Special Topics in Organic Chemistry
8833A Pulping and Bleaching Chemistry
Fall 2005

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Course Description: This course focuses on developing an understanding of the fundamental chemistry associated with pulping and bleaching of wood. The subject material encompasses: (1) the detailed analysis of the chemical structure of the major wood components, (2) the nature and scope of the reactions of pulping and bleaching reagents with typical carbohydrate and lignin functional groups, and (3) the underlying factors which explain differences in the degree of lignin vs. carbohydrate degradation during pulping and bleaching stages. The focus is on alkaline/NaSH pulping and ClO₂, H₂O₂, O₂/NaOH, O₃ bleaching chemistry of chemical and H₂O₂ bleaching mechanical pulps.

Course Objectives:
1. To provide a fundamental understanding of the chemical components present in wood and their relationship to modern pulping, bleaching and biorefinery principles.
2. To develop an advanced understanding of chemical mechanisms involved in the modern pulping, delignification, and chromophore removal reactions.

Course Outline:

Wood component structures
Lignin
- Basic structures in wood
- Structural dependency on wood species

Cellulose/Hemicellulose
- Structure (crystalline and amorphous, polymorphs of cellulose)
- Reactivity under acidic and basic conditions

Extractives
- Structures
- Tall Oil Production

Chemistry of Pulping
Lignin reactions during chemical and mechanical pulping
- Depolymerization reactions
- Condensation reactions
Carbohydrate reactions
- Peeling and stopping reactions
- Formation and hydrolysis of hexenuronic acids
- Formation of lignin-carbohydrate complexes.

Chemistry of Bleaching and Biorefinery
Reactivity of lignin and carbohydrates with
- Chlorine-containing reagents (i.e., Cl₂ and ClO₂)
- Oxygen-based reagents (i.e. H₂O₂, O₂/NaOH, activated peroxide and O₃)
- Biobleaching

Course Format:
The course is taught in a seminar style by the professor and students. Literature articles will be assigned for reading and will be reviewed at class meetings. Students will be assigned course topics for which they will research the literature and present their findings to the class in an oral and written report.

Course Grading:
Midterm Exam: 20%
Term Paper/Presentation: 30%
Presentation/Review: 30%
Final Exam: 20%

Reference Texts:

Principal Journals:
## Class Schedule

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<th>Week</th>
<th>Topics</th>
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<td>August 23th</td>
<td>Introduction</td>
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<tr>
<td>September 1</td>
<td>Lignin Structure</td>
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<td>September 8</td>
<td>Cellulose Structure</td>
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<td>September 15</td>
<td>Hemicellulose Structure</td>
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<td>September 22</td>
<td>Wood Extractives, Kraft Pulping – Lignin Chemistry</td>
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<td>September 29</td>
<td>Kraft Pulping – Lignin Chemistry</td>
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<td>October 6</td>
<td>Kraft Pulping – Lignin Chemistry, Mechanical Pulping - Mechanochemistry</td>
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<td>October 13</td>
<td>Kraft Pulping – Carbohydrate Chemistry</td>
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<td>October 20</td>
<td>Kraft Pulping – Carbohydrate Chemistry</td>
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<td>October 27</td>
<td>Review and Exam</td>
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**Student Presentations**

<table>
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<tr>
<th>Date</th>
<th>Topic</th>
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<tr>
<td>November 3rd</td>
<td>Oxygen Delignification Bleaching Chemistry</td>
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<td>November 10th</td>
<td>Ozone Bleaching Chemistry</td>
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<td>November 17th</td>
<td>Chlorine Dioxide – Chlorine Bleaching Chemistry</td>
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<td>November 24th</td>
<td>Turkey:Holiday</td>
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<td>December 1st</td>
<td>Hydrogen Peroxide Bleaching Chemistry</td>
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<td>December 8th</td>
<td>Biobleaching/Review</td>
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<td>December 12-16th</td>
<td>Final Exam Week</td>
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