UDC 532.135

F.A. Mustafayeva, N.T. Kakhramanov
Institute of Polymer Materials of Ministry of Science and Education
Republic of Azerbaijan (Sumgayit city, Azerbaijan)

INVESTIGATION OF THE MELT FLOW INDEX AND EFFECTIVE VISCOSITY OF COMPOSITES BASED ON TITANIUM DIOXIDE AND A MIXTURE OF LOW AND HIGH DENSITY POLYETHYLENE

As the fields of application of polymers expand and the requirements for their quality become more stringent, more and more attention is paid to the development of polymer composite materials. In order to obtain new polymeric materials and expand their range, research on the preparation and study of the properties of polymer mixtures based on already known large-tonnage polymers is promising [1, 2]. Blending provides a complete set of material properties, with the potential to combine the attractive qualities of each blend component in the final product, improving processability and properties.

In the processing of polymers, it is necessary first of all to control the melt flow rate, especially in injection molding. The melt flow index is a conditional value that characterizes the behavior of a thermoplastic polymer in a viscous-flowing state during its processing into products, and the determining parameter for choosing a thermoplastic processing method. In this regard, it was of interest to study the effect of titanium dioxide on the melt flow index and effective viscosity of the composites based on the polyethylene blend.

In this paper, the influence of titanium dioxide amount (0.2, 0.5, 1.0, and 2.0 wt %) on the melt flow index and the effective viscosity of a composite based on low density polyethylene (LDPE) and high density polyethylene (HDPE) mixture are considered.

Composite materials based on a mixture of polyethylenes LDPE/HDPE (50/50) and with different concentrations of titanium dioxide were obtained on laboratory rollers at a temperature of 150–170°C within 8–10 minutes. Further, at a pressing temperature of 170°C, plates were molded from which the corresponding samples were cut out for testing.

The rheological properties of the melt of polymeric materials were measured on a CEAST MF50 capillary rheometer (INSTRON, Italy) (Figure 1). The melt flow index (MFI) of polymeric materials was determined at a temperature of 190°C and a 5 kg load. The effective viscosity was measured at four temperatures (190, 210, 230 and 250°C) and two loads (3.8 and 21.6 kg).

Figure 1 – CEAST MF50 Melt Flow Tester rheology device of Instron company

Analyzing the data presented in Figure-2, it can be established that, regardless of the amount loaded, titanium dioxide contributes to a certain increase in the MFI of composites based on a mixture of LDPE/HDPE.

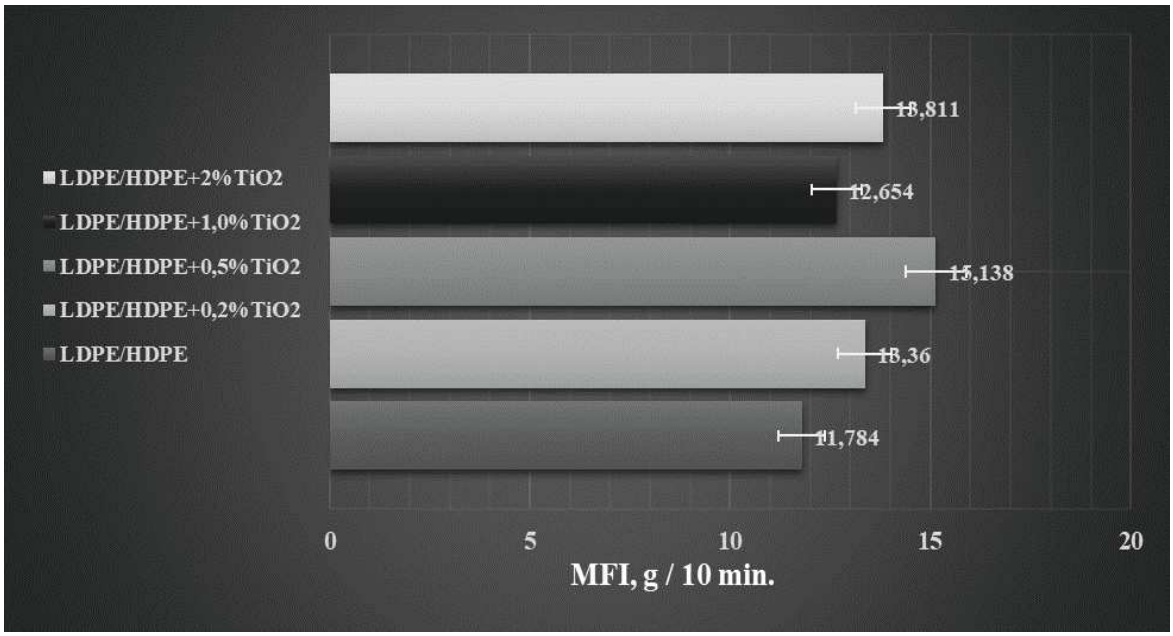

Figure 2 – Effect of titanium dioxide amount on melt flow index of composites based on LDPE/HDPE blend

Since 1.0 wt % TiO_2 is the most optimal amount which simultaneously improves both the ultimate tensile stress and elongation at break, it is

in this quantity that the value of the effective viscosity at different temperatures and shear stresses was determined (Table 1).

As can be seen from the table, in contrast to the polyethylene mixture, the composite containing titanium dioxide has a lower effective viscosity index at the studied temperatures and shear stresses.

Table 1 – Effect of titanium dioxide and temperature on effectıve viscosity of composites based on LDPE/HDPE blend

The formulation of the polymer composite, wt. %	Temperature	Shear stress ($lg\tau$)	Effective viscosity ($lg\eta$)
LDPE/HDPE	190°C	3.77	3.36
	210°C	3.77	3.07
	230°C	3.77	2.94
	250°C	3.77	2.72
	190°C	4.52	2.88
	210°C	4.52	2.66
	230°C	4.52	2.49
	250°C	4.52	2.21
LDPE/HDPE+1.0 % TiO_2	190°C	3.77	3.16
	210°C	3.77	3.05
	230°C	3.77	2.79
	250°C	3.77	2.51
	190°C	4.52	2.75
	210°C	4.52	2.58
	230°C	4.52	2.36
	250°C	4.52	2.25

REFERENCES:

1. Лавров, Н.А. Полимерные смеси на основе поливинилхлорида (обзор) / Н.А. Лавров, Е.В. Белухичев // Пластические массы. – 2020. –№ 3-4. –С. 55-59. https://doi.org/10.35164/0554-2901-2020-3-4-55-59

2. Несовместимые полимерные смеси и композиционные материалы на их основе / Ю.Н. Кахраманлы. –Баку: «ЭЛМ», 2013. –152 с.