INVESTIGATION OF TENSILE STRENGTH OF UHMWPE FIBERS EXTRACTED FROM COMPOSITE PANELS

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Introduction
- HB210 composite panel (15” x 15” x .045”)
- Filaments extracted from top, middle and bottom sublayers of the center and edge regions.

Test fibers in each region; compare them to virgin fibers to determine the effect of processing parameters on strength.

Objective

Test fibers in each region; compare them to virgin fibers to determine the effect of processing parameters on strength.

Tensile Testing
- Test frame is equipped with a 5 N load cell.
- Single fibers are tested using a gauge length of 25 mm and a cross-head speed of 5 mm/min.
- Tests were conducted on virgin fibers and fibers extracted from the three sublayers (top, middle and bottom) cut from center and edge locations.

 Failure Probability Distributions (FPD)

<table>
<thead>
<tr>
<th>Fiber</th>
<th>Strength (GPa) at 50% probability</th>
<th>Reduction in strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virgin</td>
<td>4.81</td>
<td></td>
</tr>
<tr>
<td>Top layer</td>
<td>3.65</td>
<td>24%</td>
</tr>
<tr>
<td>Middle layer</td>
<td>4.50</td>
<td>6%</td>
</tr>
<tr>
<td>Bottom layer</td>
<td>4.26</td>
<td>11%</td>
</tr>
</tbody>
</table>

Microdamage Modes-SEM Images

Summary and Conclusion
- FPD Strength data correlates with SEM imaging
- Fibers from center-top and edge-bottom exhibit the highest strength reduction and degrees of micro damage modes experienced by the fibers.
- Fibers from edge-middle exhibit a double strength reduction compared to center-middle.
- Fibers from edge-top and center-middle exhibit some degree of surface flattening. Additionally center-middle exhibits surface cracks.

Path Forward
- Investigate the processing parameters:
  - Temperature
  - Pressure
  - Time
- Investigate the mechanisms that cause micro damage:
  - Compression of fibers due to negative coefficient of thermal expansion (CTE)
  - Differences in CTE of resin and fiber
- Investigate the processing parameters: to achieve higher performance.

Microdamage Modes-SEM Images

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