EFFECT OF FIBER ASPECT RATIO ON THE MECHANICAL PERFORMANCE OF ALIGNED SHORT FIBER COMPOSITES (TUFF)

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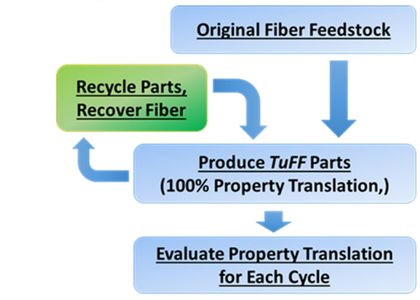
Background & Motivation

Tailored Universal Feedstock for Forming (TuFF) sheets can be made with recycled fibers. However, full translation of properties depend on

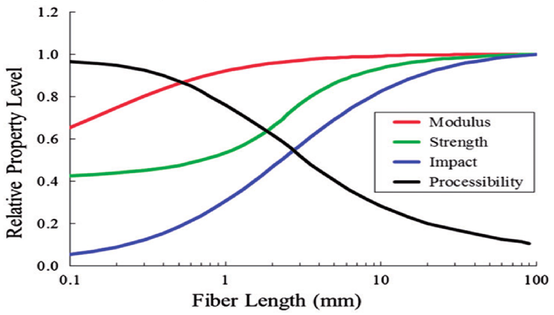
- Fiber length distribution
- Degree of Fiber strength degradation
- Alignment accuracy
- Interface quality
- Fiber volume fractions

TuFF parts were produced using discontinuous fibers with three aspect ratios to experimentally validate the challenges associated with fiber lengths



Objectives

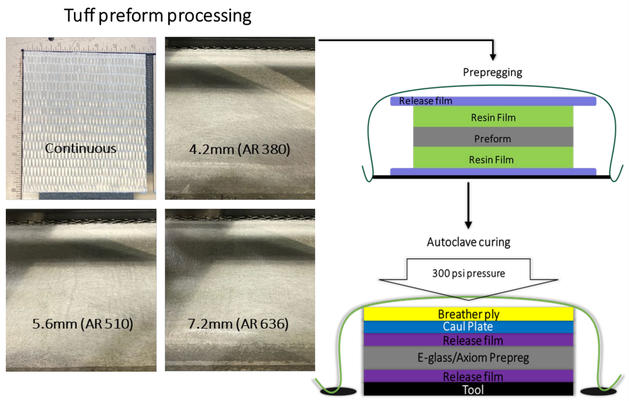
To characterize mechanical performance of highly aligned short fiber composites processed using TuFF as a function of fiber aspect ratio (AR)



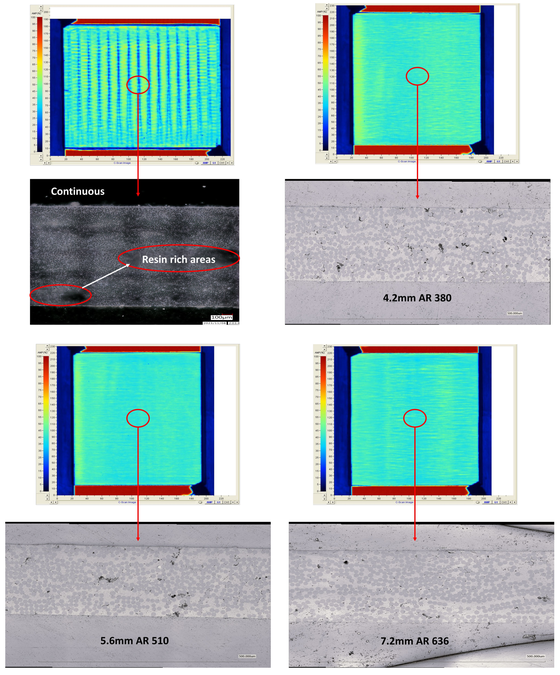
Wang, Qiushi & Jones, Joydan & Lu, Na & Johnson, Ralph & Ning, Haibin & Pillay, Selvum. (2017). Development and characterization of high-performance kenaf fiber–HDPE composites. Journal of Reinforced Plastics and Composites. 37. 073168441773912. 10.1177/0731684417739127

Experimental Approach

- Model system with E glass fibers in both continuous and discontinuous form was chosen with epoxy from Axiom
- Continuous fabric and Tuff preforms were pre-pregged using resin film infusion
- Used manufacturer recommended cure cycle



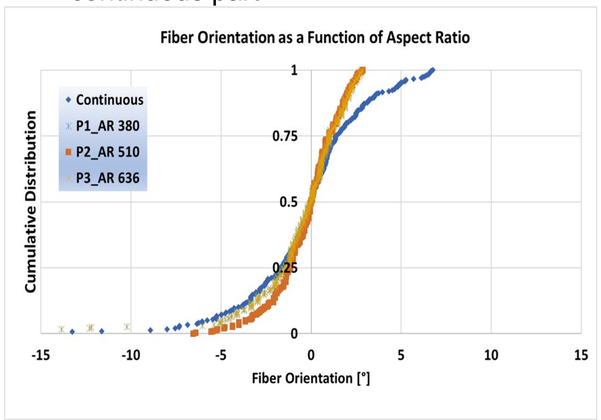
Results & Discussion



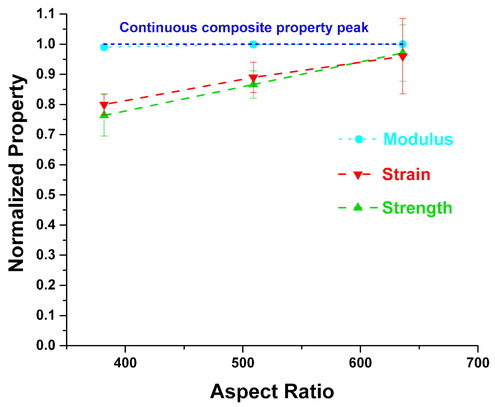
• No signs of voids or porosity detected

Results & Discussion

- Orientation results proved higher alignment accuracy in TuFF due to tight packing of fibers in contrast with continuous composite
- Several interpretations such as stitching, resin rich locations can affect the fiber orientation within the proximity of continuous part

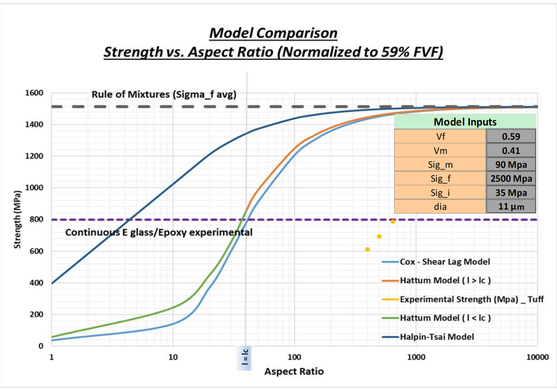


- Modulus in all the samples remained consistent irrespective of aspect ratio once normalized
- Degradation behavior in strengths with decreasing aspect ratios is clearly observed and full-strength translation compared to continuous at an aspect ratio of 636 was achieved



Results & Discussion

- Models over predict the properties as they do not account for interface failure nor other failures that occur in the composite due to fiber strength variability



Conclusions & Future work

- Experimental demonstration of strength degradation as a function of decreasing aspect ratio in short fiber composites
- Models overpredict due to fiber aspect ratio and strength variability
- Future work will focus on measuring properties with specimens with wider aspect ratios
- Specimens with multiple aspect ratios will be fabricated to demonstrate the effect on degradation and concentration effects during processing

Acknowledgements

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