POLYMER COMPOSITE MATERIALS AS DISPERSED SYSTEMS

N.A. Bulychev[1], E.B. Malyukova[2], V.N. Fomin[3]

1 - Kurnakov Institute of General and Inorganic Chemistry, Russian Academy of Sciences, Moscow, Russia
2 - Kosygin State Textile University, Moscow, Russia
3 - Scientific Center of Nonlinear Wave Mechanics and Technology, Russian Academy of Sciences, Moscow, Russia

nbulychev@mail.ru

Phenomenological similarities of polymer composite materials and dispersed systems allow to develop a new approach for investigation of structure and properties of polymer composite materials. In the framework of this approach, examination of colloid aspects of dispersions stability, surface phenomena, adsorption at interphases and mechanical treatment can provide valuable information. For stabilization of non-equilibric phase structures, application of both surfactants (physical and chemical approach) and intensification of heat and mass transfer by mixing and disintegration of components can be used. One of such intensification techniques is wave treatment, allowing to initiate non-linear resonance vibrations in multiphase media [1].
In this work, the wave vibrations in sound and ultrasound frequency ranges were applied for treatment of multiphase systems such as emulsions and suspensions based on industrial oil and water, butadiene-styrene and acrylic latexes, water-soluble polymers (gelatin, starch, polyacrylic acid, polyacrylamide) with activated coal, silica, zeolite, composition of inorganic pigments (titanium dioxide and ferrous oxide) with polymer stabilizers based on cellulose ethers [2].
The wave treatment was demonstrated to affect rheological and colloid properties of these dispersed systems. The decrease of cinematic and dynamic viscosity of polyacrylic acid, polyacrylamide and filled compositions, increase of fillers dispersity. The increase of adsorption saturation of surface of dispersed particles as a result of ultrasonic treatment was exemplarily investigated on titanium dioxide and ferrous oxide solid particles. This proves that intensive wave treatment provides the intensification of mass transfer processes, affecting the behaviour of polymer surfactants at interphase surface.
Investigation of dispersity of latex compositions have shown the decrease of latex particle diameter after wave treatment. Particles size distribution curves demonstrate narrowing the polydispersity, that proves the efficiency of wave treatment for disintegration of particle associates and increase the overall system stability. Ability to obtain more homogenic compositions allow to apply them as a base of paint materials and impregnated textile nonwoven materials with enhanced mechanical and functional properties.
As a result of this research, a technology for creation of new filtered nonwoven materials with high sorption ability for cleaning of liquids from ions of heavy metals, surfactants, oil products, microorganisms was developed. It is important to note that a range of practical valuable results, for example, development of medical bandages based on nonwoven materials and intensification of technology of paint materials is based on investigation of structure and dynamic behaviour of polymer compositions and their model systems and also on nanostructure aspects of interaction of macromolecules with interphase surface [3-4].

1. R.F. Ganiev, L.E. Ukrainsky. Non-linear wave mechanics and technology, Moscow, Scientific-publishing center “Regular and chaotic dynamics”, 2008, 712 p.
2. R.F. Ganiev. Wave machines and technologies (Introduction to the wave technology), Moscow, Scientific-publishing center “Regular and chaotic dynamics”, 2008, 192 p.

3. N. A. Bulychev, V. N. Fomin, E. B. Malyukova, N. B. Uriev, “Electrokinetic Sonic Amplitude Method as Applied to Studying Adsorption of High_Molecular Compounds at Interfaces”, Colloid Journal, 2010, Vol. 72, No. 4, pp. 456–463.
4. N. A. Bulychev, V. N. Fomin, E. B. Malyukova, N. B. Uriev, “Nanostructural Behavior Aspects of Macromolecules with Different Molecular Architecture on Interfaces”, Protection of Metals and Physical Chemistry of Surfaces, 2010, Vol. 46, No. 4, pp. 420–426.