Nanocomposites and nanomaterials

Biodegradable films based on waterborne polyurethane/starch nanoscale dispersions

T.V. Travinskaya, Yu.V. Savelyev

Institute of Macromolecular Chemistry NAS of Ukraine, Kharkovskoe shosse, 48, 02160, Kiev, Ukraine.
E-mail: travinskaya-tamara@rambler.ru

Ecological problems of polymer wastes' utilization initiated a creation of pollution-free biologically degradable polymers (BDP). The matter concerns polymers and based materials, which degrade on "green" components after complete the exploitation term. One of the commonly used ways is giving of biodegradability to existent synthetic polymers (SP) by their compounding with biodegradable components. However, in such compositions during composting a fast degradation of natural component is observed, while the SP in the most cases is not subjected to degradation as a result of lack of interaction between components. We propose the new method of obtaining the polysaccharide-containing water based polyurethane nanoscale dispersions by combination the chain elongation and dispersing stages. We used the starch (St) as natural part and ionic polyurethane prepolymer (IPU) as SP. The essential differences between newly obtained IPU/St dispersion and mechanical IPU+St blends have been shown. The stability of IPU/St dispersions amounts to 10-36 months, while IPU+St possess the stability less than 24 hours. Particle size of these new nanodispersions is in the range 100 -150 nm, in contrast to mechanical blends (greater than 800 nm). IPU/St dispersions form strong films unlike IPU+St blends, which are lack of film forming ability. The existence of covalent- along with hydrogen bonds in IPU/St system has been proved by IR, ion-exclusion chromatography, pyrolysis mass spectroscopy methods. According to X-ray data IPU/St are microheterogeneous systems with new structure elements formation. This provides the complete degradation of the overall system, unlike the mechanical blends. After keeping IPU/St samples in the ground for 6 months, their mass loses exceed the actual content of natural component in several times. Study of adhesion of *Bacillus subtilis(BS)* to the film surfaces showed the increased susceptibility of synthesized IPU/St materials to microorganisms attack in comparison with initial IPU and IPU+St: the adhesion of *BS* to IPU/St surface is in 4 - 5 times higher. It may serve as prerequisites for their biodegradation under environmental conditions. Thus, the pollution-free biologically degradable nanomaterials with controlled properties on the basis of renewable natural and synthetic polymers have been obtained.