Chemical Engineering 733  
Coal Combustion

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Spring 2008  
MWF 9-10:50 am 384 CB

Catalog Description:  
Fundamentals of coal combustion and gasification processes, including particle mechanics,  
devolatilization, heterogeneous oxidation, radiative heat transfer, and combustion of coal in practical  
flames.

Course Objective:  
The objective of this course is to help students develop a background in important aspects of coal  
combustion. Many ACERC graduate students specialize in a narrow area of coal combustion (or a  
related field), but never gain much knowledge of other areas of coal combustion. This broader  
knowledge is often useful in writing proposals, theses, and research papers, and often helps put a better  
perspective on your chosen research emphasis. We will also discuss some aspects of biomass, since it  
is closely related. Biomass reference material has been placed on the ChEn 733 class web page  
(http://www2.et.byu.edu/~tom/classes/733/Biomass/).

Required Text:  
of Coal, Plenum, 1994. (You can borrow this)

Secondary Sources:  
2. L. D. Smoot and D. T. Pratt, editors, Pulverized-Coal Combustion and Gasification, Plenum,  
   1979.
   1 through 10.
4. H.H. Lowry (editor), Chemistry of Coal Utilization, Vol. 1 and Supplementary Volume, Wiley,  
5. L. D. Smoot (editor), Fundamentals of Coal Combustion for Clean and Efficient Use, (Coal  

Topics:  
1. Processes and Properties of Coal (4)
2. Devolatilization (4)
3. Heterogeneous Oxidation (3)
4. Mineral Matter & Deposition (2)
5. Practical Flames (1)
6. NOx/SOx Formation (1)
7. Lab Tours (3)

Prerequisites:  
The course involves the development of qualitative and quantitative descriptions of the physical  
processes involved in coal combustion and gasification. The fundamental tools used to describe these  
processes include turbulent fluid mechanics, heat transfer, mass transfer, thermodynamics, and reaction  
kinetics. It is expected that each student be well founded in these subjects before beginning this course.  
Additionally, the description of these processes usually involves differential equations that often require  
umerical methods to solve. It is expected that students be comfortable in the use of the computer to  
solve these problems.

Combustion Processes or equivalents would be helpful, but are not required.
**Class Discussion:**

This is an advanced graduate level course. It is expected that students will come to class having prepared themselves thoroughly on the topic to be discussed that day. Originally, this class was heavily lecture-oriented, with the students feeling like a fire hose has been attached to their head. Overheads full of information were passed before the class, hoping for learning to take place. A different philosophy is currently employed in this course, where student learning is emphasized, rather than mere presentation by the instructor. This will be accomplished in the following manner:

1. Students will be divided into groups of two students.
2. Reading questions are placed on the class web page. Please be sure to check for updates the day before class.
3. Students are expected to read the assigned material, and then meet as a group to discuss the reading material.
4. Student groups will each prepare one set of responses to the reading questions that will be suitable for presentation to the class. PowerPoint files on a flash drive are acceptable, but please do not make the format too fancy. Focus on content rather than graphics and style.
5. One student will be randomly selected and asked to present their group answers to the class.
6. The student presentation will not be graded right or wrong, but only prepared or unprepared. The entire group will receive a demerit if one member of their group is unprepared.
7. Please bring a printed copy of your group’s PowerPoint slides to class in order to take notes. Your answers may differ from other students. You may print these in handout mode, 6 slides to a page, in order to save paper costs.
8. Additional slides from Dr. Fletcher will be posted on the web page.

This is a little different format than the usual 100% lecture format, and is written up in the engineering education literature. This method is intended to promote student learning, and has been successfully used by several faculty in our college. 30% of the grade will be given for classroom participation (25% for answers to reading questions and 5% for general participation).

Since most of the graduate students in this class have specialized in an area of combustion research, each student will be asked to contribute to the discussion in class in that area. For those students that are not directly in the coal combustion area, appropriate discussions and questions are expected.

**Homework:**

The preparation for the class discussion takes the place of homework in this class. Only a few of the "reading questions" will be of the problem-solving type.

**Trip Reports:**

We will have several field trips in this class, which may include trips to IPP, the BYU Heating Plant, and the research facilities at BYU and at the University of Utah. We will talk in class about possible benefits of visiting different sites, and vote on where we will go (and when). A one-page trip report is required of each field trip, describing what significant things you learned. This year there is a special forum on the Future of Coal at the Salt Lake City Library on May 23. I would like to attend this as a class, and have you give posters on your work (where appropriate). The registration is required, but free, at the web site: [http://www.cleancoal.utah.edu/meeting.htm](http://www.cleancoal.utah.edu/meeting.htm)

**Exams:**

Two exams will be given during the semester, one midterm and one final. Exams will be normalized so that the high score is 100%. Both exams will be oral exams, given individually to each student.

**Grading:**

Since the focus of this class is not problem solving, a large portion of the grade will be assigned to classroom participation and the answers to the reading questions. The final grade will be based on the following:

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<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Reading Questions</td>
<td>25%</td>
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<tr>
<td>Class Participation</td>
<td>5%</td>
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<tr>
<td>Trip Reports</td>
<td>5%</td>
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<tr>
<td>Midterm</td>
<td>30%</td>
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</tbody>
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Final 35%

Advice: You can get an A in this class by preparing 8+ hrs per class or 4 hrs per class. Please optimize your time by skim reading, deciding what is important, and not making the PowerPoint too fancy.

Office Hours:

I am always available to answer questions and pursue discussions on coal combustion whenever I am not in any other meeting. Come to 350E CB or phone 422-6236 as you need. Ad hoc discussions on these topics are encouraged; room 350E CB is one possible environment to promote such discussions on a regular basis. However, I am also very busy in several university assignments, and request that you be patient and that you respect my time as well. Regular office hours will be scheduled if needed.

BYU Environment:

BYU is owned and sponsored by the Church of Jesus Christ of Latter Day Saints, and BYU students and faculty are required to abide the BYU honor code and the dress and grooming standards. Visitors are also expected to abide by these standards while on the BYU campus. This generally means to be honest, dress conservatively, refrain from foul language, and abstain from tobacco, alcohol, and caffeinated beverages. This is usually not a big inconvenience for visitors; copies of the BYU standards are available in the Chemical Engineering Office or at http://campuslife.byu.edu/honorcode/.