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7. Title

Thermoplastics Composites Reinforced with Natural Fibers and Inorganic Nano-Particles

sent via BITNET/INTERNET electronic mail systems

12. Investigator Name(s) (Last Name and Initials)

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20. Termination Date 03/29/2012

40. Period Covered (mo/da/year): 03/29/2007 TO 03/29/2012

Outputs:

The information generated by this project resulted in twenty two refereed research publications, three Ph.D. dissertations, four US patent applications, and ten presentations at national and international conferences. A plastic and natural fiber composite formulation, trade-named as TigerBullets, was successfully commercialized to the oil industry as lost circulation control material. The significance and impact of the research was discussed with peer researchers and members of the wood plastic composite industry.

Outcomes/Impacts:

The project was aimed at finding technologically feasible and economically acceptable solutions of using natural fibers and commingled waste plastics for valued-added composite applications. The decomposition processes for ten types of natural fibers common used in the polymer composite industry were studied based on dynamic thermogravimetric analysis. The data were used to develop various degradation models to determine the apparent activation energy and degradation process of the fibers. By simultaneously incorporating both PE-g-MA and EPR-g-MA, the strength-toughness balance of natural fiber-reinforced composites was optimized. The optimal balance of composite properties was achieved at lower percentage of sEPR-g-MA and medium fiber loading level. Composites containing reinforcing microfibers from recycled HDPE/PET and recycled HDPE/Nylon were developed through reactive extrusion and stretching. The resultant MFCs were easily processed at the normal temperature used for processing HDPE. The dispersed R-PET phase was stretched into in-situ microfibers through the pelletizing during extrusion. The micro-fibril composites (MFCs) provide potential matrix materials for natural fiber polymer composites, and the technique provides a technology to process co-mingled plastic mixtures from recycling streams. Accelerated creep tests were conducted at higher temperatures, and smooth curves were obtained based on the time-temperature superposition (TTS) principle. Several factors affected the creep resistance of NFPCs, including polymer matrix type, natural fiber loading, additives, temperature, and weathering treatment. Introducing engineering plastics to form microfibrils in a HDPE matrix improved creep performance. Adding natural fibers into a polymer matrix greatly enhanced its creep resistance. An ultrafine titanium dioxide (UVA), slightly reduced the creep deformation of HDPE composites at a low loading level. A plastic (e.g., PET) and natural fiber composite formulation, trade-named as TigerBullets, was patented and commercialized to oil industry. Over 3,000,000 pounds of the TigerBullets have been manufactured and sold to some major oil companies. One technique of manufacturing transparent plastic reinforced with cellulose nano crystals also has been developed. Nano-sized cellulose crystals were fabricated from microcrystalline cellulose (MCC) using combined sulfuric acid hydrolysis and high-pressure homogenization. The crystals were utilized to prepare polymethylmethacrylate (PMMA) nanocomposites by the solution casting method.

Publications:

Wu. Q., 2012. Tigerbullets: A newly created wood-plastic product to control lost circulation in oil drilling. Louisiana Agriculture. Winter 55(1):9-10.

Kim, B.J., F. Yao, G. Han, and Q. Wu. 2012. Performance of bamboo plastic composite with hybrid bamboo and precipitaed calcium carbonate fillers. Polymer Composites (33):68-78.

Kim, B.J. (2012) The effect of inorganic fillers on the properties of wood plastic composites. PhD Dissertation. School of Renewable Natural Resources, Louisiana State University, Baton Rouge, LA.138 pp.

Lei, Y., and Q. Wu. 2011. High density polyethylene and poly(ethylene terephthalate) in situ sub-micro-fibril blends as matrix

for wood plastic composites. Composite Part A. 43:73-78.

Lei, Y., and Q. Wu. 2011. Recycling engine oil containers to prepare wood plastic composites. J. Applied Poly. Sci. 122, 964-972.

Xu, Y., S.Y. Lee, and Q. Wu. 2011. Creep analysis of bamboo-high density polyethylene composites: effect of interfacial treatment and fiber loading level. Polymer Composites 32(5):692-699.

Yao, F., Q. Wu, H., Liu, Y. Lei, and D. Zhou. 2011. Rice straw fiber reinforced high density polyethylene composite: Effect of coupled compatibilizating and toughening treatment. J. Applied Poly. Sci. 119:2214-2222.

Participants:

Qinglin Wu (PI), Yong Lei, and Fei Yao, LSU AgCenter; Creg Clemons, USDA FPL.

Target Audiences:

Wood/plastics composite industry, recycled plastics industry.

Project Modifications:

none

Approved (Signature)	Title	Date
[signature]		7/23/12