BRONISŁAW SAMUJŁO, ROBERT SIKORA
Department of Polymer Processing
Technical University of Lublin
36, Nadbystrzycka Street, 20-618 Lublin

The course of $Mg(OH)_2$ modified polyethylene extrusion process

RAPID COMMUNICATION

Summary — Medium-density PE (MFI, 0.712 g/10 min) was modified with $Mg(OH)_2$, FR-20 grade, particle size 2.5 μm. Antiblocking and lubricating agents, 020—04, 020—15 and Lifoslip 220 PE were added as PE concetrates. Experimental extrusions in a Brabender Plastic-Corder (PLV 151 type) were carried out at screw speed 0.75 s^{-1}, three-heating-zones temperatures 160°C, 170°C and 170°C, extruder head temperature 170°C, and extrusion velocity 1.72 mm/s. The pressure in the extruder head, the turning moment measured on the extruder screw, and the flow rate rose as the $Mg(OH)_2$ content was increased (Figs. 1—3). With the Lifoslip agent, the pressure and the turning moment attained the lowest values. At high $Mg(OH)_2$ contents, 57.5 and 60%, the pressure and the turning moment had values close to those attained with other auxiliary agents.

Key words: extrusion of MDPE, halogen-free flame retardants, magnesium hydroxide as flame retarder.

The ever-increasing requirements on reduced flammability of plastics and decreased or eliminated toxicity and corrosivity of plastics decomposition and combustion products render research on preparing and processing of new polymer materials worthwhile. These requirements are met by plastics modified with halogen-free flame retardants, such as aluminum hydroxide, magnesium hydroxide, basic magnesium carbonate, agents based on ammonium phosphate which have been finding increasingly wide applications [1, 2]. These agents which are introduced into polymers in relatively large quantities, 50 to 70%, reduce polymer flammability, but at the same time they affect the extrusion process disfavorably and degrade the mechanical properties of extrudates [3, 4].

As part of a broader research program, whose selected fragments had been presented at the PPS North American Meeting, Canada, 1998, and at the PPS 15th Annual Meeting, s'Hertogenbosch, Netherlands, 1999, studies were conducted on the extrusion process of a medium-density polyethylene (PE-MD), melt flow index 0.712 g/10 min [5, 6]. The polyethylene was modified with magnesium hydroxide, $Mg(OH)_2$, marked as FR 20, average particle size 2.5 μm. Antiblocking and lubricating agents were also introduced into the polymer in the form of polyethylene concentrates, marked as 020-04 and 020-15, with the respective concentrations of the antiblocking agent equal to 4 and 10%, and the lubricating agent 1.2 and 5%; a Lifoslip 220 PE agent was used with the concentration of the lubricant equal to 20%.

The studies were conducted in a Brabender laboratory extruder, Plasti-Corder PLV 151 type. The experimental assembly enabled the turning moment on the screw, the pressure in the extruder head, the rotational speed of the screw and the temperature in the heating zones of the plasticating system and in the extruder head to be measured. The plasticating system included three heating zones and the screw used was characterized by the ratio L/D = 25, diameter D = 19 mm. The line consisted of the head for extruding panels with the die 102 mm long and maximum 2.1 mm wide and a receiving device. Extrusion was conducted at the following parameters: screw speed, 0.75 s^{-1}; temperatures of the heating zones in the plasticating system, 160, 170, and 170°C; extruder head temperature, 170°C; extrusion velocity, 1.72 mm/s; ambient temperature, 20°C.

During the extrusion process, the pressure in the extruder head, the turning moment measured on the extruder screw, and the flow rate were studied. The pressure in the extruder head (Fig. 1), the turning moment on the screw (Fig. 2), and the flow rate (Fig. 3) are presented in relation to magnesium hydroxide in the PE.

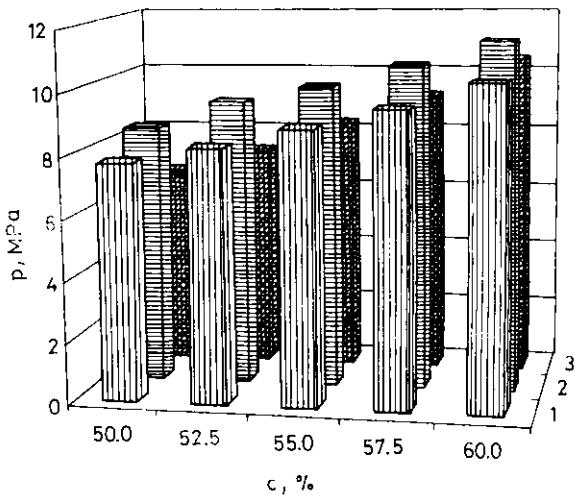

Fig. 1. Pressure in the extruder head in relation to the content of $Mg(OH)_2$ in PE: 1 — agent 020-04, 2 — agent 020-15, 3 — 220 PE Lifoslip agent

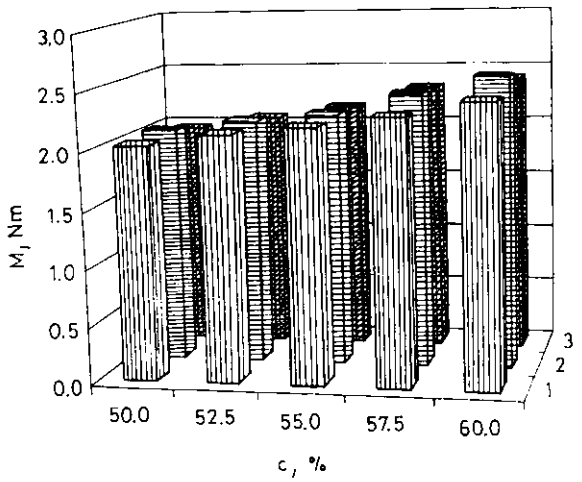

Fig. 2. The turning moment measured on the screw in relation to the content of $Mg(OH)_2$ in PE: 1 — agent 020-04, 2 — agent 020-15, 3 — 220 PE Lifoslip agent

These values are seen to increase as the $Mg(OH)_2$ contents in the PE is raised. The antiblocking and lubricating agents clearly affect the measured quantities. The lowest pressure and the lowest turning moment were received when the Lifoslip 220 PE agent was used. The

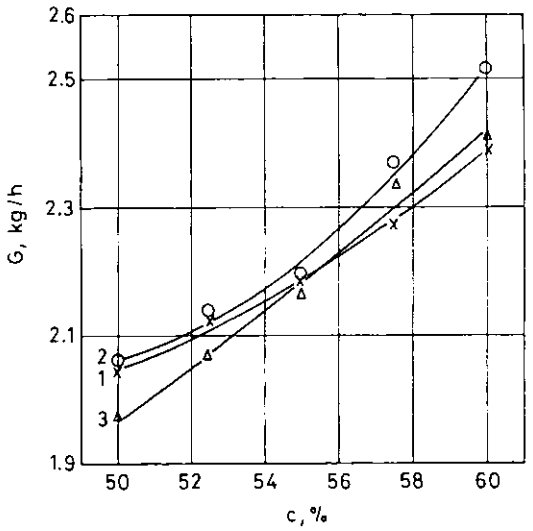

Fig. 3. Polymer flow rate in relation to the content of $Mg(OH)_2$ in PE: 1 — agent 020-04, 2 — agent 020-15, 3 — 220 PE Lifoslip agent

effect is most clearly visible (Figs. 1—3) at relatively low contents of magnesium hydroxide in the PE; at higher contents (57.5%; 60%), the pressure and the turning moment attain the values close to those received with other auxiliary agents having lower concentrations of the active substances.

REFERENCES

1. Troitzsch J.: *Kunststoffe* 1995, **12**, 2191.
2. Horn W. E., Smith D. R., Stinson J. M.: 50th Annual Technical Conference ANTEC, Detroit 1992, 2020.
3. Beluch W., Jaworski J., Stabik J.: *Polimery* 1994, **39**, 698.
4. Szabłowska B., Pełka J.: *Polimery* 1991, **36**, 294.
5. Sikora R., Samujło B.: The Polymer Processing Society, North American Meeting, Toronto, Canada 1998, 183.
6. Samujło B., Sikora R.: The Polymer Processing Society, 15th Annual Meeting, s'Hertogenbosch, Netherlands 1999, 133.

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