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SPECIAL ROLE OF FLUORINE CONTAINING POLYMERS IN SYNTHETIC HIGH MOLECULAR COMPOUNDS

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Annotation: Polymer molecules represent a broad class of compounds, the main distinguishing characteristics of which are high molecular weight and high chain conformational flexibility. It is safe to say that all the characteristic properties of such molecules, as well as the possibilities of their application associated with these properties, are due to the above-mentioned features. In our urbanized, rapidly developing world, the demand for polymer materials, mechanical and physical properties, has sharply increased.

Key words: Polymers, flexibility, above, casting, granular product, developed, method, polymerization, emulation dispersion, suspension, viscosity, molecular weight, initiators, emulsion, free radicals.

In a broad sense, polymer processing can be thought of as an engineering specialty concerned with converting raw polymer materials into desired end products. Most of the methods currently used in polymer processing technology are modified analogues of methods used in the ceramic and metalworking industries. Indeed, we need to understand the intricacies of polymer processing in order to replace common traditional materials with other materials with improved properties and appearance [1].

The role of polymers is very important and we must understand the need to recycle them. More than a third of the total volume of products made from polymer materials is produced using the injection molding method. Due to the high productivity and relatively high cost of the equipment, it is mainly used in large-scale and mass production of products.

Fluorine-containing polymers occupy a special place in the environment of synthetic high-molecular compounds. The production and consumption of fluorine-containing polymers and products based on them are constantly expanding due to the increasing demand for these materials in various sectors of the national economy. This is due to the fact that fluorine-containing polymers have such valuable properties as high chemical, thermal, thermal stability and good electrical insulating and mechanical properties. In the series of fluorine-containing polymers, a certain place is occupied by polyvinylidene fluoride (PVF), a polymerization product of vinylidene fluoride, which forms very thin, high-strength flexible and transparent films.

Many methods have been proposed for the production of PVDF, but each of these methods has its own advantages and disadvantages.

Currently, one of the main methods for producing polyvinylidene fluoride is suspension polymerization, since this method has a number of advantages over other polymerization methods. The main advantages of this method are the simplicity of the production hardware, better heat removal, the process proceeding at a fairly high speed, and the formation of a powdery and purer polymer [1,3].

Currently, suspension polymerization is fundamentally different from emulsion polymerization [1-2]. One of the disadvantages of emulsion polymerization is the difficulty of coagulating and releasing the polymer from the latex. In many cases, emulsion polymerization produces very fine, slow-filtering precipitates, making separation of coagulating salts and initiator residues a slow, expensive, and imperfect process. In order to overcome these difficulties and directly obtain a granular product, a suspension polymerization method was developed. As with emulsion polymerization, with suspension polymerization the system consists of a dispersed phase and a dispersion (suspended) medium. Monomer particles during polymerization in suspension are much larger than during polymerization in an emulsion and at first their size is 1-10 microns.

What is common among the above polymeric stabilizers is that they are water-soluble high-molecular organic substances with hydrophilic - hydrophobic properties. They are concentrated and oriented at the monomer–water phase boundary in such a way that the hydrocarbon parts of the stabilizers are directed towards the monomer, the polar hydrated groups are directed towards the water and form a hydration layer around the globule [2]. As a result, the surface tension at the monomer-water interface is reduced, which facilitates the fragmentation of the monomer into droplets during stirring and prevents the particles from sticking together during the polymerization process.

The most famous and common emulsifier is polyvinyl alcohol. The stabilizing ability of polyvinyl alcohol depends on the content of acetate groups in it.

Therefore, a number of works are devoted to studying the properties of aqueous solutions of polyvinyl alcohol (PVA) depending on the content of acetate groups in it [2].

Emulsifiers ensure the stability of the monomer emulsion in the initial stage of suspension polymerization, prevent sticking of polymer-monomer particles in the middle of the process and act as emulsifiers for the final stage suspension. In addition, the type and concentration of the emulsifier in the dispersion medium affects the dispersion of the emulation, and consequently, the particle size of the finished product. Polymer emulsifiers are often used in a concentration of less than 0.1% relative to the monomer. Such amounts have almost no effect on the properties of the polymer.

The disadvantage of suspension polymerization is the need to wash and dry the granules and the possibility of contamination of the polymer with emulsifier residues; however, suspension polymers generally contain significantly fewer impurities than polymers produced by emulsion polymerization.

Solid emulsifiers are highly dispersed powders, used in quantities from tenths to one percent relative to the monomer [1,3].

From the above, it should be noted that suspension polymerization of vinyl monomers is one of the most common industrial methods for the production of polymers. This is due to a number of valuable advantages of this method, the main ones being: in this case, the system is simpler, the droplet sizes are better regulated, there is no latex deposition stage and a cleaner product is obtained that is easier to process.

It is known from the literature [2] that PVDF, obtained even in bulk, dissolves in these solvents. Therefore, our results are not unexpected, but indicate the good properties of suspension PVDF. By comparing the solubility of PVDF synthesized by various methods, it was revealed that suspension PVDF is characterized by good solubility compared to PVDF obtained in bulk. This is apparently due to the loose packing of macromolecules and the powdery nature of suspension PVDF. A study of the viscosity of dimethyl sulfoxide polymer solutions shows that the value of the intrinsic viscosity and molecular weight of polymers depends on the type of emulsifiers used. So, for example, with other synthesis conditions being equal (concentration of initiator 1.0%, emulsifier 0.1%, temperature 40 ° C, water module 1:3, time 6 hours), a polymer with the highest molecular weight is obtained when using a stabilizer - PVP. (Table 1).

Table № 1 Dependence of [η] and molecular weight on the type of stabilizers

Stabilizers	[η]	Molecular mass
PVP	0,66	30650
Fluorinated surfactant	0,51	18310
A mixture of PVA and fluorinated surfactant	0,35	13710

With an increase in the initiator concentration from 0.5 to 1.5% of the monomer weight, other conditions being equal, polymerization [η] the molecular weight of the polymers decreases (Table 2).

Table № 2 Dependence of [η] and molecular weight of polymers on initiator concentration

Stabilizers	Initiator concentration based on monomer weight %	[η]	Molecular massPVP
PVP	0,5	0,68	31579
	1,0	0,66	30650
	1,5	0,50	18310

This is due to the fact that with an increase in the concentration of the initiator, along with an increase in the number of free radicals, the rate of chain termination also increases. Therefore, with increasing concentration of DIPDC, the yield of the polymer increases, and the molecular weight decreases.

The study of the thermal stability of PVDF obtained by suspension polymerization is of great interest due to the specific features of fluorine-containing polymers.

Experimental data show that the resulting PVDF samples are quite thermally stable. In a vacuum, thermal decomposition begins at 330°C. Moreover, during 6 hours of heating, the weight loss is only 3-5%.

It has been shown that polyvinylidene fluoride with the highest yield (81.0% at 40°C and 91.6% at 50°C) is obtained when using a fluorine-containing surfactant. A high molecular weight polymer is obtained in the case of PVP. The most powdery, finely dispersed polymer is formed when a mixture of stabilizers is used [1,2].

Thus, it was established that the synthesized PVDF samples melt at 165-175°C, the temperature of the onset of decomposition is 320-330°C. At 380°C, the most thermally stable are PVDF samples obtained in the presence of PVP, which is due to the different nature of the stabilizers used [3].

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