

Environmental and Recycling Technology (M. Eng.)

Module – Number	744	Obligatory in specialization Recycling Technology (RT)		
Module name	Future Technologies of Recycling Practice / Project Work			
Module coordinator	Prof. Dr.-Ing. Michael Rutz			
Title	Future Technologies of Recycling Practice / Project Work			
Title of examination	Future Technologies of Recycling Practice / Project Work			
Semester	2 nd			
Course type	Language	Seminar + PW	English	
Credit hours/ ECTS/ Workload	2/1/1	5	150	
Formal Conditions	for graduates holding a Bachelor of Engineering or Bachelor of Science degree			

1. Content and objectives

Content:

The following technological future fields are optionally focused on in form of seminar and project work:

- electromobility / battery cycle
- fuel cells
- wind turbines
- electric drives
- photovoltaics
- robotics
- drones
- 3D printing

Special emphasis is given on the use and recycling of rare earth metals in these technological applications. Responsible technology development as well as conflicts and responsibility in technology application and development are discussed.

The program is designed to be interactive and uses various, in some cases experimental, workshop and discussion formats, e.g. business games.

Learning objectives:

The students are able to outline the recycling industry as well as the areas of research and development for technological fields of the future. The students can recognize conflicts in the practical field of technology application and development in the raw materials area.

Bibliographical References: For preparation and follow-up the following textbooks are recommended:

1. Worell, E.; Reuter, M. (ed.): Handbook of Recycling, Elsevier Inc., 2014.
2. Prasad, M.N.V. (Hrsg.); Vithanage, M. (Hrsg.); Borthakur, A. (Hrsg.): Handbook of electronic waste management: International best practices and case studies; Oxford Cambridge, MA: Butterworth-Heinemann, Elsevier, 2020, ISBN 9780128170304; 0128170301
3. Randers, J.: 2052: A Global Forecast for the Next Forty Years, Rotterdam, 2012.
4. Baipai, P.: Carbon Fiber, San Diego: Elsevier, 2021, ISBN 9780128219058, 012821905X (electronic books)
5. Park, S.-J.: Carbon Fibers. Dordrecht: Springer, 2015
6. Mouritz, A. P.: Fire properties of polymer composite materials. Dordrecht: Springer, 2006
7. World Trade Organisation: International trade statistics, Genf 2020
8. Akhil, A.; Huff, G.; Currier, A.; Kaun, B.: DOE/EPRI 2013, Electricity Storage Handbook in Collaboration with NRECA. Sandia National Laboratories, 2013.
9. Lienhard, J.: A Heat Transfer Textbook. Dover Civil and Mechanical Engineering. Cambridge, Massachusetts, 2017.
10. ACCUREC: Li-batteries-process technology, www.accurec.de/treatment-and-recycling/technologies/li-batteries.

11. Stevels, A.; Huismann, J. Goodship, V.: Waste electrical and electronic equipment (WEEE) handbook, Oxford, England Philadelphia, PA : Woodhead Publishing Limited, 2019
12. Hu, Bin; Golloch, A.: Handbook of Rare Earth Elements: Analytics, Berlin/Boston : De Gruyter 2017, e-books
13. Adler, B.: Strategische Metalle – Eigenschaften, Anwendung und Recycling, Springer Spektrum 2017, ISBN 3-662-53035-X
14. Martens, H.; Goldmann, D.: Recyclingtechnik – Fachbuch für Lehre und Praxis, 2. Auflage, Springer Vieweg 2016, ISBN 3-658-02785-1
15. Hofmann, H., Spindler, J.: Aktuelle Werkstoffe – Neue Materialien für innovative Produkte, Springer Verlag, 2019. ISBN 978-3-662-59440-7

2. Method(s) of instruction

Seminar and Project Work

3. Requirements for attendance

There are no formal requirements for participation.

4. Usability of this module

This module is obligatory in the specialization Recycling Technology and a compulsory module in the other specialization Environmental Technology.

5. Requirements for assessment

In addition to regular participation, the preparation and discussion of a thesis paper is also planned, which exemplifies the above topics and includes future technologies.

6. ECTS Credits

Modules are assessed by a module examination, which is credited by 5 credit points according to the ECTS (European Credit Transfer and Accumulation System).

7. Frequency of offer

The module is scheduled for the first academic year.

8. Workload

Participation in the course	= 20 h
Preparation and follow-up (of the lecture)	= 20 h
Preparation for examination	= 120 h

The entire workload encompasses 150 hours, which equals 5 ECTS credit points.

9. Duration of module

The module is held within one semester.