Kinematic activation of the barrel

Presentation plan

1. Assumptions of research process
    1. Constant parameters
    2. Variables
2. Impact of the rotating sleeve activity on the selected properties of the extrusion process
3. Impact of the rotating sleeve activity on the selected extrudate properties
4. Summary

STUDIES IN THE EFFECTIVENESS OF A NEW GENERATION EXTRUDER

- **Part I**

  THE INFLUENCE OF THE LOCATION OF THE ROTATING SLEEVE OF THE BARREL IN THE PLASTICIZING SYSTEM

- Part II

  THE SHAPE OF THE INNER SURFACE OF THE BARREL ROTATING SLEEVE

- Part III

  CO-OPERATION OF THE ROTATIONAL SLEEVE WITH THE GROOVED ZONE OF BARREL

- Part IV

  THE COMPARISON OF PERFORMANCE OF THE EXTRUDER MODEL WITH ITS PROTOTYPE

Assumptions of research process

Constant factors:

- Screw type and geometry; D=25, L/D=24
- Processed polymer

  PE-LD Malen E FGNX 23D-006
- Plasticizing system and extrusion head heating zones temperatures:

T_0 = 40°C

T_I = 80°C

T_{II} = 160°C

T_{III} = 170°C

T_{IV} = 180°C

T_V = 175°C

T_{VI} = 165°C

T_{VII} = 165°C

Assumptions of research process

Constant factors:

- Length of the rotating sleeve of the barrel– 5D
- Rotating sleeve of the barrel geometry

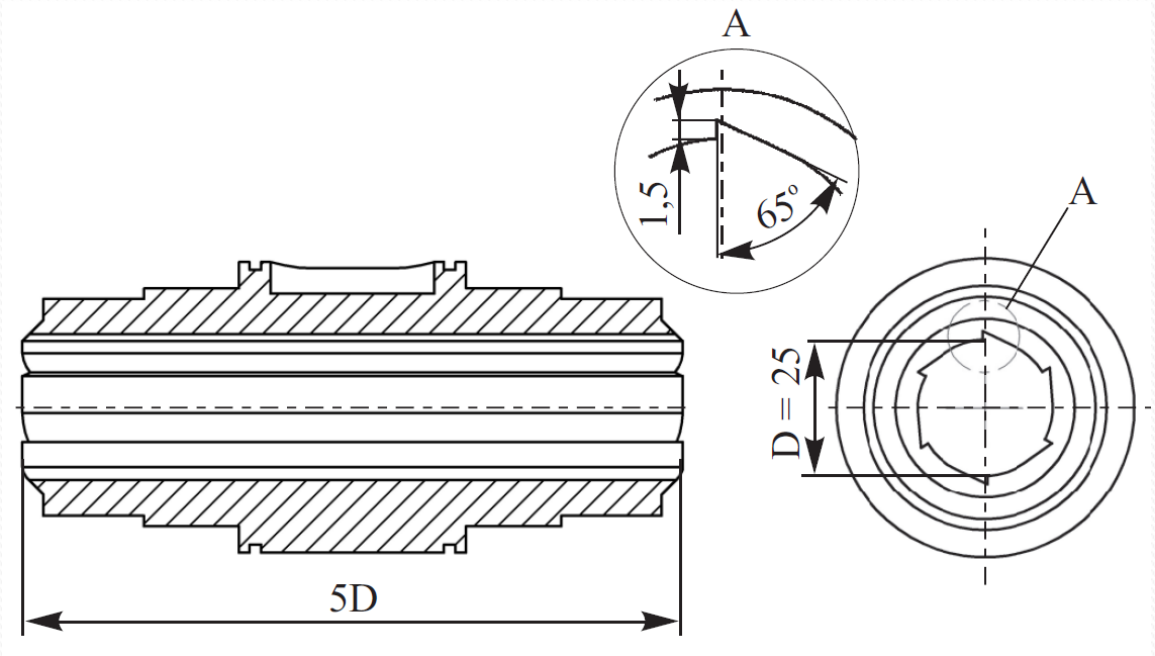

Fig. 1. The rotating sleeve of the barrel with 6 rectilinear grooves, with triangular cross section

Assumptions of research process

Variables:

- Rotational speed of the screw:

  n_s = 1,67; 3,33; 5,00; 6,67 and **8,33** RPS

- Rotational speed of the rotating sleeve of the barrel :

  nc = 0,83; 1,66; 2,50 and **3,33** RPS

- Direction of rotation of the rotating sleeve of the barrel
  - Co-rotating and **counter-rotating** in the relation to the screw rotation

Assumptions of research process

Variables:

- Location of the rotational sleeve of the barrel

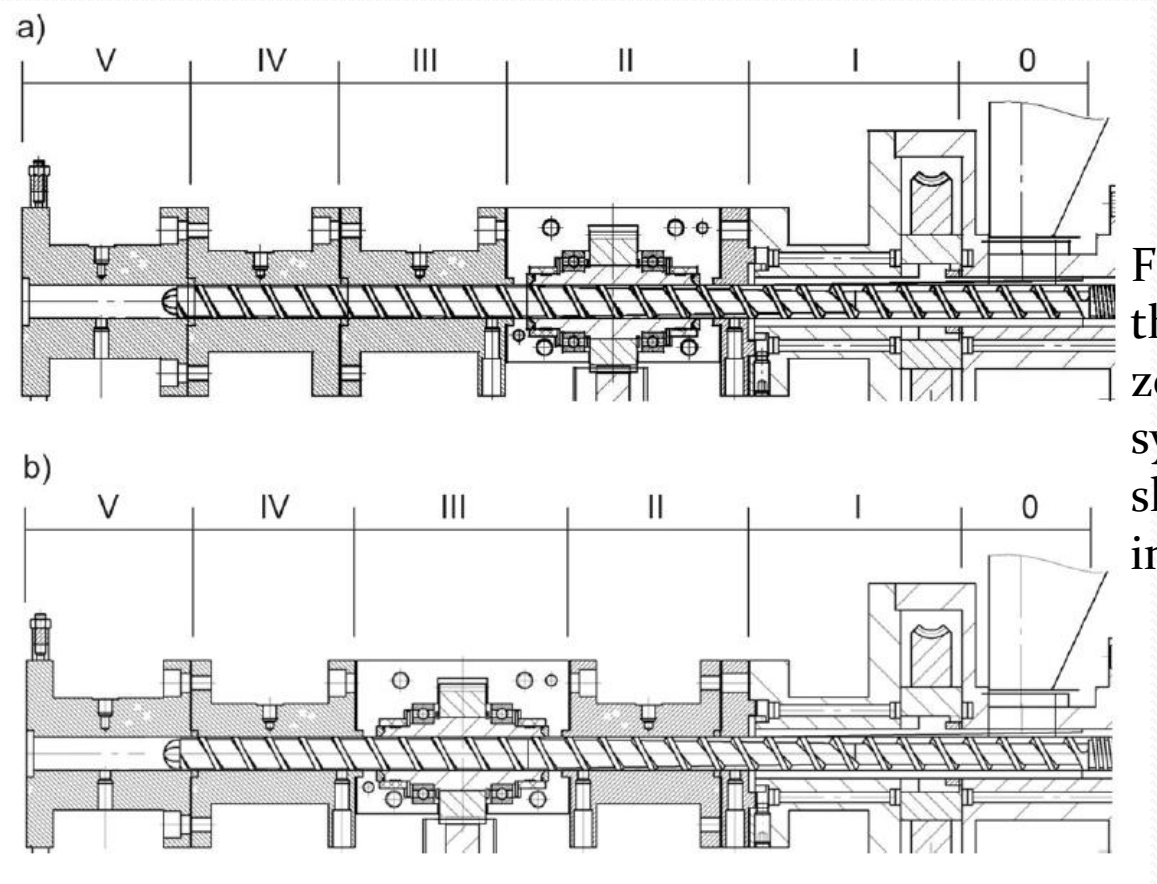

Fig. 2. The scheme indicating the partitioning of the heating zones 0—V of the plasticizing system equipped with a rotating sleeve of the barrel positioned in zones II (a) **and III** (b)

Impact of the rotating sleeve activity on the selected properties of the extrusion process

Analyzed parameters:

- Temperature of the barrel wall and extrusion head
- Polymer pressure
- Mass flow rate of the polymer
- Specific total energy comsumption
- MFR and tensile strength

Temperature of the barrel wall and extrusion head

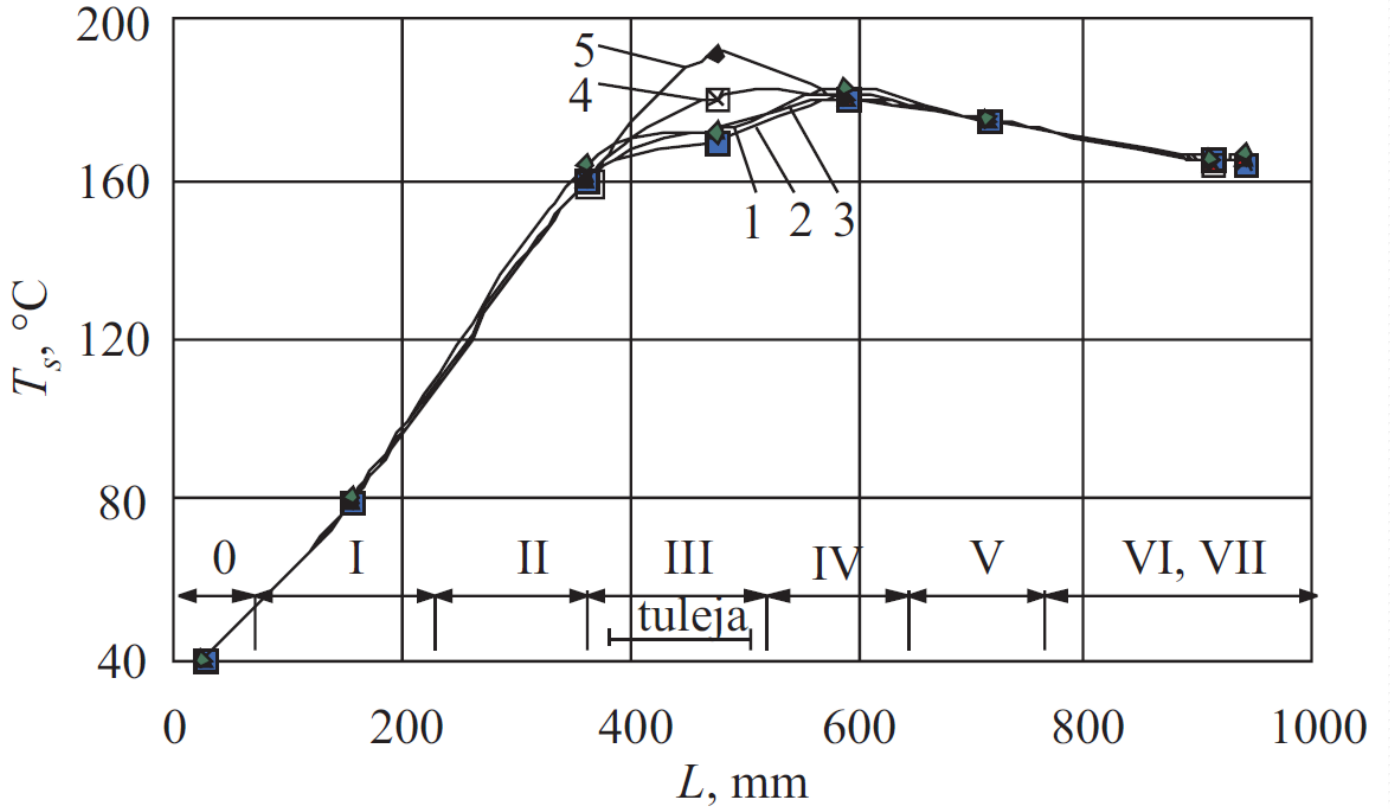

*Fig. 3. The temperature (T_s) of the barrel wall and the extruder head as a function of the length (L) in the plasticizing system at a screw rotational speed (n_s) of **8.33 RPS**. The rotational speed (n_c) of the sleeve of the barrel positioned in **zone III**: 1—0.00 RPS, 2 — 0.83 RPS, 3—1.67 RPS, 4—2.50 RPS, **5—3.33 RPS**; the plasticizing system heating zones are marked 0—V, while VI and VII stand for the extruder head heating zones*

Polymer pressure

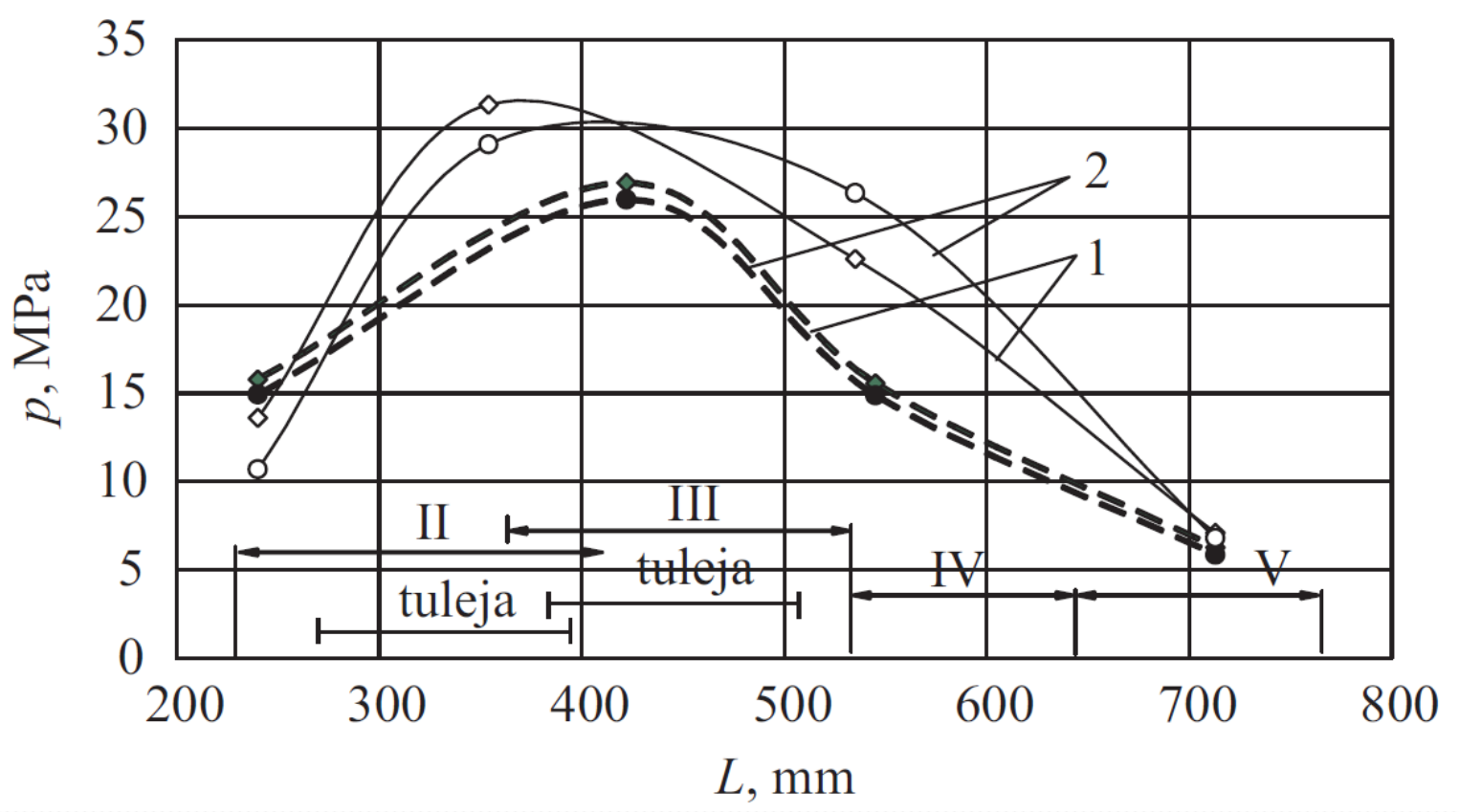

*Fig. 4. Polymer pressure (p) as a function of the length (L) of the plasticizing system at a screw rotational speed (n_s) of **8.33 RPS**; the rotational speed of the barrel sleeve (n_c): 1 — 0.00 RPS, **2** — **3.33 RPS**; rotational sleeve of barrel positioned in zone II — dashed line, **zone III positioning—solid line**, II—V— heating zones of the plasticizing system*

Mass flow rate of the polymer

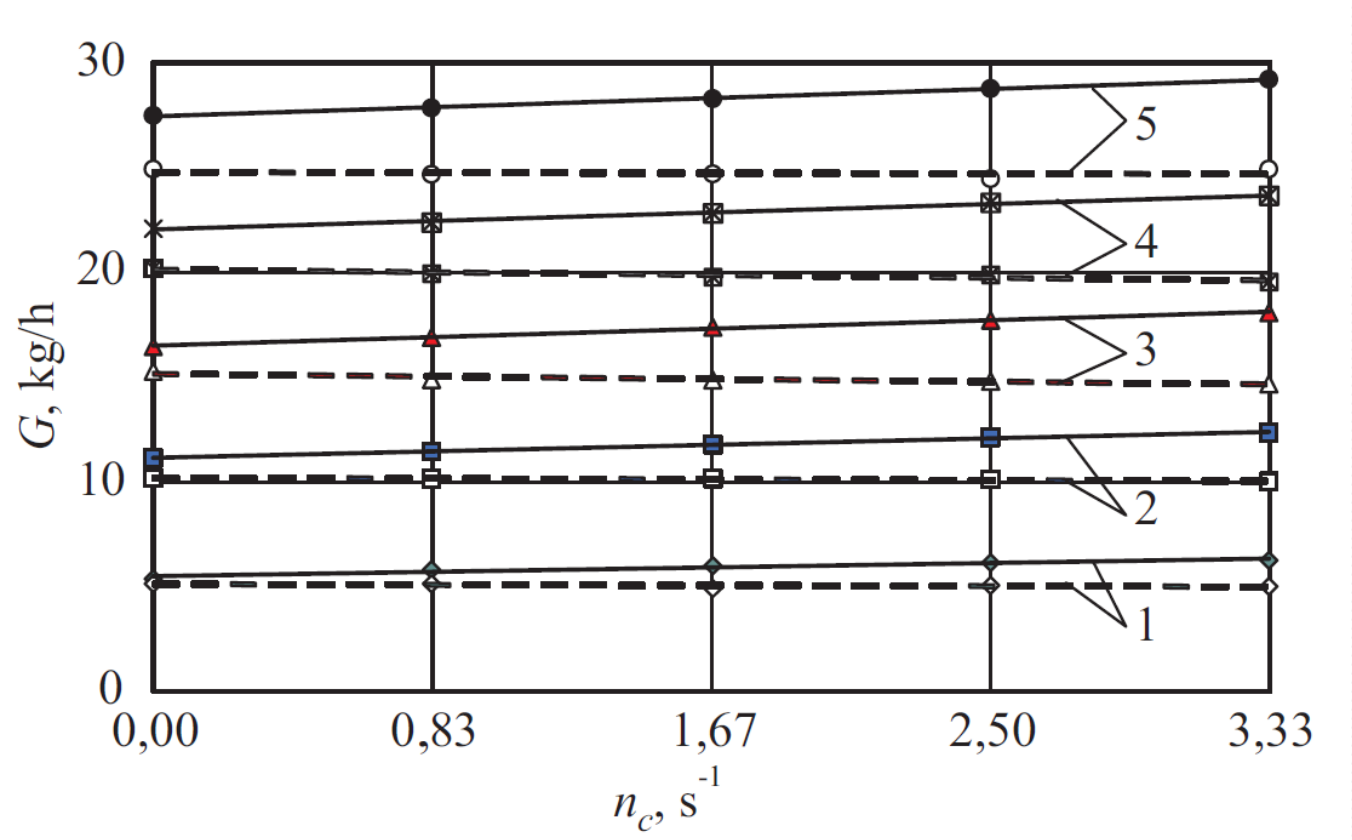

Fig. 5. Mass flow rate (G) of the polymer as a function of the barrel sleeve rotational speed (n_c) at a screw rotational speed (n_s) of: 1—1.67 RPS, 2 —3.33 RPS, 3 —5.00 RPS, 4—6.67 RPS, ***5— 8.33 RPS****; rotational sleeve of barrel positioned in zone II — dashed lines,* ***zone III positioning — solid line***

Specific total energy comsumption

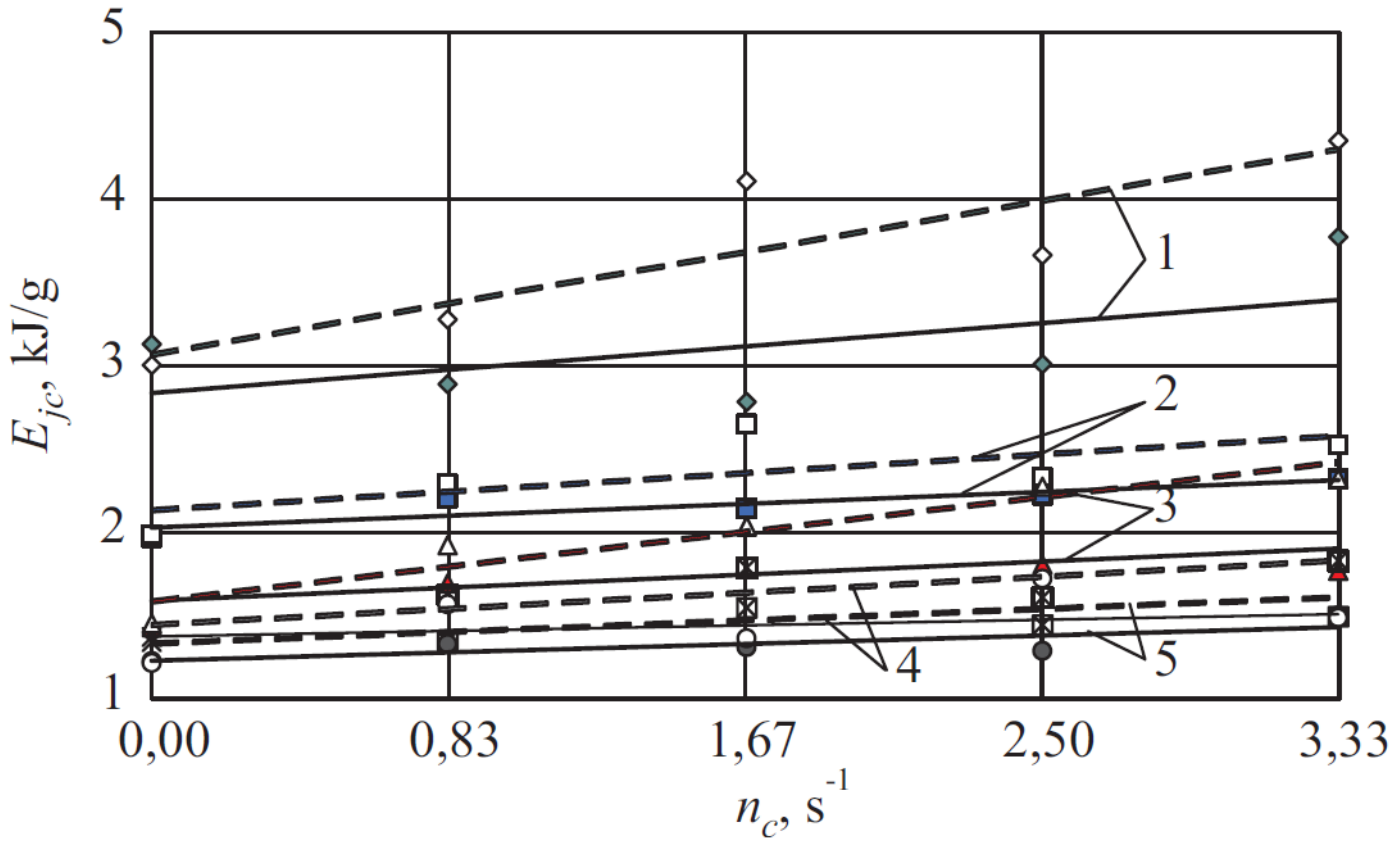

Fig. 8. Specific total energy consumption (E_{jc}) of the extruder as a function of the barrel screw rotational speed positioned in zone II (dashed line) and ***zone III (solid line)*** *of the plasticizing system at a screw rotational speed of: 1— 1.67 RPS, 2—3.33 RPS, 3 — 5.00 RPS, 4 — 6.67 RPS,* ***5 — 8.33 RPS***

Impact of the rotating sleeve activity on the selected extrudate properties

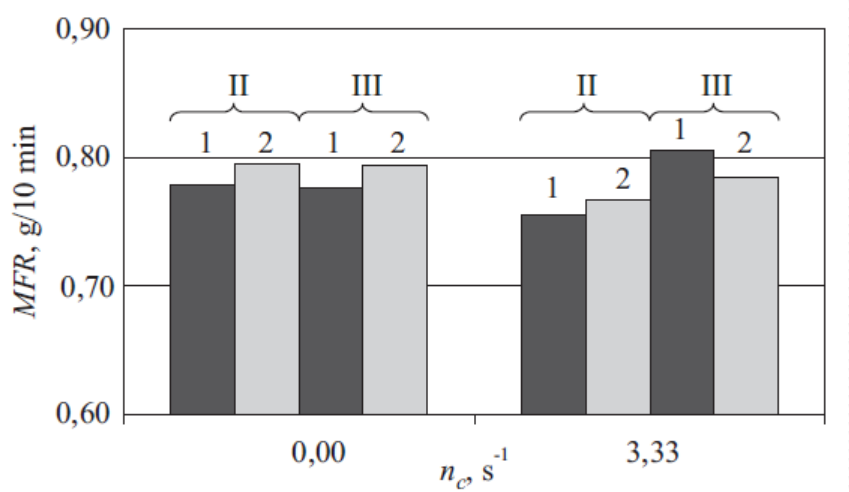

*Fig. 9. The mass flow rate (MFR) of the extrudate processed at the lowest and highest values of the rotational speed (n_c) of the barrel sleeve positioned in zones II and III of the plasticizing system, and the screw rotational speed (n_s) of: 1—1.67 RPS,2— **8.33 RPS***

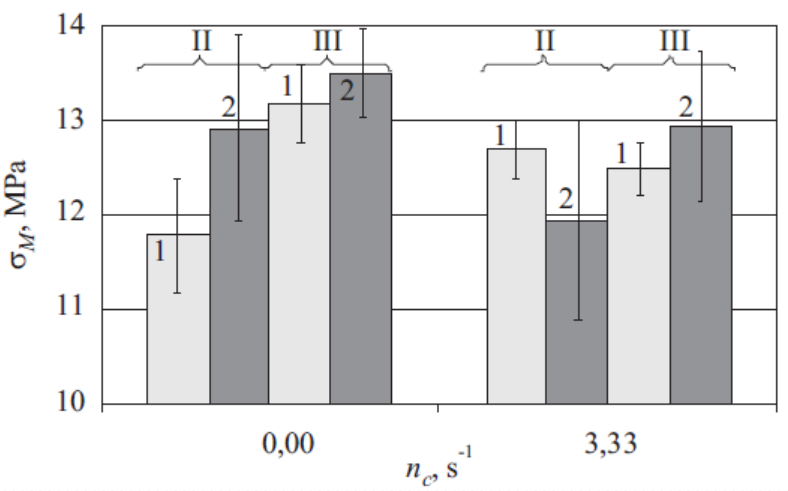

*Fig. 10. The values of tensile strength (σ_M) of the extrudate processed at the lowest and highest values of the rotational speed (n_c) of the barrel sleeve positioned in zones II and III of the plasticizing system, and the screw rotational speed (n_s) of: 1 — 1.67 RPS, **2 — 8.33 RPS***

Summary

- Positioning of the rotating sleeve of the barrel determines the efficiency of the plasticizing system
- The rotating sleeve of the barrel improves the efficiency of the extrusion process only when located in the zone III
- Increasing of the rotational speed of the rotating sleeve results in the extrusion efficiency improvement
- Introduction of the rotational sleeve of the barrel to the plasticizing system does not affect properties of the extrudate

Thank You
for your attention