MSE-430

Life cycle engineering of polymers

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Cursus	Sem.	Type
Materials Science and Engineering	MA1, MA3	Opt.

Language of teaching	English
Credits	2
Session	Winter
Semester	Fall
Exam	During the semester
Workload	60h
Weeks	14
Hours	**2 weekly**
Courses	2 weekly
Number of positions	

Summary

Students understand what life cycle engineering is and apply this methodology to adapt and improve the durability of polymer-based products. They understand how to recycle these materials and are able to perform an environmental assessment, based on several practical case studies.

Content

Introduction to life cycle engineering and sustainable development
- Resources, material intensity and durability

Durability of polymers
- Phenomenology of time-dependent polymer properties
- Aging and degradation of polymers
- Stabilization and protection of polymers
- Accelerated aging methods and long term property prediction
- Case study of an automotive component
- Non-destructive testing and health monitoring
- Self-repair polymers

Recycling of polymers
- Collection, identification and recycling methods
- Case study: closed-loop recycling of composites
- Group work: recycling of pharmaceutical packaging

Life cycle assessment and design
- Methods and examples
- Case study: natural fibers vs glass fibers reinforced composites
- Group work: life cycle engineering of an industrial component

Learning Prerequisites

Recommended courses

Polymers, structure and properties
Polymer processing

Learning Outcomes

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

- Model Define and calculate the material intensity

- Formulate Define and explain the time-temperature equivalences for polymers
- Describe Explain the principles of health monitoring and self-repair materials
- Model Predict the lifetime of a polymer part
- Develop Design a recycling process for polymers and composites
- Design Design a polymer-based part to reduce its environmental impact

Transversal skills

- Set objectives and design an action plan to reach those objectives.
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.
- Access and evaluate appropriate sources of information.
- Write a scientific or technical report.
- Make an oral presentation.

Teaching methods

Ex-cathedra with group work

Expected student activities

- Participate to the course and to the case studies
- Realize a group project on a selected topic (for example, accelerated aging, material intensity of an automotive component, etc.)

Assessment methods

The examination is in the form of a group project, which is evaluated with a "1 slide" oral presentation in english in the class and a written report in english. The final grade is the average of the following 5 grades :
1. Quality of the report (spelling, quality of the figures)
2. Bibliography (relevance of the information; all sources MUST be cited!)
3. Case study (data quality and novelty)
4. Synthesis and conclusions of the project
5. Quality of the 1-slide presentation (clarity, content and timing)

Resources

Bibliography

Lundquist L., Leterrier Y., Sunderland P.W., Månson J.-A.E., `*Life Cycle Engineering of Plastics. Technology, Economy and the Environment*¿, Elsevier, Oxford (2000).

Ressources en bibliothèque

- Life Cycle Engineering of Plastics / Lundquist

Notes/Handbook

A course 'polycopié' is available (latest edition 2013)

Moodle Link

- http://moodle.epfl.ch/course/view.php?id=14546