Study of modified thermoplastic elastomers based on polyethylene chlorinated with thiokol rubbers

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ABSTRACT : In this paper has been examined the mechanical properties of thermoelastoplastic polymer materials derived from polyethylene chlorinated with secondary polyethylene. In order to ensure the good performance of the thermoelastoplasts obtained in the external environment, attempts were made to increase their resistance to external influences by modifying them with 1% mass of polysulfide rubbers, and resistance to deformation was determined when studying the properties of the polymer material under UV light for 10 hours.

Key words: Materials, thermoelastoplast, modifier, composition, polymers.

1.INTRODUCTION

Plastic industry faces a major challenge in this decade to find an proper way to deal with an enormous quantity of waste plastics, which causes environmental hazard. From the point of environmental issues, plastic recycling is the most efficient way to manage these waste materials. Thermoplastic elastomers are one of the most versatile plastics in today's market. The emergence of thermoplastic elastomers bridges the gap between thermoplastics and conventional elastomers. Thermoplastic elastomeric materials are a physical mixture of polymers (a plastic and a rubber) and they exhibit both the properties of plastics and rubbers [1,2]. And also they exhibits high elasticity of thermoset vulcanized rubber at room temperature and good process ability of thermoplastic at high temperature [3,4]. Due to this special property, TPE is also referred as "third-generation rubber" [5]. TPEs are environment friendly and are very easy to recycle. Thermoplastic elastomer compounds can be obtained by three different structures and morphologies. They are block copolymers, rubber or thermoplastic blends, dynamically vulcanized rubber blends. The processing methods used for thermoplastic elastomers are extrusion, blow moulding and injection moulding techniques [6-8]. The viscosity of thermoplastic elastomer is significantly lower than the viscosities of traditional rubber elastomers, which offers many processing advantages for thermoplastic elastomers as compared with natural rubbers. The uses of TPE

materials are continuously increasing day by day, due to their huge applications in automotive, construction, industrial, consumers, electronics etc.

2.Methods.

In this research, thermoelastoplast polymer materials have been obtained on the basis of modification of polyethylene chlorinated with polyethylene, and samples were prepared on the basis of GOST, which required to determine the properties of mechanical and thermal destruction**.**
Obtained VPE: In order to increase the UV resistance of thermoelastoplasts based on XSPE, the mechanical properties of the samples were determined on the basis of GOST modified with polysulfide rubbers.

3.Results and Discussion.

Study of thermoplastic elastomer based on recycled polyethylene and chlorosulfonated polyethylene. Mixed thermoplastic elastomers (TEPs) were obtained by high-speed melt mixing of recycled polyethylene (RPE) with synthesized chlorosulfonated polyethylene. For blended TPEs, the strength level of the thermoplastic, as a rule, is not reached. However, as can be seen from Tab. 1, the strength of the compositions of HPE-CSPE obtained in the mode of dynamic mixing of the polyolefin is higher, which turned out to be unexpected. show the table 1a

Table-1a.

Deformation-strength characteristics of compositions

Composition WPE:HSPE	Conditions tensile strength, MPa	Elongation at break, %	residual elongation,%
Composition WPE:HSPE			
80:20	21,4	186	70
60:40	18,5	175	65
50:50	14,5	175	65
40:60	13,2	175	65
20:80	10,4	158	65
100:0	13,8	145	71

Differential thermogravimetric (DTA) has been studied of thermoplastic elastomer with the composition VPE:ChSPE (50:50) are characterized by six endothermic effects at temperatures of 130, 142, 235, 640, 720, 762 °C and two exothermic effects at 318 and 487 °C. The total weight loss in the temperature range of 80-800 °C according to the thermogravimetry curve is 92.30%. It can be seen that the process of decomposition of mixed TPEs based on HPE-ChSPE is determined mainly by the polymer that makes up the largest amount in the composition.

Table-1b

Results of TGA of mixed TPEs based on VPE and ChSPE.

Composition	$T_{initial,}$ °C	$T_{10,}$ °C	$T_{50,}$ °C
VPE	220	350	465

HSPE	162	230	378
WPE:HSPE (20:80)	175	285	410
WPE:HSPE (40:60)	175	275	410
WPE:HSPE (50:50)	178	275	420
WPE:HSPE (60:40)	180	285	450
WPE:HSPE (80:20)	184	290	450

In this case, the temperature interval for the onset of decomposition should correspond [9-17] to a less thermally stable polymer in the TPE composition. The corresponding temperatures at a loss of 10% (T10) and 50% (T50) of the initial mass of blended TPEs are in the temperature range of the initial polymers. However, TPEs based on CSPE have a higher T10 temperature compared to the original polymer (Table 1b), which is not typical for similar materials. All this can be explained by connections with the nature of the components and the peculiarity of obtaining the composition. Thus, partial dehydrochlorination of CSPE occurs during high-temperature mixing, which leads to the formation of a polymer matrix structure. In this temperature range, unstable chlorine atoms in the macromolecule are split off, which in turn improves the structure formation of the polymer. Based on this, the increase in thermal stability of the obtained compositions is quite understandable . Thus, the production of TPEs based on VPE and ChSPE in the dynamic mixing mode makes it possible to obtain compositions with high thermal stability compared to the initial polymers.

Investigation of the modification of thermoplastic elastomer based on chlorosulfonated polyethylene and recycled polyethylene with thiokol rubber. The expansion of the field of application, the tightening of technological and environmental requirements for products made of polymers necessitated an accurate assessment of the obvious advantages and fundamental disadvantages of each polymeric material. In the case of elastomers, typical disadvantages are the inability to recycle the compositions. In this situation, it is quite reasonable to use a modified thermoplastic devoid of disadvantages.

Thermoplastic elastomers obtained on the basis of chlorosulfonated polyethylene with secondary polyethylene (VPE and CSPE) and thermoplastic elastomer VPE and CSPE modified with thiokol rubber (thiokol rubber obtained on the basis of dichloroethane) were studied.

Thermoplastic elastomer VPE and KhSPE, due to its inherent set of properties, has become widespread in the creation of elastic, acid-resistant thermoplastic elastomers. However, at the same time, the VPE and KhSPE thermoplastic elastomer has a number of disadvantages, such as, first of all, low deformation-strength and adhesive characteristics when creating coatings, low moisture and heat resistance, and insufficient stability under UV radiation.

To eliminate the above shortcomings, we modified the thermoplastic elastomer VPE and KhSPE with thiokol rubber.

In the work, the influence of the modifier on the structure and properties of the thermoplastic elastomer VPE and KhSPE, which are the products of the interaction of thiokol rubber, was studied.

Table-2

Deformation-strength properties of HPE and CSPE films before and after UV irradiation

Composition of VPE and KhSPE 50:50 + modifier (1 wt.%)	Tensile strength, MPa	Elongation at break,%	Tensile strength, MPa	Elongation at break,%
	Before exposure		After 10 hours of UV exposure	
Without modifier	14,8	175	8,5	142
Modified with thiokol rubber	13,5	168	12,5	150

Changing the content of the modifier significantly affects the deformation-strength characteristics of the KhSPE:VPE thermoplastic elastomer. The table presents data on the change in the deformation-strength characteristics of films of thermoplastic elastomer VPE and KhSPE. As can be seen from the data (Table 2), the strength and relative elongation at break of the compositions slightly decrease in the modified thermoplastic elastomer, but after 10 hours of UV irradiation, the modified thermoplastic elastomer retains its deformation-strength characteristics.

Thus, it follows from the obtained results that the modifier (thiokol rubber) helps to improved the mechanical properties and increase the light resistance of the studied polymer compositions. The light stabilizing effect of the modifier can be explained by its shielding effect, as well as by the inhibition of destructive processes in thermoplastic elastomer [18-21].

Also, as a criterion for evaluating the effect of modifying additives on the stability of polymers [22-24] including HPE and HSPE thermoplastic elastomers under the influence of UV irradiation, the functional dependence of the change in the absorption spectra of polymer films in the ultraviolet and infrared regions on the time of irradiation of the samples was used[25-30].

4.CONCLUSIONS.

1. In this study, we studied the mechanical properties of modified polymer materials and their thermal properties.
2. Modification of thermoelastoplasts with thiocol rubbers, which formed secondary polyethylene with the obtained chlorosulfonated polyethylene, revealed their high resistance to external influences and resistance to deformation.
3. The obtained thermoelastoplate polymer materials have a wide range of applications in the production of anticorrosive coatings, varnishes and sealants.

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