INFLUENCE OF FILLERS ON THE PHYSICAL AND MECHANICAL PROPERTIES OF COMPOSITE MATERIALS BASED ON POLYPROPYLENE

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ABSTRACT: It is shown that the introduction of a metal-containing oligomeric flame retardant into polypropylene improves the physical and mechanical properties, and the flammability indicators of the developed polymer matrix composites also increase.
Key words: polymer, metal-containing oligomeric flame retardant, modulus of elasticity, impact strength.

Introduction

In the world, nanoparticles obtained from derivatives of polybasic acids are of particular interest for the development of fillers, plasticizers, additives, modifiers and fire retardants.

In this work, the problem of improving the mechanical properties of filled mixtures of polyethylene and polypropylene, polyamide with metal-containing compounds was solved. The aim of the work is to improve the mechanical properties of filled polyolefin thermoplastic elastomers based on polyethylenes and polypropylenes and metal acetate [1;2]. We developed studies of the obtained materials based on polypropylene containing nanosized modifiers that affect the supramolecular packing of polymer macromolecules and thus its physical mechanical characteristics.

Experimental part

Chemical modification of polypropylene and polyethylene, i.e. a directed change in its physical, mechanical or chemical properties by introducing new functional groups into the macromolecule, crosslinking or copolymerization is of great interest from a scientific and practical point of view [3].

In this work, using the method of destruction of metal oxides directly during compounding, PP + Me nanocomposites of a uniform degree of dispersity of the inorganic phase were obtained. The presence of metal nanoparticles in the polymer matrix transforms the properties of the base polymer, as shown in Table 1

During the analysis of the results, it was found that the introduction of metal oxides into the polymer improves the complex of physical and mechanical properties of polyolefins. It should be noted that the presence of atomic particles of metals contributes to a significant increase in heat resistance, flexural modulus of the base polypropylene.

Table 1

Physical and mechanical properties of the obtained composite materials based on polypropylene

Options	Standards	PP-JM350	PP+5% aluminum oxide	PP+ 5% Nickel oxide (II)	PP+5% calcium oxide	PP+ 5% iron oxide	PP+5% zinc oxide
Density, g/cm3	ASTM D1505	0,9	0,99	0,99	0,99	0,99	0,99
Modulus of elasticity MPa	ASTM D1238	1100	1270	1300	1180	1310	1355
Elongation %	ASTM D790	100	95	95	100	96	98
Elastic force, MPa	ASTM D638	24	26	25	25	25	24
Impact strength according to Izod s/n, at +23°C, kJ/m2	ASTM D638	6,5	6,4	6,2	6,1	6,4	6,51
Impact strength according to Izod s/n, at -30°C kJ/m2	ASTM D256	3	3	3,2	2,8	3,4	3,33
Tensile strength, MPa	ASTM D256	45	47	46	48	50	50
Shrinkage 24soat,%	ASTM D648	1,2	1,05	1,05	1,05	1,15	1,6
Burningrate UL-94 mm	Sample thickness 3.2 mm	45	≤40	≤40	≤40	≤40	≤40

The properties of PP improved significantly after its modification with metal acetates. For example, we see that the modulus of elasticity has increased from 1100 MPa to 1310 MPa, and the bending temperature under load has increased to 45-500C. The modifier had no significant effect on the ability of the composite material to elongate.

To determine the maximum temperature range of matell oxide-reinforced polypropylene, thermograms of the samples were obtained using TGA, the thermal stability was determined and the cold resistance of the composites was assessed by measuring the bending and fracture strength at low temperatures (Fig. 1)

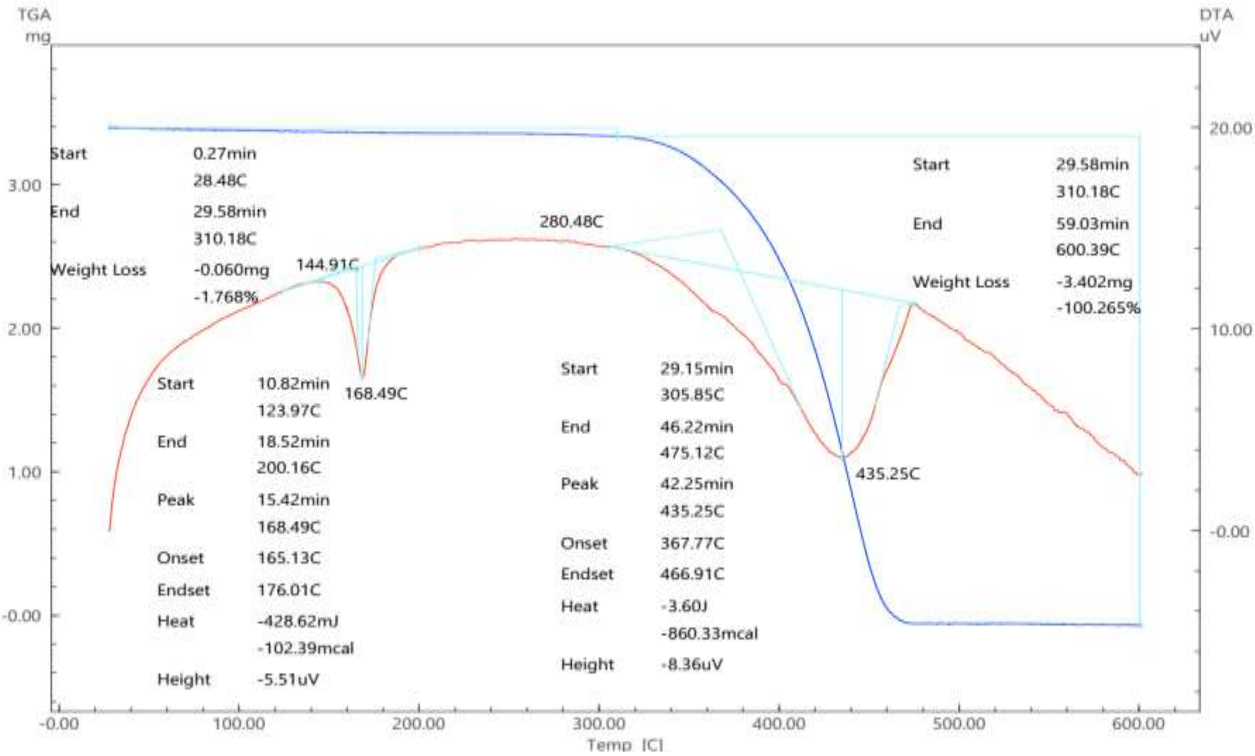

Fig.1. Thermogram of polypropylene samples with the addition of Co and Ni.

In DTA analysisofCo-Nimetals, masslossisobserved, twoendothermicandtwoexothermicprocessesoccurredintwoareas.

In the first phase of decomposition of the substances obtained for testing, the process was initiated at 28.480 °C and a mass loss of 0.060 mg or 1.768% was observed at 310.180 °C. This is attributed to the release of nitric oxide during decomposition.

The second phase of the process was the main decomposition phase, starting at 310.180 °C and ending with a loss of 3.402 mg, or 100.265% mass, at 600.390 °C. At these temperatures, metal carbonates remain from the decomposition of metal oxides and nitrogen.

In the DTA analysis of the synthesized product, heat absorption was observed at a temperature of 168.490 °C in the first stage of the endothermic process, during which the decomposition of carbon oxides and metals was observed. In the second stage, the decomposition of metal carbonates and nitrates was observed at a temperature of 435.250 °C.When heat is released, that is, in the first stage of the exothermic process, at a temperature of 144.9 10 ° C, nitrogen oxides are formed. The second stage of the exothermic process is observed at a temperature of 280.480 °C, which leads to the formation of urea and nitrite.

table 2

Composite based on metal oxides with SPP, TGA results

№	Temperature, °C	Lostweight, mg (4.5)	Lostmass,%
1	100	0,060	1,33
2	200	1,125	25
3	300	2,012	44,7
4	400	2,896	64,4
5	500	3,402	75,6
6	600	4,215	93,67

Conclusion

Based on the obtained thermograms, the melting temperature of the composite samples and the temperatures corresponding to the maximum endothermic effect of liquefaction, the enthalpy of liquefaction, and the degree of crystallization of the composites were determined.

Based on the data obtained, it can be concluded that an increase in the order of processing polymers with metal compounds, uniformity andThe mobility of structural elements leads to a decrease in the defective structure of the modified polymer and an increase in its strength, deformation, thermal stability, and thermophysical properties.

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