CHARACTERIZATION OF IM7-T*U*FF 8552 COMPOSITES: INFLUENCE OF DEFECTS

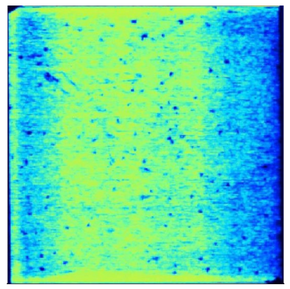
Alexander Barry[1], Dr. Sagar Doshi[2], Dr. Shridhar Yarlagadda[2], Dr. Dirk Heider[2], Prof. John W. Gillespie Jr. [2]
University of Delaware | Center for Composite Materials[2] | Cornell University[1]

Background & Objective

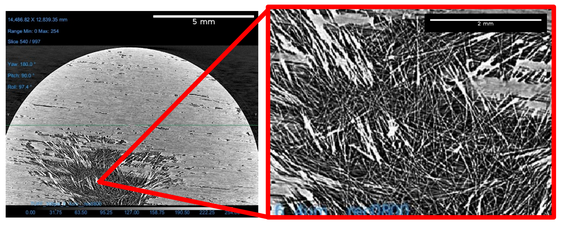
Tailored universal Feedstock for Forming (T*u*FF) enables the creation of complex geometries

Applications in NASA struts involve replacing heavy titanium joints with composites

Defects in c-scans of T*u*FF IM7 8552 panels



Composites laminates with defects were scanned with MicroCT and digitally reconstructed



The defects are observed to be clumps of stray fibers that cause resin lean areas

Objective:

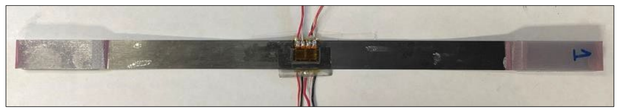
i. Quantify the effects of defects on material properties

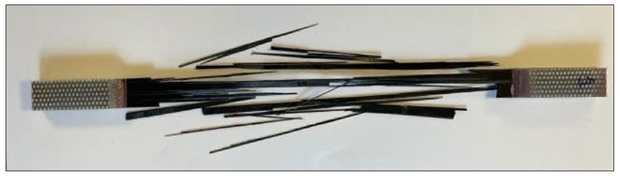
ii. Revise process to reduce resin lean areas and clumps

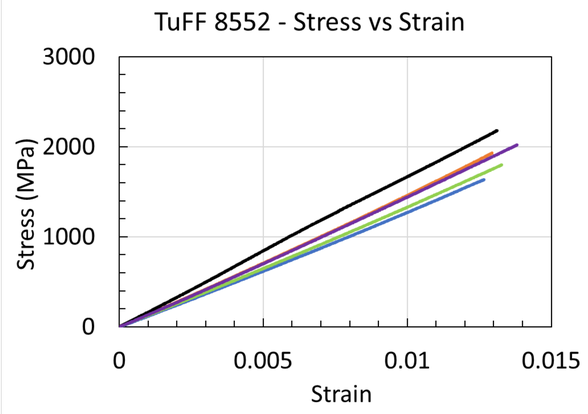
Tension Testing

4-ply unidirectional TuFF IM7 8552 panels

Tension testing on ½ inch samples with strain gauges, with explosive failure modes







	Tensile Strength (MPa)	Tensile Modulus (GPa)
TuFF IM7 8552	1887 ± 179	140.2 ± 16.7
NIAR Continuous IM7 8552	2434 ± 13	162.1 ± 0.4
% Translation	77.5%	86.5%

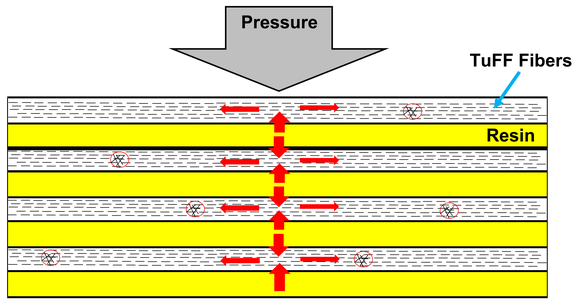
Presence of clumps significantly reduce the material properties

T*u*FF panel calculated to have 2.5 clumps per sq inch per ply using image analysis

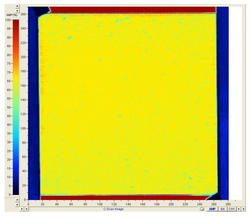
Impact of Resin Viscosity

The resin lean areas in thermosets (TS) not seen in thermoplastics (TP)

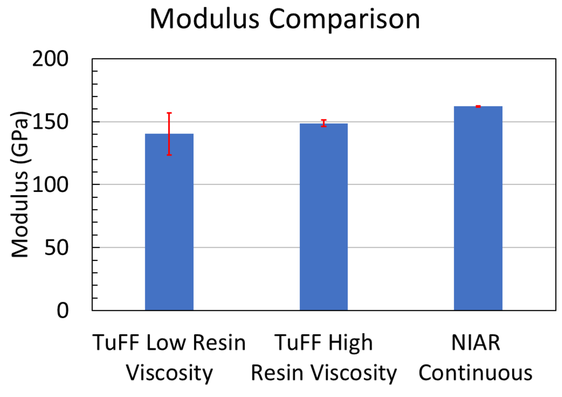
TP resins have a significantly higher viscosity than TS resins at processing temperatures, between 1000-2000 Pa*s



Higher resin viscosity allows for longer compaction time and increases the time provided for in-plane flow



TS were successfully processed with a 30 minute 47°C section and fewer resin lean areas appeared on the c-scan

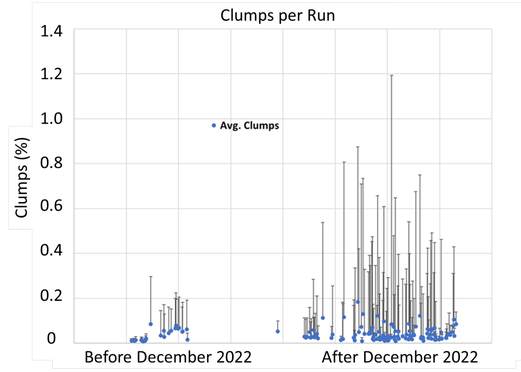


More defects were resin-filled, increasing modulus slightly and reducing variation

Presence of defects still affect material properties despite being resin-filled

Alignment Quality Control

Shifts for producing T*u*FF were increased, but not the cleaning frequency, resulting in higher clump variation



Increasing the cleaning frequency to match the increase in production resulted in a decrease in clumps

Conclusions & Future Work

- The defects negatively affect the properties of TuFF IM7 8552 panels
- Higher resin viscosities allow for more in-plane flow and reduce the number of voids due to clumps
- Reducing voids improves modulus and decreases modulus variability
- Increasing frequency of alignment line maintenance has been effective at reducing the amount of clumps
- To achieve 100% property translation from continuous fiber, there cannot be any defects present
- Additional investigation is needed to reduce the number of clumps further

Acknowledgements

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