
Wood Binders
Latest developments:
From innovation to application
Chimar Hellas S.A.
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Status and perspectives of
wood boards production
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CHIMAR activities

- Technology for the production and APPLICATION of binders in the production of composite wood panels.
  - Focus on safe, environmentally friendly technologies.
- Engineering services for formaldehyde and resin plants
- R&D for third parties
- Specialty chemicals (Hardeners, FR, Wetting agents, Bio-Polymers)
- Accredited formaldehyde testing

Acting globally, helping locally

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Binder market:
Needs and Trends

1. The formaldehyde debate
2. Alternative Raw Materials
3. Cost Improvement
4. Performance Optimisation

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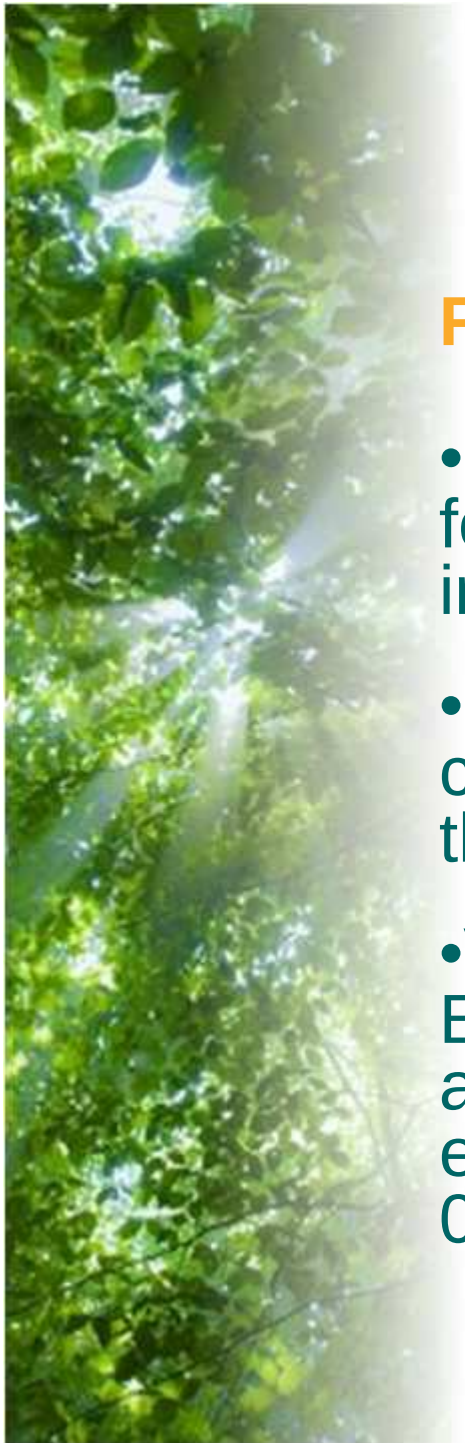
1. The Formaldehyde Debate

Re-classification of Formaldehyde (1/2)

- **World Health Organisation's International Agency for Cancer Research (IARC)** recommended (monograph vol. 88, 12/2006) classification of formaldehyde from Group 2A - "probably carcinogenic to humans" to **Group 1** - "carcinogenic to humans". This recommendation is not legally binding and was reaffirmed by IARC in October 2009.

- **EU** current formaldehyde classification: **category 2-suspected human carcinogen.** New classification of the European Chemicals Agency (ECHA) category **1B-presumed human carcinogen** will become effective EU-law as of 01.04.2015

- **US** EPA current classification: **probable human carcinogen (B1).** Draft toxicological review of formaldehyde-inhalation assessment released June 2010 supports carcinogenic effects.



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Re-classification of Formaldehyde (2/2)

- Numerous toxicological & cancer studies for formaldehyde since 1980. Major studies in Europe and USA, some still ongoing.
- **CARB** formaldehyde emission limits for composite wood products are in force throughout the US as from **January 2013**.
- Variation among national Occupational Exposure Limits (OEL) for formaldehyde around the world. The lowest OEL levels are established in Europe and range from 0.3 to 0.5 ppm.

European Standards

Board class	HCHO limit	Test method
E1 - PB, MDF, OSB	Release ≤ 0,124 mg/m^{3}air ≤ 8.0mg/100g	EN 717-1 EN 120
E1 - PW	Release ≤ 0,124 mg/m^3 air ≤ 3.5mg/h*m^2	EN 717-1 EN 717-2
E2 - PB, MDF, OSB	Release > 0,124 mg/m^3 air >8.0 ÷ ≤30mg/100g	EN 717-1 EN 120
E2 - PW	Release > 0,124 mg/m^3 air > 3.5 ÷≤ 8.0mg/h*m^2	EN 717-1 EN 717-2

Source: EN 13986

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

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Japanese Standards

Board class	HCHO limit	Test method
F****/SE0	≤ 0.3mg/L	JIS A 1460
F***/E0	≤ 0.5mg/L	JIS A 1460
F**	≤ 1.5mg/L	JIS A 1460

Source: JIS A 5908 & 5905

F** class in Japan is more or less equivalent to European E1-class
F*** and F**** are of much lower emission than the E1
F**** emission is close to the emission of solid untreated wood

AS/NZ Standards

Board class	HCHO limit	Test method
E0 - PB, MDF	≤ 0.5mg/L	AS/NZS 4266.16
E1 - PB	≤ 1.5mg/L	AS/NZS 4266.16
E1 - MDF	≤ 1.0mg/L	AS/NZS 4266.16
E2 - PB, MDF	≤ 4.5mg/L	AS/NZS 4266.16

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CARB Standards

Effective Date	Phase 2 (P2) Emissions Standards				
	HWPW-VC	HWPW-CC	PB	MDF	Thin MDF
01.01.2010	0.05	-	-	-	-
01.01.2011	-	-	0.09	0.11	-
01.01.2012	-	-	-	-	0.13
01.07.2012	-	0.05	-	-	-

Formaldehyde Emission Standards for Hardwood Plywood (HWPW), Particleboard (PB) and Medium Density Fiberboard (MDF), CARB 2008
Based on the primary test method [ASTM E 1333-96 (2002)] in ppm
HWPW-VC: veneer core, HWPW-CC: composite core
Source: CARB 2008, NOTE: Same as ANSI A208.1&2 for PB and MDF

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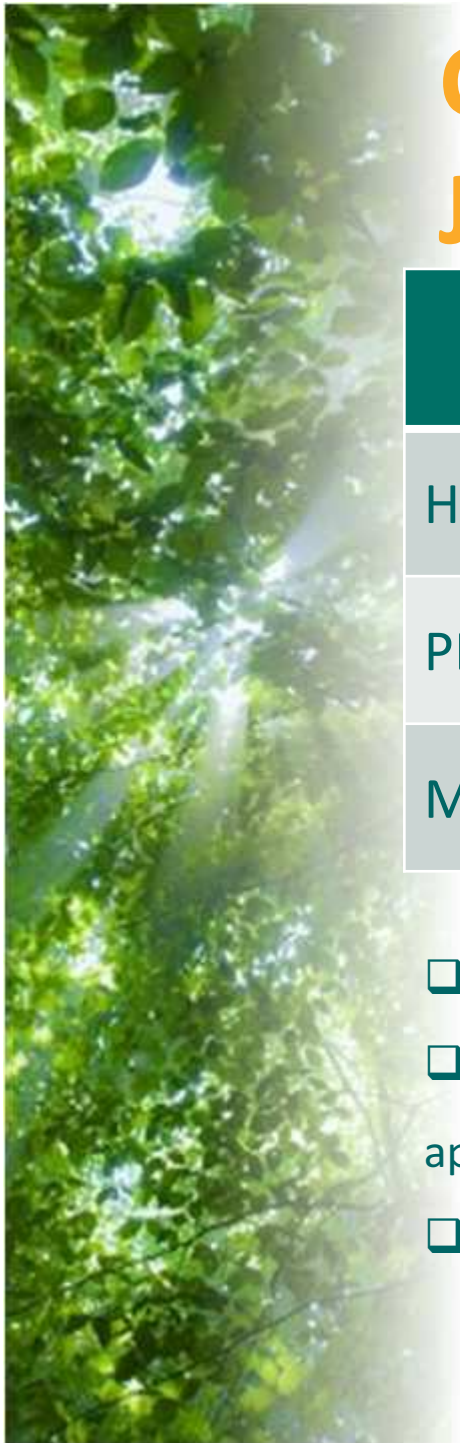

CARB vs. European & Japanese Standards

CARB II (ppm)	E1	F***	F****
HWPW (0.05)	More	More	Comparable
PB (0.09)	More	Comparable	Less
MDF (0.11)	Comparable	Less	Less

- Values in parenthesis are the Phase 2 standards in ppm.
- "More" means the proposed standard is "more stringent" than applicable E1, F***, F**** standards.
- Source: CARB 2008

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Solutions for Formaldehyde emission reduction

- **Innovative systems** of adhesive resins and chemical additives, the synergistic action between them providing successful gluing performance and desirable emission properties

- **Advanced technologies for adhesive resin synthesis,** enabling optimum use of production conditions to obtain resins with target gluing and emission performance

- **Bio-derived adhesives based on natural products and materials** (e.g. lignin, tannin, bio-polymers) combining the utilisation of renewable raw materials with high bonding performance and reduced formaldehyde emission at the same time.

Data from F***/E0 MDF

F***/E0 MDF (6 & 16mm), UF		
	6mm	16mm
Press temperature, °C	180-190	180-190
Press Factor, s/mm	As in E1	
Resin Factor, %	8.3	10.5
Board Density, kg/m^3	790-810	680-700
IB, N/mm^2	1.33 – 1.50	0.90 – 0.95
MOR, N/mm^2	40-42	30-35
Thickness swell, %	18-20	7-8
Formaldehyde emission, JIS A 1460, mg/L	0.3-0.5	
Cost Vs E1 € per m^3	**0**	

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Data from F***/E0 MR MDF

F***/E0 MR MDF (18mm), UMF	
Press temperature, ^{o}C	190
Press Factor, s/mm	As E1
Resin Factor, %	13
Board 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 $70^{o}C$)	4.9-5.3
IB after cyclic test, N/mm^2	0.2-0.4
TS after cyclic test, %	5-7
Formaldehyde emission, JIS A 1460, mg/L	0.27-0.39
Cost Vs E1 MR € per m^3	**+9**

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Data from F****/“SE0” MDF

F****/“SE0” MDF (16mm), UMF + FS	
Press Factor, s/mm	As E1
Resin Factor, %	16
Scavenger level, %	15, 20
IB, N/mm^2	0.9-1.1
Thickness swell, %	7.0-7.4
Formaldehyde emission, JIS A 1460, mg/L	0.27-0.29
Cost Vs E1 € per m^3	**+12**

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Data from ULEF thin MDF

ULEF MDF (3mm), UF + FS	
Press Factor, s/mm	As CARB P1
Resin Factor, %	8
Scavenger level, %	20
Board Density, kg/m^3	880-930
IB, N/mm^2	1.6-1.8
MOR, N/mm^2	42-50
Formaldehyde emission, ASTM E 1333, ppm	0.03-0.04
Cost Vs CARB P1 € per m^3	**+3**

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Data from F***/E0 PB

F***/E0 PB (16mm), UMF	
Press temperature, °C	210
Press Factor, s/mm	As E1
Resin Factor, %core/surface	8.5 / 9.5
Board 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**

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Data from F***/E0 MR PB

F***/E0 MR PB, MUF	
Press temperature, ^{o}C	210
Press Factor, s/mm	6.0
Resin Factor, %core/surface	8.5 / 9.5
Board 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 $70^{o}C$)	6.4
Formaldehyde emission, JIS A 1460, mg/L	0.27
Cost Vs MR E1 € per m^3	**+3**

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Formaldehyde emission reduction by CHIMAR HELLAS

High Performance gluing systems:

- Innovative **resin** and **additive** formulations
- Produced from controlled raw materials
- Best exploitation of the active ingredients during resin synthesis aiming no loss in productivity and minimal cost increase
- Efficient monitoring and control of the synthesis parameters

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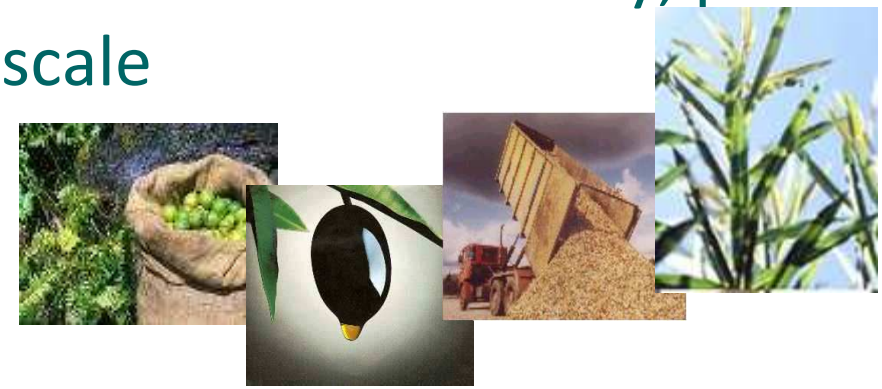
2. Alternative Raw Materials:

R&D on Bio-based Resins

- Phenol-Formaldehyde resins with partial substitution of phenol by natural materials
- Bio-based resins
- Urea-formaldehyde resins with natural products as additives
- Achievements at the laboratory, pilot and industrial scale



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Partial Phenol replacement in PF resins

Potential for Industrial Application:

- Technical studies showed that 50% replacement of phenol by Lignin is possible on an industrial scale
- Due to availability and price, Lignin is the most prominent phenol substitute
- Technology and Lignin supply readily available world-wide

Applying natural materials for biolatex® polymers

Biopolymer Source + Chemicals

Proprietary Continuous Manufacturing Process

Biolatex® Dry Polymer

Patented Formula

Patented Process

Patented Product

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3. Cost Improvement:
Become own resin producer

- Convert resin producer's profit margin to own savings
- Transportation cost savings
- Release from any binding with resin producer due to distance
- Savings through optimum utilization of storage capacity
- Absolute Control of resin quality
- Gain full control of scheduling
- Expand customer list by becoming local resin supplier
- Cost savings through byproduct water utilization

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Plant installation:

formaldehyde, UFC, resins, impregnation syrups & additives

- **CHIMAR** has gained vast experience over the last 20 years in the procurement, construction and operation management of resin, impregnation syrups, additives and formaldehyde plants.
- It acted as the branch of former ACM Wood Chemicals group responsible for the plant projects.

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Advantages of CHIMAR plants

- High quality resins suitable for the production of all grades of all wood-based panel types (even F****)
- High quality syrups for all impregnation lines
- High conversion rates of methanol to formaldehyde and long catalyst life span, resulting in long-term cost benefits and viability
- Low energy demand, low carbon footprint
- Effluent - free
- Competitive capital investment
- Minimal operating cost

Reference projects

- Argentina (formaldehyde plant, two resin plants)
- Australia (formaldehyde and resin plant)
- Belgium (formaldehyde and resin plant and their extensions)
- Canada (formaldehyde and resin plant)
- Chile (formaldehyde and resin plant)
- Germany (formaldehyde plant, two resin plants, reactor for impregnation syrups)
- Greece (formaldehyde and resin plant with reactors for impregnation syrups, formaldehyde and resin plant extensions and optimisation)
- Mexico (optimisation and revamp of existing resin plant)
- Turkey (formaldehyde plant)
- S. Africa (formaldehyde and resin plant)

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4.Performance Optimisation

- Use of technology that is a result of intensive R&D
- Implement adequate process control in resin and board production
- Invest in new available technology

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CHIMAR - GreCon

- CHIMAR is GreCon exclusive distributor of spark detection/extinguishment systems as well as inline and laboratory measurement systems.
- CHIMAR entrusted laboratory HCHO emission measurements to GA 5000 according to 717-2

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CHIMAR - GreCon

- CHIMAR ‘s Technical Representatives make use of GreCon industrial inline measurement systems in order to retrieve and make use of data concerning:
  - Thickness fluctuations/deviations
  - Weight per unit area measurement
  - Density profile
  - Moisture measurement etc
- CHIMAR’s personnel operates Contilog/Esylog optimising pressing process

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CONCLUSIONS

- Boards with low emissions are value added (higher quality) products and it is possible to meet the new demands for every low formaldehyde emission with the use of properly formulated **resin systems**.
- There are alternatives for **aminoplastic resin systems** that can significantly reduce the binders' cost.
- Becoming a resin producer can be an attractive investment for a board manufacturer.
- Investing in technology is currently the best way to increase quality and productivity while reducing operational costs.

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Final Remarks

- **CHIMAR** has reduced panel formaldehyde emissions by developing innovative resin systems, using advanced resin synthesis technologies and components that are well studied and controlled
- Through its worldwide experience, network of customers and collaborating research institutes, **CHIMAR** develops and implements integrated solutions to the formaldehyde emission problem
- **CHIMAR** research and development is ongoing and the publication of further positive data on low emission panels will follow

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CHIMAR in Figures

- **CHIMAR** expertise overreaches 37 years
- Technology applied in over 70 industrial plants located in more than 37 countries
- Annual resin capacity exceeds 1,000,000 tons following **CHIMAR's** know-how
- More than 15,000,000 m^3 of panels are manufactured annually using the technology of **CHIMAR**
- 26-strong team (chemists, chemical/electrical & computer engineers, forest & wood scientists, petroleum technologists, finance and business administration)

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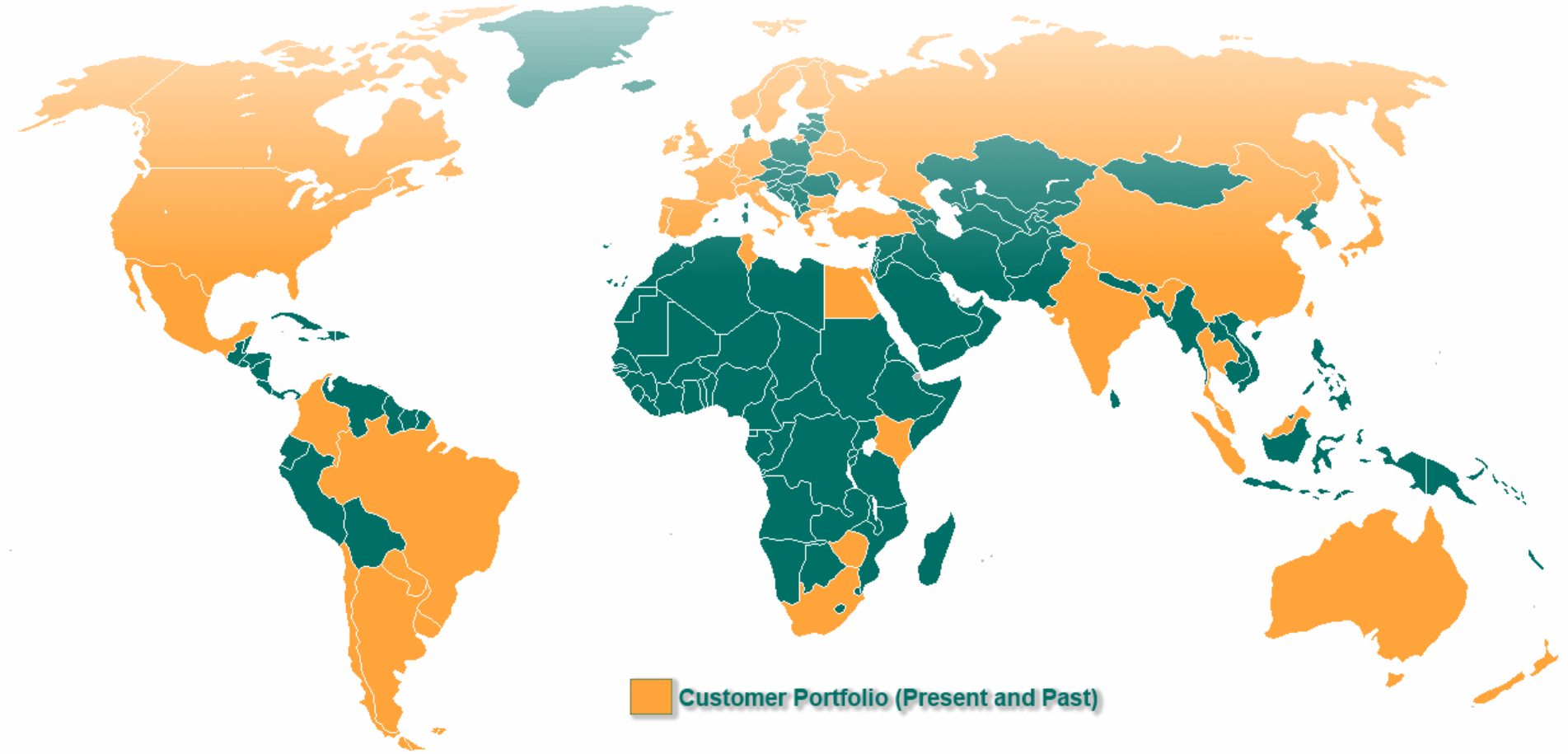
Licensing technology - 37 years in 40 countries



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NATIONAL CHAMPION for GREECE 2013-2014 in European Business Awards

For further Information please VISIT:

http://www.chimarhellas.com/european-business-awards-2013-2014-chimar-hellas-national-champion-2

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благодарю
Thank You!