Master Programme in Resource Recovery - Polymer Materials for the Circular Economy

Masterprogram i Resursåtervinning - polymera material för den cirkulära ekonomin

120 credits

Ladok Code: TAREP
Version: 1.0
Level: Second cycle
Approved by: Research and Education Board 2020-04-22
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General Objectives

Second level education shall essentially build on the knowledge that students acquire in first level education or corresponding knowledge. Second level education shall involve a deepening of knowledge, skills and abilities relative to first level education and, in addition to what applies to first level education, shall

- further develop the students' ability to independently integrate and use knowledge,
- develop the students' ability to deal with complex phenomena, issues and situations, and
- develop the students' potential for professional activities that demand considerable independence or for research and development work.

(The Higher Educations Act, Chapter 1, Section 9)

Objectives

Educational programme's goals

The overall goal of the educational programme is to provide the student with knowledge and skills in order to develop and implement systems, engineering, and technology that promote a more resource-efficient society, especially in the materials, energy, and recycling sectors. In this context, the programme is also to provide knowledge and skills that the student can take into account and critically examine when it comes to sustainability aspects, international aspects, and ethical issues. The aim of the programme is to prepare the student for doctoral education, as well.

Upon completion of the programme, the student is to be able to:

1. Knowledge and understanding

• demonstrate knowledge and understanding of resource recovery, including both broad knowledge and substantially specialised knowledge regarding the resource recovery and management of polymer materials in the circular economy as well as specialised insight into current research and development work.
• The student should also demonstrate specialised methodological knowledge in resource recovery.

2. Skills and abilities

• based on complex phenomena, problems, and situations related to resource recovery, even with limited information, have the ability to critically and systematically integrate knowledge and analyse, assess, and process it from a technical, economic, environmental, and social perspectives.
• demonstrate the ability to critically, independently, and creatively identify and formulate questions as well as plan and, with adequate methods, carry out and evaluate qualified tasks within given time frames and thereby also contribute to the development of knowledge.
• orally and in writing clearly recount and discuss conclusions and results and the knowledge and arguments on which they are based in dialogue with different groups, both in national and international contexts.
• have acquired the skills required to participate in research and development work or to work independently in other qualified settings.

3. Evaluation ability and approach
• demonstrate the ability to make assessments in the main area of resource recovery with regard to scientific, societal, and ethical aspects and demonstrate awareness of ethical aspects of research and development work.
• demonstrate insight into the possibilities and limitations of science and technology, their role in society, and people's responsibility for how they are used.
• demonstrate the ability to identify their own need for additional knowledge and to take responsibility for their own knowledge development.

Content

The educational programme consists of two years of full-time studies and is strongly linked to the research conducted within the research area Resource Recovery at the University of Borås. All courses are within the main field and are classified as being at the Advanced/Master's level (Second-cycle).
Since the main area of resource recycling requires a multidisciplinary approach, the course offerings during the first term aim to give the students broad knowledge and understanding of the main field. The students are also to be given the opportunity to specialise within the area of polymer materials and their role in the circular economy. In year two, methodological knowledge and knowledge are further specialised through the degree project, ECTS 60 credits.

Term 1
The courses given during the first term are as follows:

• Resource Recovery 1, 7.5 ECTS credits
• Resource Recovery 2, 7.5 ECTS credits
• Life Cycle Assessment, 5 ECTS credits
• Circular Economy, 5 ECTS credits
• Theory of Science and Research Methodology, 5 ECTS credits

Resource Recovery 1 provides an overview of how waste is currently handled internationally and nationally, legislation, as well as waste characterisation, which is important when choosing the right recycling technology. Social and economic aspects such as pressure on or obstacles to recycling are also taken into account in the course. The course *Resource Recovery 2* focuses on giving the student an insight into where the research front lies in the field, as well as future techniques and opportunities for improved recycling, The ethical aspects related to recycling are also addressed. How companies and society should design products and processes and services and business models to promote a development from linear economy to a circular economy is addressed and discussed in the course Circular Economy. The *Life Cycle Assessment course* focuses on the LCA method, its applications and its limitations. The course *Theory of Science and Research Methodology* is given during the first term; in this course, students gain increased knowledge and understanding of the research process and about quantitative as well as qualitative research methodologies in order to be able to apply this knowledge in project work and be well prepared for the final degree project.

Term 2
During the term, there will be a first specialisation within polymer materials i.e. plastics, composites, and textile materials and their importance for the circular economy. A focal point are the polymer materials made from renewable raw materials. During this term, larger project work is introduced in which more complex issues are handled. The courses deepen the student's knowledge of material development and manufacturing methods that enable the use of polymer materials in the circular economy, and facilitate their sustainable manufacturing, use, and recycling. The specialisation includes a review of the central definitions and concepts for the use, processing, properties, and recycling of polymer materials. The production of polymer materials from renewable raw material resources, the biodegradation of residual polymer waste, and the re-uptake to the ecosystem are also addressed. The experimental methods of manufacturing, characterisation, and material testing are dealt with in a laboratory course.
• Polymer Technology, ECTS 7.5 credits
• Polymers and Textiles in Composites, 7.5 ECTS credits
• Experimental Methods for Polymers and Textiles, 7.5 ECTS credits
• Polymeric and Textile Materials and the Environment, 7.5 ECTS credits

The course *Polymer Technology* examines the central terminology and concepts relevant to the applications, properties, and structure, and properties of polymer materials as well as their manufacturing that are necessary for their use in the circular economy. The processing of polymer materials into plastics and textile fibres is dealt with in relation to environmental impact and recycling. The course also provides knowledge about the environmental impact of polymers during their life cycle.

The course *Polymers and Textiles in Composites* deals with the manufacture, use and properties of composite materials, as well as their environmental impact, and how they should be handled from a resource recovery perspective. The course also includes the manufacture of textile reinforcements using the textile manufacturing methods, and how these can be optimised to achieve optimal properties in a composite. The interplay between plastic and textile in a composite regarding properties and life-length is an important part of the course. The main laboratory methods for polymer materials are focused on in the course

Experimental Methods for Polymers and Textiles. The course reviews practical methods for manufacturing, characterising, and material testing of polymer materials and thus provides the experimental skills necessary for the degree project in year 2. The course *Polymeric and Textile Materials and the Environment* deepens the students' knowledge in recycling plastics, composites, and textile fibres and how polymer materials can be recycled using biodegradation as well as manufactured from bio-based raw materials.

Courses year 2 (terms three and four)
Terms 3 and 4 consists only of a degree project, divided into two courses Degree project 1, 30 ECTS credits and Degree project 2, 30 ECTS credits. In Degree project 2, the research project is further specialised. During year 2, there is an opportunity for students to exchange the course Degree project 2 for courses comprising of 30 ECTS credits. The intention is to facilitate various forms of internationalisation.

Admission Requirements

Degree of Bachelor of Science or Degree of Bachelor of Science in Engineering, 180 ECTS credits, specialising in mechanical engineering, industrial economics, energy engineering, chemical engineering, polymer technologies, materials engineering, biotechnology, road and water technology, textile engineering, or construction engineering or a Bachelor's degree in physics or chemistry. In addition, knowledge of English equivalent to English 6 is required.
For further information about English language proficiency requirements, please view: www.hb.se/Englishlanguageproficiency

Degree

After completing the educational programme corresponding to the requirements in this programme syllabus, the student can, upon application to the university, receive this degree:

Degree of Master of Science (Two Years) with a major in Resource Recovery
– specialisation Polymer Technology

The diploma is bilingual (Swedish/English). Together with the diploma, you receive a Diploma Supplement (English). A Diploma Supplement is an appendix describing the place of the awarded degree within the Swedish education system. Diplomas are issued upon application via a form. More information can be found on the university’s website.

Degree certificates are issued upon application on a special form. More information is available at www.hb.se.

Student Influence and Evaluation

All courses within the programme are evaluated (see the university's policy for course evaluation). The Programme Coordinator is responsible for ensuring that students' views on the education are systematically and regularly collected. The Programme Coordinator together with the Dean of Faculty is responsible for ensuring that the programme is evaluated annually with the participation of the students. The evaluation is documented in writing and returned to the students.

Miscellaneous

This syllabus is a translation from the Swedish written original.

The language of instruction is English.