Micro-sandwich

The solution for light-weighting & sustainability available today
Schweiter – 3A Composites Group

2020
Revenues: CHF 1'160m
Employees: 4'364
3A Core Materials

75 years of experience

Global footprint in sustainable core materials

13,250 ha. of FSC® certified plantations

Free education for over 50 preschool kids in Papua New Guinea

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

1,684 no. of employees

Ca. 2 million trees planted a year

36% resin uptake saving thanks to pet sealx

31 July 2021
3A Core Materials

- AMERICAS
  - High Point, NC
  - Glasgow, KY
- EMEA
  - Sins, CH
- INDIA
  - Mumbai
- ASIA PACIFIC
  - Shanghai
- ECUADOR
  - Guayaquil
  - Quevedo
- BRAZIL
  - Sao Paulo
- PNG
  - Rabaul

- Green circle: Core Materials: Administrative / sales office
- Blue circle: Core Materials: Production site
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
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

**Combination extrusion + blockwelding**
- Larger sheet format
- Higher production volumes
- Anisotropy between “flat-grain” & “end-grain” format

**Direct extrusion**
- 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
- Thermoformable
- Large thickness changes
- Designers can take advantage of orientation to engineer specific response to dynamic & impact loads
- Fire Resistant versions available
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

28,574 t CO₂e/year
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

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

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

TF core + TP skin:
Thermoforming + bonding as one-shot process. Fast production of 3D 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
## Microsandwich: Design Details

<table>
<thead>
<tr>
<th></th>
<th>Today’s monolithic solution</th>
<th>New Microsandwich</th>
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<tbody>
<tr>
<td><strong>Material solution</strong></td>
<td>▪ Glass or natural fibre (non woven)</td>
<td>▪ Same fleece, but thinner</td>
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<tr>
<td></td>
<td>▪ Thermoplastic fibres in the fleece acting as resin</td>
<td>▪ PET core (60kg/m³)</td>
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<tr>
<td></td>
<td>▪ Same fleece, but thinner</td>
<td>▪ Possibly adhesive film between skins and core</td>
</tr>
<tr>
<td><strong>Total weight (excl. decorative layers; e.g. leather):</strong></td>
<td>1200 g/m² – 2000 g/m²</td>
<td>800 g/m² – 1100 g/m² (≈40% saving)</td>
</tr>
<tr>
<td><strong>Thickness</strong></td>
<td>1-2mm</td>
<td>2-4mm (PET core partially compressed, locally possibly highly compressed)</td>
</tr>
<tr>
<td><strong>Production process</strong></td>
<td>One-shot hot press</td>
<td>Same</td>
</tr>
</tbody>
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![Weight of Material Compounds](chart.png)
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).

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**Dry Material lay up (with thermoplastic resin)**

**Heating Press**

Approx. 200°C

**Forming Press**

Approx. 80°C

1-2 bar

**Remove part**

(trimming possibly integrated)
Innovative Processing

Direct bonding

- Skins (Heat conductive) → metals e.g. aluminum, steel, etc.

- Process
  - Heat skins to about 270° C
  - Press onto foam
  - Cool down
Lightweight micro-sandwiches gaining attention!

• Example for automotive interior trim parts

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