



**CORE  
MATERIALS**

# **Automotive Composites Conference & Exhibition**

**September, 2023**

## **High Performance, Bio-based & Sustainable Sandwich Core Materials for Automotive & Air Mobility**

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**Product Development Director**

**3A Core Materials**

# Outline

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2. Product List
3. Benefits of Sandwich
4. Sandwich Sustainability
5. BALTEK Balsa Core
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8. PET Sustainability
9. Non-woven Fabric Sandwich Cores
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# Company Introduction

## 3A Composites Core Materials – Global market leader with local resources

- Industry leader with over **80 years** of experience
- **Lightweight material** producer with focus on **PET foam and Balsa wood**
- Globally inspired, locally sourced, widely available
- A **sustainable & lean** supply chain for a world-class industry
- Fully adopted **APQP, IMDS**
- Fully committed to become a **carbon neutral company by 2025**
- Aligned with the 17 **SDGs Goals** from the UN

80 YEARS OF EXPERIENCE



GLOBAL FOOTPRINT IN SUSTAINABLE CORE MATERIALS



1,855 No. OF EMPLOYEES

13,250 ha. OF FSC® CERTIFIED PLANTATIONS



KITS@SOURCE



ca. 3,5 MILLION TREES PLANTED A YEAR



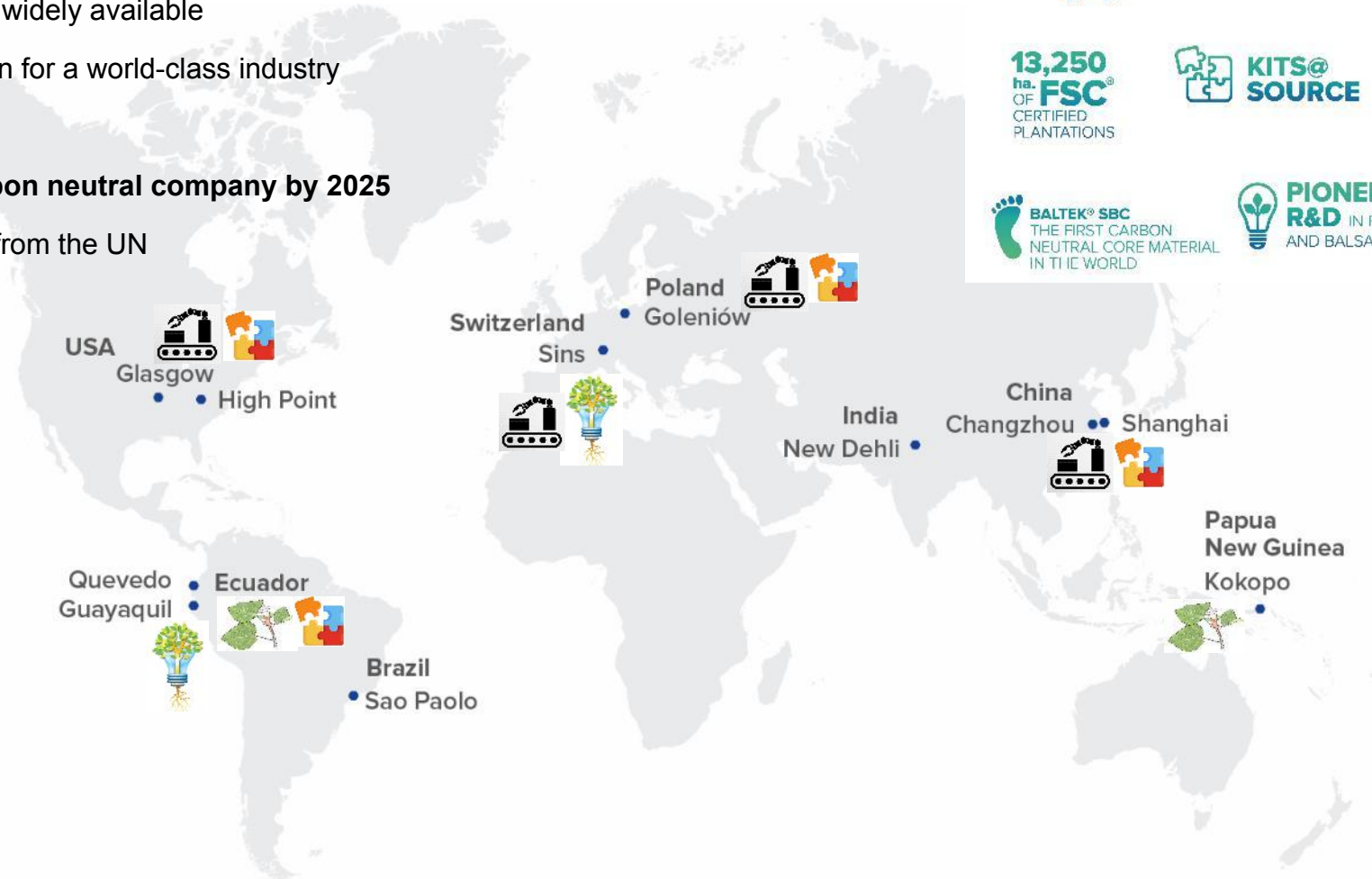
BALTEK® SBC THE FIRST CARBON NEUTRAL CORE MATERIAL IN THE WORLD



PIONEERING R&D IN PET AND Balsa



36% RESIN UPTAKE SAVING THANKS TO PET SFAI X



PET manufacturing location



Balsa manufacturing location



Kitting



Innovation center

# 3A Core Materials

## The Broadest Selection of Sandwich Core Materials Worldwide

- The perfect product solution for every single customer requirement:

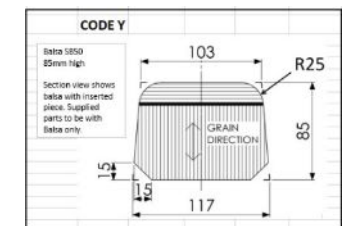
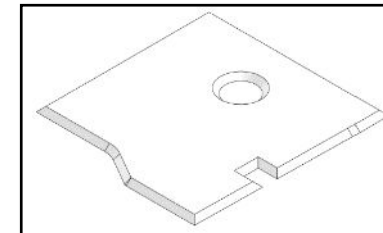
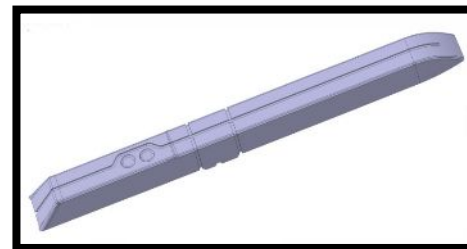
### Structural foam core materials

- AIREX® T92 – Easy Processing Structural Foam
- AIREX® T10 – Premium Structural Foam
- AIREX® R82 – High Performance Foam
- AIREX® TegraCore™ – Fire Performance Structural Lightweight Foam
- AIREX® T90 – Fire Retardant Structural Foam
- AIREX® C71 – High Temperature Lightweight Structural Foam
- AIREX® PX – Fibre-Reinforced Structural Foam Panel

### Structural balsa core materials

- BALTEK® SBC – Plantation Controlled Structural Balsa Core
- BALTEK® VBC – Oriented Grain Structural Balsa Core

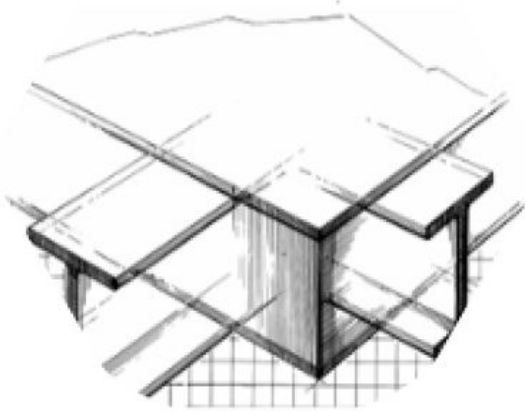
**ENGICORE**  
SHAPED CORE SOLUTIONS



### Lantor Textile Foam Cores

- SORIC® - structural textile core plus resin flow media
- Teccore® TG – for RTM & autoclave
- Teccore® TG HP – for HP RTM

# Sandwich Benefits And Processing

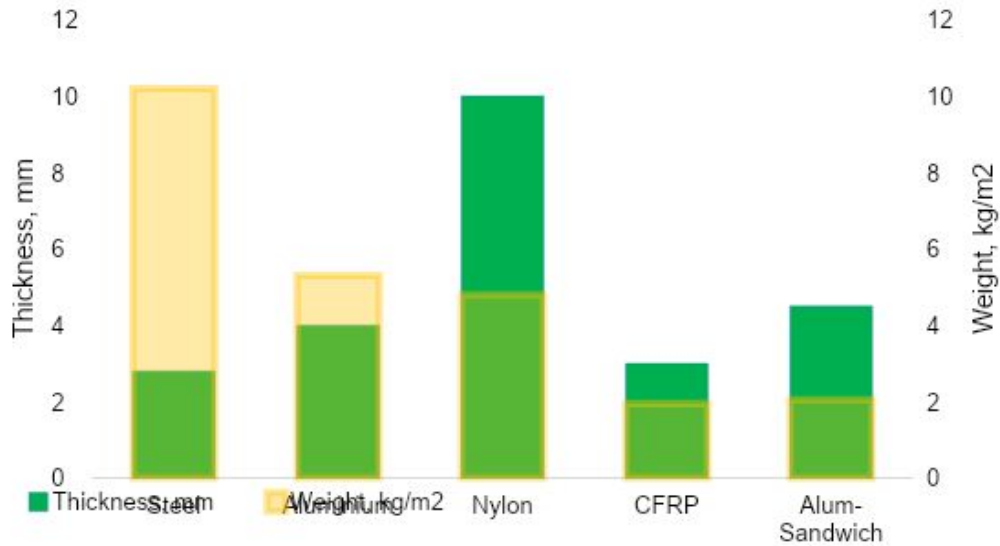


	Weight	Stiffness
	1	1
	1	12
	1	48

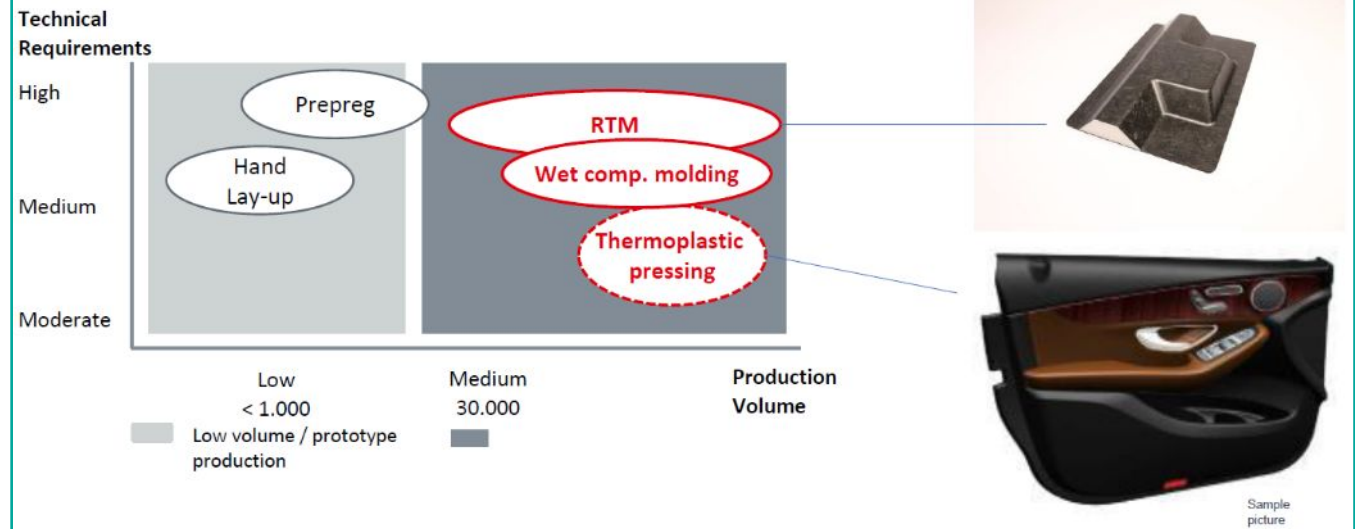
**Benefits of sandwich constructions:**

- ✓ Lowest weight
- ✓ Stiffness and strength
- ✓ Thermal insulation
- ✓ Crash behavior
- ✓ Easier and cheaper to handle (resource avoidance)
- ✓ Sound absorption
- ✓ Ecology
- ✓ Design benefits
- ✓ TCO

Same stiffness with different materials



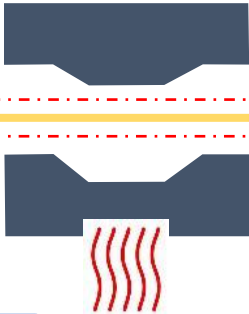
Manufacturing composite sandwich structures:



# Sandwich vs. micro-sandwich: Manufacturing

## Mass production-friendly 3D lamination process

### Forming Press

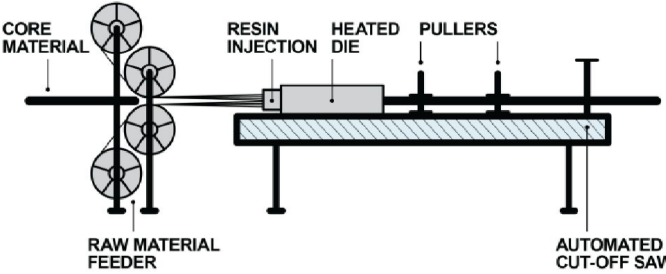
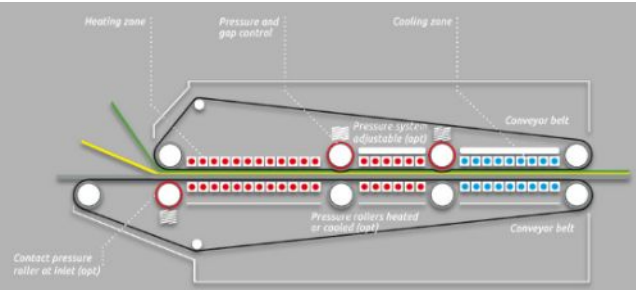


**Thin TF core + TP skin:**  
 Very fast one-shot process + easy formability of thin core sheet

**TF core + TP skin:**  
 Thermoforming + bonding as one-shot process. Fast production of 3D laminates

**Non-TF core + TP skin:**  
 Fast production 2D laminates  
 Thermoformable to 3D parts

**Core + TS skin:**  
 Slow curing process + skin not recyclable



TS = Thermosetting | TP = Thermoplastic | TF = Thermoformable

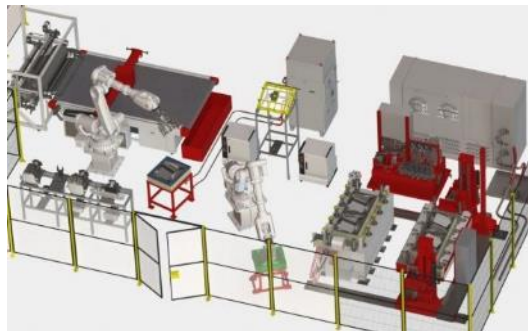
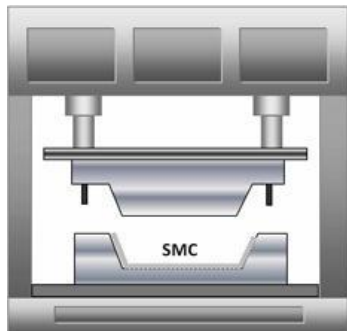
# Sandwich Sustainability

Multiple advantages over traditional materials and monolithic composite

- De-massification

- Less raw materials used
- Less energy to produce
- Less energy to handle & move
- Less energy to transport
- Less energy to operate vehicle

- Part consolidation

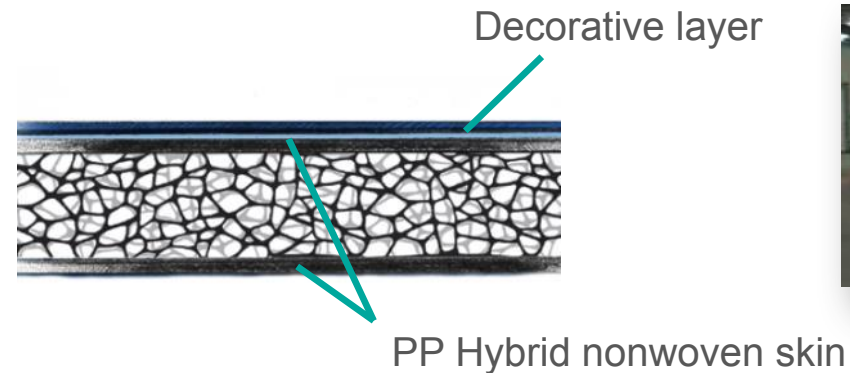


- Function Integration

- Thermal Insulation
- Sound dampening
- Fire performance
- Double wall construction
- Impact/energy absorption



- Simplified tooling

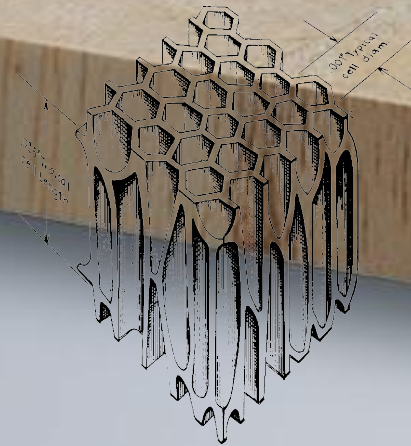


# Balsa Based Sandwich Core Materials for Automotive or Air Mobility

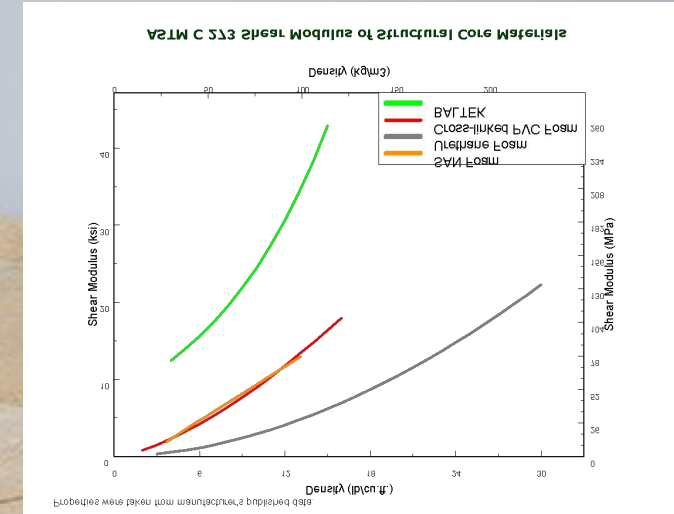


- Name: *Ochroma Lagopus*
- Avg. Height: 18m (60 ft)
- Avg. Diameter: 55 - 75 cm
- Time to maturity: 4-7 years
- Balsa is a hardwood
- Lightest known *structural* wood
- NOT a rainforest species

- Microstructure:
- Wood is itself a composite of fibers (cellulose) and resin (lignin)
- 92% of total volume is air
- Vessels make up about 8% of total volume
- Honeycomb like cells; h/d ratio ~25
- Density is dependent on cell wall thickness



- Average sheet density ~140kg/m<sup>3</sup>
- Density & grain orientation can be customized
- Precision thickness tolerances ( $\pm 0.25$ mm)
- Best strength & stiffness to both density AND price
- Sound & thermal insulation
- Good Fire resistance
- Excellent fatigue
- Can withstand high process temperatures & pressures





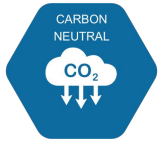
# Our Offer: Sustainable balsa forestry, fully integrated



- +14k hectares of **FSC® certified plantations** in Ecuador and Papua New Guinea
- 3.5 million trees planted yearly
- Committed to have as close to **100% internal sourcing** as possible!



- **Bio-enhanced plant breeding** program
- More biomass; less wood imperfections; more yield @ younger age



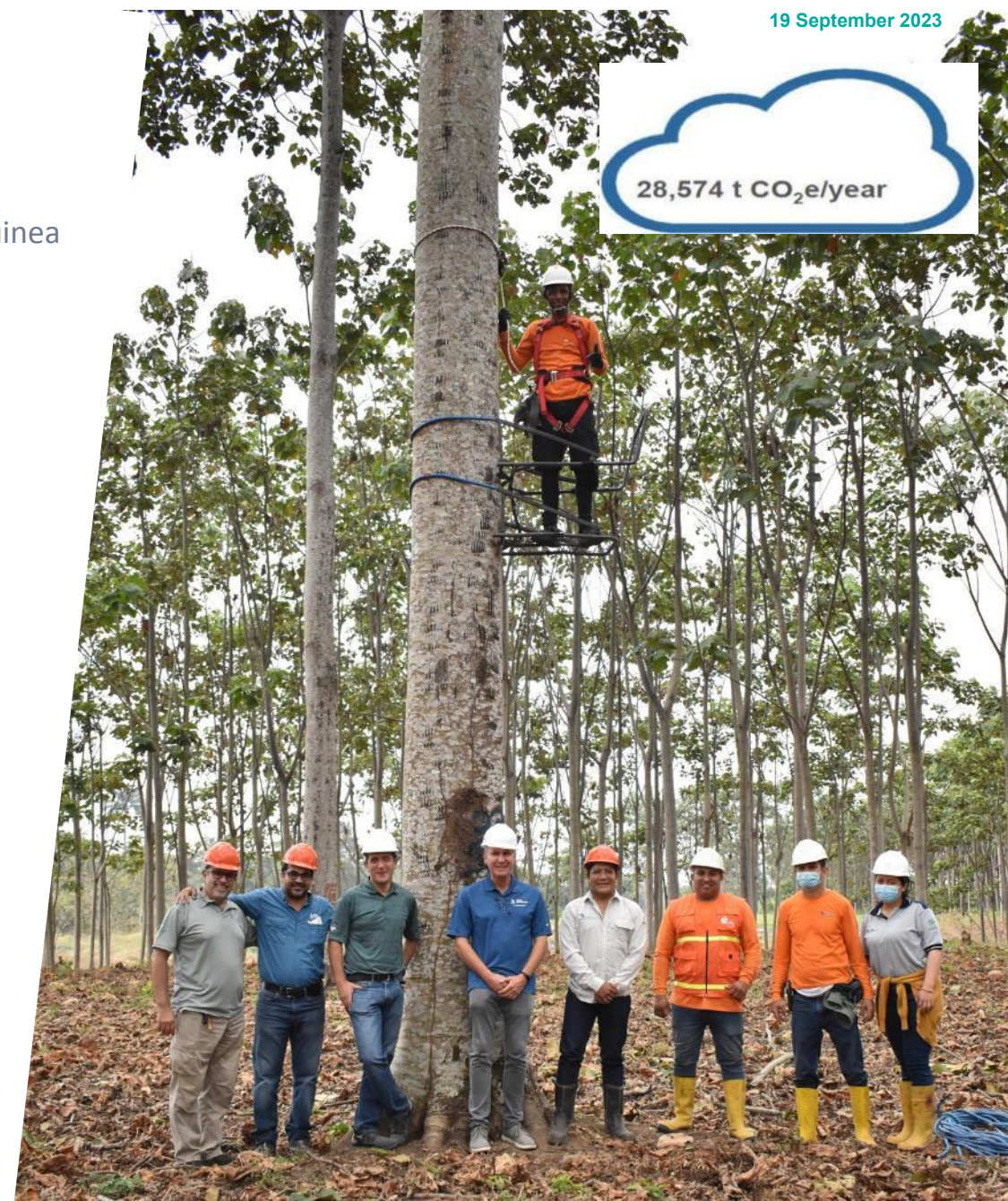
- Harvesting rate < biomass increase, generating a **carbon sink**
- Production emissions compensated through insetting from plantations
- BALTEK SBC, the first and only **carbon neutral core material**.
- ERG Product data sheet available



- **Corporate social responsibility** & forestry management
- FSC® principles
- Positive impact for low income rural communities



- **LegalSource™** certificate for all our wood supply chain:  
System to ensure NO ILEGALLY harvested wood is on any BALTEK® product
- **Fully compliant with EUTR**



# Examples of Balsa sandwich construction in automotive and aerospace



Load floor molded by MFG  
 E-glass, thermoset resin system  
 Compression mold; cycle time ~6min  
 Similar applications:

- Trunk floor
- Truck panels & load floors



Battery box demonstrator

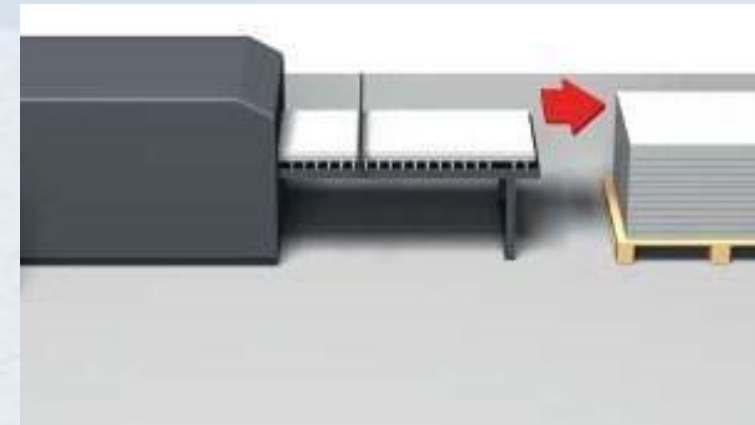
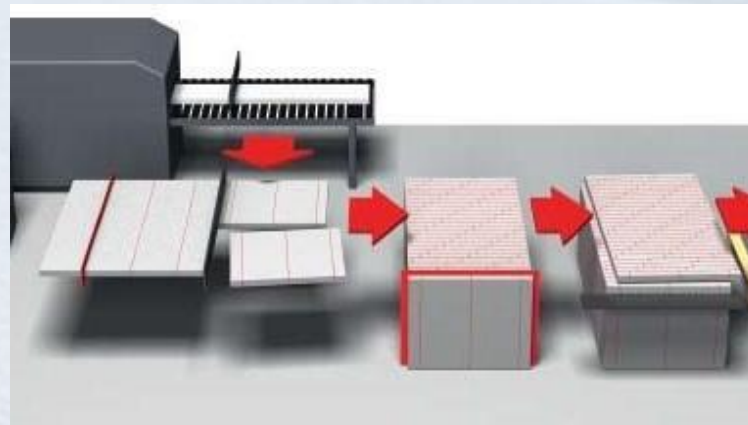
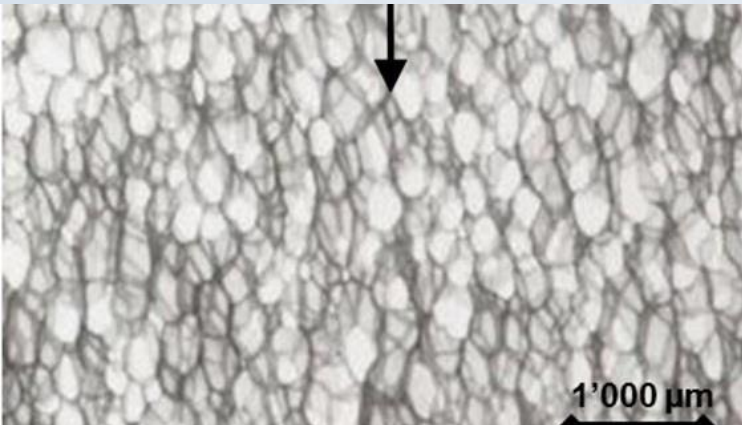


Load floors for cargo & high traffic areas  
 Aluminum or FRP face sheet  
 Press molded  
 Other applications:

- Cargo containers
- Work platforms



# PET Foam Based Sandwich Core Materials for Automotive



- Thermoplastic polymer
- Stable & inert (no outgassing)
- Virgin, mixed or recycled feedstock
- Density from 60 – 280 kg/m<sup>3</sup>
- Closed cell
- Compatible with all types of resin systems and lamination process
- Process temps up to 150C (short cycle far higher)
- Best performance vs. cost for cellular foams

## Combination extrusion +block welding

- ✓ Larger sheet format
- ✓ Higher production volumes
- ✓ Anisotropy between “flat-grain” & “end- grain” formats
- ✓ Global supply >200,000m<sup>3</sup>/annum
- Highly scalable capacity
- Fully automated production
- Tightly controlled production and product quality

## Direct extrusion

- ✓ Superior surface
- ✓ Improved mechanical properties (machine direction)
  - Anisotropy between L & W
  - Sheet thickness as low as 1.5mm
  - Can be stitched to fabrics!

# PET Foam Sustainability



Sustainability concept in recipe formulation:

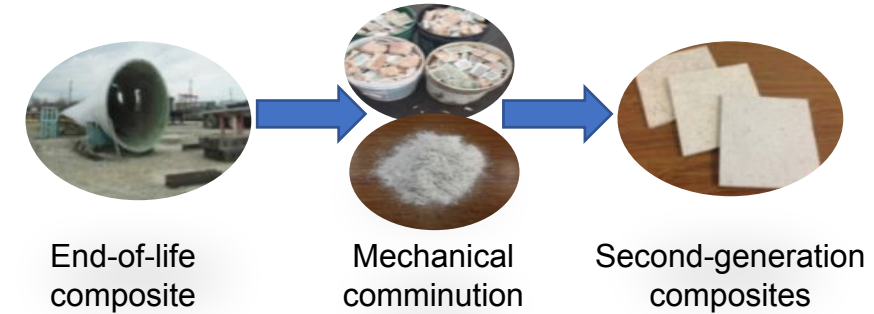
- Agglomerate
- Recyclate
- PET Flakes/Pellets/Granules



In-line process waste recycling stations.

Integrated finished kits to improve yield and recycle scrap

Multiple production sites around the globe to reduce transport

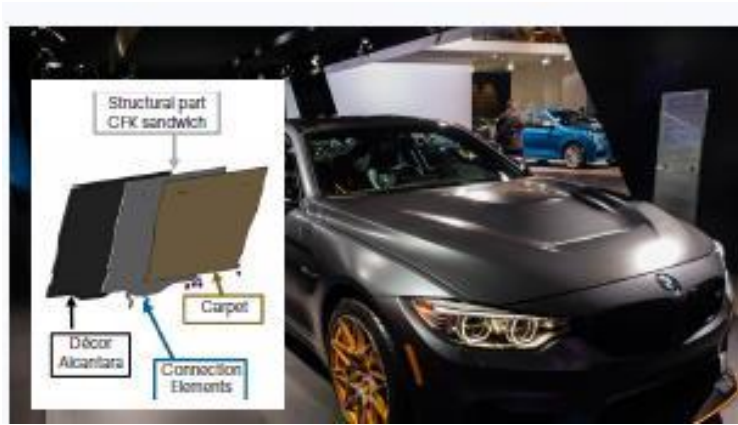


Circular Product

All thermoplastic sandwich panels

Recycling/upcycling waste foam into new parts

# Examples of PET foam sandwich construction in automotive and aerospace



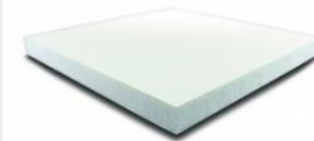
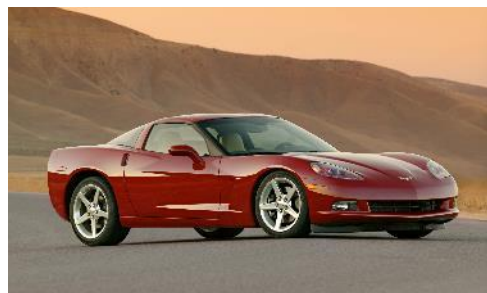
Trunk floors  
 Load floors  
 Interior door panels  
 Sidewall & roof panels



Parcel Shelf & Seat back  
 Press, PP resin, <3min cycle  
 Battery box



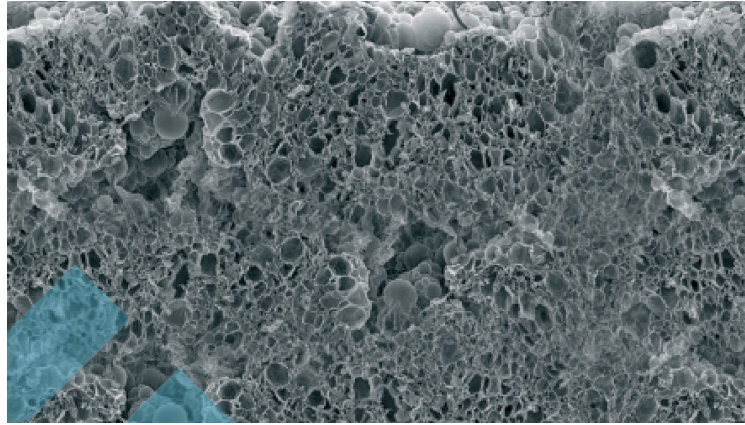
Cargo containers  
 Trays  
 Catering carts



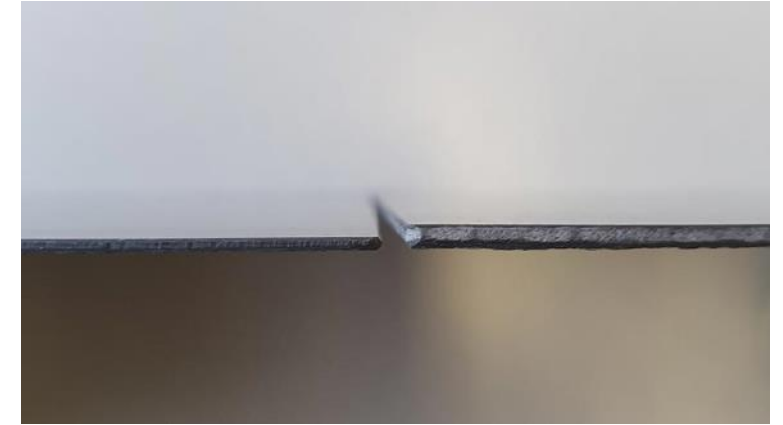
# Lantor SORIC & Teccore – Textile Foam Fabrics for Automotive or Air Mobility



Volumized non-woven fabrics impregnated with foam (microspheres + binder)  
 Available 1.5 to 5mm thick  
 Complex geometries  
 Prevents resin shrinkage (improved surface quality)  
 Reduced fiber washing  
 Can be stitched to fabrics!



Fibers produced from recycled PET  
 Processing up to 170C (higher short cycle)  
 Pressure up to 6bar (some thickness reduction)



Processes:

- Infusion / VARTM
- RTM / HPRTM
- Thermopressing
- Pre-preg



# Thermoplastic, High Performance, Structural Polymer Foam Cores for AAM



## PEI Foam

- Density 60, 80 & 120 kg/m<sup>3</sup>
- Fulfills most stringent fire requirements
- Very high property/density ratio
- Excellent dielectric properties
- Operating temps -194 to + 163°C
- Process temps far higher (short term)
- High impact resistance
- Insensitive to moisture
- Very large sheet size



## PPSU Foam

- Density 50kg/m<sup>3</sup>
- Fulfills most stringent fire requirements
- Excellent dielectric properties
- Operating temperature -194 to + 163°C
- Process temps far higher (short term)
- Good impact resistance
- Insensitive to moisture



## PET Foam

- Density 60 – 210kg/m<sup>3</sup>
- Process up to 150C (far higher for short cycle times)
- Fire resistant
- High moisture resistance
- Dielectric properties
- Large sheet size

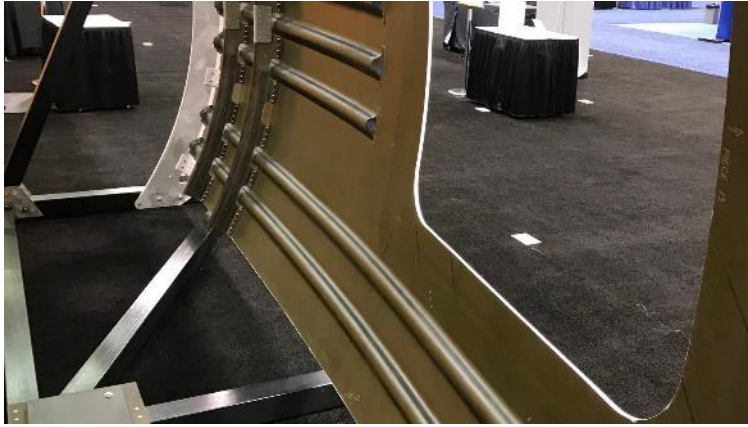
# Benefits of Foam vs. Honeycomb

- Easy to make Free-Form (3D) Shapes
- Excellent performance in fluid impingement environments
- Panel Weight Savings ~ 10%
- Panel Cost Savings ~10 – 50%
- Superior Damage Tolerance
- Superior Hot/Wet Performance
- Superior Dielectric Performance
- Resin Infusion Process Friendly
- No Film Adhesive – ↓Cost      ↓ Weight
- No Edgefill – ↓Cost      ↓ Weight
- Improved Surface Finish – ↓Cost   ↓ Weight
- Exceptional Low Heat Release & NO Smoke
- Superior Thermal & Acoustical Performance

Core Material	Flammability	Toxicity	Smoke Density	Heat Release
PEI	Pass	Pass	Pass	Pass
PPSU	Pass	Pass	Pass	Pass
PMI	Pass	Pass	Pass	Fail
PES	Pass	Pass	Pass	Pass
PET	Pass	Pass	Pass	Fail
PVC	Pass	Pass	Fail	Fail
Balsa	Pass	Pass		



# Examples of PEI, PPSU foam sandwich in aerospace



Thermoplastic fuselage demonstrator  
PPSU foam



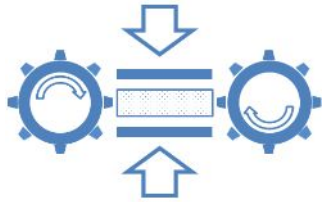
Fuselage  
PEI foam  
Carbon pre-preg, autoclave



Overhead compartment door  
Seat backs  
Tray tables  
Ducts (microsandwich)  
Radomes



# Sandwich vs. micro-sandwich: Manufacturing



- Heat skin material above  $T_m$   
+  
Heat core material in thermoforming range

- Press into a 3D panel

- Cool down below core material  $T_g$

- Open press

Foams are heat insulators  
 $\lambda \sim 0.03 - 0.04 \text{ W/mk}$

Needed heating time:  
0.2 - 1 min/mm

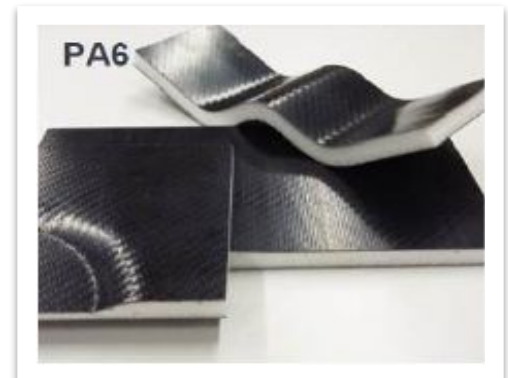


Sandwich: 30 min+  
Micro-sandwich: 1 - 2 min

Thin PET foils at thermoforming temperature are **soft and flexible**:  
With minimal pressure easily shaped to very complex structures

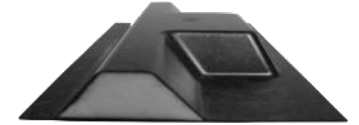
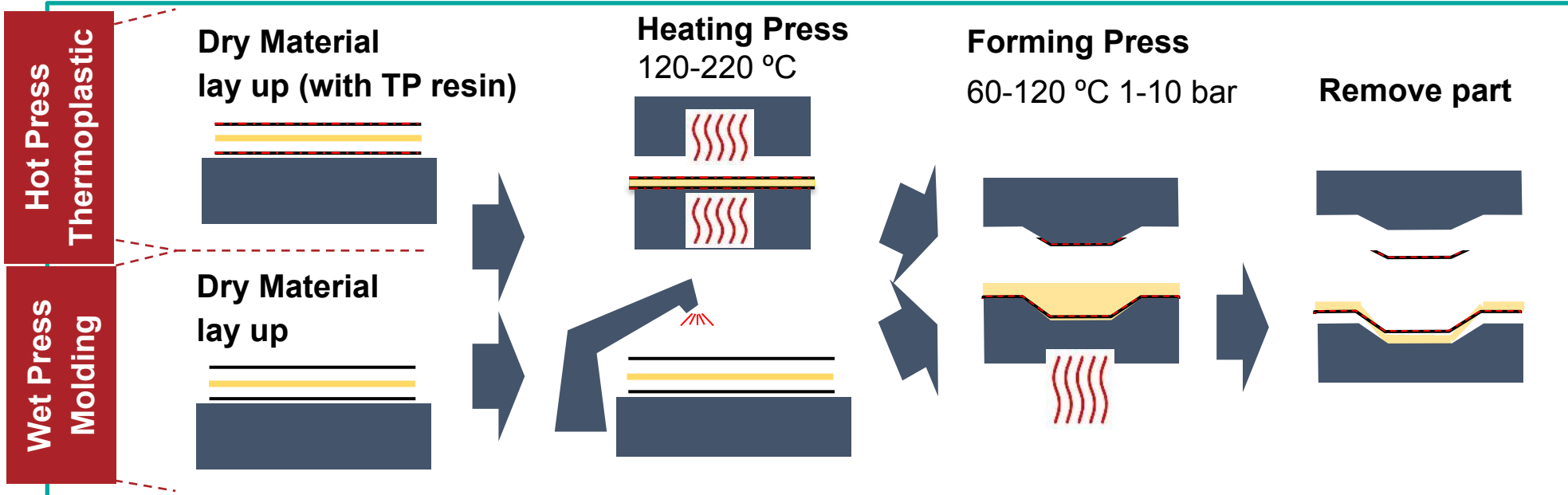
## Thermoformable foam core

- Complex geometries
- Very small radii
- No spring back
- Easy heating and forming
- Wide temperature window (150 - 190 °C)



# 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.

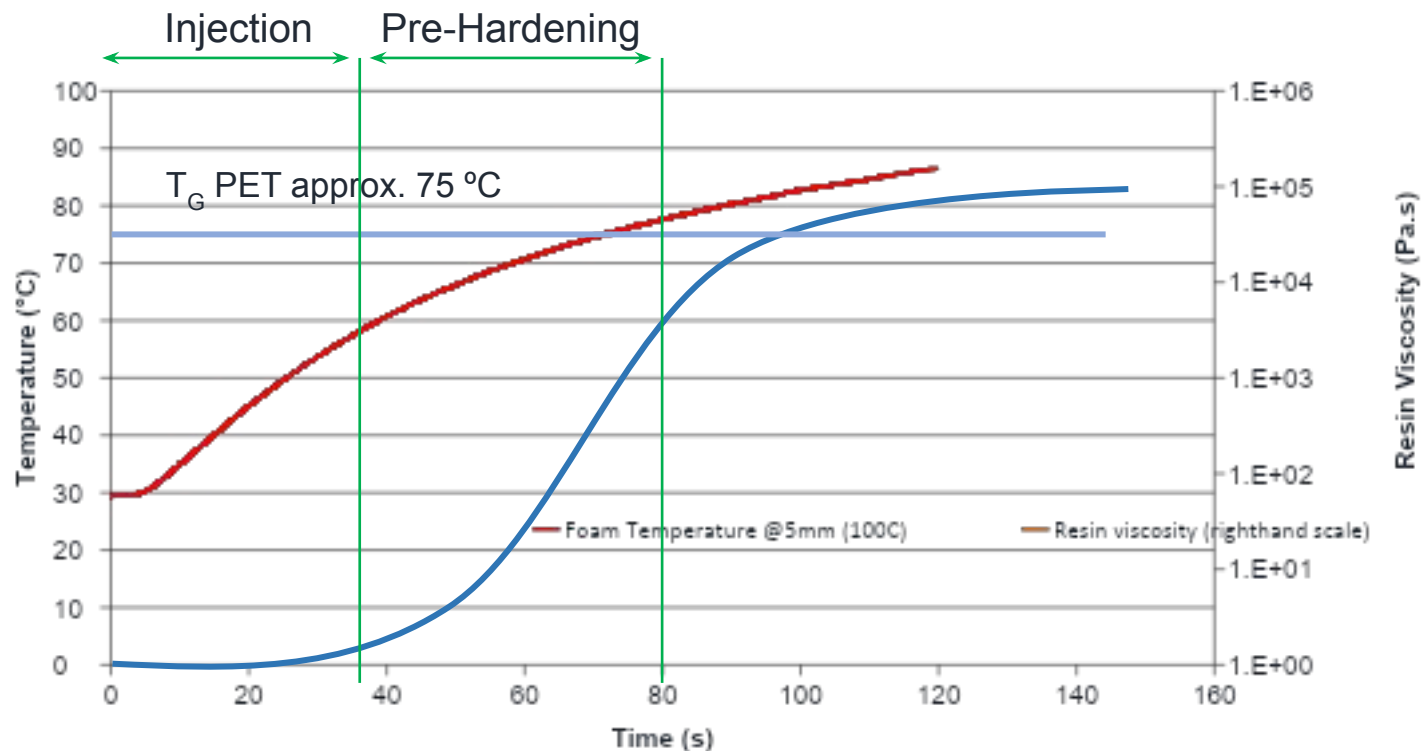


- ✓ Simple, easy-to-control process
- ✓ Low investment required
- ✓ Cost efficient thermoplastic resins possible
- ✓ Use of metal face sheets possible (thermo-bonding)

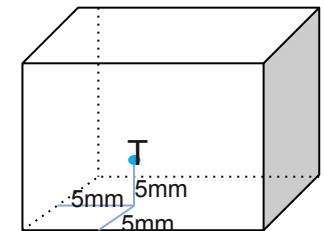
# Process Speed

Short Cycle Time Allows Consolidation While Foam Remains Cold

## Foam core temperature and resin viscosity



- ✓ Foam core (insulating) heats up slowly
- ✓ Remains below T<sub>G</sub> for some 30-60 seconds



# Sandwich vs. micro-sandwich: Manufacturing

## PPSU foam with pre-preg

### Aircraft interior case (generally 4 - 8 mm):

Standard solution: crush core with honeycomb



2-3 MPa



150 - 200 °C



10 - 20 min



#### Thermoformed foam:

Core quality // 3D formability // skin adhesion  
Thermal insulation // lower pressures // EHS

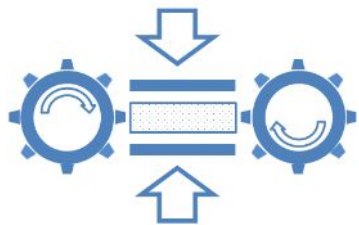
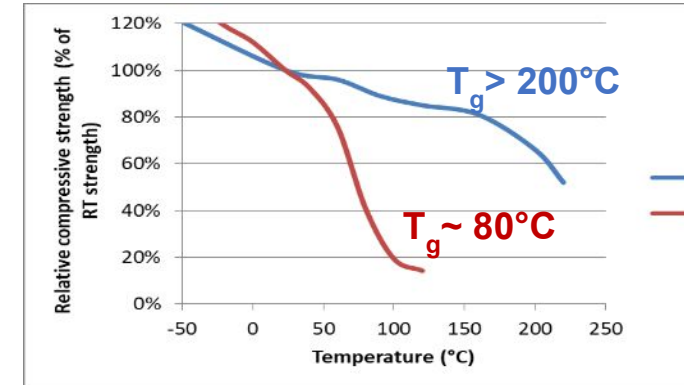
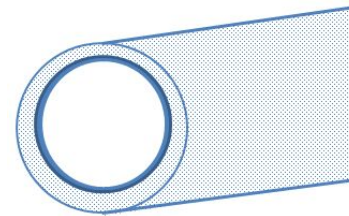
### Air duct case (2 - 3 mm):

Standard solution for flexible/semi-rigid low pressure ducting: Fiber reinforced plastic

One-sided skin composite possible:

Internal skin gives good air flow inside the duct

Weight saving: ~ 40%!



Prepare the stack: FST pre-preg + foam + FST pre-preg

- Pre-heat the press at 150 - 200 °C
- Insert the stack and press it with 0.5 - 1 MPa
- Cure the pre-preg for 10 - 20 min



# Hybrid Core Concept<sup>®</sup> - thanks to comprehensive product range

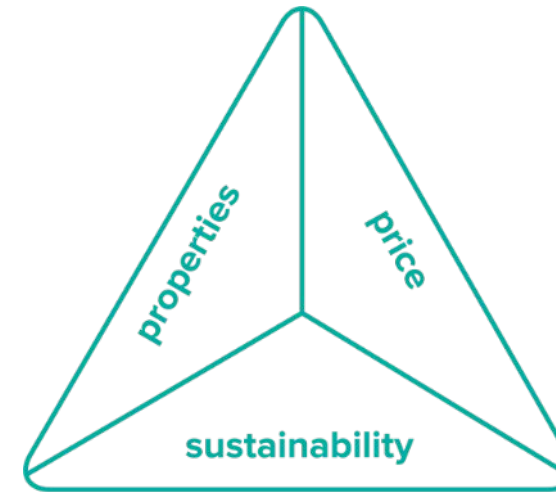
Weight reduction allows:

- Reduction of raw materials
- Reduction of energy used during lifecycle
- Reduction of end-of-life expenditures

The right choice of materials allows:

- Reduction of CO2 over entire life cycle
- Application-optimized choice of material
- Minimized carbon footprint of final product

This is physically logical. It's eco-logic



Hybrid Core Concept<sup>®</sup>

- Our products are widely used in transportation & aerospace
- Sustainable, sandwich designs are capable for multiple applications including primary structure
- Short cycle production processes can be easily adapted for high performance, low weight sandwich parts
- Weight savings up to 50% possible!
- We are ready to work with you to bring your ideas into reality

# Speaker Contact Information

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- Email: [russ.elkin@3acomposites.com](mailto:russ.elkin@3acomposites.com)