

Environmental and Recycling Technology (M. Eng.)

Module – Number	740	Obligatory in specialization Recycling Technology (RT)		
Module name	Recycling Technologies of Anthropogenic Material Flows			
Module coordinator	Prof. Dr.-Ing. Michael Rutz / Dipl.-Ing. (FH) Petra Hauschild			
Title	Recycling Technologies of Anthropogenic Material Flows			
Title of examination	Recycling Technologies of Anthropogenic Material Flows			
Semester	2 nd			
Course type	Language	Lecture	English	
Credit hours/ ECTS/ Workload	4/0/0	5	150	
Formal Conditions	Bachelor of Engineering degree			

1. Content and objectives

Content:

Metal recycling

1. Introduction to metal recycling
2. Recycling of iron and steel
3. Copper recycling
4. Zinc recycling
5. Lead recycling
6. Aluminum recycling
7. Magnesium recycling
8. Comparison of metal extraction processes with regard to energy requirements and emissions

Plastic recycling

9. Introduction to plastics, historical development
10. Overview of types of plastic, properties, processability and application of selected plastics
11. Methods of identifying plastics and plastics testing procedures
12. General overview of plastics recycling
13. Legal framework (European and national)
14. Possibilities of plastic recycling
15. Facts and figures
16. Plastics and waste management
17. Requirements for recycling
18. Overview of materials recycling
19. Quality by sorting
20. Recycling technologies
21. Recycling of mono-fraction plastics and mixed plastics
22. Plastic refinement and areas of application for recycled products

Learning objectives:

The students can describe the most important processes of metal and plastic sorting as well as the metallurgical recycling of metals from waste-derived secondary raw materials as well as the recovery of old plastics. They can evaluate known processes, assign individual material flows and define the required qualities of secondary raw materials for use in the recycling processes for the relevant sales channels. The students mainly develop technical and system skills.

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

1. Worell, E.; Reuter, M. (ed.): Handbook of Recycling, Elsevier Inc., 2014. ISBN: 9780123964595
2. Ullmanns Encyclopedia of Industrial Chemistry. 6th ed. 2002, ISBN 978-3-527-30385-4.
3. Wills, B.A.; Napier-Munn, T.J.: Wills' Mineral Processing Technology, 7th edition, Elsevier Ltd., 2006.
4. Nienhaus, K., Pretz, T., Wotruba, H. (eds.): Sensor Technologies: Impulses for Raw Materials Industry; RWTH Aachen, Schriftenreihe zur Aufbereitung und Veredlung Nr. 50, Shaker Verlag, Aachen, 2014.
5. Letcher, T.; Vallero, D.: Waste: a handbook of management; London, Academic Press, 2019
6. Schmitz, Chr.: Handbook of Aluminium Recycling, 2. Auflage Vulkan Verlag, 2014.
7. Habashi, F.: Handbook of extractive metallurgy, Wiley-VCH, Weinheim, New York, 1997.
8. UNEP: Recycling Rates of Metals – A Status Report.
http://www.unep.org/resourcepanel/Portals/24102/PDFs/Metals_Recycling_Rates_110412-1.pdf

9. UNEP 2013: Metal Recycling, www.unep.org/resourcepanel/Portals/24102/PDF.
10. Niaounakis, M.: Recycling of flexible plastic packaging, Oxford Cambridge, Plastics design library (PDL), PDL handbook series, 2020.
11. Vauck, W.R.A., Müller, H.A.: Grundoperationen chemischer Verfahrenstechnik. 11. Auflage 2003, ISBN 978-3527-30964-1.
12. Ditze, A.; Scharf, C.: Recycling of Magnesium, ISBN 978-3-89720-957-2.
13. Martens, H.; Goldmann, D.: Recyclingtechnik – Fachbuch für Lehre und Praxis, 2. Auflage, Springer Vieweg 2016, ISBN 3-658-02785-1
14. Smil, V.: Making the modern world; Chichester, West Sussex : Wiley, 2014, ISBN: 978-1-119-94253-5 pbk
15. Nickel, W.: Recycling-Handbuch, VDI-Verlag, Düsseldorf, 1996; ISBN 978-3-642-95769-7
16. Willeke, R.: Recycling: Fachbuch Stahlrecycling, Reed Elsevier, München-Gräfelfing, 1998
17. Krone, K.: Aluminiumrecycling, Verlag Vereinigung Deutscher Schmelzhütten, Düsseldorf, 2000
18. Schwarz, Otto: Kunststoffkunde; Vogel Verlag, Würzburg, 2015; ISBN 3-8023-1815-3
19. Baur, Brinkmann, Osswald, Schmachtenberg: Saechtling Kunststoff Taschenbuch; Hanser Verlag, 2013 31. Auflage; ISBN 978-3-446-43442-4

2. Method(s) of instruction

Lecture and Excursion

3. Requirements for attendance

Basics of chemistry and process engineering.

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

Students need to pass the module examination, which encompasses all contents of the lecture.

Type of examination: written examination with a duration of 120 min. Alternative types of examination are possible.

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 = 50 h

Preparation and follow-up (of the lecture) = 55 h

Preparation for examination = 45 h

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

9. Duration of module

The module is held within one semester.