

CU 7.2: CHEMICAL AND ENERGY VALUES

Director of studies: Emmanuel FREDON

General CU objectives:

- Describe and differentiate fractionation and conversion processes suitable for the production of fibrous materials (paper, cardboard, panels) or molecules (speciality lignin celluloses, biofuels, platform molecules, extractables).
- Identify the products of interest resulting from the chemical fractionation of wood biomass.
- Carry out conversion assessments and assess quantitative biomass needs with a view to obtaining a specific final product.
- Analyse a whole process, and know how to break it down into unit operations. Calculate material and energy flows.
- Discover and explain thermochemical pathways.
- Explain the operation of wood burning appliances.
- Discover and explain the new uses of wood as an energy source.
- Conduct a technological and regulatory literature review. Leverage academic articles.
- Experiment with a wet fractionation process and evaluate it with analytical techniques.

Consists of:

- Module 1: Chemical recovery
- Module 2: Energy recovery
- Module 3: Not applicable
- Module 4: Not applicable

Hourly volume

In-person

*Self-
directed
study*

21.00 H Lectures

32.00 H

8.00 H Tutorials

30.00 H Practicals

Positioning of the CU in the School reference system:

after CU 5.3 and CU 6.3

Units of skills

In accordance with the RNCP sheet

Unit 1

Unit 4

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Module 1: Chemical recovery	Coefficient 1
Session leaders: Emmanuel FREDON, Arnaud BESSERER, Pierre GIRODS	
Teaching assistants: Marie-Laure ANTOINE, Christelle PERRIN	
Prerequisites: CU 5.3 M1 and M3, CU 5.4 M1, CU 6.3	
Teaching materials: Presentation slides – Reading list – Arche Page – Project – Academic papers	
Assessment methods: individual and in groups Class assignment– Viva– experience reports– bibliographic report	

Learning outcomes	Description	Number of student hours (in-person)		
		Lectures	Tutorials	Practicals
<p>Describe and differentiate fractionation and conversion processes suitable for the production of fibrous materials (paper, cardboard, panels) or molecules (speciality lignin celluloses, biofuels, platform molecules, extractables).</p> <p>Identify the products of interest resulting from the chemical fractionation of wood biomass.</p> <p>Analyse and model a whole process, carry out simple material and energy balances, calculate yields.</p> <p>From bibliographic and theoretical resources (chemistry, enzymology), be able to propose the optimal operating conditions for the chemical and biochemical conversion of a lignocellulosic biomass to the expected products: assess the necessary raw material needs, choose and implement the operating conditions.</p> <p>Select relevant biomass characterization tools as indicators of transformations and know how to use them with the help of trainers.</p> <p>Evaluate the performance of a process, analyse tests by converting raw results into indicators, critique the results.</p>	<p>Mechanical and thermochemical fractionation technologies for the production of particles, fibres and pulps.</p> <p>Industrial fractions: Cellulose pastes, black liquors and tall oil: their production and applications.</p>	3.00		
	<p>Pre-treatments and saccharification to obtain sugars and applications.</p> <p>Extraction processes, and application markets for extracts.</p> <p>Establishment of chemical balances, example of hydrolysis.</p>	0.50	2.00	
	<p>Biotechnological processes for deconstruction and conversion to molecules of interest.</p> <p>Introduction to enzymatic kinetics.</p> <p>Main micro-organisms used in bioprocess engineering.</p>	1.75	2.00	
	<p>Process engineering concept, general modelling of flows of material and energy, balances.</p>		4.00	
	<p>Practicals: "From wood to bioethanol": bibliographical study, pre-treatments, saccharification, fermentation, distillation.</p> <p>Implementation of processes based on scientific articles, product analysis, material balances, health and economic analysis.</p>			18.00
		5.25	8.00	18.00

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Module 2: Energy recovery	Coefficient 1
Session leaders: Yann ROGAUME	
Teaching assistants: Access to documentation centre	
Prerequisites: CU 5.4 (combustion part)	
Teaching materials: Presentation slides– Reference book– Project	
Assessment methods: individual and in groups Class assignment– Viva– Report	

Learning outcomes	Description	Number of student hours (in-person)		
		Lectures	Tutorials	Practicals
<p>The student must be able to:</p> <ul style="list-style-type: none"> Describe the main existing pathways Give some context Discuss ongoing developments Illustrate the main pathways Explain the differences Choose a device according to the context of use Describe the general operation of a combustion device Describe the main systems Provide examples, illustrate 	<p>General information on the different ways of recycling wood beyond its use as material</p> <ul style="list-style-type: none"> – Role of these chemical and energy uses in the sector; – energy context: – biorefinery 	1.75		
	<p>General information on thermochemical pathways</p> <ul style="list-style-type: none"> – pyrolysis - carbonisation – gasification– biofuels; – combustion. 	5.25		
	<p>Wood-burning appliances</p> <ul style="list-style-type: none"> – general operation of appliances, general design principle; – differences between all systems for home heating; – the main industrial and collective systems. 	5.25		12.00
	<p>Main ongoing developments</p> <ul style="list-style-type: none"> – European and French context – heating networks – cogeneration 	3.50		
		15.75	0.00	12.00