CH 4620 - Polymer Chemistry Syllabus
Spring 2008

Lecturer: Dr. Pat Heiden
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Class Meetings: M,W,F 10:05 – 10:55AM
Location: Chem Sci 106
510 B, ChemSci
Text: The Chemistry of Polymers, 3rd Ed
Other reading will be assigned

Web page: http://www.chemistry.mtu.edu/pages/courses
Then scroll down and click on CH4620
To download files: Name: polymer Password: springtime

Grading:

<table>
<thead>
<tr>
<th></th>
<th>Points</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam 1</td>
<td>150</td>
<td>Friday, February 22</td>
</tr>
<tr>
<td>Exam 2</td>
<td>150</td>
<td>Monday, March 24</td>
</tr>
<tr>
<td>Exam 3</td>
<td>150</td>
<td>Monday, April 21 (Not Comprehensive)</td>
</tr>
<tr>
<td>Quizzes</td>
<td>100</td>
<td>Announced, but No Set Number or Dates</td>
</tr>
<tr>
<td>Project</td>
<td>100</td>
<td>See Project Sheet for due dates</td>
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<tr>
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<td>650</td>
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Letter Grades: Approximately 92% A ; 80% AB - B ; 70% BC - C ; 60% CD-D ; < 60% F

Quiz Policy: There will be no make-ups on quizzes but your 3 lowest quiz scores will be dropped.

Recommended Supplemental Text Resources available in the Library:

- Encyclopedia of Polymer Science and Technology, 2003
  TP1110 .E53 1st Floor
- Comprehensive Polymer Science, 1989, supp. 1992
  QD 381 .C66 3rd Floor
  TP9 .E561 1st Floor
- Encyclopedia of Polymer Science and Engineering, 1985
  TP1087 .E46 1st Floor


For Special Topics: ACS Symposium Series.. 2nd floor, most QD, TP, and TS
Note: Only the Encyclopedia of Polymer Science and Technology, 2003, is relatively current, and depending on what year you might select, the ACS Symposium Series volumes. However, on basic reactions and polymer properties all the volumes will be suitable.

Supplemental Web Resources:

Very Basic and Overviews
http://pslc.ws/macrog/kidsmac/wiap.htm
http://pslc.ws/macrogcss/intro.html
http://www.theotherpages.org/poly-faq.html#class
http://www.cem.msu.edu/~reusch/VirtTxtJml/polymers.htm

On Radical Polymerization:
http://www.warwick.ac.uk/fac/sci/Chemistry/polymers/rpk/sld006.htm

Excellent web page on many things:
http://www.psigate.ac.uk/roads/cgi-bin/psibrowse.pl?limit=0&toplevel=materials&subject=620.192c

On Silicones (go to web site then click on Technical Library): http://www.dowcorning.com/content/textiles/
CH/CM 4620 Project Topics for Wed Page for Spring 2008

You may work in groups of 3-4. Your web pages will be worth up to 100 points (15% of the course points) but you will earn 0 points if the project is not completed. There are three topics to choose from below. Overall I am looking for evidence of ability to I) assess problems, II) generate solutions, including ones that require multiple steps having multiple requirements, III) original thinking, and IV) ability to present and justify your ideas in a professional manner.

Your report will be given in a web page and presented orally to the class using your web page to illustrate your approach to your assigned problem. Your oral report should be approximately 25 minutes, including ~ 5 minutes for questions. I expect we will probably have ~ 4 groups so we will use April 23 and April 25 for presentations, and/or the scheduled Final Exam Period.

Timeline and Due Dates:

Monday, February 4 – Email me your group members and which project you will due.

Monday, February 25 – Email me a Group Progress report to tell me of any difficulties or problems of any kind so I may assist in any way necessary. You are also welcome to make individual or group appointments with me now or at any other time to assist you.

Monday, March 24 – Email me the location of your preliminary web page so I can give you a preliminary evaluation. The web page need not be complete, but the more you have there the more feedback I can give you regarding content, appearance, functionality of the buttons, appropriateness of your approach, etc. Address as many issues as possible before March 31.

Monday, March 31 – Each Group Earns 5% for emailing the address of your nearly complete web page to the class list. The web page need not be complete but should have most of the content and organization in place. Each classmate should look at all web pages and then each group meets and the group should give constructive feedback via the class list to each other group. Each groups earns another 5% for emailing good, constructive feedback to each of the other groups by April 7. Feedback should address clarity and quality of content, web page functionality and appearance, and any other ideas you can share with your classmates to help them improve their web page. The web project is not just a learning experience for you but I hope it will be something you can show a prospective employer to show them your scientific and technical skills, problem solving abilities, presentation skills, and your professionalism (e.g. failure to give proper attribution, improperly drawn structures, and worst of all mis-spelled words or poor grammar are inappropriate for a web page shown to the public). Each class member receives 1 point for each web page they evaluate (excluding your own).

Monday, April 21 – “Final” Web Page is due. Your contents should be complete although it is still OK to “fine tune” the web page (add or delete buttons, etc.).

Wednesday April 23 and Friday April 25 – Oral presentations.
Web Page Project: Required Components and 100 Point Break Down

10% Earned For Meeting Deadlines and Giving Constructive Feedback.
Posting Preliminary Web Page (March 31) and Group Feedback (April 7): 20 Points.
The group earns 10 points just for having a nearly complete web page posted and 0 points for missing the date. You must have a nearly complete web page to allow other groups to have time to give you their feedback, which is worth ten points to them. Each group can earn 10 points for giving good, constructive feedback to all other groups.

65% Points For Web Page Quality Based on Three Components
1) Introduction (15 points). Give the background needed to describe the problem. What materials and methods are in use now. What are the drawbacks if any to those methods. What are you seeking to improve. Your primary task will be to find a way to use renewable resources in place of ‘petro-polymers’ in use now, but ideally you can maintain or even improve cost and efficiency. Include not only raw material costs but disposal costs and environmental costs when making your assessments. Are the polymers part of a landfill waste stream (e.g. PE/PP) versus is your material which may be recyclable or compostable? If you think it is unlikely to be cost effective can you identify what needs to be improved or changed and hypothesize a way that might be overcome? Show the structures of the polymers currently used and how they are made including the processing to their final form. Also show how they are actually used in the application. Make the intro interesting, informative, and use it to set up your own ideas and how good they are. Use images as possible but be mindful of copyright issues. On web pages pictures are better than words where possible, but also accomplish your purpose.
Points awarded for quality of the content, depth of understanding shown in the content, and how well it communicates the material and supports your proposal.

Proposal (25 points). Explain your ideas/solutions. How does your idea address any of the drawbacks of the materials/approaches described in the Introduction? Why is your idea or approach better? Be sure to show the chemical structures of the polymers and the chemical changes you are using including reaction conditions, isolation if any, blending, and processing. How will your material function when it is in use. Are any properties likely to be better or worse than the current methods/materials? How or why? If your biopolymer is subject to attack by bacteria or fungi do you need to preserve it in the short term until it has served its purpose?

References (5 points). Quality and “legitimacy” of references. No fewer than 12 should be listed on you web page and a minimum of 8 should be from peer-reviewed sources and all key references MUST be from peer-reviewed sources. I will check all your references so any that are not available on line must be photocopied and submitted to me by April 21.

Overall Appearance and Functionality of the Web Page (10 points). The web page should appear professional and stylish. The images and chemical drawings should be of good quality. The content should be arranged logically. All buttons should work and the functionality should be good (i.e. links should also work and there should not be excess clicking).

Individual Contribution Points (10 points). Each member in the group should individually submit a brief page describing their contribution and give the name and contribution of each other group member’s contribution. The purpose of this is to ensure that each group member contribute to the group project so if one member is not doing their share of the project this will give the other group members the chance to point out an inequitable contribution to the web page. I will award these points individually to each group member based on the consensus of the contribution.

Oral Presentation (25%): 12 points will be awarded for the quality of the oral presentation in class, 8 points will be given to the group for the quality of answers given to questions asked of you, and 5 points
will be given to group members individually based on the quality of questions individuals ask other groups about their projects.

**Extra Credit:** Groups whose ideas and web page show particular quality can receive up to a half letter grade boost to *their course grade*. For example if you are in the middle range between AB and A if your web page is truly outstanding then you will receive a boost to a letter grade of A.
**Topic 1:** Look at the composition of diapers (see article posted on course web page). Design a biobased polymer that could be used to replace the sodium polyacrylate adsorbant used in disposable diapers. Design the complete use process starting from where you get the primary starting material, what chemical modification steps are involved if any (make those as environmentally benign as possible) and the process step so that they can be used in the diaper. Try to make a rough cost estimate or comparison of the economic and environmental differences involved in using sodium polyacrylate versus your material. I DO NOT expect you to do a full economic analysis, just try to estimate where they key cost differences will be.

**Suggestions:** Go to the library and look at the production of monomer and polymer from sodium polyacrylate. The syllabus gives you several likely texts to find this information. Then look at methods of purification of industrial waste streams or water purification methods using carbon black. Also, for these kinds of topics the American Chemical Society (ACS) Symposium Series books are particularly useful. I took a quick look at the library holdings in the ACS series via their web page, going back as far as 2001, and saw Subsurface contamination remediation: accomplishments of the Environmental Management Science Program / Edgar Berkey, editor, Tiffany Zachry, editor. Biogeochemistry of chelating agents / Bernd Nowack, editor, Jeanne M. VanBriesen, editor. Water quality assessments in the Mississippi Delta: regional solutions, national scope / Mary T. Nett, Martin A. Locke, Dean A. Pennington [editors]. Advanced materials for membrane separations / Ingo Pinnau, Benny D. Freeman, editors. Green engineering / Environmental chemistry--Industrial applications--Congresses. Environmental management--Congresses.

**Topic 2:** Design a NEW biobased polymer that can be a buccal (inside the cheek) insert for the controlled release of a pharmaceutical agent for 2-4 weeks. Design the complete use process starting from where you get the primary starting material, what chemical modification steps are involved if any, how you will incorporate the active ingredient, how you will manipulate the release rate to obtain a suitable release (you may need to make the system degrade faster or slower, or more hydrophilic or hydrophobic, etc). Try to make a comparison to currently used materials and why your material would be better. I DO NOT expect you to do a full economic analysis, just try to estimate where they key cost differences will be.

**Suggestion:** Review different ways of controlling release and currently used controlled release materials and how they degrade. Many of these will also be biopolymers but I want you to come up with a new material. Then look at specific materials used as buccal inserts and common biomaterials that might be used and come up with an alternative biomaterial. You may want to combine methods if there is a reason to do so. There are many excellent books in the library and some background material is available here: 
**Topic 3:** Design a biobased alternative to commonly used plastic containers containing things like shampoo or window cleaner. Ideally it will be 100% biopolymer, but you must get a 50% minimum renewable biopolymer composition. Your material selections must be practical and reasonable (i.e. are properties and processing appropriate for the application and are these reasonably economical. I do NOT expect you to do an economic study, but at the same time you must not select materials or design methods that are clearly far too costly to be practical.

**Topic 4:** Design a biobased alternative to plastics commonly used for the ‘casings’ in fans, radios, computer printers, etc. These are plastics that will need some impact and/or mechanical strength but do not need a great deal of thermal resistance. They will need a longer lifetime then plastics in Topic 2. You can consider using a composite. Ideally you will use 100% biopolymer, but you must get a 50% minimum renewable biopolymer composition. Your material selections must be practical and reasonable (i.e. are properties and processing appropriate for the application and are these reasonably economical. I do NOT expect you to do an economic study, but at the same time you must not select materials or design methods that are clearly far too costly to be practical.

**Some background and suggestions from a quick google search for Topics 3 and 4:**
http://scifun.chem.wisc.edu/chemweek/POLYMERS/Polymers.html

**Suggestions:** choose a product type to replace, and consider its requirements. What chemicals will it come in contact with, what is the needed lifetime, will it be subject to impact or need mechanical strength etc. Then find out what materials (polymer, reinforcement, other additives) are used with that product, and then also look at how it is formed (injection molded, reaction injection molded?). You might also call up a company and ask to talk with a technical representative and get additional information about properties, and maybe even talk with a mechanic or repair store for expensive tanks like automotive (cares, truck, tractors, boats) and find out how often they fail and why to get an idea of repairs and properties needed. Then, look at biopolymers that might be able to replace them. You can chemically alter biopolymers to get needed properties, but that must be a part of your overall cost considerations too. You will certainly need to crosslink the polymer and may need a reinforcement, which can be biopolymer, or traditional reinforcements. There are many resources in the area of biopolymers and biocomposites, both in the library (including in the ACS Series) and on-line.