

TECHNOLOGY OF POLYMERIC MATERIALS – EXERCISE 5, 6			
Exercise topic: PROCESSING OF POLYMERIC MATERIALS – EXTRUSION TECHNIQUES. 3D PRINTING			
Faculty:	CHEMICAL TECHNOLOGY	Year: I	Term: V
Speciality:	Chemical Technology		

1. Purpose of the exercise:

- **theoretical:** studying the extrusion as a method of processing of polymer materials; studying the mechanical properties of polymer materials and the influence of processing conditions on those properties
- **practical:** learning the cast film extrusion and determining the influence of process parameters on film properties; conducting strength tests of polymer materials under static tension

2. Theoretical issues:

extruder engineering, typical extrusion line, principles of polymer extrusion process, cast and blow film extrusion, mechanical properties of polymer materials, determination of mechanical properties under static tension, typical stress – strain curve under stretching and characteristic parameters

3. Bibliography:

- 1) Charles A. Harper: “Modern Plastics Handbook”, McGraw-Hill 1999.
- 2) Crawford R.J. : „Plastics Engineering”, Butterworth-Heinemann 1998.
- 3) Harold F. Giles Jr., Eldridge M. Mount III, John R. Wagner Jr.: “Extrusion: The Definitive Processing Guide and Handbook”, William Andrew, Inc. 2005.
- 4) Ram A.: “Fundamentals of Polymer Engineering”, Plenum Press, New York 1997.

4. Performing the exercise:

5 – the cast film extrusion

- a) Extrusion cast film line start - up and operation

CAUTION!! START – UP AND OPERATION OF THE MACHINE ONLY UNDER CONSIDERATION OF A TEACHER!!!

CAUTION!! DO NOT TOUCH ANY HEATING AND MOVABLE PARTS OF THE MACHINE!!!

- b) Determination of geometric parameters of used extrusion die
- c) Preparation of the technological extrusion line for film production: assembly of a flat extrusion die and chill-roll extraction device
- d) Optimization of the extruder operating parameters:

- temperatures of the extruder heating zones and the extrusion die,
 - rotational speed of the extruder screw,
 - chill-roll extraction device operating parameters (cooling drum speed, cooling drum temperature)
- e) Extrusion the cast film with variable settings of processing parameters - in accordance with the guidelines of the teacher
- f) Determining the basic parameters of the film: thickness, width and grammage
- g) Joining the produced films by welding

6 – mechanical properties of cast films

Carry out the mechanical properties assessment using the universal strength measuring machine Zwick Roell Z020 TH ALLround Line. Carry out the mechanical properties under static tension tests in accordance with the below standards:

- PN – EN ISO 527 – 1 „Plastics. Determination of mechanical properties under static tension. General principles.”;
- PN – EN ISO 527 – 3 „Plastics. Determination of mechanical properties under static tension. Films and sheets testing conditions”.

Determine also the mechanical properties of the prepared seals (frontal tearing, shear and peel strength tests)

Test parameters:

- samples in the form of strips cut at the angle: 0^0 to the direction of film extrusion,
- sample thickness: average of 5 measurements,
- number of samples: 5 pcs

Performing the test:

- traverse feed speed 100 mm/min,
- start distance: 50 mm

Introduction to 3D printing – a secondary processing technique that uses aa an input material product manufactured via an extrusion.

5.Elaboration of the results:

Determine the dimensions of the cast film (diameter, thickness) depending on the parameters of the extrusion process.

Describe the exercise performance, prepare a summary of the results of the measurements, prepare relevant graphs/tables, carry out a discussion about the results and draw conclusions.

Answer for the question how the parameters of the extrusion process influences on the mechanical properties of the finished product and why?

6. Safety rules:

- **Conduct the strength tests only in the presence and under the supervision of the lecturer!!!**
- **All tests and measurements involved in the exercise must be carried out in accordance with the lecturer's instructions.**
- **Take particular caution while: operating strength testing machine, always wear safety glasses while working**