New Course:

BIOREFINERY:

Application of Chemical Engineering Principles

(Course code: 416511, 5 s.p.)

For:	Focused on 4th year and Masters Student, PhD students also welcome
Dates:	19 Sept – 2 December 2011 (register by 14.9.2011)
To register:	nmartini@abo.fi/Moodle2/Minplan
Website:	https://moodle2.vasa.abo.fi/login/index.php
Coordinator:	Nikolai DeMartini (nmartini@abo.fi); +358 (0)2 215 4762

Lecturers:

Anna Sundberg
Dmitry Murzin
Johan Bobacka
Jan Gustafsson
Jyri-Pekka Mikkola
Mikko Hupa
Nikolai DeMartini
Pedro Fardim
Stefan Willför
Tapio Salmi

Laboratories:

Analytical Chemistry
Fibre and Cellulose Technology
Industrial Chemistry and Reaction Engineering
Inorganic Chemistry
Wood and Paper Chemistry

Åbo Akademi University

PROCESS CHEMISTRY CENTRE

Description

Biorefinery concepts are leading to new industries and new ideas within old industries. They involve a new feedstock, biomass vs. fossil with a unique set of challenges to utilizing the carbon and hydrogen in biomass to make fuels and chemicals. While there was a significant push in the 70's and early 80's there was not the consistent development required to bring about mature industries. There are both technical and economic uncertainties in most concepts. The objective of this course is to provide an introduction to biorefinery concepts and challenges for cellulosic biomass. Lectures will provide some background to biomass and its conversion to energy, fuels and chemicals. Examples will be given of the application of chemical engineering principals to biorefinery concepts. Five laboratories in Chemical Engineering (Analytical Chemistry; Fibre and Cellulose Technology; Industrial Chemistry and Reaction Engineering; Inorganic Chemistry; and Wood and Paper Chemistry) have come together to teach this course.

The project is intended to let you explore a biorefinery concept you find interesting. The basis for the project presentation at the end of the course will be an intensive literature study and some basic mass and energy calculations. You will have the opportunity to do the project either individually or as a group and you will be able to choose your topic for the project to a large extent. One class a week is reserved for working on the project in the computer lab. This will give you access to the internet for literature searches as well as access to excel and power point for preparation of your project. A supervisor will be present during this time to help if needed.

Schedule and Class Locations

Wk	Date	Day	Time	Location	Lecturer	Topic
38	19-Sep-11	Monday	13:15-15:00	Glaset, Axelia	DeMartini	Introduction
	21-Sep-11	Wednesday	13:15-15:00	Aspelund, Axelia	Hupa	Thermal Conversion for biorefineries
	23-Sep-11	Friday	10:15-12:00	Aspelund, Axelia	Hupa	Thermal Conversion for biorefineries
39	26-Sep-11	Monday	13:15-15:00	Glaset, Axelia	Murzin	Traditional Chemicals Industry and Biorefinery Implications
	28-Sep-11	Wednesday	13:15-15:00	PC Class, Axelia	DeMartini	Project
	30-Sep-11	Friday	10:15-12:00	Aspelund, Axelia	Murzin	Platform Chemicals
40	3-Oct-11	Monday	13:15-15:00	Glaset, Axelia	Sundberg	Building blocks and chemical bonds in biomass
	5-Oct-11	Wednesday	13:15-15:00	PC Class, Axelia	DeMartini	Project
	7-Oct-11	Friday	10:15-12:00	Aspelund, Axelia	Sundberg	Building blocks and chemical bonds in biomass
41	10-Oct-11	Monday	13:15-15:00	Glaset, Axelia	Fardim	Fractionation of biomass
	12-Oct-11	Wednesday	13:15-15:00	PC Class, Axelia	DeMartini	Project
	14-Oct-11	Friday	10:15-12:00	Aspelund, Axelia	Fardim	Fractionation of biomass
42	17-Oct-11	Monday	13:15-15:00	Aspelund, Axelia	Salmi	Catalytic conversion of sugars and extractives
	19-Oct-11	Wednesday	13:15-15:00	PC Class, Axelia	DeMartini	Project
	21-Oct-11	Friday	10:15-12:00	Aspelund, Axelia	Mikkola	Ionic Liquids
43	24-Oct-11	Monday	13:15-15:00	Aspelund, Axelia	Salmi	Reaction Engineering in Biorefinery
	26-Oct-11	Wednesday	13:15-15:00	PC Class, Axelia	DeMartini	Project
	28-Oct-11	Friday	10:15-12:00	Aspelund, Axelia		
45	7-Nov-11	Monday	13:15-15:00	Aspelund, Axelia	Gustafsson	Products from Cellulose & Lignin
	9-Nov-11	Wednesday	13:15-15:00	PC Class, Axelia	DeMartini	Project
	11-Nov-11	Friday	10:15-12:00	Aspelund, Axelia	Willför	Products from Hemicellulose & Extractives
46	14-Nov-11	Monday	13:15-15:00	Aspelund, Axelia	Bobacka	Environmental Considerations in Biorefineries
	16-Nov-11	Wednesday	OFF	OFF	OFF	OFF
	18-Nov-11	Friday	10:15-12:00	Aspelund, Axelia	All	Panel Discussion
47	21-Nov-11	Monday	13:15-15:00	PC Class, Axelia	DeMartini	Project
	23-Nov-11	Wednesday	13:15-15:00	PC Class, Axelia	DeMartini	Project
	25-Nov-11	Friday	10:15-12:00	PC Class, Axelia	DeMartini	Project
48	28-Nov-11	Monday	13:15-15:00	Aspelund, Axelia	Lecturers	Group presenations
	30-Nov-11	Wednesday	13:15-15:00	Aspelund, Axelia	Lecturers	Group presenations
	2-Dec-11	Friday	10:15-12:00	Aspelund, Axelia	Lecturers	Group presenations
50	12-Dec-11	Monday	13:15-15:00	Aspelund	DeMartini	Review
	14-Dec-11	Wed	13:15-17:00			Exam I

Project

Portion of your grade: The project grade counts for 20% of your final grade.

Group or Individual: You have the option of choosing to do this project individually or as part of a group of up to 3 people. You can choose the group you want to work in. The score your group gets will be the score you get for the project.

Topic Selection: You can propose a topic (subject to approval by the coordinator) or work with the coordinator to select a topic for the project. Please first approach project selection by trying to define a "problem". For example, Dow Chemicals wanted to make carpeting out of biomass derived fibers. They then established they could do this from PLA and then generated the PLA from corn. Another example would be to begin from a feedstock perspective. For example Denmark generates more straw than can be used in agriculture. For a long time they exported this, but eventually they began looking at co-combustion with coal and subsequently did the research needed to support that. Subsequently they have set up a demonstration plant to extract the sugars from the hay for ethanol production prior to combustion of the residues. The project concept can be small scale (such as development of a wood pyrolysis unit for home use), but you need to carry it through to what you will use it for. It can also be large scale (such as gasification for Fischer-Tropsch fuels). The concept can be novel or well established, but should be interesting to you as you will need to do a lot of reading for this project. While biomass combustion falls within the biorefinery concept, it should not be the primary concept in your project.

Project Description: Once you have defined your topic, your objective is to be able to present basic background for the evaluation of the concept. At the end of the course you will make a 20-25 minute presentation (~20 slides) of your concept with 5-10 minutes for a question and answer session with your peers. The basis for your presentation will be literature. Basic mass/energy balance calculations should be done to draw conclusions about scale, mass of biomass needed, etc., but you are not expected to present detailed mass and energy balances.

Suggested guidelines in approaching the project:

Wk 39 (28.9)	Decision about group/individual; description of topic; preliminarty literature (1-2 articles)
Wk 40 (5.10)	Solidification of topic description, collection of data on biomass composition and properties
Wk 41 (12.10)	Chemical reactions/process steps
Wk 42 (19.10)	Basic mass/energy balance calculations for inputs/products
Wk 43 (26.10)	Scale and implications
Wk 45 (9.11)	Assessment of the impact of a change in feedstock
Wk 46 (16.11)	Research needs
Wk 47 (21-25.11)	Finalize presentations
Wk 48 (28.11-2.12)	Group presentations

I will be available during the exercises sessions and by email. The above guidelines are just that, guidelines to help you stay on schedule. This is a lot of information to pull together and as biorefinery concepts are still mostly in the developmental stage, they are still mostly under development (i.e. there are gaps in the knowledge). However, there is also a great deal of information published and being published so this is an opportunity to get familiar with a concept and resources available to obtain the current thinking on biorefinery topics.