Sandwich Construction is Adaptable for High Volume Automotive Production

Automotive Composites Conference & Exhibition 2019

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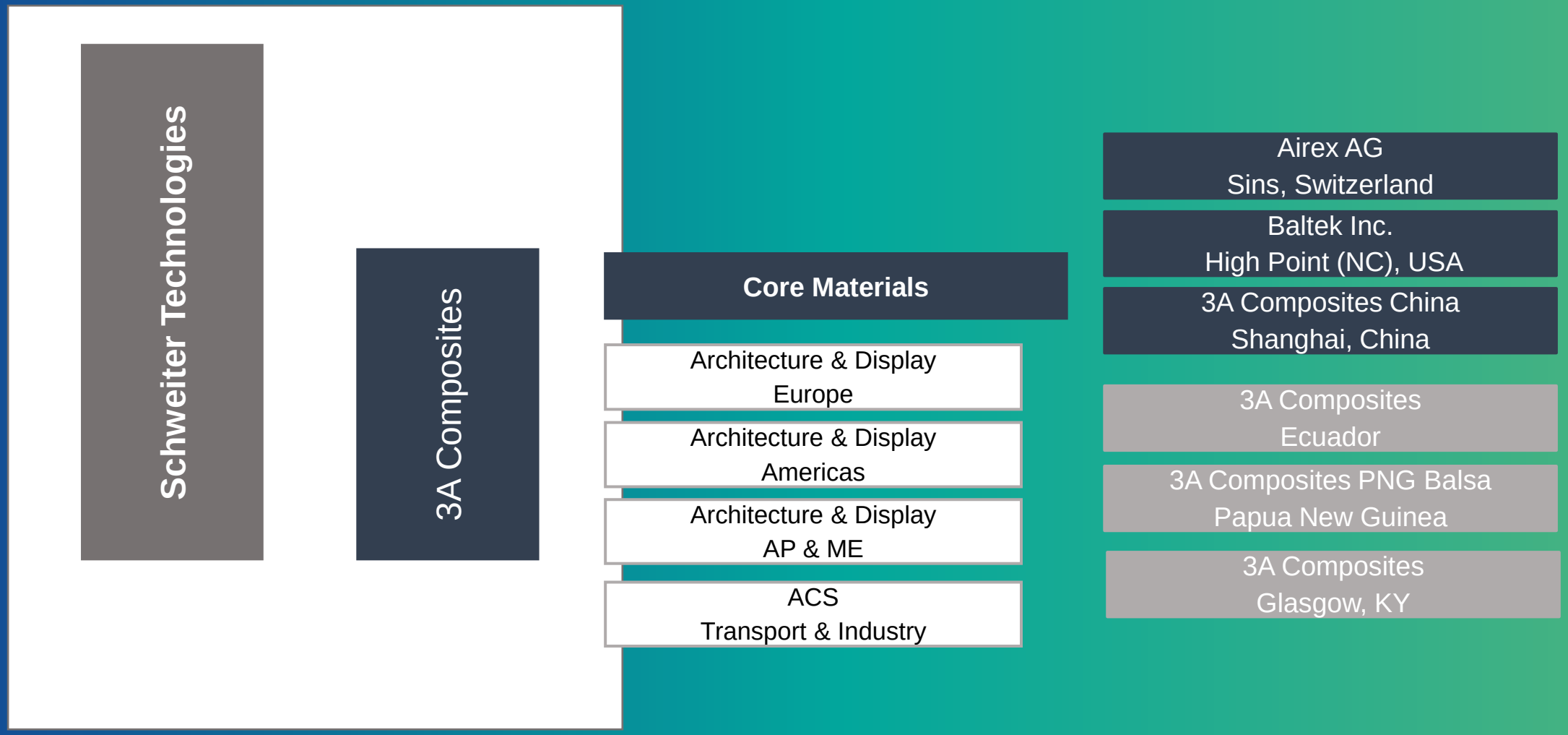
3A Composites – Group Structure

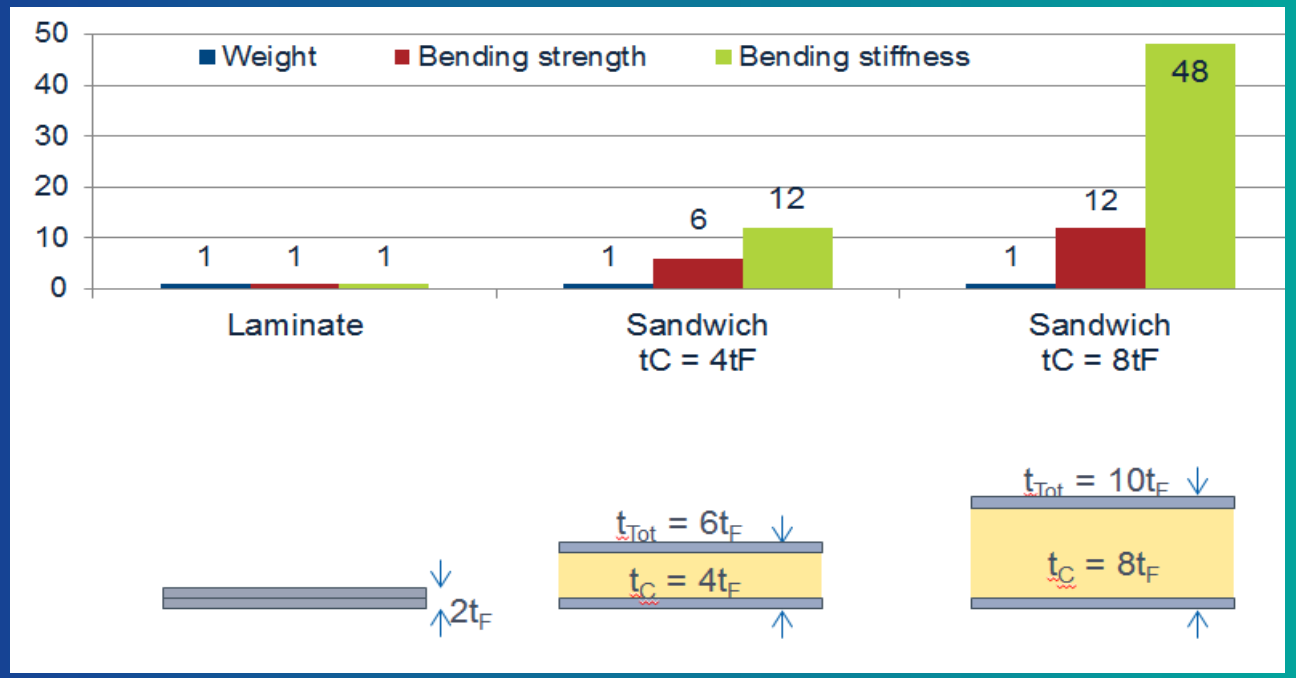


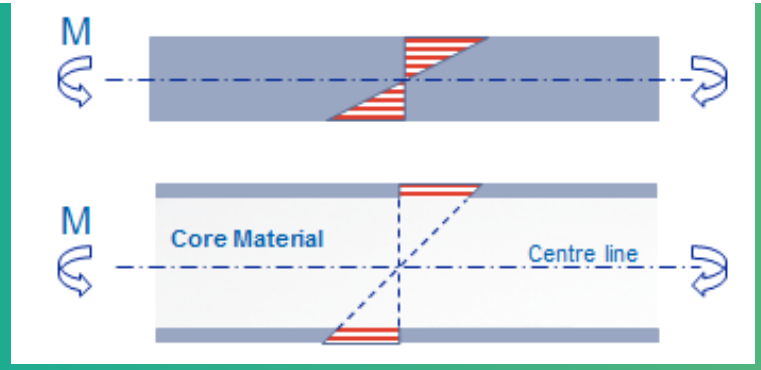
Light-weighting Concepts

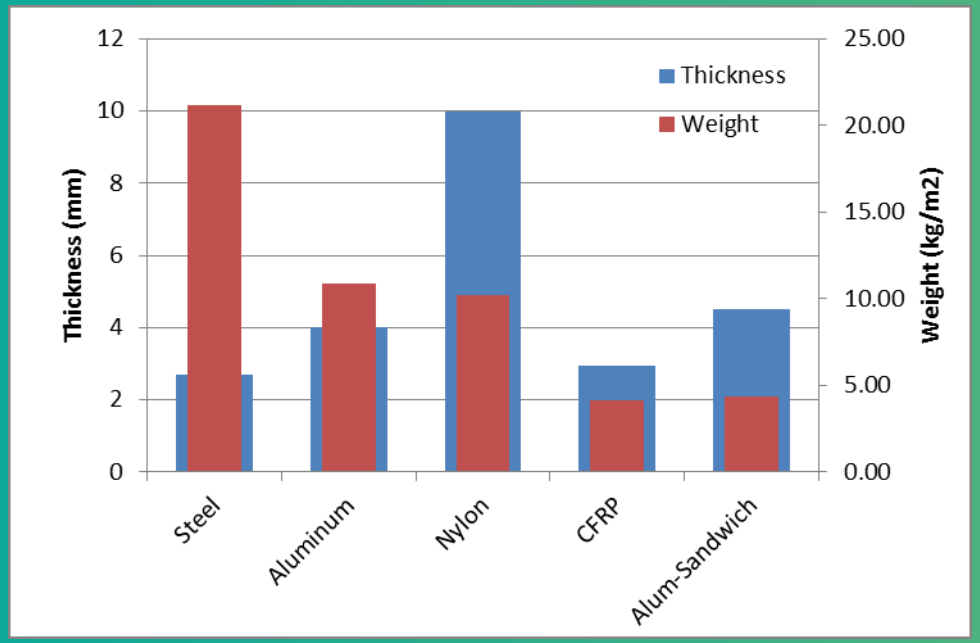
- Material
  - Specifically lighter / stronger materials (e.g. Aluminium, Titanium, HSS)
  - Fibre reinforced plastics (E-glass, Carbon)
  - Foaming to locally reduce density of injection molded plastics
  - Multi-material solutions (primary vs. secondary bonds and joints, welds)
- Geometric Design
  - Ribs, stringers, stiffeners, etc.
  - Shape / profile
  - Sandwich!
- Function Design
  - Functional integration
  - Saving of additional components (e.g. insulation)

Sandwich – The Prime Saver

Combine stiff skins around lightweight core



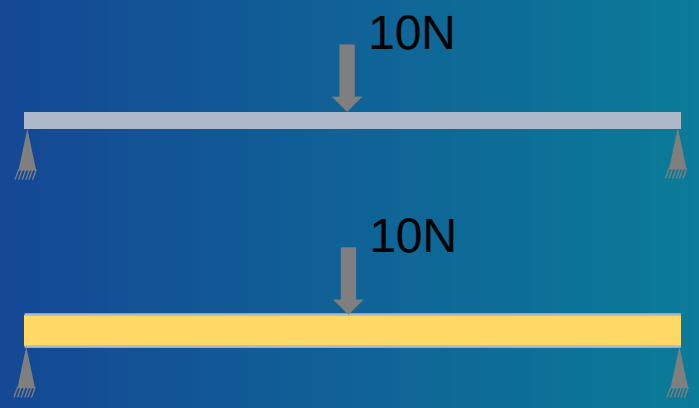




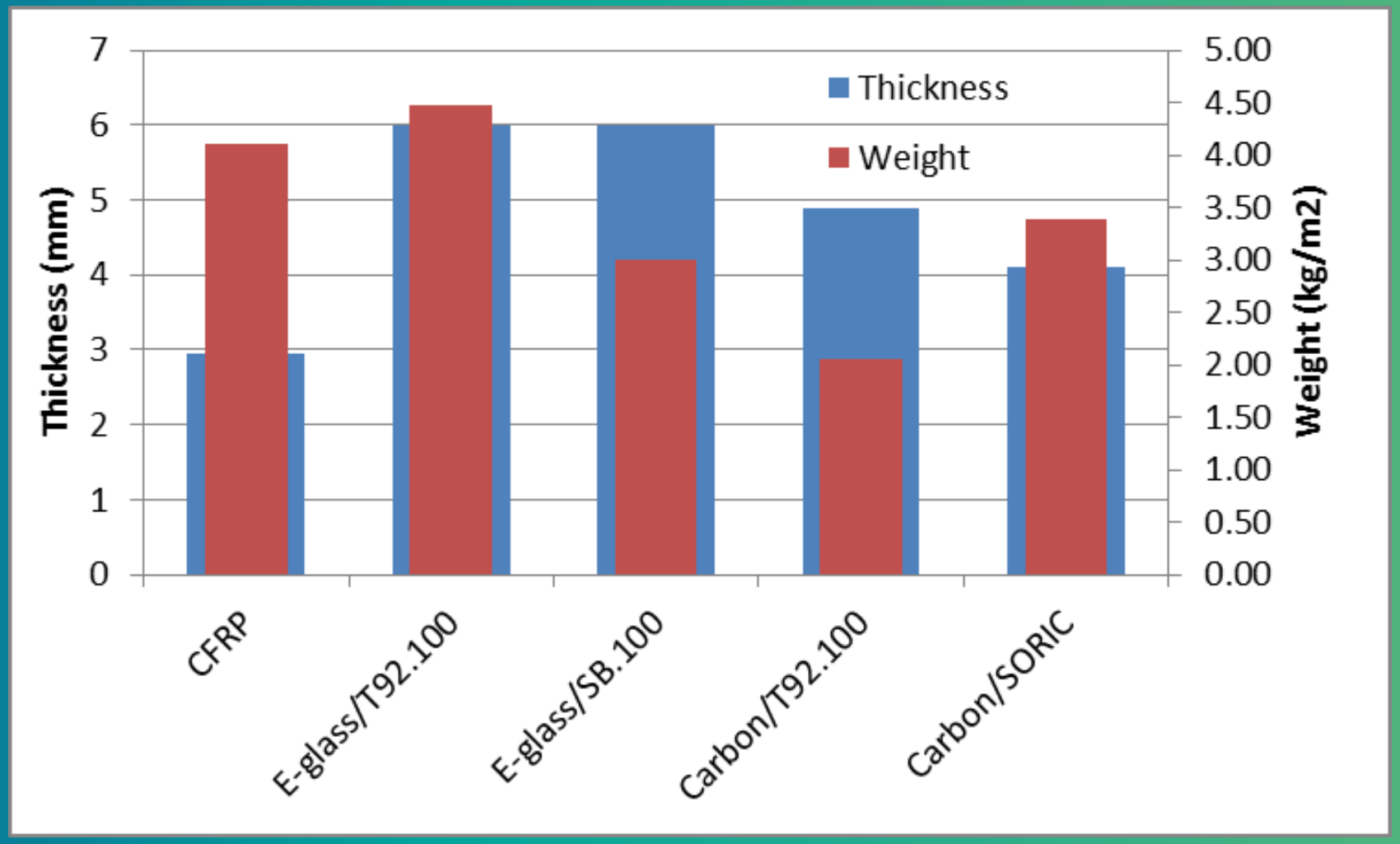
- Weight savings
- Material (mass) reduction
- Lower cost materials without sacrificing performance

- Functional integration
- Liberates part design
- Skins not limited to FRP

Sandwich: Less Material = Lower Unit Cost



- **Equal deflection**
- **Lower weight**
- **Significant reduction in material cost**

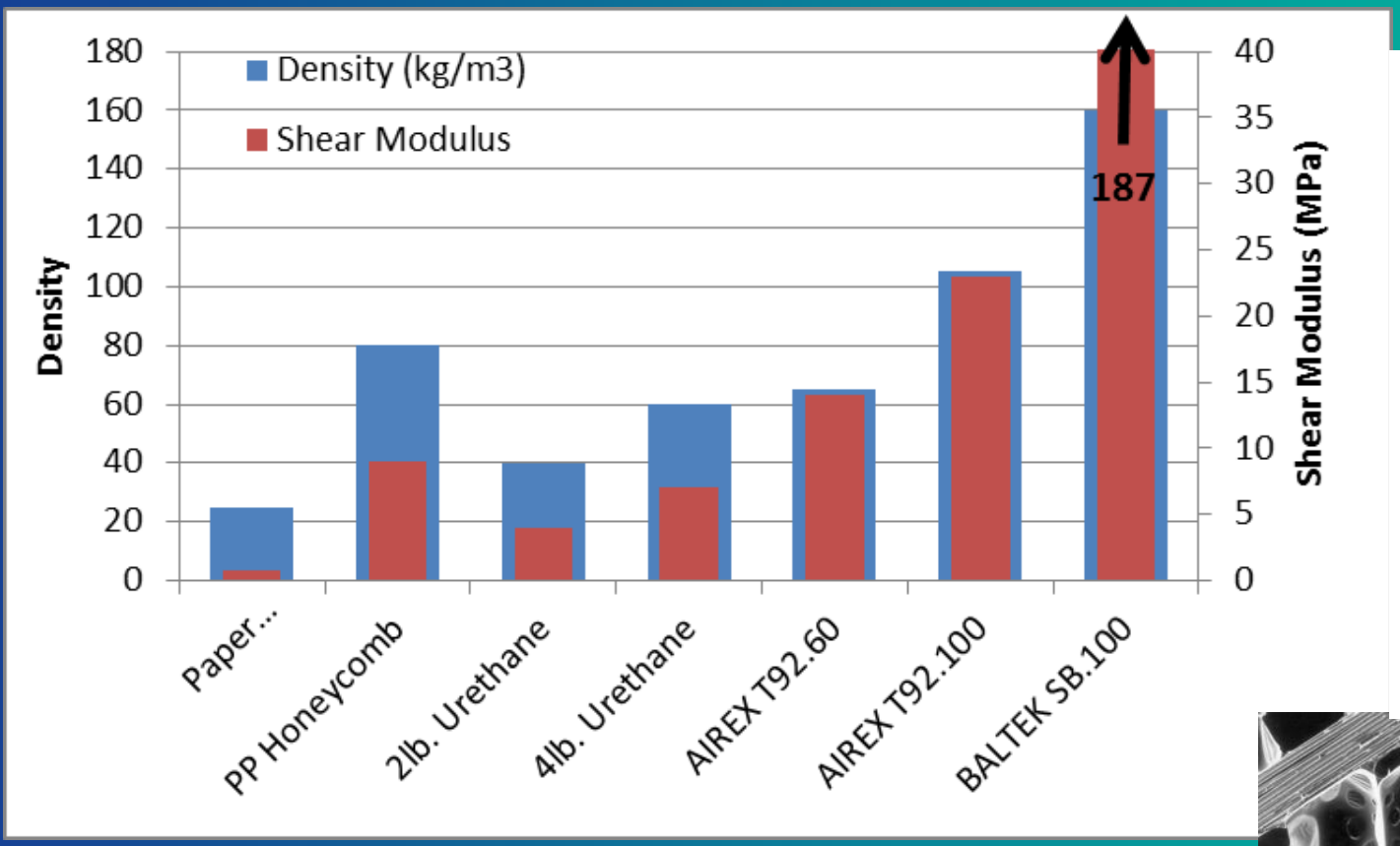


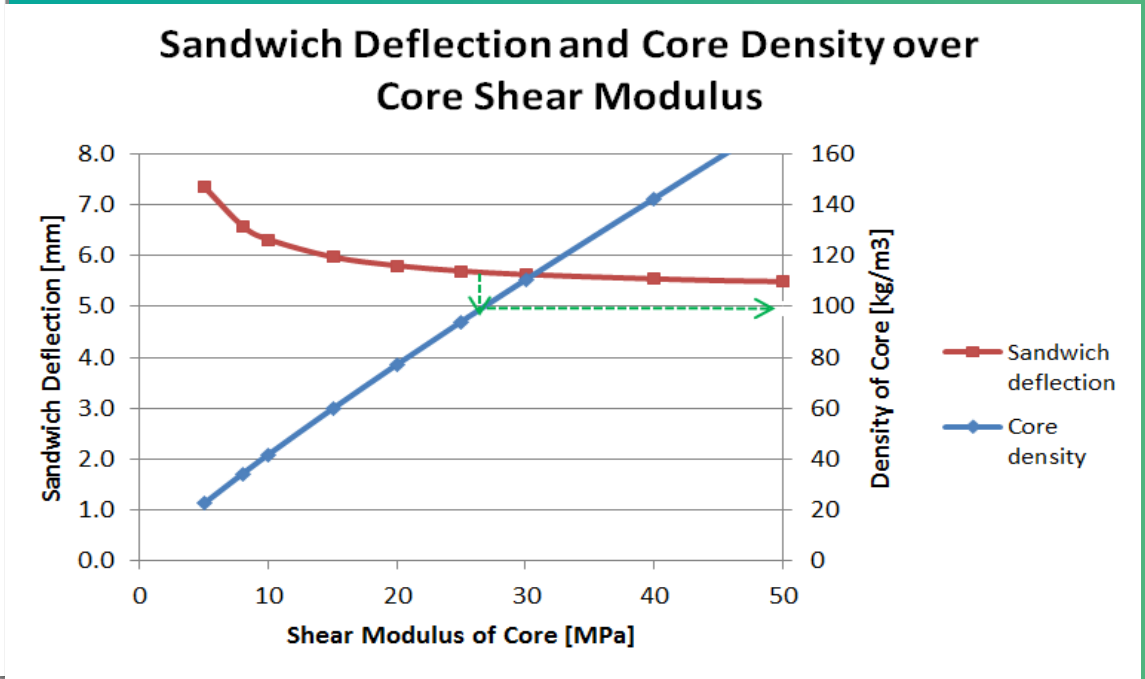
Products for the Automotive Market

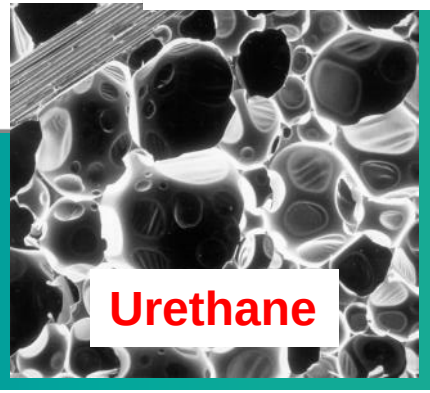
Broadest Selection of Core Materials Worldwide

- **Structural PET foam core materials**
  - ❖ **AIREX® T92** – Easy Processing Structural Foam 60 – 320 kg/m3; 2.5mm & up
  - ❖ **AIREX® T10** – The Industrialized Structural Foam 60 – 170 kg/m3; 2.5mm & up
  - • **AIREX® T90** – Fire Resistant Structural Foam 60 – 210 kg/m3; 2.5mm & up
- **Structural balsa core materials**
  - ❖ **BALTEK® SB** – Select Grade Structural Balsa 100 – 250 kg/m3 5mm & up
  - ❖ **BALTEK® SBC** – Plantation Controlled Structural Balsa (FSC Certified)
  - • **BALTEK® IG** – Industrial Grade Balsa 120 kg/m3 5mm & up
- **Structural mat core fabrics**
  - • SORIC® XF, SF – Fast resin flow media bulker mat for closed molding 2 – 6mm
  - • SORIC® TF – Print Blocker mat for closed molding 1.5 – 3mm
  - • SORIC® LRC – Low Resin Absorption mat for closed molding 1.5 – 3mm
  - • Finishmat® D7760 – Surfacing veil for closed molding (PA6)

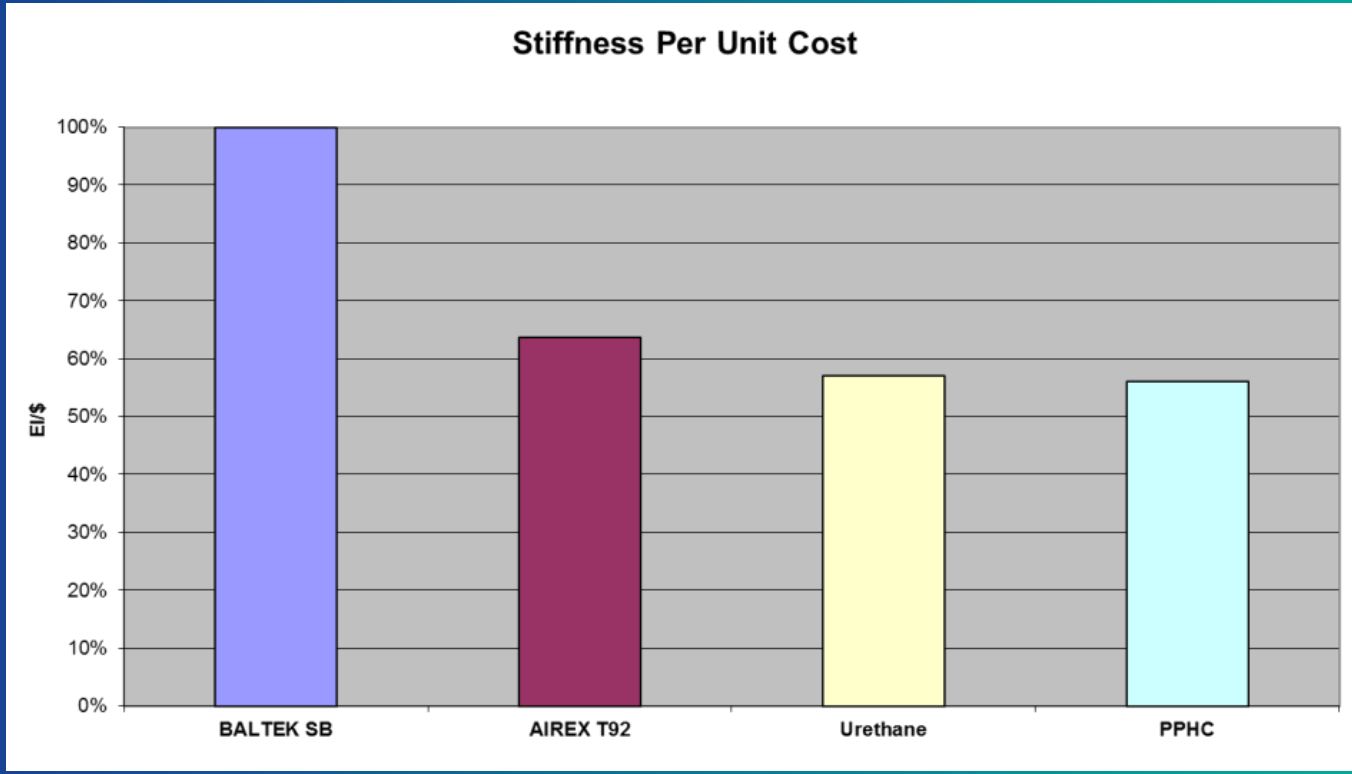
Mechanical Properties of Various Core Materials

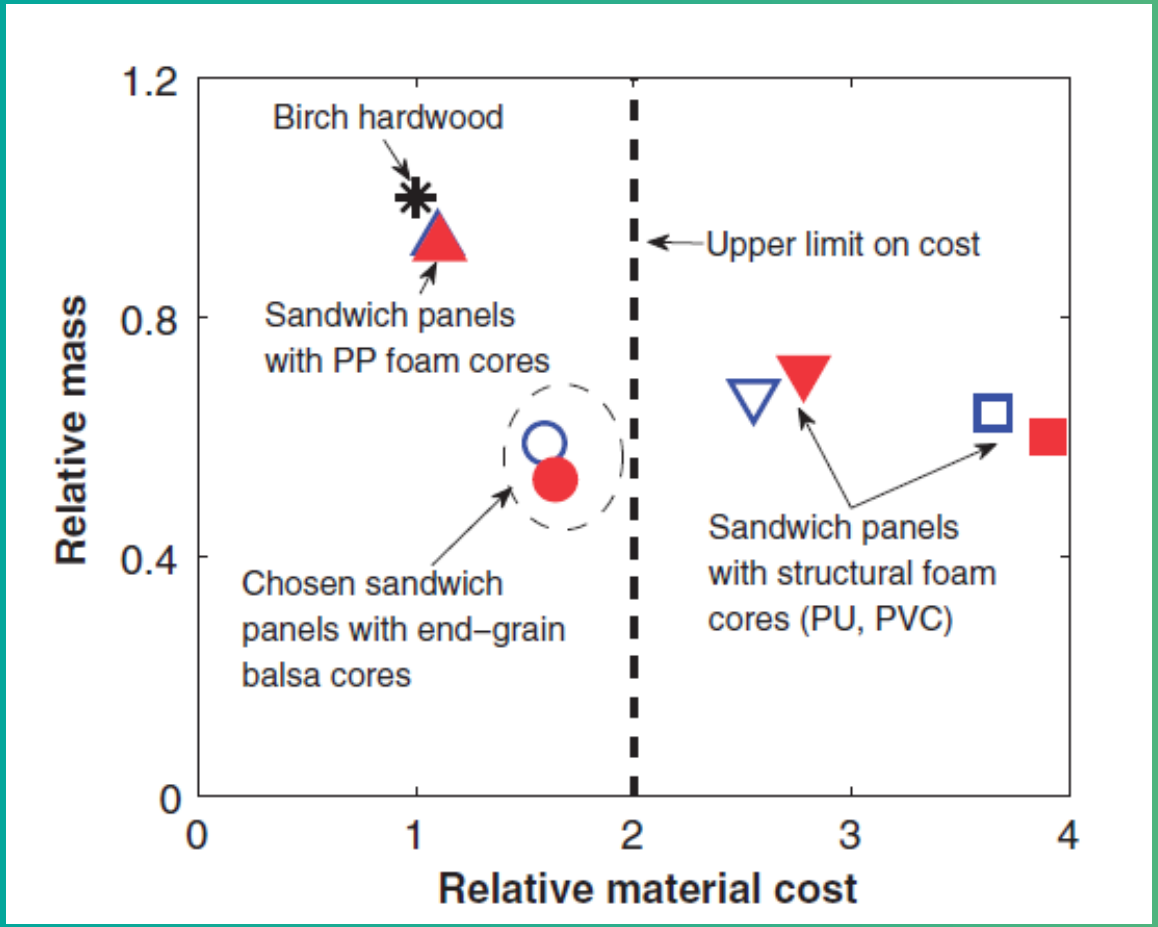






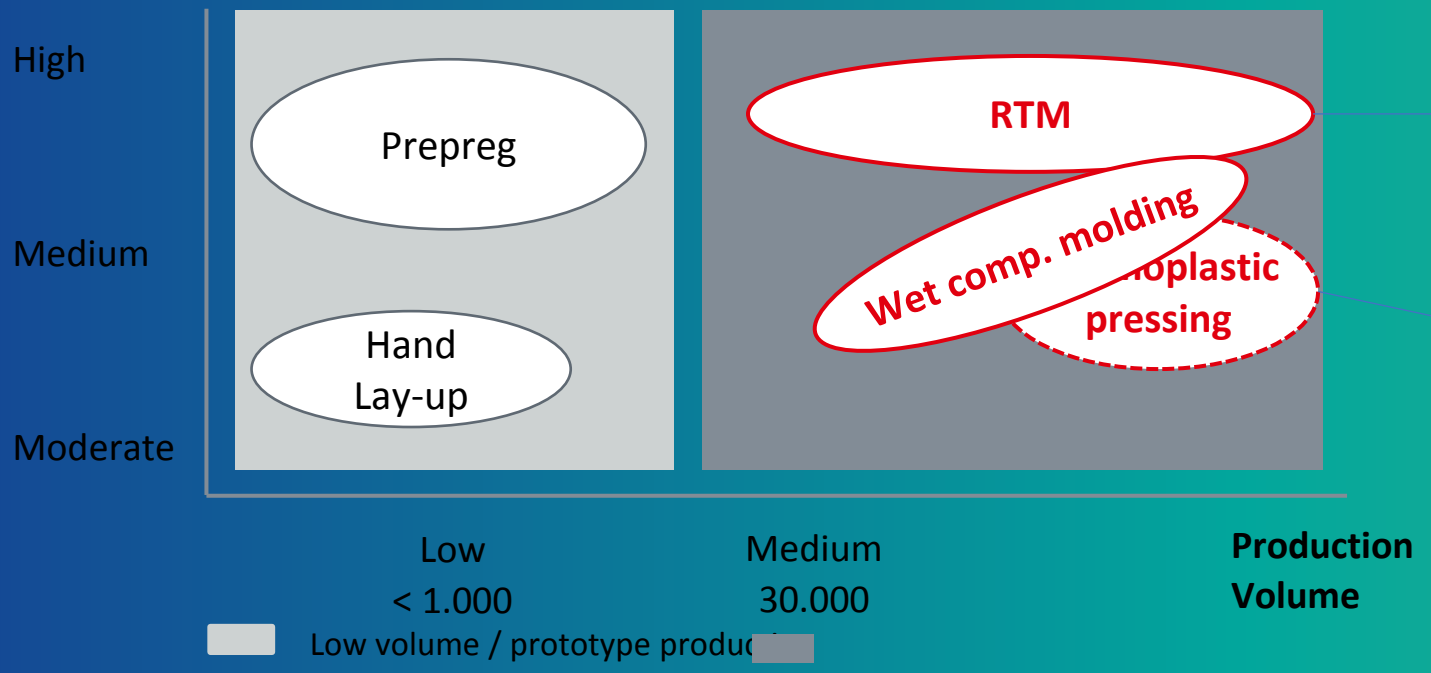
Core Material Performance vs. Cost

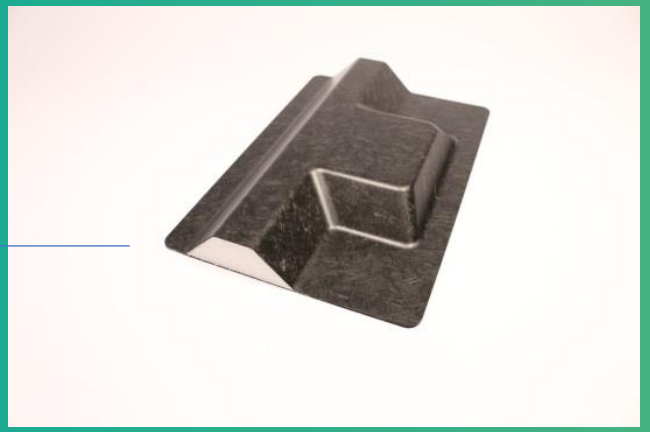




Manufacturing composite sandwich structures

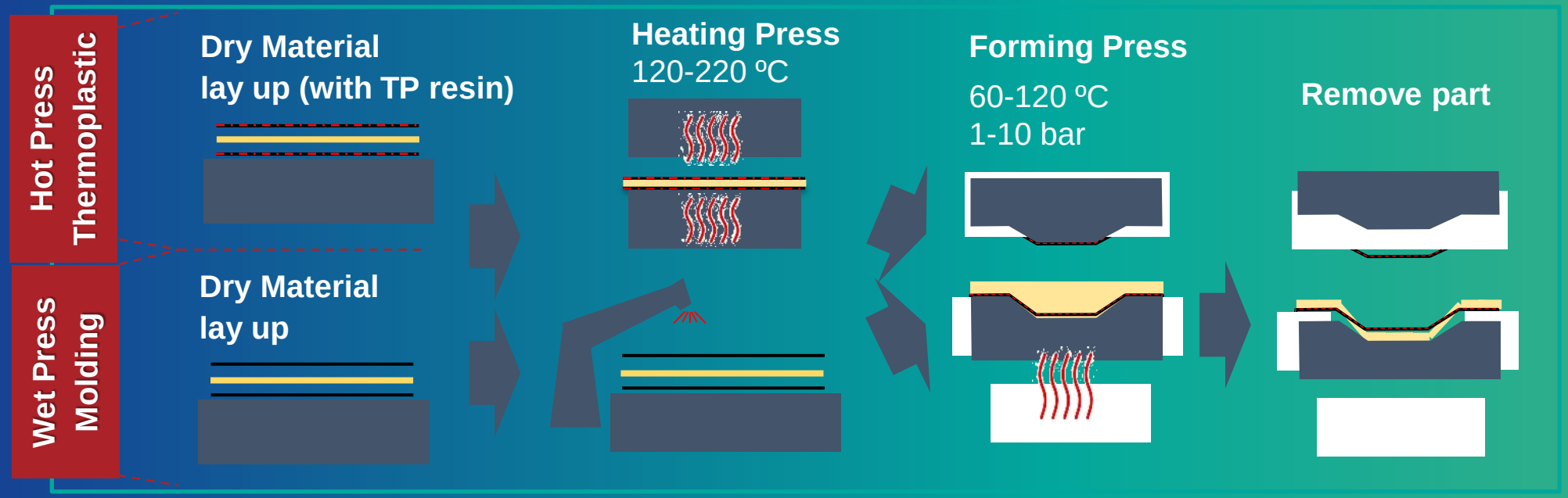
Technical Requirements

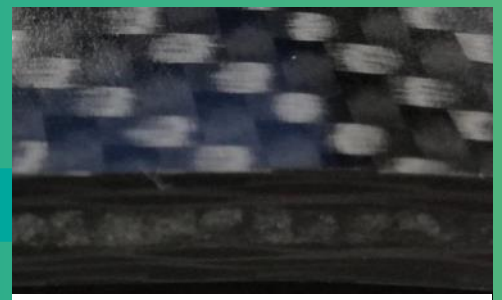


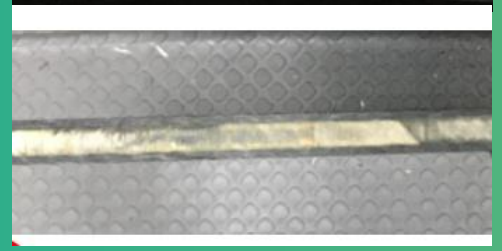


Efficient Sandwich Part Production 1/2

Compression molding





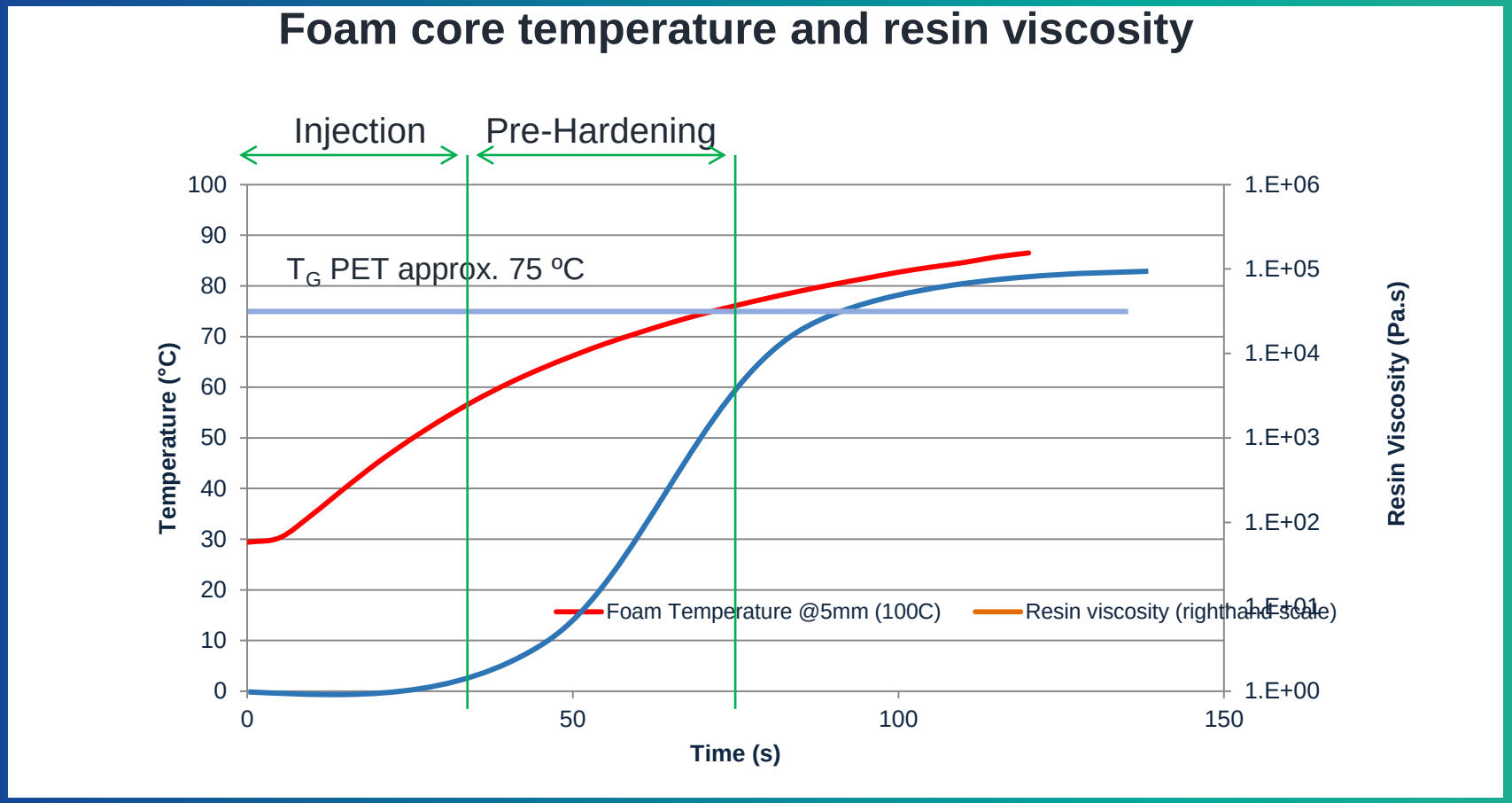


Process details	
Resins	Thermoplastic (PP, PA, PET etc.) Thermoset (Epoxy, PU etc.)
Temperatures	Depending on resin
Pressures	1-20 bar
Cycle time	Starting at ≈ 60 sec.

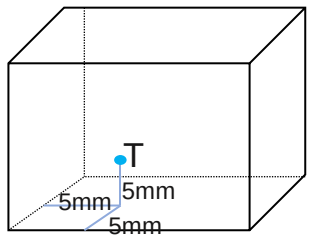
- ✓ Simple, easy-to-control process
- ✓ Low investment required
- ✓ Cost efficient thermoplastic resins possible
- ✓ Use of metal face sheets possible (thermo-bonding)

Process Speed

Short Cycle Time Allows Consolidation While Foam Remains Cold

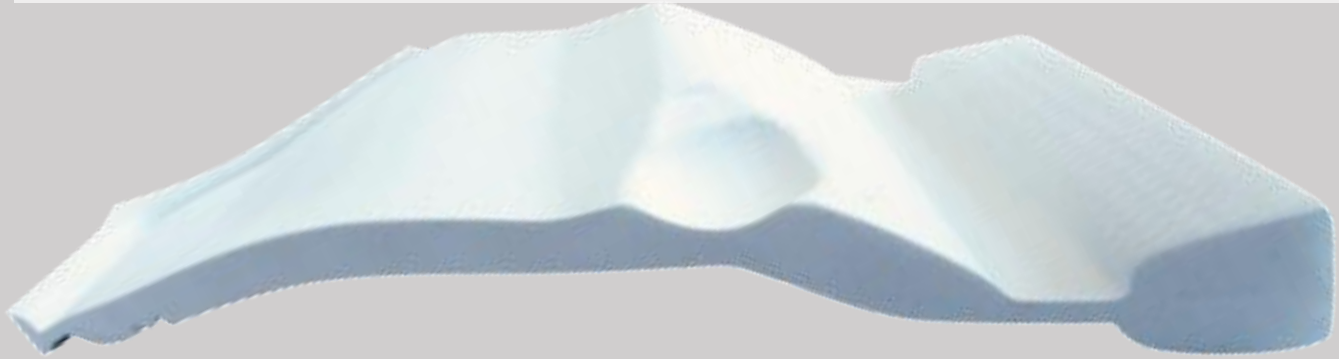


- ✓ Foam core (insulating) heats up slowly
- ✓ Remains below T_G for some 30-60 seconds



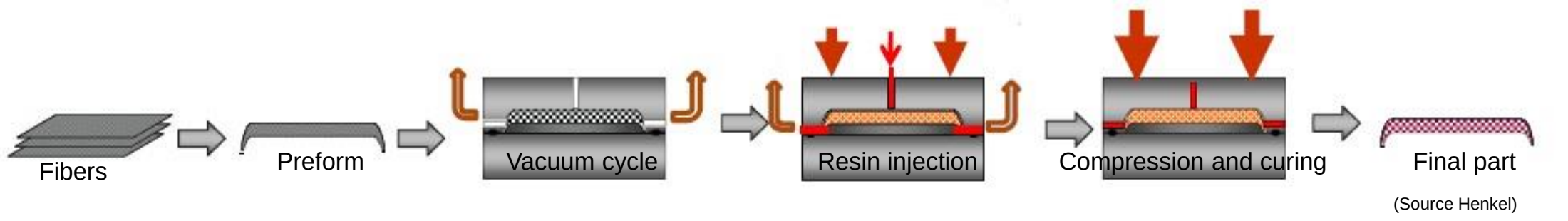
Thermoforming AIREX® Cores into Shape

- ✓PET foam cores are very simple to thermoform ≈ 160 ºC
- ✓No spring back
- ✓Large elongations possible
- ✓Thickness differences of up to 75%
- ✓Surface remains the same (skin adhesion assured)



Efficient Sandwich Part Production 2/2

High Pressure Resin Transfer Molding (HP-RTM)



(Source Henkel)

- High pressure?
  - High pressure mixing unit
  - Injection pressure in mold depending on feed rate
- HP-RTM well established for monolithic structures
- Process in development for sandwich structures
  - Only thin skins needed
  - Lower pressure in mold sufficient for full fiber wetting
  - Advantage for cost-effective core materials such as PET

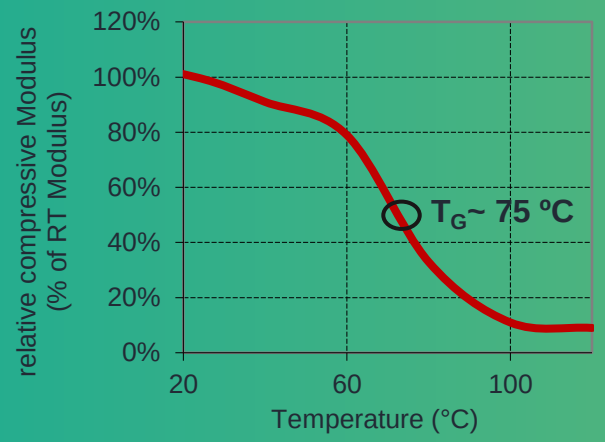
High Pressure Mixinghead

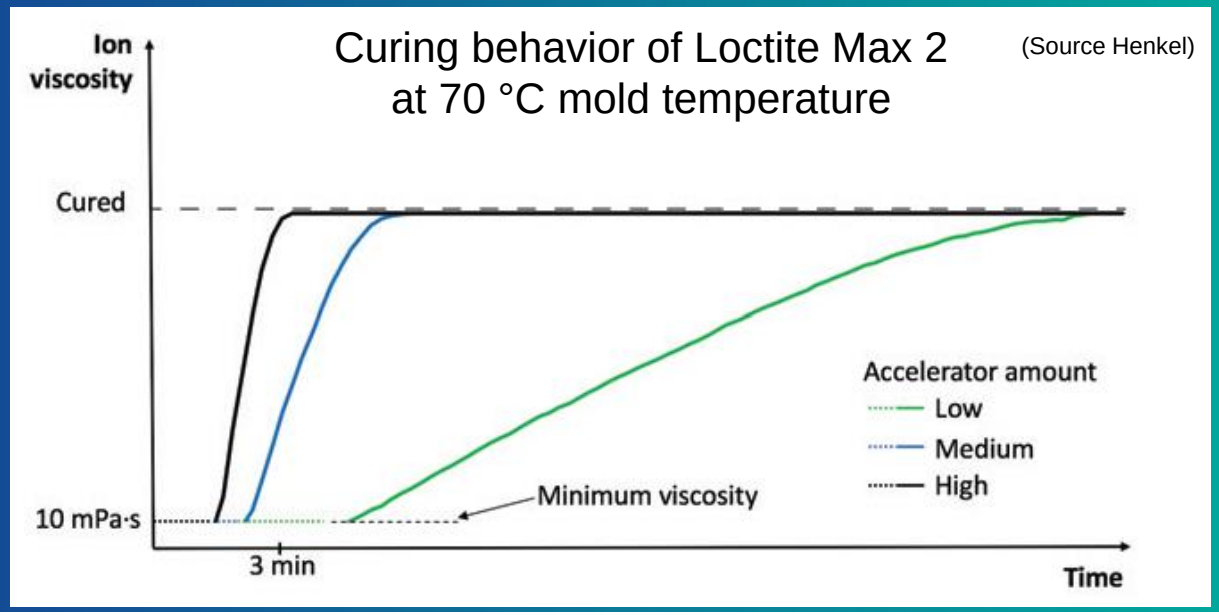
(Source Henkel)

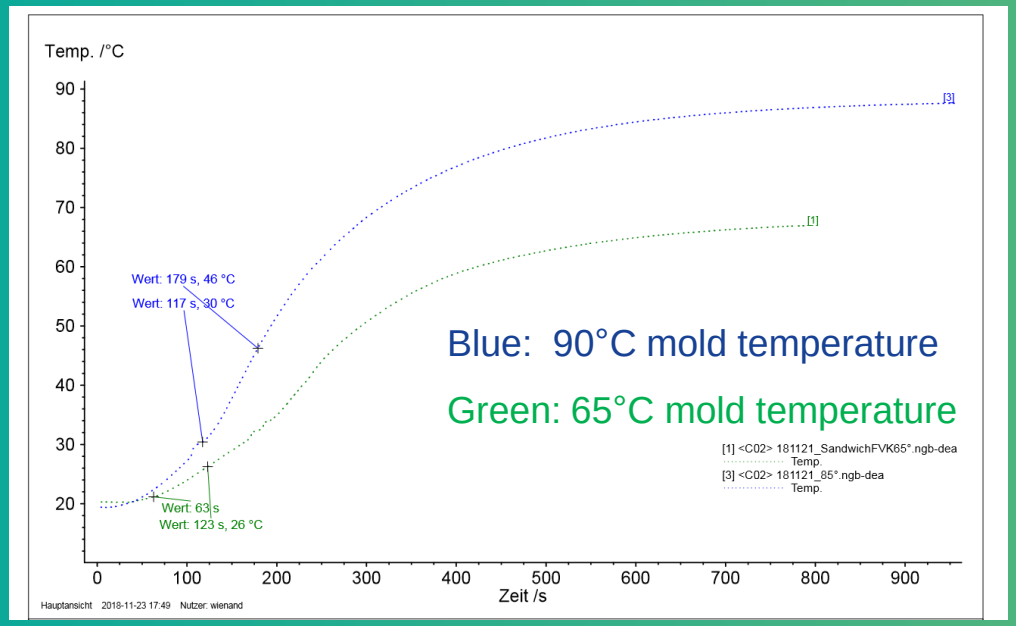
Process optimization

- Requirements for resin system
  - Low viscosity for fast filling
  - Low temperature fast curing to keep foam cold
    - Softening (Tg) of PET foam is around 75 °C
- Mold Temperature: low is best for foam
- Softening of foam is avoided with short cycles

PET foam mechanical properties vs. temperature







Examples of Successful Automotive Production

Structural floor of GM Corvette and Cadillac Roadster (approx. 70’000 pa)

- ✓ Weight reduction
- ✓ Side impact improvement
- ✓ Noise reduction

Process description	
Fibers	E-Glass Continuous Filament Mat
Resin	Thermoset
Core	AIREX® T92.130
Process	Wet Compression molding

Interiors trim parts (approx. 120’000 pa)

- ✓ Weight reduction (~40%) @ 1 mm thicker
- ✓ Crash behavior
- ✓ Thermal insulation
- ✓ Noise reduction

Process description	
Fibers	Glass hybrid fleece
Resin	PP fibers in fleece (thermoplastic)
Core	AIREX® T10.100
Process	Hot Compression molding (thermoplastic at 180 - 220 °C)

Learning's for Cost Efficient, Short Cycle Sandwich Production

- ✓Composite Sandwich combines *material* AND *constructive* light-weighting design strategies thus maximizing both weight & cost saving
- ✓Sandwich permits use of lower cost materials to create higher performing parts
- ✓Sandwich can utilize both metal and composite facing materials as well as thermoset & thermoplastic resin systems
- ✓AIREX®, BALTEK® & SORIC® cores offer far superior performance to urethane, plastic & paper honeycomb.
- ✓AIREX® & BALTEK® products are renewable & recyclable
- ✓Several series applications ongoing and successful
- ✓RTM is most challenging
- ✓Want ribs? Try a sandwich instead

Questions?

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