Effect of rice and coffee husk bio-char fillers on the properties of polypropylene based bio-composites

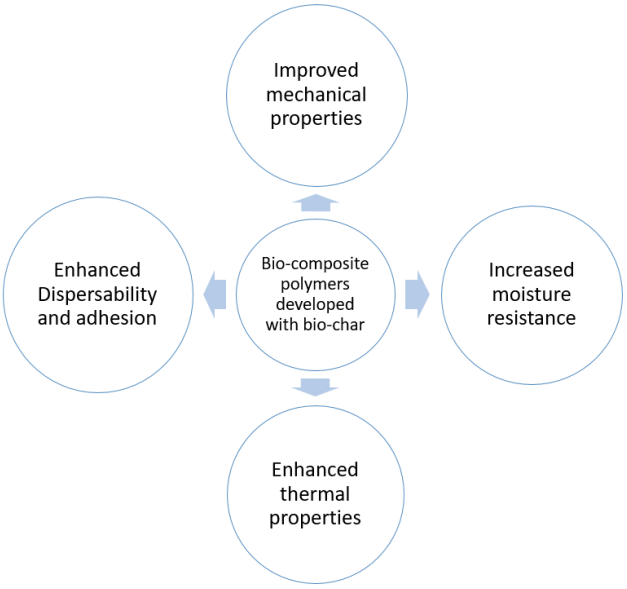
Vianney Andrew Yiga, Makerere University Kampala.
Sinja Pagel, MSc, Institut fur Kunststoffechnik der Universitat Stuttgart
Stefan Epple,PhD, Institut fur Kunststoffechnik der Universitat Stuttgart
Peter Olupot, PhD, Makerere University Kampala
*Michael Lubwama, PhD, Makerere University Kampala
Christian Bonten, Prof, Institut fur Kunststoffechnik der Universitat Stuttgart

Abstract

In recent years, the use of various natural reinforcing fibers such as hemp, jute, flax, sisal, and kapok in thermoplastics has gained acceptance in commodity plastics. However, still various fibers and particulate fillers need to be explored. Amongst the thermoplastic materials used, polypropylene is an outstanding commercially available thermoplastic material with wide range of applications. Not much work has been done on bio-composite polymers involving bio-char as a filler material. In this work, rice and coffee husks as well as their bio-chars were used as reinforcement to produce bio-composite polymers using compression molding. Filler material loading varied between 0-20% in 5% intervals. Dispersability tests were carried out. Thermal properties were determined using thermo-gravimetric analysis and burning tests, chemical properties were determined using a burning test and mechanical properties were determined using a universal testing machine.

Results showed that bio-chars, owing to their morphological structure, were found to have dispersed more uniformly in the resin than raw material husks. The colour patterns of the developed bio-composite polymers were similar to the patterns exhibited by the respective fillers used. Compared to those made with raw material husks, bio-composite polymers made with bio-char had improved moisture resistance properties, owing to the destruction of hydrophilic groups during the carbonization process and increased lignin compositions. The developed bio-composite polymers had favourable young's moduli, tensile strengths, elongations at break and notched impact strengths. Filler content had no effect on the transition temperatures. Increasing filler contents led to a decrease in crystallization and melting enthalpies and thus a decrease in the melt-able matrix. Generally, higher filler content led to higher young's modulus, lower tensile strength and elongation at break, lower crystallization and melting enthalpies. There wasn't a significant correlation between the filler content and the impact strength.

Effect of bio-char inclusion in bio-composite polymers



Recent Publications

1. Lubwama M, Yiga VA. Renewable Energy. 2018; 118: 43-55
2. Lubwama M, Yiga VA. Renewable Energy 111 (2017) 532-542.
3. Menya, E., Olupot, P. W., Storz, H., Lubwama, M., & Kiros, Y. Chemical Engineering Research and Design 129 (2017) 271-289
4. Lubwama, M., Corcoran, B., & Sayers, K. Surface Engineering 31 (2015) 1-10.
5. M. Lubwama, B. Corcoran, J.B. Kirabira, A. Sebbit, K.A. McDonnell, D. Dowling, K. Sayers. Surf. Coat. Technol. 239 (2014) 84-94



Biography

*Dr. Michael Lubwama completed his PhD in Mechanical Engineering in 2013 from Dublin City University, Ireland. He is the Deputy Center Leader of the Africa Center of Excellence in Materials, Product Development and Nanotechnology. Dr. Lubwama is a lecturer in the Department of Mechanical Engineering at Makerere University.

Email: michaellulubwama@gmail.com