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RESEARCH ON THE TECHNOLOGY OF EXTRACTING LOW MOLECULAR WEIGHT POLYETHYLENE FROM PRODUCTION WASTE

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Abstract: In the article, the synthesis of polymeric antioxidants based on local secondary raw materials was studied and applied in the stabilization of polyethylene. It is known that polyolefins have sufficiently high mechanical strength and dielectric stability, and are resistant to the effects of aggressive environments, acids, alkalis and salt solutions. Their disadvantage is poor adhesion, lack of polar groups, relatively low hardness, so these properties sometimes limit their use as construction materials. Unstabilized polyolefins lose many of their valuable properties during processing and aging during service and storage.

***Keywords*:** destructive processes, macromolecule, SGCC, Tsigler-Natta catalysts, low molecular polymer.

After the independence of our republic, the oil and gas industry has been developing at a rapid pace, not only to increase the quantity of oil and gas products, but also to prepare high-quality products based on them. Today, one of the urgent problems is to obtain chemical reagents for processing oil and gas products based on local raw materials, which significantly reduces costs in this field and the amount of expensive reagents imported from abroad [1].

The launch of the "Shurtan gas chemical complex" (SGCC) and the launch of polyethylene production in our republic made it possible to increase the types of polymers. Polyethylene is obtained in the process of polymerization of ethylene in a cyclohexanone solution using Tsigler-Natta catalysts in the "Shurtan gas chemical complex", low molecular weight polyethylene (LMPE) waste is formed as a by-product during the process. Its volume is on average 1.5-2.0 thousand tons per year, and it was found that this waste contains 5-10% low molecular weight polyethylene. Currently, this waste is decommissioned and used for various purposes.

At SGCC, polyethylene is synthesized in the anion-coordination mechanism with the participation of the Tsigler-Natta catalyst, in which the current technology allows controlling the density of the polymer in a wide range, high, medium and low density polyethylene is obtained by introducing a butene-1 link into the main polymer chain. Therefore, the product produced in the complex is a copolymer of butene-1 with ethylene. In the macromolecule of ethylene copolymer obtained under low pressure, there is a short branching in the side chain, the length of which is determined by the amount of monomer (butene-1) being copolymerized. Therefore, low-density polyethylene produced in the complex is called low-density linear polyethylene. The linear description of polyethylene macromolecule SGCC sufficiently ensures the anisotropy property of the film based on it. Low-density linear polyethylene has advantages over low-density polyethylene obtained by radical polymerization

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in some parameters (tensile strength, crack and heat stability) and polyethylene obtained under low pressure (other parameters are transparency of the film, relative elongation at break) [2].

Based on the results of the experiment, the composition and physico-chemical description of the waste of SGCC is presented in Table 1.

Table 1 Physico-chemical description of waste of SGCC

№	Content	%	T_{boil}
1	Cyclohexane	40	82-83 (80 ^{o}C)
2	Ethylcyclohexane	25	72
3	Cyclodecane	10	182
4	Intermediate fraction	15	-
5	Fraction that boils at high temperature	5	-
6	Low molecular weight polyethylene	5	-
7	Microelements	(10^{-4} %):	-
8	Chlorides	100	-
9	Vanadium	50	-
10	Titan	50	-
11	Aluminum	30	-

(low molecular polyethylene high viscosity fuel, resinous liquid, viscosity 40 sP centipoise)

The average molecular mass of low-molecular polyethylene is in the range of 1000-5000 g/mol (800-3000 g/mol), the amount of ethyl group in QMPE increases up to 3 times, it is 4-8 units per 100 carbon atoms.

Stabilizing agent reduces the molecular mass of LMPE (added to diesel fuel in the amount of 0.05% by mass), increases its stabilizing properties.

This industrial waste contains a mixture of LMPE and multi-component solvents, and their processing and production of effective products of industrial importance is of great scientific and practical importance.

A method of extracting components from the solution of polyolefins using organic solvents was developed. This developed method is designed to isolate polyolefins, and according to this method, a solution of polyolefin in organic solvents is cooled to room temperature.

The resulting paraffinic mass is crushed and mixed with water, and the mixture obtained in the presence of the original organic solvent is heated at temperatures below the liquidus temperature. This mixture is kept under a residual pressure of 15-40 mm Hg until the solvent is completely removed, and the polymer is filtered from the remaining water. Then the isolated polymer is dried. At the vacuuming stage, condensation of solvent and water vapor is carried out and then they are separated.

This developed method lowers the price of the isolated polymer, simplifies the technological process and speeds up the process.

One of the more convenient methods is the method of separating components from the PE solution in organic solvents, which are similar in technical nature and characteristics. This method is used in the production of polymer under low and medium pressure and involves the use of a precipitator.

But this proposed method is also more complicated due to its multi-stage, large-scale equipment usage. This method is not very effective, because it is necessary to use a large amount of alcohol as a precipitant. In addition, the duration of the process is not less than 2.5 hours. Due to the release of solvent vapors into the atmosphere during the drying and filtering process, this method is not safe from

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the fire and environmental point of view. In addition, the proposed method involves filtering the obtained suspension. However, filtering LMPE is not a very efficient method, because in this process the filter pores become filled with the product and the efficiency decreases.

Thus, in the scientific literature, there is no information about extremely simple and fast methods of extracting LMPE from a solution of polyolefins, in particular, in organic solvents. Taking into account the above, it is desirable to solve the problem of developing a simple method of extracting components from PE solutions in organic solvents, providing energy-saving and equipment means to a minimum [3].

Various technological methods of separation of suspensions have been developed. Among them, the methods of straining, filtering and centrifugation are of special scientific and practical importance. In order to select the method of phase separation, the size of the LMPE particles in the suspension was determined. Optical microscopy was used for this.

The size of the particles in the suspension is from 5.7 μm (their total amount is more than 80%) to 200 μm. Their average size is 36.88 μm. This makes it possible to use all known methods to separate particles of this size from suspensions. The use of the dilution method is not very effective, because the difference between the density of the solid and liquid phases is not very large. The suspension filtration method is also not very efficient because the filter pores become clogged with waxy LMPE. Therefore, we used the centrifugation method to separate the phases [4].

One thing should be emphasized when choosing a centrifuge: the various centrifuges used so far can be based on the principle of filtration (such centrifuges are called filtering centrifuges) or based on the sedimentation principle (such centrifuges are called filtering separators). The use of filter centrifuges is not very effective in separating the suspension, since only filtration is carried out.

Therefore, it is advisable to use only sedimentation centrifuges-separators for the separation of suspensions. An MLWT 23 centrifuge was used. The principle technological scheme for separating LMPE from production waste is as follows: (Fig.1).

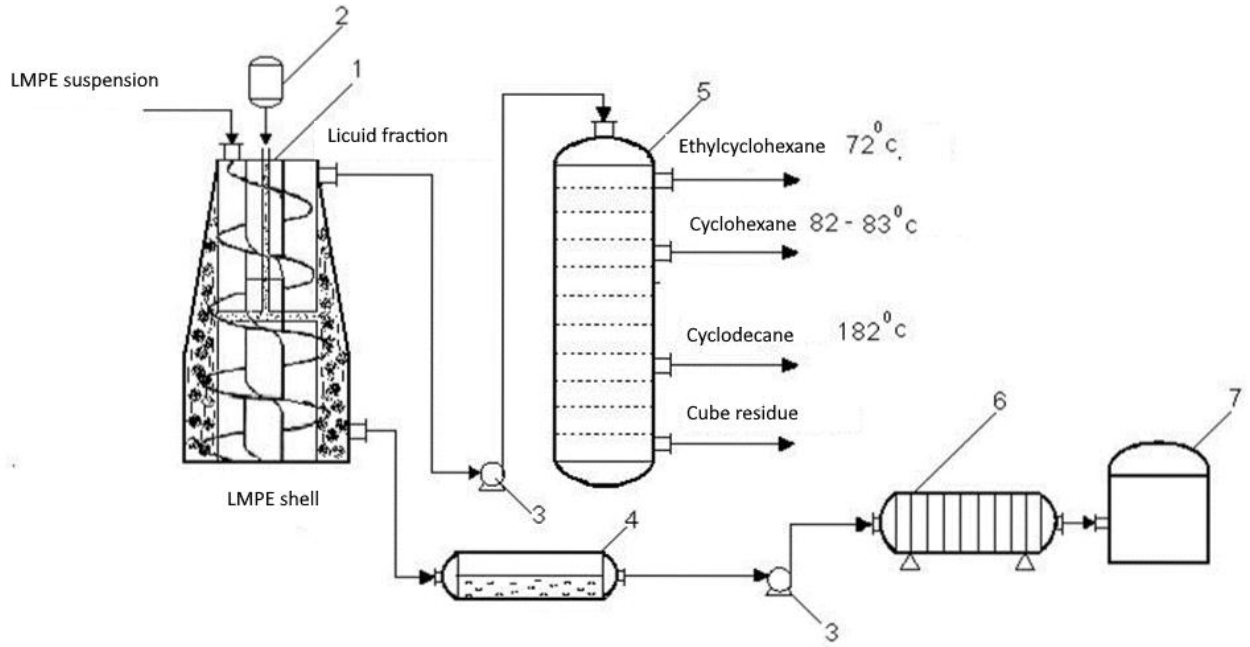

Fig. 1. Technological scheme of separation of low molecular weight polyethylene by centrifugation:

1- centrifuge, 2- motor, 3- pump, 4- filter, 5- rectification column, 6- dryer, 7- collector

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The solution is cooled to 30-50 ℃ in order to clean the LMPE dissolved in the organic solvent formed during polymerization from the catalyst and unreacted ethylene. The resulting paraffin mass is crushed and mixed with water. The cooled solution is mixed with a liquid-precipitator. The precipitant is immiscible with the solvent but does not interact with the polymer. As a result, as a result of the mixing of both liquids, crystals of LMPE are formed in suspension.

The suspension of low molecular weight polyethylene in organic solvent containing up to 80% of particles with a size of 5-7 μm, large particles with a size of up to 200 μm, and an average size of 36.88 μm is fed from the upper part of the centrifuge-1.

Centrifuge-1 is equipped with a mechanical mixer, and the mixer-drum is driven by an electric motor 2. The rotation frequency of the drum of this centrifuge, which rotates around its axis, is 3000 rev/min. is The drum is made of a perforated metal sheet, and its inner wall is covered with a filter material made of gas. From the drum, the suspension is compressed through the filter material under the influence of centrifugal forces [5].

Centrifugal force is generated as a result of the rotating movement of the mixer with the help of the electromotor 2, in which the LMPE crystals in the suspension move towards the walls of the centrifuge 2, and the relatively light liquid fraction, consisting mainly of solvents, is separated from the center through the upper exit pipe.

The condensed mass, consisting mainly of LMPE crystals, is heated at a temperature lower than the liquidus temperature and 15-40 mm.sim.above in filter-4. filtered for 1÷1.5 hours until the solvent is completely removed under excess pressure. The liquid mixture consisting of solvent and water vapors separated in filter-4 is pumped together with fugate in the rectification column-5 and divided into narrow fractions consisting of ethylcyclohexane, cyclohexane, cyclodecane and cubic residues. The filtrate is sent to dryer-6 using pump-3 and dried at 60-70 ℃ for 1.5-2.0 hours.

Solvent vapors and moisture in it are separated into layers as a result of condensation, and water and solvent are separated. Separated from water and solvent vapors, dried pale yellow waxy LMPE was collected at -7.

In order to establish a favorable technological regime, the dependence of the suspension separation efficiency on the rotation frequency of the sedimentation centrifuge rotor while keeping the centrifugation time constant was studied. The volume ratio of the solvent and LMPE retained phase was taken as the separation efficiency. As can be seen from the figure, the efficiency of suspension separation increases as the frequency of rotation of the rotor increases, keeping the duration of centrifugation constant.

This is the study of the chlorination of low molecular weight polyethylene showed that with increasing halogen concentration in the polymer antiprene property of polyethylene increased, as well as halogenation. Various factors in the process are temperature, concentration of reagents, solvent study of the influence of the nature of the quantitative laws of the process allowed to determine. Antioxidant synthesized on the basis of low molecular polyethylene stability of polyethylene to thermal and photo destruction was studied, from the results of the experiment it became clear that analog 2-4 increases the frequency. Obtaining polymer antioxidants based on local raw materials and a technological scheme of polyethylene stabilization was proposed. New and environmental in stabilizing antioxidant polyethylene it was found to be economically effective.

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