Airborne Toxic Control Measure on Composite Wood Products

Public Workshop

October 23, 2006

1001 I Street
Coastal Hearing Room
Sacramento, California

Meeting Agenda

- Regulation Order
- Health Risk Assessment
- BACT Assessment
- Enforcement Provisions
- Emissions Inventory
- Economic Impacts
- Open Session for Comments
- Next Steps
Update on Regulation Order

Background

- Previous versions of the draft regulation were released in May and June 2006
- In July-October, staff met with various manufacturers and associations to discuss aspects of the draft regulation
- Written and verbal comments received from CWIC, Jeld Wen, Columbia Forest Products, SierraPine, Timber Products, Window & Door Manufacturers Assn, American Home Furnishings Alliance, Stanley, Broyhill, Woodwork Institute, Armstrong Flooring, and numerous fabricators
Revisions to the Draft Regulation

- Modified selected definitions to improve clarity and provide specificity
- New standards for HWPW-veneer core and HWPW-composite core
- Third Party Certification requirements to be set forth in a CARB document
- Updated sell-through provisions to reflect changes in performance standard effective dates

Revisions -- Continued

- Separate provisions for distributors and importers
- Created a separate test methods section:
  - ASTM E1333 testing by panel manufacturers
  - Placeholder for CARB enforcement methods
    - Small chamber raw panel testing
    - Finished product screening method
Phase 1: HWPW-Veneer Core

- 2002 Survey: 85% at 0.09 ppm; 20% at 0.07 ppm
- All manufacturers used ammonia-UF resins with F:U ranging from 1.7 to 2.0
- Options for lowering HCHO: dryers, lower F:U ratio resins (e.g., 1.1), hardeners
- Use of hardeners appears highly effective
- Manufacturers can do more to reduce HWPW emissions

Phase 1: HWPW-Composite Core

- Should be higher than the performance standard for HWPW-Veneer Core
- Has an effective date after the Phase 1 standards for particleboard and MDF
- Exclusive use of AUF resins indicated; alternatives had not been widely explored
- 0.09 ppm was retained due to lack of robust data to demonstrate infeasibility
- Comments?
Discussion Items

- Duration of proposed sell-through periods
- Performance-based vs. technology-based exemptions for Phase 1 products
- Need for additional specificity in the chain-of-custody requirements
- Requirements for Third Party Certification Programs and Third Party Certifiers
- Other issues

Update on Health Risk Assessment
Background

- The first preliminary draft was released for comment at the June 20, 2006 workshop
- Concerns were expressed relative to the use of a 70-year exposure duration for children
- Risk was estimated by multiplying the time-weighted average formaldehyde concentration by the cancer unit risk factor

Formaldehyde Exposure Levels (µg/m³)

<table>
<thead>
<tr>
<th>Location</th>
<th>Mean</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homes</td>
<td>17</td>
<td>285</td>
</tr>
<tr>
<td>Classrooms</td>
<td>22</td>
<td>135</td>
</tr>
<tr>
<td>Offices</td>
<td>16</td>
<td>32</td>
</tr>
<tr>
<td>In-vehicles</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Outdoors</td>
<td>4</td>
<td>19</td>
</tr>
</tbody>
</table>
Calculation of Formaldehyde Exposure Concentration

- Calculated a daily time-weighted average
- References for exposure concentrations
  - CARB (2005) Report to the Legislature
  - Sherman and Hodgson (2002)
- References for activity pattern data
  - University of California, Berkeley (1991)

Summary of Revisions

- Used the “Hot Spots Program” equation for inhalation dose ($\text{Dose}_{\text{inh}}$)
- Estimated cancer risk in children and adults using 9-year and 70-year durations
- Risk in average and elevated exposure scenarios were estimated by applying OEHHA’s cancer potency factor
Revised Risk Estimates

- Children: estimated chances per million of developing cancer ranged from 22 to 62 based on a 9-year exposure duration
- Adults: estimated chances per million of developing cancer ranged from 86 to 231 based on a 70-year exposure duration
- Adoption of the Phase 1 and Phase 2 standards would reduce estimated cancer risk by 17% and 46%, respectively

Update on BACT Assessment
BACT Assessment Update

- Growing list of commercial panels meeting Phase 2 requirements
- Growing list of commercial resin systems meeting Phase 2 requirements
- Viable future resin technologies

Commercially Available Composite Wood Panels

<table>
<thead>
<tr>
<th>Tradename</th>
<th>Manufacturer</th>
<th>Wood Products</th>
<th>Resin System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medite II, Medex, and Arreis</td>
<td>SierraPine</td>
<td>MDF</td>
<td>MDI</td>
</tr>
<tr>
<td>Purebond</td>
<td>Columbia Forest Products</td>
<td>HWPW</td>
<td>Soy-based</td>
</tr>
<tr>
<td>Purekor-Particleboard Plus/MDF Plus</td>
<td>Panel Source International</td>
<td>PB, MDF</td>
<td>MDI</td>
</tr>
<tr>
<td>Purekor-FSC Plywood Plus</td>
<td>Panel Source International</td>
<td>HWPW</td>
<td>PF</td>
</tr>
<tr>
<td>Skyply*</td>
<td>Roseburg</td>
<td>HWPW</td>
<td>PF</td>
</tr>
<tr>
<td>Skyblend</td>
<td>Roseburg</td>
<td>PB</td>
<td>PF</td>
</tr>
</tbody>
</table>

*Phase 2 compliance not confirmed
Commercially Available Resin Systems

<table>
<thead>
<tr>
<th>Tradename</th>
<th>Company</th>
<th>Wood Products</th>
<th>Resin System</th>
</tr>
</thead>
<tbody>
<tr>
<td>EcoBind Resin System</td>
<td>Hexion</td>
<td>HWPW, PB, MDF</td>
<td>MUF + co-reactants, PF, Soy/PVA blend</td>
</tr>
<tr>
<td>Kenocatch Catcher System</td>
<td>Akzo Nobel</td>
<td>MDF, PB</td>
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<td>Huntsman</td>
<td>PB, MDF</td>
<td>Polyurethane &amp; MDI</td>
</tr>
<tr>
<td>Resin System</td>
<td>Franklin Chemical</td>
<td>HWPW</td>
<td>PVA</td>
</tr>
</tbody>
</table>

Future Resin Developments

<table>
<thead>
<tr>
<th>Resin</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenol-UF</td>
<td>Zhao et al., 1999</td>
</tr>
<tr>
<td>Phenol-UF-Tannin</td>
<td>Vazquez et al., 2004</td>
</tr>
<tr>
<td>Cashew Nut Shell Liquid</td>
<td>A. Pizzi, 2006</td>
</tr>
<tr>
<td>MDI Hybrids (UF, PF, MUF, PMUF)</td>
<td>Lei et al., 2006</td>
</tr>
<tr>
<td>Soyad® PF/Soy blend</td>
<td><a href="http://www.heartlandresource.com/">http://www.heartlandresource.com/</a></td>
</tr>
</tbody>
</table>
Future Resin Developments

Phenol-UF Resins

- Low to zero-formaldehyde emissions
- Trials being conducted on PB, MDF, HWPW
  - Ohyama et. al., 1995; Zhao et al., 1999; Vazquez et. al., 2004
- Press times as fast as UF resins with accelerator
- Mechanical strength better than PF resins
- Commercialization mentioned in Zhao, et. al., 1999
- Costs unknown at present

Future Resin Developments

MDI Hybrid Resins

- Commercially available in Europe
- Upgrades traditional wood adhesives
- Enhanced mechanical performance
  - Wet and dry internal bond strengths increase
Summary

- Technology already exists to meet Phase 2 standards
- Resin companies appear to be focusing on Phase 2 standards
- Future resin technology is promising

Update on Enforcement
Enforcement Related Activities

Since June 20th Workshop

- Internal coordination between enforcement and laboratory
- Initiate planning for ARB raw panel testing
- DHS coordination
- Various tours
  - Door manufacturers
  - Oakland port
  - Architectural plywood
  - DHS laboratory
- Initiate industry coordination for finished product screening test development
- Evaluation of chain of custody requirements
- Meeting with Chinese Consulate

Points for Enforcement

Board producers

Third party certifiers

Sale of raw panels

Fabricator

Retailer

Flow of Commerce

Foreign

Other States

California

Certified?

Importer Warehouse

Distributor/Wholesale

Retail Sale of Panels

Product manufacturer (e.g., cabinets, doors, furniture)

Sale of products
Composite Wood ATCM Enforcement

**Inspection Approach**

- Chain of Custody documentation audit
- Review of third party certification emissions data
- Raw panel sampling and testing at ARB’s certified small chamber under ASTM 6007
- Use finished product screening method (under development)
  - As a screening device
  - To test components of finished products
- If warranted, ARB enforcement investigation

**Other Inspection Approaches**

- Enforcement under ARB’s program on ports
- Joint enforcement activities with USEPA, US Customs and local air pollution control districts
- Follow up on complaint hotline
Future Work on Enforcement Program

- Fully define third party certification requirements
- Continue dialogue with international producers/fabricators
- Further evaluate options to strengthen Chain of Custody
- Continue development of finished product screening method

Update on Emissions Inventory
ATCM Emission Inventory Update

- Health & Safety Code section 39665(a)(1) requires ARB to assess emissions of Toxic Air Contaminants
- On Aug. 4, 2004 staff last presented an estimate of the emission inventory associated with MDF, HWPW and PB
  - Estimated at 90 tons per year
  - Considered comments by the Composite Panel Association
  - Simple calculation based on fixed emission rate and annual production
  - Did not account for decay and multi-year emissions
- ARB staff is now refining the emissions inventory calculation for 2002 to account for:
  - Emissions decay, annual CA demand, lamination of boards

2002 California Emission Inventory Methodology

\[
ES_{2002} = \sum_{i=1992}^{2002} cE_i A_i
\]

- \(ES_{2002}\) = Statewide emission inventory, tons
- \(E_i\) = Annual emission rate of each product, grams/m²
- \(A_i\) = Area of each product associated with annual demand, m²
- \(c\) = Conversion factor from grams to tons

Calculation spans 1992 to 2002 to account for emissions decay
Particleboard Formaldehyde Concentration Decay Curve

\[ C = 0.245 - 0.029 \ln(t) \]


Particleboard Emission Flux Density*

* ARB Calculation
Particleboard Annual Emission Rate Over 11 Year Span

\[ ES_{2002} = \sum_{i=1992}^{2002} E_i A_i \]

2002 Raw Particleboard Emission Estimate

\[ ES_{2002} = \sum_{i=1992}^{2002} CE_i A_i \]

<table>
<thead>
<tr>
<th>Year</th>
<th>California Consumption (m³)</th>
<th>Annual Emission Rate in 2002 (g/m³)</th>
<th>2002 Emissions (ton)</th>
<th>Cumulated 2002 Emissions (ton)</th>
<th>Percentage Contribution to 2002 Emission (%)</th>
<th>Cumulated Percentage Contribution to 2002 Emission (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>44,467,823</td>
<td>0.07</td>
<td>6.86</td>
<td>6.86</td>
<td>1.22</td>
<td>1.22</td>
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<tr>
<td>1993</td>
<td>48,681,082</td>
<td>0.11</td>
<td>11.81</td>
<td>18.67</td>
<td>2.10</td>
<td>3.32</td>
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<tr>
<td>1994</td>
<td>53,019,919</td>
<td>0.15</td>
<td>17.54</td>
<td>36.21</td>
<td>3.12</td>
<td>6.43</td>
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<tr>
<td>1995</td>
<td>49,143,820</td>
<td>0.19</td>
<td>20.59</td>
<td>56.80</td>
<td>3.66</td>
<td>10.09</td>
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<tr>
<td>1996</td>
<td>52,690,268</td>
<td>0.24</td>
<td>27.88</td>
<td>84.68</td>
<td>4.96</td>
<td>15.05</td>
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<tr>
<td>1997</td>
<td>54,269,203</td>
<td>0.31</td>
<td>37.10</td>
<td>121.78</td>
<td>6.59</td>
<td>21.64</td>
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<tr>
<td>1998</td>
<td>56,933,565</td>
<td>0.38</td>
<td>47.70</td>
<td>169.48</td>
<td>8.48</td>
<td>30.12</td>
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<tr>
<td>1999</td>
<td>57,809,217</td>
<td>0.47</td>
<td>59.91</td>
<td>229.39</td>
<td>10.65</td>
<td>40.76</td>
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<tr>
<td>2000</td>
<td>59,960,609</td>
<td>0.59</td>
<td>78.01</td>
<td>307.40</td>
<td>13.86</td>
<td>54.63</td>
</tr>
<tr>
<td>2001</td>
<td>55,737,696</td>
<td>0.78</td>
<td>95.86</td>
<td>403.26</td>
<td>17.04</td>
<td>71.66</td>
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<tr>
<td>2002</td>
<td>57,855,941</td>
<td>1.25</td>
<td>159.47</td>
<td>562.73</td>
<td>26.34</td>
<td>100.00</td>
</tr>
</tbody>
</table>
Particleboard Emissions Adjusted for Lamination Effects

\[ \text{PB Emissions} = \text{PB}_{\text{Raw}} \times \text{AF}_{\text{Lam}} \]

- \( \text{PB}_{\text{Raw}} \) = Raw particleboard emissions
- \( \text{AF}_{\text{Lam}} \) = Adjustment factor for laminated boards

- No studies showing long term decay curve of laminated particleboards
- Raw particleboard emissions (563 tons/year) adjusted to account for lamination
- Staff assumed percent of particleboard that is laminated
  - Range between 50% to 85%; midpoint 68%
- \( \text{PB Emissions} = 563 \text{ tpy} \times (1-.68) = 180 \) tons per year

Total Statewide Emissions

\[ ES_{2002} = \sum_{i=1992}^{2002} cE_iA_i \]

- Will be sum of particleboard, hardwood plywood and medium density fiberboard emissions
- Medium density fiberboard and hardwood plywood have different decay models as compared to particleboard
- Staff currently developing estimates of statewide emissions of medium density fiberboard and hardwood plywood emissions for staff report
Additional Data Needs

- Volume of laminated particleboard and medium density fiberboard
- Flux density of hardwood plywood
- Flux density of medium density fiberboard

Update on Economic Impact
ATCM Cost Impacts

- Staff presented preliminary cost analysis on June 20th workshop
- Currently refining incremental board production cost analysis
- Refined new home cost analysis
- CWIC economic analysis

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<td>Huntsman</td>
<td>PB, MDF</td>
<td>Polyurethane &amp; MDI</td>
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<tr>
<td>Reactite EP-925</td>
<td>Franklin Chemical</td>
<td>HWPW</td>
<td>PVA</td>
</tr>
<tr>
<td>Multibond</td>
<td>States Industries</td>
<td>HWPW</td>
<td>PVA</td>
</tr>
</tbody>
</table>

- Additional research shows that minimal production equipment upgrades necessary for most Phase 2 resin systems
Cost Structure for Average House

National Average Home Price: $252,000

- Composite wood ~0.4%
- All Material ~30%
- Finished Lot/Financing - 25%
- Sales/Marketing - 6%
- Profit - 16%
- Labor - 22%

Source: Professional Builder and NAHB, March 2003
*ARB Staff Analysis, Oct 2006

Estimate of Composite Wood Cost for a House

National Average House Price $252,000 *

<table>
<thead>
<tr>
<th>Board Thickness and sq. ft. Used **</th>
<th>Price ($) ***</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4 &quot;</td>
<td>1/2 &quot;</td>
</tr>
<tr>
<td>PB</td>
<td>---</td>
</tr>
<tr>
<td>MDF</td>
<td>273.44</td>
</tr>
<tr>
<td>HWPW</td>
<td>194.32</td>
</tr>
</tbody>
</table>

Total Composite Material Cost : $1013.81
$1013.81/$252,000= 0.4%

Source: * National Association Home Builders
** Pricing: Gainah Lumber, Lake Forest, CA
*** Material: Designer Custom Cabinets, Mission Viejo, CA
**Pre - and Post-ATCM Cost Increase**

**Case 1:** PB and MDF board cost increases by 30%
HWPW board cost increases by 15%

<table>
<thead>
<tr>
<th></th>
<th>Pre-ATCM</th>
<th>Incremental Cost</th>
<th>Post-ATCM</th>
</tr>
</thead>
<tbody>
<tr>
<td>PB</td>
<td>$438.90</td>
<td>+ $131.67</td>
<td>$570.57</td>
</tr>
<tr>
<td>MDF</td>
<td>$160.01</td>
<td>+ $48.00</td>
<td>$208.01</td>
</tr>
<tr>
<td>HWPW</td>
<td>$414.90</td>
<td>+ $62.24</td>
<td>$477.14</td>
</tr>
<tr>
<td>Total Cost</td>
<td>$1013.18</td>
<td>+ $241.91</td>
<td>$1255.75</td>
</tr>
</tbody>
</table>

Assumptions to further define cost sensitivity:

**Case 2:** All composite wood price increases by 30%

**Case 3:** All Composite wood price increases by 50%

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**ATCM Sensitivity Cost Analysis of a New House**

<table>
<thead>
<tr>
<th></th>
<th>Home Price</th>
<th>Home Price % Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-ATCM New Home Price</strong> (Composite Wood Material Cost)</td>
<td>$252,000 ($1,013.18)</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Post-ATCM New Home Price Case 1</strong>  PB and MDF cost increase by 30% HWPW cost incases by 15%</td>
<td>$252,241 (+ $241.91)</td>
<td>0.096 %</td>
</tr>
<tr>
<td><strong>Post-ATCM New Home Price Case 2</strong>  - All Composite Wood Material Cost Increase by 30%</td>
<td>$252,304 (+ $304.14)</td>
<td>0.12 %</td>
</tr>
<tr>
<td><strong>Post-ATCM New Home Price Case 3</strong>  - All Composite Wood Material Cost Increase by 50%</td>
<td>$252,507 (+ $506.90)</td>
<td>0.20 %</td>
</tr>
</tbody>
</table>
CWIC Economic Analysis

- Analysis shows $154 million to $1.04 billion cost to state
  - PB and MDF only

- Potential decline in final demand
  - Decline in final demand from 0% to 40%
  - Decrease in local manufacturing and related sales activity
  - Layoffs and business closures

- Increase in market prices to consumers
  - Cost data provided by resin suppliers and PB/MDF producers
  - Cost data reflect conditions under Phase 2
  - 100% of the cost increases are passed onto the consumer

Next Steps

- Individual meetings (international/domestic)
- Finished product screening method workgroup
- Continue development of enforcement provisions
- Publish staff report – December 8, 2006
ADJOURN

THANK YOU FOR YOUR PARTICIPATION!