THERMOSET MATERIAL DATA CARDS AND PROCESS MODELING - GAME CHANGER FOR SMC MARKET

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TopCon | May 2023

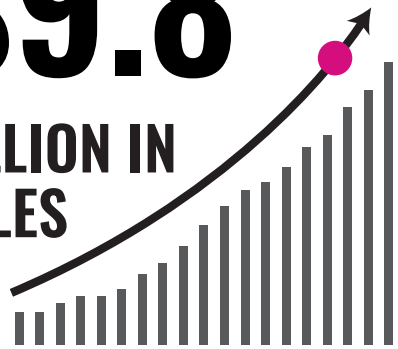
OWENS CORNING AT A GLANCE

68

CONSECUTIVE YEARS AS A FORTUNE® 500 COMPANY

$9.8

BILLION IN SALES



***2022 REVENUE**

19,000

EMPLOYEES PLUS 1 PINK PANTHER

31

COUNTRIES WHERE WE OPERATE

Serving residential, commercial, and industrial markets

INSULATION | ROOFING | COMPOSITES

REDUCING OUR ENVIRONMENTAL FOOTPRINT IS KEY

2021 energy savings

Initiated

29

energy-saving projects

Shrank energy use by

34,000+

megawatt hours

Reduced greenhouse gas emissions by over

8,000

metric tons

Welcome to the

PINKTANK™

A ONE-STOP SHOP

for development of **customized solutions** to **optimize the end product** and **bring future material conversion** opportunities to life.

A COMPREHENSIVE RESOURCE

TEST

performance characteristics

MODEL

Produce using composite material

SHOW

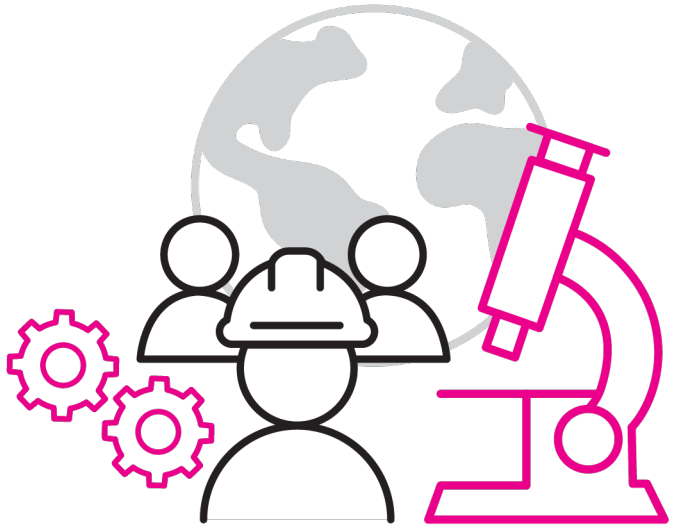
cost/performance of the end part

SMC MARKET PAIN POINTS

- SMC is one of the leading materials for many composite markets (Transportation, Automotive, Sanitary …)
- SMC is made up of TS resin, long chopped fibers, fillers & additives, all those ingredients interacts together during manufacturing
- During the compression molding process, SMC material will flow to fill the mold and shape the part
- The flow pattern dictates the fiber distribution and accordingly the final part performance
- For complex part shapes, our customers often experience high performance variability & part defects leading to not meeting the specs.

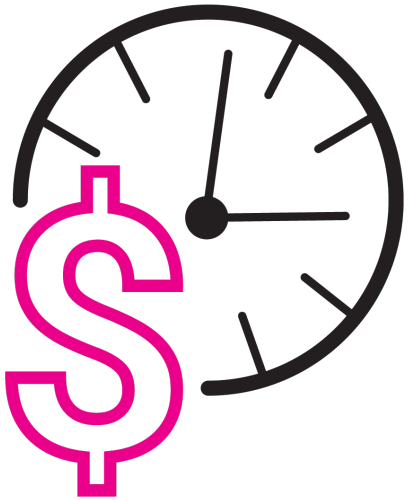
SMC MATERIAL DATA CARDS & PROCESS MODELING

Unique capability to develop full characterization



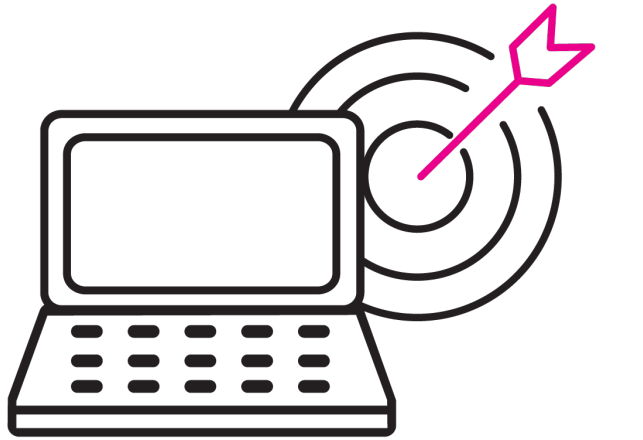
One of few labs globally

Start-to-finish modeling from material data cards to part design



Saves time and money

Increased accuracy for predictive modeling



SMC design applications

VALUE FOR COMPOUNDERS

The PINKTANK™ team determines the **right process** using the **right product**. We test and quantify the outcome of the formulation to **substantially limit** the “guesswork”, **saving time** and **money.**

Use of material data cards to determine

Low formula variability

Optimized formulation (FW fraction)

Tweaks for different applications (viscosity, reactivity, etc.)

Root cause of quality concerns (mechanical, aesthetics, etc.)

Target (medium) range of viscosity & reactivity for ideal balance

Better understanding of material data card = better design of SMC

VALUE FOR MOLDERS

The PINKTANK™ team determines the **right process** using the **right product.** We test and quantify the outcome of the formulation to **optimize productivity** and **save money.**

Use of material data cards to determine

- Flow prediction
- Part design
- Ideal Molding Parameters
- Defect reduction

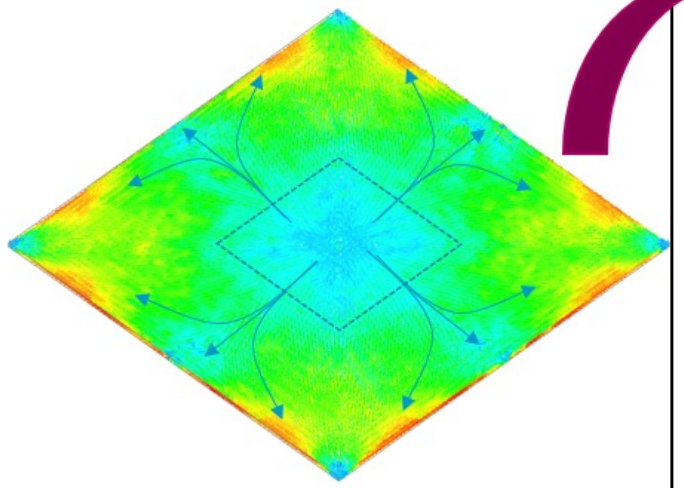
OWENS CORNING CAPABILITY

FROM MATERIAL DATA CARDS TO PERFORMANCE, QUALTY & PRODUCTIVITY

Leverage fiber orientation & distribution obtained on micro-scale to understand localized part performance, identify weakness areas, and optimize design.

Process Modeling

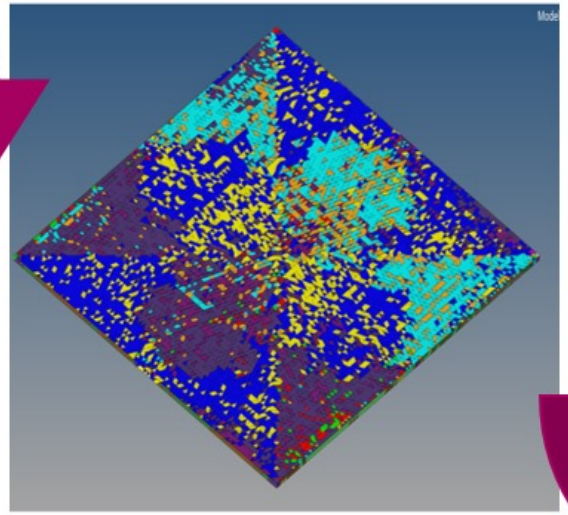
Fiber Orientation



SMC flow dictates fiber orientation

Mapping & Homogenization

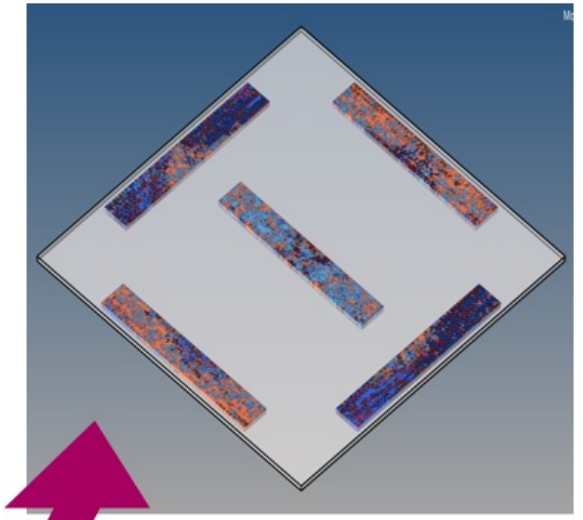
Localized Material Properties



Different color = different material card

FE Solver

Part-Level Behavior



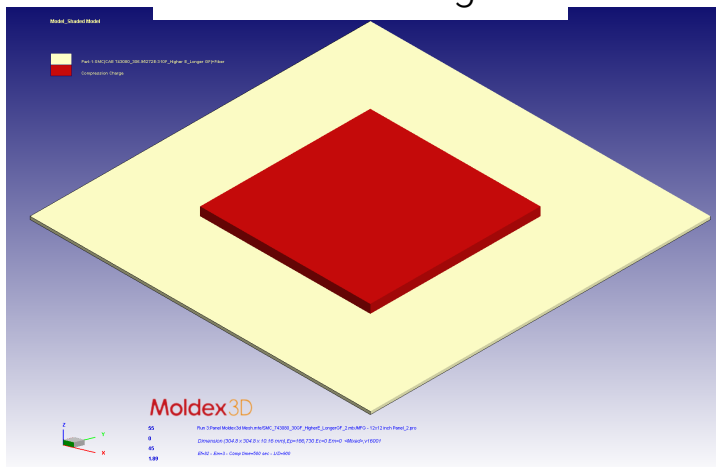
More realistic FEA results

SMC TEST CASE
FLAT PANEL

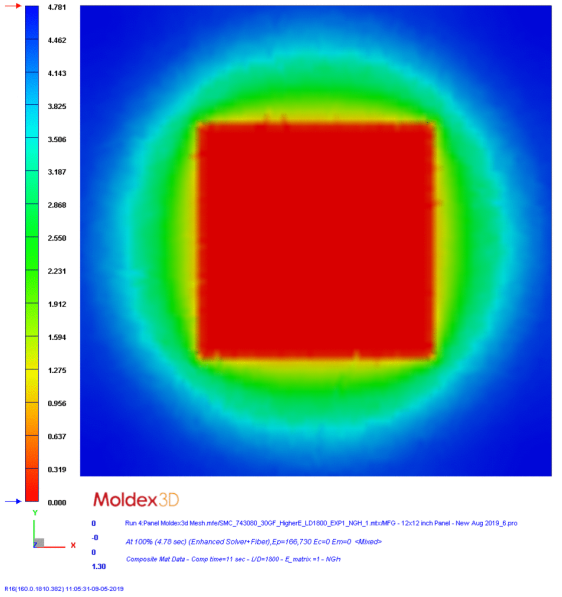
SMC FLAT PANEL TEST CASE

Process modeling able to accurately predict filling pattern of SMC material within flat panel mold.

Mold & Charge

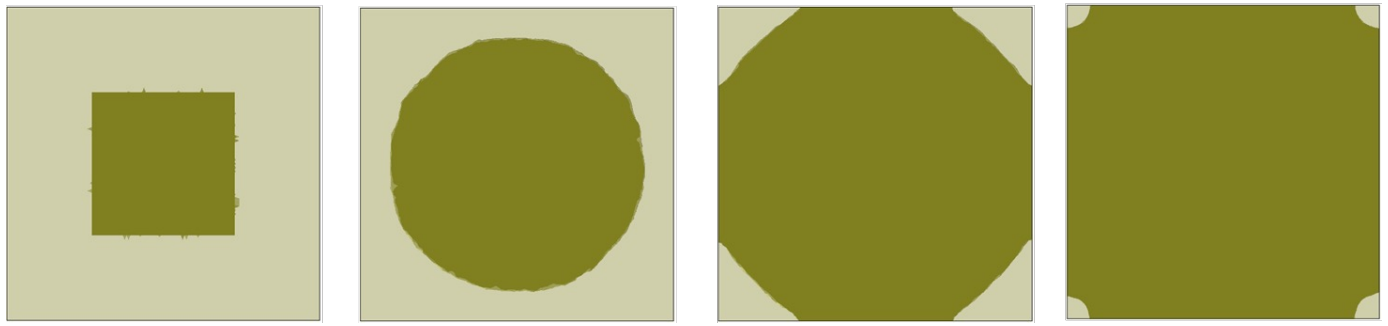


Mold Flow

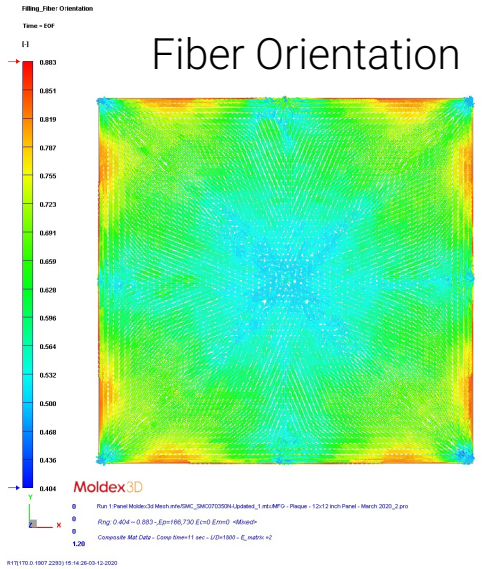


Experimental

Simulation

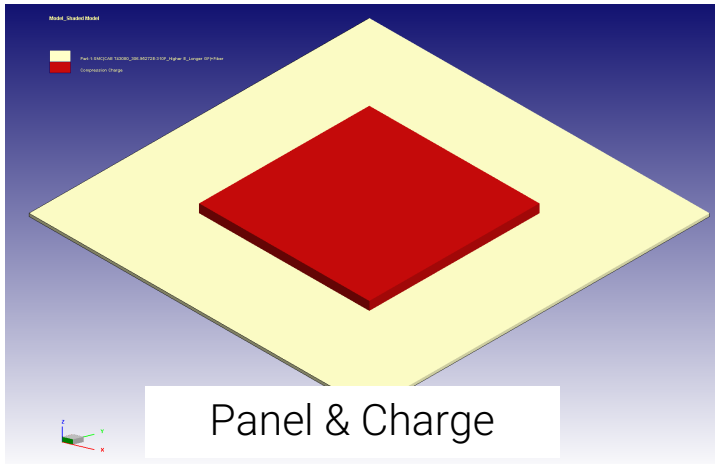


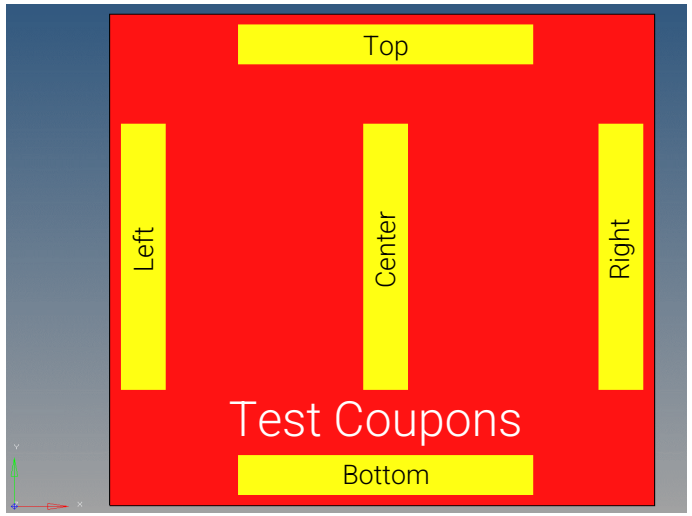
Fiber Orientation

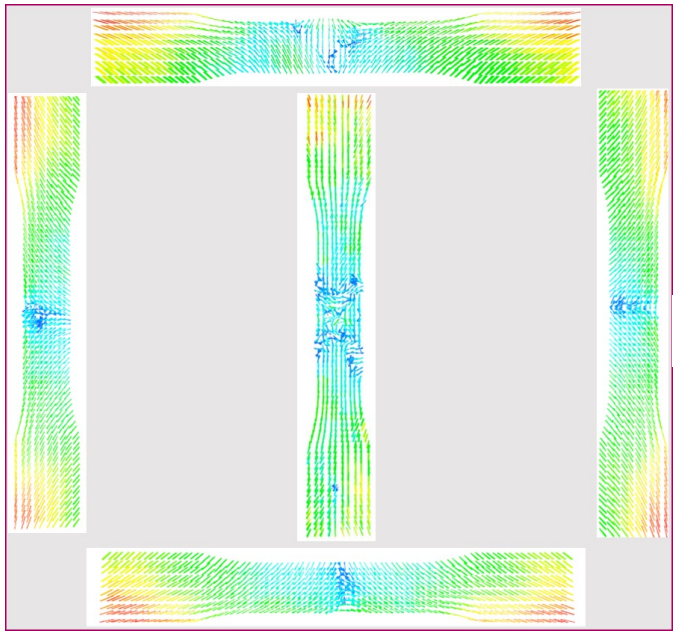


SMC FLAT PANEL TEST CASE

Predicting impact of fiber orientation on tensile properties within flat SMC panel.

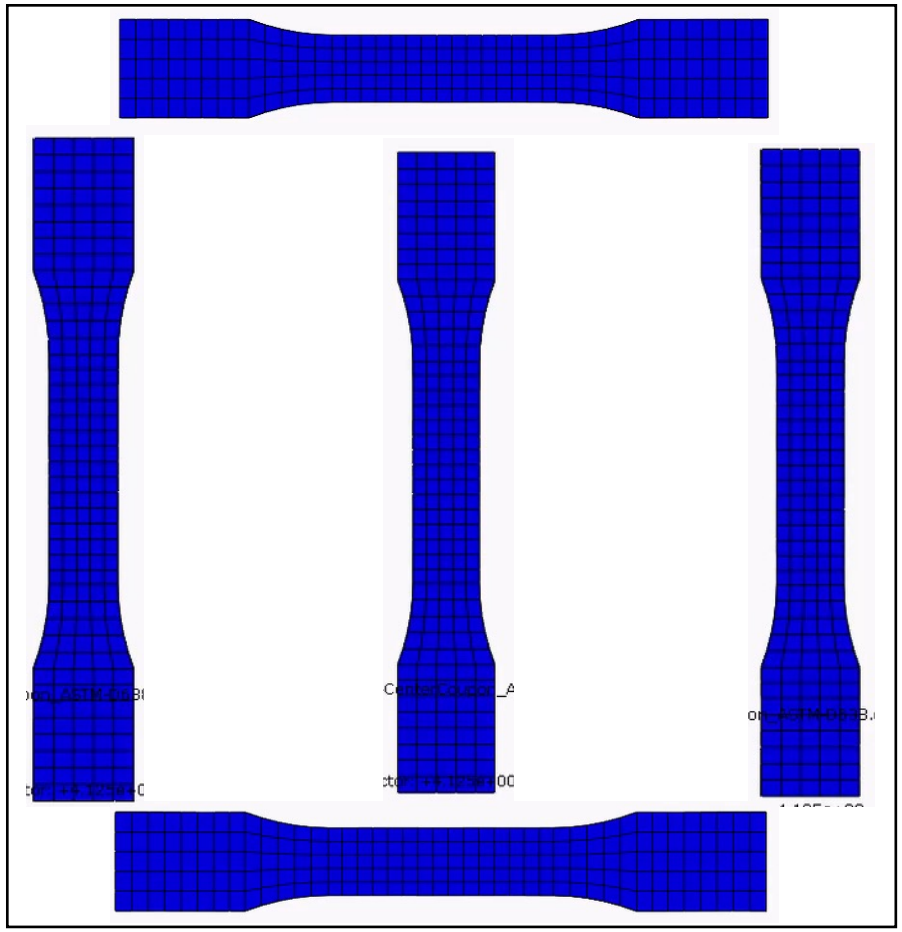


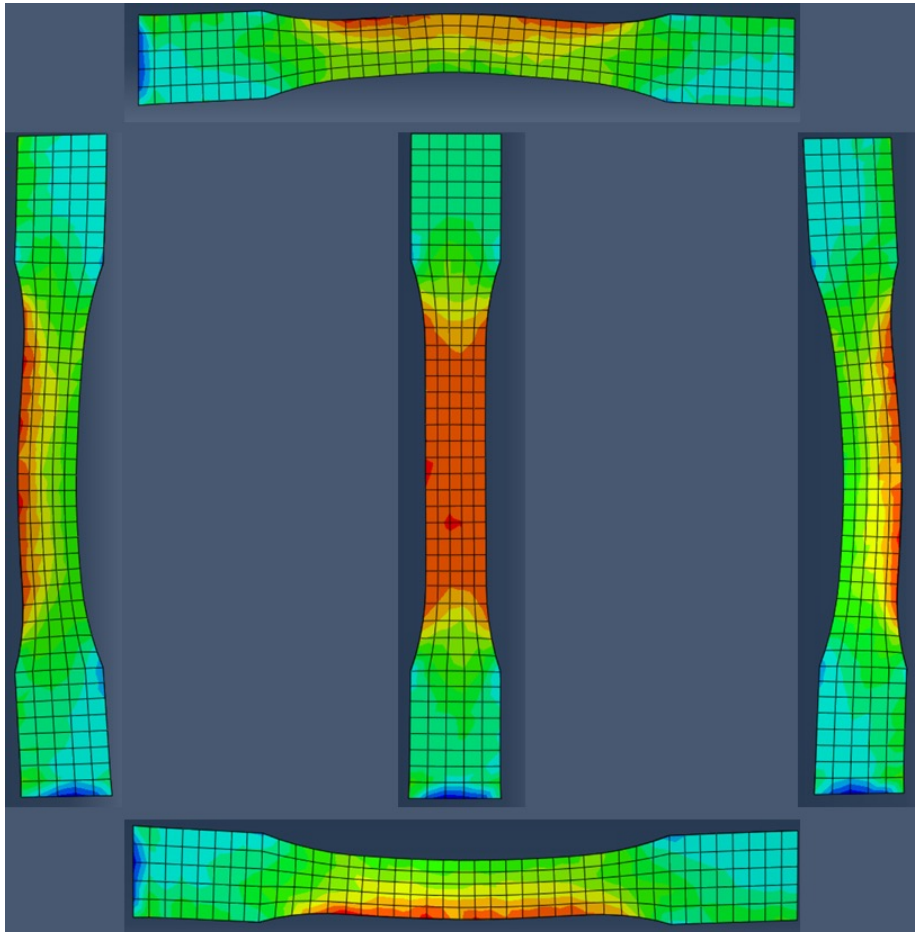




Fiber Orientation

COUPLED FEA SIMULATION

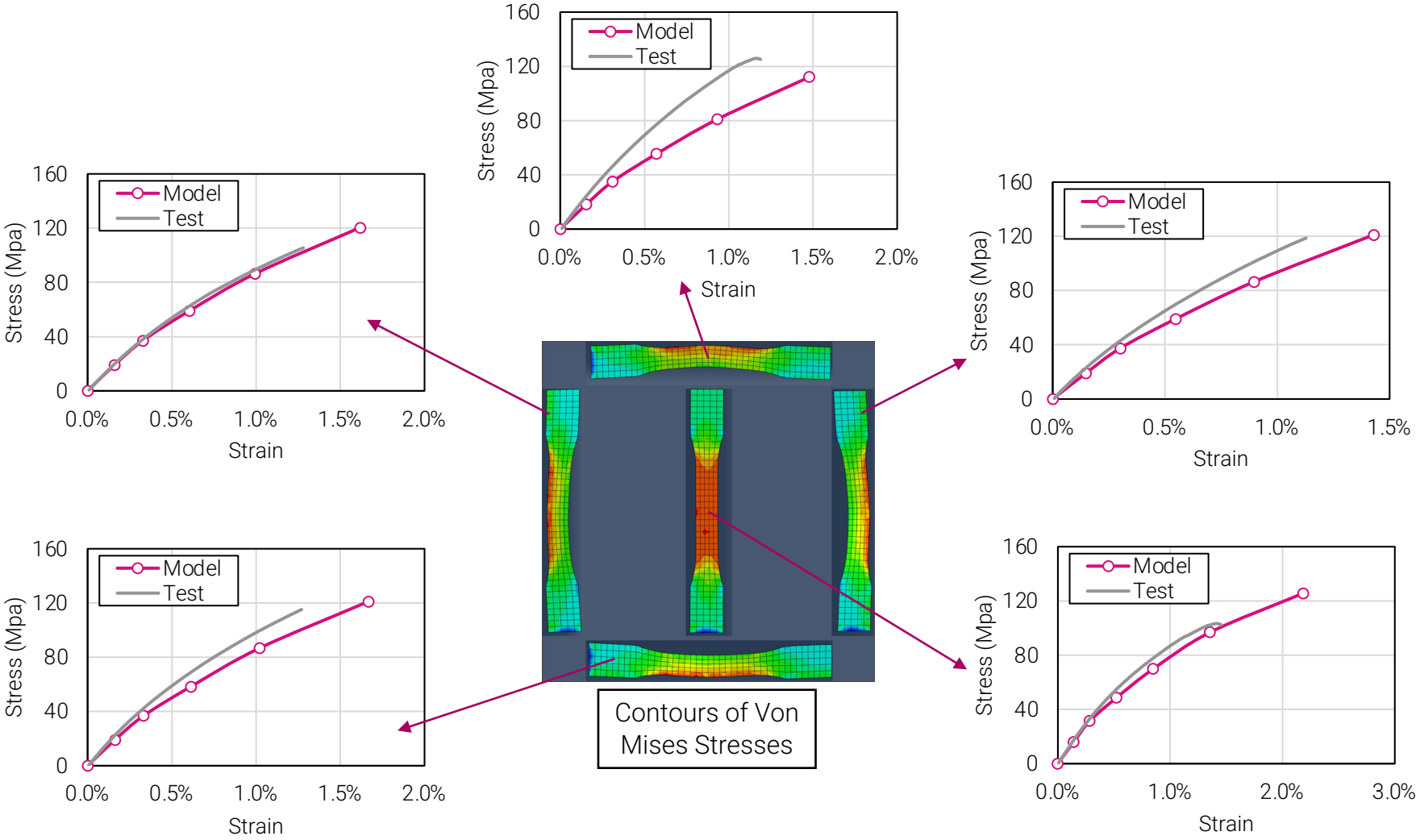




Contours of Von Mises Stresses

- Each coupon deforms differently based on its fiber orientation.
- Bending toward the outer edge where there is higher fiber alignment.
- Center coupon does no bend due to random fiber orientation.

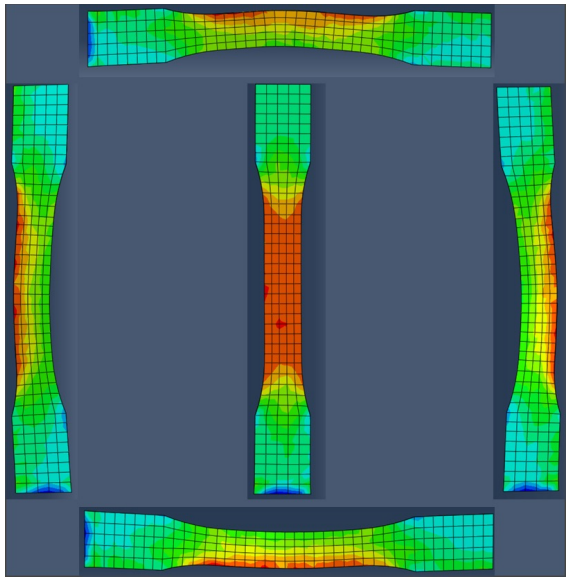
COUPLED FEA SIMULATION



Good accuracy in predicting stress-strain curves at multiple coupon locations. Note that the experimental curve is an average of multiple curves.

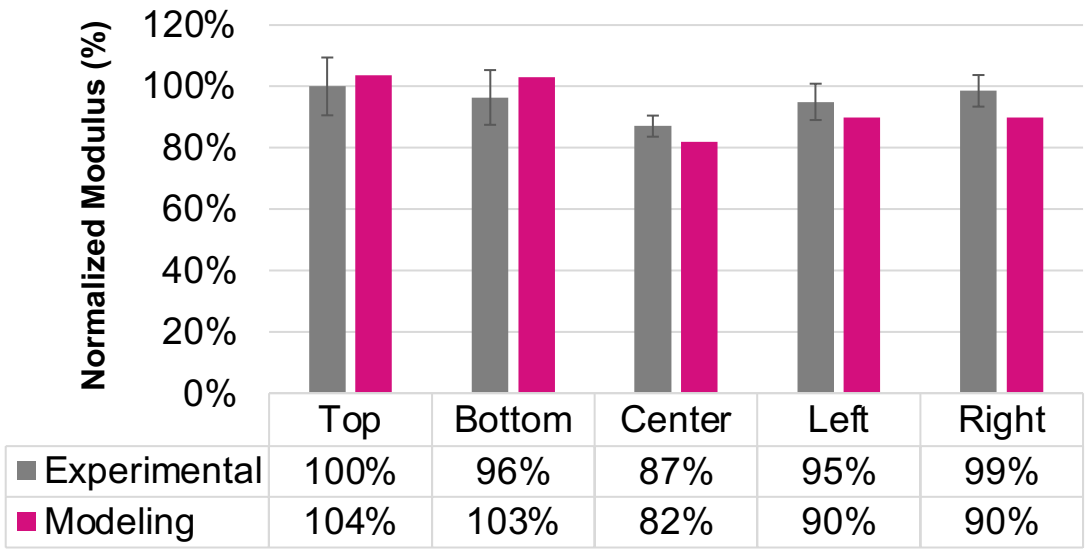
COUPLED FEA SIMULATION

Contours of Von Mises Stresses

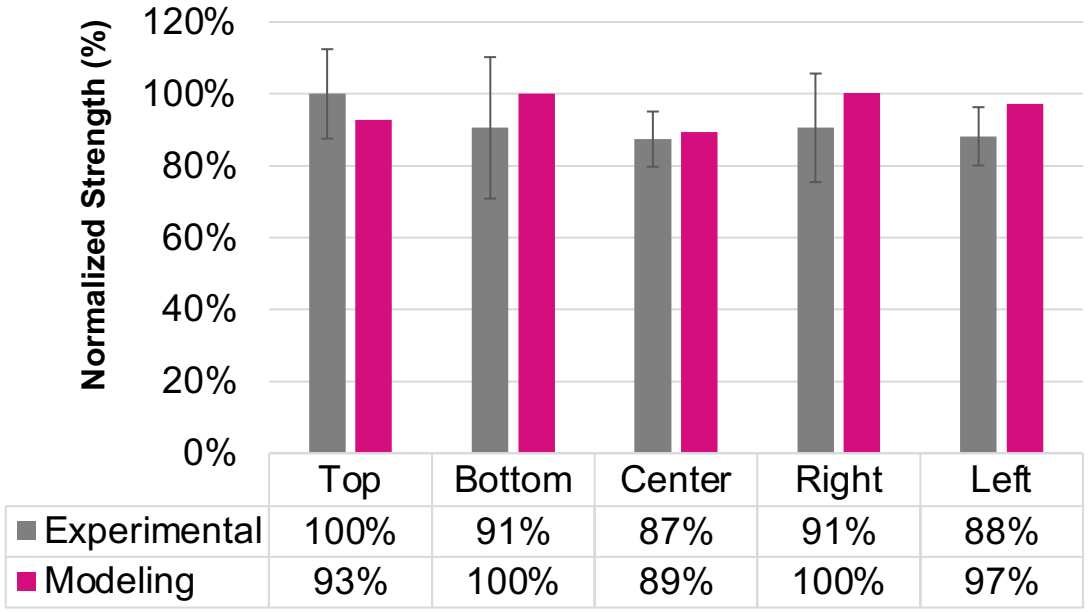


	Test data	Model data
Min Strength	87% @ Center	89% @ Center
Max Strength	100% @ Top	100% @ Bottom & Right
Mean Strength	91%	96%
Standard Deviation	4.5%	4.3%

+90% accuracy in predicting SMC stiffness and strength by this modeling approach! This could not be achieved without the accurate Material Data Cards.



	Top	Bottom	Center	Left	Right
Experimental	100%	96%	87%	95%	99%
Modeling	104%	103%	82%	90%	90%



	Top	Bottom	Center	Right	Left
Experimental	100%	91%	87%	91%	88%
Modeling	93%	100%	89%	100%	97%

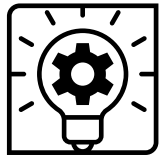
DESIGN AT THE SERVICE OF SMC

BETTER QUALITY. MORE BENEFITS. MORE OPPORTUNITIES.

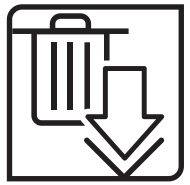
- A boost in quality, part performance or cost optimization through design.

OPTIMIZING QUALITY

VARIABILITY

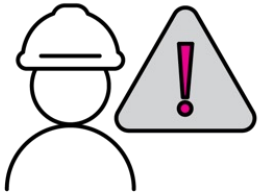


CHARGE PLACEMENT DESIGN

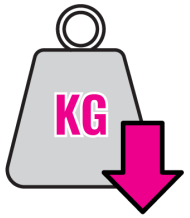


SCRAP RATE

OPTIMIZING COST PERFORMANCE

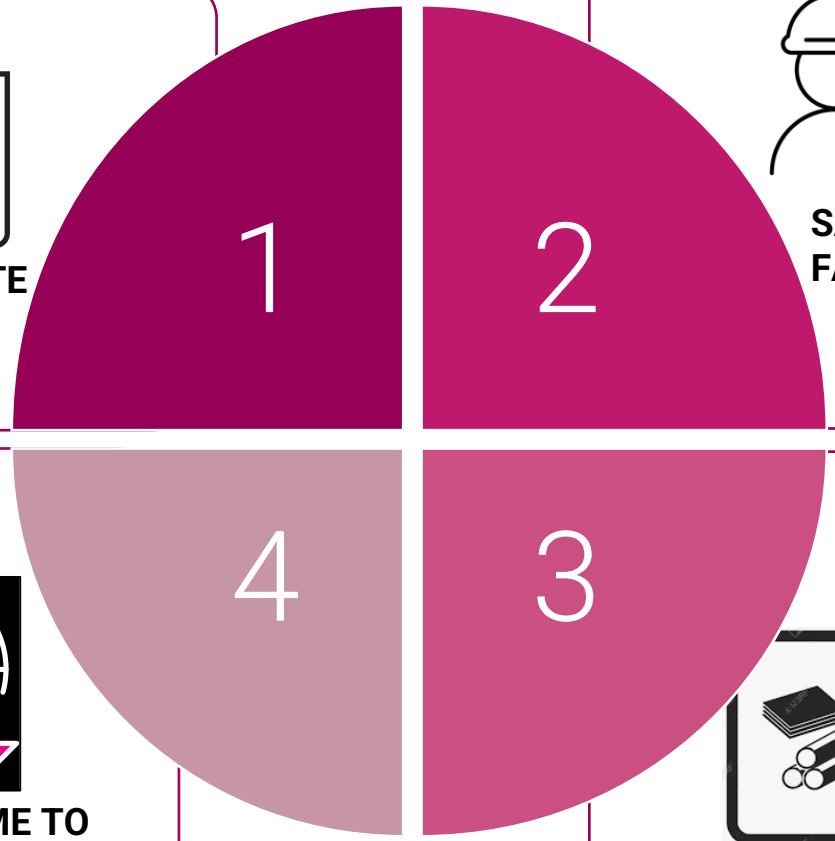


SAFETY FACTOR

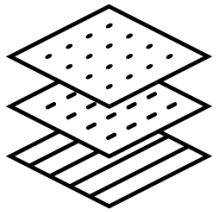


WEIGHT REDUCTION

COST REDUCTION

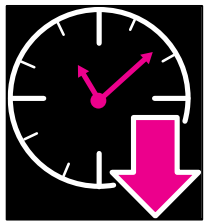


ACCELERATE R&D



MULTI-MATERIALS

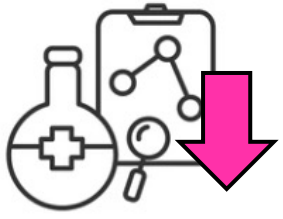
NEW FEATURES



REDUCED TIME TO MARKET

ACCELERATE MATERIAL CONVERSION

MATERIALS SUBSITUTION



REDUCED TRIALS

NEW MARKET SHARES

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