APPLICATION OF UV-CURING RESINS FOR IN-PLACE PIPE REPAIR

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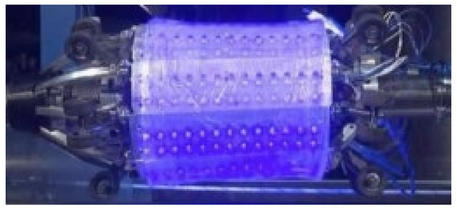
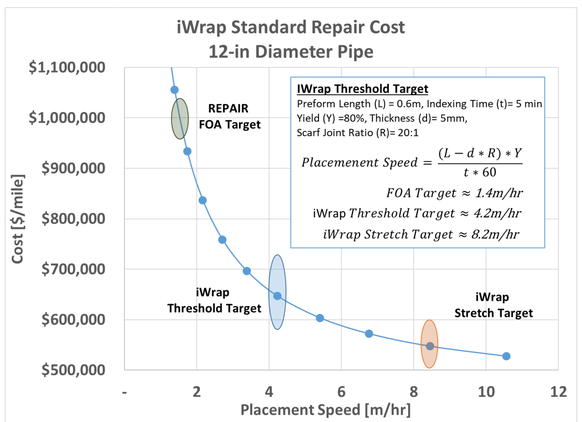
Introduction

- Traditional methods of pipe and pipeline repair include excavation which is costly and time consuming
- Using UV-Curing resins offers a fast in-situ and nonintrusive alternative
- These resins contain photo initiators that react when exposed to UV light and create free radicals.
- Free radical based polymerization and crosslinking results in structurally sound liner



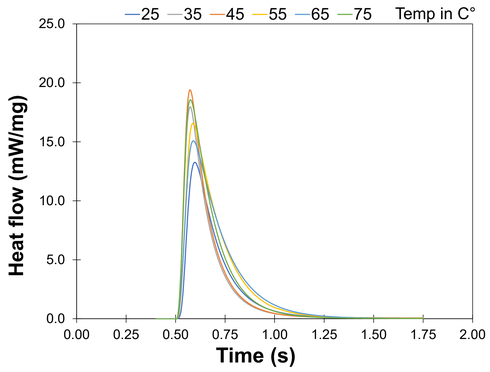
Objective

- Develop a light source and resin system that can rapidly cure inside pipe
- Evaluate practical feasibility of commercially available liner systems
- Test mechanical properties compared to ASTM standards
- Analyze cure behavior



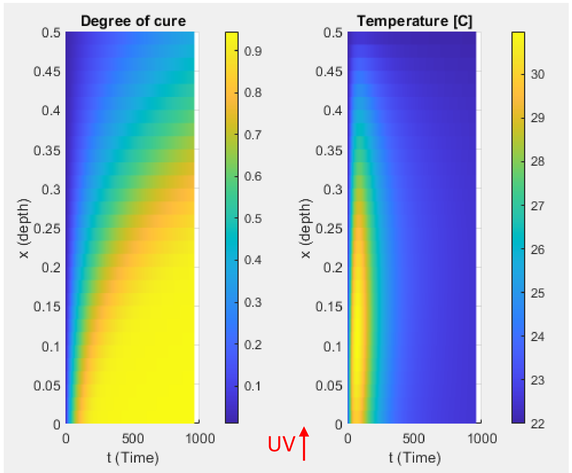
UV-DSC Cure Kinetic Study

- Differential Scanning Calorimetry (DSC) To obtain the kinetics of the resin multiple samples were tested at varying temperatures.



Cure Modeling

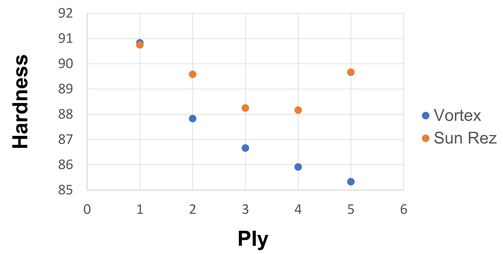
- Using the parameters gained from the UV-DSC as input to existing model adapted from Beyene et al. we simulated the curing of the resin.



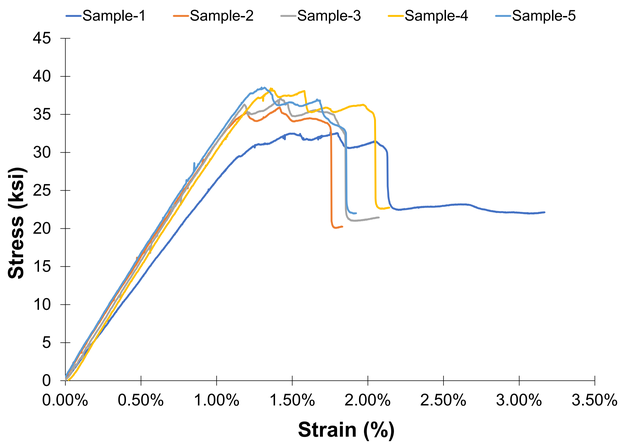
- The depth of cure exponentially increases cure time
- Backside has lower degree of conversion
- Heat generated by reaction quickly dissipates into environment

Mechanical Property Testing

- Shore Hardness is an easy way to measure degree of cure indirectly
- No of layers used makes hardness lower as we are limited by UV cure penetration depth

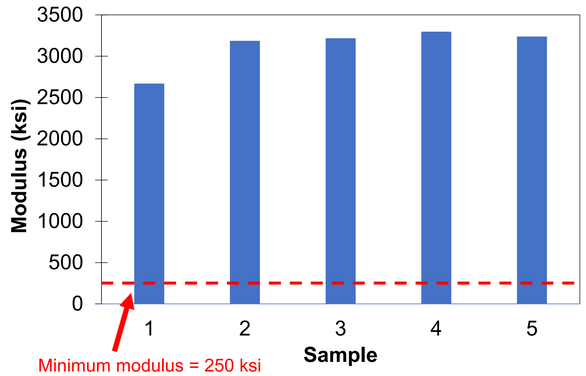


- Ultimate goal of achieving minimum ASTM flexural modulus of materials in situ
- Flexural test of 18 plies of 7781 E-glass and Vortex resin



Conclusions and Future work

- Further work is required to optimize system selection and cure schedule
- Function of intensity of level and exposure
- Need to minimize cure time for a practical application given real life constraints
- Effects of part thickness on absorbance/intensity decay
- Conduct experiments to establish process window to satisfy stiffness requirements for repair
- Cross correlate degree of cure and hardness level to achieve stiffness requirement vs hardness
- Real time measurement of storage modulus versus time in DMA
- Use these calibration curves to define repair time
- Identify the process conditions that minimizes repair time



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