



HEXION

Specialty Chemicals

CHANGE – Its Challenges and Opportunities

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Structural & Engineered Wood Products Shipments – North America¹

<u>Product</u>	Millions of M ³		<u>Change</u>
	<u>2007</u>	<u>2008 (P)</u>	
Softwood Plywood	12.9	11.1	-14.0
OSB	21.2	16.9	-20.3
Glulam	0.9	0.7	-22.2
LVL	<u>2.1</u>	<u>1.6</u>	<u>-23.8</u>
TOTAL	37.1	30.3	-18.3

¹ Data from the Engineered Wood Technology Association News – August 2008.

Challenges

- Regulatory pressures to reduce formaldehyde emissions
 - Workplace limits
 - California's Air Toxics Control Measure for Formaldehyde Emissions from Composite Wood Products
- Environmental movement to severely restrict or ban the use of UF resins.
 - US Green Building Council (LEED rating system) – No UF resin
 - Architects and Specifiers focus on improving indoor air quality
 - Sierra Club is championing lower formaldehyde (FEMA trailers)
- A number of large customers are also lowering the emissions limits for the composite wood products they purchase.
- Mill VOC emission abatement equipment requirements (BAT)

Formaldehyde Limits – Workplace

	Now	Future?
<u>Australia</u>		
Time Weighted Average (TWA): ppm	1 ppm	0.3
Short Term Exposure Limit (STEL):	2 ppm	0.6 ppm
<u>New Zealand</u>		
Time Weighted Average (TWA): ppm	1 ppm	0.3
Short Term Exposure Limit (STEL):	None	0.6 ppm
<u>USA</u>		
Time Weighted Average (TWA): ppm C	0.75 ppm	0.3
Short Term Exposure Limit (STEL):	2 ppm	
Action Level	0.5 ppm	

Formaldehyde emissions now – Plywood, MDF, Particleboard

Australia & New Zealand

- Local Market: E1 or below (Japanese Desiccator Test) voluntary limit dictated by standard and not regulation
- Export: JAS/JIS F**** (Japanese Desiccator Test): Formaldehyde emissions dictated by regulation

North America

- Structural and Engineered Wood Products – HCHO Not Regulated
- HUD (Manufactured Housing) – Particleboard 0.3 ppm, Hardwood Plywood Paneling 0.2 ppm by US E1333 Chamber test (~ E2 +)
- Particleboard & MDF - 0.3 → 0.2 ppm ; voluntary (>95% compliance)

Formaldehyde emissions future – Plywood, MDF, Particleboard

Australia & New Zealand

- Local Market: E1 or below (Japanese Desiccator Test) voluntary limit dictated by standard and not regulation (?)
- Export: JAS/JIS F**** (Japanese Desiccator Test): Formaldehyde emissions dictated by regulation
- **Export MDF & PB: May be influenced heavily by North America and large international customers**

North America

- Structural and Engineered Wood Products – Changes (?)
- HUD (Manufactured Housing) – **Being considered for significant revision, to lower limits.**
- HWPW, Particleboard & MDF – **See CARB** (following slides)

CARB Regulation Basics

- Covers – hardwood plywood, particleboard and MDF – and in-process or finished goods containing them.
- Does not cover – primarily structural panels and structural engineered wood products – but is defined primarily under US standards / methods
 - “Structural Plywood” (PS 1-07)
 - “Wood-Based Structural-Use Panels” (PS 2-04)
 - “Structural Composite Lumber Products” (ASTM D 5456- 06)
- Violation fines only in California – can be significant!

CARB has not yet answered whether structural wood products that have not been certified under the US standards specified in the regulation are actually exempt.

CARB Regulation – Limits (Ceiling) ppm

Table 1

Phase 1 and 2 Emission Standards for Hardwood Plywood (HWPW), Particleboard (PB), and Medium Density Fiberboard (MDF)¹

Effective Date	---- Phase 1 (P1) and 2 (P2) Emission Standards (ppm) ----				
	HWPW-VC	HWPW-CC	PB	MDF	Thin MDF
1-1-2009	P1: 0.08	-----	P1: 0.18	P1: 0.21	P1: 0.21
7-1-2009	-----	P1: 0.08	-----	-----	-----
1-1-2010	P2: 0.05				
1-1-2011	-----	-----	P2: 0.09	P2: 0.11	-----
1-1-2012	-----	-----	-----	-----	P2: 0.13
7-1-2012	-----	P2: 0.05	-----	-----	-----

⁽¹⁾ Based on the large chamber test Method (ASTM E1333-96) in parts per million (ppm). HWPW-VC = veneer core; HWPW-CC = composite core, where the core material is PB or MDF.

RISK MANAGEMENT RESPONSIBILITY

- The **panel manufacturer** is ultimately responsible for assuring that products meet the applicable Phase limit or Exemption.
- Essentially chain-of-custody documentation will be required of downstream importers, fabricators, distributors, retailers.

Importer is one bringing the product into the State of California.

- **Documentation is a cornerstone of the regulation, and is also critical to mitigating liability.**
 - Potential litigation \$ penalties
 - Potential loss of business \$ penalties

Non-Regulatory Group Influences

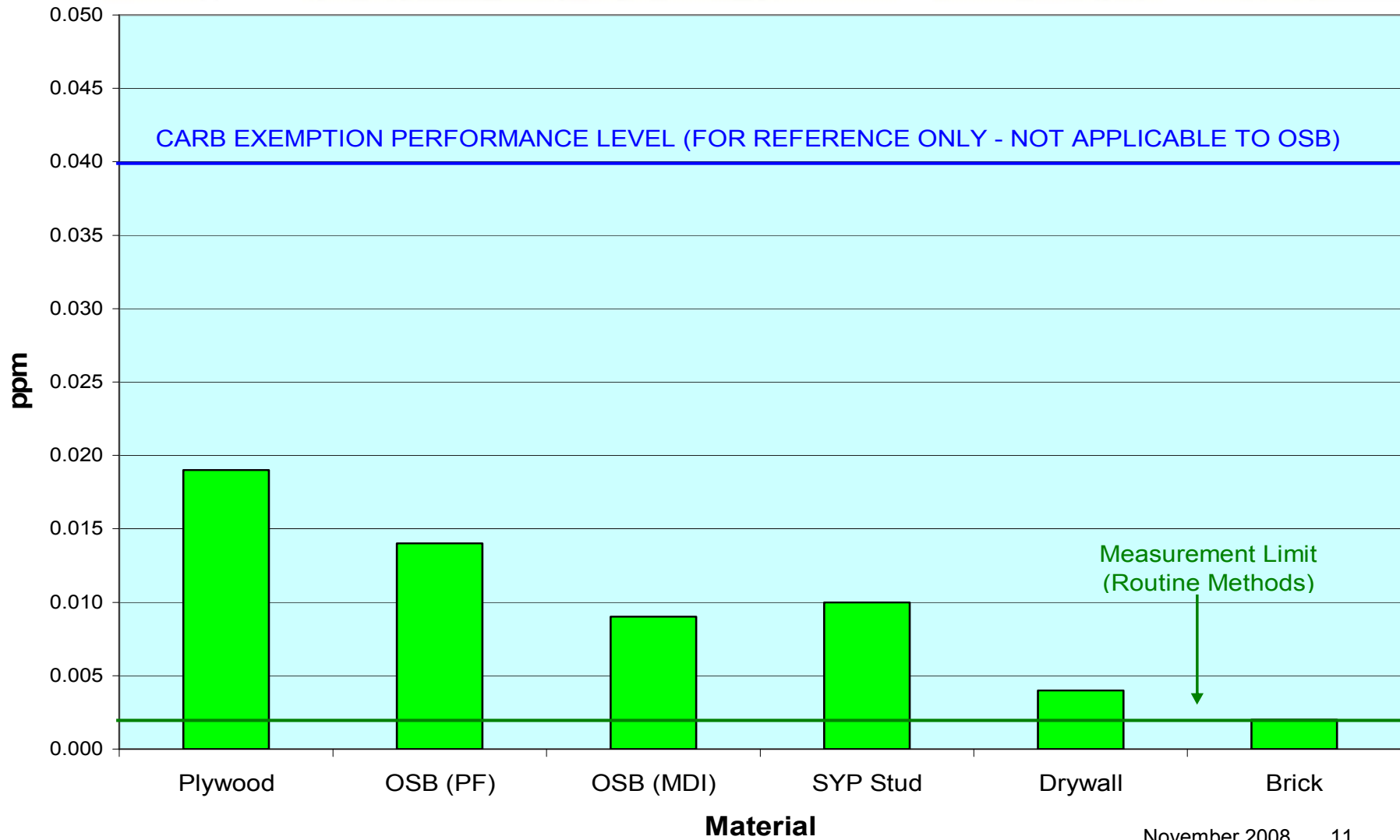
- Environmental concern spreading internationally
 - Blue Angel (Germany) – (~0.05 ppm HCHO limit)
 - US Green Building Council LEED Rating Program – (No UF)
 - Green Globe, Green Seal, GREENGUARD, etc.

- Major customers are also specifying lower emitting products
 - IKEA (furniture) will require “E0.5” for particleboard and MDF
 - AHFA (furniture) will require CARB-compliant products
 - Costco (distributor) will require CARB-compliant products
 - Mohawk (engineered flooring) will require CARB-compliant products

- EMB (European MDF Trade Org) – Voluntary – all to E0.5

- CPA & HPVA (US) – Adding CARB-compliant categories

How Do Emissions Compare for Different Building Products?



Methods Comparisons – Particleboard¹

Method	Japan F***	Japan F****	EMB E1	EMB E0.5	CARB P 1	CARB P 2
JIS A 1460 mg/l	≤ 0.5	≤ 0.3	≤ 0.9	0.4 max	1.3 max	0.6 max
EN 120 mg/100g	≤ 4.5	≤ 2.7	≤ 8.0	4.0 max	11.3 max	5.6 max
EN 717-1 mg/m ³	≤ 0.054	≤ 0.034	≤ 0.124	0.050 max	0.176 max	0.088 max
ASTM E1333 ppm	≤ 0.055	≤ 0.035	≤ 0.127	0.051 max	0.180 max	0.090 max

¹ Exact correlation required for different products and densities.
Above shows relative relationship for a fixed particleboard product.

Opportunities

- Develop and market products for highest growth and value potential
 - Changes in customer demands
 - Additional and/or new applications
- Cover both regional and appropriate global product needs
 - emerging potential

Formaldehyde based Binder Options

- CARB Phase 1 – PBD & MDF
 - Existing resin products/technologies – with some ‘fine tuning’.
- CARB Phase 1 and Phase 2– HWPW
 - New Ultra-Low Emitting UF resin formulations (ULEF series “-05” and “-04”)
- CARB Phase 2 – PBD & MDF
 - Low mole ratio (< 1:1) urea-formaldehyde resins, some melamine modified at low levels
 - Melamine-formaldehyde and melamine-urea-formaldehyde resins, usually used with a second component
 - Scavenger
 - Scavenger resin
 - Co-reactant
- Structural Products
 - Phenol-formaldehyde resins
 - Phenol-resorcinol-formaldehyde resins
 - Tannin-formaldehyde resins (also applicable to non-structural products)

Non-Formaldehyde (NAF) Binder Options

- CARB Phase 2 – HWPW
 - Polyvinyl acetate (PVA)
 - Epoxidized polyamide / soy
- CARB Phase 2 – PBD & MDF
 - Isocyanates (pMDI)
 - Epoxidized polyamide / soy
- Structural Products
 - Isocyanates, polyurethane systems (e.g. PU & EPI)

Other Binder Technologies

- Tannins and lignin –based systems
- Soy-based systems
- Enzyme-modified biomass-derived resins
- Casein-based (or even vegetable-based) protein systems
- Starch-based
- Modified oils (e.g. from Tung & Linseed)
- Polyamides, Polyesters, Epoxies, Polyketones, etc.

Some of these systems are revisited, and others are newer. While there are some regional applications of the above technologies, most do not have the infrastructure/manufacturing in place to deliver commercial quantities globally.

QUESTIONS ?