UDC 678.073

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ASSESSMENT OF THE INFLUENCE OF ANTIMICROBIAL ADDITIVE ON THE RHEOLOGICAL PROPERTIES OF COMPOSITE MATERIAL BASED ON BLEND OF POLYPROPYLENE/ MAGNESIUM HYDROXIDE

The surface of polymeric materials can become a carrier of colonies of microorganisms coming both from the environment and from contact with a nutrient medium. As a result of studies conducted with various synthetic polymers, it was found that streptococci develop well on the surface of polyester, polypropylene and polyamide products [1]. One of the most significant technological breakthroughs in the polymer industry was the possibility of modifying them with substances with antimicrobial properties [2, 3].

Thermoplastic antimicrobial polymeric materials are obtained by introducing special additives into compositions.

The purpose of this investigation was to study the effect of the concentration of an antimicrobial additive – a functionalized macromonomer, temperature and shear stress on the rheological properties of composite materials.

A mixture of polypropylene (PP) and magnesium hydroxide at a ratio of 30/70 was used as an object of study, and oligopropylene ester of salicylic acid was used as an antimicrobial additive. The use of oligopropylene ester of salicylic acid as an antimicrobial additive is due to the fact that low molecular weight antimicrobial additives are gradually washed out from the surface of the product and therefore the development and use of high molecular weight antimicrobial additives is one of the promising areas.

Rheological studies of the melt of polymeric materials were carried out in accordance with the ASTM D1238 standard on a CEAST MF50 capillary rheometer (INSTRON, Italy) in the temperature range of 190–250°C and in the load range of 3.8–21.6 kg.

The influence of the concentration of oligopropylene ester of salicylic acid, temperature and shear stress on the pattern of changes in effective viscosity, shear rate was established. Figure 1 shows the rheograms of a mixture of polypropylene and magnesium hydroxide in a ratio of 30:70 and composites based on it. As can be seen from the rheograms shown in Fig. 1, at low temperatures, the flow curves are linear, and at relatively high temperatures and shear rates, a non-linear rheological

behaviour is observed. From a comparative analysis of the flow curves, it can be seen that the dependences of the shear rate on the shear stress of the initial mixture of PP/$Mg(OH)_2$ and its filled compositions are almost the same, some change is observed only at a temperature of 250°C.

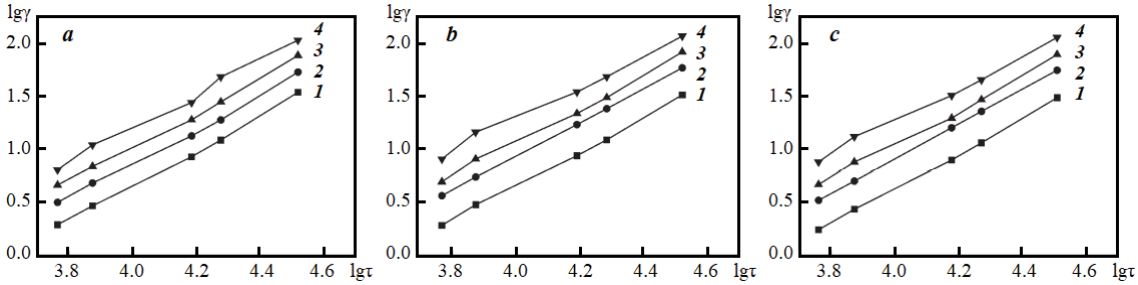

Fig. 1. Dependence of shear rate on shear stress of: a — PP/$Mg(OH)_2$ (30/70); b – PP/$Mg(OH)_2$ + 1.66 wt. % OPESA; c – PP/$Mg(OH)_2$ + 3.33 wt. % OPESA at various temperatures, °C: 1 – 190; 2 – 210; 3 – 230; 4 – 250.

The dependence of viscosity on temperature in Arrhenius coordinates is determined, according to which the "apparent" activation energy of viscous flow for the initial mixture of polypropylene and magnesium hydroxide in a ratio of 30:70 and composites based on it, filled with salicylic acid oligopropylene ester, varies accordingly in the range 40.7-42.8 and 55.6-59.9 kJ/mol. It is shown that with an increase in the concentration of oligopropylene ester of salicylic acid in the polymer mixture to 3.33 wt.%, the shear rate remains practically unchanged relative to the initial mixture of polypropylene and magnesium hydroxide (30/70).

The antimicrobial additive oligopropylene ester of salicylic acid does not affect the rheological properties of the resulting polymers in any way and meets the requirements for antimicrobial additives.

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