

**SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY**

**SAULT STE. MARIE, ONTARIO**



Sault College

**COURSE OUTLINE**

**COURSE TITLE:** BLEACHING, SCREENING and CLEANING: CHEMICAL PULPS

**CODE NO. :** PPE 123

**SEMESTER:**

**PROGRAM:** PULP and PAPERMAKING OPERATIONS

**AUTHOR:** J. BETHUNE

**DATE:** APR 2004      **PREVIOUS OUTLINE DATED:** Aug. 2001

**APPROVED:**

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**DEAN**

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**DATE**

**TOTAL CREDITS:** 4

**PREREQUISITE(S):** NONE

**HOURS/WEEK:** 4

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**I. COURSE DESCRIPTION:**

This course deals with the technical aspects of pulp purification and includes the processes of pulp washing, screening, cleaning and bleaching. The technologies of each of these types of processes will be investigated though the major emphasis will be on bleaching. Screening requirements, equipment and basic theories will be covered. Process conditions, fundamental flow diagrams and material balances will be discussed. Removal of contaminants from pulp by washing or cleaning systems will be studied in terms of equipment and process conditions. Pulp bleaching for chemical pulps will be studied in terms of basic theories, process types, conditions and process flows. The basic chemistry of bleaching and the preparation of bleaching chemicals will also be discussed along with some of the hazards of these chemicals.

**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 the principles of screening theory and common screening equipment.

Potential Elements of the Performance:

- Draw and label a schematic of a typical screen.
- List the common type of screen plate perforations.
- Name several types of coarse screens.
- Explain why shower water is added to rotary screens.
- List the drawbacks of vibratory screens.
- Name the main operating force in most coarse screens.
- List the criteria that stiff fibres must meet to travel through screen openings.
- Explain the effects of stock flow, shower water and consistency on screen operation.
- Explain the function of the rotor in a pressure screen.
- Discuss the environmental impact of a screen room.
- Explain how screen plates are characterized.
- Explain what happens to the material rejected by knotters in a chemical pulp mill.
- List the process variables that affect screen performance.
- Calculate reject rate, cleanliness efficiency and screen quotient.

2. Indicate a knowledge of washing mechanisms and washer designs.

Potential Elements of the Performance:

- Explain why pulp is washed.
- List the two main washing mechanisms and explain how each works.
- Explain how a vacuum washer works.
- Explain how some washers combine dilution/extraction and displacement.
- Explain the effect of temperature, pressure differential and shower dilution water volume on washer efficiency.
- Distinguish between countercurrent and cross flow washer sequences.
- Explain the greatest environmental impact of washers in a pulp mill.
- List the two main factors which influence the effectiveness of dilution/extraction washing.
- Explain why a thune press is a dilution/extraction washer.
- Name two types of combination washers.
- Describe the operation of a combination washer.
- List five process variables that affect the operation of a washing system.
- Perform calculations on dilution factor, wash liquor ratio, washer yield and displacement ratio.

3. Indicate a knowledge of centricleaners, their operating principles and basic design.

Potential Elements of the Performance:

- Explain why cleaners are used.
- Name the physical property that cleaning is based upon.
- Explain the difference between forward and reverse cleaners.
- Describe how cleaners separate fibres from dirt.
- Explain, in general terms, how cone design affects cleaner operation.
- Explain how reject rate affects cleaner operation.
- Define pressure drop and explain its effect on cleaner operation.
- Explain how consistency effects cleaner operation.
- Explain why it is necessary to use several cleaning stages.
- Explain why it is necessary to sewer some material from the cleaner system.

- Describe how cleaner efficiency is measured.
  - List the four forces that cause separation in a cleaner.
4. Indicate a knowledge of the principles of lignin removal bleaching and why it is necessary for chemical pulps.

Potential Elements of the Performance:

- Explain why lignin removal bleaching is done.
- List the two main type of reactions taking place in bleaching.
- Explain why bleaching is carried out in several stages.
- Name the reactions that take place in the delignification stage.
- Describe the effect of bleaching reactions with cellulose and hemicellulose on the final pulp.
- Sketch three common bleaching towers.
- List the symbol, form, use benefits and drawbacks of common bleaching chemicals.
- Explain how chlorine dioxide is generated.
- Discuss the effects that chemical charge and pH have on bleaching.
- Explain how time and temperature are interrelated.
- Explain why additives are used.
- Name the three types of chemicals that cause the biggest concern for bleach plant effluents.
- Explain what oxidants do in bleaching.
- Explain the purpose of alkali in bleaching.
- Define end peeling.
- Explain why the carry-over of liquids from the brown stock washers is not desirable.
- List three purposes for bleach plant mixers.
- Explain why there is a practical maximum for chemical charge.
- Discuss the drawbacks to increasing temperature.
- List five factors that dictate the choice of a bleaching sequence.
- Explain why chlorine and chlorine dioxide towers normally have an up-flow section.
- Explain why chlorine dioxide is a popular choice of bleaching agent.
- Explain why many mills are using elemental chlorine free bleaching sequences.
- Name one or more reasons why more mills are not brightening with hypochlorite.
- List the major health hazard of ozone bleaching.

**III. TOPICS:**

1. Screening
2. Washing
3. Cleaning
4. Bleaching

**IV. REQUIRED RESOURCES/TEXTS/MATERIALS:**

Tunney, A., Sugden, A., and Bethune, J., Bleaching, Screening and Cleaning: Chemical Pulps, Course Manual PPE 123, Sault College of Applied Arts and Technology, Sault Ste. Marie, 2001

**V. EVALUATION PROCESS/GRADING SYSTEM:**

A final grade for this course will be based upon the results of two tests weighted equally.

For testing purposes, the course will be divided as follows:

Test #1 on Module 1  
Test #2 on Module 2

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 unusual circumstances, students with a final grade of 45-49% could be allowed to write a supplementary exam for maximum possible grade of D provided they obtain a minimum grade of 60 % in one of the regular 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.