Hexcel – Characterization of HexPly Nature Range Composite

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Background

Our goal was to characterize Hexcel's HexPly® Nature Range NR-M78.1-LT/48%/UD210P/Flax Material by exposing and testing it to a variety of conditions. What is unique about this product is that it features a matrix made from a bio-based resin reinforced with flax fibers, enhancing sustainability and reducing environmental impact. In addition, it is also cost-effective, lightweight, and flexible, opening up a variety of opportunities for future applications.

Fig. 1.Hexcel Team working on layup

Methods

- Layup
  - Quasi-Isotropic
  - Autoclave cure
- OHC: ASTM D6484 determine modulus change with respect to
- TGA: Samples ranged from 4.1 mg to 9.2 in weight, and were heated at a rate of 10 C/min to a maximum of 400C.
- DMA: ASTM D5023 to determine the change in modulus over temperature.
- DSC: Samples ranged from 4.1 to 9.2 mg in weight , and were heated at a rate of 10 C/min up to a maximum of 250 C.
- SEM: A comparable and Hexcel samples were soaked, freeze dried, and fractured.
- Water soak: Samples were soaked at room temperature (25C) and in a elevated temperature (70C) for a max of 2 weeks.
- 4-point bend: Used ASTM D6272; a load span of 29.54 mm and support span of 63.07 mm (1:2 ratio). Load rate was 2 mm/min

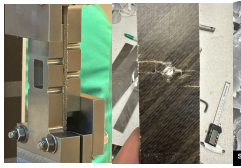

Fig. 2 OHC Test

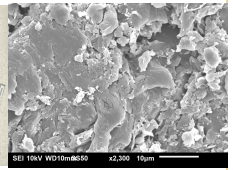

Fig. 5 SEM of Microstructure

Results

- Visual Observations: **Clear color difference** in soaked samples.
- OHC: Significant change in Modulus and failure behavior.
- TGA: **Decomposition temperature ~300C.**
- DMA: Modulus and glass transition temperature on **average 130C.**
- DSC: The temperature at which curing took place for the uncured samples averaged out to **130 C.** For the cured samples, the glass transition temperature was found to be the same around **130C.**
- SEM microstructure images
- Water soak: The samples soaked at **70C had an average change % change in weight of 15.8 and 17.2 % for the 1-week and 2-week** soaks respectively. The **1-week soak at room temperature had an average change of 5.30%**
- 4-point bend: Although the material did not fail, it still experienced considerable deformation. **The elastic modulus was calculated to be 7611.44 MPa, while the maximum flexural strain was recorded to be 2.655% (0.02655 mm/mm). The maximum load applied was 719 N.**

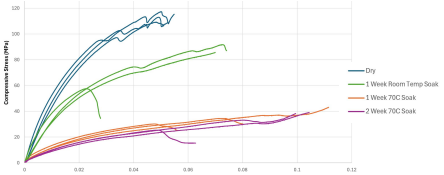

Fig. 3.Compressive Stress vs Strain on 12 samples with various conditions.

Discussion

Overall, water absorption seems to be a large prevalent issue with material use. Prolonged exposure to water causes mechanical properties to change drastically making it difficult to predict material properties in differing environments.

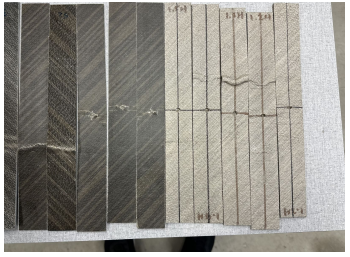

Fig. 4. Tested samples of HexPly composite. No soak on the left soaked samples on the right.

Conclusion

This type of material would be best suited for applications such as interior components of cars or sports paddles, which take advantage of the light weight and affordability of the material while limiting exposure to moisture. Applications in moisture environments such as winter sports may be a possibility as colder temperatures of water seem to have less of an impact on the overall performance of the material.