columbia
FOREST PRODUCTS

PVA adhesive as a low-emitting hardwood plywood adhesive alternative

Chinese panel emissions test report

February 7, 2007

Ed Woods, Executive Vice President
Elizabeth Whalen, Director of Corporate Sustainability
Paul Davis, Sr. Marketing Analyst

Topics to Review

I. Poly Vinyl Acetate (PVA) is a commercially viable adhesive alternative in use today
   - Review of low-emitting products and adhesive technologies, where does PVA fit?
   - PVA – background
   - Emission properties of PVA-bonded panel assemblies
   - In-plant tests of PVA-bonded hardwood plywood

II. Chinese plywood HCHO test reports
   - Portland area
   - China

Review of materials available now for low-emitting hardwood plywood construction

Company	Product	Type	Emissions[1]
Columbia Forest Products	PureBond™	Hardwood Plywood Assembly	.00 - .02 ppm
Roseburg	SkyBlend™ SkyPly™	Particleboard Hardwood Plywood	< 0.04 ppm < 0.09 ppm
Dongwa		PF-Bonded MDF	Not Avail.
Sierra Pine	Medite II™ Arreis™	MDF MDF	< 0.05 ppm
Various	Poly Vinyl Acetate	Hardwood Plywood Assembly	.02 - .08 ppm

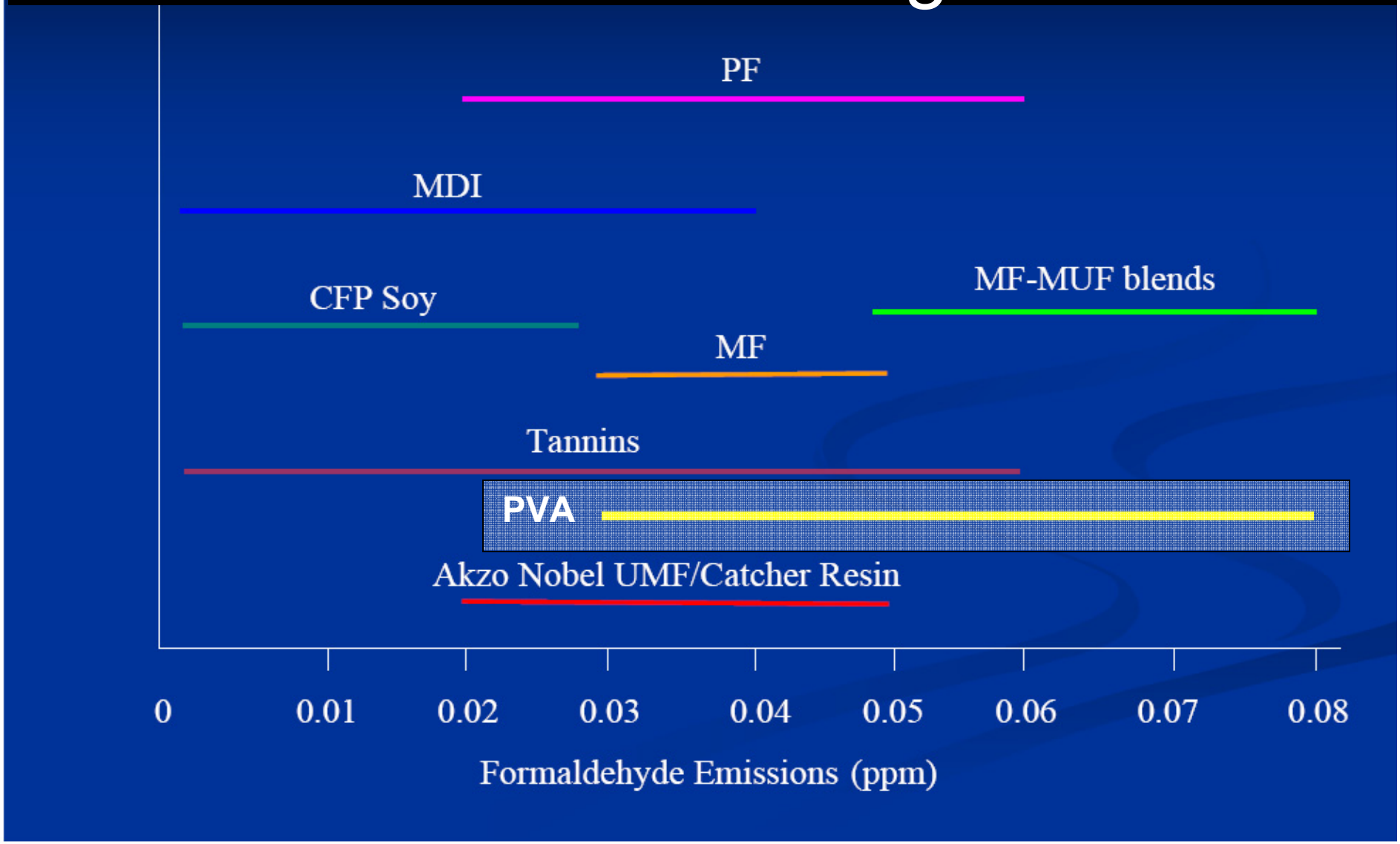
Footnote-1: Information source: Manufacturer's cut sheets, SCS certificates or third party testing arranged for by Columbia Forest Products

Low-emitting plywood adhesive systems - available **now**

Company	Products	Large Chamber ppm[1]
Hexion – EcoBind™	**Ultra-low emitting urea formaldehyde resins**	**≤ 0.06 ppm**
EcoBind™ is a family of resin technologies from Hexion, specifically developed to reduce formaldehyde emissions from wood products to the lowest possible levels.	**Co-reactants to standard UF resin systems**	**≤ 0.03 ppm**
	PVA/Soy adhesive formulation	**Not Avail.**
Akzo Nobel	**UMF Catcher™ Resin**	**0.02 – 0.05 ppm**
Hercules/CFP Soy	**PureBond™**	**≤ .02 ppm**
An entire industry	Poly – Vinyl Acetate (PVA)	.02 - .08 ppm
Hexion, Dynea, GP	Phenol Formaldehyde (PF)	.02 - .06 ppm

Footnote-1: Information source: Manufacturer's cut sheets, CARB presentation

PVA and other Low-Formaldehyde Resin Technologies



Poly Vinyl Acetate (PVA) Background

- Invented in 1913
  - Dr. Fritz Klatte in Germany
- Introduced widely in the late 40's by Borden under the familiar ELMER's® brand name
- Non Chlorinated (no dioxin in life cycle), non-toxic
- Huge industry, many players with billions of pounds of PVA adhesive sold annually in the US alone[1]
- Wood end uses include: Millwork (windows and doors), architectural panels, flooring, furniture

1 – Source: http://www.chemquest.com/store/polyvinyl-chloride-us-adhesives.html

PVA Manufacturers

HEXION™
Specialty Chemicals

National Starch & Chemical
A member of the ICI Group

ASHLAND

AIR PRODUCTS

Celanese

Franklin Adhesives

Research available which characterizes PVA as a Multi-Billion Lb. Per Year Resin in the US

- **15.27USA - Polyvinyl Chloride (PVC) - U.S. Adhesives**
  Polyvinyl chloride (PVC) includes information on polymers of all molecular weights formed from the polymerization of vinyl chloride monomer. Polyvinyl chloride is a multi-billion pound per year resin in the U.S. This thermoplastic polymer is used in a wide spectrum of fabricated goods, including extruded, calendered and molded products. Unlike many other polymers and copolymers, PVC has limited solubility, compatibility, and thermal stability, which restricts adhesive usage to specific areas. It should be noted that the solution grade vinyl chloride/vinyl acetate copolymers are not included in this raw material category, but may be found in the Other Vinyl Acetate (Copolymers) section of this study. This resin classification market report on polyvinyl chloride (PVC) estimates 2003 demand with a historical perspective back to 2000 as well as forecasts through 2005 and 2010 within the U.S. Adhesives Industry.
- **$400.00**

  Report Table of Contents
  Polyvinyl Chloride (PVC) Report - U.S. Adhesives Industry - **RAW MATERIAL** Market

  Market Information - Forecasting Size and Growth Trends
  Market Sector Information – Forecasting Size and Growth Trends
  Market Segment Information – Forecasting Size and Growth Trends
  Formulative Technology Information – Forecasting Size and Growth Trends
  Raw Material Suppliers
  Growth Opportunities – Size and Growth Trend
  Commentary

http://www.chemquest.com/store/polyvinyl-chloride-us-adhesives.html

http://www.ascouncil.org/news/reports/marketreport06.cfm

Not all vinyl is alike…PVA has no CL

- **Vinyl is commonly used as a shorthand name for polyvinyl chloride (PVC) plastic as used in a range of products from flooring to siding to wall covering. Most commonly, when a product is referred to as "vinyl," it is comprised primarily of PVC. Occasionally it also may refer to polyvinylidene chloride (PVDC) a closely related compound, used in food wraps ('Saran') and other films, that shares most of the same environmental health problems.**

- **In chemistry, however, the term "vinyl' actually has a broader meaning, encompassing a range of different thermoplastic chemical compounds derived from ethylene. In addition to PVC, "vinyls" in building materials also include: ethylene vinyl acetate (EVA), used in films, wire coating and adhesives; polyethylene vinyl acetate (PEVA) a copolymer of polyethylene and EVA used in shower curtains; polyvinyl acetate (PVA), used in paints and adhesives, such as white glue, and polyvinyl butyral (PVB), used in safety glass films.**

- **What differentiates PVC from the other vinyls is the addition of a chlorine molecule (the chloride "C" in PVC and PVDC). Chlorine is the source of many of the environmental health concerns with PVC, such as the generation of dioxin, a highly carcinogenic chemical produced in both the manufacture and disposal of PVC. Due to its persistent and bioaccumulative nature (it travels long distances without breaking down and concentrates as it moves up the food chain to humans) dioxin has become a global problem and an international treaty – the Stockholm Convention on persistent organic pollutants (POPs) - now prioritizes the elimination of processes that produce dioxin.**

- **Some of the non chlorinated vinyls (EVA, PEVA, PVA and PVB) are now beginning to be used as direct substitutes for PVC. EVA has been in use for several years as a chlorine free substitute for PVC – primarily in non building materials like toys and athletic shoes, but occasionally as a protective film or binder. In the building industry, post-consumer recycled PVB is now beginning to be used to replace PVC in carpet backing. Absence of chlorine alone does not make these other vinyls the final answer in the search for green polymers. There are still plenty of toxic challenges and untested chemicals in the life cycle of any petrochemical product. As is the case with most other polymers competing with PVC, however, the weight of available evidence indicates that the absence of chlorine in the formula will generally render the lifecycle environmental health impacts of PVB and the other vinyls less harmful than PVC and initial study is bearing this out. Like the polyolefin plastics, the use of PVB and the other non chlorinated vinyls represents a step forward in the search for alternatives to PVC.**

- **In summary, with the exception of paints, glues and certain films, "vinyl" as a product description almost always means made of PVC. The term vinyl in ethylene vinyl acetate (EVA), polyethylene vinyl acetate (PEVA), polyvinyl acetate (PVA), and polyvinyl butyral (PVB), however, does not refer to PVC and does not raise the same concerns associated with chlorinated molecules like PVC.**

Source: http://www.healthybuilding.net/pvc/SortingOutVinyls.html

PVA is even consumed orally as it is used for delivery of ingestible, time-release pharmaceuticals

Kollidon® SR: A polyvinyl acetate based excipient for DC-sustained-release oral dosage forms

by

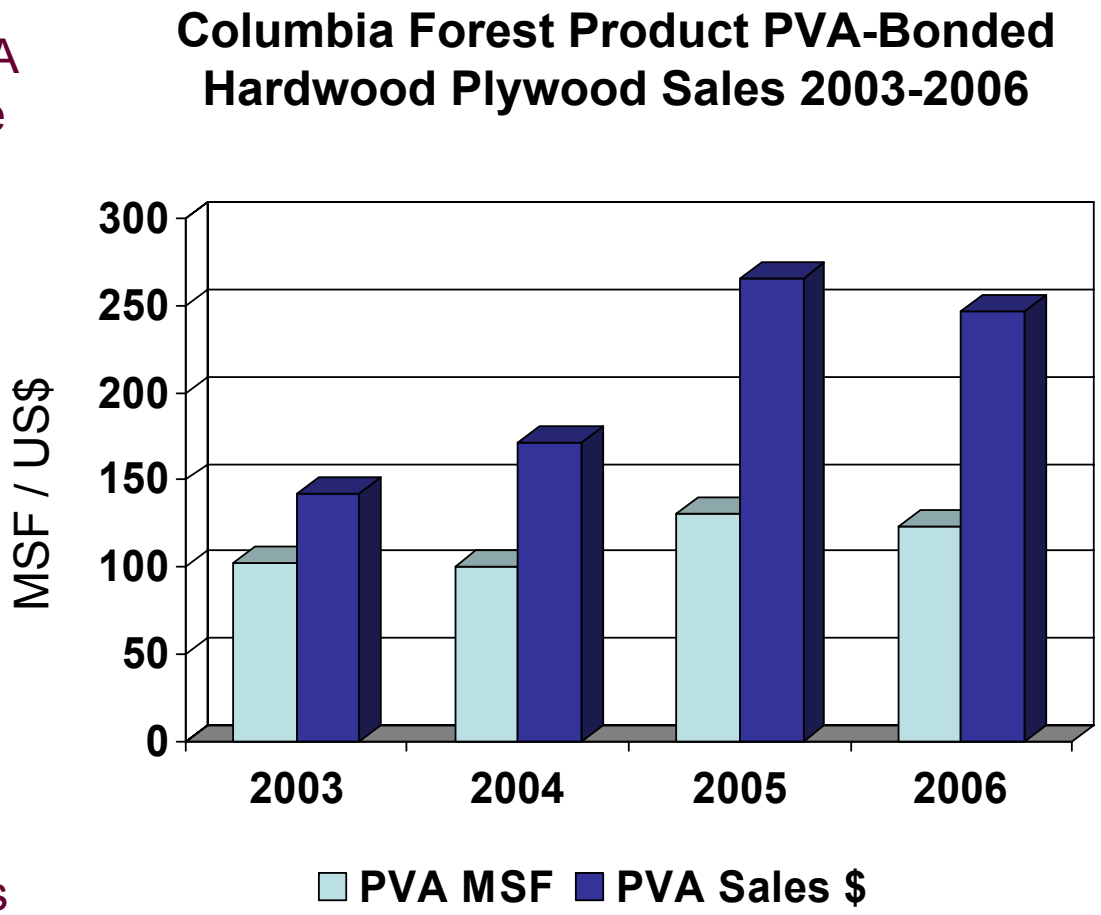
Dr. Bernhard Fussnegger
BASF Aktiengesellschaft, Ludwigshafen
Strategic Marketing Pharma Excipients

- *Introduction*

Sustained-release oral dosage forms are in the focus of interest for several reasons. Customer compliance with the trend to simplicity and more comfort of use, the prolonged drug release with more reliable blood levels than those obtained with conventional dosage forms and life-cycle management of existing APIs directed the pharmaceutical development towards sustained release formulations [1, 2].

PVA used to meet LEED requirements by hardwood plywood manufacturers

- Columbia used the equivalent of Hexion/Borden XB90MI PVA adhesives for the bulk of these orders
- Upcharge required as regular production of UF had to be suspended, equipment and delivery systems cleaned before and after small panel runs
- Columbia not the only company using PVA during this time
- Columbia even manufactured LEED architectural sample kits using PVA-bonded panels



Door, window manufacturers believed to be largest wood-based manufacturing consumers of PVA

Marshfield® DoorSystems

1992

1992 - Cold Press plant fuels growth.

In 1992, growth was fueled by the addition of the cold press manufacturing facility. The addition of the cold press facility brought an additional capability for manufacturing doors, entirely new to the Marshfield plant. Now in addition to manufacturing doors with the traditional hot press method, which adheres glue through the use of heat, Weyerhaeuser was able to manufacture doors by allowing time and pressure to adhere glued veneer skins.

The Cold Press Technology is used in the manufacturing of 7-Ply Particleboard Core Doors

Marshfield Door Systems

- **All wood veneers now laminated to cores with PVA adhesives**
- **Company based on UF 15 years ago…**
- **Began Conversion to PVA because of business benefits**
  - **↓Press times**
  - **↓Press temperatures**
  - **↓Staffing (no mixing/formulation required)**

Architectural plywood and door manufacturers target LEED with PVA capability

Eggers Industries

We may be known for doors, but there's so much more behind them...

Model Specification for Optimal LEED Construction
LEED-NC Version 2.2

A. Door Construction

6. **Adhesives:** Glue lines for assembly between the plies of face, crossbanding and core are to be Type 1 polyvinyl acetate (PVA). *LEED Credit EQ 4.1 (refer to section C)*

VT Architectural Wood Doors Are 'Essential' To Ambitious Environmental Office Project

When the Alberici Corp. started work on its new headquarters in St. Louis, the company's goal was to achieve the highest LEED® (Leadership in Energy and Environmental Design) level awarded by the U.S. Green Building Rating System. Alberici Corp. is parent company of Alberici Constructors, which has offices in four U.S. regions, Canada and Mexico.

Under the LEED system, the building's owners can earn points toward achieving green building certification by using Forest Stewardship Council (FSC) certified wood materials. A total of 52 to 69 LEED points are required to achieve LEED's highest platinum rating.

Negwer Materials provided VT architectural wood doors in addition to hollow metal doors and hardware to assist Alberici Constructors with achieving LEED points.

All adhesives and sealants used by VT in constructing the flush doors have no added urea formaldehyde and meet or exceed volatile organic chemical component limits.

'Green' doors

According to Jerry Lenger at Negwer Materials, "More than 100 VT maple veneer architectural wood doors are being used throughout the office building."

The doors were constructed from stave lumber cores made of 100 percent FSC (Forest Stewardship Council) Smartwood™ certified wood, which accounts for more than 70 percent of the door's overall volume. Stave core consists of wood blocks edge-glued with PVA glues and no bonding agents.

FSC-certified products can assist a project in achieving up to six points based on criteria

continued on page 3

PVA Adhesive Cost Comparison

- 3 ply construction, 2 glue lines 4 X 8, PVA would cost $30/msf ($1.00 per sheet)
- 7 ply VC panel, 6 glue lines, 4 X 8, PVA would cost $110/msf ($3.52 per sheet)
- Historically, the upcharges have been higher due to set up, clean up and high waste as PVA was not run 100% of the time

Emissive Properties of PVA-Bonded Panel Assemblies

Assemblies constructed at Oregon State University Wood Technology Department Test Lab

June-July 2006

columbia FOREST PRODUCTS

Contents

- Objectives
- Materials and Methods
- Test Results
- Conclusions
- Reference

Objectives

- Utilize the Oregon State University Forest Products Lab to laminate hardwood plywood assemblies in a small scale, controlled environment
- Demonstrate PVA glue bond performance on a variety of substrates and veneers available to hardwood plywood mills in the US
- Conduct the following tests on each sample
  - Emissions (ASTM D5582 desiccator test)
  - Moisture content
  - Glue bond performance

Materials and Methods -Raw Materials

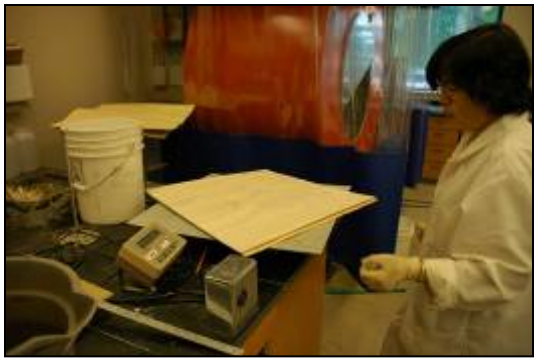
- Veneer innerply material, UF-bonded composites and decorative face veneers were shipped to OSU in Corvallis, OR from Columbia manufacturing plant locations. (All samples shipped in plastic or foil to maintain moisture content and to prevent absorption/emission of VOCs.)
  - Veneer core types
    - Fir
    - Poplar (three different sources)
  - Composite core types differentiated by vendor
    - PBC
    - MDF
  - Decorative rotary oak veneer overlays

Materials and Methods - Adhesive

- Columbia secured a readily available, off-the-shelf, PVA glue from a major adhesive manufacturer
  - Formaldehyde is included in small quantities in this adhesive as a preservative
  - According to the manufacturer, the formaldehyde in the adhesive formulation is not involved in the bonding chemistry of the product

Materials and Methods – Adhesive Application

- The lab has a mini glue spreader which is adjustable
- The veneer is weighed before and after the glue is applied to determine the appropriate spread rate for each veneer core combination
- The composite substrates were treated differently in that a specific weight of adhesive was measured and rolled onto the core with a rubber glue roller by hand as the cores were too thick and heavy to be passed through the spreader safely



Materials and Methods - Pre-Press

After the products were either passed through the spreader or had the measured adhesive applied by hand, they were allowed to stand for 5 minutes at 0 psi to simulate the time encountered in an actual plant between the spreader station and the pre-press

The panels were then loaded into the pre-press where they remained at 100 psi. for 5 minutes to bond the assembly together for the next step of thermosetting the glue line in the hot press

Materials and Methods - Hot Press

Platen temperature and hydraulic pressure were electronically controlled.

Curing times were logged by sample and varied by substrate type

Veneer core - 5 min., 150 psi., 110° C 230° F

Composite - 1.5 min., 150 psi., 110° C 230° F

Press loading

Pressing assembly

Platen temp. control

Materials and Methods -Labeling/Shipping

Cured panel assemblies were then labeled, logged and wrapped in foil and plastic for transportation to PSI Laboratories in Eugene, OR.

Pressed Assembly

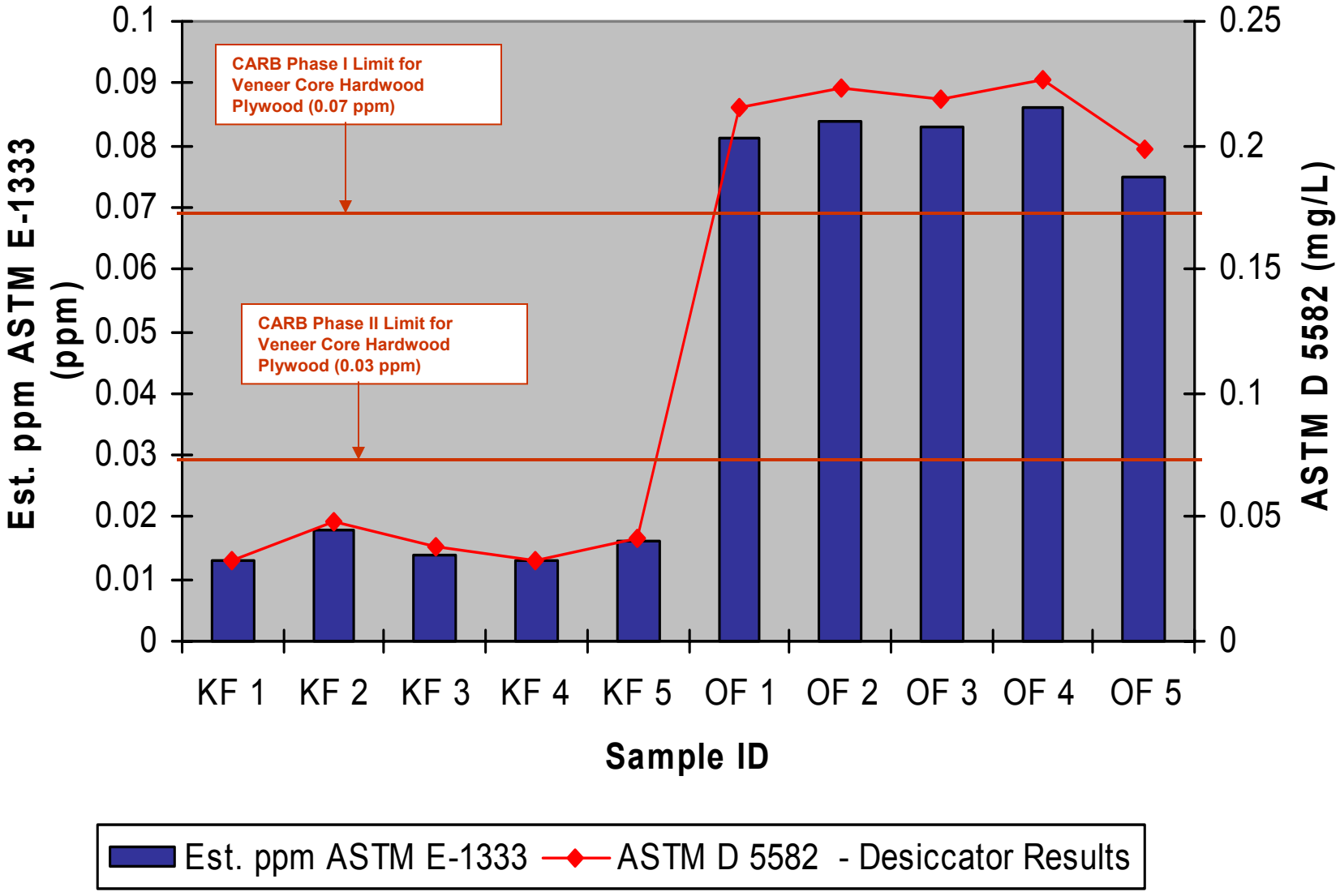
Wrapped assemblies

Delivery to the PSI in Eugene, OR

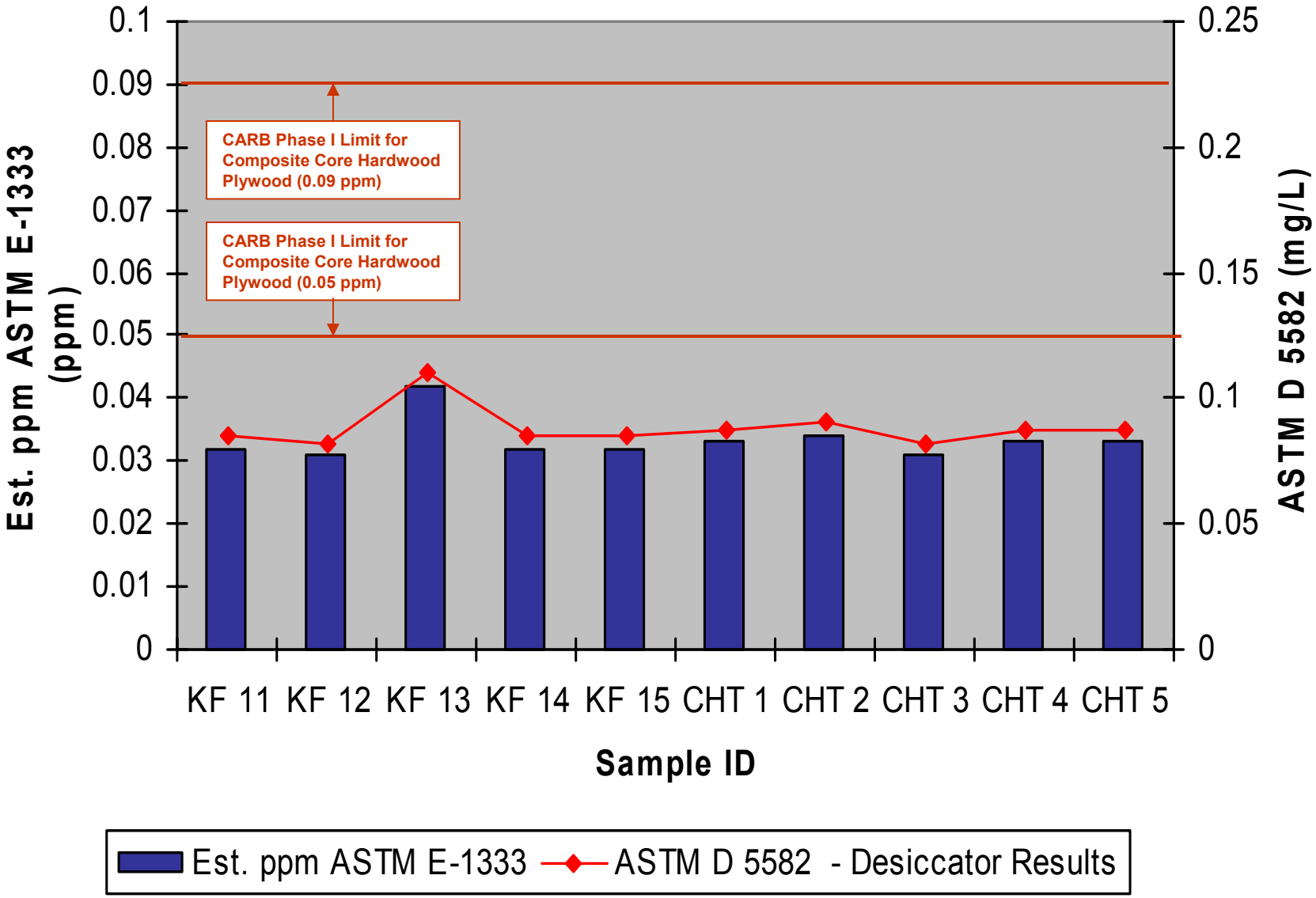
Comments:

The panels were edge trimmed but not sanded before transfer to the PSI lab for testing

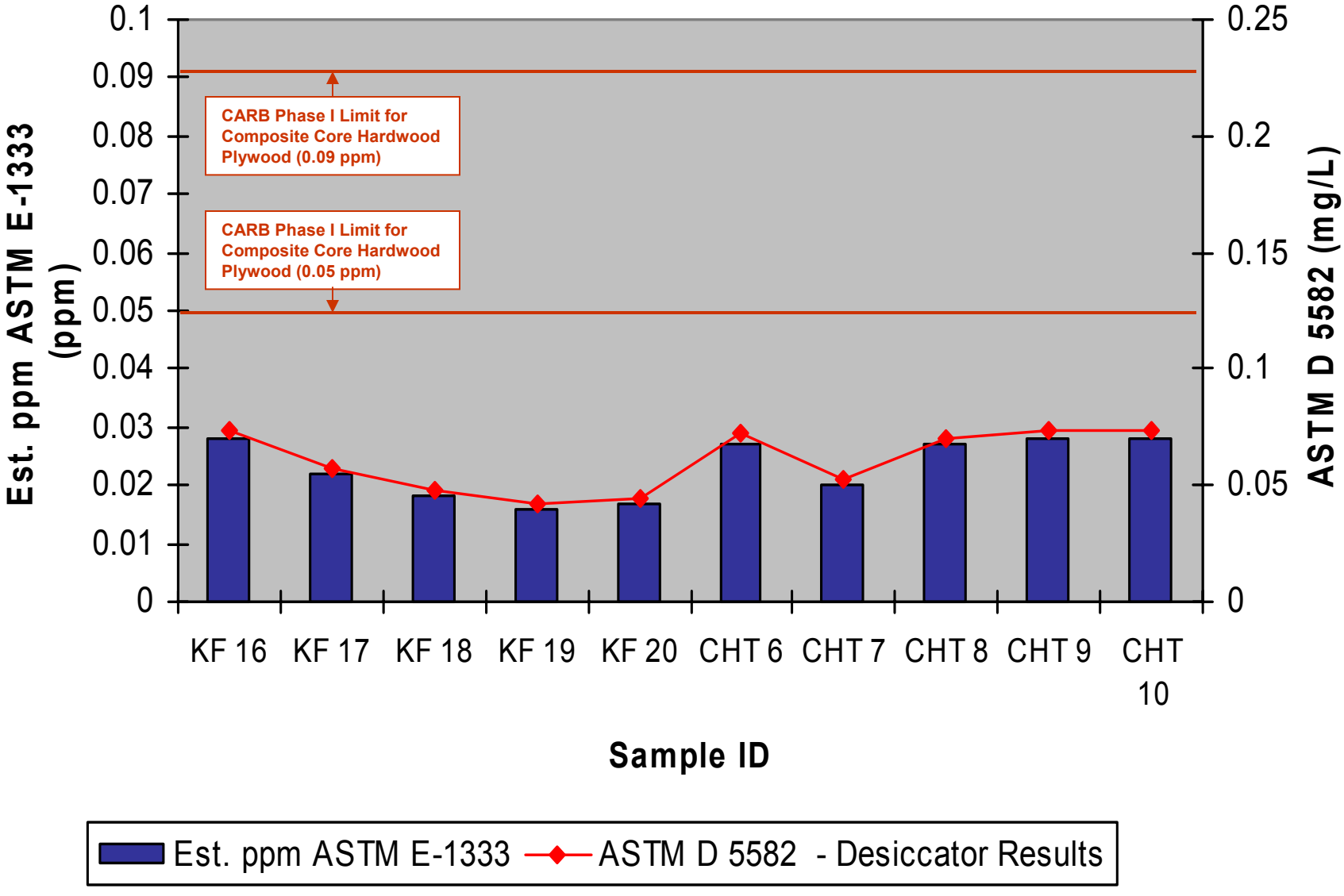
Desiccator Results, ASTM E-1333 Estimate for PVA-Bonded, Veneer Core Assemblies



Desiccator Results, ASTM E-1333 Estimate for PVA-Bonded, MDF Core Assemblies



Desiccator Results, ASTM E-1333 Estimate for PVA-Bonded, Particleboard Core Assemblies



Conclusions

- Emissions estimates on Fir/pine, MDF and PBC constructions show HCHO emissions lower than CARB proposed phase II levels (< 0.03 ppm)
- Emission estimates on Poplar veneer core construction show HCHO emissions higher than CARB proposed phase I levels (> 0.07 ppm)
- Using a general correlation coefficient on desiccator tests to arrive at a large chamber test result is an estimate only (70-80% accurate)
- Additional testing should be performed on panels constructed in a working hardwood plywood mill to confirm these results with actual large chamber tests

Reference

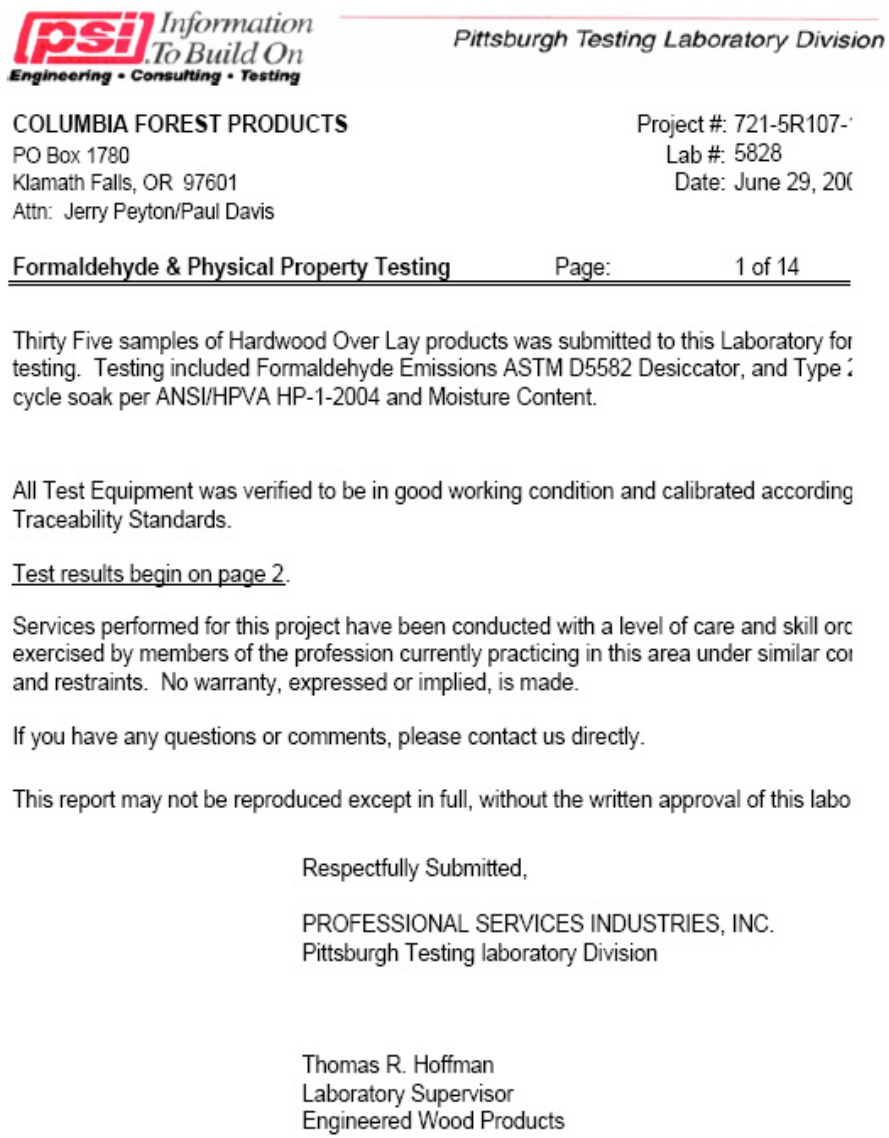
Independent laboratory test results referenced in this presentation are from the following lab report:

PSI

Project #:

721-5R107-14

A copy of this report is supplied in the packet provided today.



PSI Information To Build On
Engineering • Consulting • Testing

Pittsburgh Testing Laboratory Division

COLUMBIA FOREST PRODUCTS
PO Box 1780
Klamath Falls, OR 97601
Attn: Jerry Peyton/Paul Davis

Project #: 721-5R107-
Lab #: 5828
Date: June 29, 20(

Formaldehyde & Physical Property Testing Page: 1 of 14

Thirty Five samples of Hardwood Over Lay products was submitted to this Laboratory for testing. Testing included Formaldehyde Emissions ASTM D5582 Desiccator, and Type 2 cycle soak per ANSI/HPVA HP-1-2004 and Moisture Content.

All Test Equipment was verified to be in good working condition and calibrated according Traceability Standards.

Test results begin on page 2.

Services performed for this project have been conducted with a level of care and skill orc exercised by members of the profession currently practicing in this area under similar cor and restraints. No warranty, expressed or implied, is made.

If you have any questions or comments, please contact us directly.

This report may not be reproduced except in full, without the written approval of this labo

Respectfully Submitted,

PROFESSIONAL SERVICES INDUSTRIES, INC.
Pittsburgh Testing laboratory Division

Thomas R. Hoffman
Laboratory Supervisor
Engineered Wood Products

In-Plant Tests of PVA-Bonded Hardwood Plywood

- Introduction
- Materials & Methods
- Test Results
- Conclusions
- Reference

Paul Davis, Sr. Mktg Analyst, Columbia Forest Products
Chris Watt, Adhesive Technology Manager, Columbia Forest Products

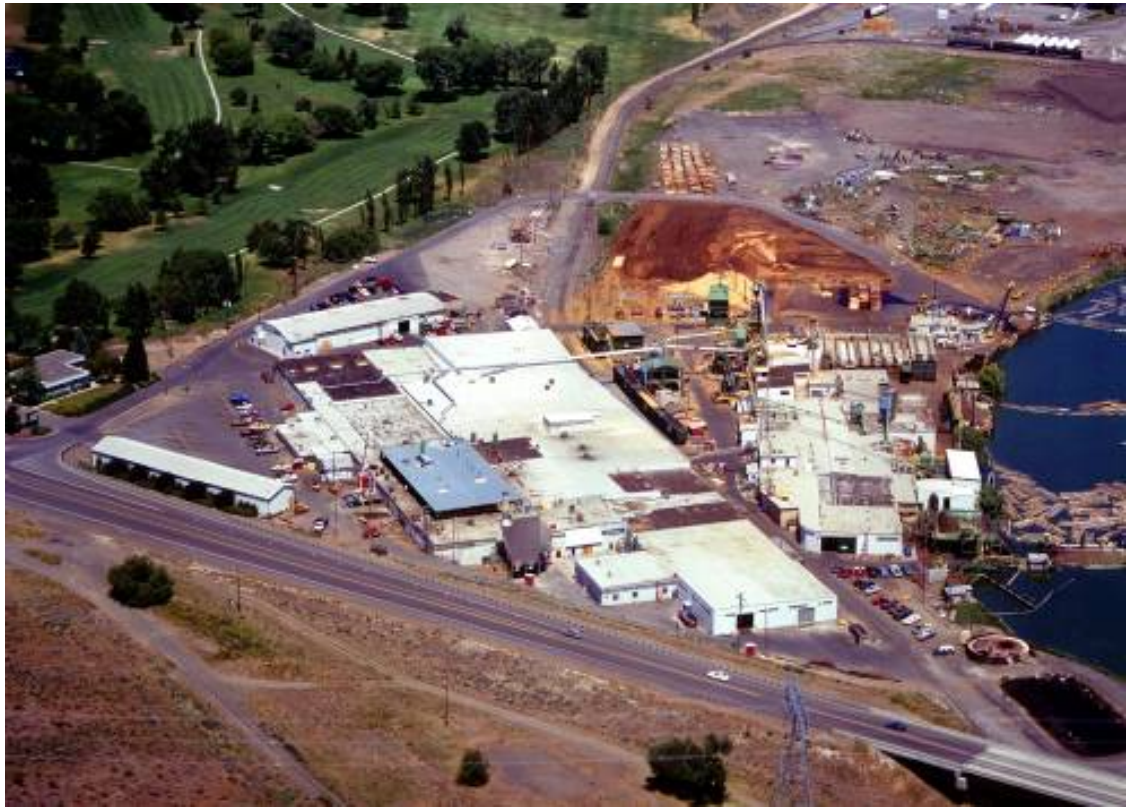
October 2006

Introduction

- Scale up the lab effort and manufacture actual PVA plywood panels in a working hardwood plywood mill
  - Same adhesive formulation, spread rate
  - Same press temperatures and timing
- Panel assemblies manufactured
  - Fir/pine veneer core
  - All poplar veneer core
  - UF-MDF core
  - UF-PBC core
- All panels had rotary-cut, decorative, spliced oak faces
  - Same conservative veneer specification as the lab test
  - Open cellular structure, can also emit HCHO (4 ppb[1]) naturally
- Material tracked through the plant and shipped to PSI Labs in Eugene, OR for ASTM E-1333 large chamber testing

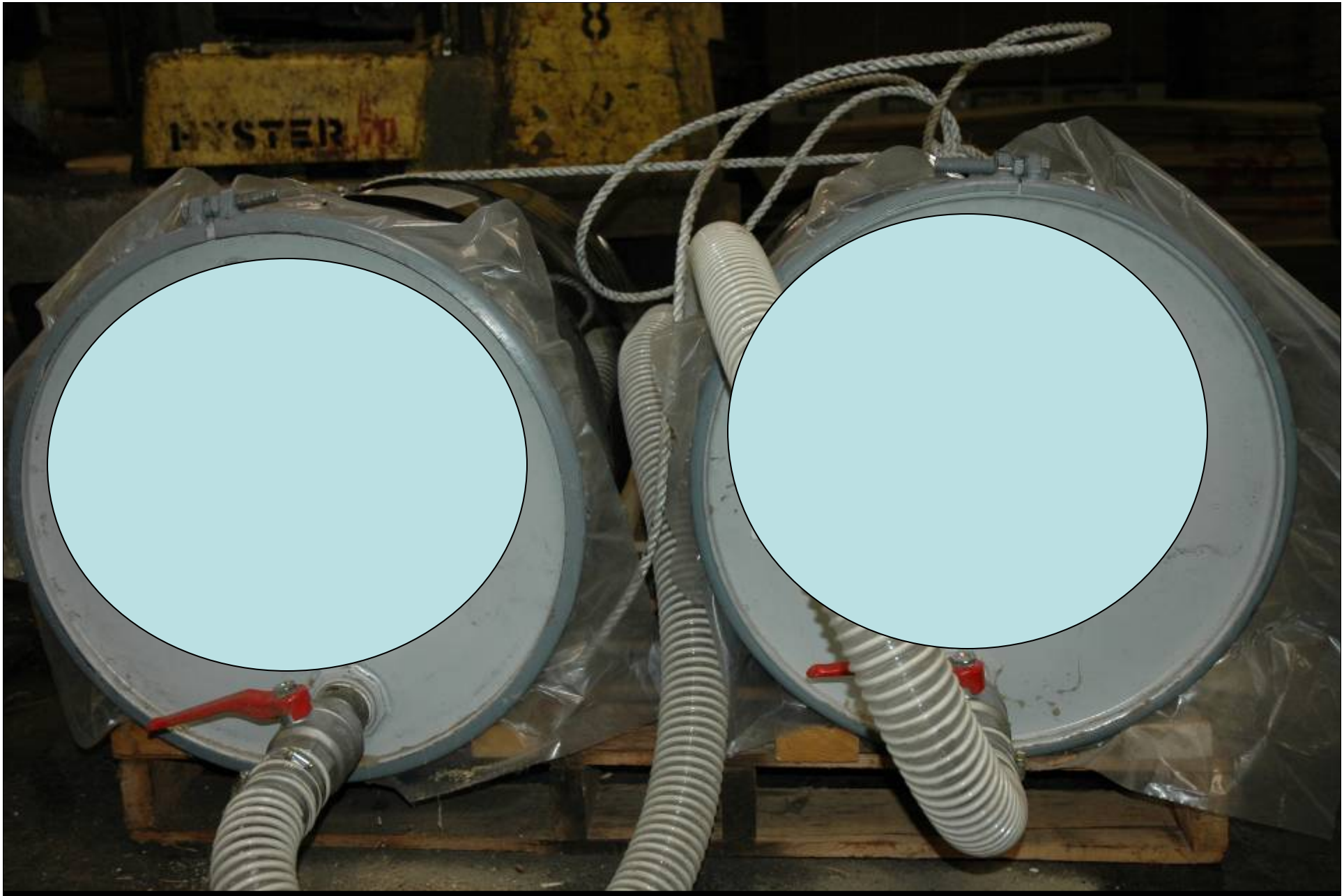
Footnote: 1 – Formaldehyde Emission from Solid Wood, FPS 1997

Materials and Methods



Columbia's Klamath Falls, OR

Hardwood Plywood Mill



Test Panel Adhesive – Columbia Secured 100 gallons of PVA identical to lab test

Flowing PVA into the spreader - no modifications required

Flowing PVA into the spreader - no modifications required

Lay up of veneer core with PVA adhesive

Lay up of veneer core with PVA adhesive

Lay up of MDF core with PVA

Lay up of MDF core with PVA showing oak veneers before pre-pressing

First PBC core through the spreader before the next pair of decorative veneers

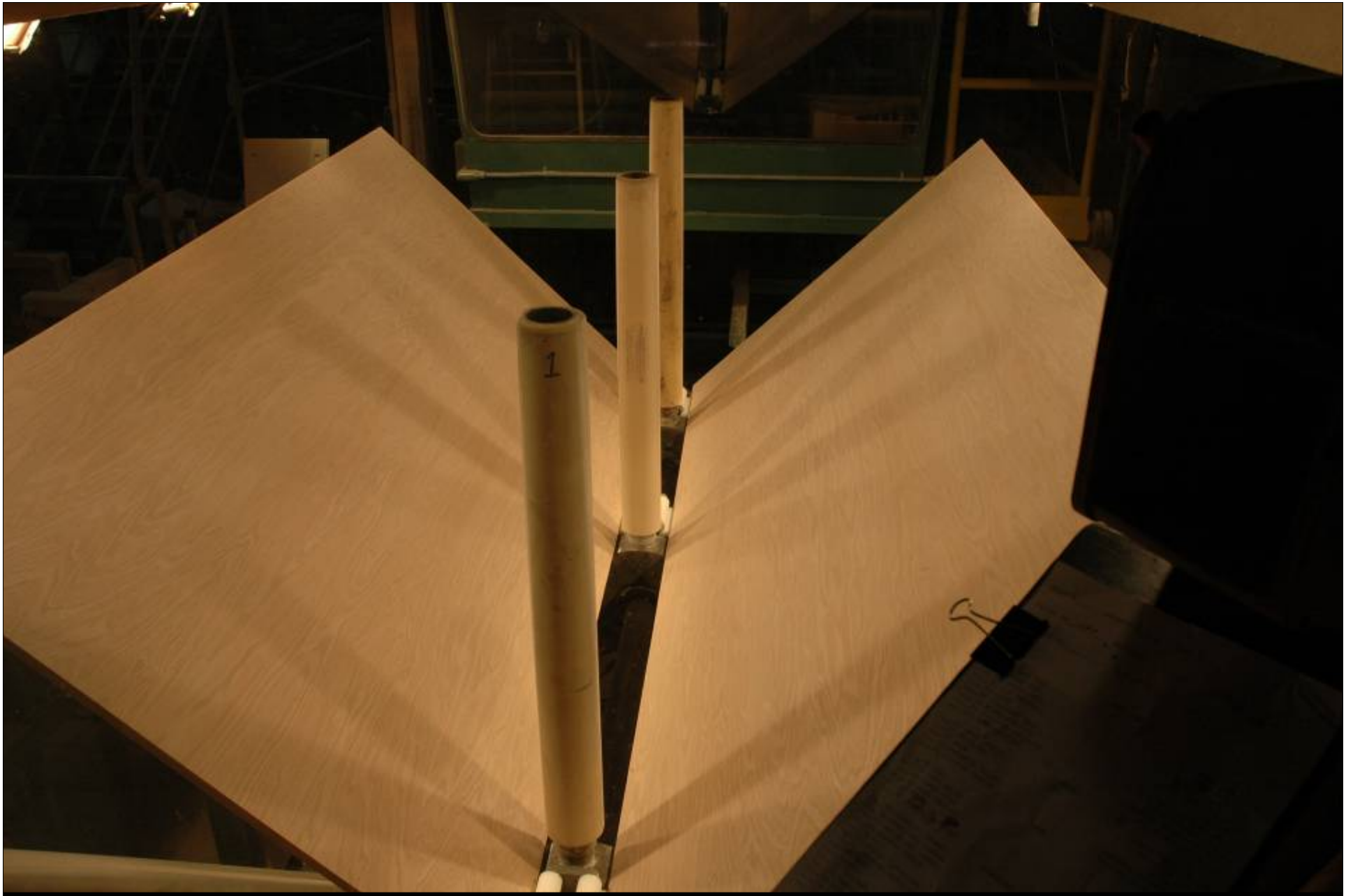
Pre Pressing VC panels to get them to tack together for loading into the hot press

Charging the press

Platen Temp 237° F, panels heated to 190° at center

Panels ready for the sander

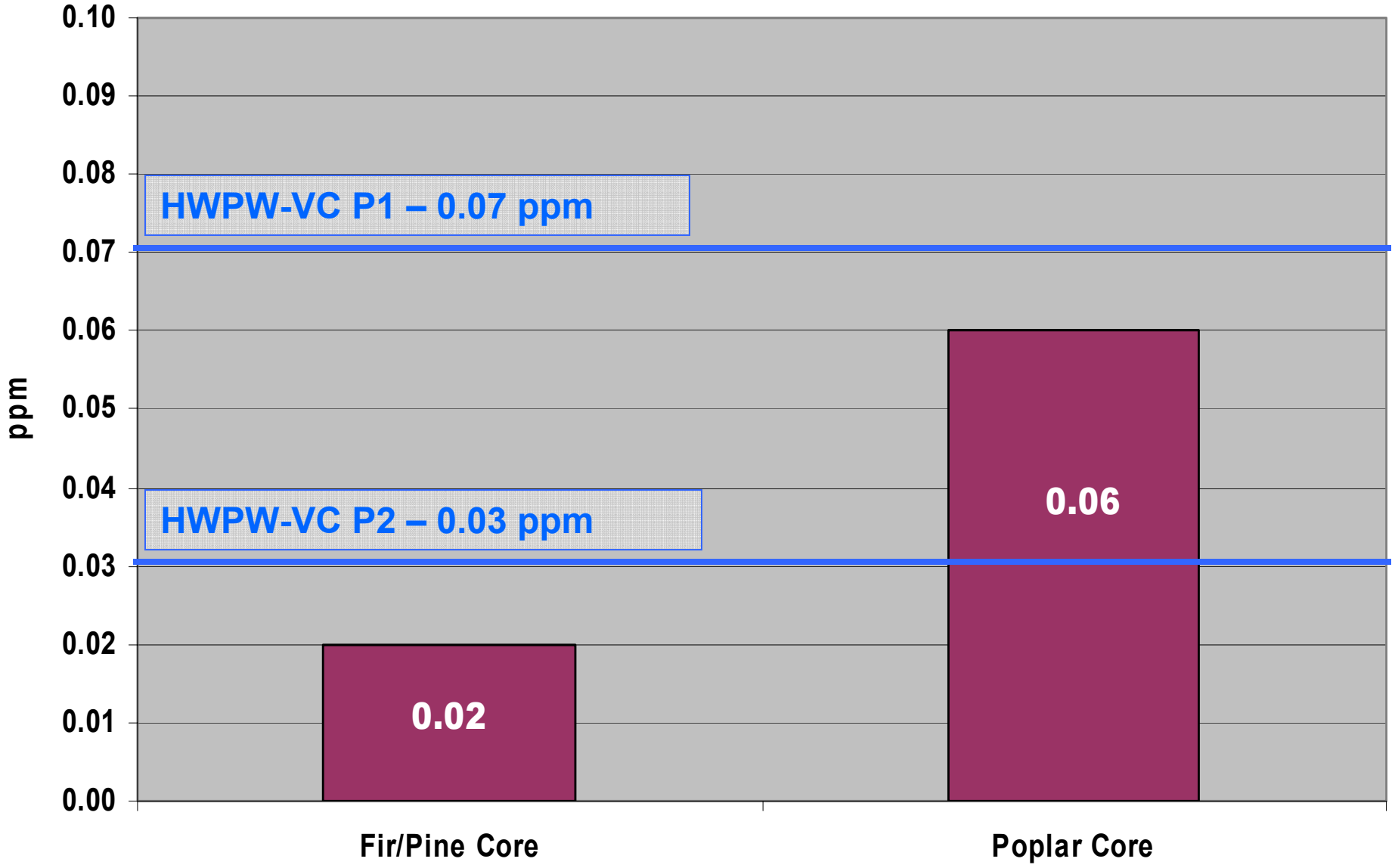
Panels exiting the sander

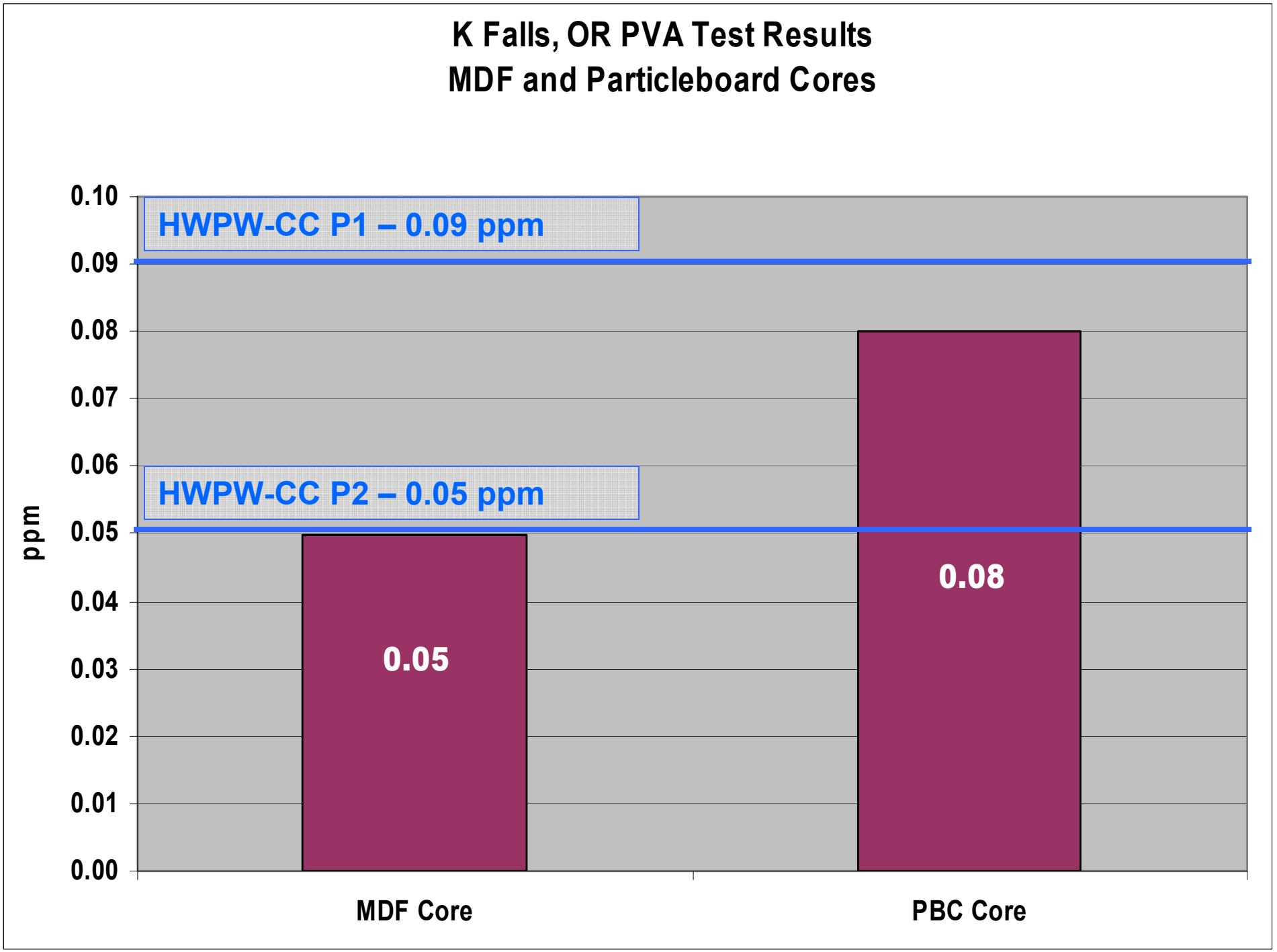


Panel grading booth view of finished product

Products ready for shipping to the PSI lab in Eugene, OR

K Falls, OR PVA Test Results
VENEER CORE




K Falls, OR PVA Test Results
MDF and Particleboard Cores
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
ppm
HWPW-CC P1 – 0.09 ppm
HWPW-CC P2 – 0.05 ppm
0.05
0.08
MDF Core
PBC Core

Conclusions

- PVA-constructed fir/pine VC panels tested below the CARB phase II VC threshold of 0.03 ppm
- UF bonded MDF with PVA decorative veneers also passed CARB phase II CC threshold of 0.05 ppm
- PVA-constructed poplar VC and UF-PB panels passed CARB phase I emission limits for their respective categories, but did not pass CARB phase II limits
- Workers experienced reduced exposure to formaldehyde in comparison with UF adhesives during this project
- Press times were reduced, panel quality was excellent
- Emissions levels could conceivably be driven lower by using PF-bonded plywood platforms and PF-bonded particleboard cores laminated with decorative veneers using PVA adhesives

Reference

Independent laboratory tes
results referenced in this
presentation are from the
following lab report:

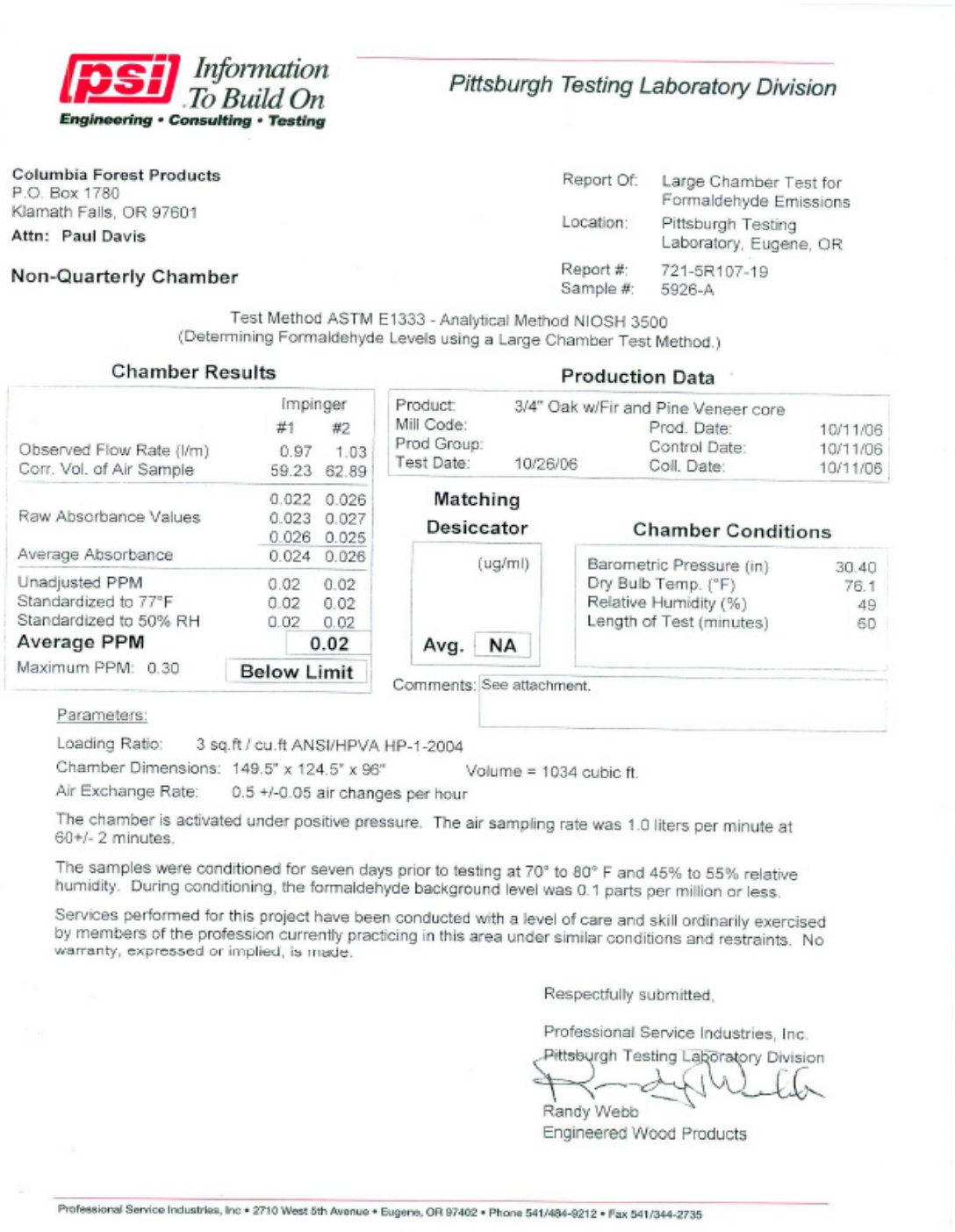
PSI

Project #:

721-5R107-22

Samples 5926 A-D

A copy of these reports ar
provided in the handout.



psi Information To Build On
Engineering • Consulting • Testing

Pittsburgh Testing Laboratory Division

Columbia Forest Products
P.O. Box 1780
Klamath Falls, OR 97601
Attn: Paul Davis

Non-Quarterly Chamber

Report Of: Large Chamber Test for Formaldehyde Emissions
Location: Pittsburgh Testing Laboratory, Eugene, OR
Report #: 721-5R107-19
Sample #: 5926-A

Test Method ASTM E1333 - Analytical Method NIOSH 3500
(Determining Formaldehyde Levels using a Large Chamber Test Method.)

Chamber Results

	Impinger #1	Impinger #2
Observed Flow Rate (l/m)	0.97	1.03
Corr. Vol. of Air Sample	59.23	62.89
Raw Absorbance Values	0.022 0.023 0.026	0.026 0.027 0.025
Average Absorbance	0.024	0.026
Unadjusted PPM	0.02	0.02
Standardized to 77°F	0.02	0.02
Standardized to 50% RH	0.02	0.02
Average PPM	**0.02**	
Maximum PPM: 0.30	**Below Limit**	

Production Data

Product:	3/4" Oak w/Fir and Pine Veneer core		
Mill Code:		Prod. Date:	10/11/06
Prod Group:		Control Date:	10/11/06
Test Date:	10/26/06	Coll. Date:	10/11/06

Matching Desiccator

(ug/ml)

Avg. NA

Chamber Conditions

Barometric Pressure (in)	30.40
Dry Bulb Temp. (°F)	76.1
Relative Humidity (%)	49
Length of Test (minutes)	60

Comments: See attachment.

Parameters:

Loading Ratio: 3 sq.ft / cu.ft ANSI/HPVA HP-1-2004
Chamber Dimensions: 149.5" x 124.5" x 96" Volume = 1034 cubic ft.
Air Exchange Rate: 0.5 +/-0.05 air changes per hour

The chamber is activated under positive pressure. The air sampling rate was 1.0 liters per minute at 60+/- 2 minutes.

The samples were conditioned for seven days prior to testing at 70° to 80° F and 45% to 55% relative humidity. During conditioning, the formaldehyde background level was 0.1 parts per million or less.

Services performed for this project have been conducted with a level of care and skill ordinarily exercised by members of the profession currently practicing in this area under similar conditions and restraints. No warranty, expressed or implied, is made.

Respectfully submitted,

Professional Service Industries, Inc.
Pittsburgh Testing Laboratory Division

Randy Webb
Engineered Wood Products

Professional Service Industries, Inc • 2710 West 5th Avenue • Eugene, OR 97402 • Phone 541/484-9212 • Fax 541/344-2735

Measuring Emission Properties of Chinese and Other Imported Veneer Core Decorative Hardwood Plywood

Samples gathered May – June of 2006 and tested in July 2006

columbia FOREST PRODUCTS

Contents

Introduction

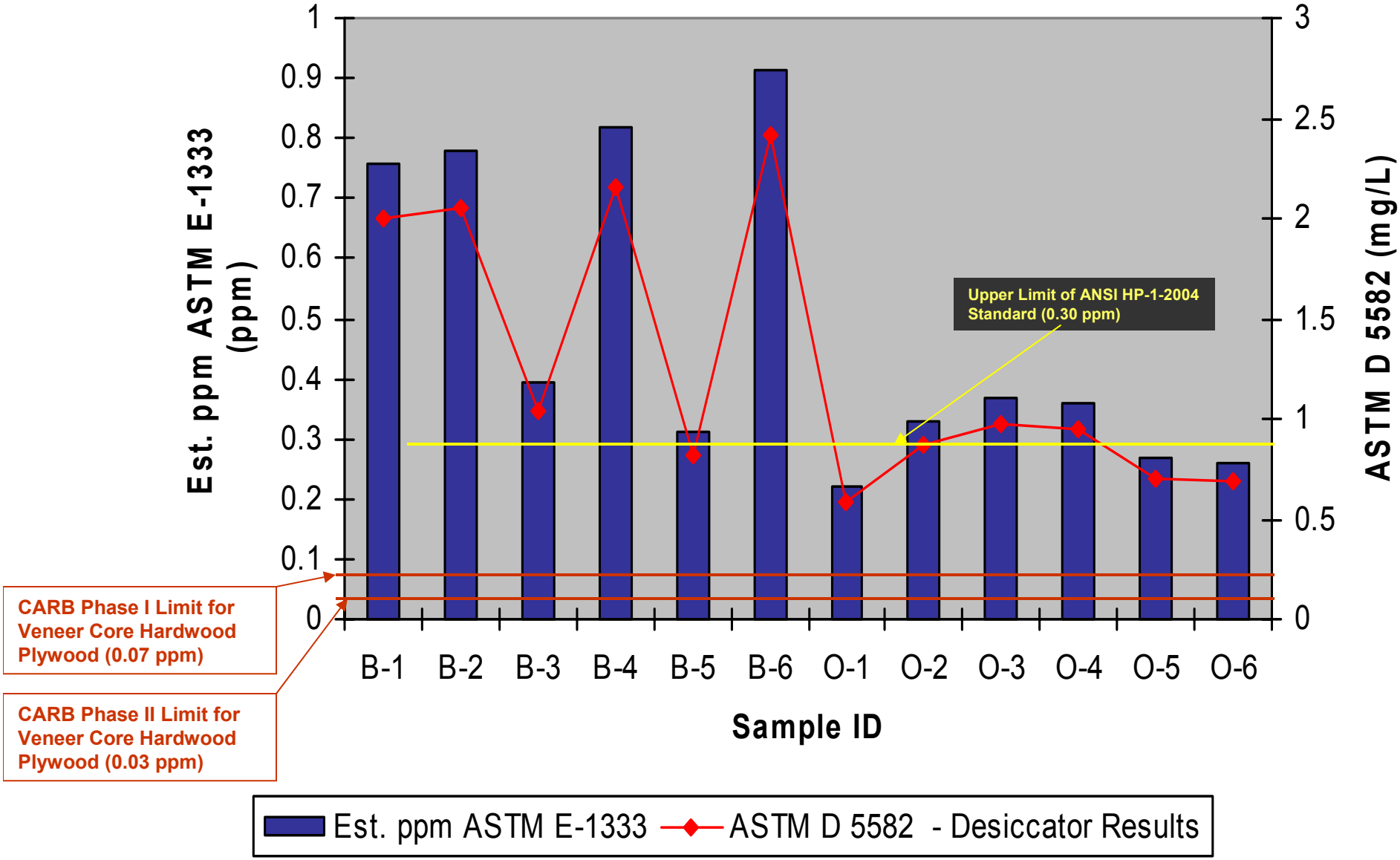
- Confirm emissions rates of non E-1 plywood products currently shipped into the California/US from China
- Emissions testing comprised of two sample collection efforts:
  - Local collection of imported plywood samples in the Portland, OR market
    - A local audit of what could be pulled off of the shelf and how it would test
    - No way to tell how old the material is with this collection method
    - Non E-1 certified production was sought out for bulk of tests
    - One E-1 panel was tested to compare emissions levels to non E-1 products
  - Collection of non E-1 plywood samples in China to avoid logistics delays caused by ocean freight
    - Effort to secure plywood “fresh off of the press” in China which would be more comparable to domestic sample testing where samples are collected at the mill and transferred to the lab in a shorter, known time frame
    - Collection effort took place in a very short period of time (two days) in China
    - Panel samples air freighted to Portland for inspection and were then immediately shipped to PSI labs in Eugene, OR for testing

Part I. Samples Sourced in China

Materials and Methods - Sample Collection in China

- Collected samples of Chinese, decorative hardwood plywood produced with standard, (non E-1) UF resin
- Sample dimensions: 20W” X 36L”
- Sample thickness: 19 mm
- Sample species
  - Five Birch
  - Five Okoume
- Samples were individually wrapped in newspaper, covered with cardboard and shipped via airfreight to Portland, OR
- Samples were then transferred to PSI Labs in Eugene for desiccator testing
- These samples were approximately one week “old” at the time they were received at PSI

Desiccator Results and ASTM E-1333 Estimates
Chinese Birch and Okume, Veneer Core



Conclusions/Remarks – Panels Sourced in China

- The panel samples sourced from China definitely emit formaldehyde at a rate in excess of proposed Phase I emissions standards [0.07 ppm]
- 7 out of 10 panels tested would not have passed under the US HUD standard formaldehyde emission threshold of 0.30 ppm.
- Note
  - ✓ Desiccator tests are divided by the correlation coefficient of 2.64 to get to an estimate of large chamber result
  - ✓ The accuracy of the conversion approximately 70-80%
  - ✓ These desiccator tests can not be interpreted in the same degree of certainty as an ASTM E-1333 large chamber test

Reference - Part I. Samples sourced in China

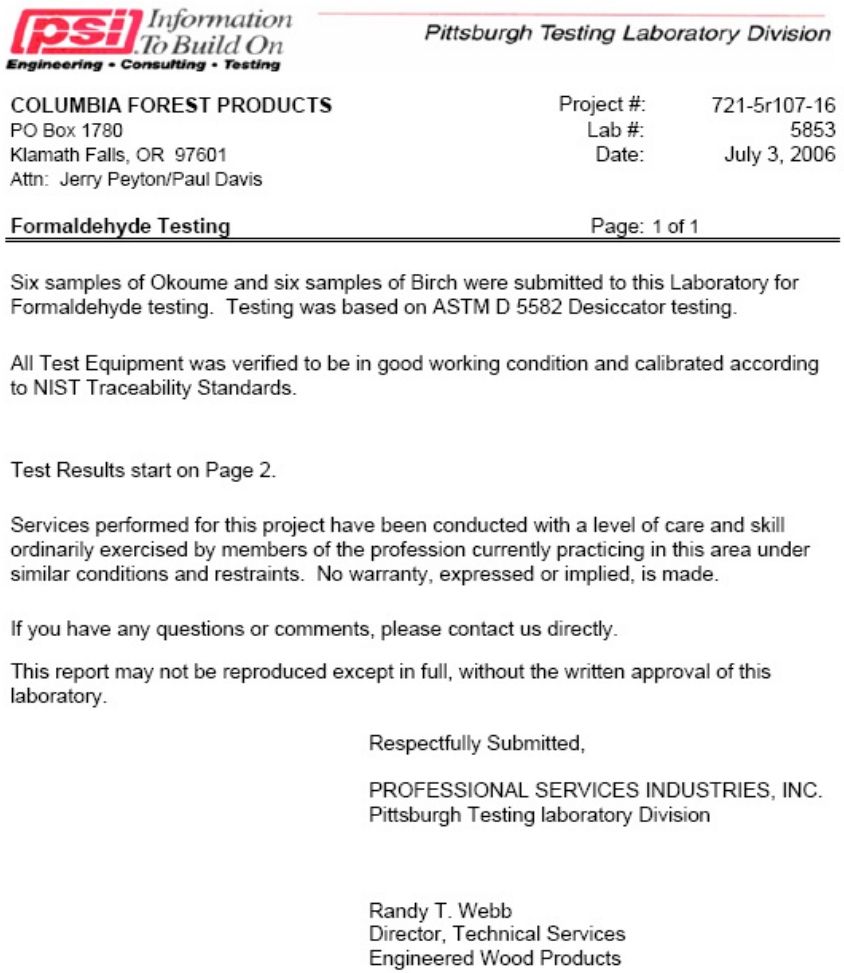
Independent laboratory test results referenced in this presentation are from the following lab report:

PSI

Project #:

721-5r107-16

A copy of this report has been provided in the handout.



psi Information To Build On
Engineering • Consulting • Testing

Pittsburgh Testing Laboratory Division

COLUMBIA FOREST PRODUCTS
PO Box 1780
Klamath Falls, OR 97601
Attn: Jerry Peyton/Paul Davis

Project #: 721-5r107-16
Lab #: 5853
Date: July 3, 2006

Formaldehyde Testing Page: 1 of 1

Six samples of Okoume and six samples of Birch were submitted to this Laboratory for Formaldehyde testing. Testing was based on ASTM D 5582 Desiccator testing.

All Test Equipment was verified to be in good working condition and calibrated according to NIST Traceability Standards.

Test Results start on Page 2.

Services performed for this project have been conducted with a level of care and skill ordinarily exercised by members of the profession currently practicing in this area under similar conditions and restraints. No warranty, expressed or implied, is made.

If you have any questions or comments, please contact us directly.

This report may not be reproduced except in full, without the written approval of this laboratory.

Respectfully Submitted,

PROFESSIONAL SERVICES INDUSTRIES, INC.
Pittsburgh Testing laboratory Division

Randy T. Webb
Director, Technical Services
Engineered Wood Products

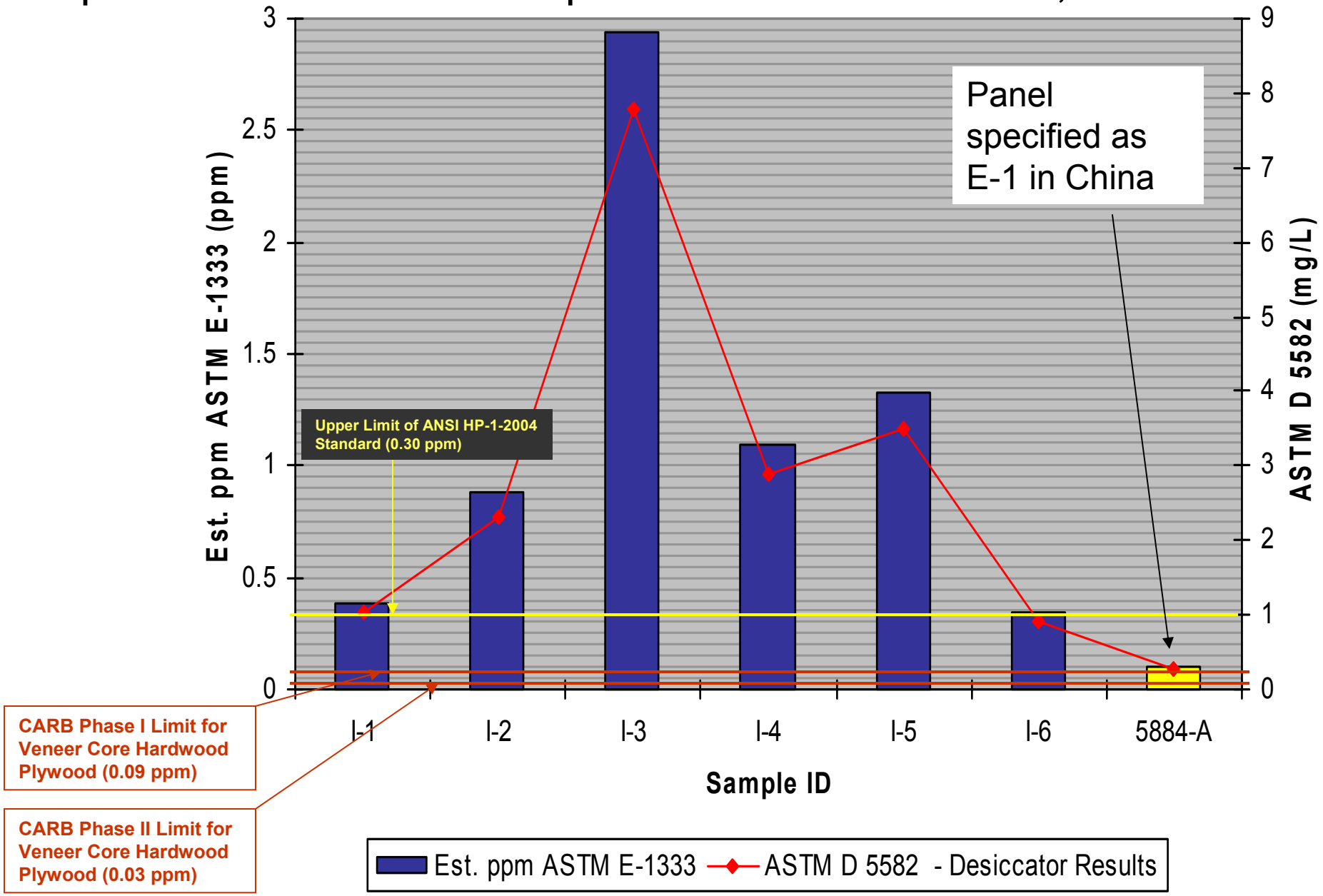
Part II. Chinese Plywood Samples sourced from Portland area home centers and building material dealers

Materials and Methods - Sample Collection in PDX

- Visited area mass merchants and wholesale distributors in search of imported panel products for testing
- These panels were gathered over a four week timeframe, stored in an unheated underground garage
- Samples were cut from the center of these panels in the approximate dimensions of 22W" X 36L"
- The table below provides the source locations and type of sample purchased in addition to the emission test result and correlated large chamber emission estimate
- These results do not include one test, run at a later date, of a Chinese decorative hardwood plywood panel sourced in Portland as being E-1 compliant

Import Panel Desiccator Testing							
June-July 2006							
Sample ID	**Description**	**Thickness**	**Source**	**Date Purchased**	**Date Samples Submitted to PSI for Testing**	**PSI ASTM D 5582 Test Results (mg. /L)**	**Estimated ASTM E-1333 large chamber equivalent (ppm)**
I-1	13 ply hardwood	19 mm	Distributor	5/22/2006	6/12/2006	1.026	0.39
I-2	11 ply Oak Home Center Handy Panel	19 mm	Home Center	5/12/2006	6/12/2006	2.319	0.88
I-3	13 ply Birch Home Center Handy Pane	19 mm	Home Center	5/12/2006	6/12/2006	7.769	2.94
I-4	Fancy Oak - 13 ply	19 mm	Distributor	5/22/2006	6/12/2006	2.878	1.09
I-5	Fancy Oak - 13 ply	19 mm	Distributor	5/12/2006	6/12/2006	3.502	1.33
I-6	Shop Birch - 13 ply	19 mm	Distributor	5/12/2006	6/12/2006	0.907	0.34

Test Results Chart – D 5582 Emissions
Imported Non E-1 VC samples sourced in Portland, OR



Conclusions/Remarks – Panels sourced in the Portland, OR area

- The non E-1 panel samples sourced from the Portland, OR area definitely emit formaldehyde at a rate in excess of proposed CARB Phase I VC emissions standards [0.07 ppm]
- None of panels tested would have even passed under the US HUD standard formaldehyde emission threshold of 0.30 ppm
- A panel which was represented as E-1 from China did test out at 0.105 ppm

Notes to results

- ✓ Desiccator tests are divided by the correlation coefficient of 2.64 to get to an estimate of large chamber result
- ✓ The accuracy of the conversion approximately 70-80%
- ✓ These desiccator tests can not be interpreted in the same degree of certainty as an actual ASTM E-1333 large chamber test

Reference - Part II. Samples sourced Portland, OR

Independent laboratory test results referenced in this presentation are from the following lab report:

PSI

Project #:

721-5r107-15

A copy of this report has been provided in the handout

psi Information To Build On
Engineering • Consulting • Testing

Pittsburgh Testing Laboratory Division

COLUMBIA FOREST PRODUCTS
PO Box 1780
Klamath Falls, OR 97601
Attn: Jerry Peyton/Paul Davis

Project #: 721-5r107-15
Lab #: 5834
Date: July 3, 2006

Formaldehyde Testing Page: 1 of 1

Six samples were submitted to this Laboratory for Formaldehyde testing. Testing was based on ASTM D 5582 Desiccator testing.

General Dessicator Testing ASTM D 5582

Sample #	Production Date	HCHO (mg/L)
5834-I-1	N/A	1.026
5834-I-2	N/A	2.319
5834-I-3	N/A	7.769
5834-I-4	N/A	2.878
5834-I-5	N/A	3.502
5834-I-6	N/A	0.907

All Test Equipment was verified to be in good working condition and calibrated according to NIST Traceability Standards.

Services performed for this project have been conducted with a level of care and skill ordinarily exercised by members of the profession currently practicing in this area under similar conditions and restraints. No warranty, expressed or implied, is made.

If you have any questions or comments, please contact us directly.

This report may not be reproduced except in full, without the written approval of this laboratory.

Respectfully Submitted,

PROFESSIONAL SERVICES INDUSTRIES, INC.
Pittsburgh Testing laboratory Division

Randy T. Webb
Director, Technical Services
Engineered Wood Products

Presentation Review

I. PVA is a commercially viable adhesive alternative in use by the wood products industry today that bears additional attention by CARB staff as a compliance pathway for the hardwood plywood industry standing alone or in combination with PF adhesive

II. Chinese plywood HCHO test reports show that non E-1 Chinese plywood significantly exceeds HUD and CARB thresholds for UF emission

Questions?

columbia
FOREST PRODUCTS