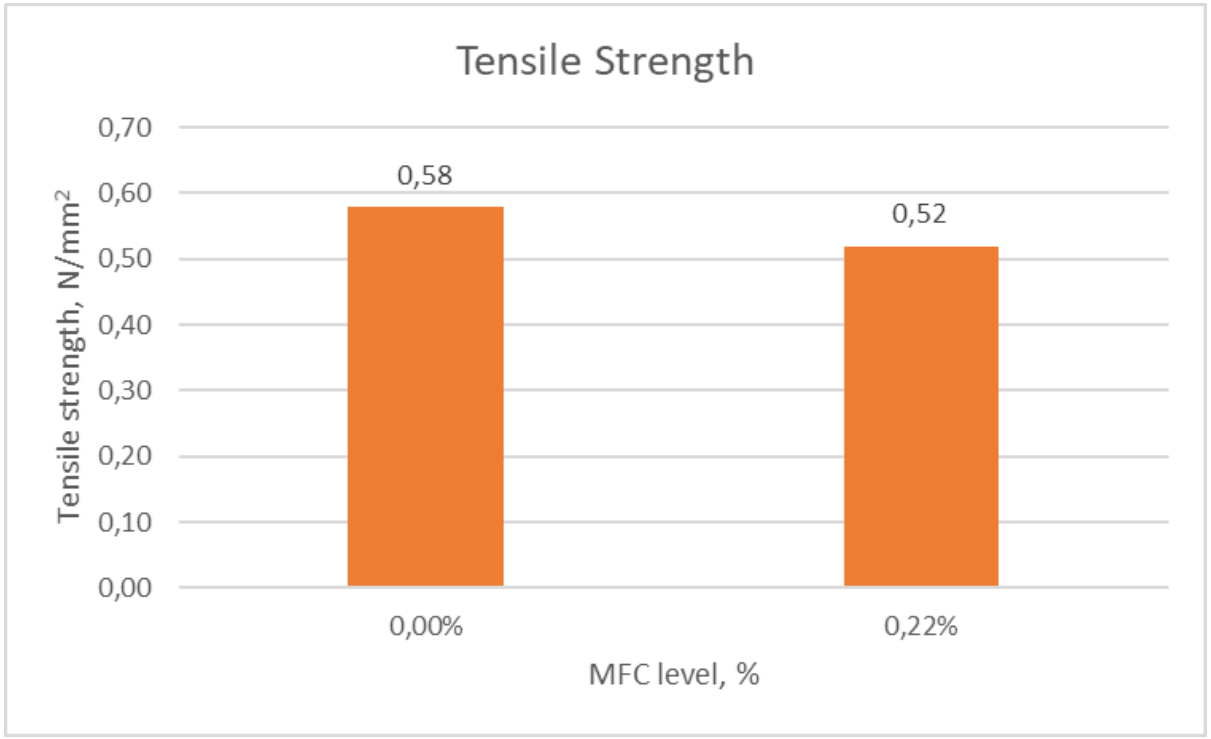
- MFC 10% paste admixed with the resin

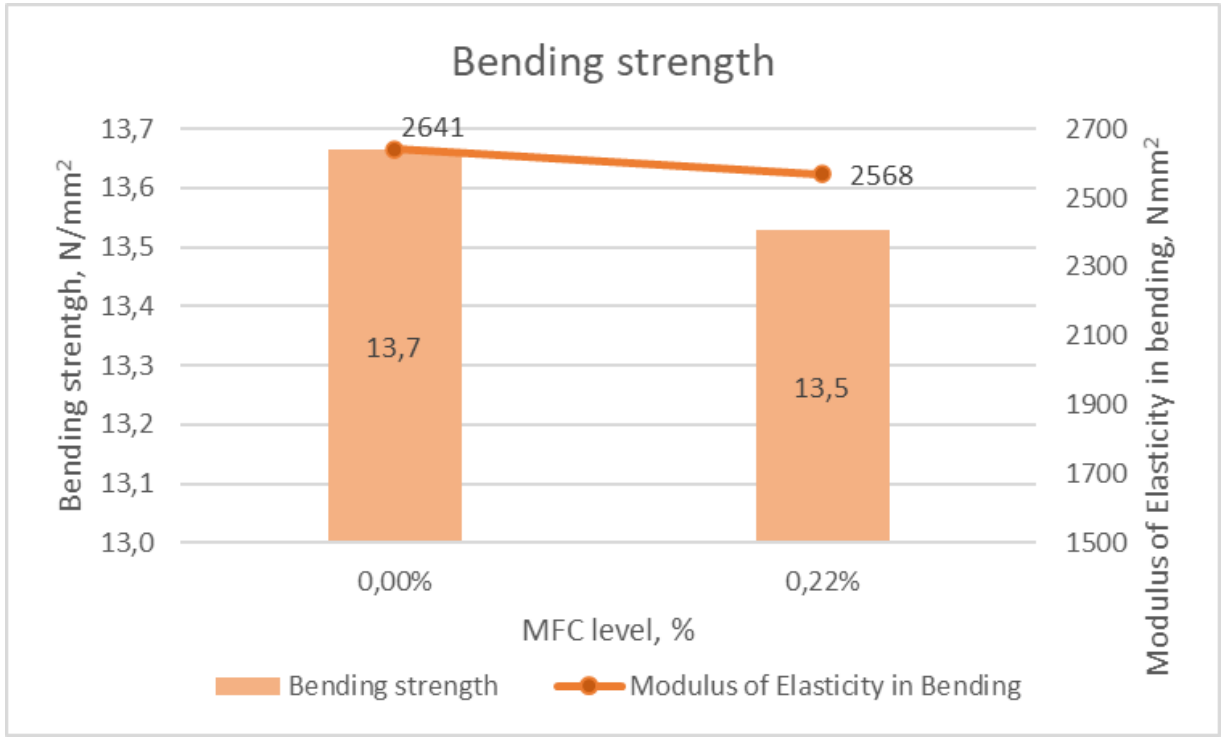
Formulation	0.0% MFC	0.25% MFC	0.50% MFC	0.75% MFC	1.00% MFC
Viscosity, cP	270	465	1140	8000	>10000

- Significant viscosity increase by increase of MFC paste level
- Sprayable due to shear thinning attribute

Results – Particleboard analysis

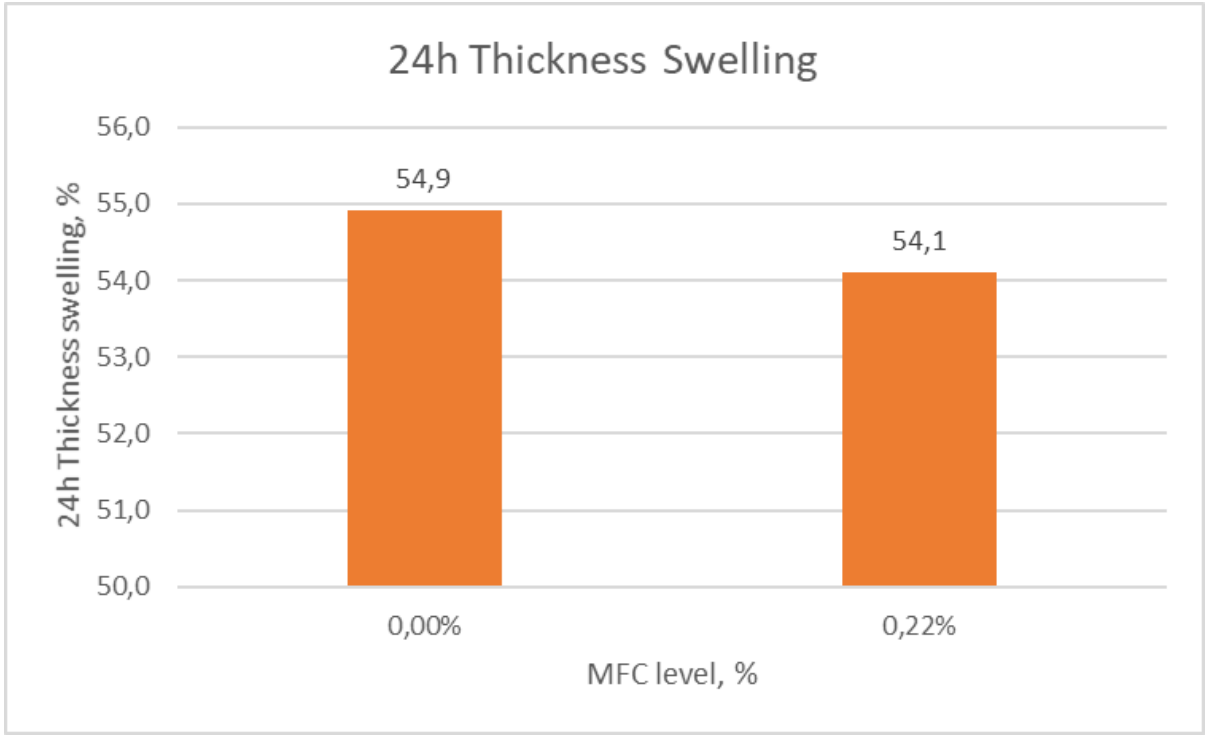
MFC 2% suspension added in UF resin during its synthesis

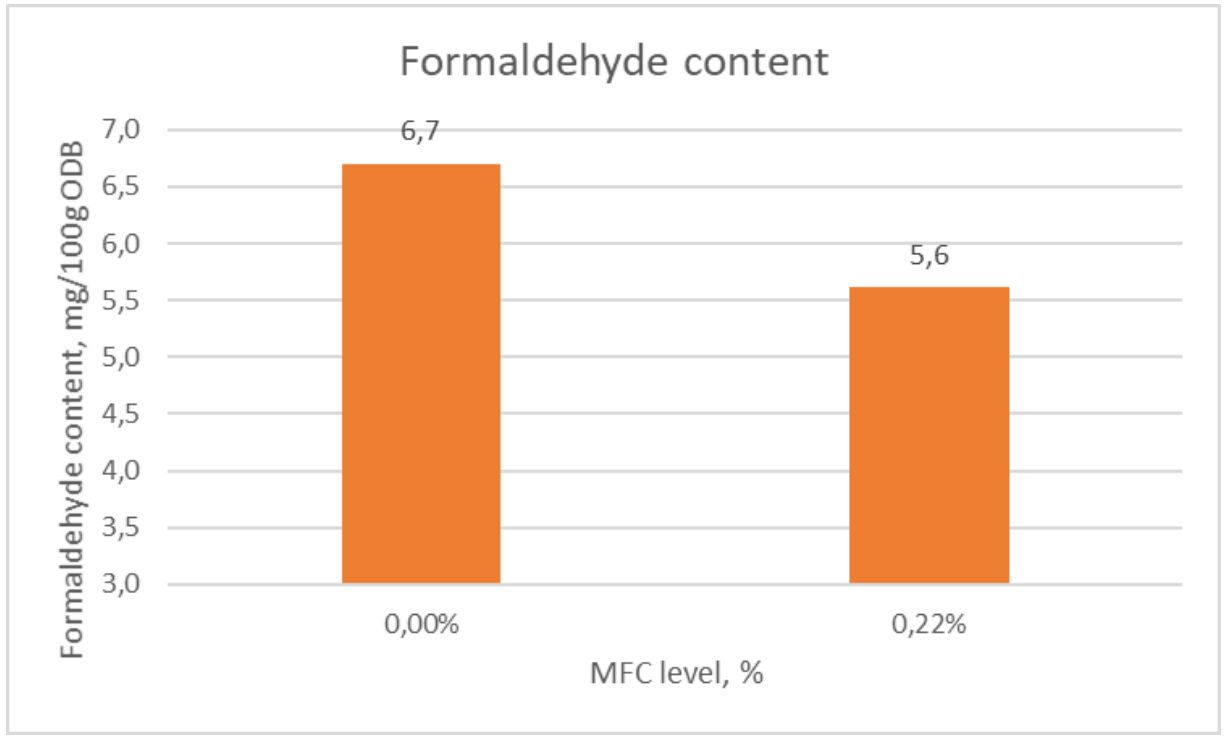




Results – Particleboard analysis

MFC 2% suspension added in UF resin during its synthesis

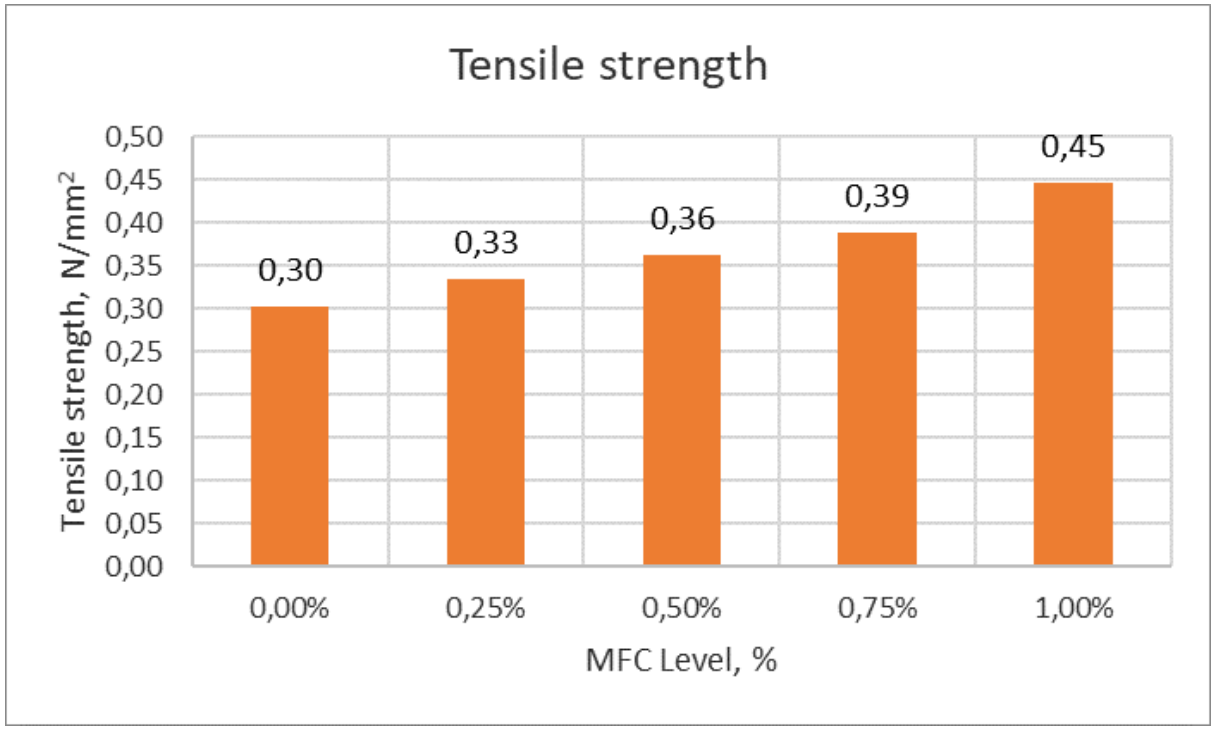


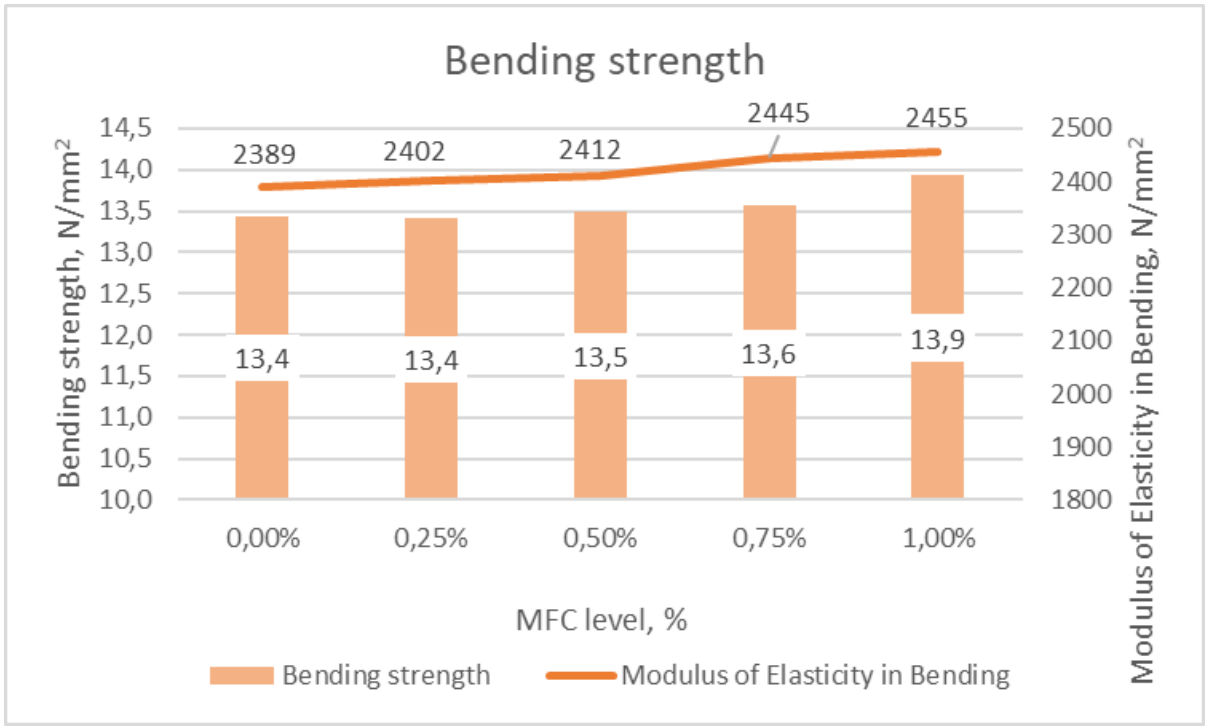


Results – Particleboard analysis

MFC 10% paste admixed with the UF resin

Increasing addition levels of MFC 10% paste / Stable resin level

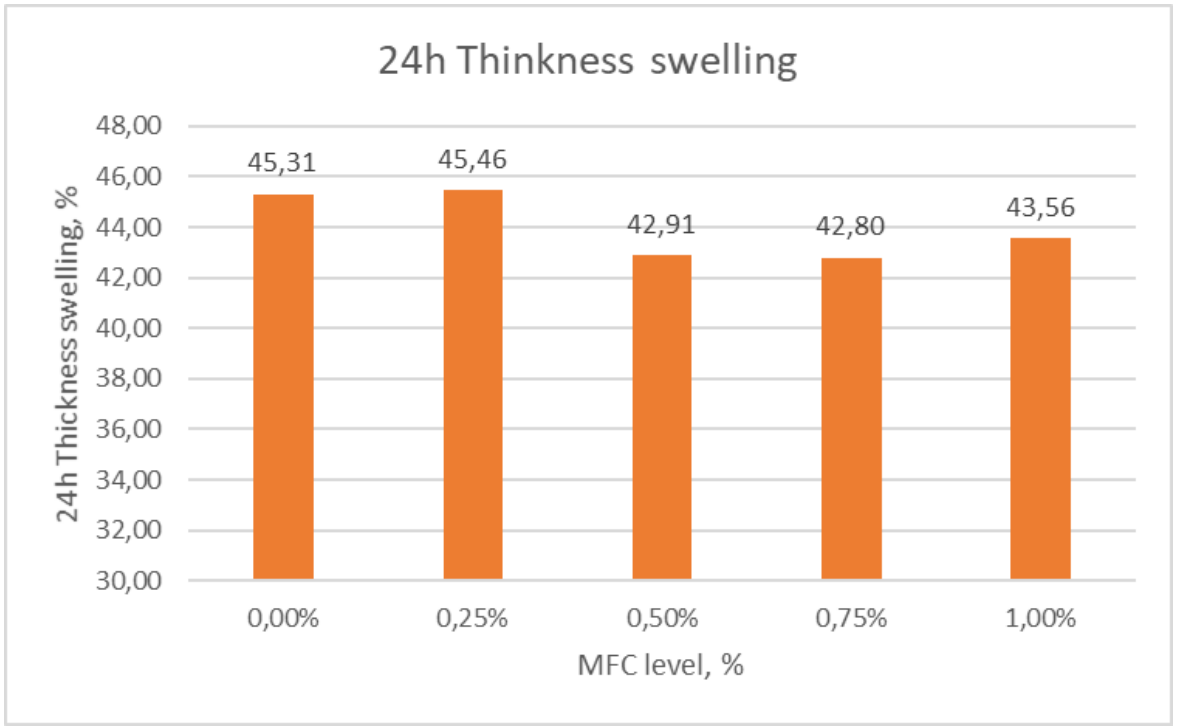


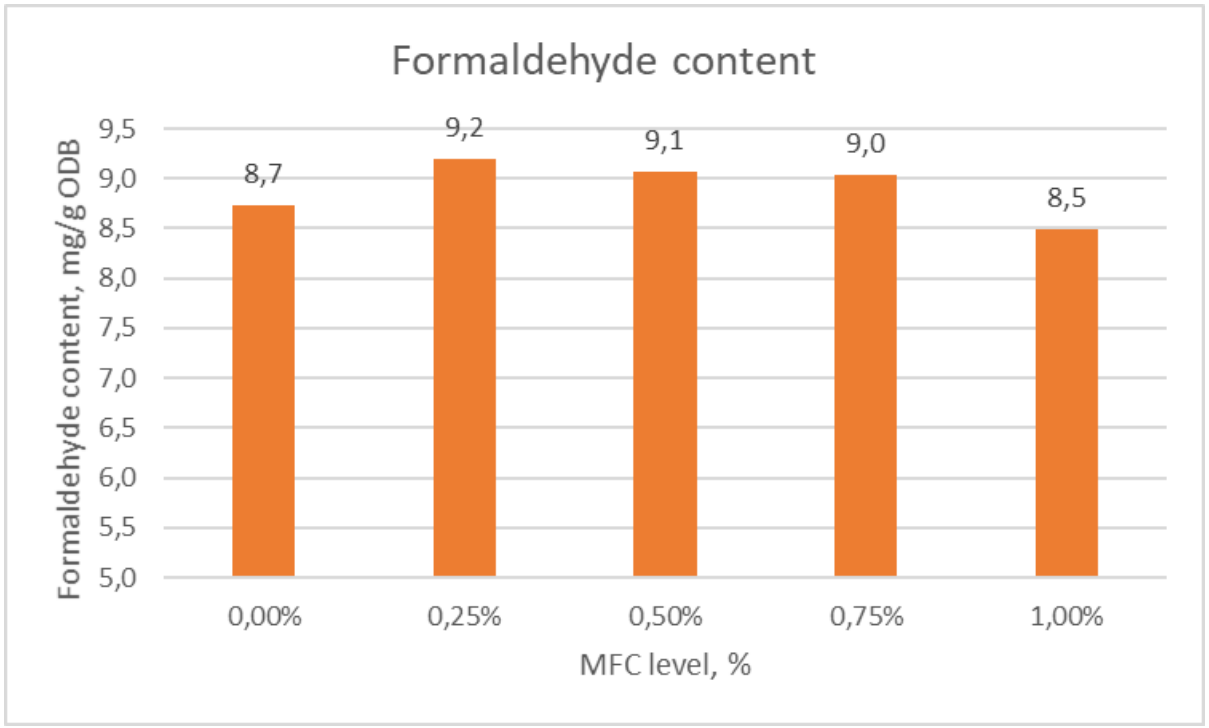


Results – Particleboard analysis

MFC 10% paste admixed with the UF resin

Increasing addition levels of MFC 10% paste / Stable resin level

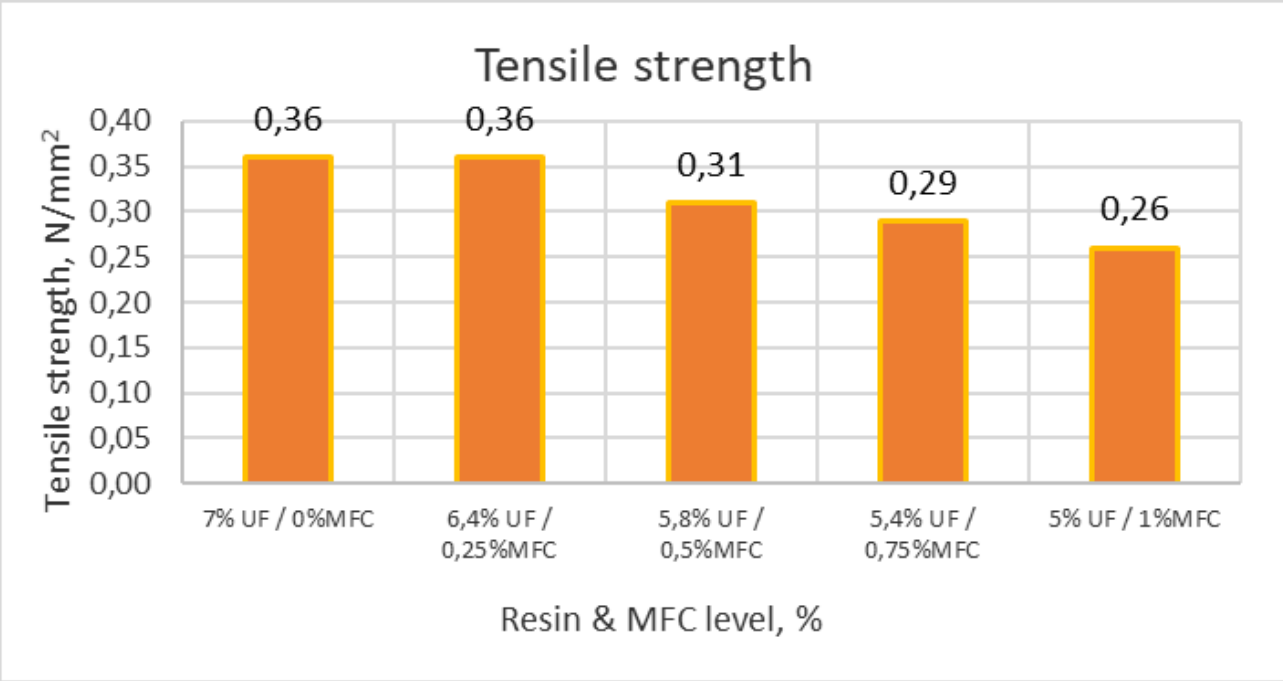


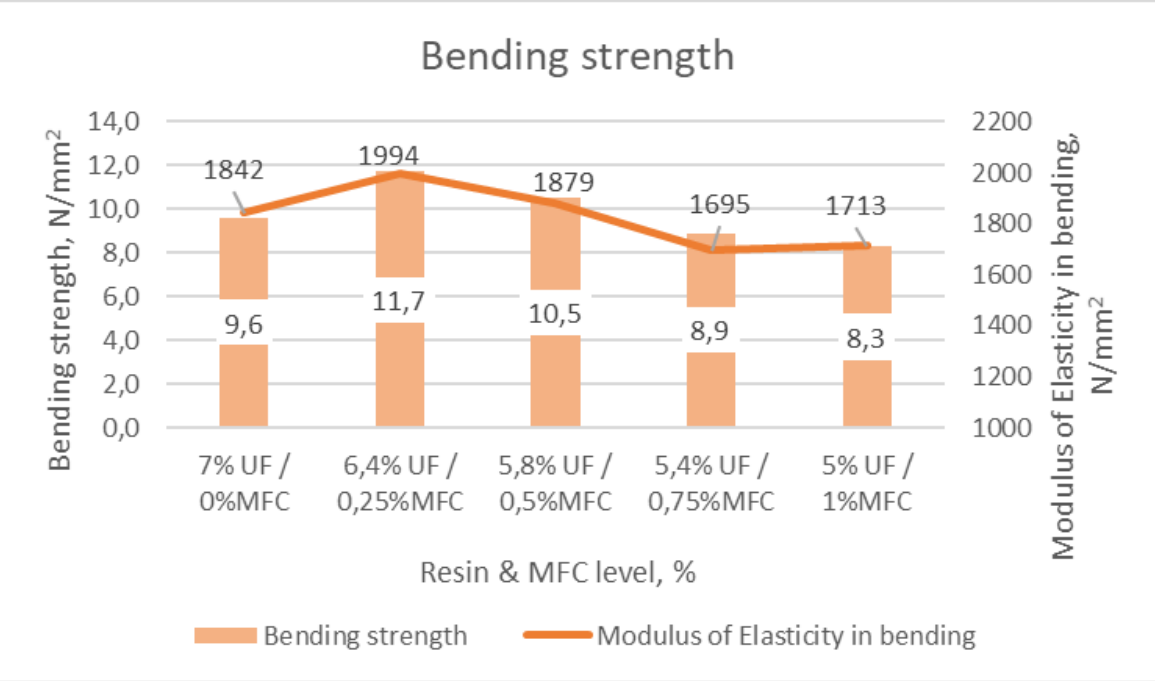


Results – Particleboard analysis

MFC 10% paste admixed with the UF resin

Increasing addition levels of MFC 10% paste / Decreasing resin level

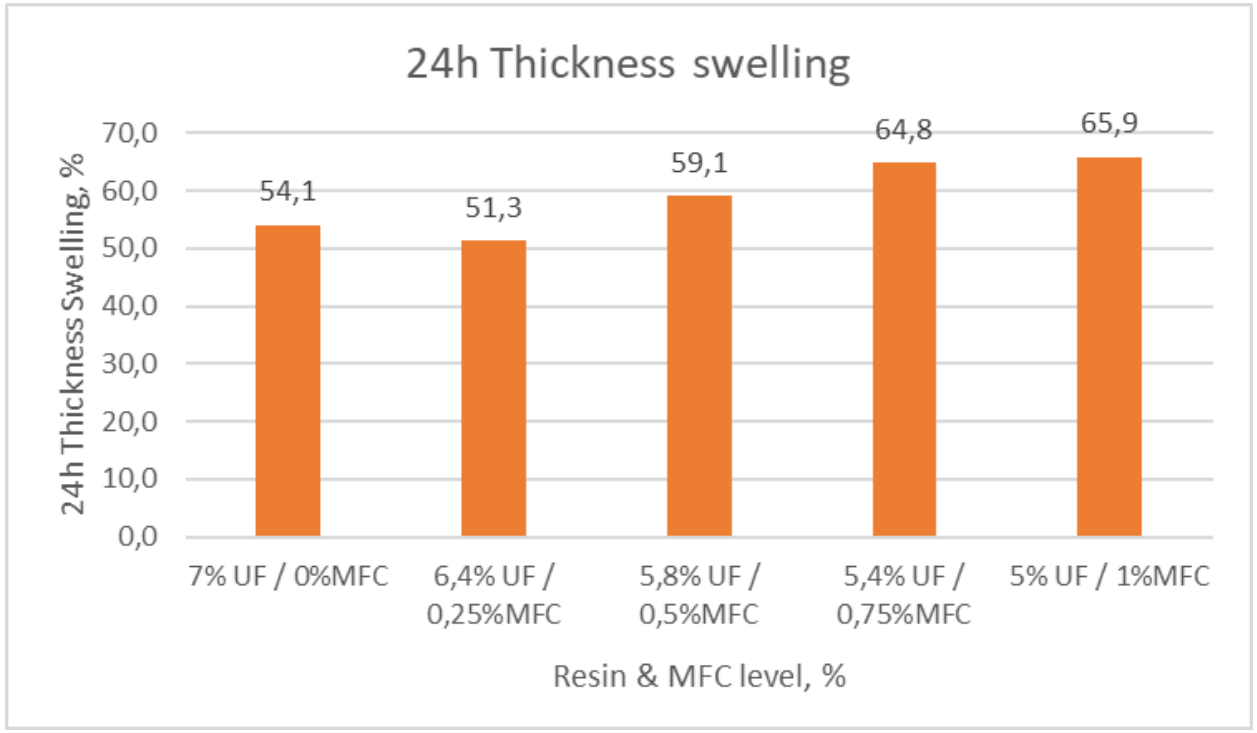


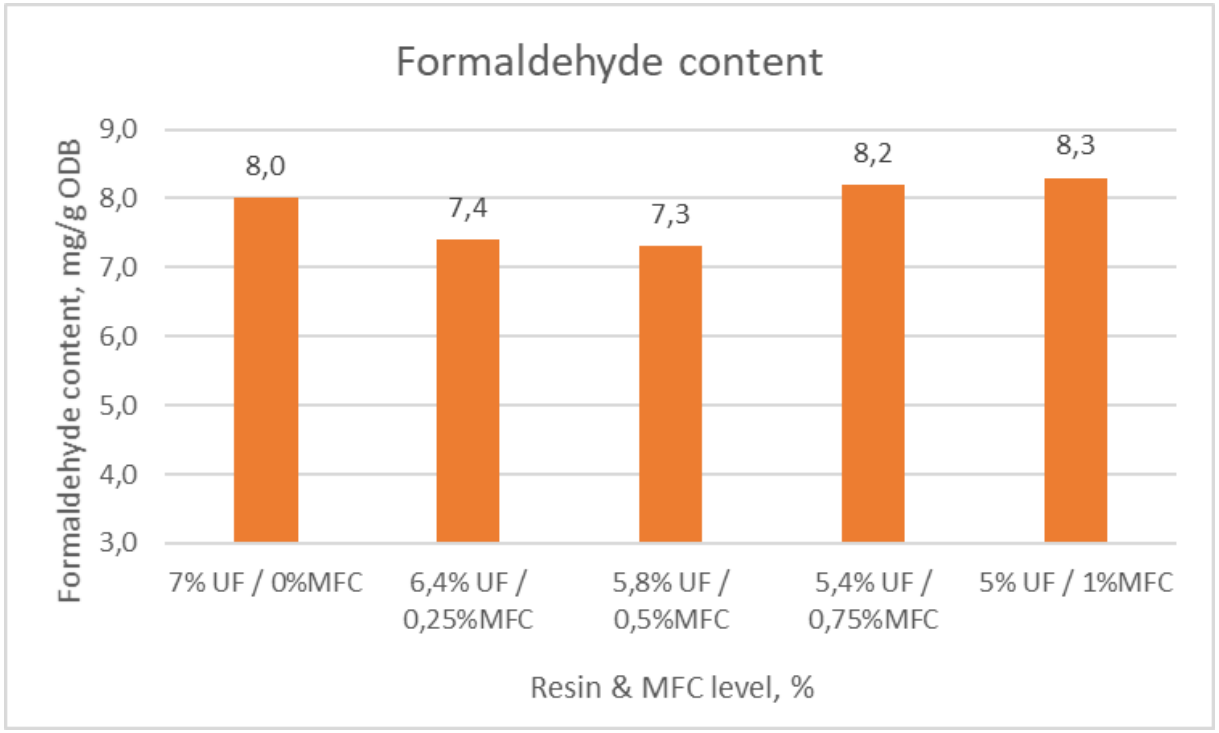


Results – Particleboard analysis

MFC 10% paste admixed with the UF resin

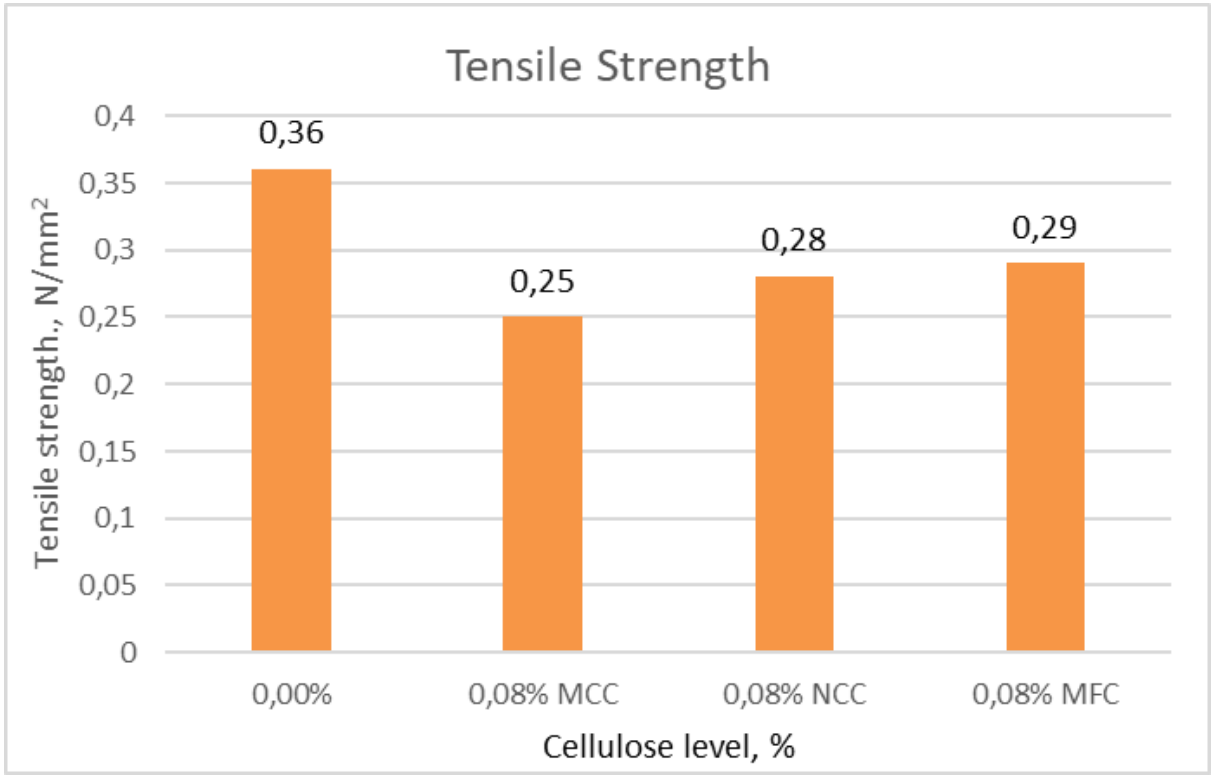
Increasing addition levels of MFC 10% paste / Decreasing resin level

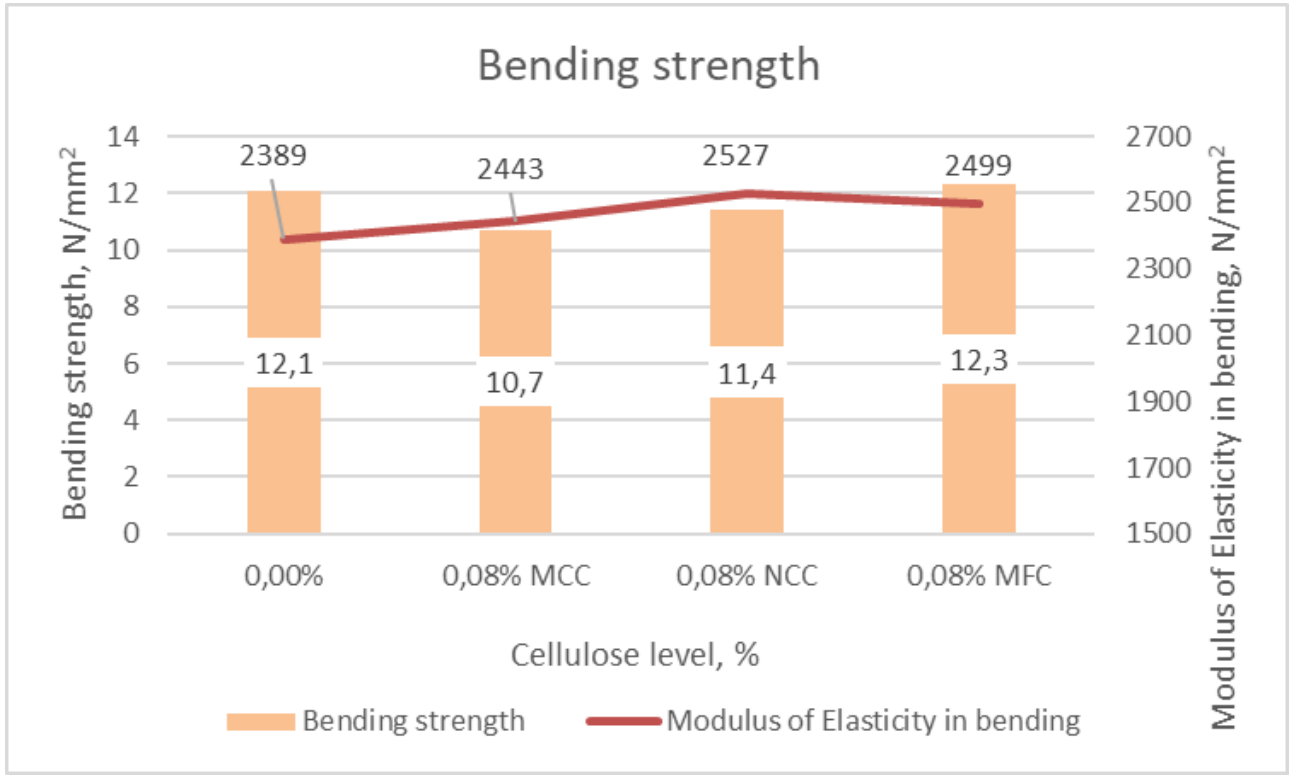




Results – Particleboard analysis (CELL4GLUE)

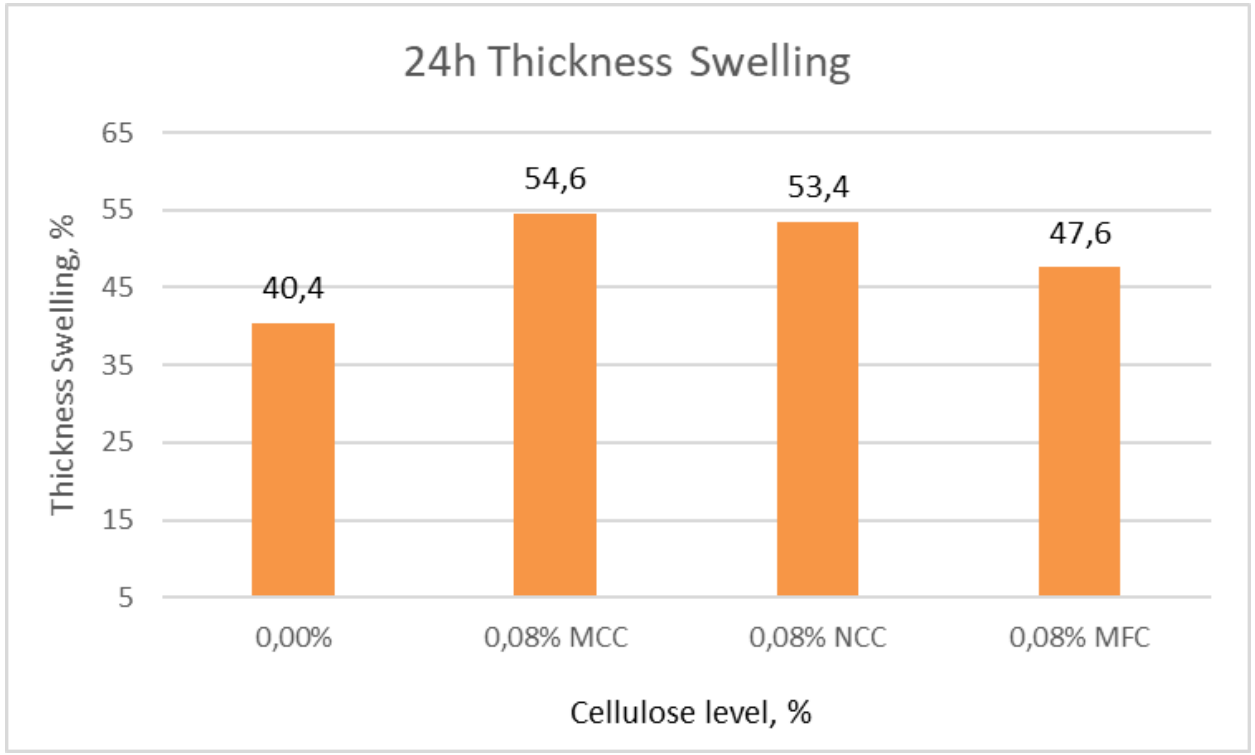
- MCC 1% suspension (65.5µm) added in UF resin during its synthesis
- NCC 1% suspension (0.17µm or 170nm) added in UF resin during its synthesis
- MFC 1% suspension added in UF resin during its synthesis

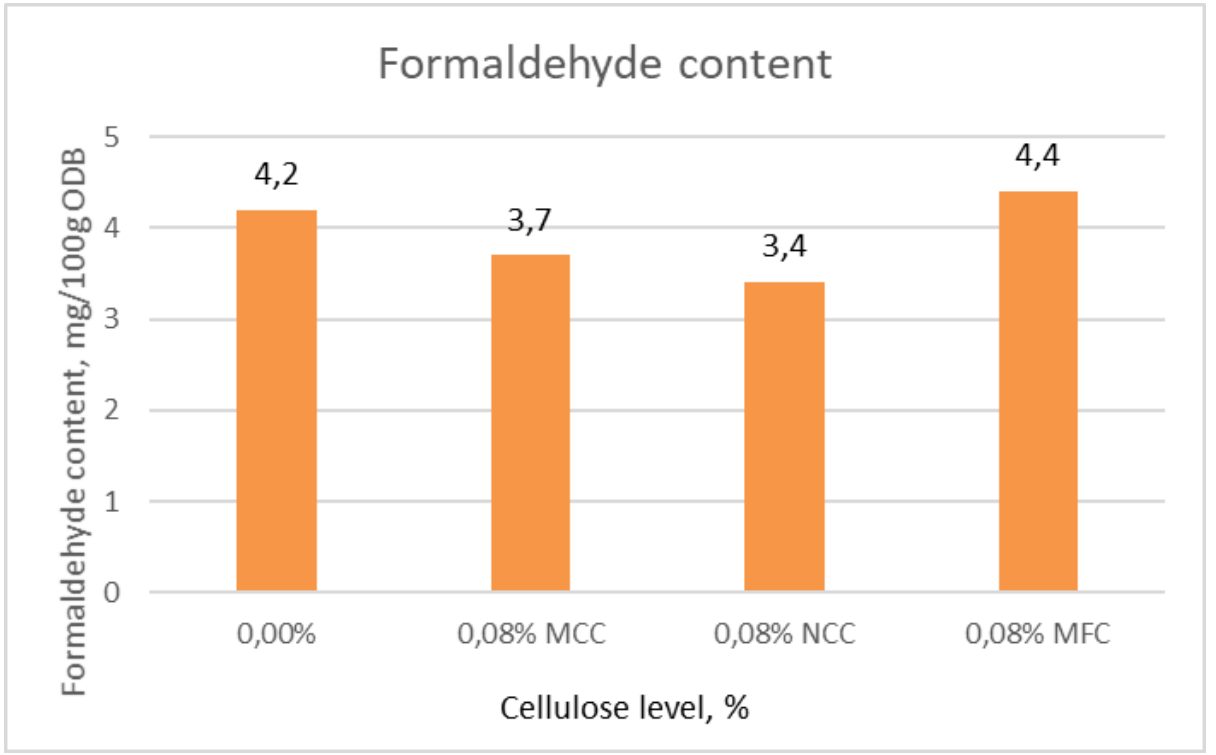




Results – Particleboard analysis (CELL4GLUE)

- MCC 1% suspension (65.5µm) added in UF resin during its synthesis
- NCC 1% suspension (0.17µm or 170nm) added in UF resin during its synthesis
- MFC 1% suspension added in UF resin during its synthesis

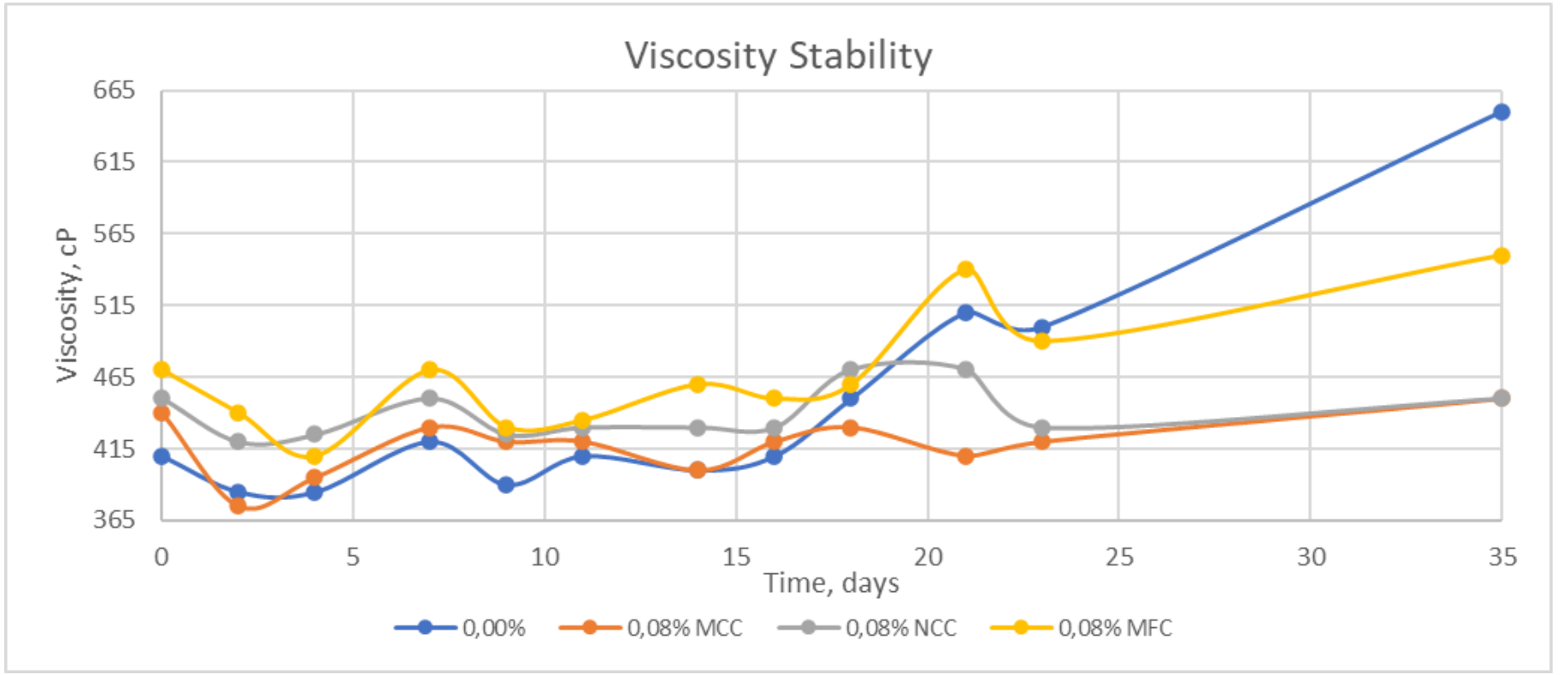




Results – Resin/Adhesive system(CELL4GLUE)

CHIMAR.

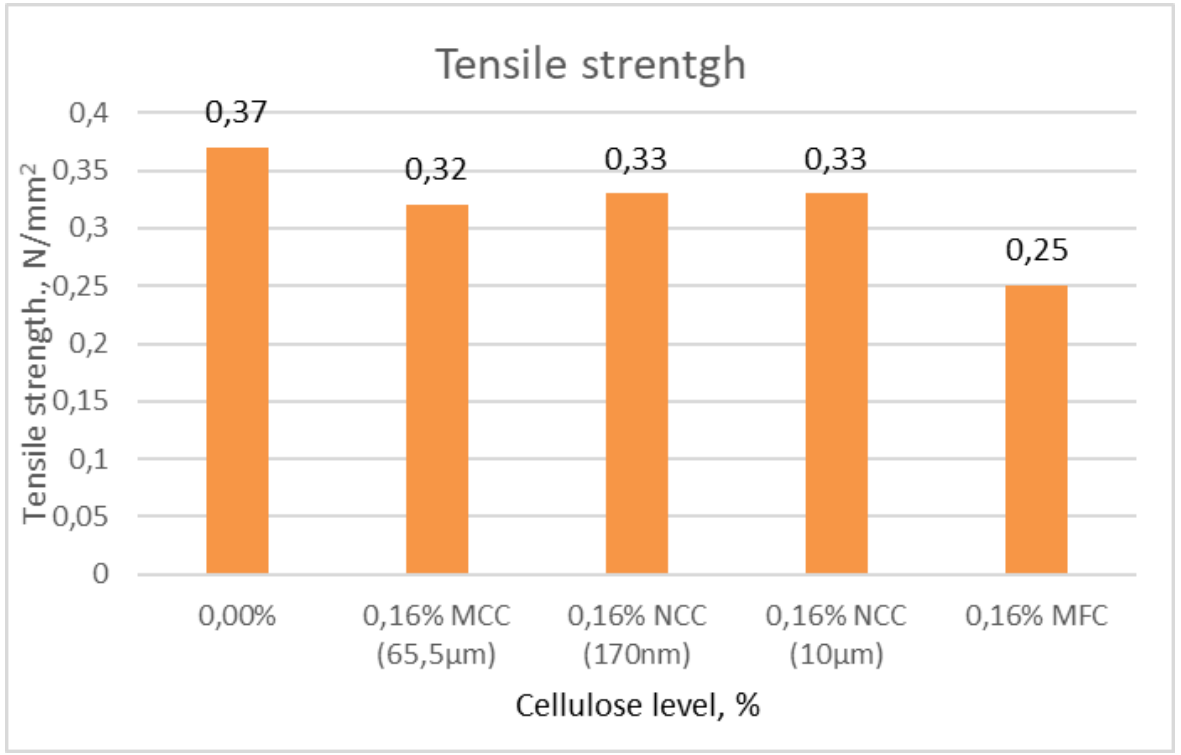
- MCC 1% suspension (65.5μm) added in UF resin during its synthesis
- NCC 1% suspension (0.17μm or 170nm) added in UF resin during its synthesis
- MFC 1% suspension added in UF resin during its synthesis

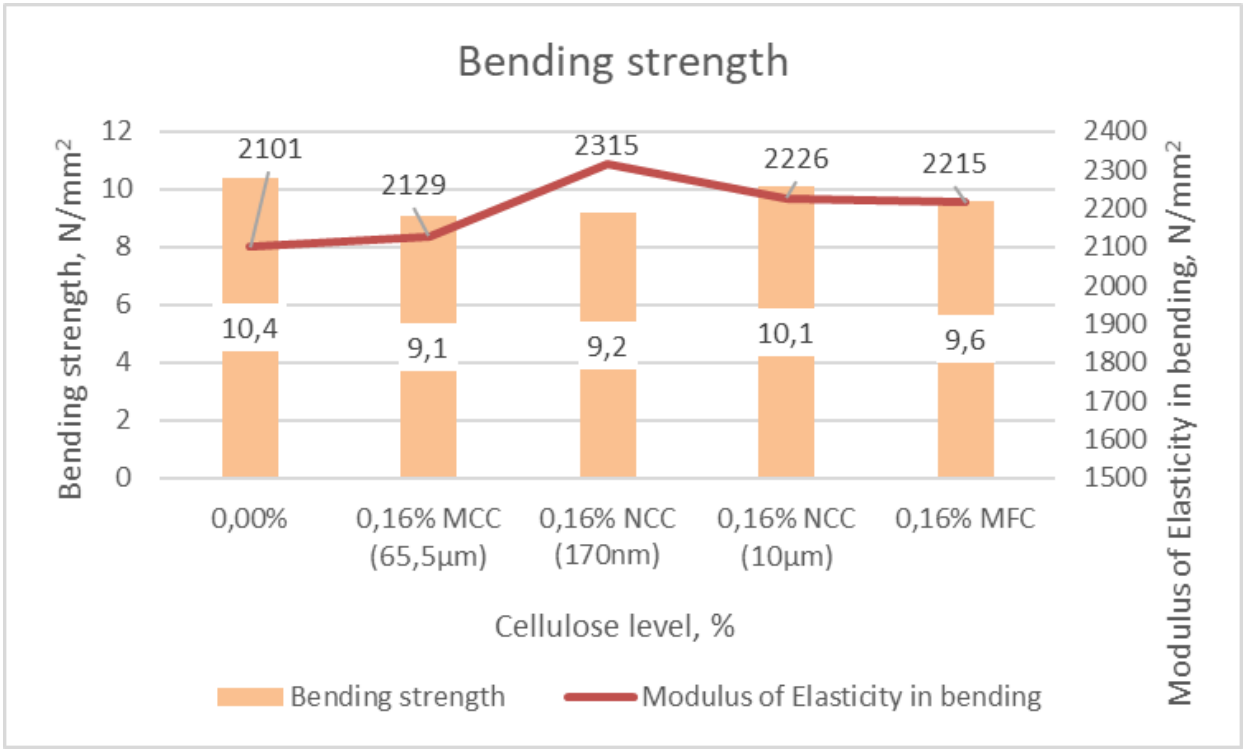


- Both MCC/NCC samples improved the resin stability against viscosity development through time

Results – Particleboard analysis(CELL4GLUE)

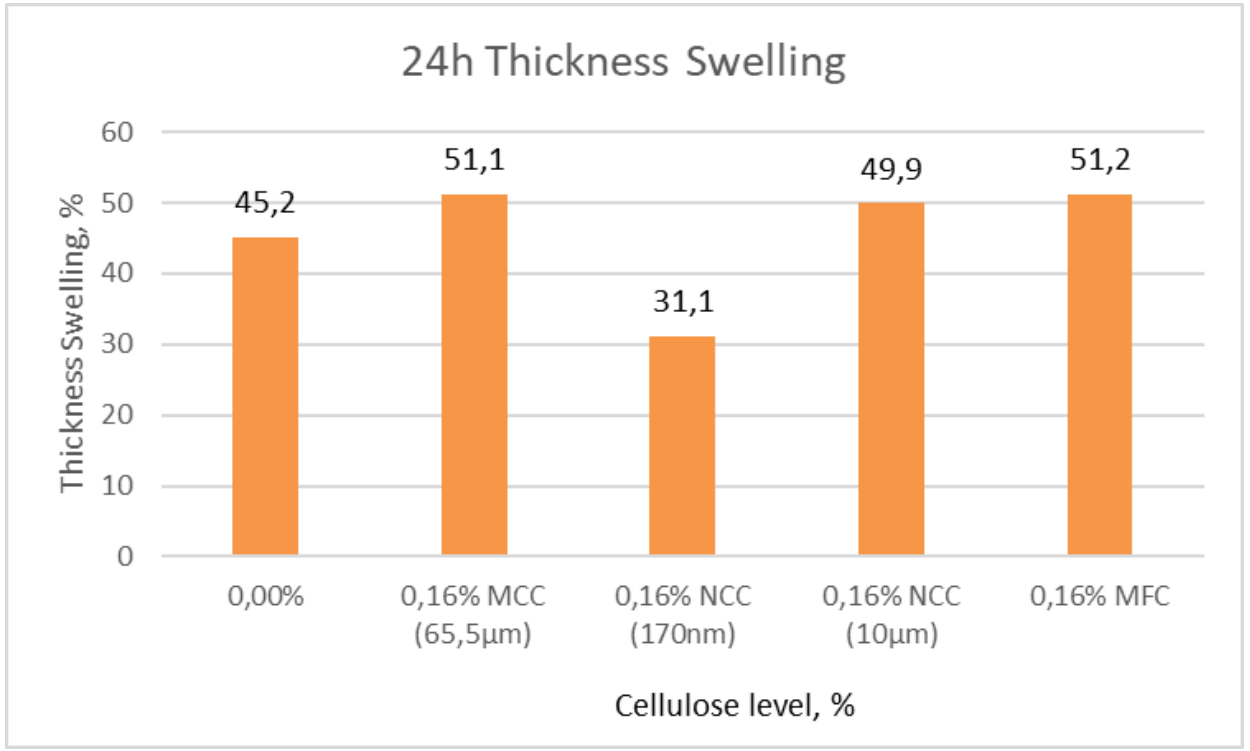
- MCC 2% suspension (65.5µm) added in UF resin during its synthesis
- NCC 2% suspension (0.17µm or 170nm) added in UF resin during its synthesis
- NCC 2% suspension (10µm added in UF resin during its synthesis
- MFC 2% suspension added in UF resin during its synthesis

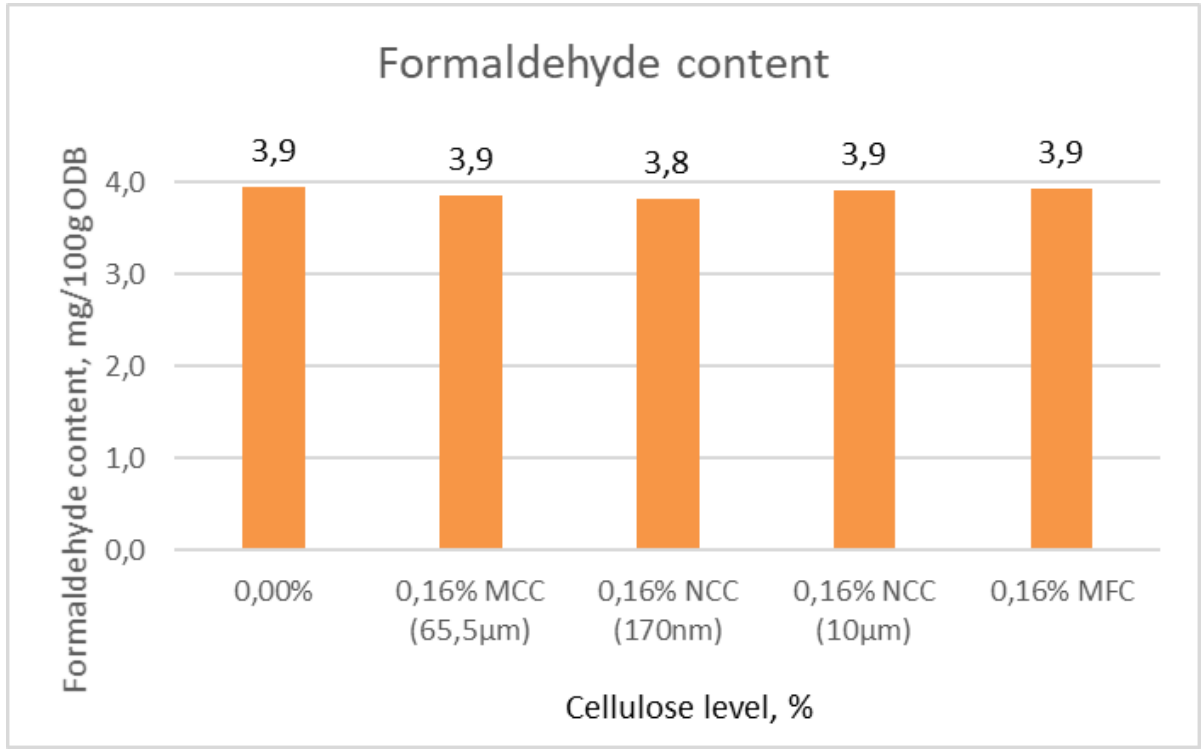




Results – Particleboard analysis(CELL4GLUE)

- MCC 2% suspension (65.5µm) added in UF resin during its synthesis
- NCC 2% suspension (0.17µm or 170nm) added in UF resin during its synthesis
- NCC 2% suspension (10µm added in UF resin during its synthesis
- MFC 2% suspension added in UF resin during its synthesis





Conclusions/Discussion

MFC

- Increases the viscosity of the resin (Approach 1) or of the glue mixture (Approach 2) but is sprayed rather easily
- When added during the resin synthesis, it impairs mechanical properties of the produced particleboards. But it improves thickness swelling and acts as a formaldehyde scavenger
- When admixed with resin during the preparation of the glue mixture, it improves the mechanical and wet properties of the produced particleboards, but does not act as formaldehyde scavenger
- Seems to maintain the performance of UF-based particleboard panels, when added upon reduction of the UF resin down to a specific level (-9%)
- Does not improve resin stability

Conclusions/Discussion

MCC/NCC (CELL4GLUE)

- Added only during resin synthesis
  - It impairs mechanical and wet properties but seems to act as a formaldehyde scavenger
  - NCC is better than MCC regarding all properties
  - MFC outperforms either MCC or NCC at all properties, when added at same levels, except for formaldehyde content, which is lower for MCC/NCC
  - When MCC/NCC are added at higher levels, the particleboard performance is improved, which is not the case when MFC level is increased. Formaldehyde content was not influenced
  - Improves resin stability

CHIMAR in brief

Core Business
Development & Application of Industrial Technology for Binders & Additives
Technical Support & Training Services for resin & panel manufacturers
R&D Services for 3rd parties
Participation in EU research projects

- ✓ Acting globally
- ✓ Helping locally
- ✓ Anticipating and addressing future needs

✓ Focus on safe, environmentally friendly products & technologies:

- technology for bio-based adhesive systems, using biomass-derived materials and biopolymers

Key figures

- ❖ **Since 1977 in 40+ countries**
- ❖ **10% of global PB & MDF production uses CHIMAR services**
- ❖ **20+ patent families in 50+ countries**
- ❖ **70 EU funded projects /networks**
- ❖ **Team of 30+**

Acknowledgements

Project Title: **Development of innovative nanocellulose-reinforced composite wood products with advanced hydrophobic and antimicrobial properties**

Project Acronym: **CELL4GLUE** Project Code: **Τ6ΥΒΠ-00341**

This study was carried out within the framework of Special Action "Industrial Materials" which is co-financed by the European Union and Greek national funds through the Operational Program Competitiveness, Entrepreneurship and Innovation (EPAnEK 2014-2020) as well as by private funds.

European Union
European Regional Development Fund

EPAnEK 2014-2020
OPERATIONAL PROGRAMME
COMPETITIVENESS • ENTREPRENEURSHIP • INNOVATION

ΕΣΠΑ 2014-2020
ανάπτυξη - εργασία - αλληλεγγύη
Partnership Agreement 2014 - 2020

Co-financed by Greece and the European Union

Thank you!!!

Contact details

CHIMAR HELLAS S.A.

15 km National road Thessaloniki-Polygyros,

P.O. Box 60666, 57001 Thermi, Thessaloniki, GREECE

+30 2310 424167

+30 2310 424149

manos.karag@ari.gr & office@ari.gr

www.chimar-hellas.com

https://www.linkedin.com/company/ari-ltd-chimar-hellas-sa/