KF2505 Polymer Materials Processing 7.5 credits

Polymera materials bearbetning

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

Course syllabus for KF2505 valid from Autumn 2018

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Specific prerequisites

Admission requirements for programme students at KTH:
At least 150 credits from grades 1, 2 and 3 of which at least 110 credits from years 1 and 2, and bachelor's work must be completed, within a programme that includes:
50 university credits (hp) in chemistry or chemical engineering, 20 university credits (hp) in mathematics and in computer science or corresponding.

Admission requirements for independent students:
50 university credits (hp) in chemistry or chemical engineering, 20 university credits (hp) in mathematics, computer science or corresponding. Documented proficiency in English corresponding to English B.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

Upon completion of the course the student should be able to:

- Survey different processing strategies of polymers with different charateristics, related to the possibility to use them in continous or intermittent polymer processing
- Relate the processing conditions to specific processing equipment, taking into account the rheological flow behaviour of the polymers in injection molders, extruders (with film blowing systems), calendaring equipment, hot molding vacuum forming, rotational molding et c. as well as vacuum bagging techniques for fibre laminate preparation.
- Explain the internal components (their function ad relevance) in the most common polymer processing machinery used in the polymer processing industry.
- Describe how fiber laminates, sewage pipes, vinyl floors, fibre reinforced inflatable boats, plastic bags, PET bottles, car tires, and the most frequently encountered large scale produced polymer products are made in the industry.
- Describe the relevance of polymer crystals and to which extent crystallization and post processing actions can be used to improve the performance of the polymer products.
- Select and motivate the use of different vulcanisation components in order to assess a vulcanized elastomeric polymeric material, and further describe the relevance of the intrinsic components in a vulcanisation system.
- Carry out the basics in processing of thermosets, thermoplastics and elastomeric materials in a processing laboratory.

Course contents

The course provides an overview of the major industrial processing routes for thermoplastics, thermosets and rubbers, and describes how these can be used to convert polymers into products as related to the macromolecular structures of the polymers. The polymer categories are described to extents that represent their processing abundance in the society. Melt processing of the thermoplastics is described in terms of mechanical and physical behaviors as related to processing parameters, including: melting, rheology and viscosity, molecular orientation, crystal formation/growth and the relevance of post processing methods. The industrial techniques extrusion, injection molding, hot forming, film blowing and calendaring are discussed in detail. The techniques are exemplified by laboratory exercises, including extrusion and injection molding of some of the most common thermoplastics. Thermosetting polymers are introduced as a polymer category with cross-linked polymer chains and described as a matrix material for fiber reinforced polymer structures. Thermosetting polymer composite fiber laminates reviewed and different fiber impregnation techniques are discussed (for epoxies, polyesters and vinyl esters) as well as high and low-temperature curing conditions. An introduction into the most common industrial methods to improve composite fiber/filler interfaces is given, e.g. for improved mechanical properties. Cross-linked

elastomers (rubbers) are presented and the main types are discussed in detail, which is followed by a laboratory exercise introducing the students to natural rubber vulcanization, A part of the course consists of student projects and demands that the student identifies the polymer processing techniques for a known product, identifies its constituent materials, and in group/individually discuss possible improvements in a presentation. The aim is that the student should be able to critically analyze and motivate the best selection of materials as related to its demands and production cost, with possible improvements. The overall learning goal with the course is that the students have acquired a general knowledge of the utilization of engineering thermoplastics, thermosets and rubber-like materials used in the diverse polymer processing industry. Each lecture is accompanied with 8-12 more specific learning goals to facilitate repetition of the lectured course content.

Course literature

Handouts and lecture notes

D.H. Morton - Jones: Polymer processing; Chapman and Hall, 1989: ISBN: 0 412 26 690/700 is available at Kårbokhandeln or at Amazon.com

Examination

- TEN1 - Written exam, 4.5 credits, grading scale: A, B, C, D, E, FX, F
- PRO2 - Project, 1.5 credits, grading scale: P, F
- LAB2 - Laboratory course, 1.5 credits, grading scale: P, F
- LAB1 - Laboratory course, 1.5 credits, grading scale: A, B, C, D, E, FX, F
- PRO1 - Project, 1.5 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH’s coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.