

Rheology of Polymers

5 ECTS

Lecturer: L. Slemenik Perše

Lectures: 30h | Tutorials: 18h | Labs: 12h | Project: 65h | Lang.: 

Objectives

The objectives of the course are to understand the importance of rheology for polymer materials, determination of rheological properties and interpretation of the obtained results, to learn about the importance of rheological properties in mechanical engineering and R&D. With this course student will get the following competences:

- application of rheological properties for polymer products,
- the ability to analyse the experimental results of rheological tests,
- the ability to apply rheological properties in special process applications,
- the ability to use rheological properties in R&D,
- the ability to analyse the published scientific results.

Programme

- INTRODUCTION: Basic rheological parameters, Material functions in time and frequency domain, Flow regimes, Effect of molecular weight on mechanical and rheological properties
- RHEOMETRY: Instruments, Sensor systems, Methods, Analysis
- YIELD STRESS: Engineering examples, Equations for rheological behaviour of materials with yield stress, Determination and prediction of the behaviour of polymers with yields stress
- VISCOELASTICITY: Creep and relaxation, Energy absorption, Mechanical models, Explanation of general stress-strain state of viscoelastic materials using material functions
- LINEAR THEORY of VISCOELASTICITY: Linear and non-linear behaviour of materials, Practical meaning of linear theory of viscoelasticity, Determination of stress limit
- TIME DEPENDENCY: Relaxation time, Thixotropy, Physical aging, Mechanical spectra
- EFFECT of TEMPERATURE: Temperature tests, Phase transitions, Degradation
- RHEOLOGICAL PROPERTIES of POLYMERS in RESEARCH and DESIGN: polymer processing (Dye swell effect, Weissenberg effect, melt fracture, yield stress), time dependent properties and life-time of polymer products (gears, seals, valves, ...)
- SPECIAL APPLICATIONS of RHEOLOGICAL PROPERTIES of POLYMERS in MECHANICAL ENGINEERING: Thixotropy, Tribology, Life-time assessment of different polymer products for various applications (ferro and magneto-rheological, chromogenic materials, self-healing polymers, ...)

Prerequisites

Meeting the enrolment conditions for the Master's study programme of Mechanical Engineering - Research and Development program.

Learning outcomes

In-depth theoretical and practical knowledge of rheological properties of polymers in mechanical engineering applications.

- Preparation of basic methods for determination of rheological properties of polymers.
- Application of various rheological methods for prediction and interpretation of rheological behaviour of polymers in real process applications.

Assessment

- 40% Theoretical part (lectures), 30% Individual work during laboratory practice, 30% Laboratory work (report included)

Literature

- Shaw M.T.: Introduction to Polymer Rheology, John Wiley & Sons, 2012
- Ferry J.D.: Viscoelastic Properties of Polymers, John Wiley & Sons, 1980
- Osswald T.A., Rudolph N.: Polymer Rheology Fundamentals and Applications, Hanser Publishers, 2014