Wood & nanotechnology

Overview of research projects

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Research projects

- **Description of each experiment**

1. ***Particleboard-MDF-OSB:*** *reducing thickness swell*

2. ***UV protection:*** *reducing discolouration on treated woods; with a nanoparticulate surface treatment*

3. ***Biological resistance:*** *vacuum treatment of wood with nanocompounds (against termites-fungi-mold)*

4. ***Plywood:*** *decreasing water swelling & increasing water repellency*

1. *Particleboard-MDF-OSB: reducing thickness swell*

- A new nanocompound was used, namely ***SurfaPore® W***
- Commercial wood-based panels were used (MDF-OSB-particleboard) in this experiment

→ The nanocompound is composed of **nano-TiO_2** and a **paraffin**, in an aqueous solution.

→ Treatment was done with a ***30 sec immersion*** of panels

→ Wood panels exhibited *minor swelling*, after treatments.

1. *Particleboard-MDF-OSB: reducing the thickness swell*

There was a reduction in the 24-hour swelling of the wood based panels

Type of wood panels	*24h Thickness swelling (%)*
PB - treated	7.56 (0.09)
- non treated	8.60 (0.07)
OSB - treated	7.40 (0.05)
- non treated	8.21 (0.06)
MDF - treated	4.97 (0.04)
- non treated	5.75 (0.10)

Reducing the thickness swelling of wood based panels by applying a nanotechnology compound

by George I. Mantanis and Antonios N. Papadopoulos (TEI of Kavala, Greece)

Abstract

The potential of improving the thickness swelling of commercial wood based panels by applying a new nanotechnology compound was investigated. The application of the compound SurfaPore W an aqueous wood-water repellent resulted in a significant improvement in the thickness swelling of the panels tested. The application was done by immersion of wood panels in a bath for 30 sec in order to achieve a surface treatment. This treatment resulted in an decrease in the thickness swelling, namely 13.6% decrease in MDF panels, 12.1% decrease in the particleboard panels and the lowest, 9.9% decrease in the OSB panels.

Key words: nanotechnology, swelling, dimensional stability, wood based panels.

In: Eur. Wood J. (2010), 68: 237-239

2. *UV protection: reducing discolouration on treated woods, with a nanoparticulate surface treatment*

- A new nanoparticulate ***Hombitec RM*** was used. This is a proprietary product by German ***Sachtleben S.A.*** company

- Wood species: European pine (*Pinus sylvestris*), Bosnian pine (*Pinus leucodermis*), Greek fir (*Abies cephalonica*), chestnut (*Castanea sativa*), cherry (*Prunus avium*)

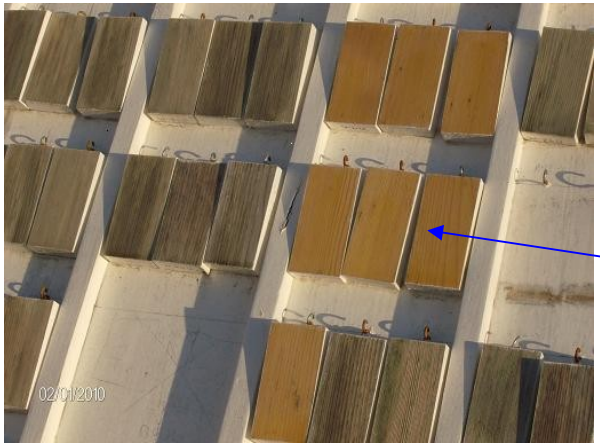
→ Surface soaking in a bath for ***30 sec time***

→ Conditioning for a week, to normal climatic conditions before the UV testing

2. *UV protection: reducing discolouration on treated woods, with a nanoparticulate surface treatment*

*Wood surfaces have been treated **by immersion**, with this aqueous nanoparticulate.*

*The samples were both tested **in outdoors**, but also **in chamber** with artificial UV irradiation.*



Surface colour characteristics of untreated and anti-UV treated wood measured by CIE (1976) colour system

Species	ΔL	% Improvement	Δa	% Improvement	Δb	% Improvement
Cherry (Cont)	-9.57	79.4	4.86	91.6	9.8	107.9
Cherry (Trt.)	-1.97		0.41		-0.78	
Chestnut (Cont)	-4.85	4.32	2.04	57.8	8.23	129.6
Chestnut (Trt)	-4.64		0.86		-2.44	
Bosnian Pine (Cont)	-6.30	10.6	3.01	14.6	2.69	78.0
Bosnian Pine (Trt)	-5.63		2.57		0.59	
European Pine (Cont)	-5.95	48.1	2.68	45.5	8.37	61.3
European Pine (Trt)	-3.09		1.46		3.24	
Greek Fir (Cont)	-5.12	52.9	1.58	35.8	9.26	60.1
Greek Fir (Trt)	-2.41		1.05		3.69	

Surface yellowness characteristics of wood measured by ASTM-D

Wood species	*Yellowness Index*
Cherry (Cont)	26.64
Cherry (Trt.)	**0.58**
Chestnut (Cont)	20.13
Chestnut (Trt)	**0.45**
Bosnian Pine (Cont)	12.01
Bosnian Pine (Trt)	**7.61**
European Pine (Cont)	18.49
European Pine (Trt)	**8.16**
Greek Fir (Cont)	19.01
Greek Fir (Trt)	**8.28**

Colour changes in wood surfaces modified by a nanoparticulate surface treatment

by Turgut Sahin (SDU, Turkey) and George I. Mantanis (TEI Larissa, Greece)

Summary

The colour changes in wood surfaces of European pine, fir, Bosnian pine, chestnut and cherry, which had been modified by a new nanoparticulate treatment were studied in here. The results have shown a certain effectiveness of the anti-UV surface treatment used; however it is necessary to employ some stabilizers to inhibit this discolouration for specific wood species, namely Bosnian pine.

However, wood discolouration appears to be a phenomenical issue and not well understood for most wood species. To determine the causes of discolouration one has to understand factors such as extractives composition, temperature, humidity, light and storage conditions. However, discolouration is merely an indication of a chemical modification, which does not itself affect all of the colour properties of wood.

Keywords: *wood, ultraviolet radiation, nanoparticulate based treatment, European pine (Pinus sylvestris), Bosnian pine (Pinus leucodermis), Greek fir (Abies cephalonica), chestnut (Castanea sativa), cherry (Prunus avium)*

*In: **Wood Research (2011), in press***

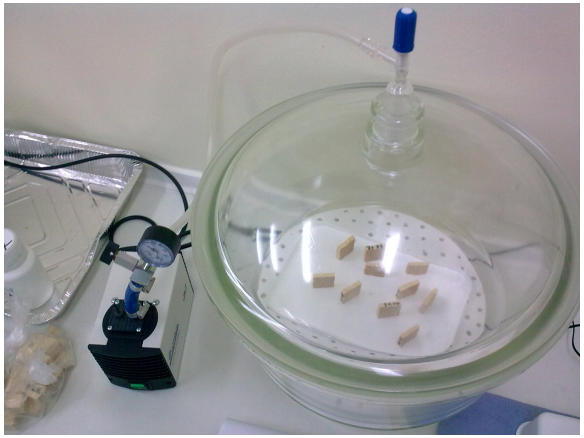
3. *Biological resistance:* ***vacuum treatment of wood with nanocompounds*** *(against termites-fungi-mold)*

- New formulations of nanocompounds being investigated based on **nanozink** and **nanoboron**; this is done in cooperation with the Greek R&D ***NanoPhos S.A.***

- Wood species: Black pine (*Pinus nigra* L.*)*

→ **Vacuum treatments** of wood for ***5-10 min time***

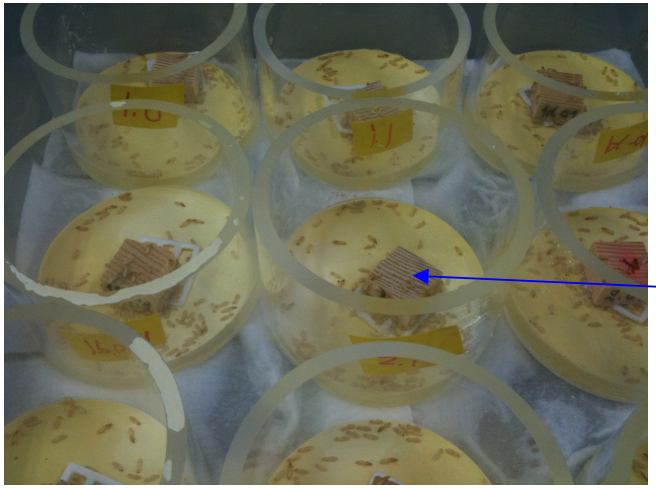
→ High pressure (7 bar) trials also running



3. *Biological resistance:* ***vacuum treatment of wood with nanocompounds***

Wood blocks have been treated ***in vacuum****; 4 different nanocompound formulations*

The effect of using ***special binders*** *in formulation is done successfully yielding* ***less leaching*** *in treated wood*



Termite test

Preliminary termite resistance test results for wood specimens

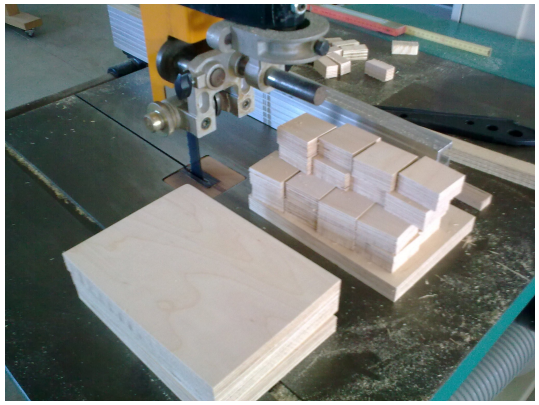
	Wood Specimens	Mass loss (%) Average	Std Dev
	Control		
LEACHED SPECIMENS	0	*23,30*	*3,16*
	1	*5,50*	*0,24*
	1a	*7,47*	*1,11*
	1b	*6,86*	*0,70*
	2	*5,43*	*0,16*
	2a	*5,26*	*0,76*
	3	*11,96*	*1,63*
	3a	*12,68*	*1,20*
	3b	*17,08*	*1,26*

*In: **Eur. Wood J. (2012)** to be submitted*

4. *Plywood: decreasing water swelling and increasing water repellency*

- A new nanocompound ***SurfaPore F*** was used.
- Commercial plywood panels from ***FinnForest S.A.*** were used in this experiment
- Plywood type: ***exterior grade***; Species: 7-ply ***Spruce &*** 15-ply ***Birch***

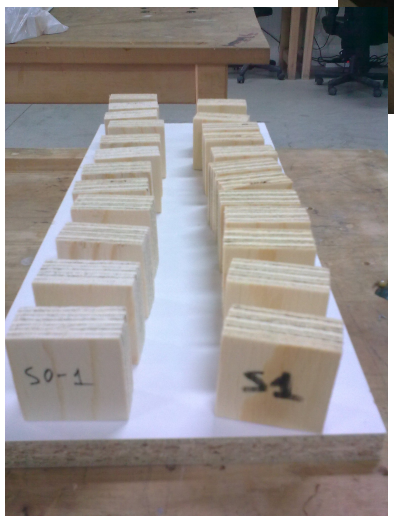
→ **Wood surface treatments** for **30 sec**



4. Plywood: decreasing water swelling

2-hour thickness swell

- Spruce plywood, after treatment had **32%** less swelling (1.91% vs. 1.30%)
- Birch plywood, after treatment had **50%** less swelling (1.69% vs. 0.84%)
- Both plywood types, after 24 hour swelling showed **almost the same** swelling behaviour



4. *Plywood: increasing water repellency of surface*

Water absorption after spraying

100 ml of water was sprayed on surfaces

- *In **Spruce plywood** there was: 7-8 times of increase in repellency*
- *In **Birch plywood** there was: 4 times of increase in repellency*

Thanks for your attention !