



University of Miskolc
Faculty of Materials Science and Engineering
Antal Kerpely Doctoral School of Materials Science
and Technology



Introduction to the Chemistry of Polymers

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PROGRAM DESCRIPTION

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Introduction to the Chemistry of Polymers

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Lecturer

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Recommended for

The course is available for all students of the Kerpely Doctoral School, especially recommended for the ones workin on the field of Polymers and Chemical Engineering.

Language

Hungarian and English.

Aim

The Lecture's aim is to introduce the basic chemical properties of polymers, the general rules of polymerization, the reactivity of polymers, and the physical and mechanical properties of the polymer materials resulting from their chemical structure.

Method of lecturing

If larger number of students are registered scheduled lectures are held, in case of 1-3 students individual consultation and self study of the actual material: 3 blocks of topics of the material is discussed covering the whole field and giving useable literature sources. Self test questions are also provided for each block. During consultation the topics are checked trough the self test questions and the questions of the students are discussed for understanding the actual topic and major correlations.

Thematic

1st Topic

Polymerization and polymerization processes: Properties of polymers and monomers, introduction of the different polymerization mechanisms, description of the processes using reaction kinetics. Introduction of the practical polymerization techniques and the description of the polymerization technologies used for the major polymers.

Self test questions:

1. *What is the polymerization define polymer, monomer?*
2. *Different forms of polymerization, what is the difference between poly-addition and poly-condensation.*
3. *List the chemical compounds useful for initiating chain polymerization, explain the different processes.*
4. *Show the kinetics of chain reactions.*
5. *What is the difference between a chain reaction and chain polymerization.*
6. *What is the Gel effect phenomenon?*
7. *Explain Carothers' equation trough the kinetics of stepwise polymerization.*

8. Show the practical techniques of polymer preparation, list their strengths and weaknesses.

2nd Topic

Chemical properties of Polymers, polymer analogue reactions

Chemical modification of polymers, co-polymerization

Self test questions:

1. Basic organic chemical reactions by type.
2. Define polymer analogue reactions.
3. Describe the production of some significant polymers using polymer analogue reactions.
4. How can polymer analogue reactions be used to change and tailor the properties of polymers.
5. What is cross-linking, give some examples and show the different possibilities for cross-linking polymers.
6. Define co-polymerization, explain the resulting structures and how they affect the properties.

3rd Topic

Primary and more advanced structure of polymers

Effect of chemical structure on the macroscopic properties

Behaviour of polymers on structural bases

Self test questions:

1. How does the chemical structure of polymer affect their secondary, tertiary structure?
2. How can the polymerization affect the structure of the polymer?
3. Introduce the constitutional, the cis- trans-, and the stereo isomerism, define their presence in polymers and show which of them and how can they significantly affect the properties of polymers and plastic products.
4. Define the following concepts> monomer, polymer oligomer, critical segments length and glass transition temperature.
5. Show the thermo mechanical behavior of polymers.
6. On a graph showing the thermo mechanical behavior of polymers please demonstrate the effect of structural changes on the macroscopic behavior of polymers and plastics.

Recommended Literature

1. Charles E. Carraher Jr.: Introduction to Polymer Chemistry; CRC Press; 3 edition (December 4, 2012)
2. J.M.G. Cowie, Valeria Arrighi: Polymers: Chemistry and Physics of Modern Materials; CRC Press; 3 edition (July 27, 2007)
3. Bakó Péter, Fogassy Elemér, Keglevich György: Szerves vegyipari technológiák, BME jegyzettár 2012
4. +If the student uses this knowledge basis for her PhD studies she will receive relevant literature also.

Completion, Grading

Grade is given on an oral examination after correctly answering the self tests questions.

Complex Examination Questions

1. Ordering the polymer producing reactions from the organic chemistry perspective.
2. Kinetic description of chain polymerization, show the parameters to affect the process, explain their effect.
3. Kinetic description of stepwise polymerization; show the factors controlling the properties of the resulting polymers, describe and explain the Carothers' equation, demonstrate how it treats special cases.
4. Explain the definition of polymer analogue reactions, how can they be used for producing specialty polymers and modify existing ones.
5. Chemical structure of polymers and the resulting secondary and more advanced structures. Demonstrate, how they will generate the polymers' macroscopic behavior using thermo mechanical graphs.