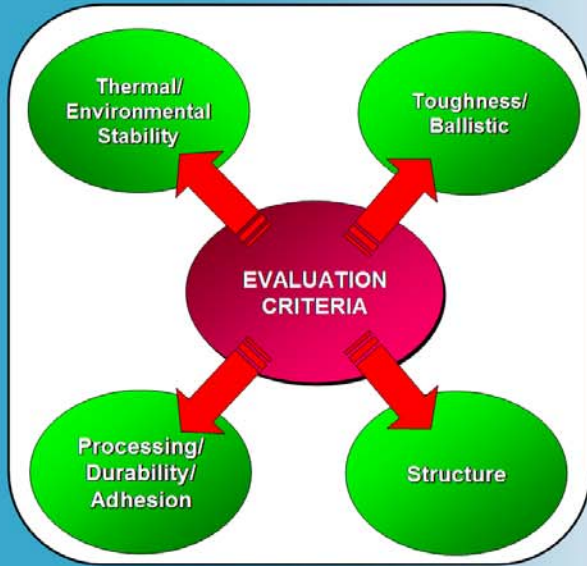


A. Chatterjee, J. Deitzel, J. Thiravong, A. Abu Obaid (PD), A. Paesano, and J. W. Gillespie, Jr.

University of Delaware . Center for Composite Materials



Materials

- SC15
- SC79
- Blends of SC15 and SC79 in various ratios

Results

Thermal/Environmental Stability

DMA- Low Temperature Cure Saturated Samples

Two DMA graphs showing Loss Modulus (GPa) vs Temperature (°C). The left graph shows peaks at 118°C, 143°C, and 197°C. The right graph shows peaks at 100°C, 104°C, 108°C, 112°C, and 116°C.

- CCMFCS Resins Qualified Wet Tg Requirements
- Long-Term Ageing for Neat Resin in on-going

Composite Performance

Toughness

Double Cantilever Beam

- > Panel Preparation: VARTM (Smart Molding)-SC79/Blends+S₂ Glass (24 Oz, Eight Layers).
- > Cure Cycle:
 - > RT 36hrs-200F-8hrs
 - > RT 36hrs-250F-4hrs

Two images: the left shows a DCB test setup, and the right shows a specimen in "Fracture Mode".

Interlaminar Fracture Toughness of Epoxy Resins

(ASTM D 5528-04a Compliance Calibration Method)

Resin	Interlaminar Fracture Toughness (G _{IC} /mm ²)
SC-15/33	1104
SC79/33	316
SC79 w/30% S2 Glass	364
SC79/SC79 (1+1)	713
SC79/SC79 (1+1)+S2	456
SC79/SC79 (1+1)+AA-799	958
SC79/SC79 (1+1)+AA-799	975
SC79/SC79 (1+1)+S2	832
SC79/SC79 (1+1)+S2	1619

- > Blends of SC15 and SC79 improved toughness over 200F cured SC79
- > SC79 has lower toughness than SC15
- > CCMFCS Resins have comparable toughness to SC15
- > Toughening agents incorporated into the fiber layers increases the toughness by ~50%

Composite Performance: Structural

- > Open Hole Tension
- > Open Hole Compression
- > Tension(TBD)
- > Compression(TBD)
- > Short Beam Shear(TBD)
- > Compression After Impact (TBD)

Open Hole Compression & Open Hole Tension of SC79+S₂ Glass

(SACMA SRM 3-88; ASTM D 5766/5766M-95)

Resin	Compression (Psi)	Tension (Psi)
SC-15	~60000	~20000
SC79	~60000	~20000
SC79 RT 36 hrs 200F 8hrs	~60000	~20000
1579(1+1)	~60000	~20000
1579(1+1)+AA-799	~60000	~20000

- > Structural properties of the SC79/SC15 blends exceed SC15 baseline (T-8%, C-55%) and are comparable to SC79

Conclusions & Future Work

- > CCMFCS resins exceed SC15 baseline structural properties
- > Toughness is comparable to SC15.
- > Rubber binder increases the toughness ~ 50%
- > Long-term environmental ageing of neat resins is ongoing
- > OHC, OHT, CAI, C and T at RT and Elevated Temperature, 180F of QIP is ongoing
- > OHC, OHT, CAI, C, T (RT and 180F) testing of QIP after Moisture Saturation (70%RH at 180F) is ongoing

Acknowledgements

This work is supported by the Tank-Automotive Research, Design, and Engineering Center through the Composite Materials Technology program.