

Summary of ARB Testing of Laminated Products

“Laminated products” are defined in the Composite Wood Products Airborne Toxic Control Measures (ATCM) as “a finished good or component part of a finished good made by a fabricator in which a laminate or laminates are affixed to a platform.”

“Laminates” can consist of wood veneer or synthetic materials. The ATCM requires fabricators of laminated products to use certified platform materials, but the resulting laminated products have no additional emission standards or testing requirements. When the ATCM was developed, emissions data were not available to indicate whether the glue used to affix the laminate might lead to formaldehyde emissions of concern.

To address the lack of emissions data, Air Resources Board (ARB) staff conducted a study in cooperation with the American Home Furnishings Alliance (AHFA) to measure the emissions from laminated products. The primary objectives were to:

- evaluate formaldehyde emissions of laminated products that consist of a wood veneer affixed using urea-formaldehyde (UF) resin to platforms consisting of particleboard (PB) or medium density fiberboard (MDF); and
- compare the emissions of delaminated products with raw panel emissions to determine the level of delamination that correlates best with the emissions of the original raw panel.

For the study, AHFA member companies prepared laminated product panels. These panels were cut in half, with one half of each panel provided to ARB for testing and the other half provided to AHFA for testing.¹ Most panels were well wrapped in layers of plastic to reduce emission losses prior to testing, although one set of panels was shipped in a box with no plastic wrap. Panels were prepared by ARB’s Enforcement Division (ED) staff and tested by ARB’s Monitoring and Laboratory Division (MLD) staff over the period of October 2011 to September 2012. (Even though several panels were stored for several months prior to testing, the results indicate that the plastic wrap retained the formaldehyde, as some of the panels that sat the longest prior to preparation and testing had some of the highest results.)

A total of 16 laminated product sample sets were tested. Each sample set consisted of three panels: 1) the “raw” PB or MDF platform; 2) a panel consisting of the PB or MDF with an oak, maple, or cherry veneer attached using a UF resin; and 3) a panel consisting of the PB or MDF with the veneer attached using a UF resin and a stain or finish applied to the veneer. Emissions testing consisted of duplicate or triplicate specimens for the following scenarios for each panel: a) as received; b) with stain removed for finished panels (which included a portion of the veneer); c) with veneer removed (at the glue line), and d) at three levels below the glue line or surface of the raw panel (0.01, 0.02, and 0.04 inches). All removals were conducted using a sander.

¹ This summary only provides ARB’s testing results.

The protocol for the emissions testing is provided in Attachment 1. A table with all of the results is included in Attachment 2, with samples referred to by a number assigned to each fabricator (e.g., FAB2). Below is a summary of the findings.

Findings

- The platform material (PB or MDF) complied with the Phase 1 or Phase 2 emission standards.
- Several of the laminated products emitted considerably more formaldehyde than was emitted by the platforms, due to the UF resin used to affix the veneer.
- Most samples with no stain or finish had higher emissions than identical products with a stain, indicating that the application of stain can reduce formaldehyde off-gassing and decrease exposures to formaldehyde, although many samples with a stain still emitted more formaldehyde than the platforms.
- Regarding deconstructive testing, the emission measurement results after removal (by sanding) of material to 0.01 and 0.02 inches below the glue line compared best with the raw panel emissions.

Attachment 1

Protocol for Testing Laminated Products in Coordination with AHFA

Objective

The primary objective of this testing is for ARB to evaluate formaldehyde emissions of laminated products that consist of a wood veneer affixed using a UF glue to Phase 2 particleboard and MDF. Some wood veneers (e.g., red oak) are much more porous and have the potential to lead to higher emissions, especially if UF glue is used to affix the veneer to the platform. The evaluation will include a comparison of panels made with a porous veneer (red oak) and a less porous veneer (maple). Emissions of these laminated products will be compared with the Phase 2 HWPW standard (0.05 ppm), to help determine if such laminated products need to be regulated differently than under the current ATCM.

A secondary objective is to compare the emissions of delaminated products with raw panel emissions to determine which delamination amount correlates best with the emissions of the original raw panel. This will add to our information from prior deconstructive testing to help establish the delamination amount for preparation of enforcement samples that consist of laminated products.

AHFA will be keeping split samples. AHFA wants to prepare samples using ARB's sample preparation procedures. AHFA will have their samples tested by an independent lab, for comparison with ARB's results.

Test Materials

AHFA and member companies have committed to provide samples of raw Phase 2 compliant particleboard and MDF, and samples using the same platforms with red oak and maple veneers affixed using UF glue.

Procedures

1. Conduct screening testing of the emissions of raw panels and laminated products using the FLEC/Interscan, and report results on sample transfer record (optional).
2. Cut specimens from all raw panels and laminated products provided by AHFA to the appropriate size to meet ARB/MLD's small chamber flow to area (Q/A) ratio.
 - a. A minimum of two specimens of each size will be cut from each raw panel and laminated product to provide data on duplicate samples.
 - b. Specimens cut from laminated products that consist of a wood veneer are to be cut to the size appropriate for testing HWPW, which is 7" x 5 5/8".

Emissions from these samples will be compared with the Phase 2 standard for HWPW of 0.05 ppm.

- c. At least two specimens from raw panels (MDF or PB) will be cut to the HWPW size, to be able to compare the emissions of the raw panel with the laminated product for equal size specimens. This will provide information on the effectiveness of the veneer to act as a barrier to formaldehyde emissions.
 - d. All other specimens, that will consist of delaminated specimens and specimens cut from raw panels, should be cut to the size appropriate for the platform used in making the laminated product: 7" x 5 5/8" for particleboard and 7" x 3.5" for MDF.
3. Prepare specimens cut from all raw panels and laminated products provided by AHFA by using a sander or planer, as follows:
 - a. As received (no surface removal),
 - b. With 0.01 inch removed from the surface of raw panels or from below the glue line of laminated products,
 - c. With 0.02 inch removed from the surface of raw panels or from below the glue line of laminated products, and
 - d. With 0.04 inch removed from the surface of raw panels or from below the glue line of laminated products.
 4. Wrap and label each specimen, keeping track of raw panels and laminated products using the AHFA labeling information.
 5. Provide samples with sample transfer record to ARB/MLD.
 6. MLD will condition and test emissions following MLD's SOP for "Sampling and Analysis of Formaldehyde Emissions from Composite Wood Products."
 7. Report emissions data to Lynn Baker, ARB/SSD.
 8. SSD will compare emissions data with AHFA testing results.

Attachment 2

Testing Results - Laminated Products

Fabricator/ Sample #	Veneer	Resin used to affix veneer	Platform	Finish/ stain applied?	Emissions as received (ppm)	Deconstructed emissions at glue line (ppm)	Deconstructed emissions (ppm) below glue line by:		
							0.01"	0.02"	0.04"
FAB 2									
FAB 2-AA1	raw	-	PB	no	0.03	-	0.04	0.04	0.05
FAB 2-AA2	oak	UF	PB	no	0.13	0.06	0.06	0.05	0.06
FAB 2-AA3	oak	UF	PB	yes	0.05	0.05	0.05	0.06	0.05
FAB 2-AB1	raw	-	PB	no	0.04	-	0.04	0.04	0.05
FAB 2-AB2	maple	UF	PB	no	0.13	0.09	0.06	0.04	0.06
FAB 2-AB3	maple	UF	PB	yes	0.08	0.08	0.06	0.05	0.06
FAB 2-AC1	raw	-	MDF	no	0.07	-	0.08	0.10	0.10
FAB 2-AC2	oak	UF	MDF	no	0.11	0.05	0.09	0.09	0.11
FAB 2-AC3	oak	UF	MDF	yes	0.05	0.05	0.09	0.09	0.11
FAB 2-AD1	raw	-	MDF	no	0.08	-	0.08	0.10	0.10
FAB 2-AD2	maple	UF	MDF	no	0.17	0.08	0.08	0.08	0.11
FAB 2-AD3	maple	UF	MDF	yes	0.07	0.08	0.10	0.10	
FAB 2-LA1	raw	-	PB	no	0.03	-	0.05	0.05	0.13
FAB 2-LA2	oak	UF	PB	no	0.79	0.30	0.09	0.09	0.12
FAB 2-LA3	oak	UF	PB	yes	0.57	0.33	0.09	0.09	0.13
FAB 2-LB1	raw	-	PB	no	0.05	-	0.05	0.07	0.10
FAB 2-LB2	maple	UF	PB	no	0.98	0.22	0.08	0.08	0.12
FAB 2-LB3	maple	UF	PB	yes	0.58	0.22	0.09	0.08	0.13
FAB 2-LC1	raw	-	MDF	no	0.04	-	0.05	0.05	0.06
FAB 2-LC2	oak	UF	MDF	no	0.55	0.07	0.05	0.05	0.06
FAB 2-LC3	oak	UF	MDF	yes	0.40	0.09	0.04	0.05	0.05
FAB 2-LD1	raw	-	MDF	no	0.04	-	0.05	0.05	0.05
FAB 2-LD2	maple	UF	MDF	no	0.82	0.18	0.05	0.05	0.07
FAB 2-LD3	maple	UF	MDF	yes	0.36	0.13	0.04	0.04	0.05

Fabricator/ Sample #	Veneer	Resin used to affix veneer	Platform	Finish/ stain applied?	Emissions as received (ppm)	Deconstructed emissions at glue line (ppm)	Deconstructed emissions (ppm) below glue line by:		
							0.01"	0.02"	0.04"
FAB 6									
(received unwrapped)									
FAB 6-1	raw	-	PB	no	0.07	-	0.06	0.06	0.06
FAB 6-2	maple	UF	PB	no	0.07	0.04	0.07	0.05	0.07
FAB 6-3	maple	UF	PB	yes	0.03	0.05	0.07	0.05	0.07
FAB 6-4	raw	-	MDF	no	0.17	-	0.17	0.19	0.16
FAB 6-5	maple	UF	MDF	no	0.09	0.08	0.14	0.14	0.15
FAB 6-6	maple	UF	MDF	yes	0.03	0.09	0.13	0.15	0.15
FAB 7									
FAB 7-1	raw	-	MDF	no	0.18	-	0.17	0.18	0.16
FAB 7-2	raw	-	PB	no	0.14	-	0.10	0.12	0.10
FAB 7-3	maple	UF	MDF	no	1.35	0.16	0.16	0.22	0.22
FAB 7-4	maple	UF	PB	no	1.29	0.33	0.25	0.24	0.24
FAB 7-5	maple	UF	MDF	yes	0.30	0.26	0.20	0.25	0.24
FAB 7-6	maple	UF	PB	yes	0.45	0.45	0.26	0.25	0.25
FAB 8									
(did not test emissions at glue line)									
FAB 8-1	raw	-	MDF	no	0.04	-	0.04	0.04	0.04
FAB 8-2	raw	-	PB	no	0.03	-	0.04	0.06	0.07
FAB 8-3	maple	UF	MDF	no	0.22	-	0.04	0.05	0.04
FAB 8-4	maple	UF	PB	no	0.19	-	0.04	0.05	0.08
FAB 8-5	maple	UF	MDF	yes	0.09	-	0.04	0.04	0.04
FAB 8-6	maple	UF	PB	yes	0.09	-	0.04	0.05	0.10

Fabricator/ Sample #	Veneer	Resin used to affix veneer	Platform	Finish/ stain applied?	Emissions as received (ppm)	Deconstructed emissions at glue line (ppm)	Deconstructed emissions (ppm) below glue line by:		
							0.01"	0.02"	0.04"
FAB 9									
FAB 9-1	raw	-	PB	no	0.04	-	0.05	0.05	0.07
FAB 9-2	raw	-	MDF	no	0.04	-	0.04	0.04	0.05
FAB 9-3	oak	UF	PB	no	0.07	0.05	0.06	0.06	0.06
FAB 9-4	cherry	UF	MDF	no	0.02	0.03	0.05	0.05	0.06
FAB 9-5	oak	UF	PB	yes	0.17	0.04	0.06	0.07	0.07
FAB 9-6	cherry	UF	MDF	yes	0.06	0.02	0.05	0.04	0.05