

Mechanical stability of wood flour / polyhydroxyalkanoate (PHA) composites modified by boron nitride and talcClement Chan¹, Luigi-Jules Vandi¹, Steven Pratt¹, Peter Halley¹, Desmond Richardson², Alan Werker^{1,3} and Bronwyn Laycock¹¹The University of Queensland, Australia²Norske Skog Paper Mills (Aust) Ltd, Australia³Promiko AB, Sweden

The wood plastic composites (WPCs) market has been rapidly expanding over the past few decades. Recently, the use of polyhydroxyalkanoates (PHAs) as the polymer matrix in WPCs has been of increasing interest, as these polymers are renewable, biodegradable and have a low melt viscosity. However, there have been concerns over the slow crystallisation rate and in-service stability of such bioderived and biodegradable materials. The aim of this study is to investigate the individual and combined effect of boron nitride (BN), a nucleating agent, and talc, a micron-sized inorganic filler, on the properties of a composite made from radiata pine wood flour and poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (PHBV) polymer (50/50 by weight) and their in-service mechanical stability. In this study, wood composites were manufactured using twin screw extrusion and their mechanical and thermal properties were experimentally determined initially and after 1 year of conditioning under a controlled temperature of 25°C and humidity of 50%. The nucleating effects of both BN and talc were demonstrated through isothermal crystallisation kinetic analysis, with BN being more effective. No further observable improvements were noted when these additives were combined compared to the use of BN alone. However, the addition of 1 wt% of BN was not found to affect the tensile properties initially nor after 1 year of controlled aging. After conditioning, the mechanical properties of the composite without additives were retained. Inherent in-service mechanical stability for such biocomposites is therefore possible. The addition of talc improved the initial tensile strength and tensile modulus of the composite. However, such initial improvement in mechanical performance was reduced after 1 year of conditioning. It is proposed that the combination effects of multiple factors such as the swelling of wood through moisture uptake, the shrinkage of PHBV through secondary crystallisation and the localised stress around talc particles could lead to a weakened talc-PHBV interface.

Biography

Clement is currently a PhD student at the School of Chemical Engineering, the University of Queensland, Australia. His major experiences are in functional materials and composites. He graduated with a Bachelor's of Chemical Engineering from the University of Minnesota - Twin Cities, U.S.A. During his studies, he also involved in a project focused on the toughening of graphene-epoxy nanocomposites through the functionalisation of graphene. After working as a production engineering in a pharmaceutical company in Hong Kong, he started his PhD at UQ in early-2015 focusing on the processing and characterisation of high performance bioderived and biodegradable polyhydroxyalkanoates (PHAs)-based wood plastic composites. His primary research interests are in the area of biodegradable polymers, composite materials and sustainable engineering.

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