Wood-Based Composite Science and Technology Online Distance Education Series

Course Module: Wood & Water Relationships

Instructor:

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Course Description:

This course describes the interactions of wood and water and the effect on a number of properties – shrinking and swelling in particular. The course begins with lectures on gas behavior and humidity. This information serves as background for understanding interactions between temperature and humidity, and their impact on wood behavior. The information on wood and water relations is divided into two lectures. The first presents a review of wood structure, how wood holds water, how we calculate moisture content, why wood shrinks and swells, and how wood's moisture content changes with changes in temperature and humidity. The second lecture on wood and water relations focuses on shrinking and swelling. Solid wood is presented first followed by unique issues with composite wood products such as restraint due to cross-lamination, the impact of densification, and variability in density. The course also includes information on common methods and tools used for measuring moisture content.

It has been said that 90% of the challenges we face with wood can be addressed with the phrase, "it's a moisture problem." And there is a lot of truth in that statement. Understanding wood and water relationships is critical for anyone that works with wood to be able to effectively design, manufacture, and troubleshoot products.

Prerequisites:

Students should complete the *Wood Structure* module prior to this module. In addition, a general knowledge of wood composite manufacturing processes would be helpful, but not required.

Course Lectures:

Lecture	Title
1	Introduction
2	How gases behave
3	Humidity

4	Wood and water relations A
5	Wood and water relations B
6	Measurement of moisture in wood
7	Review

Approximate Time:

10 hours of asynchronous online instruction, available during 13-week period. The length of each lecture varies. Lectures 1 and 2 will likely only take 15-20 minutes each; however, lectures 4 and 5 on wood and water relations will likely require 1 to 2 hours each to complete.

Learning Assessment:

There are 3 quizzes in the course – one each after lectures 3, 4 and 5. Quizzes are not graded and may be retaken. A one-hour final examination is required for completion and may also be retaken. The course is graded on a pass or fail basis, with 70% score on final examination to pass. Exam must be completed prior to the end of six months after enrolling. *Students must email the instructor after completing the final exam!*

Certificate of Completion:

Students must complete all lectures, quizzes and the final exam to receive a Certificate of Completion. To request a certificate, students must email the instructor after passing the final exam.

Questions and Comments:

Students may contact the instructor about course-related inquiries using the email listed above. For technical questions (e.g., receiving a Certificate of Completion), students should email **workspace@oregonstate.edu**

Recommended Reading:

The following documents can be downloaded from the Course Documents section of this course website.

Carrier Corp. 1975. Psychrometric Chart. Cat. No. 794-001.

Leavengood, S. 2003. *Wood.xls*. Excel-based program for estimating shrink and swell in wood.

References:

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Bowyer, J. and J. Haygreen. 2003. Forest Products and Wood Science – An Introduction. Iowa State Press, Ames. Iowa.

Brown, T.L. and H.E. LeMay Jr. 1985. Chemistry: The Central Science. Prentice Hall Inc., Upper Saddle River, NJ

Cassens, D.L., J.P. Bradtmueller, and F. Picado. 1994. Variation in selected properties of industrial grade particleboard. Forest Products Journal 44(10):50-56.

Composite Panel Association. 1997. Linear expansion of particleboard and medium density fiberboard (MDF): A 1996-97 survey of North American plants.

Hoadley, R.B. 1980. Understanding Wood. Taunton Press, Newtown, Conn.

James, W.L. 1988. Electric moisture meters for wood. USDA Forest Products Laboratory General Technical Report FPL-GTR-6.

Panshin, A.J. and C. de Zeeuw, 1980. Textbook of Wood Technology. McGraw-Hill, New York.

Siau, J.F. 1984. Transport Processes in Wood. Springer-Verlag, New York, NY.

Simpson, W.T. 1988. Equilibrium moisture content of wood in outdoor locations in the United States and worldwide. USDA Forest Products Laboratory Research Note FPL-RN-0268. http://www.fpl.fs.fed.us/documnts/fplrn/fplrn268.pdf

Simpson, W.T. (Ed.). 1984. Dry Kiln Operator's Manual. USDA Forest Products Laboratory Ag Handbook 188, http://www.fpl.fs.fed.us/documnts/usda/ah188/ah188.htm

Suchsland, O. 2004. The Swelling and Shrinking of Wood: A Practical Technology Primer. Forest Products Society, Madison, WI.

Suchsland, O. and G.E. Woodson. 1991. Fiberboard Manufacturing Practices in the United States. Forest Products Society, Madison, WI.

Suchsland, O. 1973. Hygroscopic thickness swelling and related properties of selected commercial particleboards. Forest Products Journal 23(7):26-30.

Ringbell – on-line relative humidity calculator. http://www.ringbell.co.uk/info/humid.htm [accessed March 17, 2008]

USDA. 2007. Wood Handbook: Wood as an Engineering Material, USDA Forest Prod. Lab. Gen. Tech. Rep. FPL-GTR-113, http://www.fpl.fs.fed.us/documnts/FPLGTR/fplgtr113/fplgtr113.htm

Werren, F. and J.D. McNatt. 1975. Basic properties and their variability in twenty commercial hardboards. USDA Forest Products Laboratory, Madison, WI. Unpublished report.

Wu, Q. and O. Suchsland. 1996. Linear expansion and its relationship to moisture content change for commercial oriented strandboards. Forest Products Journal 46(11/12):79-83.

Xu, W. and P.M. Winistorfer. 1995. Layer thickness swell and layer internal bond of medium density fiberboard and oriented strandboard. Forest Products Journal 45(10):67-71.

Zylkowski, S.C. 1986. Dimensional stability of structural-use panels. American Plywood Association. Tacoma, WA. Report No. R&D 866-43.