

Current Status of Polymers Based on Organosilicon Compounds

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Annotation: Polyvinyl chloride (PVC) is one of the most bulky polymers produced both in Russia and abroad. The production of PVC and products based on it has been established at more than 100 enterprises in 50 countries around the world. In recent years, significant progress has been made in the production of PVC and products from it: pipes, profiles, including window films, sheets, PVC products.

Keywords: glycerin, calcium-zinc multifunctional stabilizers, glycerol monopalmitate, palmitic acid, thermal stability, effective viscosity

Currently, the world's consumption of polymers is more than 300 million tons, of which polyethylene accounts for 37%, polypropylenes - 26% and polyvinyl chlorides - 18%. Satisfying the demand for polymer products is one of the main tasks in various sectors of the economy; however, special attention is paid to the production of polymers.

Improving the quality of the raw material base of polymers of industrial enterprises and obtaining import-substituting products on their basis, as well as saturating the domestic market with the necessary consumer goods and increasing the growth of export potential are among the important indicators at the world level. In this regard, one of the urgent problems is the use of flame retardants as raw materials, instead of imported modifiers for polyethylene, as well as various additives. For water-dispersion paints, products of silicon-containing oligomers obtained on the basis of silicates by the addition of carboxyl, epoxy, borate, amine and phosphate groups, with available technology and on local raw materials, contributing to an effective increase in heat resistance, fire resistance and a decrease in the flammability of polymers, which as a result corresponds to the development of a new trend in the republic of organ element synthesis. Thus, it is possible to reduce the production costs of enterprises and the cost of finished products.

During the years of independence, the country has seen an expansion of the scope and range of polymers, especially in the production of finished products of polyethylene and polypropylene, with an increase in consumption in the national economy. For example, in increasing the growth of the production of polyethylene and polypropylene from natural gas, a special place is occupied by flame retardant additives obtained on the basis of silicon-containing compounds with available technology, which effectively improve heat resistance, fire resistance and reduce combustibility in the process of improving the quality and strength of materials. Improving the quality of ingredients of domestic polymer compositions is associated with the main directions of the program of Strategic Actions for the Further Development of the Republic of Uzbekistan, which provide for the following tasks: "The rise of industry by transferring it to a qualitatively new level, further intensifying the production of finished products based on release of new types of products and technologies [1].

The main problem with PVC is its low stability. Various types of impacts cause a series of transformations in PVC macromolecules, causing the aging of materials and products during the processing of PVC compositions, storage and operation of materials and products based on it. Therefore, during the storage, processing and operation of PVC, as well as during the production, storage and use of materials and products based on it, it is necessary to apply a set of methods that lead to an increase in the resistance of PVC to the action of various factors, to its stabilization. [2-4].

In this regard, the purpose of this work was to study the effect of various secondary stabilizers on the effectiveness of a multifunctional stabilizer in a PVC composition. At the first stage of research, the influence of the quantitative ratio of calcium-zinc salts on the change in the thermal stability of PVC was determined. The assessment of the thermal stability of the PVC composition (PVC C 7059M 100 parts by weight; calcium-zinc stabilizer 1 part by weight) according to GOST 14041-91 under isothermal conditions shows that all the studied samples increase the thermal stability of PVC. The highest values of thermal stability of the PVC composition were achieved at a molar ratio of calcium-zinc salts of 1.5:0.5 (Figure 1), therefore, for further use, it was this ratio that was used.



Picture 1. Influence of the molar ratio of calcium-zinc palmitates on the thermal stability of PVC at 160 °C: 1 – Ca salts: Zn salts = 1.25:0.75; 2 – Ca salts: Zn salts = 1.5:0.5; 3 - Ca salts: Zn salts = 1:1

In order to increase the functionality of the stabilizer in the environment of calcium-zinc salts of palmitic acid, glycerol monopalmitate (lubricant) was obtained to further achieve maximum efficiency in the processing of PVC compositions. The interaction of palmitic acid with glycerol was carried out at an equimolar ratio of the initial reagents in the presence of calcium-zinc salts of palmitic acid. The synthesis was carried out until an acid number of 5–10 mg KOH/g was reached at a temperature of 160–170°C.

At the second stage of research, the optimal ratio of calcium-zinc salts of palmitic acid and glycerol monopalmitate used as a lubricant was determined. The experiments were carried out in a reference sample - an industrial non-plasticized composition of a window profile based on PVC S 6669 PZh containing hydrophobic chalk, a heat stabilizer, titanium dioxide, a mixture of technological lubricants, processability modifiers, fluidity in balanced ratios.

Results and discussion

The obtained dependences of effective viscosity (Figure 2) and thermal stability (Figure 3) on the content of glycerol monopalmitate in the composition of the multifunctional stabilizer show that the latter leads to a significant decrease in effective viscosity and an increase in thermal stability

PVC compositions.



Picture 2. Dependence of the effective viscosity ($T = 180\text{ }^{\circ}\text{C}$) of PVC composition on the content of glycerol monopalmitate in the multifunctional stabilizer



Picture 3. Dependence of thermal stability ($T = 190\text{ }^{\circ}\text{C}$) of PVC composition on the content of glycerol monopalmitate in the multifunctional stabilizer

An analysis of the results showed that the developed multifunctional stabilizer based on calcium-zinc palmitate contributes to a decrease in viscosity.

The introduction of a multifunctional stabilizer into the PVC composition, obtained at a molar ratio of calcium palmitate : zinc palmitate : glycerol monopalmitate equal to 1.5:0.5:0.5, improves the processability of materials.

Table

Test results of molded products (Content of stabilizer 4 wt.h. per 100 wt.h. PVC)

Name of indicator	Multifunctional stabilizer	THAT 5772-215-00203312-02
Hardness determined by indentation of a steel ball with a diameter of 3 mm at a force of 1 kgf/mm, not more than	0,12	0,14
Elasticity, %, not less	76	50
Longitudinal shrinkage, %, no more	0,25	0,4

Water absorption by mass, %, no more	0,06	1
Brittleness temperature, °C, not higher	minus 41	minus 40

Evaluation of the influence of the content of glycerol monopalmitate in the multifunctional stabilizer made it possible to establish that the developed formulation makes it possible to increase the thermal stability of PVC compositions without degrading the technological properties. The use of a multifunctional stabilizer in the formulation of molded products did not lead to a decrease in its physical and mechanical characteristics, which confirms the balance of its composition (table).

Findings

Thus, the conducted complex of studies shows the multifunctionality of the action of new stabilizers based on calcium-zinc salts of palmitic acid. Secondary stabilizers: trinonylphenyl phosphite and dipentaerythritol significantly increase their effectiveness in providing thermal stability and color stability of PVC compositions. The most balanced composition of a multifunctional stabilizer based on palmitic acid salts is a modified formulation.

List of sources used

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