

Thermoplastic Sheet for Railway Interiors

Railway Interiors Expo Cologne

November 8, 2007

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Summary of this presentation

- Why Thermoplastics are new to the Railway Industry
- Thermoplastics in Mass Transportation
- Specific requirements for Railway Mass Transportation
- Developments on the resin side (Flame retardant)
- Developments on the sheet extrusion side (Graffiti & Chemical resistance)
- The importance of thermoplastic sheet & thermoforming
- Reference applications

Thermoplastics in Transportation

- On Land

- Automotive

- Commercial Vehicles

- Mass transportation



- In the Air

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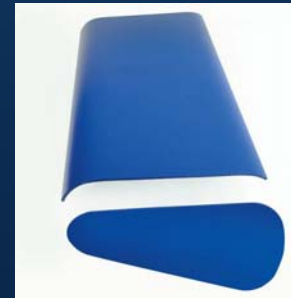
Why are thermoplastics new to the Railway Industry?

- The nature of the Rail Industry
- Limited numbers of units
- Limited availability of plastics that meet the specifications

Specifications in Rail Coach Interiors

- Flame retardant
 - Makrolon FR (transparent PC)
 - Bayblend FR 3030
 - Bayblend MTR
- Impact resistance
- Light weight
- UV resistance
- Chemical resistance
- Anti - Graffiti

NEW!



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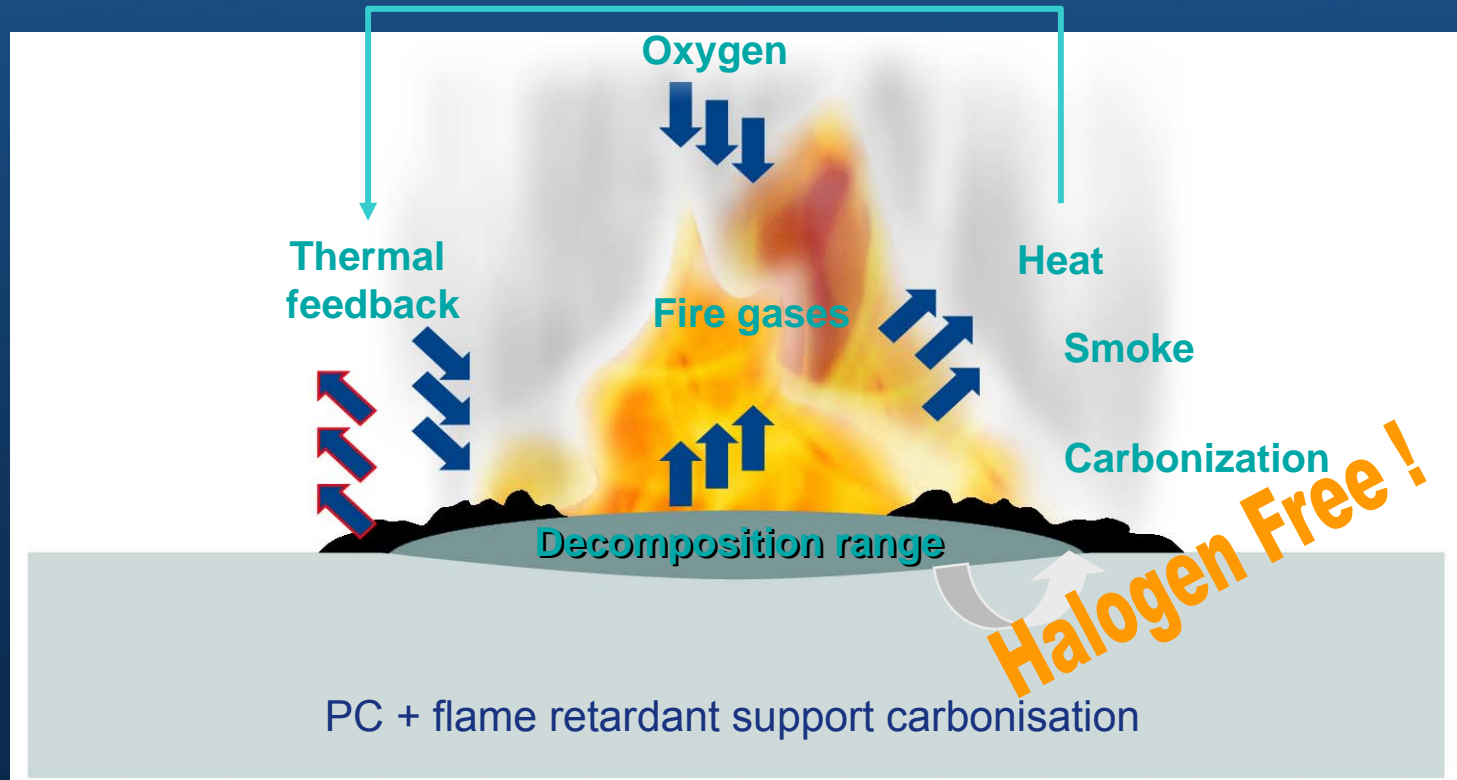
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PC5

Technique of fire retardant thermoplastics



Bayblend® FR (PC/ABS) / Makrolon® FR (PC)

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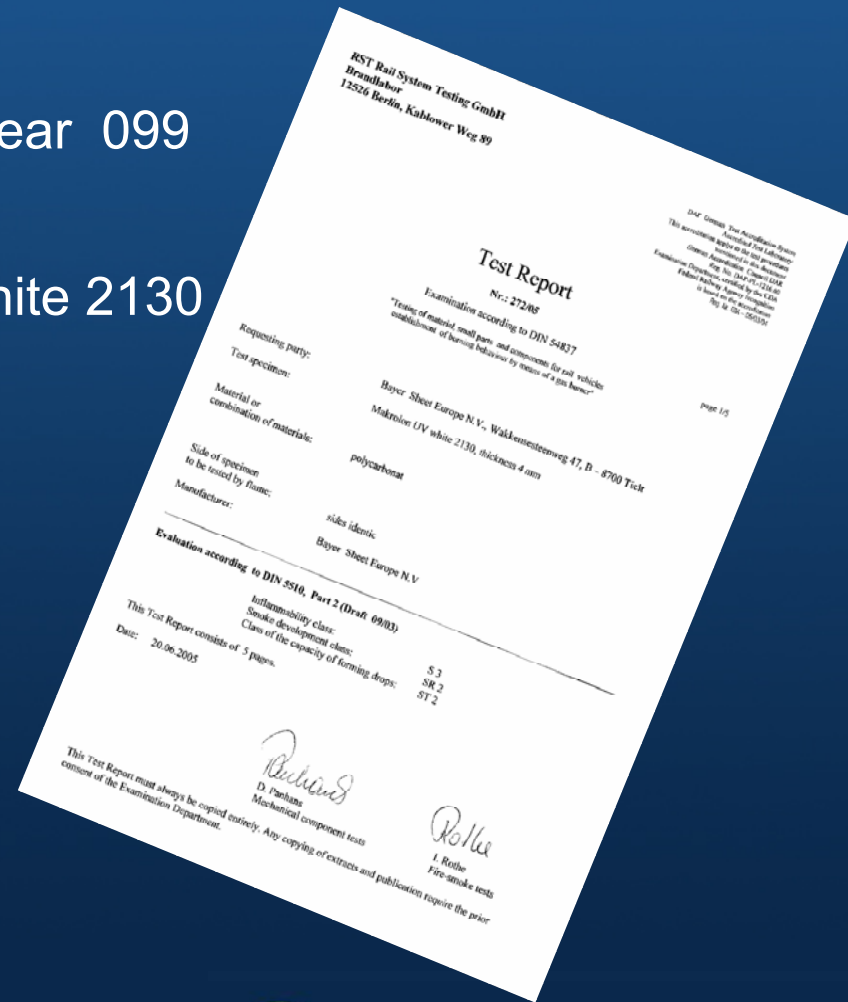


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Transparent Makrolon® sheet for lamp covers

Makrolon® FR clear 099

Makrolon® UV white 2130



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Opaque colored PC/ABS blends (Bayblend®) for interior cladding

Polycarbonate

- high impact strength
- high heat distortion temperature

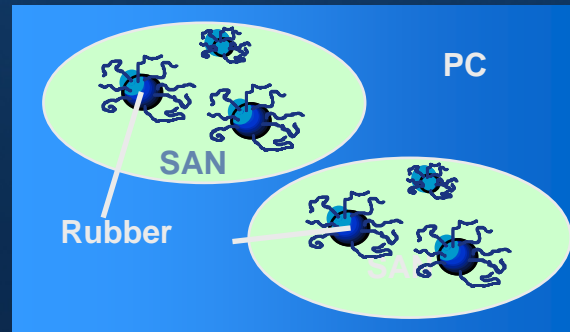
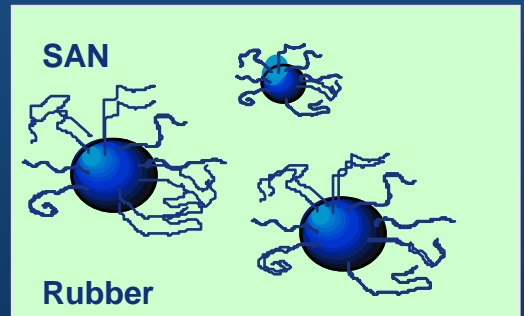
ABS

- good toughness (notched)
- good process ability

Polycarbonat
(PC)

PC/ABS blend

Synergy of Properties



- very good low temperature toughness
- high heat distortion temperature

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Bayblend[®] FR 3030

- Combines mechanical properties with Heat Resistance

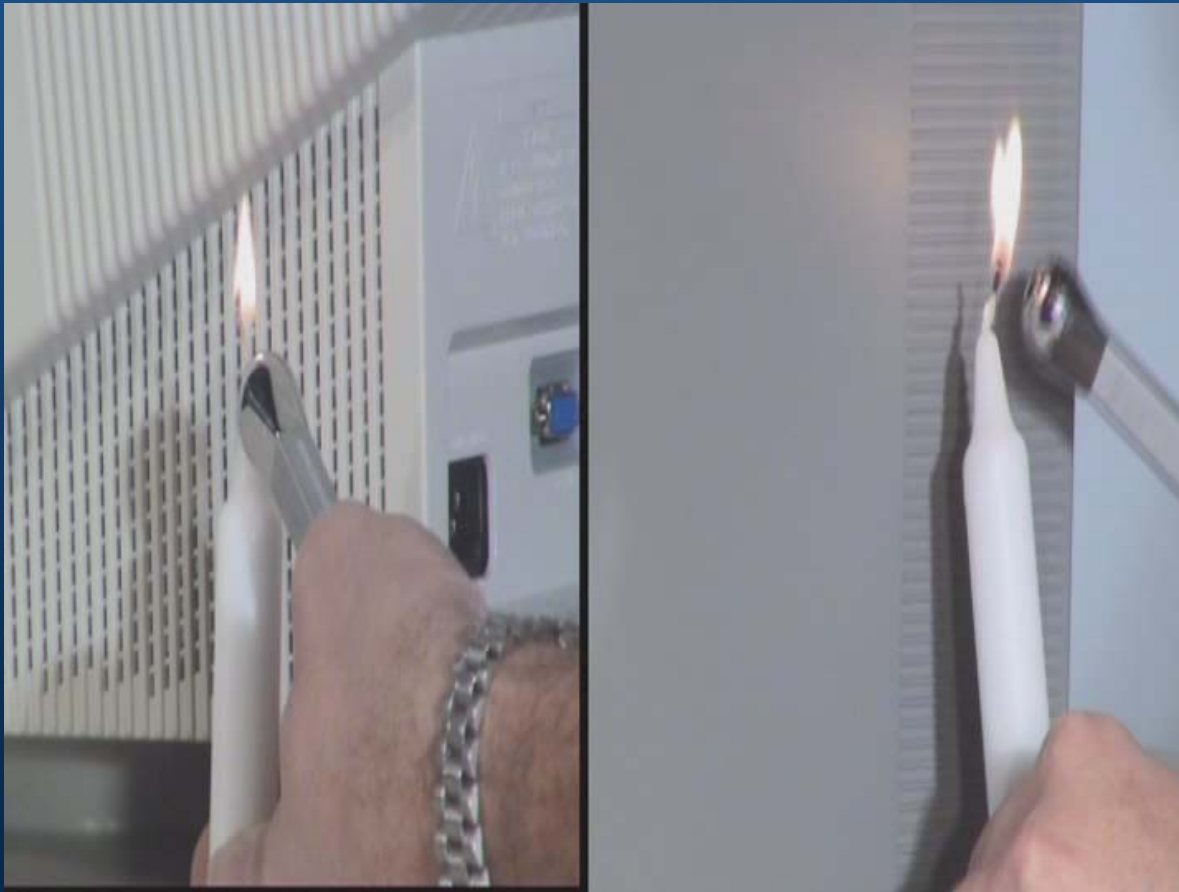
	Test conditions	Unit	Test method	Typical values
Mechanical				
Tensile modulus	1mm/min	MPa	ISO 527-2/1B/1	2700
Elongation	at break	%	ISO 527-2/1B/50	>50
Impact strength:	Izod notched @ 23°C; 3,2 mm	kJ/m ²	ISO 180/1A	40
	Izod notched @ -30°C; 3,2 mm	kJ/m ²	ISO 180/1A	10
Thermal				
Vicat softening temperature	50 N; 120°C/h	°C	ISO 306	115
Coeff. of linear thermal expansion		mm/m °C	ISO 11359-1,-2	0,076

Bayblend® FR 3030 Flame Retardant Properties

- Meets European Standards for Railway Vehicles

	Test conditions	Unit	Test method	Typical values
UL 94	Thickness	Class		V-0 (1,5 mm)
UL 94-5V		Class		5VB (2,0 mm)
UL 94-5V		Class		5VA (3,0 mm)
Fire test for materials and parts in railway applications	sheets 190 x 500 mm, thickness 1,5 mm/2,0 mm/2,5 mm	Class	DIN 5510-2	S-4/SR-2/ST-2
French Railway vehicles	Fire Behavior	Class	NF P 92-501/92-502	M1 (2-3 mm)
French Railway vehicles	Smoke density & toxicity	Class	NF X 10-702/ NF X 70-100	F2 (3 mm)

Fire Behaviour Bayblend® FR 3030



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Bayblend[®] MTR

NEW!

- High stiffness

	Test conditions	Unit	Test method	Typical values
Mechanical				
Tensile modulus	1mm/min	MPa	ISO 527-2/1B/1	3800
Elongation	at break	%	ISO 527-2/1B/50	20
Impact strength:	Izod notched @ 23°C; 3,2 mm	kJ/m ²	ISO 180/1A	10
	Izod notched @ -30°C; 3,2 mm	kJ/m ²	ISO 180/1A	7
Thermal				
Vicat softening temperature	50 N; 120°C/h	°C	ISO 306	109
Coeff. of linear thermal expansion		mm/m°C	ISO 11359-1,-2	0,052

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Bayblend[®] MTR Exceptional FR Properties

NEW!

- Improved Flame Retardant properties

	Test conditions	Unit	Test method	Typical values
Burning Behaviour				
Fire test for materials and parts in railway applications	sheets 190 x 500 mm, thickness 1,5 mm/2,0 mm/2,5 mm	Class	DIN 5510-2	S-4/SR-2/ST-2 (3 mm)
Fire test for materials and parts in building & construction	2,5 x 190 1000 mm	Class	DIN 4102-1	B1 (3 mm) no burning droplets
French Railway Vehicles		Class	NF P 92-501/92-502	M1 (1.5 mm, 2 mm, 3 mm)
French Railway Vehicles		Class	NF F 16-101/102	F1 (3 mm) F2 (1.5 mm, 2 mm)
Docket 90A	ASTM E 162: Flame spread index Is Burning dripping?			< 35 (2 mm, 3 mm) No (2 mm, 3 mm)
Docket 90A	ASTM E 662: Ds 1.5 min Ds 4.0 min			< 100 (1.5 mm, 2 mm, 3 mm) < 150 (1.5 mm, 2 mm, 3 mm)

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Bayblend® FR 3030 and Bayblend® MTR FR Properties

Requirements	Branch	FR 3030	MTR
UL 94 V-0 @	E/E	1.5 mm	0.75 mm
DIN 5510 / DIN 54837 DB-Brandschacht	Rail, Germany	S-4/SR-2/ST-2 (1.5/2.0/2.5 mm)	S-4/SR-2/ST-2 (3 mm)
NF P 92-507 Epiradiateur test	Rail, France	M1 (2.0 and 3,0 mm)	M1 (3.0 mm)
NF X 70-100 / NF X 10-702 Smoke toxicity / density	Rail, France	F2 (3,0 mm)	F1 (3.0 mm)
Docket 90A / ASTM E162 Radiant panel test	Rail, US	-	3.0 mm (Al-Backing)
Docket 90A / ASTM E662 Smoke density	Rail, US	-	2.0 mm 3.0 mm

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How do we solve this....?



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Anti - Graffiti PVDF Top Layer

- Less adhesion and dirt pick up
- Excellent chemical resistance
- Excellent UV stability
- Easy thermoformable
- Cost effective



Anti - Graffiti Test NF F 31-112

- Results on Bayblend FR 3030 AG grey 704 (light grey)

graffiti	cleaning agent (class G)	ΔE (class G)
Permanent marker	G1	< 1
Alkyd paint	G1	< 1
Acrylic paint	G1	<1
metallic cellulose paint	G1	<1
tar based paint	G1	<1

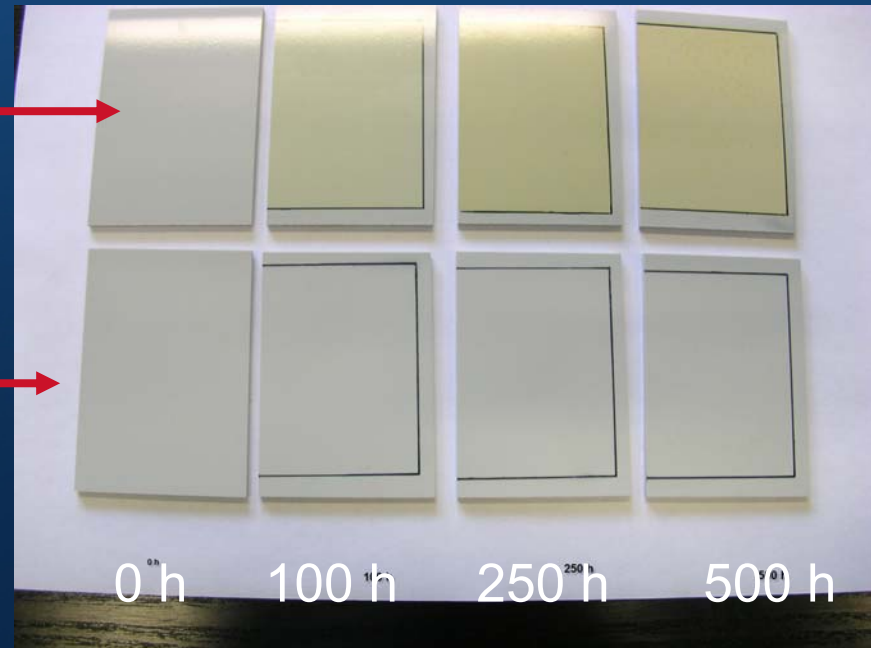
UV Resistance

- $\Delta E = 0,8$ after UV-B testing

without PVDF



with PVDF layer



Applications



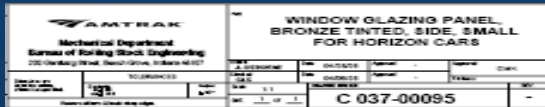
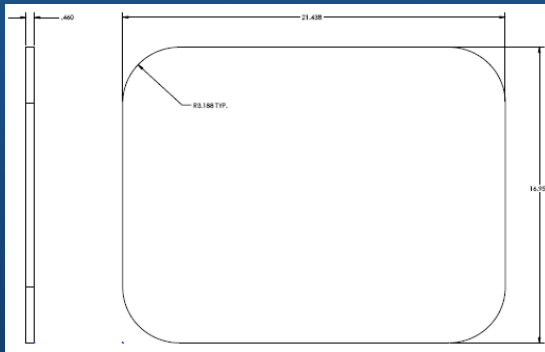
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Application: Side Windows



■ Amtrak (US)

➤ Dual Glazed Rail Window.

- Two pieces of 6mm Makrolon
- Desiccant embedded aluminum spacer
- Hot butyl sealant
- Silicone/ Butyl tape

➤ Laminate

- 3mm glass, 4.5mm Makrolon, 3mm glass

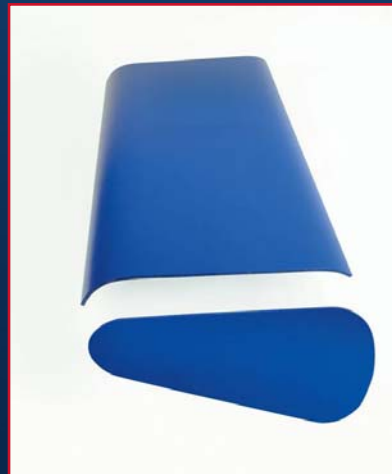
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Application : Seat



- Product used: 6 mm Bayloy FR 10
- Production technology: Thermoforming
- OEM: Integral Coach Factory, Chennai
- End-user: Indian Railways
- Thermoformed by: Malibu Plastic (India)



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Application : Lamp cover

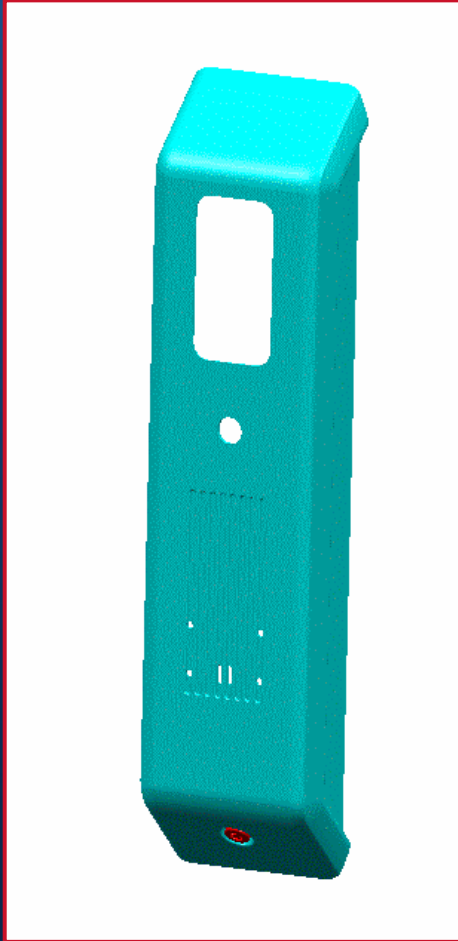


- Product used: makrolon white 2130
- Production technology: Thermoforming
- OEM: Siemens
- End-user:: ICE
- Thermoformed by: Cristallux (DE)

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Application : Instrument cover



- Product used: 6 mm Bayblend FR 3030
- Production technology: Thermoforming
- OEM: Alstom
- End-user:: Urban Transport
- Thermoformed by: Vitalo Industires

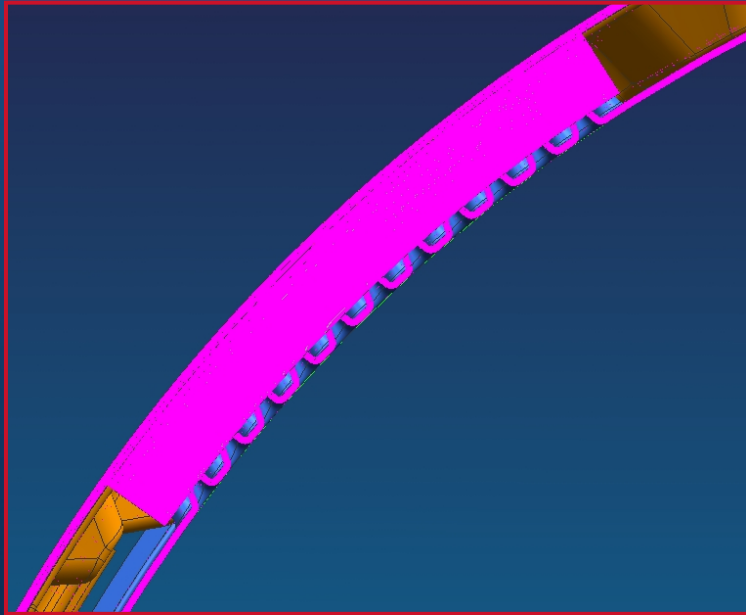
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Concept: ceilings and side wall panels



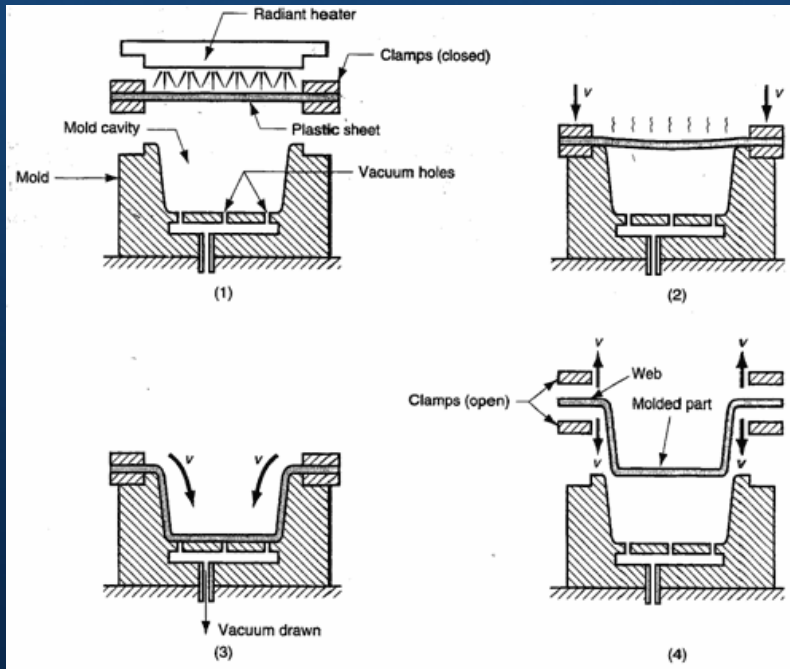
- Product used: 6 mm Bayblend FR 3030
- Production technology: Thermoforming
- OEM: all rail coach manufacturers
- End-user: all Rail/bus operators
- Concept & Thermoforming: by: Vitalo Industries

Basic characteristics of thermoforming

- Versatile process
- Simple to complex components
- Large parts
- Low cost moulds allow cost efficient production of small and medium series
- Freedom of design
- Through coloured sheets/parts

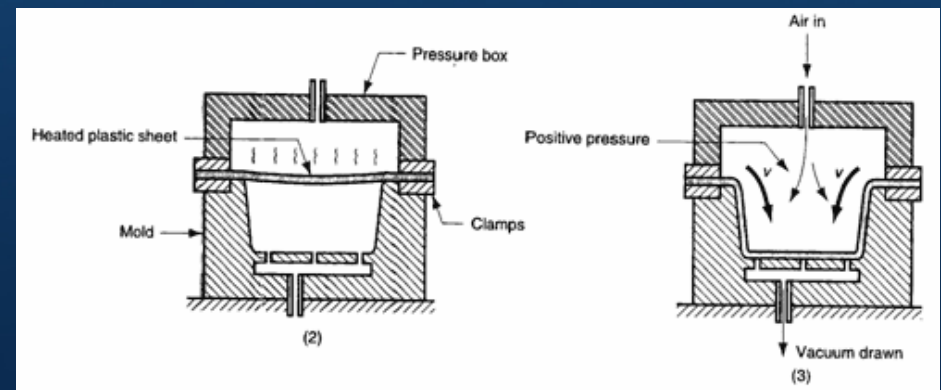
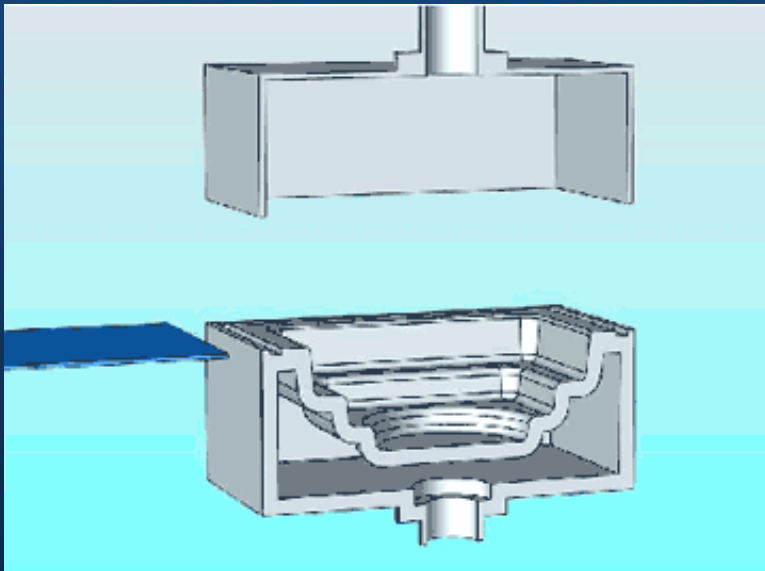
Vacuum Forming

- Vacuum draws the part against the mold “cavity”



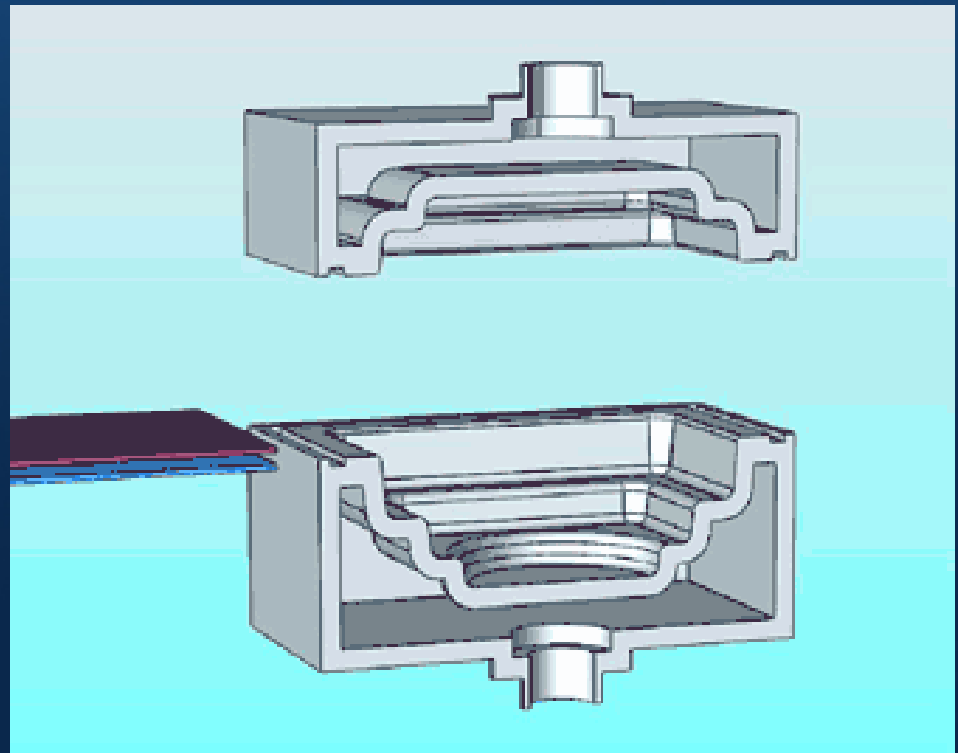
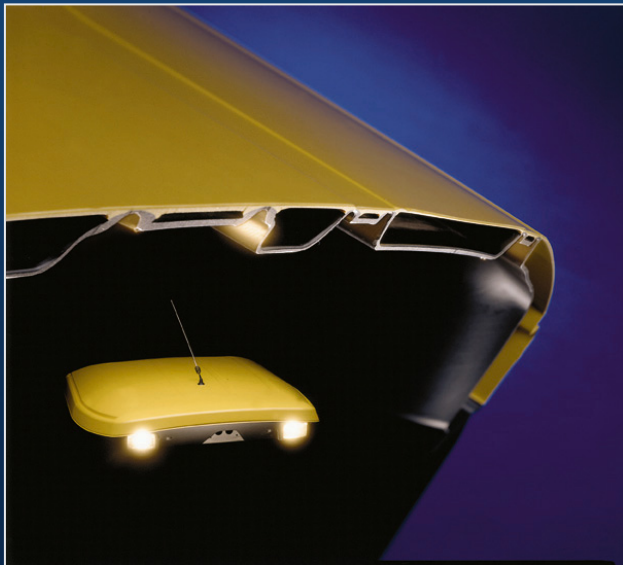
Pressure Forming

- Air pressure presses the sheet against the mold “cavity”



Twin Sheet Thermoforming

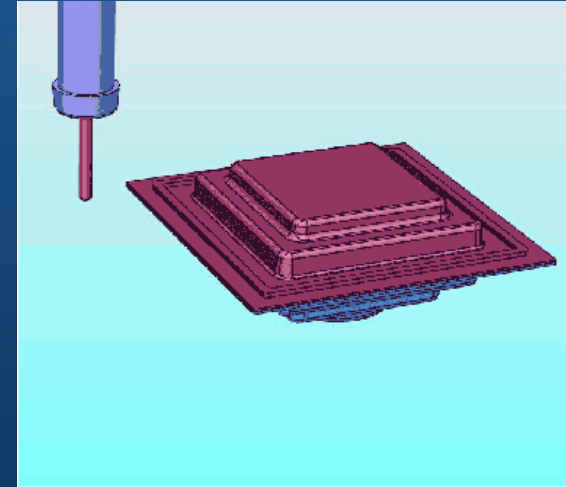
- Thermoforming of two sheets simultaneously
- Multiple colors or textures



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Finishing

- Trimming



Locations SFP



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Thank You for Your Attention

Welcome to booth 5040

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