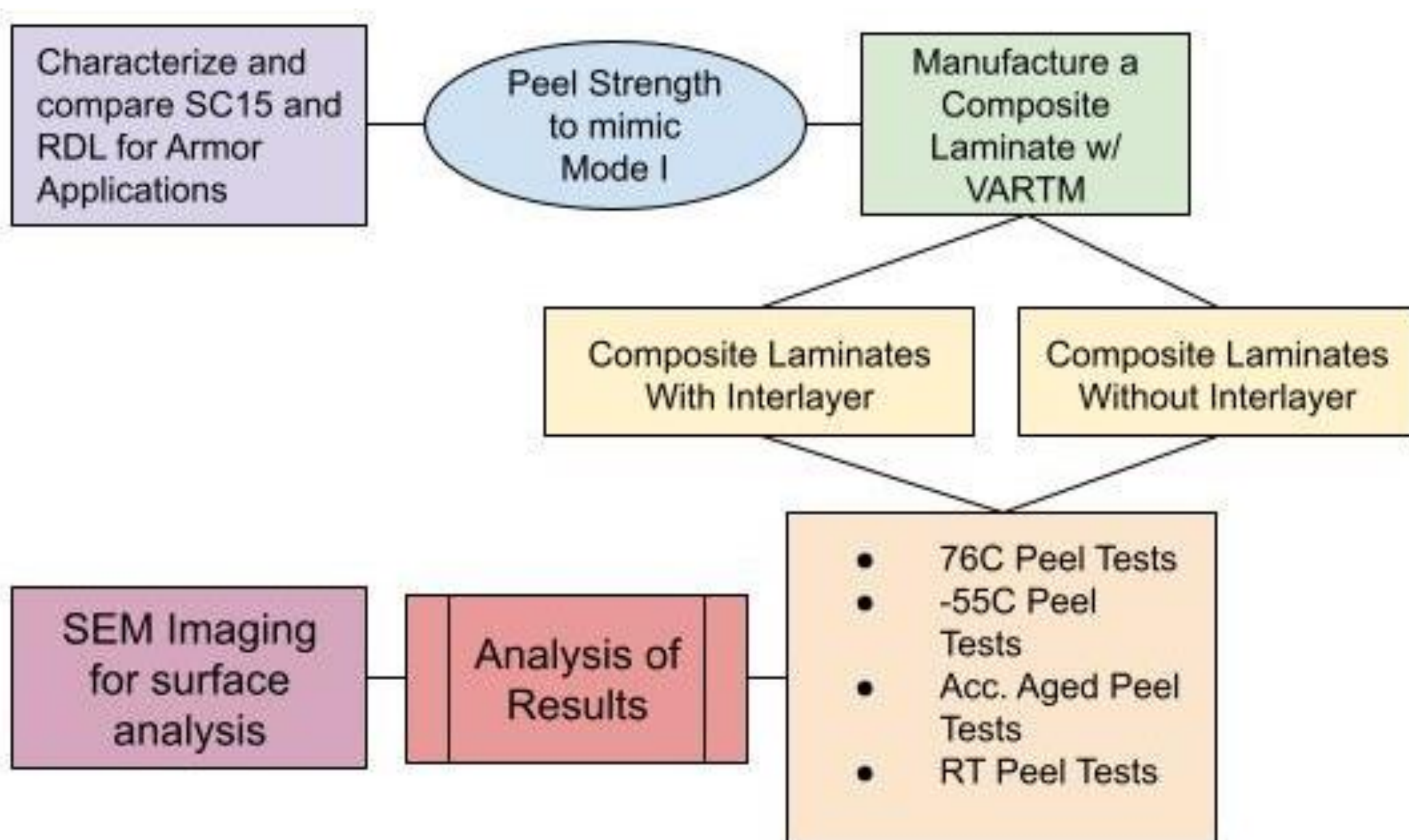


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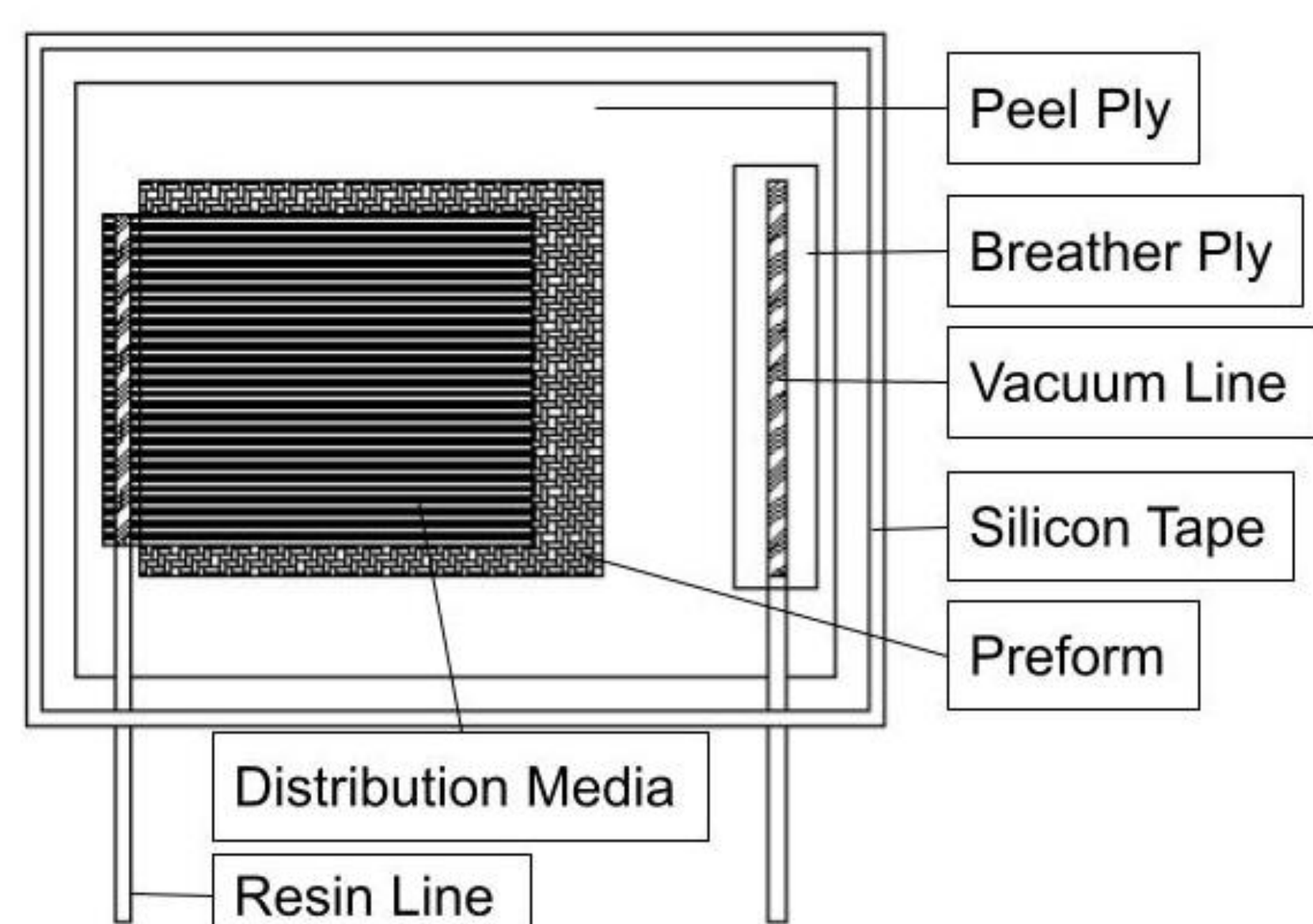
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## Introduction and Motivation

- Goal: Characterize the peel strength of composites with different epoxy resins under extreme environmental conditions
- Characterization involves multiple steps 1) Composite Manufacturing 2) Curing 3) Peel Testing 4) SEM Imaging



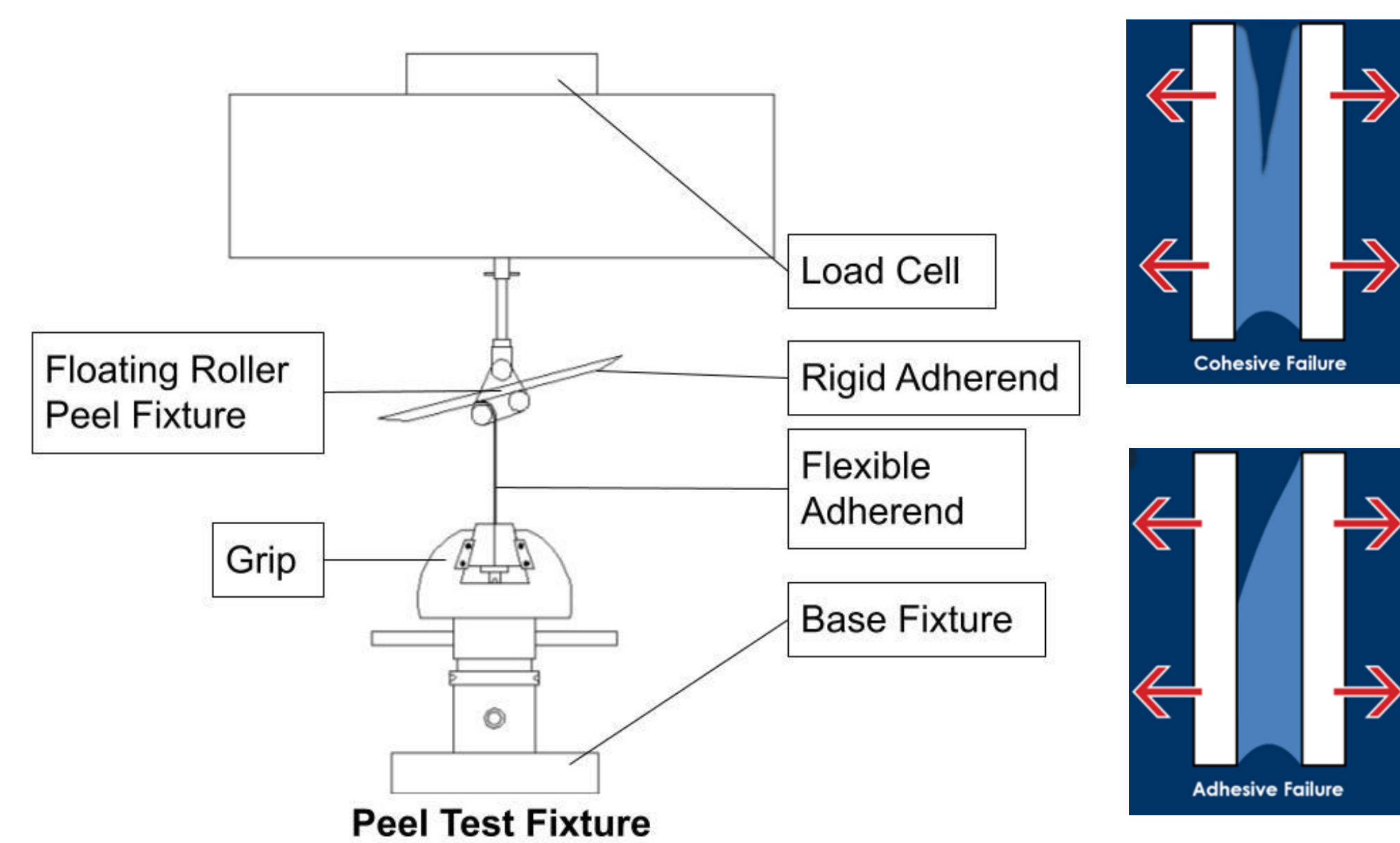
## VARTM



### V.A.R.T.M.

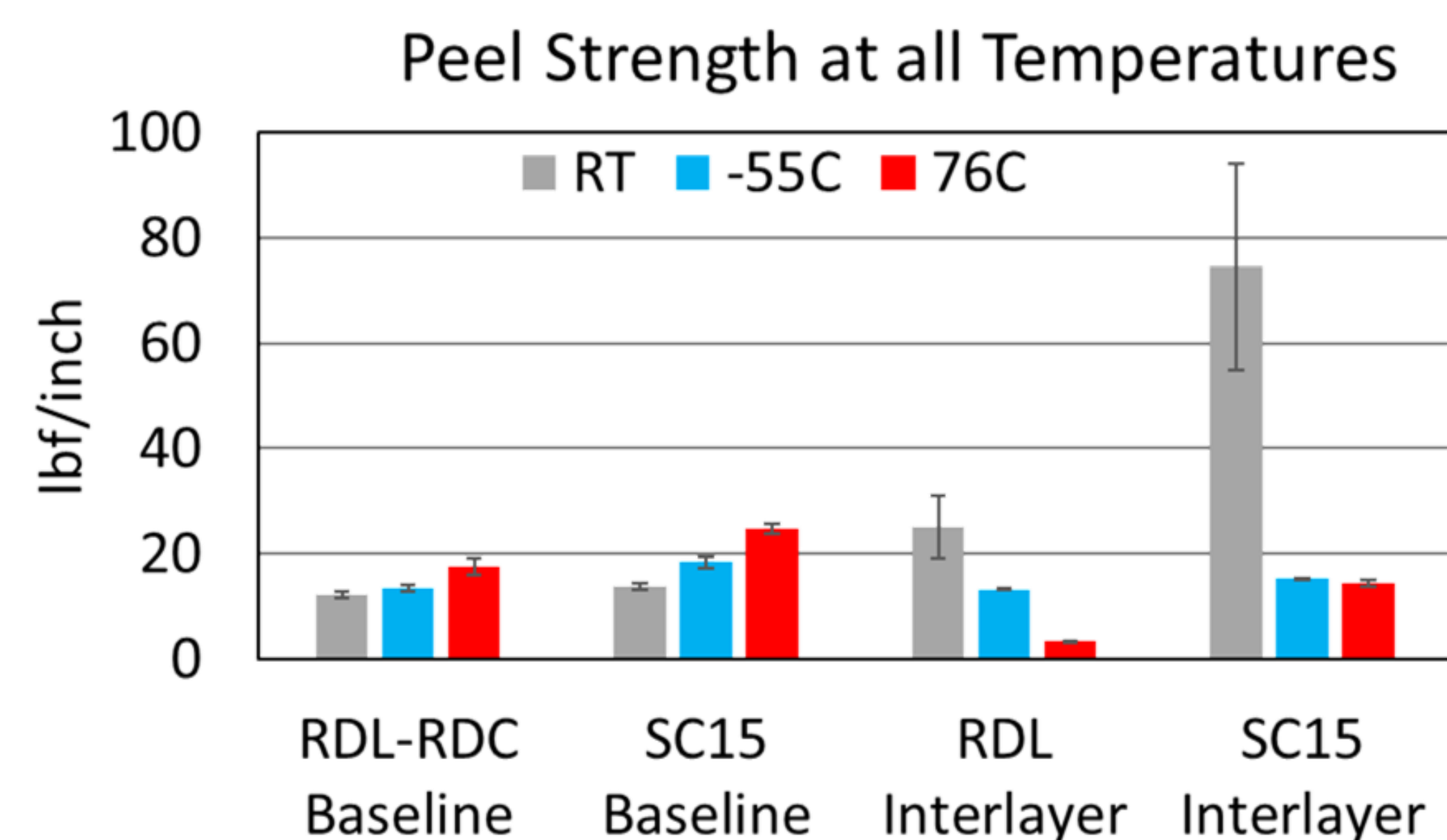
- VARTM is an effective method for composites manufacturing
- Uses a vacuum seal which draws resin across a distribution media to allow for infusion of resin into a composite preform
- The vacuum assistance helps to reduce stress concentrations due to air pockets
- Four types of panels were created and tested; Baseline and Interlayer for both RDL/RDC & SC15

## Peel Test



- Measures average peel strength
- Conducted using specially designed floating roller peel fixture
- Displacement rate: 6 in/min (ASTM D903)
- Minimum of 3 inch test
- The two modes of failure shown on the right are cohesive and adhesive
- Cohesive failure indicates a failure along the TPU or the resin
- Adhesive failure indicates failure between the fibers and resin

## Results and Discussion

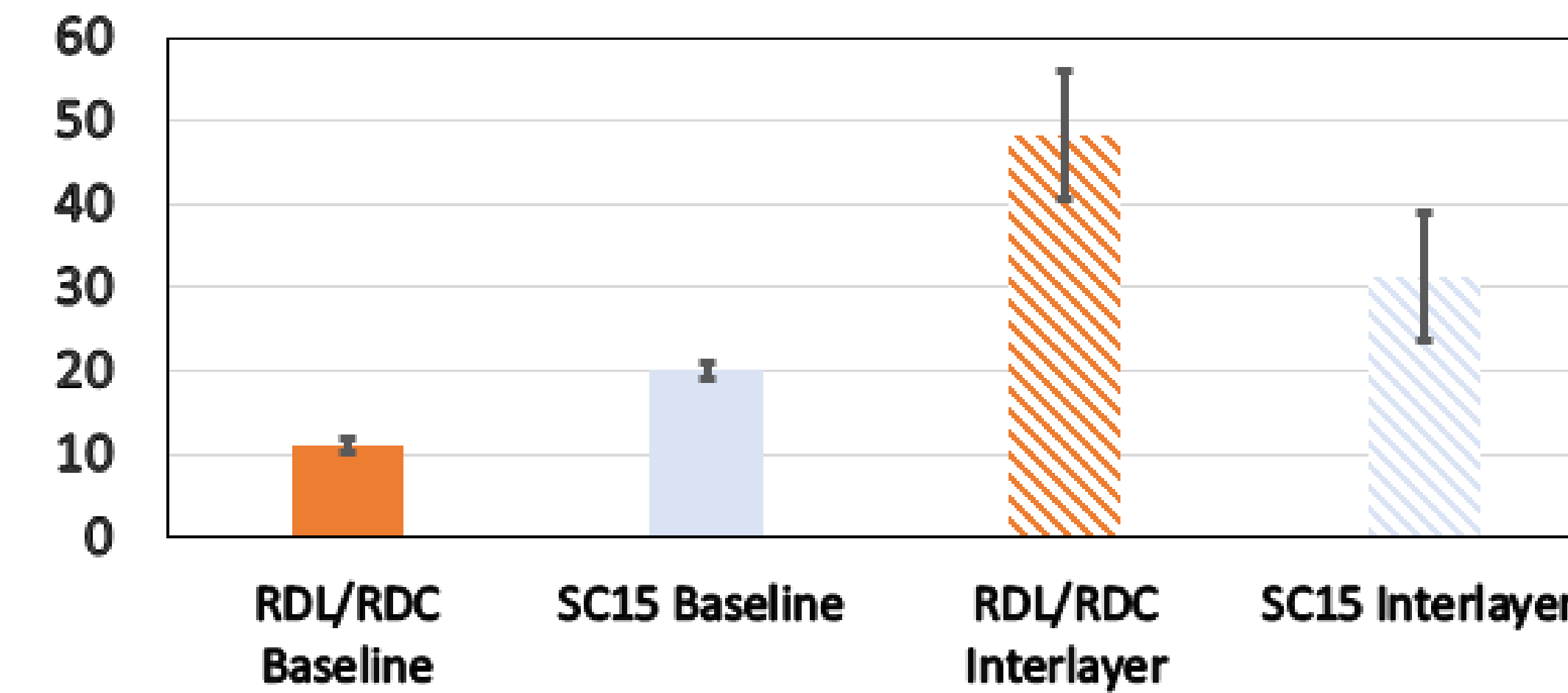


Room Temp.	(lbs/inch)	76C	(lbs/inch)
RDL Baseline	12.3 ± 0.6	RDL Baseline	17.6 ± 1.5
SC15 Baseline	13.8 ± 0.7	SC15 Baseline	24.8 ± 0.9
RDL W Interlayer	25.1 ± 6.0	RDL W Interlayer	3.5 ± 0.1
SC15 W Interlayer	74.5 ± 19.5	SC15 W Interlayer	14.3 ± 0.6

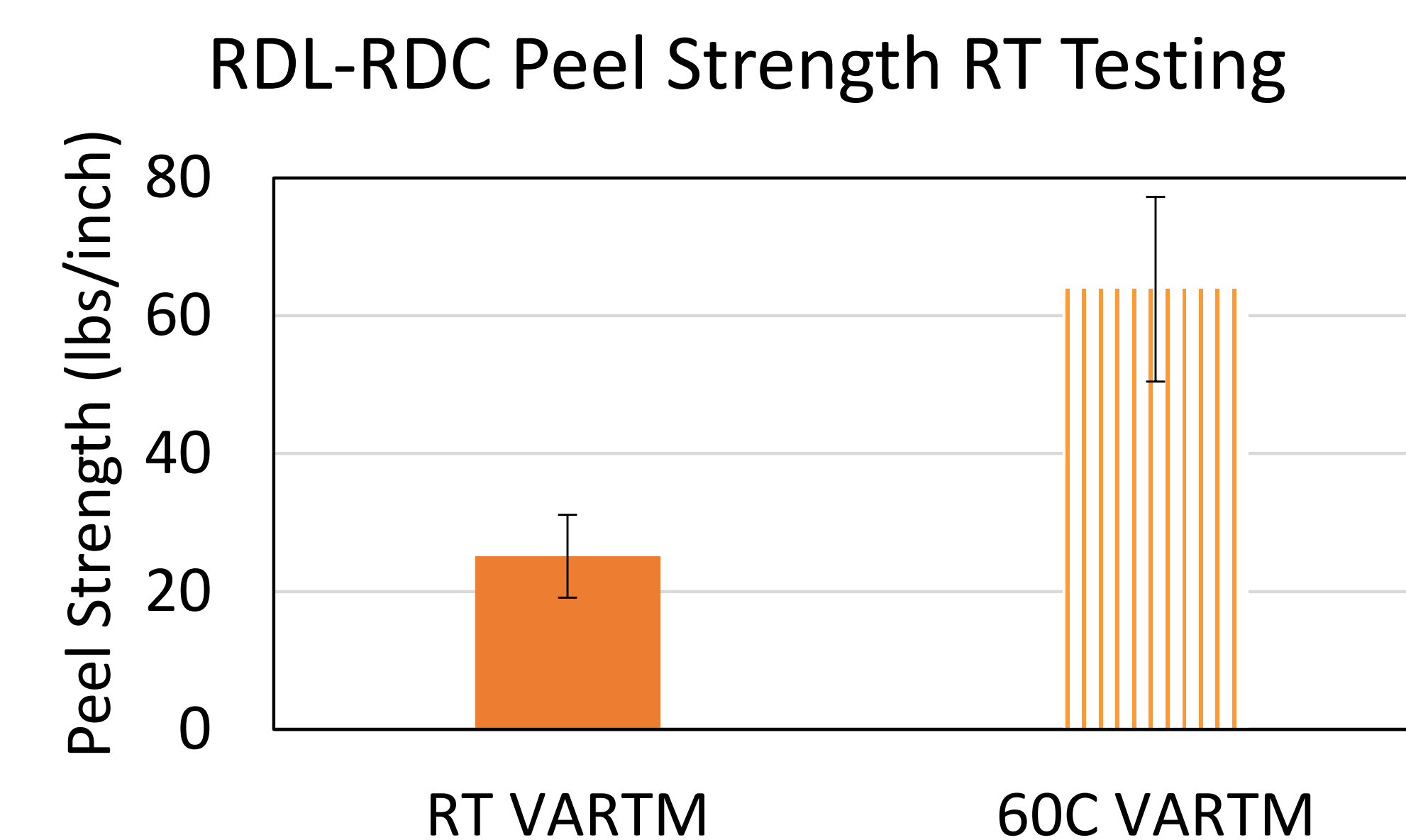
Accelerated Aged	(lbs/inch)	-55C	(lbs/inch)
RDL Baseline	11.1 ± 0.8	RDL Baseline	12.5 ± 1.5
SC15 Baseline	20.1 ± 1.1	SC15 Baseline	17.5 ± 1.5
RDL W Interlayer	48.2 ± 7.7	RDL W Interlayer	12.3 ± 1.3
SC15 W Interlayer	31.3 ± 7.8	SC15 W Interlayer	15.5 ± 0.5

## Peel Strength At Room Temp With Acc. Aging



- Peel strength for baseline RDL & SC15 improve at extreme temperatures while the interlayer specimens get weaker
- The opposite was observed with the Accelerated Aging specimens with RDL increasing the most with interlayer
- SC15 with interlayer has the largest peel strength of all the test and performs better on average than RDL Specimens

## Effect of resin penetration into TPU

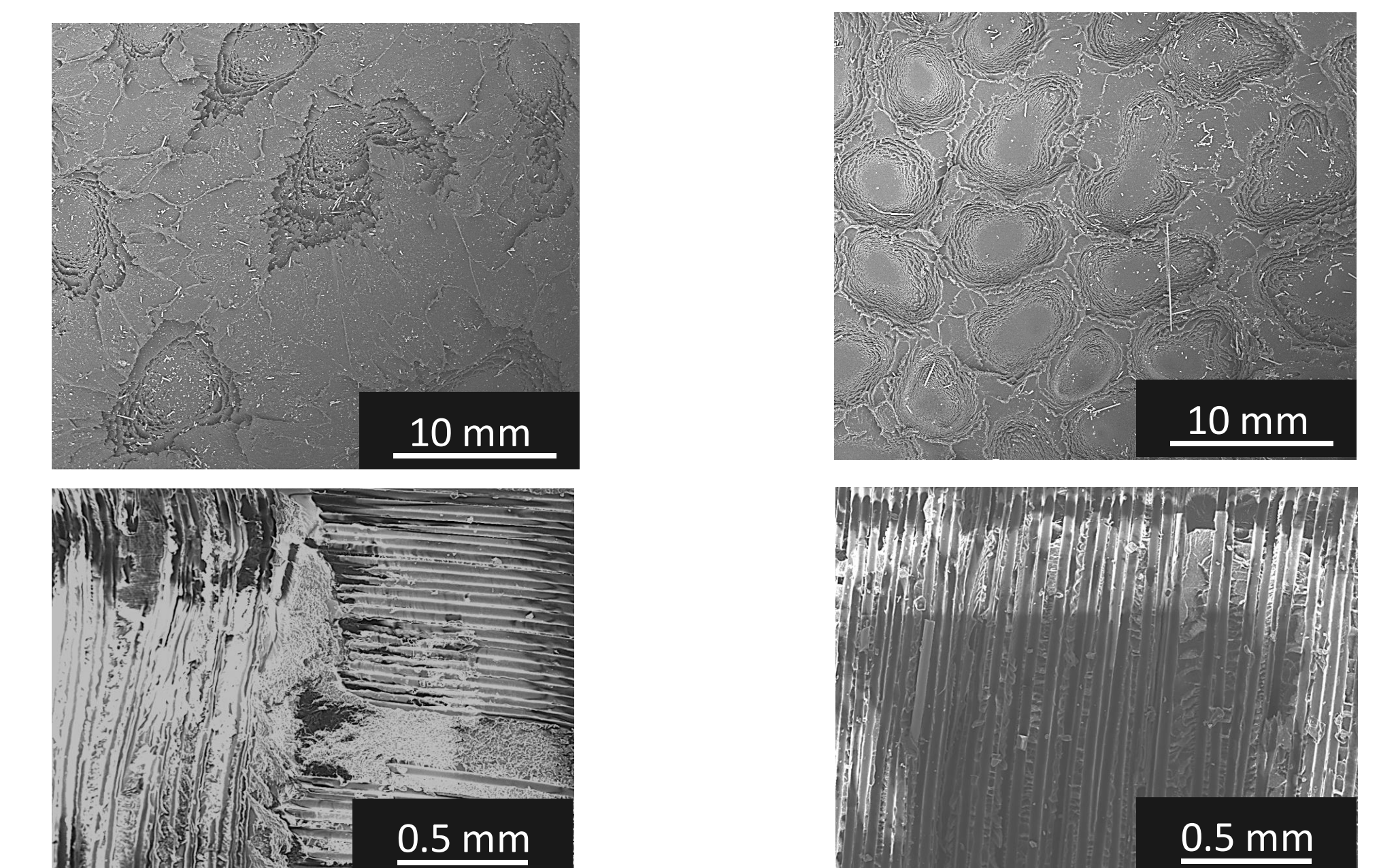
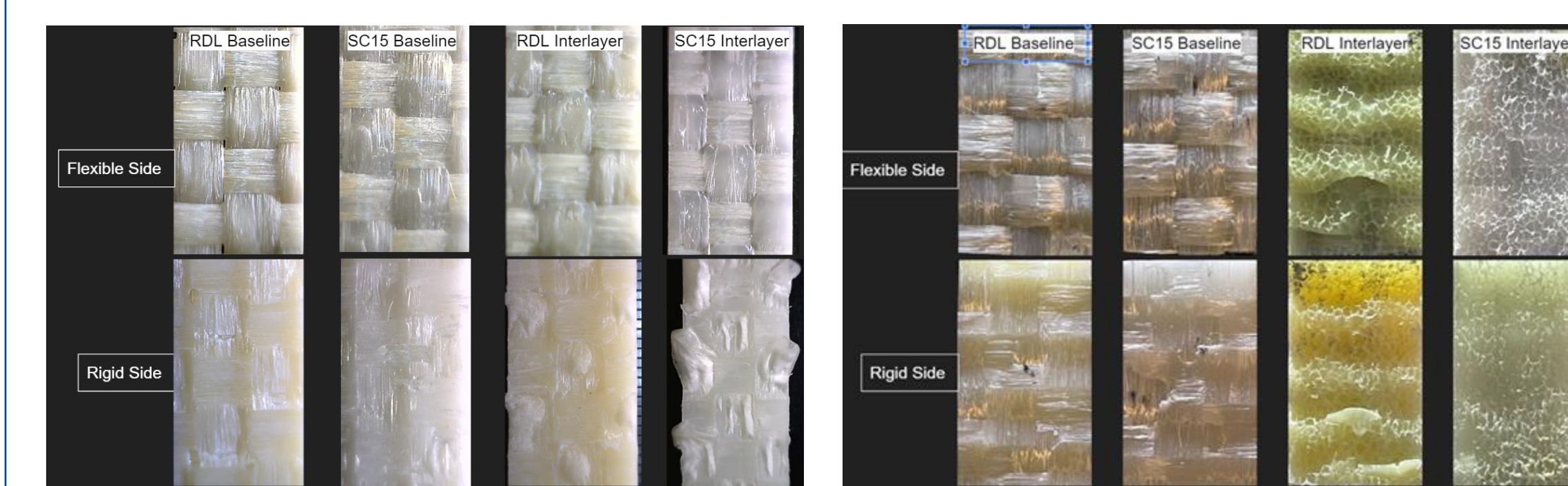
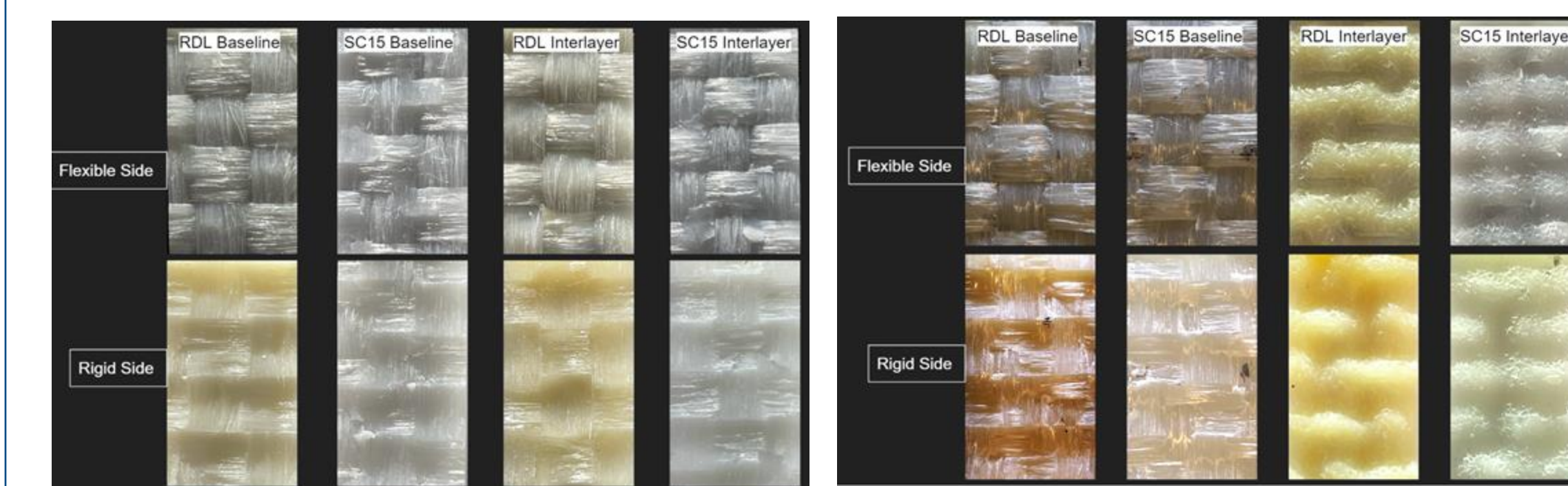


RDL VARTM	(lbs/inch)
Room Temperature Infusion	63.9 ± 13.4
60 C Infusion	25.1 ± 6.0

- TPU at elevated temperature significantly increases the peel strength
- Higher viscosity at room temperature → less penetration
- Lower viscosity at elevated temperatures → greater penetration

## Findings

- 76 C → TPU cohesive failure
- -55 C → Adhesive interface failure
- RT → Mixed failure, fiber interface/TPU yielding



- The next step is to improve the properties of both resins at extreme temperatures as this interlayer proved to be ineffective

## Acknowledgements

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