ENV-500

Solid waste engineering

Ludwig Christian

Cursus	Sem.	Type
Energy Management and Sustainability	MA1, MA3	Opt.
Energy Science and Technology	MA1, MA3	Opt.
Energy minor	H	Opt.
Environmental Sciences and Engineering	MA1, MA3	Opt.
Minor in Engineering for sustainability	H	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	During the semester
Workload	120h
Weeks	14
Hours	**3 weekly**
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Summary

The book "Solid Waste Engineering - A Global Perspective" is the basis for this course. This textbook is an excellent introduction to the field of Solid Waste Engineering and gives insight into relevant solid waste treatment technologies and practices.

Content

With the third edition of Solid Waste Engineering, the authors have decided to expand this college textbook to focus on the worldwide problem of solid waste management. This change is illustrated by the addition of "A Global Perspective" to the title. Given that we are currently using our natural resources at an unsustainable rate, polluting our oceans and land with a variety of waste products and altering our atmosphere with gases that are causing further global warming, now is the time to educate future engineers with knowledge and tools to address these worldwide problems.
The course is following the logic structure and the chapters of the book. The third edition has been rearranged to follow the hierarchy of solid waste management: reduce, reuse, recycle and recovery. Thus, students will first learn about integrated waste management strategies, an expertise which will support the future engineer to take measures for pollution prevention as well as for resources conservation. In chapter 2 the students are introduced to municipal solid waste characteristics, including the identification of different waste components and materials. Component specific information is needed for recovery, separation and recycling of waste materials. The relevance of chemical, physical and mechanical properties are discussed in more detail as a basis for the chapters which follow. These properties are most helpful in order to identify potentially meaningful recycling pathways, as well as to decide about possible technological separation and purification options. The next chapter is dedicated to the collection of municipal solid waste, a key, but many times overlooked, component of integrated waste management. Following collection is mechanical processing, in most cases the necessary first step to the recycling and recovery of municipal solid waste. The students will then study mechanical, biological, and thermal processes. For each of these topics the authors have dedicated a separate chapter which will introduce the students to the basic principles of these separate disciplines in the context of waste management. Since not all waste streams can be recovered, students move on to residue management by combustion and landfilling. Finally, students are exposed to the current issues in solid waste management and the principles of integrated and sustainable solid waste management.
In past years the lectures at EPFL and the home reading were complemented with field visits and excursions to waste treatment facilities. Deepening of a specific teaching content, which was selected by the students, was performed in groups and presented in a "fire" and poster session where the students were challenged by different experts. This situation simulated typical discussions of experts at a conference. The course implementation was adapted to cope with the current Corona pandemic (see teaching methods below).
It is recommended to buy the book in advance of the course as e-book or as printed edition. (One can get the book at the Rolex Learning Center book store, but if they run out of stock the delivery may take several weeks). A limited stock of books can be borrowed from the teacher for a deposit of CHF 100.

Keywords

Waste Technologies, Recycling, Recovery, Secondary Resources, Mechanical Treatment, Thermal Treatment, Co-treatment, Landfilling, Residues, Stabilization, Heavy Metals, Biomass, Bioenergy, Technical Ordinance on Waste,

Material and Elemental Flow Analysis

Learning Prerequisites

Required courses

No specific course is required.

Recommended courses

Environmental chemistry
Analyse des polluants dans l'environnement
Informatique pour l'ingénieur
Numerical analysis
Microbiologie pour l'ingénieur
Communication pour l'ingénieur

Learning Outcomes

By the end of the course, the student must be able to:

- Judge some waste characteristics
- Assess / Evaluate waste treatment pathways
- Estimate flows and quantities of waste and materials
- Justify the choice of different waste treatment options
- Perform simple calculations to determine relevant parameters and process efficiencies
- Take into consideration measures for resources conservation and pollution prevention
- Transcribe teaching content into a video presentation

Transversal skills

- Demonstrate a capacity for creativity.
- Manage priorities.
- Respect relevant legal guidelines and ethical codes for the profession.
- Demonstrate the capacity for critical thinking
- Identify the different roles that are involved in well-functioning teams and assume different roles, including leadership roles.

Teaching methods

The book "Solid Waste Engineering" is the basis for the course content which will be complemented with information from other sources (see "further literature" given below).
Due to the situation with the Corona pandemy, we can unfortunately not do the visits to waste treatment facilities this year. The exchange with external experts is therefore very limited this year. However, a beach litter survey will be performed with the entire class together with a specialist in this field. As we are outside, the distance rules can be easily followed also with the entire class. However, the students should bring their own masks in case it would be adequate to wear them.
No courses will be performed in the class room. As Zoom teaching over 3 hours is annoying the learning this year will focus on self-study using the book Solid Waste Engineering. The book has been specifically developed for the needs of the course at EPFL.
However, weekly exchange with the teacher is guaranteed in short Zoom sessions (with the entire class (and also with the project groups, see below) and in chat rooms to discuss open questions of the students or to challenge the students.
Self-study and reading a book is a very efficient way to learn. However, to learn tackle problems jointly in a team is another success factor for an environmental engineer. Therefore, all students will also perform a specific project in a small team.

No fire and poster session, and exchange with experts is possible like in previous years. Therefore, this year the team project will aim to produce a video, which is covering a relevant part of a book chapter in Solid Waste Engineering or is related to the litter survey which will be performed with the entire class. The teacher will provide a list of topics from which the students can select. However, students can also make an own suggestion, which the teacher has to approve. Goal is to transfer teaching content into small videos which will support future teaching of this course.
Considering the learning outcomes and the transversal skills described above the students have to justify their planned approach in delivering a short proposal structured in the following way:
a) Content and focus of the video
b) Justification for your choice of content. Why will this be helpful for students? How does it fit into the logic and concept of the book Solid Waste Engineering. Describe cognitive levels and transversal skills which are considered in the video.
c) Methods to be used in the video (didactic and graphic elements you want to use)
d) Description of how the result will look like (screenplay for the video)
e) Organizational structure of your team (roles in the team, information flow, and decision rules)
f) Work to be performed (a time plan with milestones and deliverables complements this part: who is doing what and when)
The course structure is in such way, that the first part of the semester will be used to read and study the content of the book. Based on that we initiate the second part which is focussing on the team project.

Expected student activities

- Presence on the first day of the course to decide if this course complies with your expectations. You will learn what this course is about. This is essential information for you to decide about participation.
- **Presence in the class and participation in discussions and team activities.**
- Participation at the litter survey
- **Performing substantial reading and other work at home** (the working load of 120h is high and corresponds on average to about a working day/week.
- Safety. During the field study for the litter survey, keep distance and wear a mask if appropriate.
Disabled students should contact the teacher as early as possible to discuss options in order to participate at the litter survey.

Assessment methods

The students will deliver
- The proposal for the video which will account 25% of the mark
- The video which will account 75% of the mark
The evaluation criteria will be provided when the team project will be initiated.

Supervision

Office hours	No
Assistants	Yes
Forum	Yes
Others	- Moodle (- Google Documents, or other platforms if appropriate).

Resources

Bibliography

Course book:
William A. Worrell & P. Aarne Vesilind & Christian Ludwig (2017) Solid Waste Engineering, 3rd edition. CENGAGE Learning (also available as eBook)
It is advised to buy the book at the Rolex Learning Center (SI edition, paperback, or the e-book via webpage of the publisher).
Further advanced reading:
Christian Ludwig & Stefanie Hellweg & Samuel Stucki (2003): Municipal Solid Waste Management. SPRINGER-VERLAG BERLIN
Dr. Martin Lemann (1997): Fundamentals of Waste Technology, 1st English Edition. C. HERRMANN CONSULTING
Peter Baccini & Paul H. Brunner (1991): Metabolism of the Anthroposphere. SPRINGER-VERLAG BERLIN

or Peter Baccini & Paul H. Brunner (2012): Metabolism of the Anthroposphere. The MIT Press
Werner Stumm, ETHZ (1992): Chemistry of the Solid-Water Interface. JOHN WILEY & SONS, INC.

Ressources en bibliothèque

- Fundamentals of Waste Technology / Lemann
- Chemistry of the Solid-Water Interface / Stumm
- Metabolism of the Anthroposphere / Baccini
- Municipal Solid Waste Management / Ludwig
- Solid waste engineering /Worrell

Notes/Handbook

Information which is not given in the book "Solid Waste Engineering" will be available as electronic copies via moodle.