

INDUSTRIAL AMINO ADHESIVES SATISFYING STRINGENT FORMALDEHYDE LIMITS

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BINDING INNOVATION

Structure

1. Meet CHIMAR
2. Wood-based panels & Adhesives for them
3. The formaldehyde issue
4. Amino adhesives for stringent requirements

Summary of CHIMAR activities

CORE Business

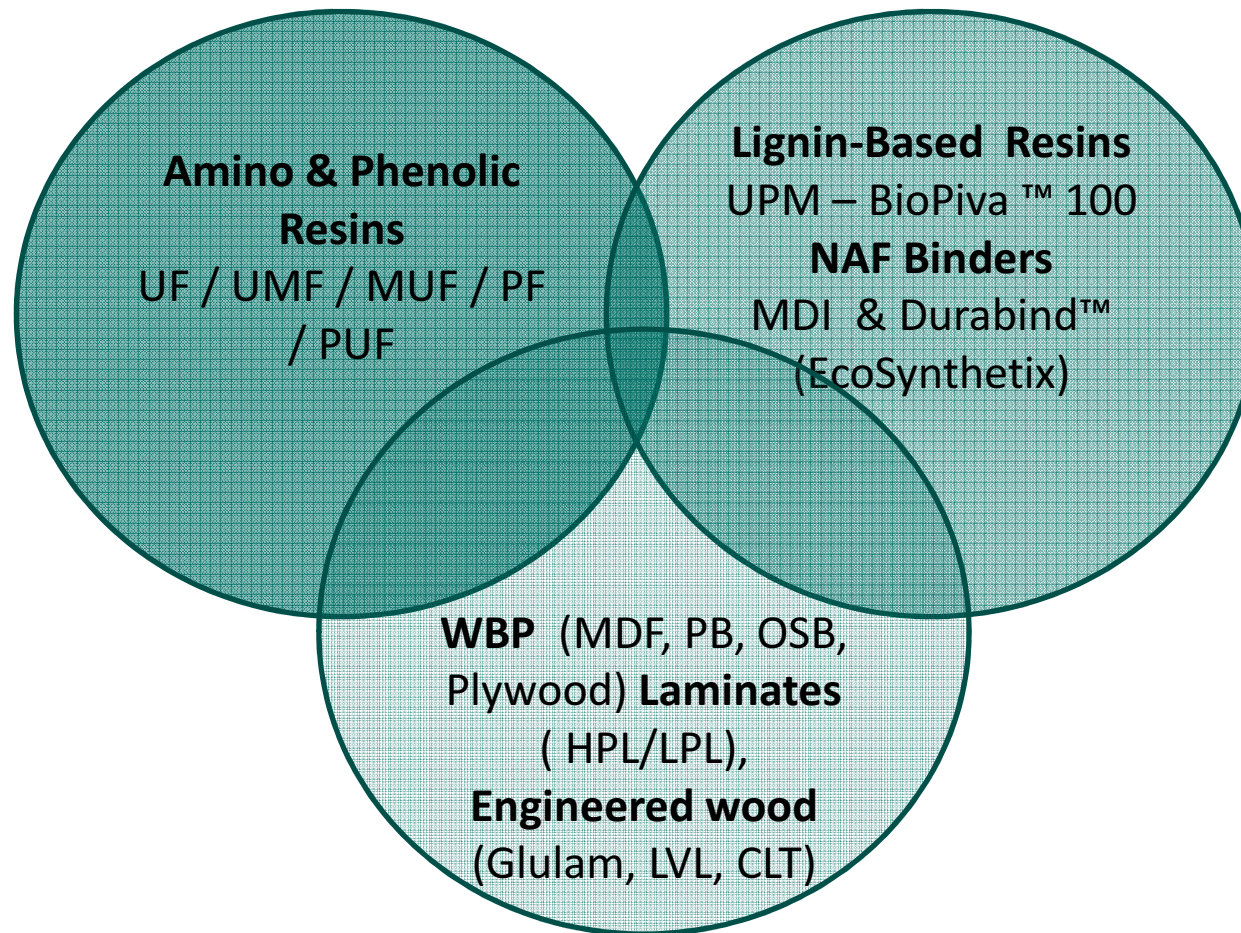
1	Development & Application of Industrial Technology for Binders & Additives
2	Engineering Services & Equipment Supply for resin plants
3	Technical Support & Training Services for resin & panel manufacturers
4	R&D Services for 3 rd parties
5	Participation in EU research projects

Specialty SERVICES

1	Chemicals production upon request
2	Accredited testing (EN 17025)
3	Resin, Additives & Board testing and evaluation
4	Equipment Representation

CHIMAR Industrial Technology

For the PRODUCTION AND APPLICATION of binders:



CHIMAR in figures

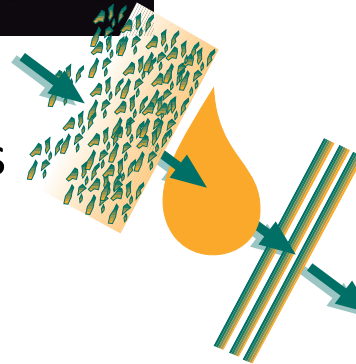
- ✓ Over 38 YEARS expertise in 40+ countries
- ✓ Know-how applied in 100+ industrial sites
- ✓ Over 1 MT resin per year is produced under CHIMAR technology
- ✓ Over 10% of global wood panel production uses our services
- ✓ Participation in 50+ EU funded projects & networks
- ✓ Strong team of 28 highly motivated experts

Wood-based panels (WBP)

Medium Density Fibreboard (MDF), Particleboard (PB),
Oriented Strand Board (OSB), Plywood (PW)



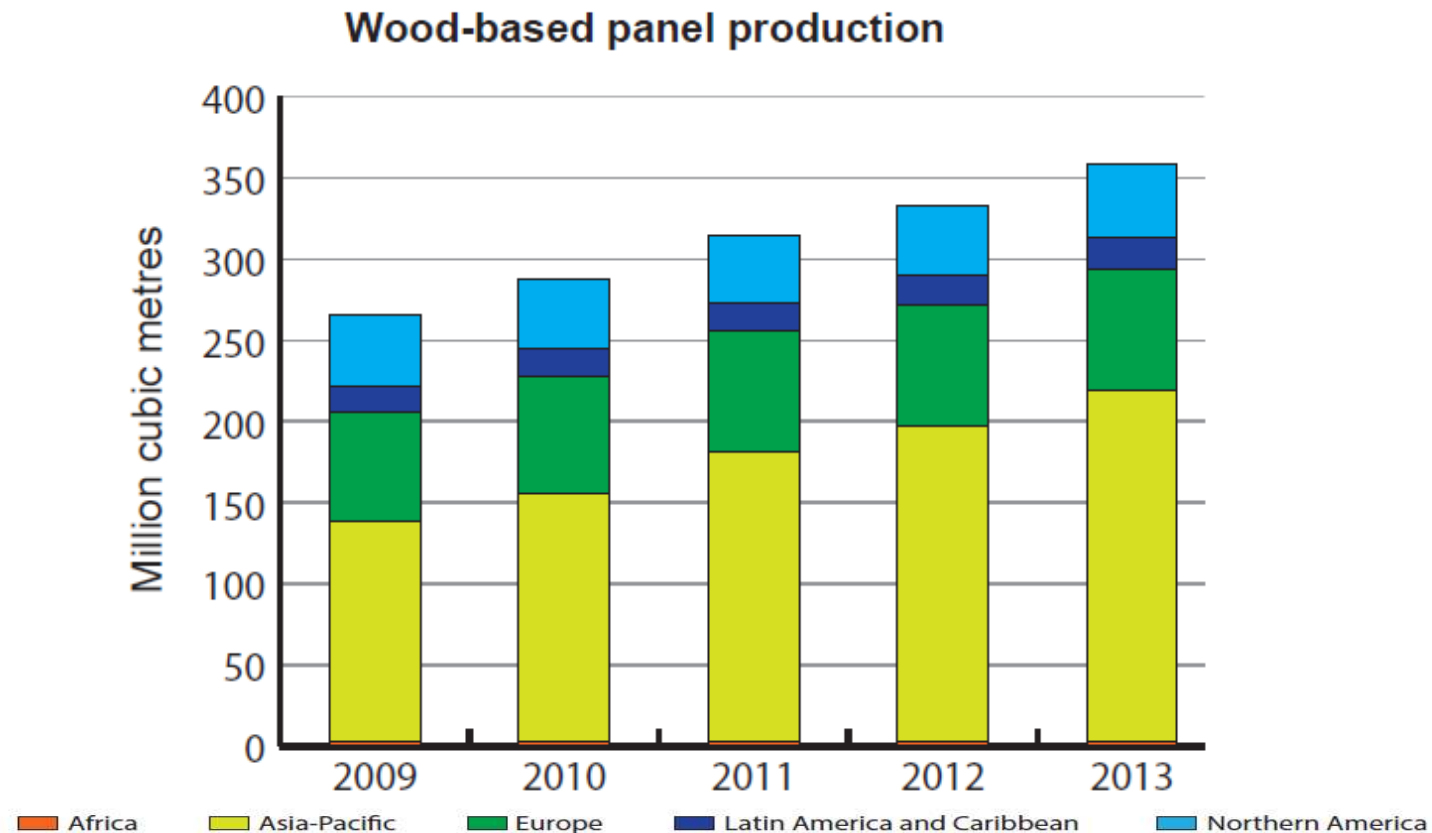
Wood particles/fibres/strands or veneers are mixed/coated with a mix of resin and additives to form a composite mat. The composite mat is hot-pressed to form a panel.



Applications of wood-based panels



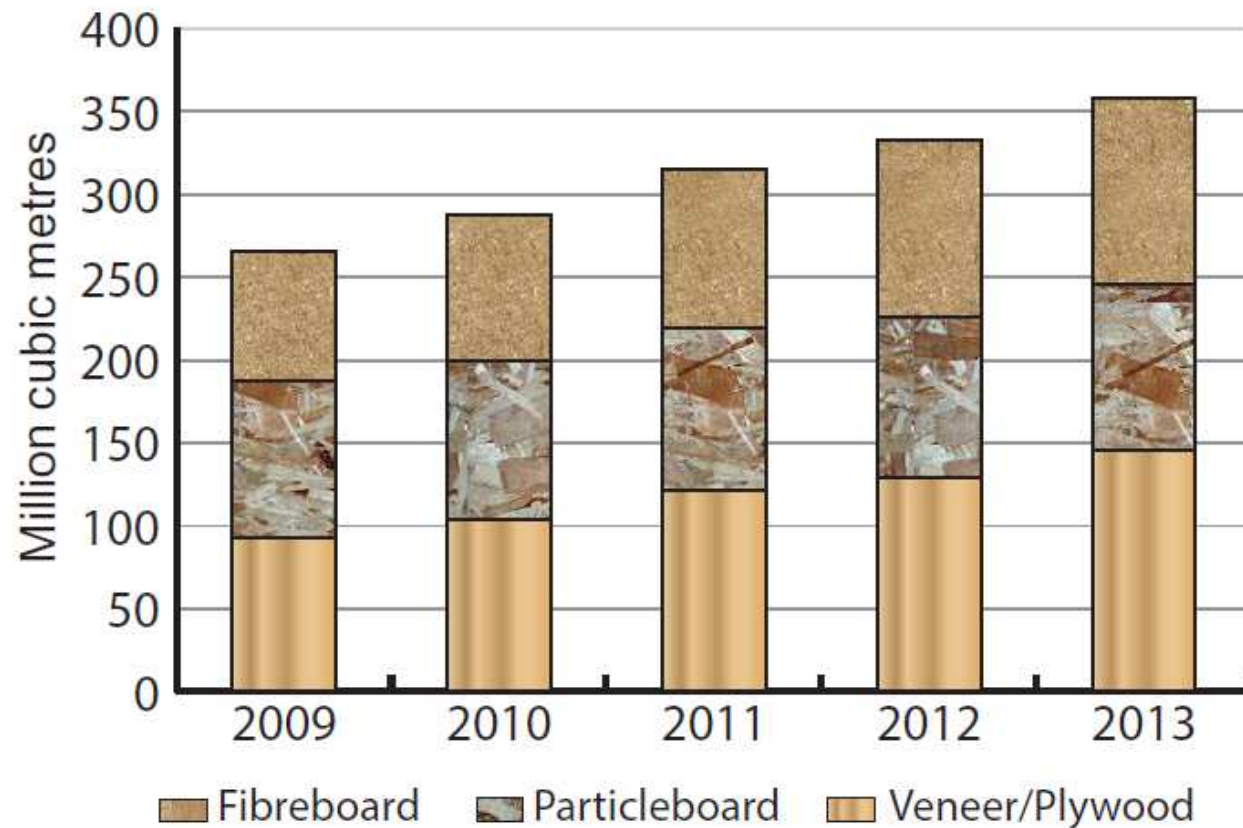
Global WBP production per region*



*Source: FAOSTAT database, <http://faostat3.fao.org/browse/F/FO/E>

Global WBP production per product category*

Wood-based panel production



*Source: FAOSTAT database, <http://faostat3.fao.org/browse/F/FO/E>

Adhesives for WBP

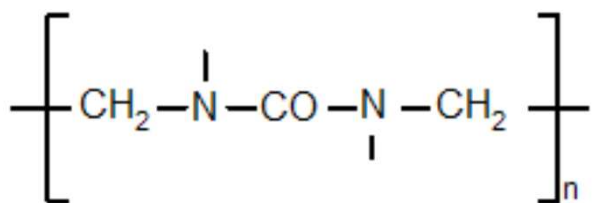
Amino resins: Urea Formaldehyde, Melamine Formaldehyde,
Melamine Urea Formaldehyde

Phenolic resins: mostly Resols

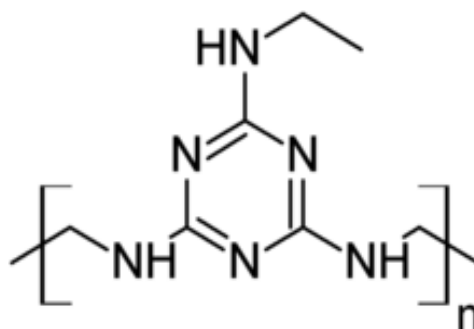
Polyisocyanates: MDI, TDI

TOP APPLICATION: as wood adhesives in the manufacture of WBP!

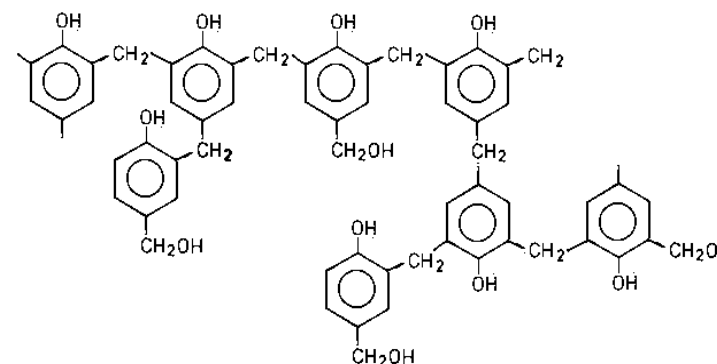
Formaldehyde-based Resins



Urea-Formaldehyde

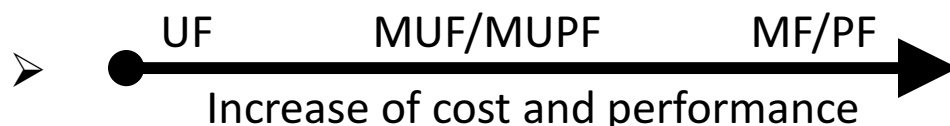


Melamine-Formaldehyde



Phenol-Formaldehyde

- Thermosetting polymers derived from Formaldehyde, Urea, Melamine, Phenol
- Main type of wood adhesives: performance, applicability and cost

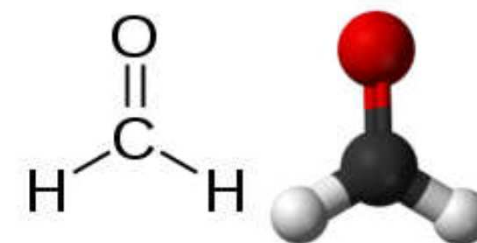


Re-classification of formaldehyde

➤ **IARC WHO** recommended classification of formaldehyde in **Group 1**-“carcinogenic to humans” (monograph 88/2006, monograph 100F/2012). This recommendation is not legally binding.

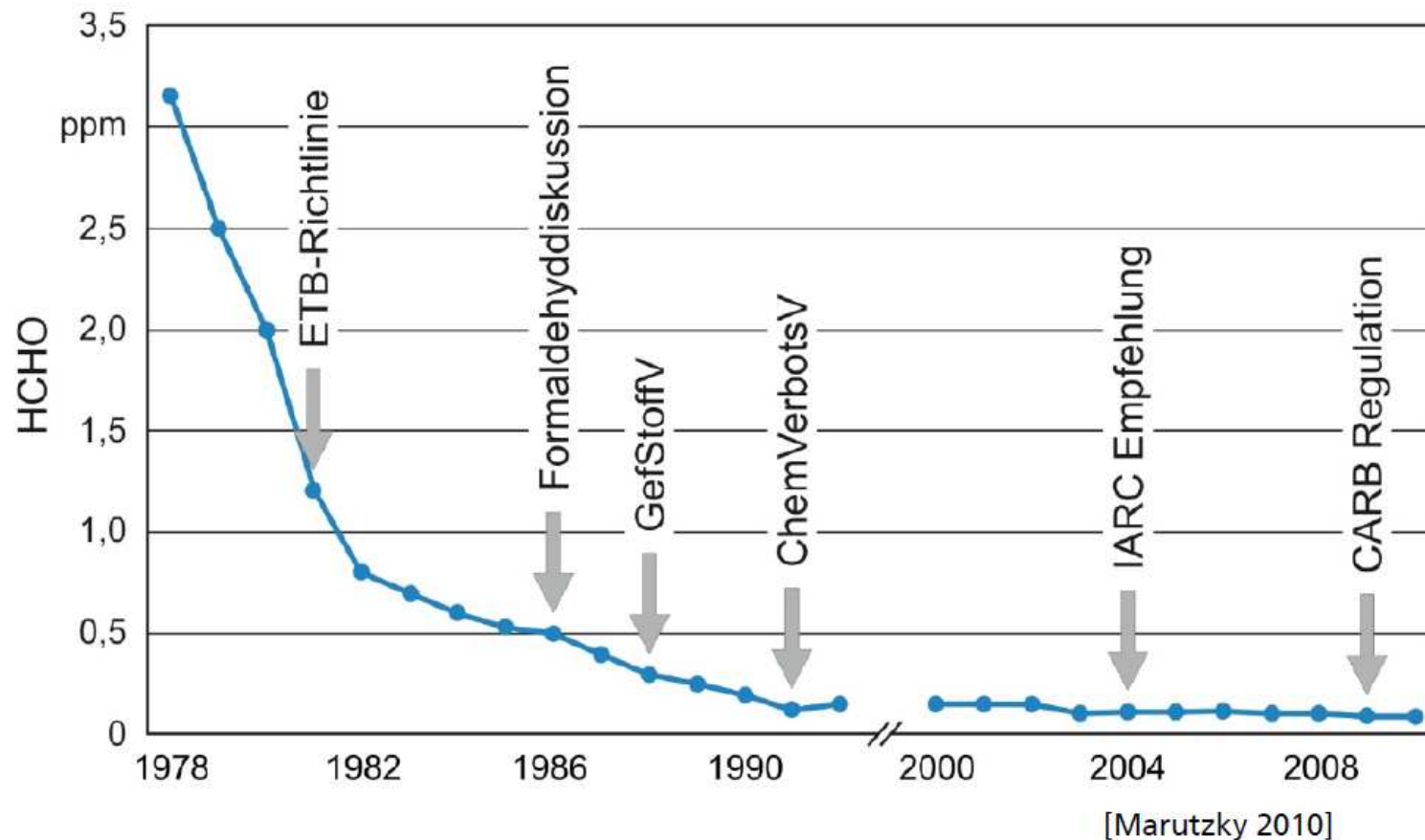
➤ **ECHA** (European Chemicals Agency) reclassified formaldehyde in category **1B-presumed human carcinogen** (June 2014 but transition period until 1 January 2016).

➤ **US EPA** considers formaldehyde a **probable human carcinogen-Group B1**. Draft toxicological review of formaldehyde-inhalation assessment (June 2010) supports carcinogenic effects but it is not finalised yet. **CARB-II** formaldehyde emission limits for composite wood products apply throughout the US from **January 2013**.



Formaldehyde molecule

Reduction of WBP formaldehyde emission due to the evolution of regulations



Formaldehyde Test Methods

Region	Method	Standard	Units	Application
Europe	Chamber	EN 717-1	ppm	All panel types
	Gas analysis	EN 717-2	mg/h*m ²	All panel types
	Perforator	EN 120	mg/100g	PB, MDF, OSB
Australia	Desiccator	AS/NZS 4266.16	mg/L	PB, MDF
	Perforator	AS/NZS 4266.15 / EN 120	mg/100g	PB, MDF
N.America	Large chamber	ASTM E1333	ppm	All panel types
Japan	Desiccator	JIS A 1460	mg/L	All panel types

Formaldehyde Limits for WBP

Region	Class	Product Standard	Limit (Test method)	Application
Europe	E1	EN13986	0.1ppm (EN 717-1) 8.0mg/100g (EN120) ¹	All panel types PB, MDF, OSB
N. America	CARB P2 ²	ANSI A208.1 for PB ANSI A208.2 for MDF	0.05 ppm 0.09 ppm 0.11 ppm (ASTM E1333)	HWPW PB MDF
Japan	F** F***/E0 F****/SE0	JIS A 5908 PB JIS A 5905 FB JAS PW	1.5mg/L 0.5mg/L 0.3mg/L (JIS A 1460)	All panel types

¹ E1 rolling average for half year <6.5mg/100g PB/OSB, <7mg/100g MDF

² Ultra-Low-Emitting Formaldehyde (ULEF) resins: formaldehyde emissions below 0.04ppm

Solutions for Formaldehyde Emission Reduction in Amino Adhesives

➤ **Advanced technologies for the synthesis of melamine-based adhesives**, enabling optimum use of the melamine and other active ingredients, to obtain resins with the target gluing and emission performance.

➤ **Innovative systems of melamine-based resins and chemical additives**, the synergistic action between them allowing the production of wood-based panels with no loss in productivity and no or minimal cost increase.

Melamine in Adhesives for Optimum Panel Performance & Formaldehyde Emission Reduction

% Melamine in adhesive

Class	PB standard	PB moisture resistant	MDF standard	MDF moisture resistant
E1/F**	0-2	11-13	0-2	2-4
E0/F***	4-6	15-18	2-4	6-8
SE0/F***	13-15	28-30	4-6	16-20

Data from “E0” PB

F***/E0 PB, UMF	
Press temperature, °C	210
Press factor, s/mm	As E1
Resin factor, % core/surface	8.5 / 9.5
Target density, kg/m ³	630
IB, N/mm ²	0.42
MOR, N/mm ²	16.3
Thickness swell, %	12.1
Formaldehyde emission, JIS A 1460, mg/L	0.29
Cost Vs E1 € per m ³	+5

Data from “E0” MR PB

F***/E0 MR PB, MUF	
Press temperature, °C	210
Press factor, s/mm	6.0
Resin factor, % core/surface	8.5 / 9.5
Target density, kg/m ³	642
IB, N/mm ²	0.61
Thickness swell, %	4.3
MOR, N/mm ²	18.2
MOR-A, N/mm ² (2h 70°C)	6.4
Formaldehyde emission, JIS A 1460, mg/L	0.27
Cost Vs MR E1 € per m ³	+3

Data from “SEO” PB

CARB-ULEF/SEO PB, UMF + FS	
Press factor, s/mm	6.5
Resin factor, % core/surface	8 / 10
Scavenger level, %	1.8-2.5
Target density, kg/m ³	670-690
IB, N/mm ²	0.52-0.58
MOR, N/mm ²	15-18
Formaldehyde emission, ASTM E 1333, ppm	0.02-0.04
Cost Vs CARB P1 € per m ³	+5

Data from “E0” MDF

E0 MDF, UMF + FS	
Press factor, s/mm	As E1
Resin factor, %	20% higher than E1
Target density, kg/m ³	690-710
IB, N/mm ²	0.6-0.7
Formaldehyde content, EN 120, mg/100g dry board	2.5-3.0
Cost Vs E1 € per m ³	+9

Data from “E0” MR MDF

F***/E0 MR MDF, UMF	
Press temperature, °C	190
Press factor, s/mm	As E1
Resin factor, %	13
Target density, kg/m ³	700-720
IB, N/mm ²	1.0-1.2
Thickness swell, %	5.1-5.8
MOR, N/mm ²	37-40
MOR-A, N/mm ² (2h 70°C)	4.9-5.3
Formaldehyde emission, JIS A 1460, mg/L	0.27-0.39
Cost Vs E1 MR € per m ³	+9

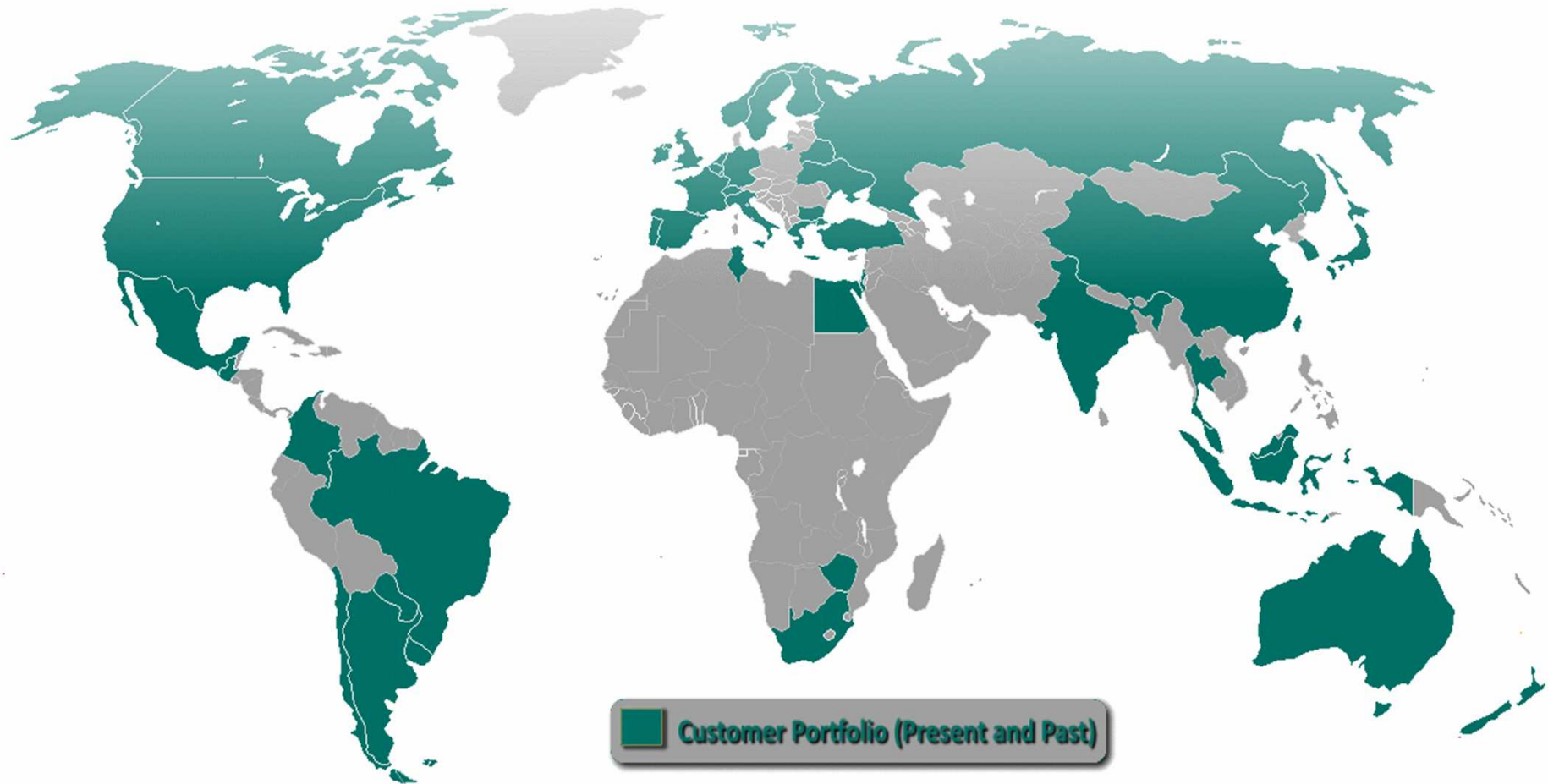
Data from “SEO” thin MDF

F****/SEO MDF (3mm), UMF	
Press temperature, °C	180-190
Press factor, s/mm	As E1
Resin factor, %	14
Hardener level, %	0-1.5
Target density, kg/m ³	840-860
IB, N/mm ²	1.6-1.8
MOR, N/mm ²	50-60
Thickness swell, %	16-21
Formaldehyde emission, JIS A 1460, mg/L	0.26-0.28
Cost Vs E1 € per m ³	+9

Highlights & Conclusions

- Wood-based panels with low emissions are value added (higher quality) products.
- CHIMAR made it possible to meet the new demands for wood-based panels with very low formaldehyde emission by developing properly formulated **melamine-based resin** systems.
- By application of CHIMAR technology there was no deterioration in wood panel performance or significant modification of the operating conditions of the board manufacturing plant or need to employ other types of binders.
- **Formaldehyde emission values at the level of natural wood can be obtained by CHIMAR technology at no sacrifice of the production cost.**
- Through its worldwide experience, network of customers and collaborating research institutes, CHIMAR develops and implements integrated solutions for the wood-based panel industry.

Licensing technology - 38 years in 40+ countries



38 Years / 40+ Countries

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THANK YOU!



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