Derivatives of Cellulose

Subject area: Chemical Engineering

University:	TalTech
Level:	MA all years
Teaching mode:	hybrid: some students participate online, other students attend real-life
Instructor(s):	Andres Krumme, Nutan Savale

Short description

The course is giving overview of cellulose structure, sources, preparation for processing, solvents and functionalisation environments; principles of synthesis of cellulose derivatives; main chemical and physical properties of the derivatives; processing technology, applications and environmental impact of the derivatives.

Full description

Cellulose is the most common bio-based polymer in the biosphere. Only a fraction of this raw material could replace fossil resources based polymers by renewable, carbon-neutral materials. Cellulose is also a widespread raw material in the Nordic countries and Estonia. Through chemical modification, derivatives have the potential to revitalize cellulose to replace fossil-based plastics in various sectors of the economy, such as the packaging industry and construction, as well as in high-tech fields such as filtration or energy storage. This course introduces promising sources and preparation methods of cellulose in terms of the green economy. Modification of cellulose takes place mostly in dissolved form, so an important part of the course is the introduction of traditional as well as modern solvent systems. The course provides an overview of a wide range of cellulose derivatives, with a focus on the most common esters and ethers. The potential applications of the derivatives are explained through their physical and chemical properties. Methods for processing cellulose derivatives in the plastics and textile industries are introduced. The main goal of the course is to provide knowledge for the design and synthesis of future cellulose derivatives with minimal environmental impact in all aspects of the production process.

Learning outcomes

After completing this course, the student:
- correlates the structure, chemical and physical properties of cellulose to acquire the following techniques of chemical modification and processing of it;

- describes the most important sources of cellulose and is able to assess their sustainability. Correlates the most important techniques for separating cellulose from biomass and knows why it is necessary to activate cellulose before subsequent dissolution and chemical modification processes,
- compares historical and modern cellulose solvent systems, can distinguish between derivative and non-derivative dissolution,
- interprets the main reaction mechanisms of cellulose derivatives, mainly esterification reactions and the synthesis of cellulose ethers, explains the chemical and physical properties of cellulose derivatives and relates the properties of the derivatives to applicability in various products;
- correlates the most important methods of processing cellulose derivatives in the plastics and textile industries and elsewhere. Selects a suitable processing method for a particular derivative based on the properties of the product being manufactured;
- prioritizes the right methods, solvents and reagents with the least environmental impact for the synthesis of the desired cellulose derivatives;
- compares the methods of recycling materials based on cellulose and relates recycling accordingly.

General information

Contact hours per week:	4
Total workload:	150 (in student hours for the whole course)
ECTS credits:	6
Language:	English
Course start date:	01 September 2022
Course end date:	18 December 2022
Add. info about start date:	Exact dates will be specified
Weekly teaching day/time:	Seminary meetings in every second week
Time zone:	CET +1 (Estonia, Israel)
Further information:	
Prerequisites:	Basic understanding of organic chemistry, polymer chemistry and biopolymers
Activities and methods:	Seminars, Group work, Self-study, Exercises, Lab-work reports are based on analysis of video recordings of relevant laboratory activities, oral presentations are given during the (MS Teams based) seminary meetings.
Presence on campus:	Completely online participation is possible.

Final examination

Form:	Course mark is published by average of marks of evaluative activities conducted during the semester

Date:

Location/format:

Re-sit possibility:

Transcript available: end of semester

Add. info/requirements: Active participation during the semester is needed for good results.

Registration

To register for this course, follow the registration requirements of your **home university** as specified here: www.euroteq.eu/courses-registration.

Administration

Number of places: Not limited.

Minimum participants: Not limited.

Internal course code: EKP0360

Contact: andres.krumme@taltech.ee

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