World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:18, No:07, 2024

Characteristics of Wood Plastics Nano-Composites Made of Agricultural Residues and Urban Recycled Polymer Materials

Authors : Amir Nourbakhsh Habibabadi, Alireza Ashori

Abstract : Context: The growing concern over the management of plastic waste and the high demand for wood-based products have led to the development of wood-plastic composites. Agricultural residues, which are abundantly available, can be used as a source of lignocellulosic fibers in the production of these composites. The use of recycled polymers and nanomaterials is also a promising approach to enhance the mechanical and physical properties of the composites. Research Aim: The aim of this study was to investigate the feasibility of using recycled high-density polyethylene (rHDPE), polypropylene (rPP), and agricultural residues fibers for manufacturing wood-plastic nano-composites. The effects of these materials on the mechanical properties of the composites, specifically tensile and flexural strength, were studied. Methodology: The study utilized an experimental approach where extruders and hot presses were used to fabricate the composites. Five types of cellulosic residues fibers (bagasse, corn stalk, rice straw, sunflower, and canola stem), three levels of nanomaterials (carbon nanotubes, nano silica, and nanoclay), and coupling agent were used to chemically bind the wood/polymer fibers, chemicals, and reinforcement. The mechanical properties of the composites were then analyzed. Findings: The study found that composites made with rHDPE provided moderately superior tensile and flexural properties compared to rPP samples. The addition of agricultural residues in several types of wood-plastic nano-composites significantly improved their bending and tensile properties, with bagasse having the most significant advantage over other lignocellulosic materials. The use of recycled polymers, agricultural residues, and nano-silica resulted in composites with the best strength properties. Theoretical Importance: The study's findings suggest that using agricultural fiber residues as reinforcement in wood/plastic nanocomposites is a viable approach to improve the mechanical properties of the composites. Additionally, the study highlights the potential of using recycled polymers in the development of value-added products without compromising the product's properties. Data Collection and Analysis Procedures: The study collected data on the mechanical properties of the composites using tensile and flexural tests. Statistical analyses were performed to determine the significant effects of the various materials used. Question addressed: Can agricultural residues and recycled polymers be used to manufacture wood-plastic nano-composites with enhanced mechanical properties? Conclusion: The study demonstrates the feasibility of using agricultural residues and recycled polymers in the production of wood-plastic nano-composites. The addition of these materials significantly improved the mechanical properties of the composites, with bagasse being the most effective agricultural residue. The study's findings suggest that composites made from recycled materials can offer value-added products without sacrificing performance.

Keywords : polymer, composites, wood, nano
Conference Title : ICPC 2024 : International Conference on Polymers and Composites
Conference Location : Toronto, Canada
Conference Dates : July 18-19, 2024