WOOD-BASED PANELS WITH IMPROVED SURFACE PROPERTIES

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Market trends

Furniture, kitchen and bathroom cabinets and tops → **durability + new properties like high aesthetic appearance, waterproof and oleophobic performance[1].**

Products with new properties mostly on the surface.

The demand is greater mostly for products with green materials. Generally the demand for environment friendly, non-hazardous, VOC complaint green coatings for various applications (architectural, automotive, wood, packaging, etc.) has increased since the last decade. In **2013**, the global green coatings demand was estimated to be worth nearly **$64.2 billion** and is expected to reach **$85.7** billion by **2018** at a CAGR of 5.9% from 2013 to 2018[2].

1. http://www.coatingsworld.com/issues/0214/view_features/the-wood-coatings-market-144259/#sthash.6dOmLODD.dpuf
2. http://www.marketsandmarkets.com/Market-Reports/green-coatings-market-1260.html

New achievements

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NanoPhos
Pioneering
Nanotechnology

Urea – Formaldehyde and Melamine – Formaldehyde resins enhanced with nanoadditives suitable to give both hydrophobic and oleophobic properties to lignocellulosic materials (wood-based panels and papers for lamination).

Particleboards – nanomaterials in resin

Target: improved **water repellency throughout the panel**

How: Urea – Formaldehyde resin + 3 types of nanomaterials (at the levels of 0.5% s/dry wood) ,

Single-layer particleboards - typical production conditions.

Testing of panels:

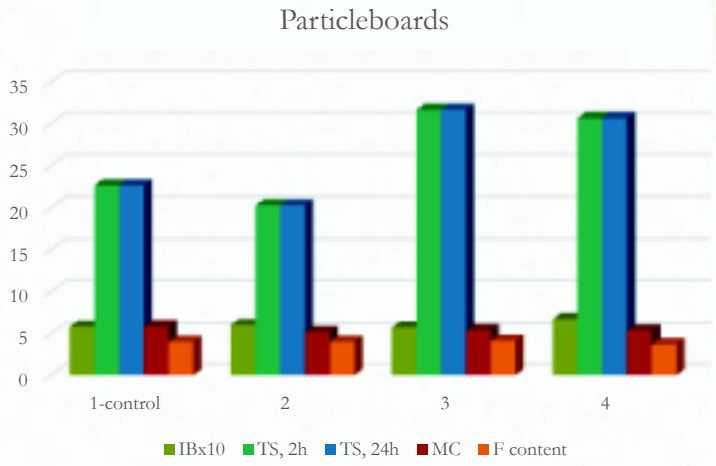
- Internal Bond: EN 317:1993
- Thickness swelling: EN319:1993
- Moisture content: EN 322:1993
- Formaldehyde content: EN 120:1992

The most promising ones were studied for their waterproof properties by **contact angle measurements, weather artificial tests** (**QUV**) according to EN 11507 and evaluation tests for the **effectiveness of water repellent coatings (WRE)** according to ASTM D5401.

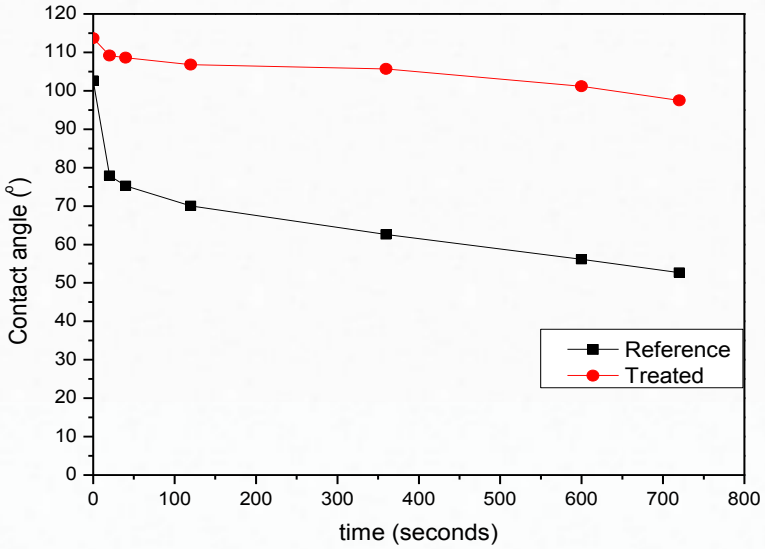
Particleboards – testing results (1)

Formula			1-control	2	3	4
Resin Type			UF	UF	UF	UF
Sample No			Wax	A	B	C
	Unit	Value				
Internal Bond (EN319:1993)	N/mm^2	Ave	0.58	**0.60**	0.57	**0.67**
		SD	*0.06*	*0.07*	*0.04*	*0.07*
Thickness Swelling 2h, 20°C	%	Ave	22.67	**20.28**	31.69	30.69
		SD	*1.79*	*1.51*	*1.12*	*1.58*
Thickness Swelling 24h, 20°C (EN317:1993)	%	Ave	41.94	**37.97**	42.25	38.48
		SD	*2.80*	*1.83*	*2.64*	*2.20*
Absorption 24h, 20°C	%	Ave	**104.99**	113.88	115.00	116.28
		SD	*3.44*	*7.38*	*6.14*	*5.98*
Moisture content (EN322:1993)	%		5.82	**5.15**	5.38	5.34
Perforator value (EN120:1992)	mg/100g		4.00	3.99	4.10	**3.69**
Formaldehyde content 6.5% MC	mg/100g		4.35	4.69	4.69	4.24

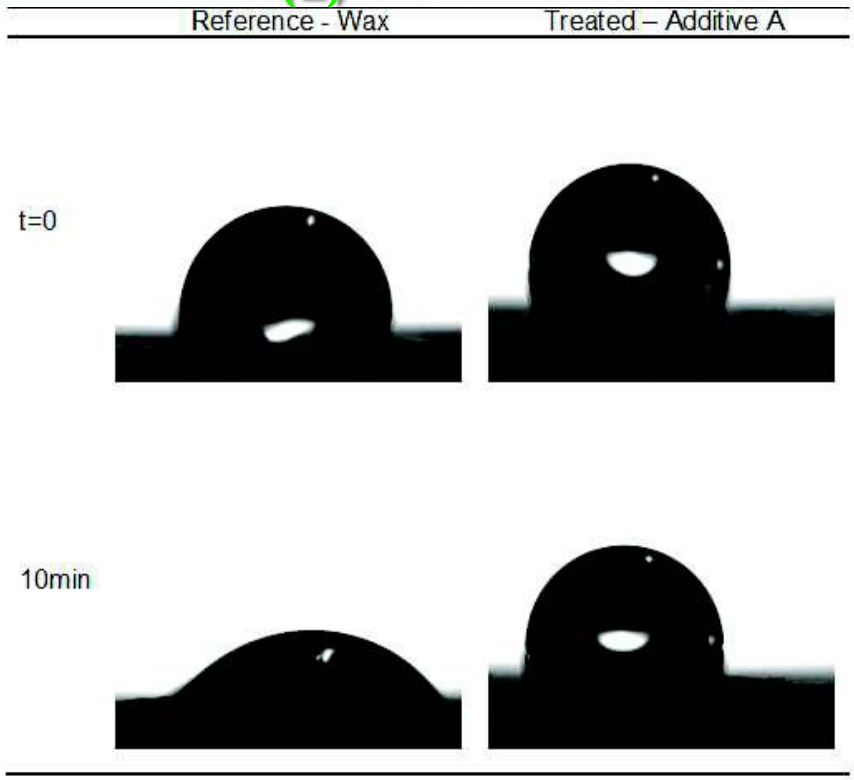
Outcome: ***Sample A*** *had the lowest thickness swelling values while the performance of the other properties remained close to the control (wax).*



Particleboards – testing results (2)

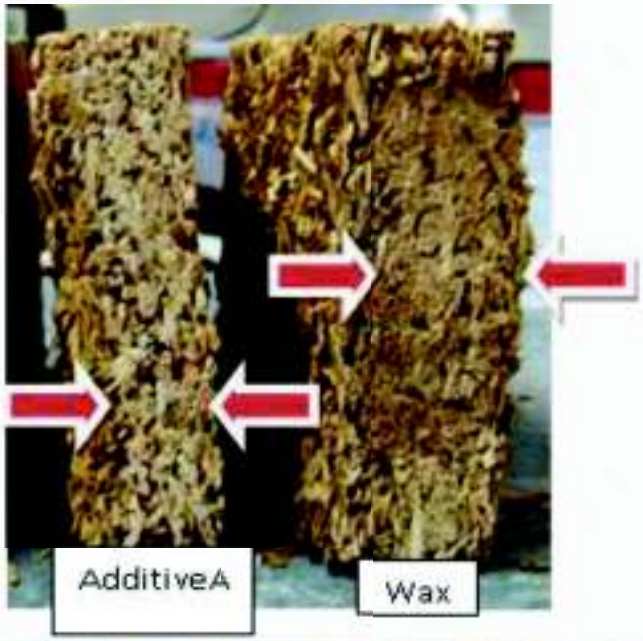


Contact angle measurements of reference panel and the treated panel



Photos of the water droplet during the measurement

Particleboards – testing results (3)



The QUV test showed that the panel with wax (control) is extensively damaged, while the swelling of the other sample with the additive A is in acceptable range of values.

Particleboards – testing results (4)

The results of the water repellency efficiency tests of the panels according to the ASTM D5401 are presented in the following table. It is obvious that the A nanoadditive increases the WRE of the panel.

	mass before floating (gr)	mass after floating (gr)
Reference (Wax)	48,8	54,28
Treated Additive A	46,38	51,59
	WRE =	4,93%

Particleboards – nanomaterials on coating

Four samples of emulsified nanomaterials were tested as coating materials of commercial particleboards.

The same quantity of solid material per cm^2 was applied at each panel.

The particleboards were allowed to dry at room temperature for 15h before subjected to testing for water absorption(standard AS 4266.12) and thickness swelling (EN 317: 1993).

Particleboards – coating - results

Test of 2h and 24h Swelling & absorption

Sample	2h swell (%)	24h swell (%)	Absorption %	Density kg/m³
A	**18.13**	**21.65**	97.07	653
B	18.68	22.26	96.24	662
C	19.28	22.69	96.24	667
D	20.65	25.02	**94.66**	691
Blank	21.96	25.70	96.95	689

Outcome: All samples had close performance at thickness swelling tests. Sample D had superior performance at absorption test.

Paper impregnation-preparation

Five samples of nanomaterials were tested as additives in a Melamine – Formaldehyde (MF) resin suitable for paper impregnation.

The addition level was 5% w/w.

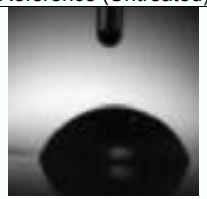
The papers were subjected to double impregnation. After each cycle they were oven dried (130°C) for 2 min.

The resin with nanomaterials was used only in the 2nd bath.

The impregnated papers were used for commercial MDF lamination.

The final panels were tested for their water and oil repellency properties by contact angle measurements and visual inspection.

Paper impregnation – hydrophobic performance

	Reference (Untreated)	Treated
t=0		
1min		
10min		
20min		

Contact angle measurements of water droplets

	time (min)						
	0	1	2	5	10	15	20
Reference	69.32	67.35	66.11	62.72	58.4	49.44	46.81
Treated (sample No 4)	102.41	101.37	99.04	97.00	93.31	89.25	83.45

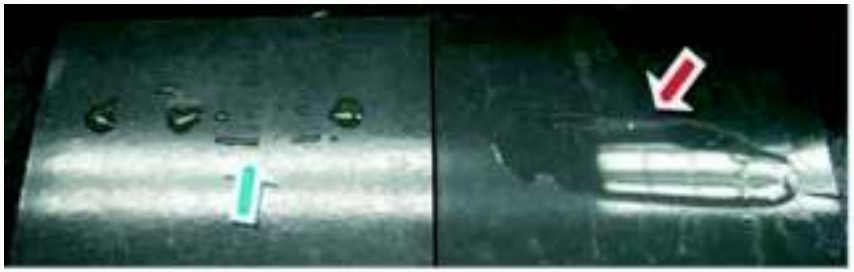
Photos of water droplet during the measurement of the untreated and treated panel.

Paper impregnation – oleophobic performance

The best sample

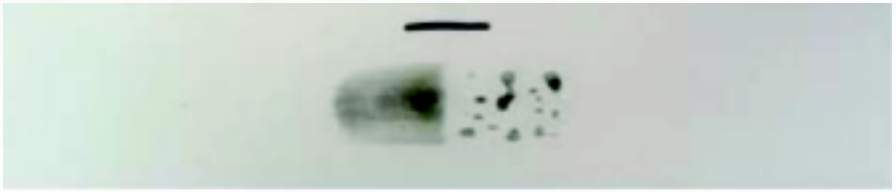
Contact angle measurements of oil droplet

	time (min)			
	0	1	10	20
Reference	13.32	13.21	10.74	8.28
Treated (sample No 4)	67.00	64.84	63.89	61.08



Photos of the treated surface (left) and untreated surface (right).

<u>Outcome:</u> Such systems can render both hydrophobic and oleophobic anti-finger print performance to papers impregnated with them.



Photos of untreated surface (left) and treated surface (right).

Overall outcome

The production of wood-based panels with improved water and oil repellency properties is practically easy and feasible.

The new products offer surfaces with improved properties and have lower need for maintenance through their life time.

Such resin – nanoadditives systems are ready for the market.

CHIMAR Activities in Brief

- ✓ Developer and supplier of industrial technology and services in the field of adhesive systems for wood based panels.
- ✓ Focus on safe, environmentally friendly products and technologies. Technology for bio-based adhesive systems.
- ✓ Pioneer in the reduction of formaldehyde emission from wood panels (technology for emission at the level of natural wood).
- ✓ Engineering & equipment procurement services for formaldehyde/UFC/resin/chemical additives plants
- ✓ Versatility of services: R&D for third parties, Testing and evaluation, Technical support for field industries (remotely and on-site), Consulting and Training, Chemicals production on demand, Accredited formaldehyde testing (EN ISO/IEC 17025), Patent services, Industrial Equipment Representation.

Acting globally and helping locally

CHIMAR in figures

- ✓ SME company located in Greece.
- ✓ 26 people strong team of chemists, chemical/electrical & computer engineers, forest and wood scientists, petroleum technologist, finance & business administration.
- ✓ Annual resin capacity following CHIMAR K-H exceeds 1,000,000tons.
- ✓ More than 15,000,000m^3 of wood-based panels are manufactured annually using the technology of CHIMAR.

37 Years Expertise in 40 Countries

Indicative references

- Hadjilucas
- Sapemus
- Kronospan Bulgaria
- Flakeboard
- Duraplay
- Alto Parana
- GPC Química
- Wood Chemicals P.G. Bison
- Karpatsmoly
- Borg Group
- Finsa
- Tableros de Aglomerado
- UPM
- Forestal
- Borisov

Thank you very much

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