

Forestry 486 – Moisture Interactions of Lignocellulosic Materials
Spring 2006, 3 credits

MW 12:10-1:00, 202 Science II
T 3:10-6:00, 202 Science II & 25 Bessey Hall

Instructor:

Dr. Douglas Stokke
138 Science II
294-2115, dstokke@iastate.edu

Office Hours:

Walk in or by appointment

Course Description:

Principles of moisture relations in hygroscopic materials; adsorption, desorption, equilibrium moisture content. Transport processes in natural materials such as wood. Drying processes for wood and other lignocellulosic materials. Influence of moisture on dimensional stability and durability of lignocellulosics and composites. Nonmajor graduate credit.

Course Student Learning Outcomes

At the conclusion of this course, it is expected that you will be able to:

1. Demonstrate understanding of psychrometric relationships and the ability to utilize tools such as psychrometric charts and models to estimate relative humidity and moisture content of wood, wood-based products, and other related lignocellulosic materials.
2. Acquire knowledge of the mechanisms of moisture movement in hygroscopic materials. Develop an understanding of the nature of drying stresses in wood. Apply this knowledge to wood drying practice.
3. Describe the major wood drying technologies in use today. Develop an understanding of industrial drying operations for wood and particles. Demonstrate awareness of environmental considerations for such operations.
4. Generate, use, and effectively communicate technical information regarding drying processes and related phenomena.
5. Be able to explain the effects of moisture on dimensional stability and long-term durability of hygroscopic materials.

NREM Departmental Student Learning Outcomes Addressed in Part by this Course:

4. Assess, analyze, synthesize and evaluate information fairly and objectively.
5. Work effectively individually and with others.
7. Communicate clearly and effectively via electronic and written communication.
10. Exercise life-long learning skills developed before graduation.

Required Text:

Simpson, W.T., ed. 1991. Dry Kiln Operator's Manual. USDA Agricultural Handbook No. 188. Reprinted in 1997 by the Forest Products Society, Madison, WI. ISBN 0-935018-91-3.

Supplemental Reference:

Siau, J.F. 1995. Wood: Influence of Moisture on Physical Properties. Department of Wood Science and Forest Products, Virginia Polytechnic Institute and State University. 227 pages. ISBN 0-9622181-0-3.

Course Web Page: <http://www.nrem.iastate.edu/class/for486.htm>

Contains a self-extracting file for the "Wood Physics Assistant" program, a pre-formatted Excel spreadsheet, and several required readings in pdf format.

Course Lecture Schedule (subject to change as circumstances may dictate)

Lecture	Date	Topic	Reading*
P-1	January 9	Intro/MC, density, specific gravity review	DKOM, ch. 1; Handout P-1 (Siau), p. 13-17
P-2/Q1*	January 11	Fundamental structure of plant cell walls	Handout P-2 (Siau, ch. 2)
January 16: University Holiday - Martin Luther King Jr. Day			
Topic 1: Basics of Moisture Interactions in Hygroscopic, Lignocellulosic Materials			
1-1	January 18	Psychrometrics: Properties of moist air	Handout P-1, p. 1-10
1-2a/Q2	January 23	Thermodynamic properties of water I	Handout 1-2
1-2b	January 25	Thermodynamic properties of water II	
1-3	January 30	Sorption theories for lignocellulosic materials	Handout 1-3
1-4/Q3	February 1	Equilibrium moisture content/sorption hysteresis	Handout P-1, p. 10-13 Handout 1-4
1-5	February 6	Fiber saturation point; free and bound water	
1-6/Q4	February 8	Permeability, mass flow, and diffusion	
Topic 2: Effects of Moisture Interactions in Wood			
2-1	February 13	Moisture gradients	
2-2/Q5	February 15	Drying stresses	DKOM, p. 125-130, 215; Web FPL-RPT 1652
2-3	February 20	Dimensional change	Handout P-1, p. 17-19
2-4/Q6	February 22	Drying Defects: physical, chemical, & biological	DKOM, ch. 8
	February 27	<i>Midterm Exam Review Session</i>	
2-5	March 1	Moisture effects on physical properties	
2-6	March 6	Moisture effects on long-term durability of lignocellulosic materials	
2-7/Q7	March 8	Your worst nightmare...	
March 13-17: Spring Break			

Topic 3: Drying Technology			
3-1	March 20	Air drying	Web, FPL-GTR 117, p. 1-54
3-2/Q8	March 22	Conventional kiln drying	DKOM, ch. 2
3-3	March 27	High temperature kiln drying	
3-4a/Q9	March 29	Environmental considerations I	Web, "Emissions from Wood Drying"
3-4b	April 3	Environmental considerations II	
3-5/Q10	April 5	Dehumidification drying	Handout 3-4
3-6	April 10	Vacuum, solar, and radio-frequency drying	Web, FPL-GTR 118, ch. 10
3-7/Q11	April 12	Fiber, particle, and flake drying	
Topic 4: Miscellaneous Subjects			
4-1	April 17	Dimensional stabilization treatments	Web, FPL-GTR 243
4-2	April 19	Heat effects on hygroscopicity	
4-3	April 24	Interesting responses	
	April 26	<i>Course Review and Critique</i>	
May 1-5: Final Examinations			

- * Readings will be assigned from the required text (DKOM), supplemental reference (Siau), hard copy handouts (designated by corresponding lecture number), and articles found on the course web page (designated as Web Reading with associated report reference number). Chapters 3-7 & 9 of the DKOM will be assigned for laboratory preparation, and are thus listed under the Laboratory Schedule. Note that the DKOM chapters are also found on the course web page.
- ** A short quiz will be given at the beginning of class period on most Wednesdays throughout the semester. These will typically cover material for the previous week and/or lecture and reading material for the current week. The quizzes are intended to help you keep up on the assigned reading and class lecture notes.

Laboratory Schedule (subject to change as circumstances dictate)

Date	Topic/Exercise/Reading
January 10	Student expectations; MC/Density/SG calculation exercises
January 17	Installation of "Kil-Mo-Trol" system in dry kiln; Lab safety and cleanup; DKOM ch. 4
January 24	Temperature, Relative Humidity, and EMC
January 31	MC/Density/SG determination; DKOM ch. 3
February 7	Kiln schedules/initiate first drying run; DKOM, ch. 5-7
February 14	Electronic moisture meters for wood and lignocellulosics; Web FPL-GTR-6
February 21	Initiate second drying run; DKOM ch. 9
February 28	Mid-Term Examination
March 7	Dimensional change
March 21	Catch-up/floating lab
March 28	Initiate third drying run
April 4	MC/Density/SG/Temperature-RH/EMC revisited!
April 11	Field trip*** - RBP 1875, Story City
April 18	Lab Practical Examination
April 25	Field trip*** - Pierce Lumber Co., Belle Plaine

*** Subject to availability

Course Grading:

20% - Midterm Exam

10% - Laboratory Practical Exam

25% - Comprehensive Final Exam

30% - Laboratory Assignments/Problems/Problem-Based Learning Exercises

10% - Weekly quizzes (11 quizzes, drop low score)

5% - Attendance

You will be allowed three unexcused absences during the semester with no penalty, except that in the event that the unexcused absence occurs on the day of a quiz or exam, there will be no opportunity given to make up that quiz or exam. Once you have exceeded three unexcused absences, I will deduct 1% from your total class score for each additional absence, up to a maximum of 5%. If you are absent for a quiz or exam, I will require a WRITTEN excuse from your doctor or other similar documentation of family emergency, etc. My expectation is that you will attend class. Late assignments will be docked 10% per day, no exceptions.

A = 90%+

B = 80-89%

C = 70-79%

D = 60-69%

F = < 60%

Plus and minus grades assigned to top and bottom three points of each range.

My expectations of you:

Behave as a responsible, respectful young adult.

Conduct yourself and complete your assignments in the manner of a professional. You will shortly enter the professional world, so it is to your advantage to approach the class with this perspective.

Attend class.

Do your assigned reading prior to class.

Participate in class discussion and exercises to the best of your ability.

Abide by all safety instruction and rules.

Seek clarification of anything you do not understand by asking me, your classmates, or through further study of text and reference material.

Obtain prior permission for absence or provide a valid medical or family emergency reason for missing an exam or for not handing in assignments on time.

Have some fun and learn something new.

Statement of Accommodations for Disabilities

Students who desire learning accommodations due to disability are encouraged to discuss their needs with the instructor as soon as possible following the beginning of the semester. Reasonable accommodations will be made with advice and assistance from the ISU Academic Success Center.