SHEAR STRENGTH TESTS BY USING HEXPLY® M77 RESIN FILM AND VIRGIN T800 FIBERS

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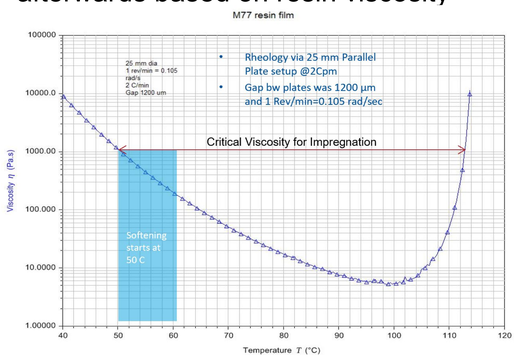
Motivation

- HexPly® M77 resin is a snap-cure resin that has potential for use especially in automotive parts production via TuFF system
- Curing times determined from DSC and cure prediction studies are:
  - <9 min at 120°C
  - <6 min at 130°C
  - <3 min at 140°C
  - <1.5 min at 150°C
- Interfacial Shear Strength (IFSS) testing is important to figure out the fiber resin adhesion behavior. Test results give an idea of their adhesion characteristics when they are used together in the same matrix in manufacturing composite materials
- Virgin T800 fibers were chosen because of their prevalent use in the TuFF process

Rheology and Test Parameters

- Rheology tests were performed to determine the ideal temperature for fiber insertion and to get best curing afterwards based on resin viscosity

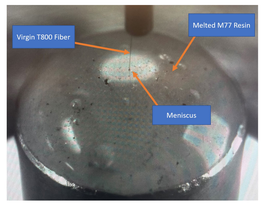


- From the rheology experiments it was determined that 80-100°C was the ideal temperature to insert the fiber
- <150°C was expected to be the best cure temperature, as curing too quickly could result in air bubbles stuck in the crucible
- Air bubbles stuck in the structure may cause changes in the determined embedded lengths of inserted fibers
- 75 µm was chosen as the nominal embedded length based on the expected IFSS
- The final determined parameters were:
  - Melt at 100°C for 2 minutes to allow maximum melting without advancement of early cure
  - Cure at 130°C for 10 minutes to ensure full cure

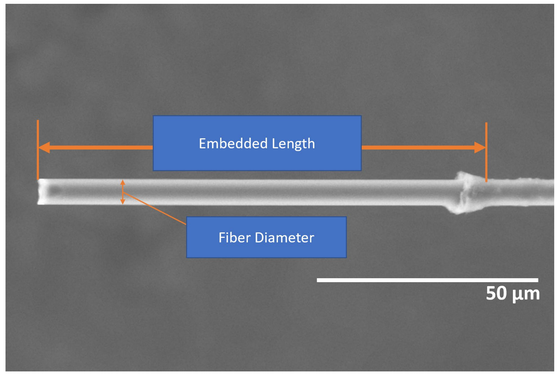
Testing and Mechanism

- Samples were made using the Textechno Fimabond (‘a’ below) and tested in the Textechno Favimat (‘b’ below) with the fiber pullout fixture.
- Sample preparation chamber was purged with argon at 1 L/minute.
- All tests were conducted at 0.1 mm/min extension rate

- 10 samples were prepared initially:
  - 1 sample was observed to have been inserted with a double fiber
  - 2 samples gave no pull-out force data (likely fiber or insertion failures)



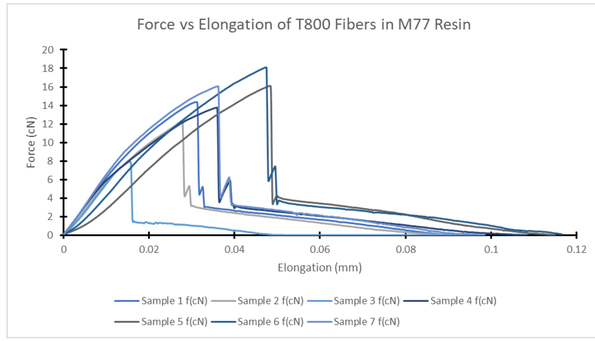
- After failure, the fibers were analyzed under the Hitachi TM3030 Tabletop SEM to find precise embedded length and individual fiber diameters

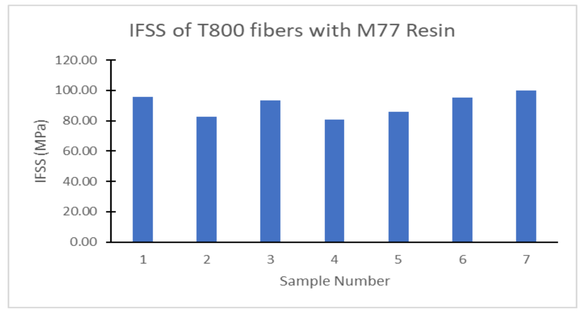


- Embedded lengths came out 20-40% higher than intended
- This is because of the nature of the snap-cure resin
- The fiber insert time is very quick

Results and Future Work

- 7 usable samples were analyzed using their embedded lengths, measured diameters, and max break forces (seen below) to determine their IFSS between the M77 resin and Virgin T800 fibers





- The experimental IFSS of the resin-fiber matrix was determined to be **90.55 MPa with an STD of 7.35**
- This agrees perfectly with the expected strength, and validates the methodology

	L_e (µ)	F_{max} (cN)	Diameter (µ)	IFSS (MPa)
Sample 1	89	14.36	5.37	95.62
Sample 2	87	12.19	5.38	82.82
Sample 3	51	7.92	5.28	93.58
Sample 4	103	13.77	5.27	80.70
Sample 5	113	16.12	5.29	85.84
Sample 6	115	18.11	5.25	95.46
Sample 7	97	16.08	5.28	99.83
AVE	**93.57**	**14.08**	**5.30**	**90.55**
STD			0.051	7.35
COV			1.0%	8.1%

- In the future, this M77 resin pullout test methodology can be used with different fiber types

Acknowledgements

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