ENV-500

Solid waste engineering

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Cursus	Sem.	Type
Energy Management and Sustainability	MA1, MA3	Opt.
Energy minor	H	Obl.
Environmental Sciences and Engineering	MA1, MA3	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 ocean 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 a few cases the lectures at EPFL and the home reading will be complemented with field visits to waste treatment facilities.

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. For students without any chemistry background the class can be mastered but will be partly challenging.

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:

- Characterize wastes
- 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

Transversal skills

- Respect relevant legal guidelines and ethical codes for the profession.
- Take account of the social and human dimensions of the engineering profession.
- Demonstrate a capacity for creativity.
- Demonstrate the capacity for critical thinking
- Communicate effectively with professionals from other disciplines.
- Write a scientific or technical report.
- Design and present a poster.

Teaching methods

The book "Solid Waste Engineering" is the basis for the course content which will be complemented with content from other sources (see "further literature" given below). Excursions or field visits (35%) will play a central role in studying and understanding waste related challenges and process technologies. If possible the time of the visit will be set to best match with the learning content during the course. However, this is not always possible. Excursions and visits will take place according to the availability of the companies and experts. Due to the excursions less time for classic ex cathedra teaching is available and the amount of reading at home will be substantial.
All students will perform a specific project in a small team based on a field investigation (e.g. we will collect, identify and quantify waste items: tentative date for this workshop is October 5th). Preliminary results complemented with simple calculations and information from literature will be used for a poster presentation. It is planned to present the results at the World Resources Forum 2017 conference (October 24-25) in Geneva. After the conference the team will complete their project and write a report.
Remaining time for exercises will be used in a flexible way for own work, teamwork, and discussions.
Normally every afternoon is representing a new and independent learning bloc related to a particular field or aspect of waste management or treatment technology (see content above). The course is taking place in the afternoon 2-5pm, however, some field excursions may take longer and in exceptional cases we may also have to leave earlier. The amount of field excursions at which a student is allowed to participate may be reduced in case the class is taken by more than 24 students. The time would be compensated by additional homework. Students who can participate in all joint activities and are ready to invest substantially in homework will appreciate this course.

Expected student activities

- Presence in the class and participation in discussions and joint activities.
- Participation at excursion(s) and the field investigation (and if feasible at WRF 2017)
- 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. This is including the lectures and excursions).

Assessment methods

60% 3 short tests during the semester. The examination dates will be announced on the first course day.
20% Poster presentation at WRF 2017.
20% Project report which is due on December 13th.

Supervision

Office hours	Yes
Assistants	Yes
Others	- Moodle (- Google Documents, 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)
Further 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

- Chemistry of the Solid-Water Interface / Stumm
- Fundamentals of Waste Technology / Lemann
- 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.

Moodle Link

- http://moodle.epfl.ch/enrol/index.php?id=304

Prerequisite for

The joint experience and participation in the excursions as a group is essential. The success of the class will depend on the participation and contribution of each student.
During excursions good shoes and warm all-weather suitable clothing is mandatory. Waste treatment facilities are dangerous due to the trucks and other mobile heavy machinery driving on the sites. Groups should always stay together and follow the advise of the group leader or authorized staff.
Disabled students should contact the teacher as early as possible to discuss options in order to participate at the excursions.