

Project Title: Development of ‘E-glass/Bio-based Polyurethane’ ‘Multifunctional Reinforced Nanocomposites’ using ‘low-cost VARTM process’

Investigator: Jitendra Tate

Department: School of Engineering

Project Summary:

Low viscosity soy-based polyol was modified using nano-silica and Halloysite nanotubes (HNT) at different loadings. Nano-silica that was dispersed in high concentration in petroleum based polyol. HNT was dispersed using planetary centrifugal mixer. Aliphatic polyisocyanate was used for HNT composites and aromatic isocyanate was used with nano-silica composites as a curing agent to formulate non-foam and full density thermoset polyurethane resin. Further this polyurethane resin was used in conjunction with low cost vacuum assisted resin transfer molding (VARTM) process to manufacture E-glass reinforced composites. Aliphatic polyisocyanate was not compatible with petroleum-based-polyol in which nano-silica was dispersed therefore, aromatic isocyanate was used. This non-compatibility resulted in delaminations of plies in composites after curing. Polyisocyanate products are very sensitive to the moisture in the air therefore; special care was taken in their handling and storing. Mechanical tests were performed on these composites including compression, flexure, and interlaminar shear strength (ILSS). For 0.8 wt% loaded HNT modified composites, flexural strength, flexural modulus, and ILSS were increased by 6%, 28% and 82%, respectively. For 7.5 wt% loaded Nanosilica modified composites, compressive strength, flexural strength, flexural modulus, and ILSS increased by 135%, 64%, 34%, and 120%, respectively.

Publications:

The following 2 conference papers were published based on the research.

1. Jitendra S. Tate, Adenkunle T. Akinola and Srujan Konga, “Nano-modified Soy-based Polyurethane/E-Glass Composites – Mechanical and Thermal Properties”, SAMPE 09, Baltimore, MD, USA, May 18-21, 2009, B106.

2. Jitendra S. Tate, John Massingill, Pulin Patel, and Srujan Konga, “Enhancement in mechanical properties by improving fiber/matrix adhesion in bio-based polyurethane/E-glass composites”, SAMPE 08, Long Beach, CA, USA, May 18-22, 2008.

Presentations:

Graduate students presented above mentioned conference papers at professional conferences, SAMPE 08 and SAMPE 09.

SAMPE (Society for Advancement of Materials and Process Engineering)

External Grants Applied:

The following proposal was submitted based on lessons learned while handling dry nano-particles in this research. Though it is NOT directly related to this proposal it is very much relevant.

Program: NSF08-544 Project Category: Nanotechnology Undergraduate Education (NUE) in Engineering, Sub-category: NUE Nanotechnology Undergraduate Curriculum Addressing

Environmental and Health Issues

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Senior Personnel: Dr. Walt Trybula

External Grants Awarded:

Review of above proposal is in progress.

Student Number: 3