3A COMPOSITES CORE MATERIALS

Micro-sandwich

The solution for light-weighting & sustainability available today

Schweiter – 3A Composites Group

Schweiter Technologies

2020
Revenues: CHF 1’160m
Employees: 4’364

3A Core Materials

GLOBAL FOOTPRINT
IN SUSTAINABLE
CORE MATERIALS

1,684 No.
OF EMPLOYEES

13,250
ha.
OF **FSC®**
CERTIFIED
PLANTATIONS

FREE EDUCATION FOR
OVER 50 PRESCHOOL
KIDS IN PAPUA
NEW GUINEA

ca.
2 MILLION
TREES PLANTED A YEAR

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

27–29 m
IT TAKES 4–5 YEARS
FOR A BALSA TREE
TO GROW THAT HIGH

36% RESIN UPTAKE
SAVING THANKS
TO PET SEAL*X*

CORE MATERIALS

3A Core Materials

3A Core Materials
The Broadest Selection of Sandwich Core Materials Worldwide

- The perfect product solution for every single customer requirement:

Structural foam core materials

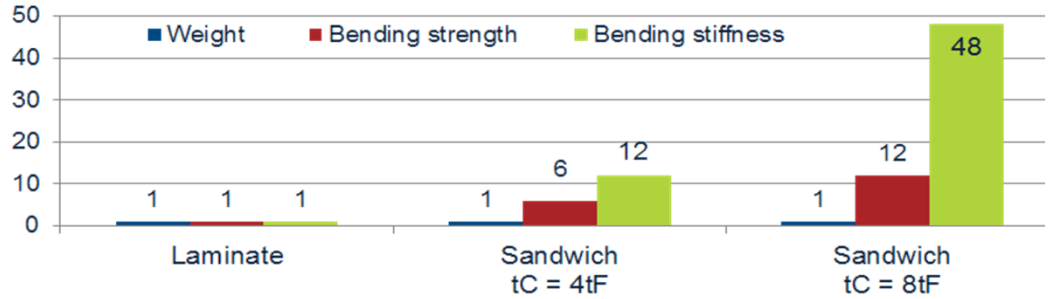
- AIREX® T92 – Easy Processing Structural Foam
- AIREX® C70 – Lightweight Structural Foam
- AIREX® T10 – Premium Structural Foam
- AIREX® R82 – High Performance Foam
- AIREX® TegraCore™ – Fire Performance Structural Lightweight Foam
- AIREX® T90 – Fire Retardant Structural Foam
- AIREX® PX – Fibre-Reinforced Structural Foam Panel

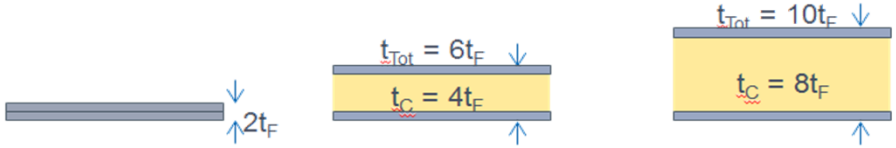
Structural balsa core materials

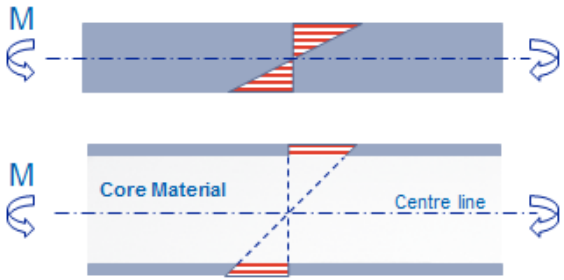
- BALTEK® SB – Select Grade Structural Balsa Core
- BALTEK® SBC – Plantation Controlled Structural Balsa Core for Infusion
- BALTEK® VBC – Oriented Grain Structural Balsa Core
- BALTEK® IG – Industrial Grade Balsa Core

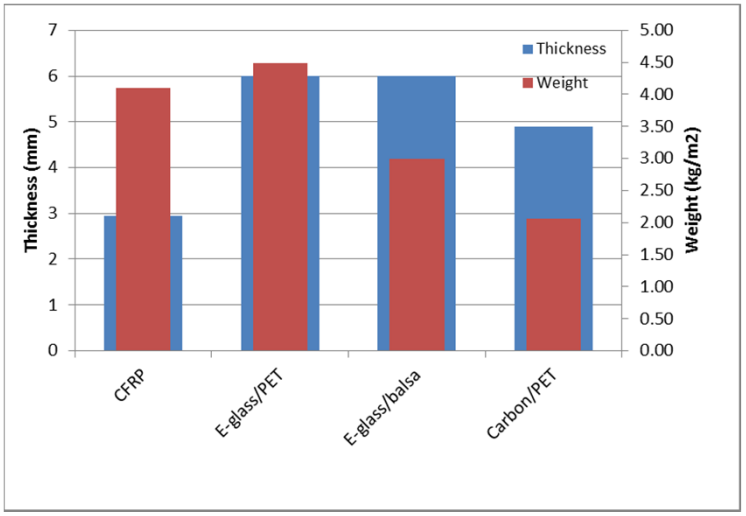
Sandwich Construction

Combine stiff skins around lightweight core









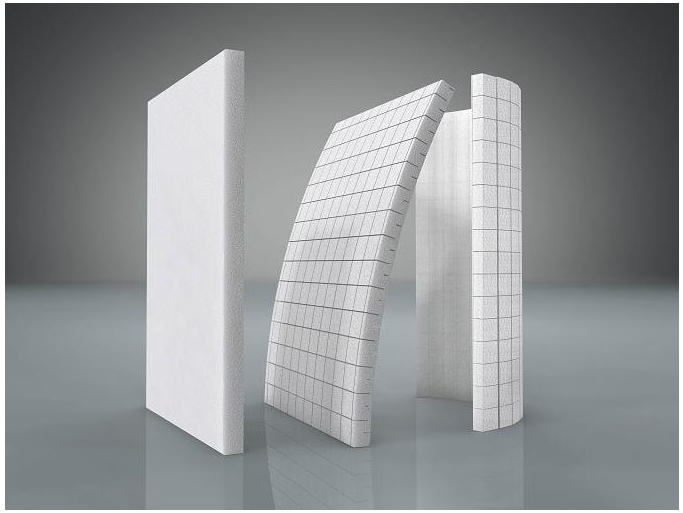
- Weight savings
- Material (mass) reduction
- Lower part cost without sacrificing performance
- Functional integration
- Liberates part design
- Skins – FRP, CFRP, Plastic, Metal

- **Equal deflection (10N bending load)**
- **Significant reduction in material cost**

Structural & Sustainable Sandwich Core Materials for Automotive and Transportation Markets

- Balsa core
- Global supply
- Volume & potential growth
- Properties
- Sustainability (carbon negative)

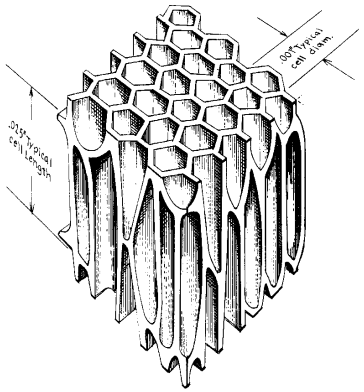
- PET polymer foam core
- Global supply
- Volume & estimated growth
- Properties
- Sustainability



CORE MATERIALS

Balsa Based Sandwich Core Materials

- Name: Ochroma Lagopus
- Avg. Height: 18m (60 ft)
- Avg. Diameter: 75 cm (30 in)
- Time to maturity: 5-7 years
- Balsa is a hardwood
- Lightest known *structural* wood



- 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

- Lumber density 70 – 350 kg/m3
- Lumber is cut to minimize density variation, but maximize yield
- 85 – 90% of volume between 100 & 250kg/m3 (Avg. ~140)
- Graded for density & defects
- Format:
  - End-grain
  - Oriented grain

Global Supply & Capacity

Balsa plantations & forests located near the Equator

~90% located in Ecuador

~14k hectares of plantations worldwide

Global volume is >350,000m3

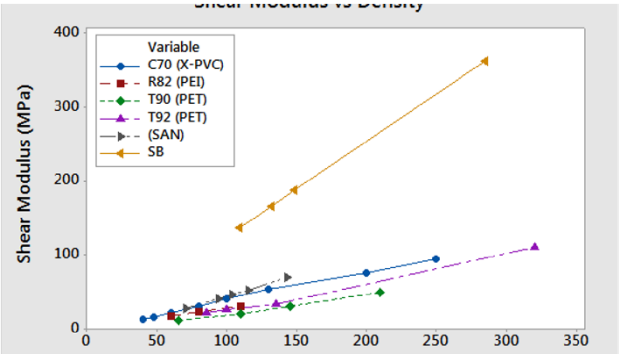
<10% of suitable land cultivated

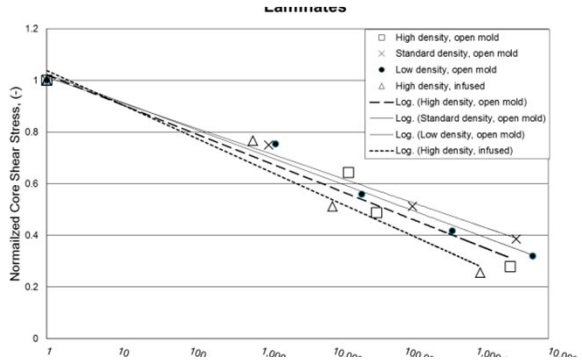
Not a rainforest species

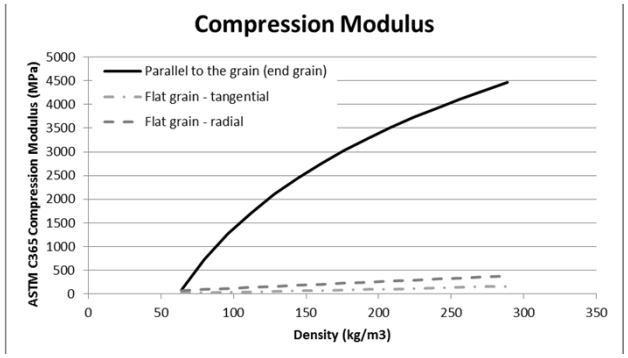
Production can be FSC Certified

- Computer controlled sawmilling
- Automatized lumber density classification and block production measures
- Highly accurate slicing and sanding equipment
- Constant monitoring of density and moisture content
- Integrated tablet quality system

Balsa Core Mechanical Performance







Excellent Mechanical Properties

Best strength & stiffness to weight ratio

Widest operating temperature range (-180C to +180C)

R-value ~2.2/in

Noise & vibration damping

Excellent Fatigue Strength

Resistant to Creep

Process Temperatures above 180C*

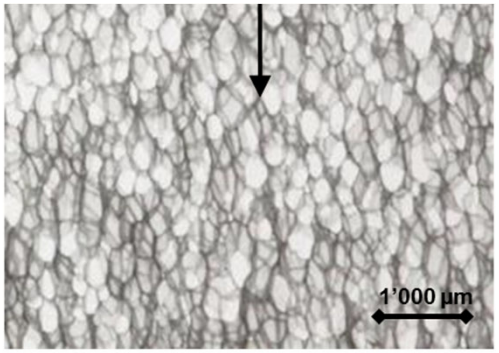
Good Chemical Resistance

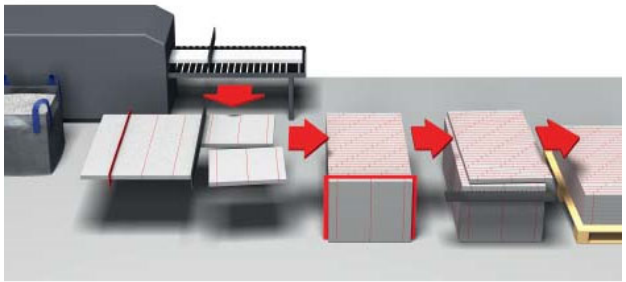
Fire Resistant

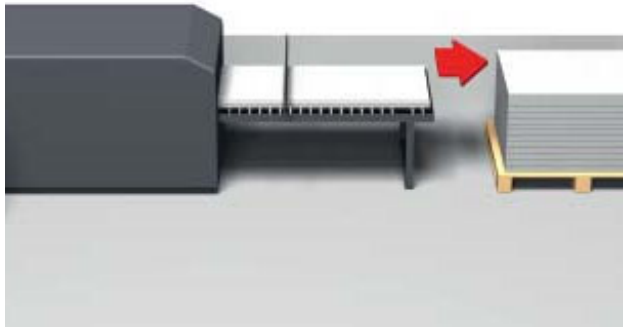
Flat grain vs. End-grain properties are highly isotropic

Designers can take advantage of grain direction to engineer specific response to dynamic & impact loads

PET Foam Based Sandwich Core Materials







- Thermoplastic polymer
- Stable & inert
- Virgin, mixed or recycled feedstock
- Density from 60 – 320 kg/m3
- Closed cell
- Compatible with all types of resin systems and lamination process

<u>Combination extrusion +blockwelding</u>

✓ Larger sheet format
✓ Higher production volumes
- Anisotropy between “flat-grain” & “end-grain” format

<u>Direct extrusion</u>

✓ Superior surface
✓ Improved mechanical properties (machine direction)
- Anisotropy between L & W

Global PET Foam Production

Global availability

Production sites in Europe, N. America & China

Global supply >200,000m3

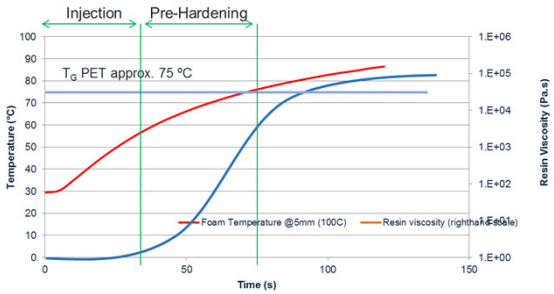
Scalable production capacity

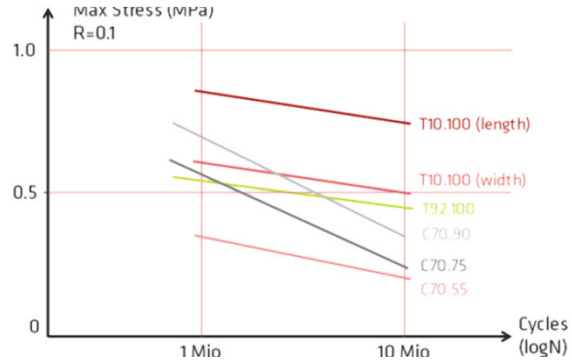
Continuous extrusion process

Fully automated production

Tightly controlled production and product quality

PET Foam Core Mechanical Performance



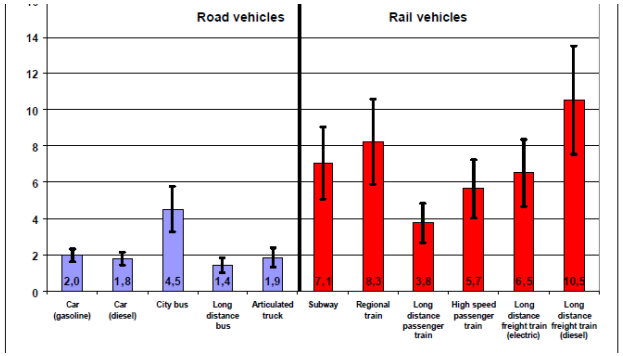


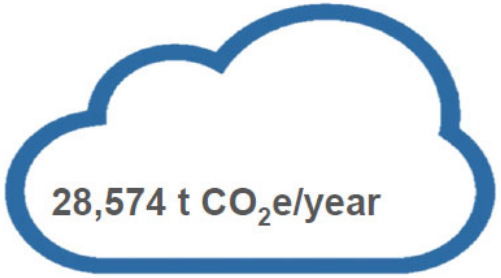
- High mechanical properties
- Good combination of stiffness & toughness
- Dimensionally stable
- Does not outgas
- R-value ~4.8/in (80kg density)

- Excellent Fatigue
- Process temperatures >150C; short term far higher
- Very low moisture absorption
- Excellent Chemical Resistance
- Fire Resistant versions available

- Thermoformable
- Large thickness changes
- Designers can take advantage of orientation to engineer specific response to dynamic & impact loads

Sustainability





Sandwich Construction = weight savings

More efficient use of resources

Lower part weight translates to less mass & energy in:

- Production
- Transport
- Use

Balsa is not a rainforest species

Most balsa grows on plantations

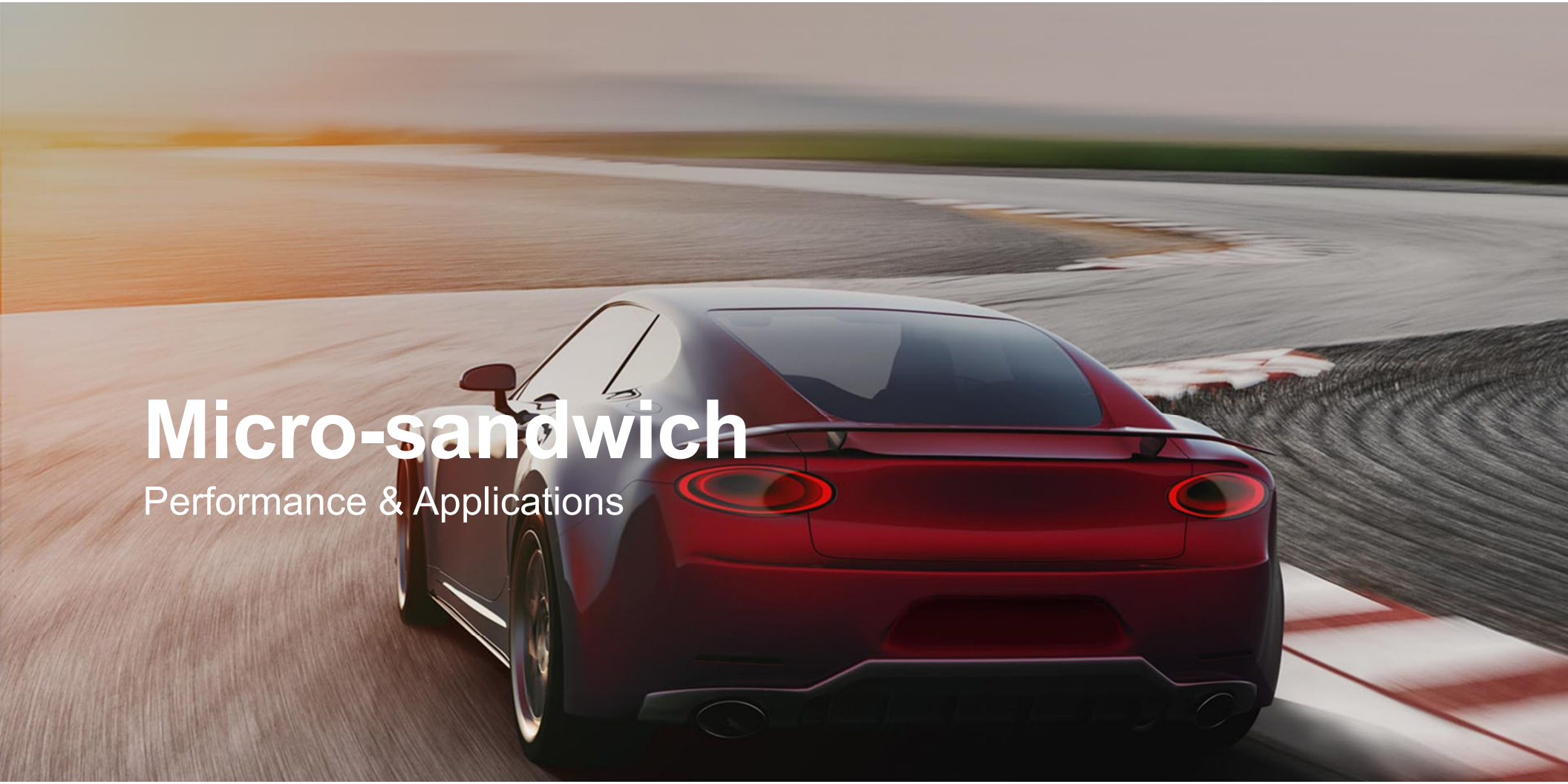
Very few natural resources used

BALTEK® SBC is FSC certified & a carbon sink

Circular product

PET Foam is made from recycled materials and can be recycled

“All-thermoplastic” sandwich panel possible



Micro-sandwich

Performance & Applications

CORE MATERIALS

Design Parameters, Challenges & Solutions

- Plastics performance is far less than steel & aluminum
- High cost of Carbon fiber
- Sandwich only considered for thick parts
- Thin sheets (<6mm) are:
  - Typically more expensive to produce
  - Slower production rates

- Micro-sandwich:
  - Overcomes the “thickness problem”
  - Sheet thickness from 1.5 – 5mm
  - High production volumes
  - Highly formable
- Design flexibility
- Function Integration
- Low cost

Floor panel

- High compression strength
- High stiffness / modulus
- Good fatigue resistance
- Noise dampening

Side wall & Roof panel

- High stiffness
- High modulus
- Low weight
- Noise dampening

Front ends, crash belts

- High impact resistance
- High stiffness

Interior trim

- High stiffness
- Low weight
- Noise dampening
- Thermal Insulation

Sandwich vs. micro-sandwich: **Manufacturing**

Thermoplastic skins with thermoformable thin core

Mass production-friendly 3D lamination process

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

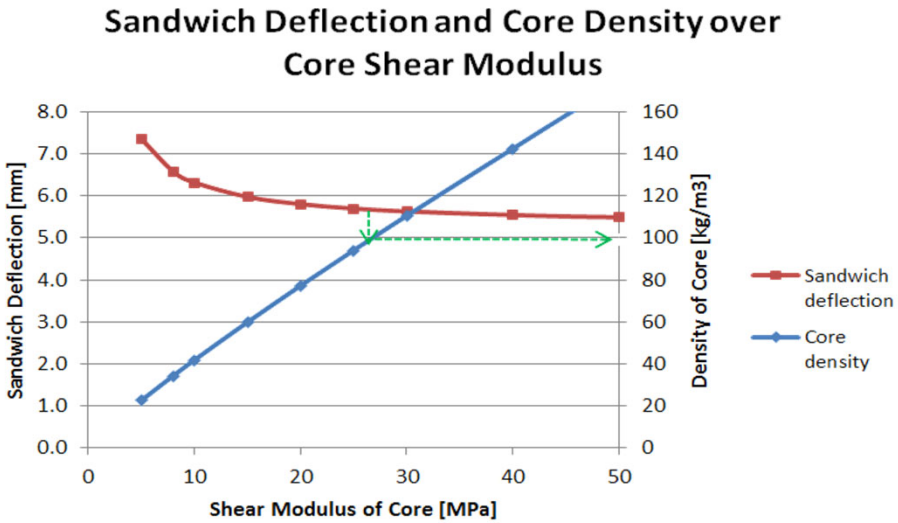
TF core + TP skin:
Thermoforming + bonding as one-shot process. Fast production of 3D laminates

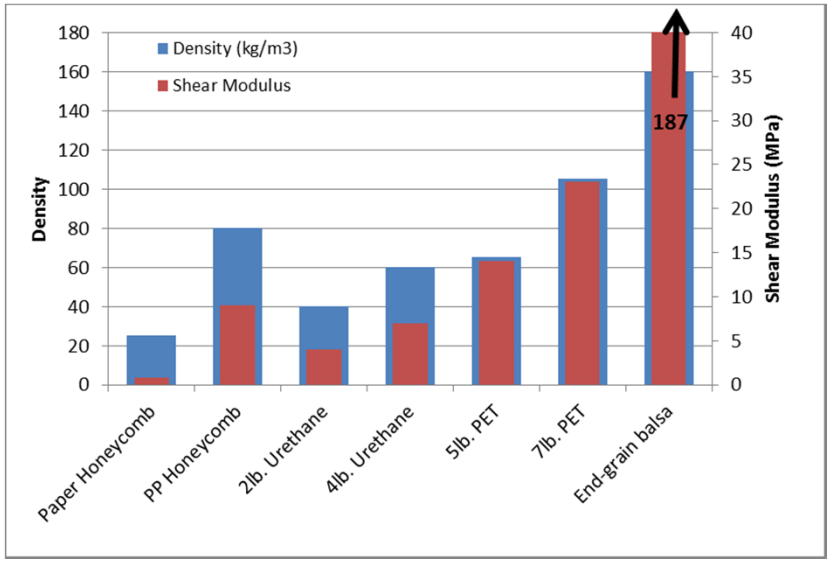
Non-TF core + TP skin:
Fast production 2D laminates

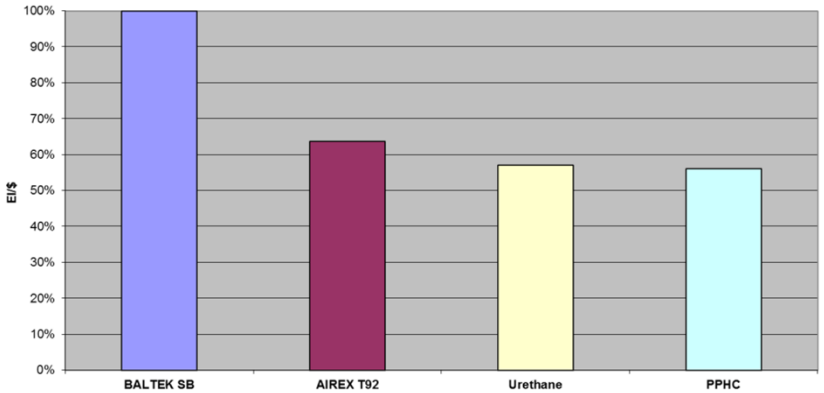
Core + TS skin:
Slow curing process + skin not recyclable

TS = Thermosetting | TP = Thermoplastic | TF = Thermoformable

Core Material Choice Affect on Sandwich Laminate Performance





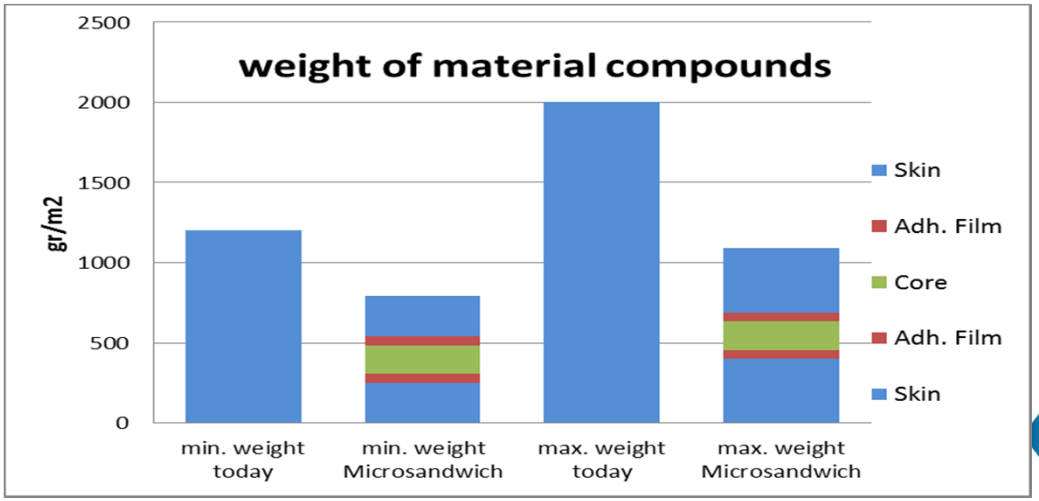


Other advantages
Water absorption PET vs. urethane
No outgassing
Recyclable

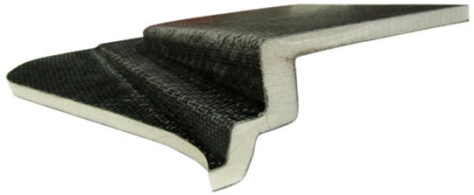
CORE MATERIALS

Microsandwich: Design Details

	Today's monolithic solution	New Microsandwich
Material solution	▪ Glass or natural fibre (non woven) ▪ Thermoplastic fibres in the fleece acting as resin	▪ Same fleece, but thinner ▪ PET core (60kg/m3) ▪ Possibly adhesive film between skins and core
Total weight (excl. decorative layers; e.g. leather):	1200 g/m2 – 2000 g/m2	800 g/m2 – 1100 g/m2 (~40% saving)
Thickness	1-2mm	2-4mm (PET core partially compressed, locally possibly highly compressed)
Production process	One-shot hot press	Same

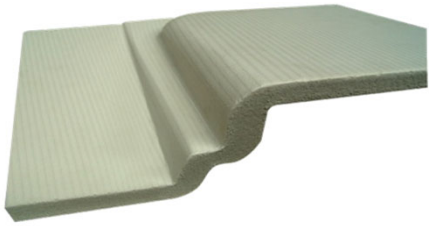


Microsandwich – Production Details



Sandwich Production → Hot Press

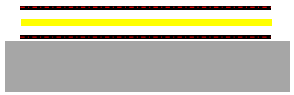
- Fully automatable one-shot process (sandwich production and forming in one step) same equipment as for today's single-skin process
- Complex shapes are possible
- Integration of decorative surface cloth (if desired)
- Total cycle times approx. 60-90 sec.



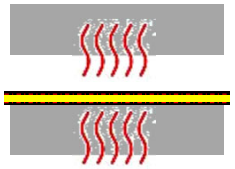
Additional details

- Part trimming process may be integrated in the forming press tool (last of 4 steps below).

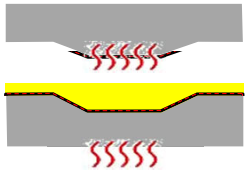
Dry Material lay up (with thermoplastic resin)



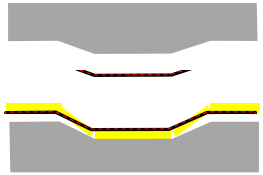
Heating Press
Approx. 200C ºC



Forming Press
Approx. 80 ºC
1-2 bar

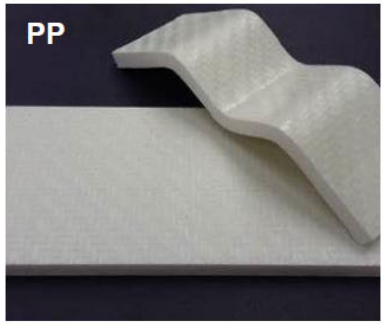


Remove part
(trimming possibly integrated)

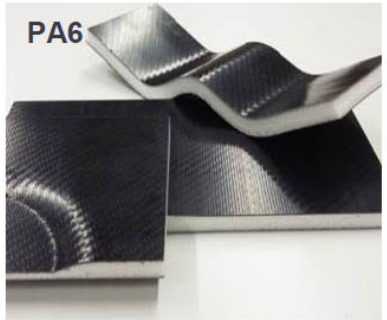


Innovative Processing

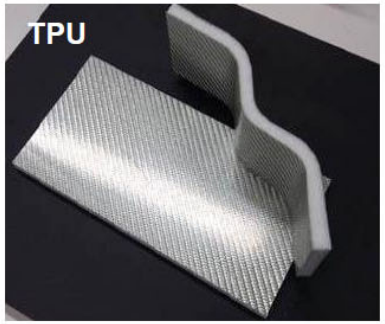
Forming Temperature: ca. 170-180°C



Forming Temperature: ca. 190-200°C

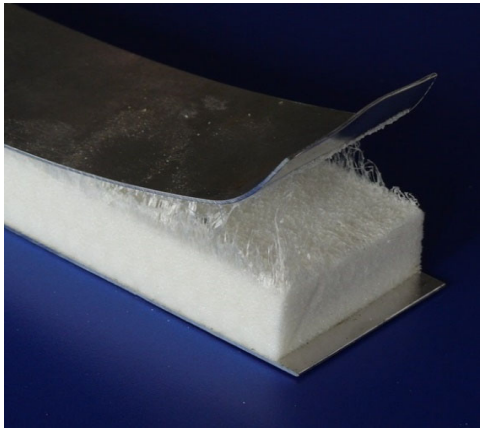


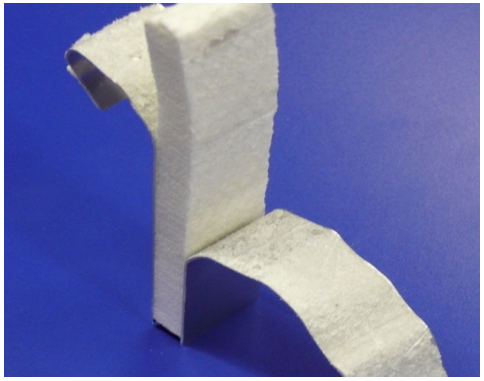
Forming Temperature: ca. 190-200°C



Direct bonding

- Skins (Heat conductive)
  → metals e.g. aluminum, steel, etc.
- Process
  - Heat skins to about 270° C
  - Press onto foam
  - Cool down

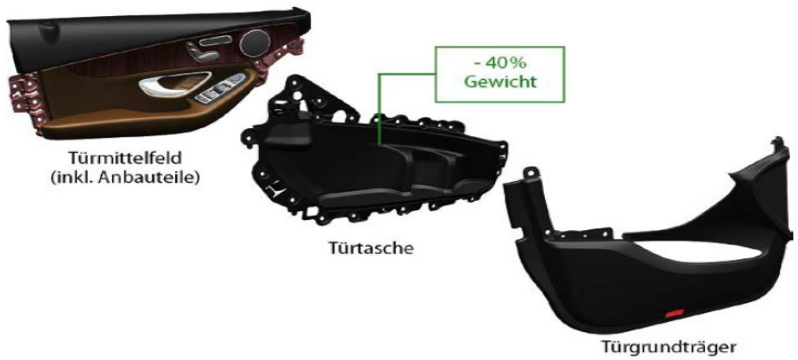


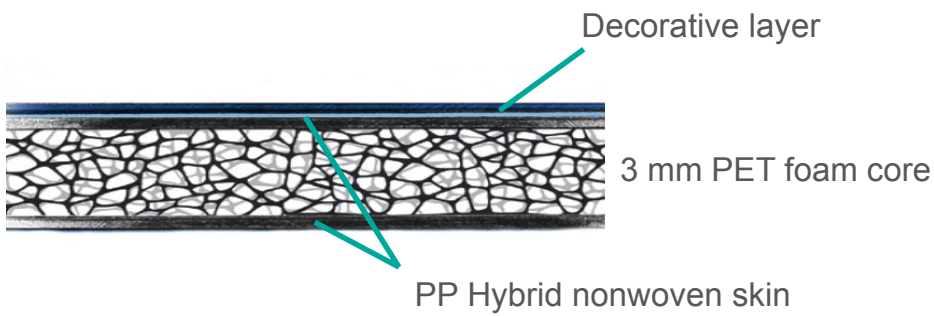


CORE MATERIALS

Lightweight micro-sandwiches gaining attention!

- Example for automotive interior trim parts
  (Menzel, C et al. Schlanker Materialmix für leichtes Interieur. Kunstoffe, 5/2017, S. 90-93)





Benefits:

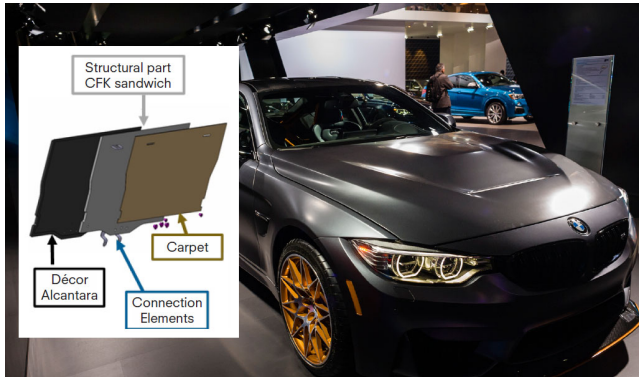
- Weight 40 - 50 % below current, single skin solution
- Total cost approximately same (savings on skin material and process costs)
- Improved damage tolerance

31 July 2021

Other Examples of Successful Automotive Production

Custom vans
PET foam & balsa
Floors walls, roof & interiors

Delivery vans
PET foam
Floors walls & roof



Rear panel
PET foam
>50% weight reduction
Improve crash performance

Thank You

3A COMPOSITES CORE MATERIALS