Imprinted Glass Fiber Reinforced Polymer (FRP) Vascular Network for Self-Healing Composites

(OTT ID- 1670)

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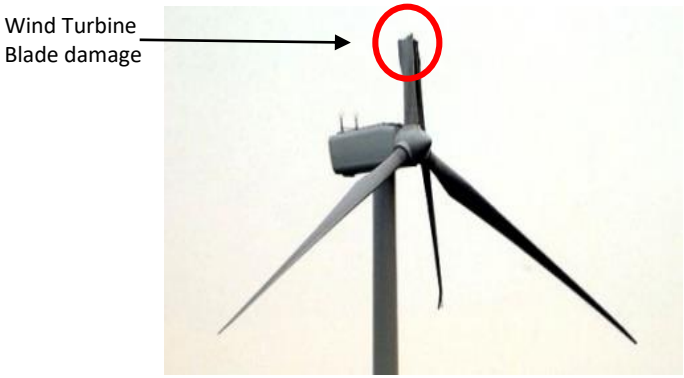
Current Problems

- Increase in sustainable energy needs
- Mechanical and structural failure due to uncontrolled environmental conditions or impact loading
  - Example - cracks in wind turbines due to high wind speeds
- Increase in manufacturing costs with average composite life



Technology Solutions

- Self healing provides a fool proof safety measure against catastrophic failure by healing the damages autonomously
- 3D printed technology used to prepare the entire composite network makes it easy to install and infinitely more configurable for multifunctional composites
- Autonomous healing upon crack formation enables continuous operations without service interruptions
- The entire process is cost effective due to reduce catalyst and resin requirements

Intellectual Property and Licensing

- Provisional patent application (PPA) filed in Nov 2019

Current Status

- Proposed technology is a part of active on going research program at UW-Milwaukee
- Seeking collaborative partners for manufacturing and scale up
- Technology is currently available for licensing under exclusive or non-exclusive terms

Market Potential

Applications

- Wind Turbine Blades
- Hydro Turbine Rotors
- Airplane Wings to secure longevity
- Gas Turbine Rotors
- Self-Healing FRP Composites for Alternative Energy Sources

Proposed Technology

Imprinted Network – Design and Assembly

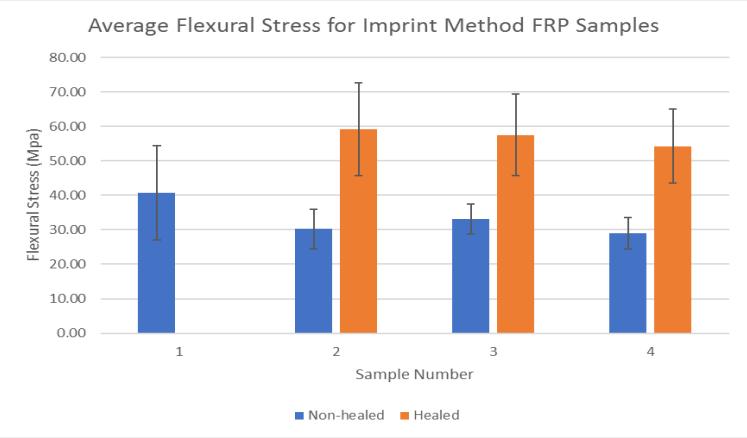
- Template preparation: General purpose adhesive was used to coat the template surface prior to VARTM to provide sacrificial layer that peels off when removing the imprint layer
- DCPD imprint layer distribution – DCPD was liquid and distributed over the template
- DCPD imprint layer was sealed via hand-punch adhesive with perforated sheeting placed in between the layers to avoid delamination and improve resin distribution
- Imprint layer was incorporated into glass fiber sheet to create the composite sample

Vascular Network with Imprint layers

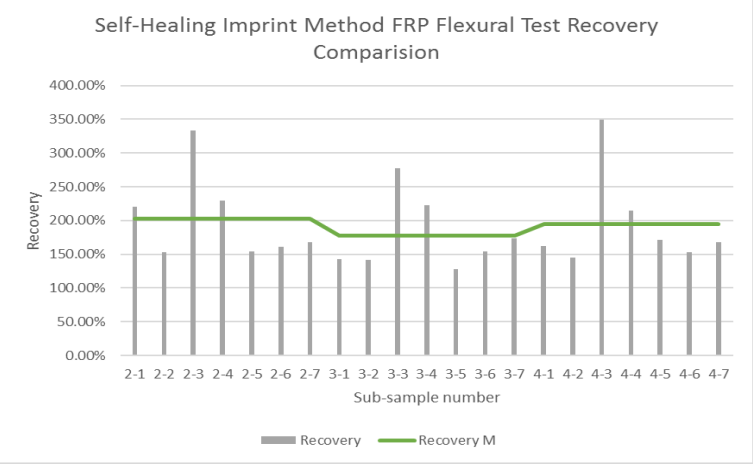
Material Testing – Imprinted Networks

Three-Point Bending

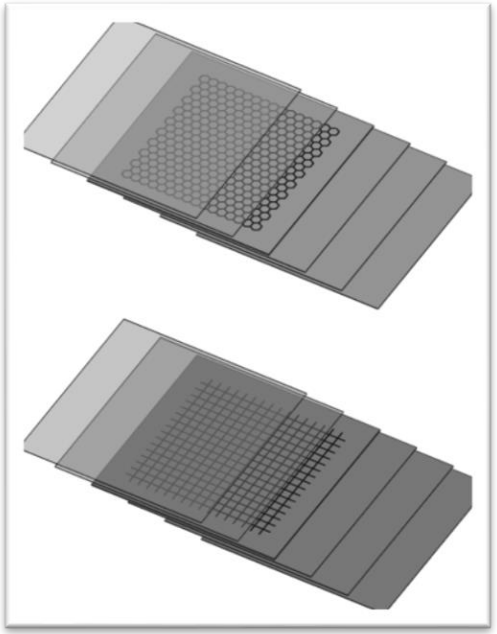
- Ultimate stress and recovery plots for 4 samples



- Recovery Comparison for 4 Samples



Self healing composites



Imprinted Networks

Advantages and overall results

- Multiple configurations – highly tailorable method
- Cost effective
- No sample degradation – No heating
- Storage efficiency, 100 %
- Yield rate, 100 %
- Recovery rate, > 175 %
- Catalyst location has little to no effect on sample strength or recover

Next Steps

- Continue the development and testing to demonstrate the use of imprint method
  - Investigate alternate grid configurations
  - Alternate methods to prevent premature catalyst reaction
- Scale up and large sample testing
- Look for collaborative partners for development and manufacturing support

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