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Hydrothermal degradation of biobased poly(butylene succinate)/nanofibrillated cellulose composites

Olesja Starkova [1,*], Oskars Platnieks [2], Alisa Sabalina [1], and Sergejs Gaidukovs [2,*]

[1] Institute for Mechanics of Materials, University of Latvia, Jelgavas 3, LV-1004 Riga, Latvia
[2] Institute of Polymer Materials, Faculty of Materials Science and Applied Chemistry, Riga Technical University, P. Valdena 3/7, LV-1048 Riga, Latvia
* Correspondence: olesja.starkova@lu.lv; Tel.: +371-29884248

Abstract: Biobased polymers and composites have gained increased global attention owing to their abundance, renewability, and biodegradability. Natural fillers, e.g. cellulose-based fillers, improve mechanical properties of biopolymers extending their application range, while keeping the eco-friendliness of the materials. Mowing towards engineering applications, requirements imposed to materials' durability under environmental impact and high performance is necessity. Variations of ambient humidity and temperature could essentially reduce service lifetime of biobased polymer composites. This study is focused on hydrothermal degradation of poly(butylene succinate) (PBS) filled with nanofibrillated cellulose (NFC) up to 50 wt.% aimed to identify the most efficient PBS/NFC composition, while keeping a reasonable balance between the reinforcement effect and accelerated degradation inherent for most natural fillers. Water absorption and its effect on the structure, thermal, mechanical, and thermomechanical properties were studied. High reinforcement and adhesion efficiency is obtained for PBS/NFC composites and properties are reasonably retained after their hydrothermal ageing. Water absorption capacity and diffusivity increased significantly with NFC content in PBS. Degradation of the mechanical properties is higher with increased NFC content in the polymer matrix. PBS filled with 20 wt.% of NFC is identified as the most efficient composition, for which negative environmental degradation effects are counterbalanced with the positive reinforcement effect.

Keywords: biopolymer; cellulose nanofibrils; durability; water absorption; mechanical properties; ageing; adhesion efficiency; biodegradation; modelling