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Properties of Nanocomposites Based On High Density Polyethylene

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ABSTRACT: The paper compares the rheological and mechanical properties after ultraviolet (UV) irradiation of composites based on high density polyethylene with graphene oxides. The dependence of the physical and mechanical characteristics of the composites on the specific surface area of the additives is shown.

KEYWORDS: polymer composites, polyethylene, graphene oxide, nanofibers, carbon black, rheology, strength

I.INTRODUCTION

Carbon additives have been used for many years in the preparation of composites based on polymers. It is known that the introduction of structuring additives increases the strength, thermophysical and rheological properties of polymers.The use of carbon black as a filler for pipe polyethylene will increase the resistance of products to UV radiation, as well as to some extent the mechanical properties.

II. SIGNIFICANCE OF THE SYSTEM

The paper mainly focuses on how to get effective additives for motor oils and their application. The study of literature survey is presented in section III, Methodology is explained in section IV, section V covers the experimental results of the study, and section VI discusses the future study and Conclusion.

III. LITERATURE SURVEY

The dependence of the rheological and mechanical characteristics of the obtained composite material (CM) on the specific surface area of the introduced series of additives has been investigated.A comparison is made of the effect of additives and carbon black in composites based on HDPE on the physicochemical properties when exposed to UV radiation. [1-5]

IV. METHODOLOGY

The article selected HDPE pipe grade polyethylene, which is used for the manufacture of pressure, gas pipes and pipes for drinking water. For modification, graphene oxide (GO) was used in an amount of up to 0.1 wt. %.

V. EXPERIMENTAL RESULTS

Comparison of the melt flow rate (MFR) and rheological properties of composites based on HDPE with exhaust gases of different nature and carbon black are shown in Figure 1.

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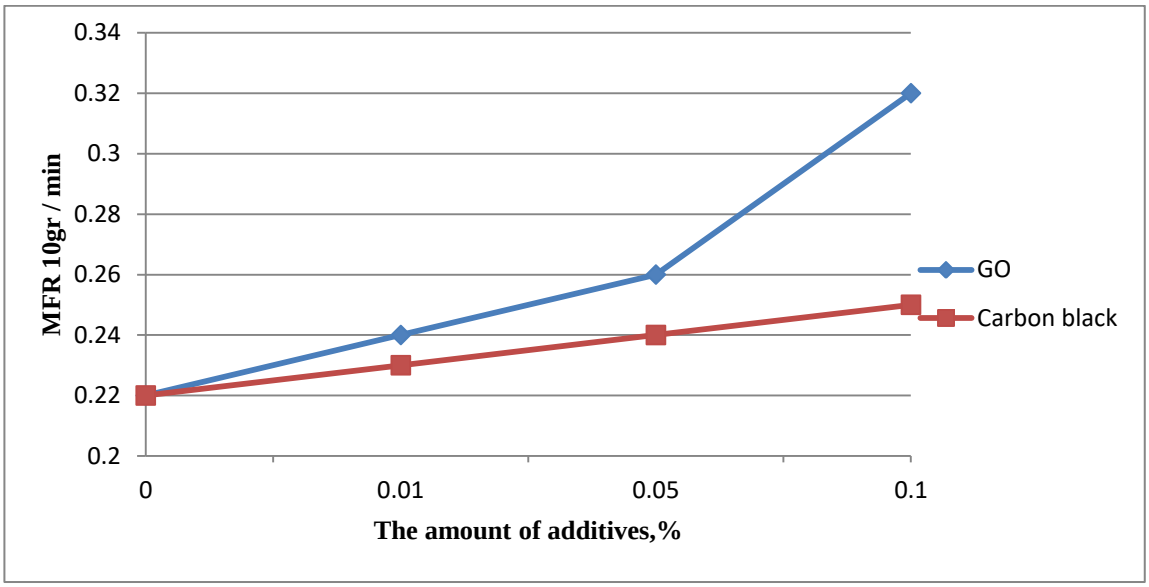
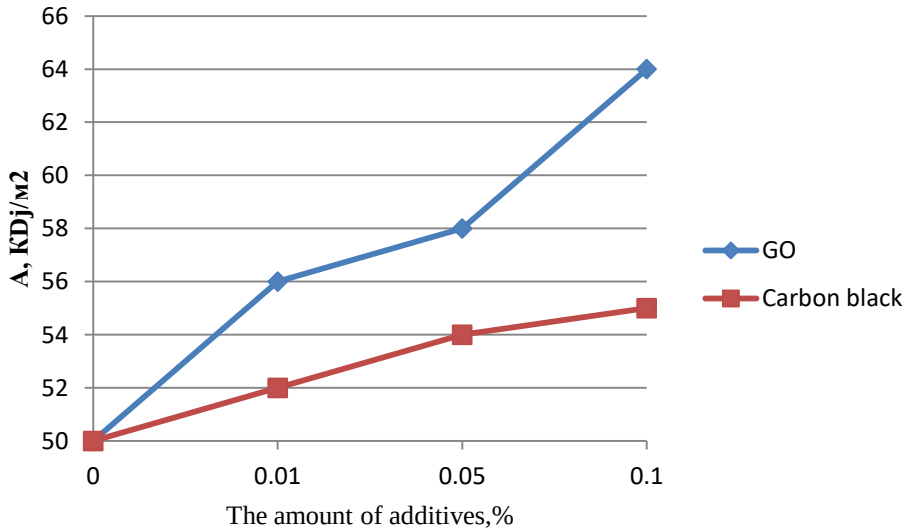


Fig 1.MFR of HDPE-based compositions with additives of exhaust gases and carbon black.

When considering the rheological properties of the composition with carbon additives, an increase in MFI and shear rate is observed and, accordingly, a decrease in viscosity in comparison with the original polyethylene and filled with carbon black. In this case, the strength parameters also increase (Fig. 2).

When carbon black is introduced into polyethylene, the MFR practically does not change, and the rheological properties decrease with an increase in the shear stress, which directly affects the parameters of processing such compositions into products.



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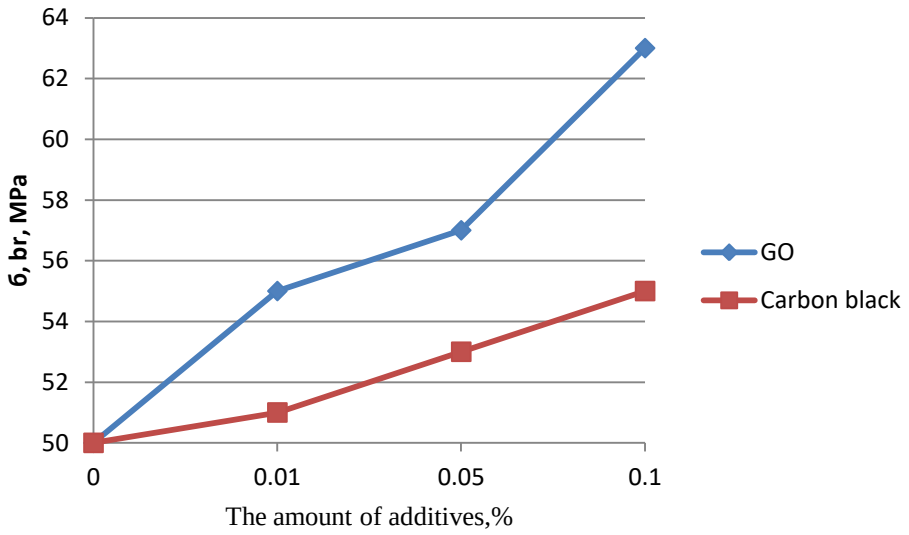

Fig. 2. Influence of additives on impact strength (a) and tensile strength (b) of composites based on HDPE.

The addition of carbon additives to HDPE provides local (as opposed to carbon black) reinforcement of the matrix at the microlevel with beams of additives, accompanied by the formation of a spherulite structure. Also, due to structural features, carbon additives have large volumes of sorption space and specific surface area, which testifies in favor of their high sorption and adhesive activity.

One of the reasons for adding carbon black to polyethylene is the polymer's sensitivity to oxidation and aging.It is known that polyethylene has a certain degree of branching, having tertiary carbon atoms that absorb light with high wavelengths, which leads to the formation of free radicals .Exposure to oxygen, UV and high temperatures impairs the physical and mechanical properties of polyethylene. Soon, in this case, plays the role of an ultraviolet absorbent, slowing down the rate of oxygen absorption.

To assess the effect of additives on changing the parameters of the composition, HDPE samples with additives in the form of bars were exposed to UV radiation at a wavelength of 290-320 nm and a temperature of 23 ° C for 120 hours.

The dependence of the change in impact strength (A), strength at break on the time of irradiation for a composition with additives (concentration up to 0.1 wt%) is shown in Figure 2 a and b.

Figure 3 shows a slight decrease in the strength and toughness of the composites filled with GO.

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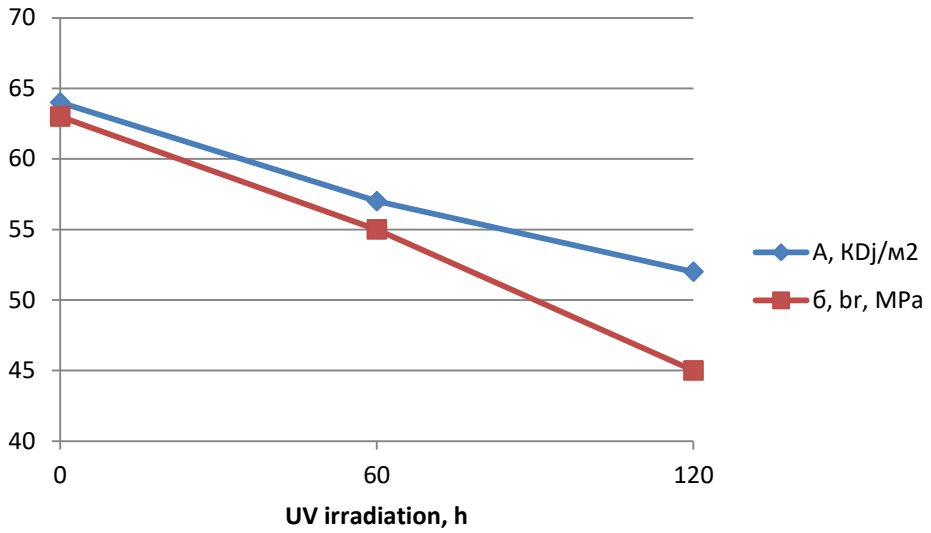

Fig. 3. Changes in the properties of the HDPE + GO after exposure to UV radiation

The change in parameters under the action of UV radiation of filled HDPE occurs quite intensively (Fig. 3), possibly due to insufficiently uniform distribution of the additive in HDPE, which can not only lead to a decrease in resistance to UV radiation, large agglomerates of the additive can act as local stress concentrators , increasing the likelihood of destruction of the composition upon application.

VI. CONCLUSION AND FUTURE WORK

The results obtained showed that exposure to UV rays leads to a decrease in the strength properties of the original HDPE, as well as the composition with particles with a small specific surface area: carbon black, GO .It should be noted that the specific surface area of the additive and their amount in the composition of composites play a huge role in the stabilization of properties. Thus, a composition based on HDPE with exhaust gas in an amount of up to 0.1 wt. % c is the optimal formulation, UV resistant.

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