Evaluation of Three Laboratories Using the California Air Resources Board's Sample Preparation Procedures and Small Chamber Testing to Measure Formaldehyde Emissions from Composite Wood Products Contained in Finished Goods

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Summary

California Air Resources Board (CARB) staff conducted a study to evaluate the variability in measurements of formaldehyde emissions from composite wood products contained in finished goods. Finished goods include consumer items such as laminate flooring, cabinets, and furniture. CARB contracted with three CARB-approved third-party certifier laboratories that use CARB's sample preparation procedures and the small chamber test method to measure formaldehyde emissions from composite wood products.

CARB's sample preparation procedures require that a laminate or coating (e.g., wood veneer, synthetic laminate, or varnish) be removed from a finished good prior to formaldehyde emissions testing. This is done in order to test the emissions of the underlying composite wood product for compliance with CARB's formaldehyde emission standards. The process of removing laminates or coatings is referred to as "deconstructing samples."

Three types of laminated products were used in this study. Identical samples were sent to each laboratory. CARB's laboratory also participated in the study.

Testing results indicated minimal variability between the laboratories for the three laminated products, with mean test results for each of the three laboratories within 0.02 ppm of CARB's laboratory. Additionally, each laboratory's mean test results for the deconstructed samples were within 0.03 ppm of the formaldehyde emissions of the original composite wood product prior to lamination. CARB staff believes that this study demonstrated that deconstructing samples is an effective step in determining whether composite wood products in finished goods comply with the applicable formaldehyde emission standards.

Introduction

In 2007, the California Air Resources Board (CARB) approved the Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products (title 17, California Code of Regulations, sections 93120-93120.12). The ATCM established formaldehyde emission standards for three types of composite wood products: hardwood plywood, particleboard (PB), and medium density fiberboard (MDF). Composite wood products are used in making finished goods (consumer items such as laminate flooring, cabinets, and furniture). In the process of making finished goods, composite wood products are commonly used as platform (core) material and covered with a veneer, laminate, or coating (e.g., paint or varnish).

The ATCM requires that any composite wood products in finished goods offered for sale in California must comply with the formaldehyde emission standards. In addition, the ATCM requires CARB to test composite wood products in finished goods for compliance with CARB's formaldehyde emission standards.

In 2013, CARB finalized sample preparation procedures[1] that describe the process of separating or cutting a finished good into component parts, followed by removal of the wood veneer, synthetic laminate or coating, and glue-line so that the formaldehyde emissions of the underlying composite wood product platform may be tested for compliance with the applicable formaldehyde emission standard. The process of removing laminates or coatings is referred to as "deconstructing samples." In developing these procedures, CARB staff tested the emissions of over 200 samples that consisted of different types of wood veneer and synthetic laminate affixed with different types of glue to composite wood product platforms. In each case, CARB also tested the emissions of the original composite wood product platform prior to the material being laminated or veneered. Laminated products were deconstructed with different removal amounts below the glue-line, to determine which removal amount most closely compared with the original emissions prior to lamination.

CARB's sample preparation procedures allow the use of a planer or sander. After removal of the surface laminate, coating, and glue, an additional 0.005 - 0.03 inches of composite wood product platform is removed to ensure that any glue that may have penetrated into the underlying composite wood product platform is also removed. CARB's sample preparation procedures specify that samples can be deconstructed on one or both sides of the component part.

Since adoption of the ATCM, several industry groups representing flooring, cabinet, and furniture fabricators expressed concern that CARB would not be able to take enforcement action against finished goods. Their concern was based on the uncertainty associated with testing the emissions of composite wood products contained in finished goods. Industry groups claimed that "deconstructing" finished goods in order to test the

[1] Standard Operating Procedure for Finished Good Test Specimen Preparation Prior to Analysis of Formaldehyde Emissions from Composite Wood Products, CARB – Enforcement Division, September 13, 2013.

emissions of the underlying composite wood product platform would change the emission characteristics.

In March 2015, following the CBS News “60 Minutes” story about Lumber Liquidators selling laminate flooring that did not comply with the ATCM, CARB staff received hundreds of calls and emails from concerned consumers from across the country. Consumers wanted to know if their flooring was safe and many wanted to have their flooring tested for formaldehyde emissions. CARB staff asked the CARB-approved third-party certifiers (TPCs) based within the United States if any would be willing to conduct testing of flooring for consumers. Three TPCs expressed willingness to follow CARB’s sample preparation procedures to conduct tests for consumers that wanted to have their flooring tested. These three TPCs were selected for participation in this study.

Study Design

CARB entered into contracts with the three CARB-approved TPCs that agreed to conduct tests for consumers as a means of:

- Evaluating the variability of testing results using identical products for laboratories that use CARB’s sample preparation procedures and the CARB secondary test method for formaldehyde (small chamber, ASTM D 6007, deemed equivalent to test results from a large chamber, ASTM E 1333).

- Verifying that the TPCs were providing consumers with accurate information.

CARB’s laboratory participated in the evaluation for comparison purposes. In addition, CARB’s laboratory tested the emissions of the original composite wood product platform (PB and MDF) prior to lamination. CARB intentionally did not send samples of the material used as the platform to the TPCs to avoid any potential conflict with the TPCs having knowledge of the emissions of the platform prior to deconstructing the laminated products. CARB’s study director labeled samples so that CARB’s laboratory could not identify samples of the original platform as being related to the deconstructed samples.

<u>Test Materials</u>

CARB had the following three types of laminated products specially made for use as test materials during this evaluation:

- PB with thermally-fused melamine overlay affixed to the face and back (glue is incorporated in the overlay).

- PB with wood veneer affixed to the face and back using urea formaldehyde glue.

- MDF with wood veneer affixed to the face and back using urea formaldehyde glue.

Each of the three TPC laboratories and CARB's laboratory were provided with identical laminated products, including three partial panels (thirds or halves of 48-inch x 96-inch panels) of each of the three test materials. Each partial panel was labeled with a sample number. In order to preserve the integrity of the evaluation, the laboratories were not informed regarding the glues used to make the laminated products or the underlying composite wood product platform.

Methods

The scope of work for these contracts specified that only one side of each test material needed to be deconstructed to form one sample for testing. The three TPC laboratories and the CARB laboratory used a sander or planer to remove the laminate or wood veneer from the item to be tested. Two deconstructed specimens were then placed back-to-back (deconstructed sides exposed) with the edges taped to make one sample for emissions testing using the secondary test method.

Each laboratory used their secondary method testing chambers to measure the formaldehyde emissions of two samples from each of the three partial panels for each test material, resulting in six test results per test material.

Results

Tables 1 through 3 present the deconstructed test results, reported in parts per million (ppm), for the three test materials, along with the original formaldehyde emissions of the composite wood product platform prior to lamination. Each of the three TPC laboratories was assigned an anonymous identifier, noted below.

The mean deconstructed test results for each of the three laboratories were within 0.02 ppm of the CARB laboratory. Each laboratory's mean test results were within 0.03 ppm of the formaldehyde emissions of the original composite wood product prior to lamination. The results of duplicate analyses of the same samples had a difference of no more than 0.02 ppm. The differences in mean test results between the laboratories for deconstructed samples and for duplicate analyses were comparable to the repeatability (within laboratory) of 0.01 – 0.02 ppm and reproducibility (between laboratories) of 0.02 – 0.05 ppm reported in the ASTM D 6007 test method for composite wood products that emit between 0.06 and 0.24 ppm of formaldehyde.

Table 1 – PB with Melamine Affixed

(Prior to lamination, the PB had a mean test result of 0.10 ppm)		
Laboratory	Deconstructed test results (ppm)	
	Mean	Range
CARB	0.10	0.09 – 0.12
Lab D1	0.10	0.09 – 0.10
Lab D2	0.10	0.09 – 0.11
Lab D3	0.10	0.10 – 0.11

Table 2 – PB with Wood Veneer Affixed

(Prior to lamination, the PB had a mean test result of 0.10 ppm)		
Laboratory	Deconstructed test results (ppm)	
	Mean	Range
CARB	0.09	0.08 – 0.11
Lab D1	0.07	0.07 – 0.08
Lab D2	0.11	0.09 – 0.13
Lab D3	0.10	0.10 – 0.11

Table 3 – MDF with Wood Veneer Affixed

(Prior to lamination, the MDF had a mean test result of 0.09 ppm)		
Laboratory	Deconstructed test results (ppm)	
	Mean	Range
CARB	0.08	0.07 – 0.09
Lab D1	0.06	0.06 – 0.07
Lab D2	0.07	0.05 – 0.09
Lab D3	0.07	0.06 – 0.07

Conclusions

Each laboratory followed CARB's sample preparation procedures and the secondary test method to measure the formaldehyde emissions from the composite wood product platforms contained within three types of laminated products. The results demonstrate that there is minimal variability between laboratories that follow CARB's sample preparation procedures and use the secondary test method. In addition, the deconstructed results were comparable to the emissions of the original composite wood product platform prior to lamination. CARB staff believes that the results demonstrate that deconstruction is an effective step in determining whether composite wood products in finished goods comply with the applicable formaldehyde emission standards of the ATCM. It is important to note that CARB staff accounts for the variability in test results when considering any enforcement action.