Chodak Ivan

Polymer Institute of the Slovak Academy of Sciences, Slovakia

Effect of Biodegradation on physical properties of PLA- based blends

Biodegradable plastics are the subject of substantial changes of properties due to degradation initiated by enzymes produced by various bacteria. Before obvious changes are observed visually, modification of physical properties is important, occurring in the stage when the material is apparently unchanged. We investigated degradation in compost of virgin polylactic acid (PLA), PLA with a plasticizer triacetin (TAC), and a mixture of PLA / polyhydroxy butyrate (PHB) with TAC. Degradation proceeded at 58°C up to 16 days and physical properties were measured. The degradation rate varied a little for the three samples. For virgin PLA the degradation test was performed also at 25 and 37°C. Biodegradation was substantially slower compared to 58°C, but hardly any difference was observed between 25 and 37°C. Obviously, the key factor for the degradation rate is glass transition temperature of PLA, being around 55°C. Physical properties were measured for 8 days (testing specimens keeping their shape intact) or in some cases up to 16 days. At longer periods the materials have been disintegrated to too small fragments to perform any analysis. Complex design of testing methods involved molecular weight and molecular weight distribution made by GPC, supported by measuring measurement of viscosity by rheology. Changes in structure of the materials were determined from changes in Tg and crystallinity determined by DSC. Mechanical properties of samples after certain time of composting were measured and the data were compared with information obtained from dynamic mechanical analysis (DMTA), which provided also exact data on changes in glass transition temperature. From the courses of alterations of various parameters the conclusions have been made regarding the effect of TAC and PHB presence on the biodegradation of PLA, and related changes concerning the structure / mechanical relations. Acknowledgement: VEGA 2/0019/18, VEGA 1/0570/17, APVV 15-0741

Speaker Biography

Chodak Ivan is a senior scientist at Polymer Institute SAS in Bratislava, Slovakia. His scientific interests cover crosslinking of polyolefins (patented extremely efficient system for polypropylene crosslinking), multiphase systems, i.e. polymer blends and composites with polymeric matrices including nanocomposites and electroconductive composites. Investigation of biodegradable polymers belongs to his most successful topics (patented material based on PHB and PLA with very high toughness, the commercial production is under preparation). He is the author of over 150 scientific publications, 15 patents (4 of them applied in industry). Frequent and long-term cooperation with industry (DSM, BASF, Biomer, National Power, GE Plastics etc.).

e: upolchiv@savba.sk

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