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Research of Physical and Mechanical Properties of Materials Based on Polyethylene

Ruzikulov Abdumalik Abdumannon ugli[1], Chuliyev Jamshid Ruziboyevich[2]

[1] Karshi Engineering-Economic Institute master`s degree
[2] Karshi Engineering-Economic Institute PhD

Abstract: Polyethylene is also resistant to acids and alkalis. The article provides chemical properties of polyethylene. It has been demonstrated that the addition of PE wax reduces the cavitation effect that occurs in the polymer during its thermal orientation hardening.

Key words: polymer, thermoplastic polymer, polypropylene.

Polyethylene is a thermoplastic polymer of ethylene, belongs to the class of polyolefins. It is an organic compound and has long molecules …—CH2—CH2—CH2—CH2—…, where it denotes covalent bonds between carbon atoms. It is a white mass (thin sheets are transparent and colorless). Chemically resistant, dielectric, not sensitive to shock (shock absorber), softens when heated (80-120 ° C), adhesion (sticking) is extremely low. Often incorrectly called cellophane.

The chemical properties of polyethylene also deserve attention. This is a non-toxic material that does not emit harmful compounds and unpleasant odors, does not allow water, gases and pathogenic microorganisms to pass through. Polyethylene is also resistant to acids and alkalis.

Physical models of orientational strengthening of UHMWPE have been constructed depending on the Chemical element of D.I. Mendeleev's periodic system - carbon has a variety of unique properties. This is precisely the reason the fact that carbon itself, its compounds, and materials based on it serve as objects of fundamental research and are used in a wide variety of personal areas. Until the beginning of the 60s. XX century It was generally accepted that there were only two forms of crystalline carbon - diamond and graphite, widespread in nature and known to mankind since ancient times. The question of the possibility of the existence of forms of carbon with *sp*-ibridization of atoms has been repeatedly considered theoretically. Back in 1885, the German chemist A. Bayer tried to synthesize chain carbon from acetylene derivatives using a stepwise method. However, Bayer's attempt to obtain polyine was unsuccessful. He obtained a hydrocarbon consisting of four acetylene molecules connected in a chain, which turned out to be extremely unstable.

1. The mechanism of deformation of the supramolecular structure of the polymer, describing the likelihood of the occurrence of the cavitation effect.
2. It has been demonstrated that PE-wax additives act as an intermolecular lubricant and increase the mobility of UHMWPE macromolecules, which results in an increase in the degree of crystallinity of UHMWPE xerogels and the formation of a homogeneous lamellar structure with a high predisposition to thermal orientation strengthening.
3. It has been demonstrated that the addition of PE wax reduces the cavitation effect that occurs in the polymer during its thermal orientation hardening. PE wax reduces the stresses that arise on the amorphous phase during thermal orientation drawing, which reduces the effect of cavitation.

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4. The addition of graphene nanoplates to the UHMWPE polymer matrix increases the cavitation effect during thermal orientation strengthening of the polymer.
5. For the first time, crystallization of dissolved UHMWPE macromolecules on the surface of oriented UHMWPE crystals under supercritical carbon dioxide conditions was carried out, as a result of which a supramolecular shishkebab structure with a high degree of crystallinity and the absence of an amorphous phase between the "disks" was obtained. The absence of an amorphous phase makes it possible to obtain highly crystalline UHMWPE materials with textured porosity [1].

Experimental part. Chemical modification of polypropylene and polyethylene, that is, a targeted change in its physical, mechanical or chemical properties by introducing new functional groups into the macromolecule, cross-linking or copolymerization, is of great interest from a scientific and practical point of view.

The introduction of modifying additives significantly changes the properties of the filled polymer material. The main parameter that determines the properties of polymer composite materials is the filler concentration. Concentration has a special impact on the physical and mechanical characteristics of polymer composites and the technology for processing the original polymers. Low-density polyethylene of PE, PP and PA grades was chosen as the polymer, and oxides of aluminum, nickel, cobalt, iron and zinc were used as fillers. To find the optimal concentration of fillers that provide the best combination of mechanical properties of the resulting composites and technological parameters of the process of their processing, five types of polyethylene were obtained and studied, the filler concentration in which varied from 1 to 5% (Tables 1–3) [2].

This is the development of nanocomposite materials, including reinforced ones, based on HDPE and carbon nanofillers with different structures and specific surface areas to improve the complex properties of the resulting composites. To achieve this goal, the following tasks were set:

- develop a method for introducing nanoparticles of various shapes and properties into HDPE to obtain materials with a uniform distribution of nanoadditives [3].
- conduct research into the influence of various nanoparticles on the technological, rheological, relaxation properties, cracking resistance, and thermal stability of HDPE-based nanocomposites;
- to develop a technology for producing basalt and carbon plastics based on HDPE modified with nanoadditives, as well as to identify the main patterns of changes in the properties of these composites.

Practical significance of the work.

1. Based on the thermomechanical research method using the SMIP-RKhTU device, a methodology has been developed for assessing the spatial mesh of cross-linked polyethylene cable insulation and its resistance to thermal deformation. The method for assessing mesh density using the SMIP-RKhTU device was introduced at the Polimerplast enterprise and passed pilot testing at the plants of ZAOor NP Podolskkabel, ABB Moskabel, Kavkazkabel, OJSC Elektrokabel Kolchugino, Saransk Cable.
2. It is shown that it is inappropriate to use a time-consuming and non-ecological method for assessing the degree of cross-linking based on the size of the gel fraction.
3. A correlation equation has been found that makes it possible to calculate the content of MPC and TMP to ensure the required degree of cross-linking of cable insulation based on domestic grades of PE, depending on the values of their MFI.
4. The use of TMP as part of a modified peroxide curing system makes it possible to increase the productivity of the PE insulation curing process by 1.5-2 times.
5. The introduction of 3% TMP into the polyethylene composition in the form of a 20% concentrate in polar copolymers SEVA - 118 or TSEV 2113 ensures the thermodynamic stability of the

system during storage and transportation up to the 4th manufacturer's plant, increases the degree of crosslinking and makes it possible to reduce the MPC content to 1%.

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