VACUUM INDUCED PREFORM RELAXATION FOR THE MANUFACTURING OF THERMOSET COMPOSITES WITH IMPERMEABLE INTERLAYERS

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Introduction

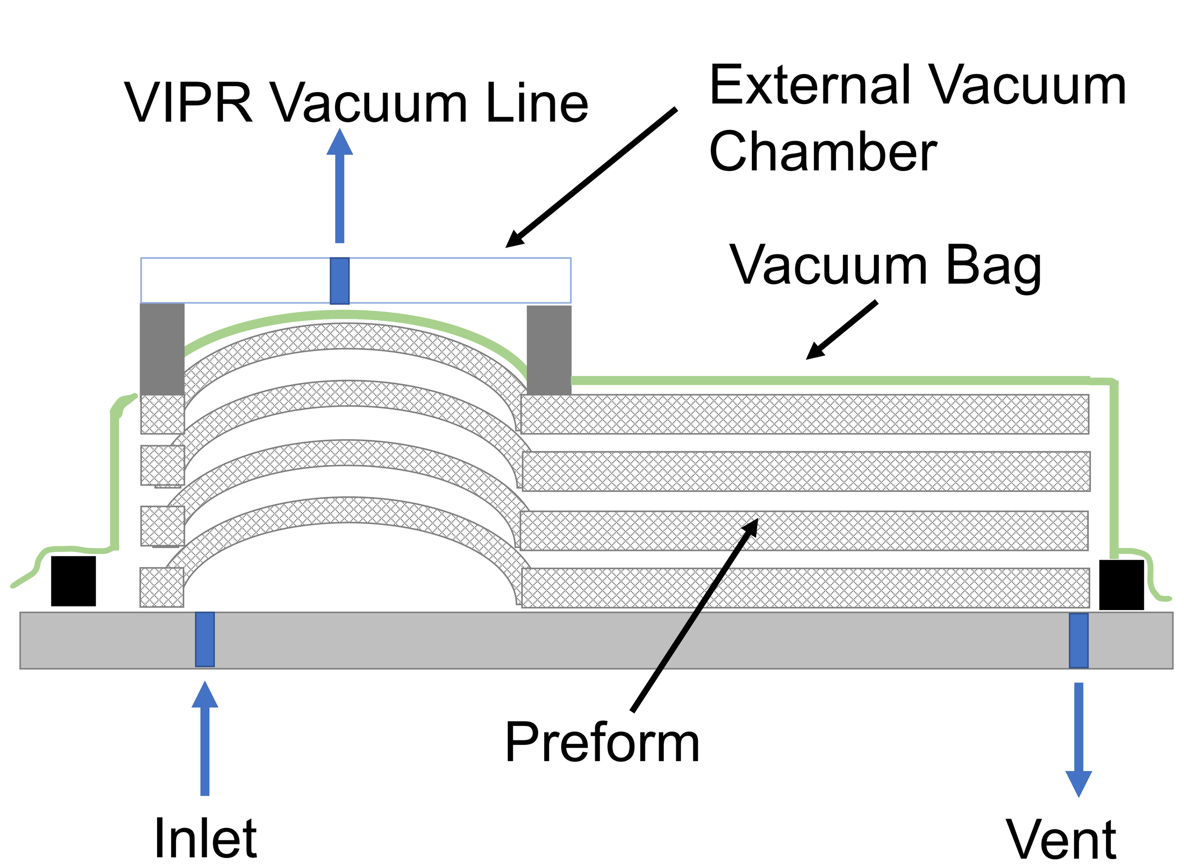
VARTM of Polymer Composites with Impermeable Interlayers

- + Improved delamination resistance.
- + Cost-effective manufacturing of large parts.
- − Unpredictable flow patterns in sub-laminates during injection.
- − Increased meso- and micro-variability of permeability.

Vacuum induced preform relaxation (VIPR) to reduce filling time

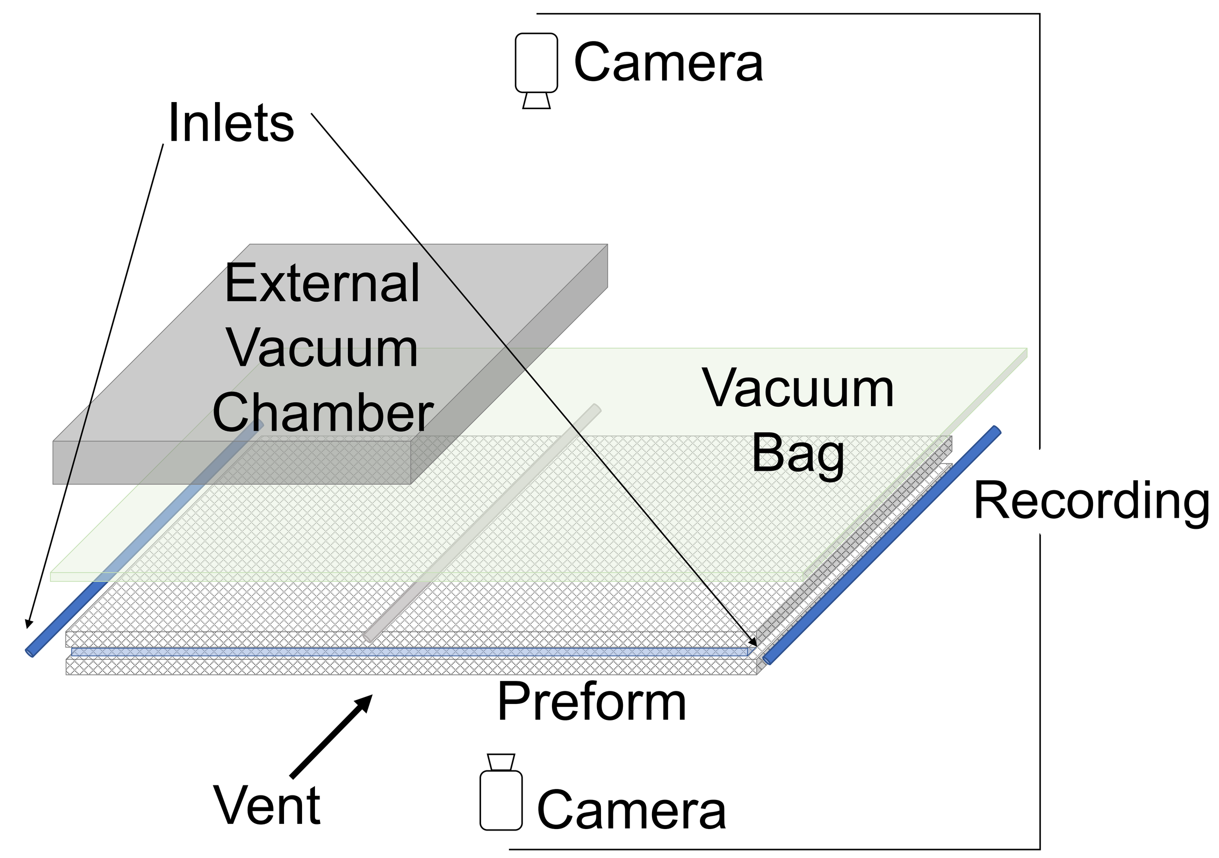
Vacuum Induced Preform Relaxation

- ❑ Vacuum chamber with separate vacuum line placed over vacuum bag.



Experiment Set-Up

- ❑ Preform: 4 glass fabric/1 TPU/4 glass fabric.

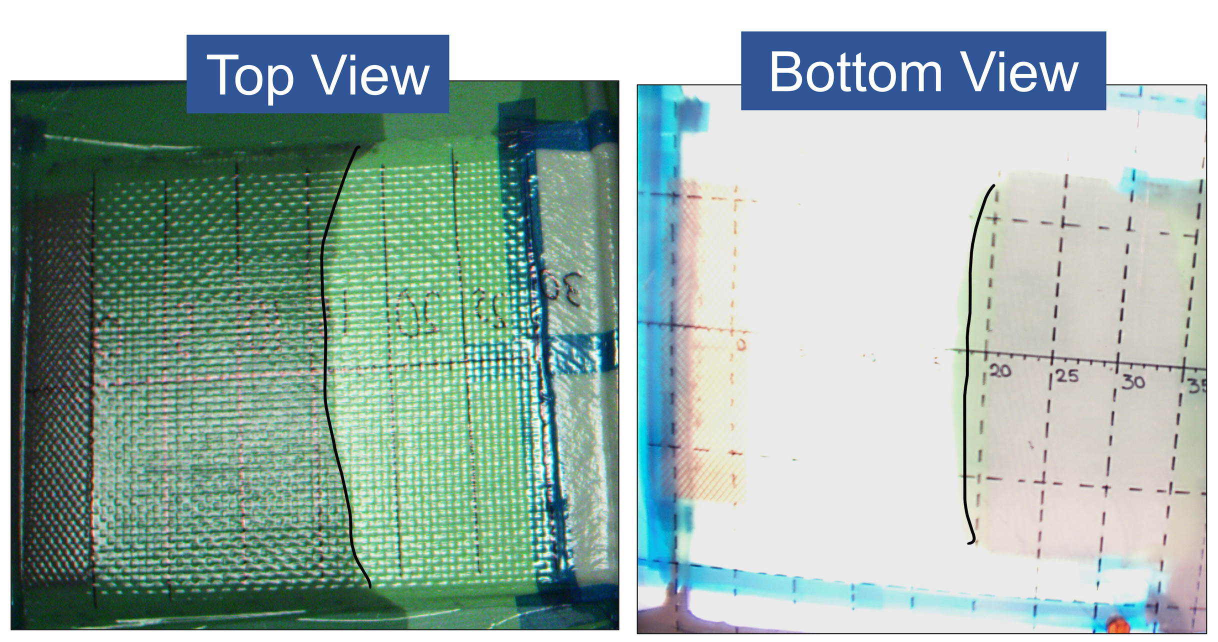


Experimental Plan

	External Chamber	VIPR Vacuum Level	Preform Width
No VIPR	No	N/A	300 mm
VIPR 30 inHg	Yes	30 inHg	300 mm
VIPR 10 inHg	Yes	10 inHg	300 mm
VIPR 5 inHg	Yes	5 inHg	460 mm

No VIPR Flow Fronts

- ❑ After 60 minutes from the start of injection.

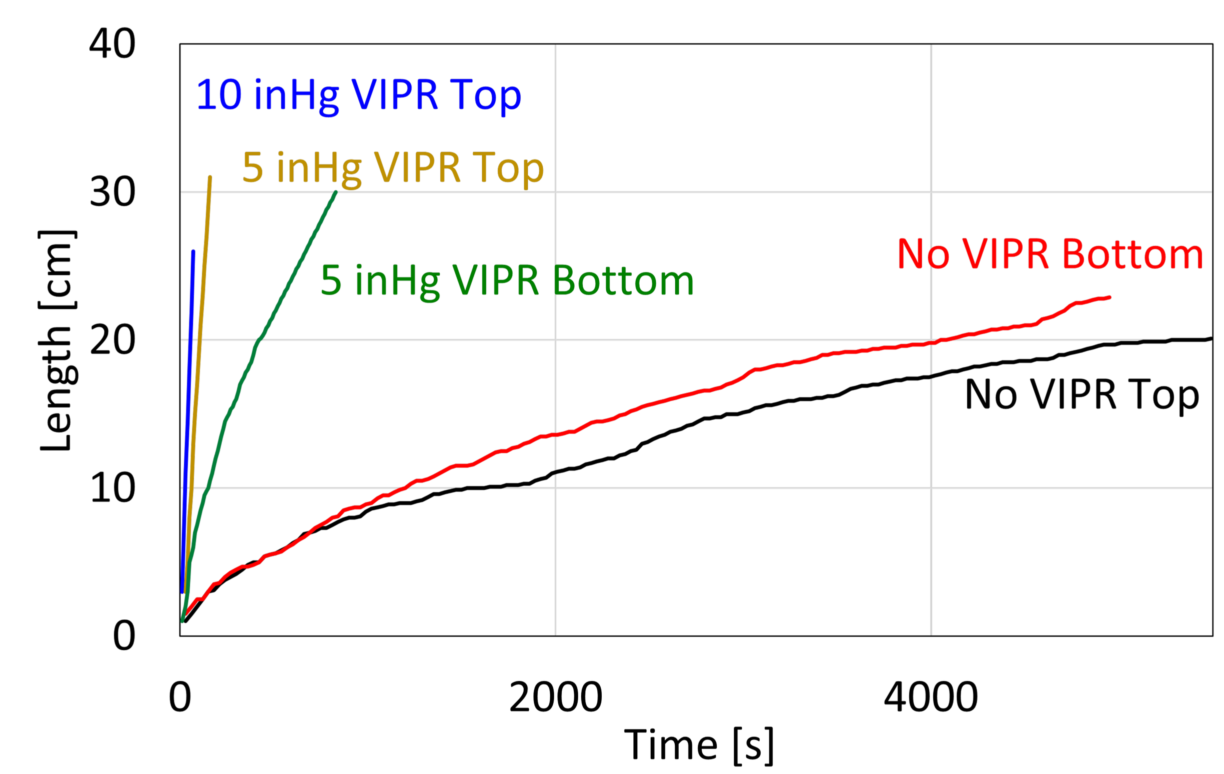


Permeability Comparison

- ❑ Large race-tracking in 30 inHg and 10 inHg experiments → VIPR bottom fronts not measurable.

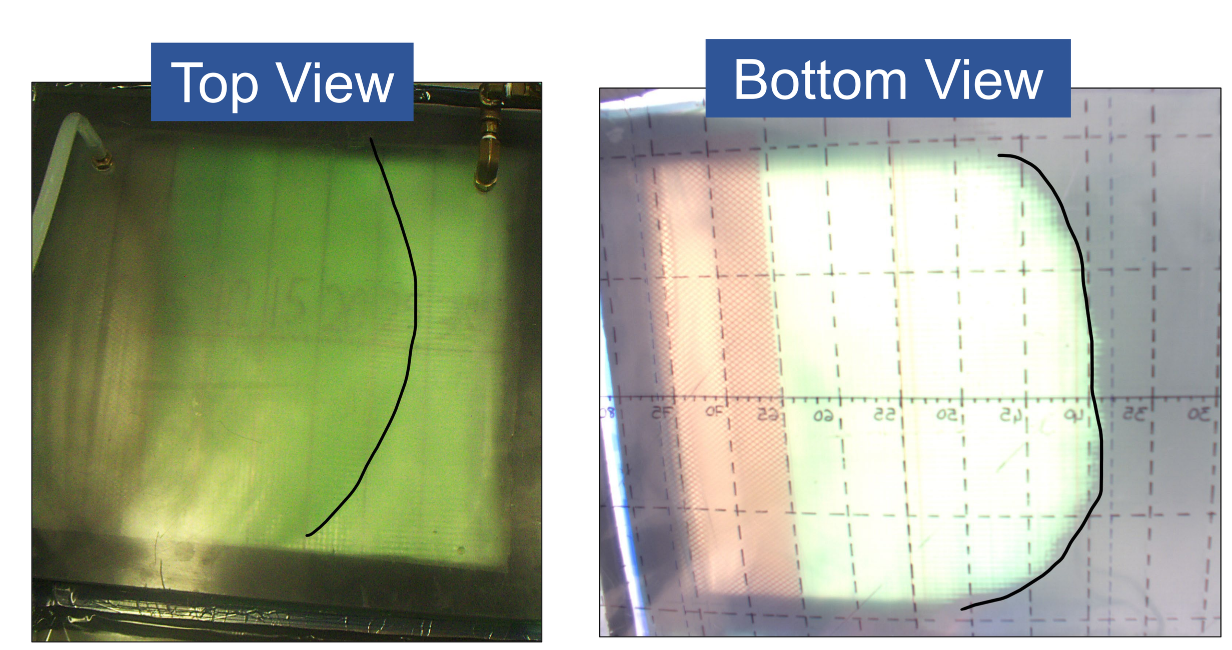
	Fill Time [min]		Permeability [m²]	
	Top	Bottom	Top	Bottom
No VIPR	86.5	76.5	1.25E-11	1.56E-11
VIPR 10 inHg	1	N/A	1.02E-09	N/A
VIPR 5 inHg	2	7	6.52E-10	9.31E-11

Filling Times Comparison



VIPR Flow Fronts 5 inHg

- ❑ Top view after 2 minutes from the start of injection.
- ❑ Bottom view after 15 minutes from the start of the injection.



Conclusions

Advantages

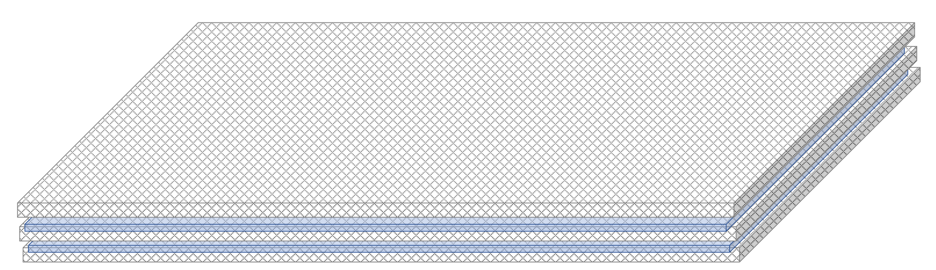
- ❑ Decreased fill time and increased permeability with VIPR.
- ❑ Comparable FVF to no VIPR processes.
- ❑ Cost-effective alternative to RTM and VARTM to manufacture large and thick composites with flexible impermeable interlayers.

Challenges

- ❑ Vacuum bag deformation during VIPR.
- ❑ Exacerbation of race tracking.
- ❑ Increased resin consumption.

Future Works

- ❑ Increased number of sub-laminates and interlayers.



- ❑ Strategies to control resin consumption.

Acknowledgements

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