Fact Sheet: South East Regional Research Initiative, Department of Homeland Security

**Research Project**: Nano particle reinforced composites for critical infrastructure protection

Research Topic: Dynamic Mechanical Analysis (DMA)

Problem

DMA is particularly useful for evaluating polymeric materials, which exhibit time, frequency, and temperature effects on mechanical properties because of their viscous nature.

Approach

Dynamic Mechanical Analysis is a powerful technique which allows for the storage and loss modulus, damping and glass transition properties of viscoelastic materials to be characterized in the frequency domain by subjecting small samples to an oscillatory load under a controlled temperature program. At the onset of glass transition, the increase in molecular motion within these materials results in a dramatic step decrease in the storage modulus with a simultaneous increase in the damping (loss factor) values. Peaks of the tan delta or loss modulus curves are found to be sensitive indicators of glass transition temperature and are associated with the impact properties of elastomeric materials. The time-temperature superposition principle is also employed for characterizing the long-term behavior of polymeric material systems. A TA Instruments Model Q800 DMA was bought and being used at at the University of Mississippi.
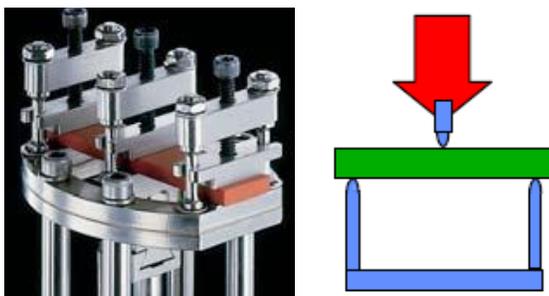

*Single/ Dual Cantilever*

Findings

This instrument is being used for characterizing the viscoelastic response along with the long term creep and stress relaxation behavior of various thermoplastic and thermoset resins reinforced with carbon nano tubes, nanoclay and graphite platelets.

This is an ongoing research. At this stage we can report that the following was accomplished:

Constant strain test with temperature ramp from -50oC to 150oC at a frequency of 1 Hz using 3 point bend clamp was done on Nylon 6,6, Vinyl ester and all reinforcements. Storage Modulus, loss modulus, glass transition temperature and loss factors were calculated for naylon 6,6 composites with different weight fractions of MWCNT reinforcements. Figure shows the modulus, tan delta, and Tg for 1.25% nanoclay/vinylester as a function of temperature obtained with a TA
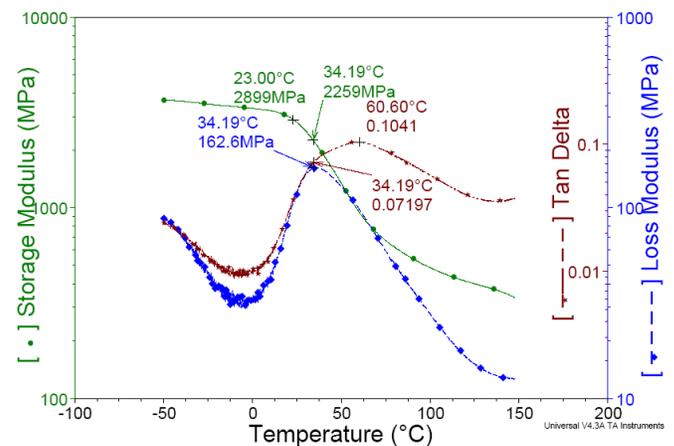
Typical output of pure Nylon 6,6
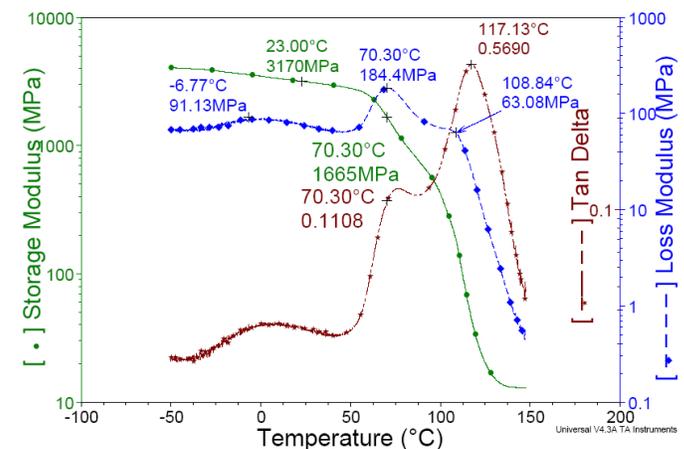
Typical output of 1.25% Nanoclay/ Vinyl ester

Impact

Experimental results using DMA will be used to obtain parameters that are needed for theoretical modeling. Final outcome will be a material data base that can be used for infrastructure protection against various loading conditions.

Researcher:

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