Modelling the Mechanical Behavior of Microcrystalline Cellulose-Based Polymer Composites

J. Amutheesan; S. Sukirtha; A.M.P.B Samarasekara*

Department of Material Science and Engineering, University of Moratuwa, Sri Lanka

**Email: bandu@uom.lk*

There is an increasing demand of environment friendly natural polymer reinforced polymer composites in the industrial sector today. The Sri Lankan agricultural industry is one of the areas which generate great amounts of plant-based waste. From these unnecessary agricultural wastes, microcrystalline cellulose can be extracted easily as a value-added product with variety of advantages. Microcrystalline cellulose has been used in wide variety of applications as a reinforcing filler material in the polymer composite. Polypropylene is a widely used useful polymer for polymer composite manufacturing due to its low production cost, recyclability, transparency, ability to mix easily and low density. This research mainly focused on the development of a model to predict the mechanical behavior of polypropylene - microcrystalline cellulose-based composites.

Main disadvantage of polymer composite fabrication is extreme hydrophilicity of microcrystalline cellulose and hydrophobicity of Polypropylene. That results weak compatibility and poor performance in the composite. Therefore, surface modification is vital to decrease the hydrophilicity of microcrystalline cellulose and thereby to improve the compatibility and overall performance of the polypropylene-based composite. Sunflower oil ethyl esters were used to modify the microcrystalline cellulose surface in order to improve cellulose surface hydrophobicity. Surface modified microcrystalline cellulose was characterized by using FTIR analysis, SEM analysis, and Wettability test. Polypropylene was blended with different loadings (0, 1, 2, 3, 4 and 5%) of microcrystalline cellulose to study the property variation with microcrystalline cellulose loading. Tensile, hardness, and impact properties were measured experimentally for the fabricated composite. Meanwhile, mathematical models were developed by using theoretical approach to evaluate the mechanical properties. Developed mathematical models indicated the corelated mechanical properties with experimental values.

Keywords: Microcrystalline cellulose, Composite, Polypropylene, Mathematical model