

SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ONTARIO



Sault College

COURSE OUTLINE

COURSE TITLE: RAW MATERIALS AND MECHANICAL PULPING
CODE NO. : PPE 112 **SEMESTER:**
PROGRAM: PULP and PAPER MAKING OPERATIONS
AUTHOR: J. BETHUNE
DATE: April 2004 **PREVIOUS OUTLINE DATED:** April
2002
APPROVED:

	DEAN	DATE
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TOTAL CREDITS: 5
PREREQUISITE(S): NONE
HOURS/WEEK: 5

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I. COURSE DESCRIPTION:

This course discusses the sources and nature of woody raw materials used by the pulp and paper industry with an emphasis upon chemical pulping requirements, including how wood is processed in the mill prior to pulping. Generalities of fibre separation by all mechanical pulping processes are discussed.

II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

Upon successful completion of this course, the student will demonstrate the ability to:

1. Indicate a knowledge of Canada's forest regions, including where and how trees grow.

Potential Elements of the Performance:

- Explain what constitutes a forest region.
- Name and locate Canada's forest regions.
- Explain and calculate MIA.
- Explain how a tree grows.
- Differentiate between primary and secondary growth.
- Indicate how many km² of forest land there are in Canada.
- Relate the effects of extreme temperatures and low rainfalls of central Canada on our forests.
- Describe how cells of a tree divide.
- Calculate the maximum size mill possible without depleting the forest.

2. Demonstrate a knowledge of the structure of a tree.

Potential Elements of the Performance:

- Define xylem, phloem, nucleus, cell wall, ray cells, and lumen.
- Name the three functions of cells in wood.
- Discuss why ray cells are a concern in the manufacture of pulp and paper.
- Explain the difference between diffuse porous and ring porous hardwoods.
- List three ways that hemicellulose differs from cellulose.

- Calculate the density and specific gravity of a block of wood.
- List four factors that contribute to the specific gravity of wood.
- Calculate solids content and moisture content of wood.
- Define bound water.

3. Demonstrate an understanding of the structure of a fibre.

Potential Elements of the Performance:

- Define a microfibril and a macrofibril.
- Calculate the number of fibres in a given weight of pulp.
- Identify the various layers of a fibre wall.
- Explain the term fibril angle.
- Discuss the problems caused by vessels in papermaking.
- Indicate where the shortest fibres are found in a tree and discuss their implications on the quality of pulp.
- Explain fibre flexibility index.
- Explain runkle ratio and why it is important to burst strength.
- Discuss the significance of variations in a mill's wood supply.

4. Demonstrate an understanding of how wood and fibre characteristics control pulp and paper properties.

Potential Elements of the Performance:

- Arrange a group of pulping processes in order of yield.
- Name the forces that cause the removal of fibres from wood.
- Define glass transition temperature.
- Explain why lignin will soften at a lower temperature in wetter wood.
- List three types of damage that fibres may receive in mechanical pulping.
- Explain why more total energy is needed to make a ton of mechanical pulp from hardwoods.
- Give a general statement about the effect of wood colour or brightness on the brightness of mechanical pulps made from the same wood.
- List two ways that lignin affects mechanical pulping.
- Name three negative effects of using high density wood in mechanical pulping.
- Explain how the CTMP process may overcome some of the problems of using high specific gravity wood.
- Discuss, in relative terms, the breaking length of Tamarac and

- Eastern White Pine.
 - Name three factors that control tear strength in paper.
 - Explain the difference between machine direction stretch and cross-machine direction stretch in paper.
 - Explain the effect of thick walled fibres on Opacity.
 - Explain the effect of latewood content on Bulk.
 - Explain the effect of specific gravity on Tear.
5. Demonstrate a knowledge of the mill's bulk raw material.

Potential Elements of the Performance:

- Explain the difference between crown land and private ownership.
 - Explain the differences between land ownership in Canada and the United States.
 - Discuss how forest management areas are managed.
 - Explain stumpage fees.
 - Explain the argument for private ownership of forest land in Canada.
 - Give reasons why river drives were ended in Ontario.
 - Explain why mechanical harvesting is used.
 - Discuss factors limiting efficiency of mechanical harvesting.
 - Explain why a kraft mill would prefer to use sawmill chips.
 - Discuss the problems caused by crooked logs in a mill.
 - Discuss defects in wood and their affect on pulp quality.
6. Demonstrate an understanding of how wood is processed in the mill.

Potential Elements of the Performance:

- Explain the advantages of small woody raw material inventories.
 - Conduct a case study on a mill's raw material requirements.
 - Explain why a mill measures the woody raw material it receives.
 - Discuss the quality properties a mill would measure on its woody raw materials.
 - Calculate chip dryness.
 - List three conditions log storage piles should meet.
 - Explain FIFO.
 - Discuss the different types of chip unloading equipment.
 - Discuss the technical reasons for paving chip storage pads.
7. Demonstrate an understanding of how wood is prepared for pulping.

Potential elements of the performance:

- Explain why a mill might use log sorting.
- Discuss problems that decayed wood could cause in a pulp mill.
- Discuss the quality problems associated with large branch stubs on logs.
- Explain the purpose of a slasher.
- Describe how a drum barker works.
- Explain the difference between cambial shear and cutterhead debarkers.
- Calculate the amount of bark needed to heat a given quantity of water.
- Discuss the purpose and function of a bark press.
- List three factors that control chip length in a disc chipper.
- Name the three technical problems caused by broomed chips.
- Give four technical reasons for removing thick or long chips from digester feed.

8. Demonstrate an understanding of groundwood pulping.

Potential elements of the performance:

- Explain what causes fibres to separate from each other in the SGW process.
- List the two forms in which shower water is present when wood is ground.
- Define regrinding.
- Name the type of wood used as a general rule for groundwood pulping.
- Name the species of wood preferred for groundwood.
- Explain how an intermittent grinder works and name an example of one.
- Label the main components on a grinder diagram.
- Name three materials used to make abrasive grits.
- Label a diagram of a pulpstone.
- Draw a typical groundwood mill flow.
- Define stone sharpening.
- Name four basic types of burrs.
- Give four reasons for sharpening a stone.
- Explain hoe stone sharpening affects energy use in grinding.
- Explain how stone sharpening affects pulp fibre length.
- Explain the terms lead angle and pitch when referring to a burr.
- Define sharpening cycle.
- List the objectives of stone showers.
- Explain how grinding zone temperature is controlled.
- Explain the traditional method of controlling grinding pressure.
- Define specific energy.
- Explain how speed control of grinding is done.
- Explain the main problem with production control grinding.
- Explain how programmed speed control tries to overcome the problem of production control.
- Cite the largest environmental concern with a groundwood mill.
- Explain how a pressurized grinder differs from a regular grinder.
- Draw a flow diagram for a grinder and its associated equipment.
- Explain the effects of elevated temperature and pressure on the pulp produced in the PGW process.

Explain the difference between PGW and PGW-S.

9. Demonstrate an understanding of refiner mechanical pulping.

Potential elements of the performance:

- List the main mechanisms of refiner pulping.
- Explain how refiner pulping is similar to groundwood pulping.
- Define latency.
- Name the type of wood used in refiner pulping.
- Correctly label a diagram of a refiner plate segment.
- Draw a simple diagram of each type of refiner.
- Define taper in terms of refiner plate design.
- Draw a typical RMP mill block diagram.
- Explain the purpose of grooves, bars and dams on a refiner plate.
- Explain how an appropriate refiner plate pattern is determined.
- List the strategies used to control motor load.
- Explain the effect that consistency has on refining.
- Name the greatest environmental concern with an RMP mill.
- Explain how TMP pulping is different from RMP pulping.
- List the additional equipment needed in a TMP mill and explain its purpose.
- Draw a block diagram of a TMP mill.
- Explain how some of the additional energy costs associated with TMP pulping is recovered.
- Explain how CTMP pulping differs from TMP pulping.
- List the additional equipment associated with CTMP pulping.
- List the typical chemical charge applied in the CTMP process using softwood and that applied using hardwood.
- Draw a block flow diagram of a typical CTMP mill.

10. Demonstrate a knowledge of the properties and uses of mechanical pulps.

Potential elements of the performance:

- Explain why it is difficult to make comparisons between pulping processes.
- Show the effect of yield on pulp manufacturing cost.
- Explain why refiner pulp mills can sometimes obtain wood at a lower price than groundwood mills.
- Explain why mechanical pulps are bulkier than chemical pulps.
- List various mechanical pulps in order of increasing strength properties.

- Name two properties that enhance printing qualities of mechanical pulps.
- Describe brightness reversion.
- Explain why white papers are dyed.
- Cite the typical composition of newsprint.
- Name three types of groundwood specialty papers.
- Define wood-free paper.
- Explain why CTMP can be used in fine paper.
- List the main concerns relating to the use of mechanical pulps for absorbent products.

III. TOPICS:

1. What you need to know about Canada's forests.
2. All you ever wanted to know about wood.
3. Fibres and other useful stuff.
4. How wood and fibre characteristics control pulp and paper properties.
5. Preparation of raw materials.
6. Wood handling at the mill.
7. Preparing wood for pulping.
8. Groundwood pulping.
9. Refiner mechanical pulping.
10. Properties and uses of mechanical pulps.

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

Sugden, A.E., Kelly, R., Tunney, A., and Bethune, J., "Study Guide for PPE 112 Raw Materials and Mechanical Pulping", Sault College of Applied Arts and Technology, Sault Ste. Marie, 2002.

V. EVALUATION PROCESS/GRADING SYSTEM:

A final grade will be based upon the results of four tests weighted equally. Course material will be divided as follows:

*Test 1 on Module 1 Lessons 1 and 2
 Test 2 On Module 1 Lessons 3 and 4
 Test 3 On Module 2 Lessons 1, 2 and 3
 Test 4 on Module 3 Lessons 1, 2 and 3.*

The following semester grades will be assigned to students in all credit courses:

<u>Grade</u>	<u>Definition</u>	<u>Grade Point Equivalent</u>
A+	90 – 100%	4.00
A	80 – 89%	4.00
B	70 – 79%	3.00
C	60 – 69%	2.00
D	50 – 59%	1.00
F (Fail)	49% or below	0.00
CR (Credit)	Credit for diploma requirements has been awarded.	
S	Satisfactory achievement in field/clinical placement or non-graded subject areas.	
U	Unsatisfactory achievement in field/clinical placement or non-graded subject areas.	
X	A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.	
NR	Grade not reported to Registrar's office.	
W	Student has withdrawn from the course without academic penalty.	

Under extreme circumstances, students receiving a final grade of 45-49% may be permitted to write a supplementary exam for a maximum of D provided they receive a minimum of 60% in at least two other tests.

VI. SPECIAL NOTES:

Special Needs:

If you are a student with special needs (e.g. physical limitations, visual impairments, hearing impairments, or learning disabilities), you are encouraged to discuss required accommodations with your instructor and/or the Special Needs office. Visit Room E1204 or call Extension 493, 717, or 491 so that support services can be arranged for you.

Retention of course outlines:

It is the responsibility of the student to retain all course outlines for possible future use in acquiring advanced standing at other postsecondary institutions.

Plagiarism:

Students should refer to the definition of “academic dishonesty” in *Student Rights and Responsibilities*. Students who engage in “academic dishonesty” will receive an automatic failure for that submission and/or such other penalty, up to and including expulsion from the course/program, as may be decided by the professor/dean. In order to protect students from inadvertent plagiarism, to protect the copyright of the material referenced, and to credit the author of the material, it is the policy of the department to employ a documentation format for referencing source material.

Course outline amendments:

The Professor reserves the right to change the information contained in this course outline depending on the needs of the learner and the availability of resources.

Substitute course information is available in the Registrar's office.

VII. PRIOR LEARNING ASSESSMENT:

Students who wish to apply for advanced credit in the course should consult the professor. Credit for prior learning will be given upon successful completion of a challenge exam or portfolio.

VIII. DIRECT CREDIT TRANSFERS:

Students who wish to apply for direct credit transfer (advanced standing) should obtain a direct credit transfer form from the Dean's secretary. Students will be required to provide a transcript and course outline related to the course in question.