

P-14: The Use of Ultrasound in Matrix Polymerization of Vinyl Monomers

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Polyvinylpyrrolidone (PVP) and its copolymers containing the vinyl monomers are effectively used in various fields, particularly in medicine and pharmacy. However, if in case of polymerization, conducted in the block, solution and suspension and initiated by the peroxides, azoinitiators and the oxidation reduction systems, polymerization is properly studied, the data describing the polymerization under the effect of ultrasound of the abovementioned compositions are unknown.

The polymerization in the presence of PVP under the effect of ultrasound as an active factor influencing the inter-phase and surface renewal factor was accomplished with the use of a number of hydrophobic (meth)acrylic monomers and styrene. The investigations were accomplished at the intensity of radiation $1 \dots 5 \cdot 10^5 \text{ W/m}^2$ within the conditions of the room temperature in the presence of Oxygen and the initiators of polymerization were not additionally used. The outcomes of the investigations resulted in the basic regularities concerning the researched monomers: all of them polymerize in the presence of PVP under the effect of ultrasound wherein the induction period is excluded. Polymerization rate increases in the following sequence: butylacrylate – methylacrylate – styrene.

The research of the effect of PVP on the kinetics of styrene polymerization demonstrated that PVP impacts the initialization and fastens the formation of polymers and the dependence of polymerization velocity on PVP content in water phase has extreme nature with its maximum at the PVP mass concentration at about 1%. With the increase of the PVP molecular weight, the process velocity decreases as a result of the viscosity increase of the PVP water solutions. Simultaneously, the nature of polymer matrix has a considerable influence on the kinetics of polymerization. Although the molecular weight of polyethylene glycol (PEG, $M_w = 7 \cdot 10^3$) and PVP ($M_w = 12 \cdot 10^3$) are close, they considerably differ while influencing the kinetics of polymerization. If PVP significantly fastens the process, then PEG influence on the kinetics of polymerization is insignificant.

To explain the mechanism of influence of the polymer matrix on polymerization, the activity of matrix in ultrasound field was studied. The PVP with high molecular weight ($360 \cdot 10^3$) is most prone to ultrasound destruction resulting in the formation of macro-radicals. PVP with molecular weight ($12 \cdot 10^3$) is hardly ever destroyed, whereas the compositions containing PVP are featured by the highest reaction capacity. This enables to state that the influence of macro-radicals formed during the PVP decay is not decisive over the initiation of the polymerization. Apparently, the overwhelming part of macro-radicals participates in the reactions of chain break and chain transfer.

The emulsions synthesized under the effect of ultrasound are featured by high sediment resistance and sound film-forming properties. On this basis the experimental membranes were obtained using the method of pouring with further evaporation of the solvent. The dissolubility, thermal–physical and physical–mechanical properties of the obtained copolymers membranes were defined. The researched copolymers are soluble in chloroform, benzene, toluene, and partially in cyclohexanol which evidences the absence of the structured fraction. The following conclusions were obtained on the basis of the abovementioned research findings:

1. Unstructured block copolymers and adjusted copolymers are created during the polymerization of hydrophobic monomers in water solutions of PVP under the effect of ultrasound.

2. In such macromolecules the share of the polystyrene or methacrylic chains overwhelms the share of non-dissolved PVP in benzene or toluene.

PVP increases hydrophilic and elastic properties of copolymers, while the firmness is high. These outcomes enable to recommend such polymers for the formation of vast variety of covers that exclude bio-compatibility or bio-inertness, such as: to capsule microelements and seeds for agricultural purposes.