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Influence of different treatments of aspen wood particles on their compatibility with polymer matrix in wood-polymer composites.

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Abstract

Statement of the Problem: The biocomposites such as wood-polymer composite (WPC) have gained more attention in past years due to their sustainable, environment friendly nature. However, there are still many issues obtaining WPCs, mainly because of the poor compatibility between a hydrophobic polymer matrix and hydrophilic wood filler. The mechanical and wetting properties of WPCs depend on the polymer/filler interfacial adhesion, which represents one of the main problems since wood has a strongly polar structure, but the most polymer matrices are non-polar. The purpose of this study is to compare the treatment of aspen wood filler by acid hydrolysis at different temperatures and ammoxidation with the introduction of different amide groups in the filler for improving its compatibility with recycled polypropylene in WPC. Methodology & Theoretical Orientation: aspen wood (Populus tremula) sawdust with a fraction less than 100 µm from Latvian wood mechanical processing company was used. The wetting behaviour and surface free energy of the treated wood particles were analysed using tensiometer Kruss 100M. The composite samples were extruded on a twin-screw extruder at 175oC and then injection moulded at 450 bars. Mechanical tests were carried out according to ASTM D638 and EN ISO 178. Findings: the effectiveness of the acid hydrolysis and ammoxidation of the wood filler for increasing the compatibility with the polymer matrix depend on the hydrolysis temperature and the content of the introduced amide bonds. Conclusion & Significance: Both treatments of aspen wood particles led to increased hydrophobicity of wood particle surface that positively impacted the mechanical properties of the obtained composite samples. With increasing the temperature of the mild hydrolysis from 60 oC to 90 oC, and the content of nitrogen form 1,05% to 2,1%, the mechanical properties of the composite samples have increased, but their wetting with water has decreased. The ammoxidation is a more effective method for modification of the wood filler for enhancing its compatibility with recycled polymer.

Biography:

Jevgenijs Jaunslavietis currently is a PhD student in Riga Technical University (Latvia) Chemical Engineering studies and a Researcher in Latvia State Institute of Wood Chemistry. Has an expertise in characterization of the surface properties and wetting behaviour of wood fibers, chemical modification of wood particles, studies of WPC interfacial matrix-filler interactions, characterization of WPC with improved functional properties. Participant in National Research Program and European Regional Development Fund projects. Currently, a first author of 4 SCOPUS and/or WoS cited publications in WPC research area.

Speaker Publications:

1. Jaunslavietis J, Shulga G,Ozolins J,Neiberte B, VerovkinsA, Vitolina S, Betkers T (2018) Hydrophilic-Hydrophobic Characteristics of Wood-Polymer Composites Filled with Modified Wood Particles. Key Engineering Materials762:176-181
2. Jaunslavietis J, Shulga G,Ozolins J,Neiberte B, VerovkinsA, Vitolina S,Shakels V (2017) Surface energetic characteristics of wood-polymer composites, containing a valorised hardwood by-product. Solid State Phenomena 267: 68-75
3. Jaunslavietis J, Shulga G, Ozolins J, Neiberte B, Verovkins A, Vitolina S, Livca S (2017) Effect of the Acidic Treatment of Domestic Wood Residue on Biocomposite Wettability and Moisture Sorption Properties. Environment. Technology. Resources: Proceedings of the 11th International Scientific and Practical Conference. 1:129-133
4. Shulga G, Neiberte B, Verovkins A, Vitolina S, Jaunslavietis J, Ozolins J (2016) Short Fibre Filler from Wood Residue for Polymeric Composite Materials. Materials Science (Medžiagotyra) 22(3):370-375
5. Shulga G, Neiberte B, Verovkins A, Jaunslavietis J, Shakels V, Vitolina S, Sedliačik J (2016) Eco-friendly constituents for making wood-polymer composites. Key Engineering Materials "Selected Processes at the Wood Processing" 688:122-130.

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