NEW TRENDS IN WOOD ADHESIVE TECHNOLOGY

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INTRODUCTION

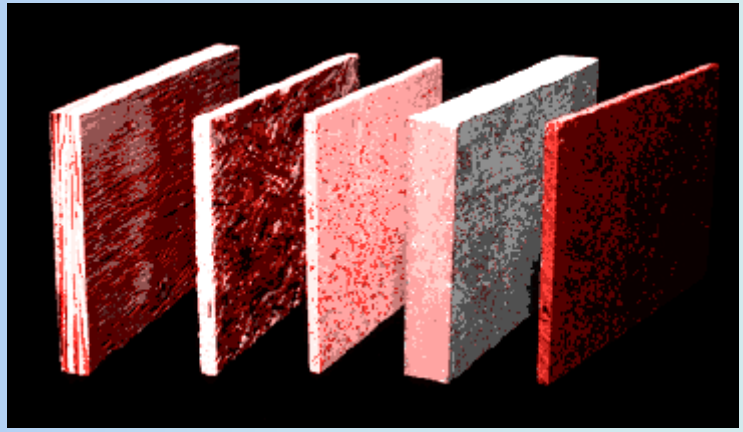
WOOD ADHESIVE TECHNOLOGY :

•The recorded history of bonded wood dates back at least 3,000 years to the Egyptians, and adhesive bonding goes back to early mankind
(Skeist, I. and Miron, J. (1990). Introduction to adhesives. In: Skeist, I. (Ed.), *Handbook of Adhesives.* (3rd)
Van Nostrand Reinhold, New York, chap 1.)

•The conventional wood-based composite products are typically made with a thermosetting or heat-curing resin or adhesive that holds the lignocellulosic (wood) fibre together.

•Wood composites are grouped into three general categories: plywood, particle and fibre composite

•Commonly used resin–binder systems include phenol-formaldehyde, urea-formaldehyde, melamine-formaldehyde, and isocyanate.



Examples of various wood composite products. From left to right: plywood, OSB, particleboard, MDF, and hardboard.

FORMALDEHYDE BASED ADHESIVE RESINS

- FORMALDEHYDE BASED ADHESIVE RESINS REPRESENT BY FAR (>95%) THE BIGGEST VOLUMES WITHIN THE WOOD ADHESIVES

✓UF RESIN ADHESIVES: 85%

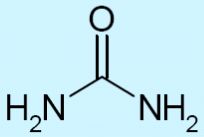
✓MELAMINE BASED RESIN ADHESIVES: 10%

✓PHENOL BASED RESIN ADHESIVES: <5%

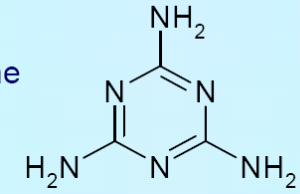
Condensation resins based on formaldehyde are formed by the reaction of formaldehyde with various chemicals like urea, melamine, phenol or combination of these substances.

Monomers:

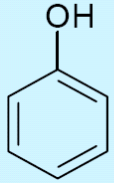
Urea



Melamine



Phenol



Formaldehyde

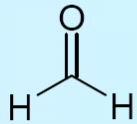


Table 1. Overview on formaldehyde based glue resins.

UF	urea-formaldehyde-resin
MF	melamine-formaldehyde-resin
MUF	melamine-urea-formaldehyde cocondensation resin
mUF	melamine fortified UF-resins
MF+UF	mixture of a MF- and an UF-resin
MUPF, PMUF	melamine-urea-phenol-formaldehyde resin
PF	phenol-formaldehyde resin
PUF	phenol-urea-formaldehyde resin

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ADVANTAGES AND DISADVANTAGES OF THE THREE MAJOR CATEGORIES OF FORMADELHYDE BASED ADHESIVES

Property	Type of adhesive		
	UF	MF	PF
Price	*Low*	*High*	*Medium*
Necessary hardening temperature	*Low*	*Medium*	*High*
Press time	*short*	*Medium*	*Medium to Long*
Susceptibility against wood species	*High*	*Medium*	*Low*
Efficiency	*Low*	*Medium to High*	*Medium to High*
Manipulation	*Easy*	*Easy*	*Easy*
Resistance against hydrolysis	*No*	*High*	*High*
Use in humid conditions	*No*	*Yes*	*Yes*
Formaldehyde emissions	*E1*	*Ezero*	*More or less no emissions*

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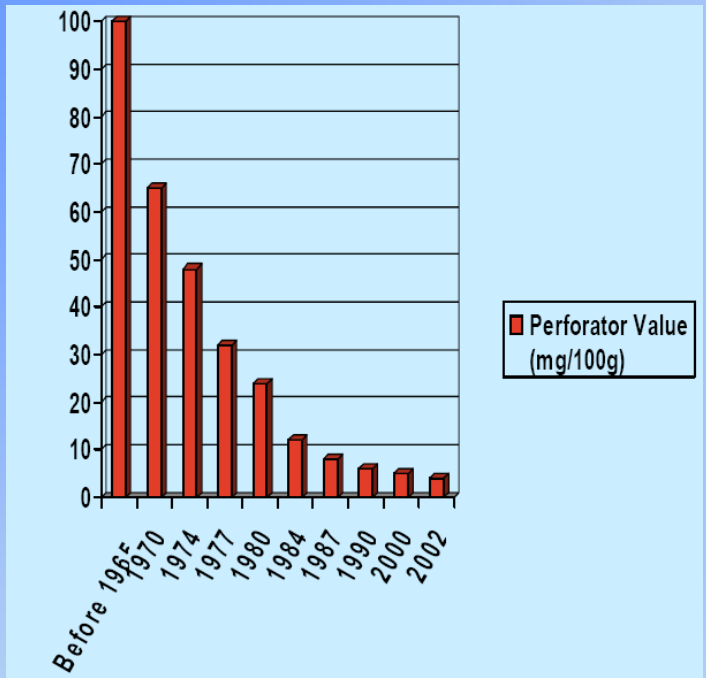
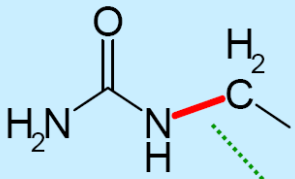
THE FORMADELHYDE EMMISIONS PROBLEM



ACTUAL REQUIREMENTS CONCERNING THE SUBSEQUENT FORMALDEHYDE EMISSIONS	
BOARD QUALITY	**LIMITS OF EMISSIONS ACCORDING TO THE PERFORATOR TEST (EN120)**
F**	6.5 mg/100g dry board
F*** (E-ZERO)	2.5-3 mg/100g dry board
F**** (SUPER E-ZERO)	1.5-2 mg/100g dry board

UF resin

low resistance against hydrolysis:

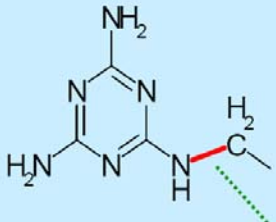


easily to split

MUF resin

increased stability against hydrolysis:

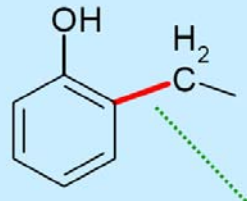
- stabilization of the C-N-bonding due to the quasi aromatic ring structure of the melamine
- slower decrease of the pH in the bond line due to the buffer capacity of melamine



higher hydrolysis resistance

PF resins

the C-C bonding is very stable against hydrolytic attack



hydrolytical stable C-C bonding

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TRENDS AND REQUIREMENTS IN WOOD PANEL INDUSTRY

Trends and requirements	Options	Offered adhesive solution
Low cost and cost effective production to survive on the high competition market of wood based panels	➢ Increased output of the line by shorter press times ➢ Reduction of board density (substantial savings in wood raw materials costs) ➢ Reduction the portion of off spec material ➢ Reduction of the necessary resin consumption	➢ High reactive systems (UF acceletors) ➢ Flexible resins for low density boards ➢ Optimization of the whole production ➢ Better resin distribution
Strong competition on the board market	➢ Cost leader production ➢ Special products	➢ Low adhesive prices ➢ Adhesives for special demands of the board producers
Reduction of formaldehyde emissions	➢ Resin systems with low content of formaldehyde ➢ Formaldehyde free adhesives	➢ Resin systems for the production of boards with limited formaldehyde emissions

WHAT DOES THE MARKET ASK FROM ADHESIVE PRODUCERS

1. **High and constant resin quality**

2. **For special applications top performance tailor made bonding solutions:**
   - **Boards for use in humid conditions**
   - **Boards with lower thickness swelling**
   - **Fire retardant boards**

3. **Improvement of their production**

4. **Alternative raw materials and novel bonding solutions**

5. **Cost effective adhesives**

6. **Further decrease in formaldehyde emissions**

SOLUTIONS BY CHIMAR

CHIMAR HELLAS S.A. is an innovating industrial company with manufacturing and research expertise in chemicals and technologies for the resin and wood panel industries.

The company offers a wide range of solutions regarding the wood adhesive industry.

✓**Innovative adhesive resins and additives**

(e.g. Specially developed know how's for the production of aminoplastic resins (**UF-UMF-MF-MUF-PF**) with various polymerization procedures and additives such as formaldehyde scavengers, crosslinking agents, additives for improved humidity resistance)

✓New adhesive technologies for zero formaldehyde emissions without decreasing the mechanical properties of wood panels

Property	Wood panel with conventional resin	Wood panel with CHIMAR E0 resin
Density, Kg/m^3	674	670
Internal bond strength, N/mm^2	0,72	0,7
Bending strength, N/mm^2	20,2	20,3
Water swelling at 100^0C for 24 hours, %	13,8	13,7
Formaldehyde emmisions, mg/100g panel	7,5	1,9

✓Development of new eco-efficient and bio-based adhesives taking into consideration both ecological and cost aspects.

(e.g. **TANNIN ADHESIVES - LIGNIN ADHESIVES – SOY PROTEIN ADHESIVES- FORMALDEHYDE SUBSTITUTION WITH FURFURAL)**

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NEW IDEAS IN WOOD ADHESIVES ?

- **Bio-Based products that are not based on oil**
- **Environmentally friendly product and process (Zero Emissions)**
- **Stronger bonding to wood**
- **Alternative curing mechanism (RF, UV)**
- **Long shelf life**
- **Reduced energy requirements**
- **Tolerates wide moisture variations**
- **Tolerates wide species mix**
- **Lower application rates**
- **Ease of application**
- **Improved long term durability**
- **Non-Toxic**
- **Cheap**

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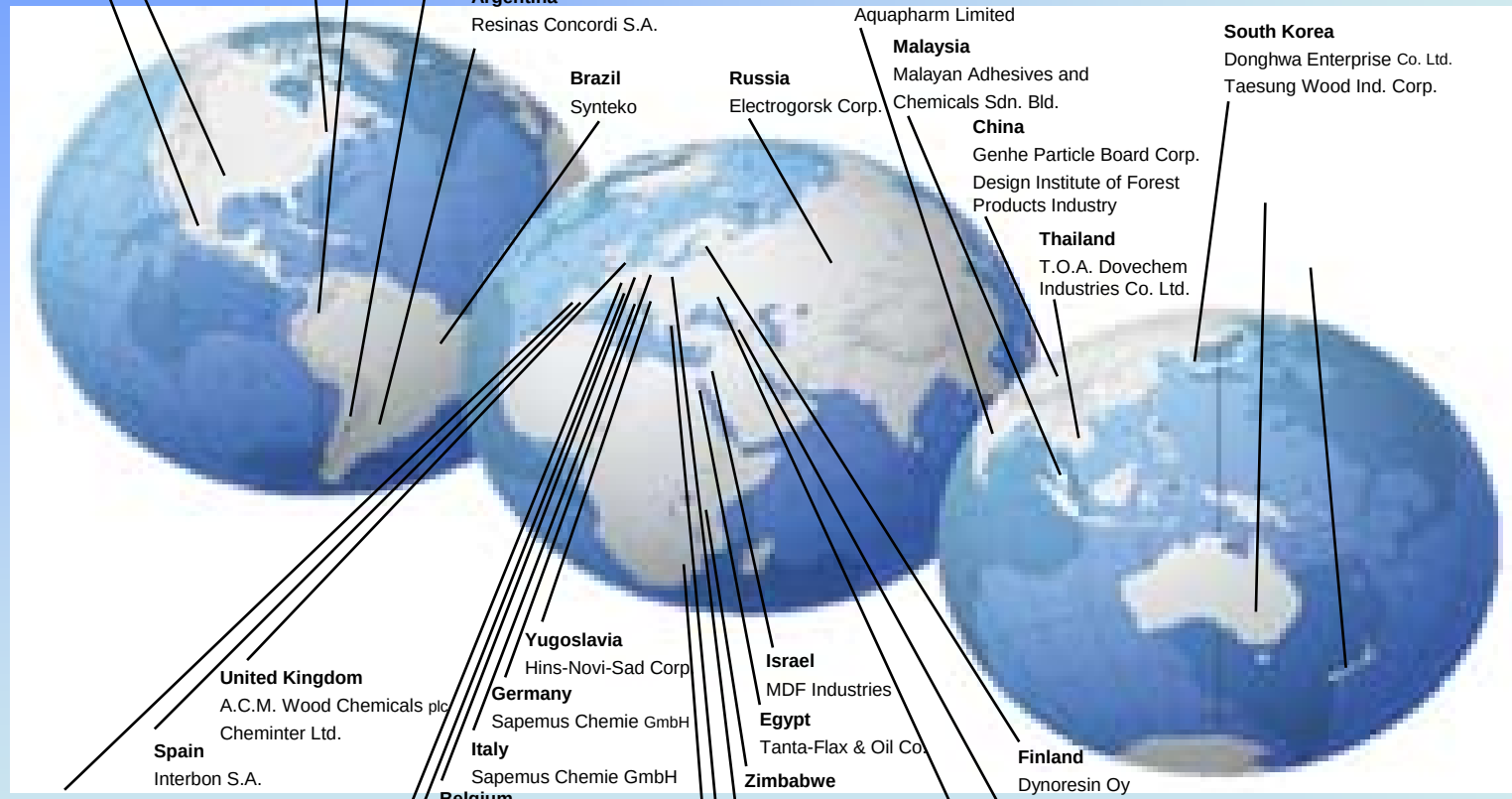

Mexico
Duraplay de Parral S.A.

Canada
Woodchem Canada Ltd.

U.S.A.
Georgia Pacific Corporation
Woodchem Canada Ltd.

Colombia
Pizano S.A.

Chile
Georgia Pacific/Masisa Resinas Limitada

Argentina
Resinas Concordi S.A.

Brazil
Synteko

Russia
Electrogorsk Corp.

India
Aquapharm Limited

Malaysia
Malayan Adhesives and Chemicals Sdn. Bld.

China
Genhe Particle Board Corp.
Design Institute of Forest Products Industry

South Korea
Donghwa Enterprise Co. Ltd.
Taesung Wood Ind. Corp.

Thailand
T.O.A. Dovechem Industries Co. Ltd.

Portugal
Hoechst Portuguesa S.R.I.

Spain
Interbon S.A.

United Kingdom
A.C.M. Wood Chemicals plc
Cheminter Ltd.

Yugoslavia
Hins-Novi-Sad Corp

Germany
Sapemus Chemie GmbH

Italy
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Belgium
Woodchem Europe S.A.

Switzerland
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Sapemus Chemie GmbH

South Africa
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Greece
Marlit EPE

Poland
Sapemus Chemie GmbH

Zimbabwe
P.G. Zimboard Products (PVT) Ltd.

Egypt
Tanta-Flax & Oil Co.

Israel
MDF Industries

Ukraine
Kiewer Experimental Kombinat and Consortium Oriana

Turkey
A.C.M. World Chemicals Ltd.

Finland
Dynoresin Oy

6th PanHellenic Polymer Conference

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