

# Thermoplastic Sheet for Railway Interiors

Railway Interiors Expo Asia

2010, November 16

Wim Van Eynde



Bayer MaterialScience



# Summary of this presentation

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- Thermoplastics in transportation
- Why thermoplastics are new to the railway industry
- Specific requirements for Railway Mass Transit
- Developments in thermoplastic sheet
- The advantage of thermoforming
- Reference applications

# Thermoplastics in Transportation

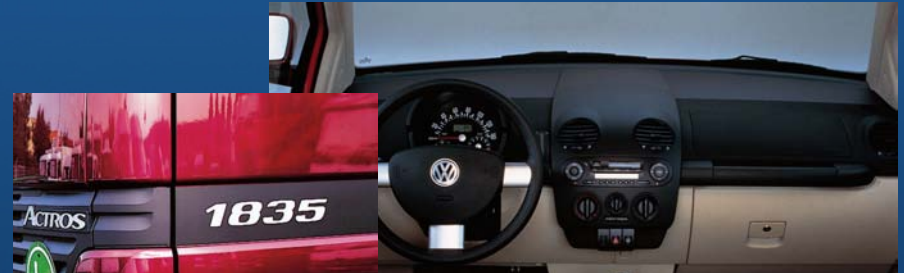
- On Land

- Automotive

- Commercial Vehicles

- Mass transportation

- In the Air



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# Why are thermoplastics new to the Railway Industry?

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

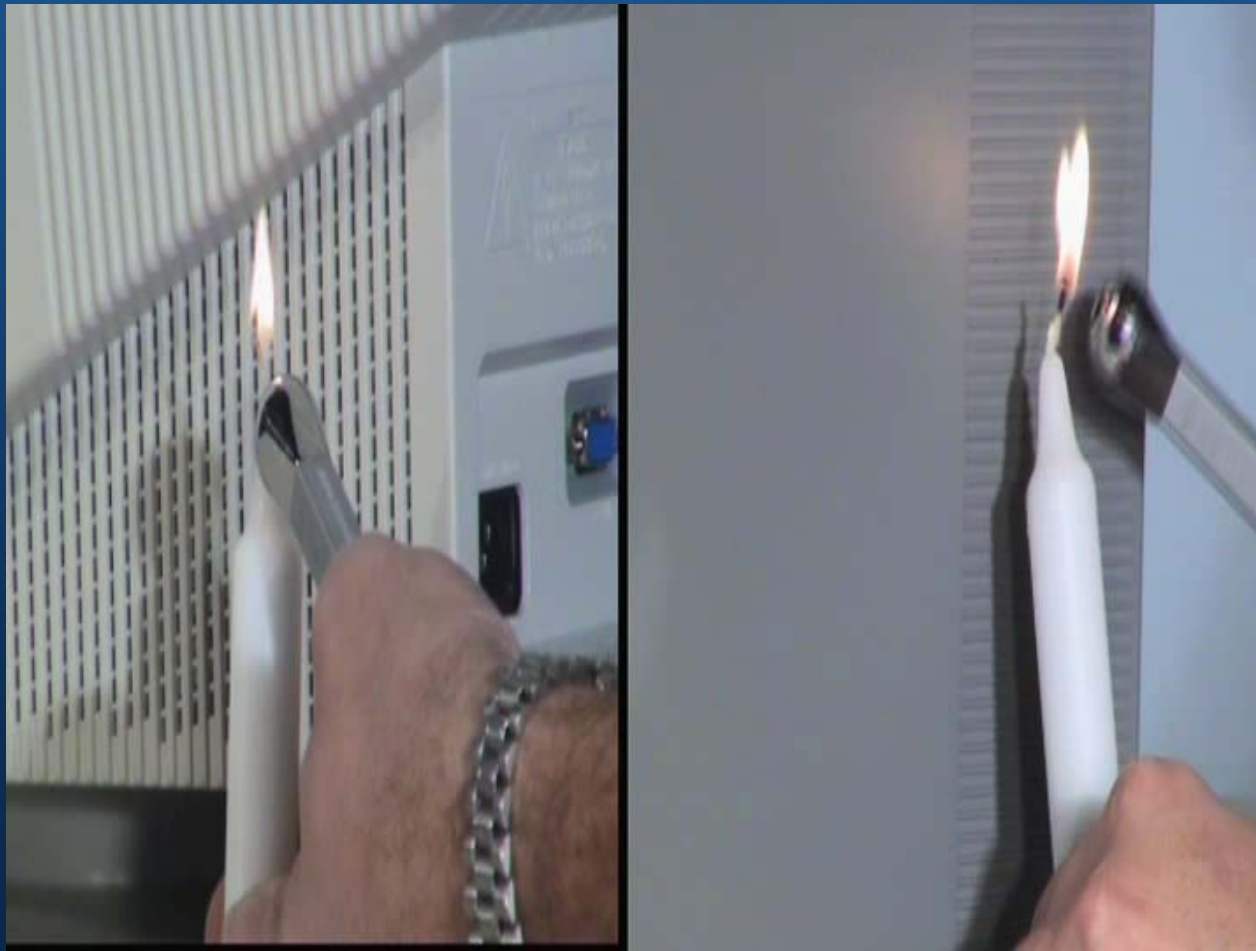
# Specific requirements to Railway Mass Transit

- Burning behaviour
  - Difficult ignition
  - Low flame spread
  - Low smoke density
  - Low smoke toxicity
  - No burning droplets
- Impact resistance
- UV resistance
- Anti - Graffiti
- Light weight
- Recycable
- Passenger safety
- Durability
- Durability
- Vandalism resistant
- Energy saving
- Cradle-to-cradle

# Developments in thermoplastic sheet

## Burning behaviour

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# Developments in thermoplastic sheet

## Burning behaviour

Requirements	Branch	Properties
UL 94 V-0 @	E/E	Ignition & flame spread
DIN 5510-1 / DIN 54837 DB-Brandschacht	Rail, Germany	Flame spread, smoke density, dripping behaviour
DIN 5510-2 / ISO 5659-2	Rail, Germany	Smoke toxicity
NF P 92-507 Epiradiateur test	Rail, France	Flame spread & dripping behaviour
NF X 70-100 / NF X 10-702 Smoke toxicity / density	Rail, France	Smoke density & toxicity
Docket 90A / ASTM E162 Radiant panel test	Rail, US	Flame spread
Docket 90A / ASTM E662 Smoke density	Rail, US	Smoke density

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# Developments in thermoplastic sheet

## Burning behaviour

Requirements	Branch	Possible classifications of thermoplastics
UL 94 V-0 @	E/E	V-0 V-2
DIN 5510-2 / DIN 54837 DB-Brandschacht	Rail, Germany	S4-SR2-ST2 S3-SR2-ST2
DIN 5510-2 / ISO 5659-2	Rail, Germany	FED(tzul) < 1
NF P 92-507 Epiradiateur test	Rail, France	M1 M2
NF X 70-100 / NF X 10-702 Smoke toxicity / density	Rail, France	F1 F2
Docket 90A / ASTM E162 Radiant panel test	Rail, US	Ls < 35 No burning droplets
Docket 90A / ASTM E662 Smoke density	Rail, US	Ds 1.5' < 100 Ds 4.0' < 150

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# Developments in thermoplastic sheet

## Burning behaviour

Requirements

Branch

Properties

pr-EN45545

Rail, Europe

Ignition  
Flame spread  
Smoke density  
Smoke toxicity  
Burning droplets

# Developments in thermoplastic sheet

## Burning behaviour

Requirements

Branch

Possible classifications  
of thermoplastics

pr-EN45545

Rail, Europe

HL3 ?  
HL2 ?

# Specific requirements to Railway Mass Transit

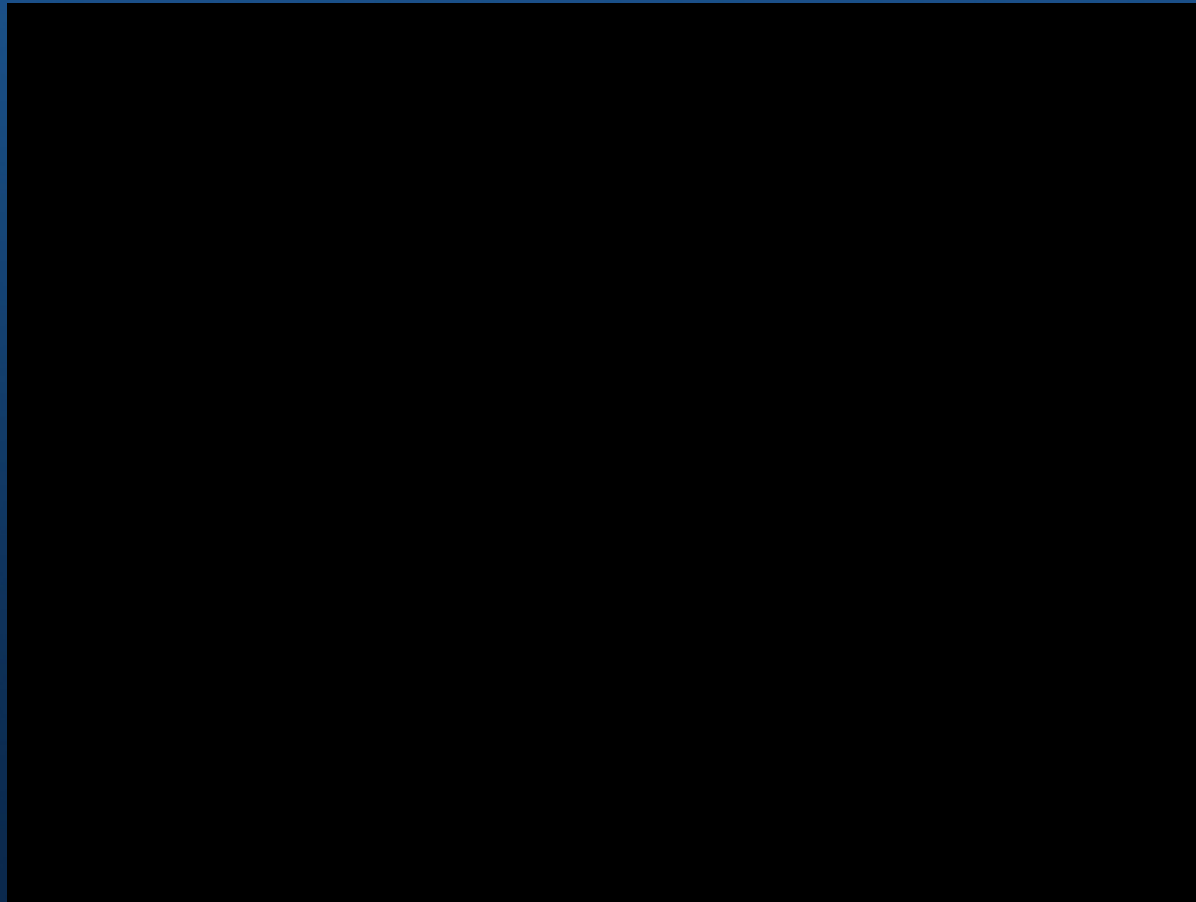
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# Developments in thermoplastic sheet

## Impact resistance

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# Specific requirements to Railway Mass Transit

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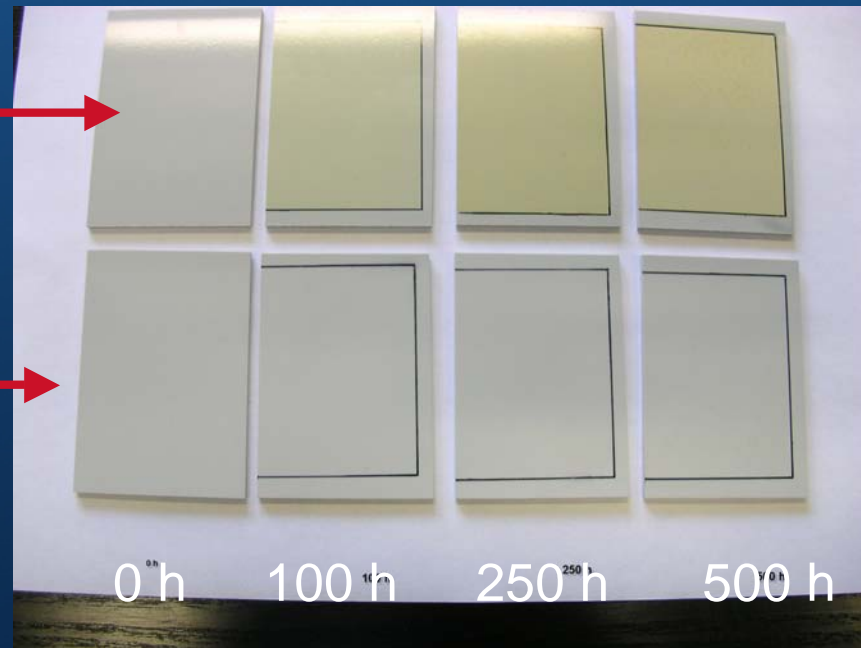
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# Developments in thermoplastic sheet UV resistance

QUV-weathering test

without protective layer

with protective layer



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- Durability
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# Developments in thermoplastic sheet Anti-graffiti



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# Developments in thermoplastic sheet

## Anti-graffiti

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### 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 sheets with PVDF top layer

graffiti	cleaning agent (class G)	$\Delta E$ (class G)
Permanent marker	G1	< 1
Alkyd paint	G1	< 1
Acrylic paint	G1	<1
metallic cellulose paint	G1	<1
tar based paint	G1	<1

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- Energy saving

# Developments in thermoplastic sheet

## Light weight

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### Interior cladding

- Thermoplastic sheet typically has a density of 1.1 -1.4 g/cm<sup>3</sup>  
→ much lower than metal or GRP
- Thermoplastic sheet allows for thin gauge constructions  
→ reducing thickness = reducing weight



# Developments in thermoplastic sheet

## Light weight

### Glazing

- Polycarbonate has half the weight of glass

### Example

- Amtrak Makrolon side window
- Dual glazed, 2 x 6 mm Makrolon sheet
- Weight savings: approx. 150 kg/wagon
- Additional advantage: vandalism proof



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# Developments in thermoplastic sheet Recyclable

## Thermoplastics can be recycled

- Cradle-to-cradle concepts become possible
- Existing network of recycling companies is well established
- Major advantage over GRP systems



# The advantage of thermoforming

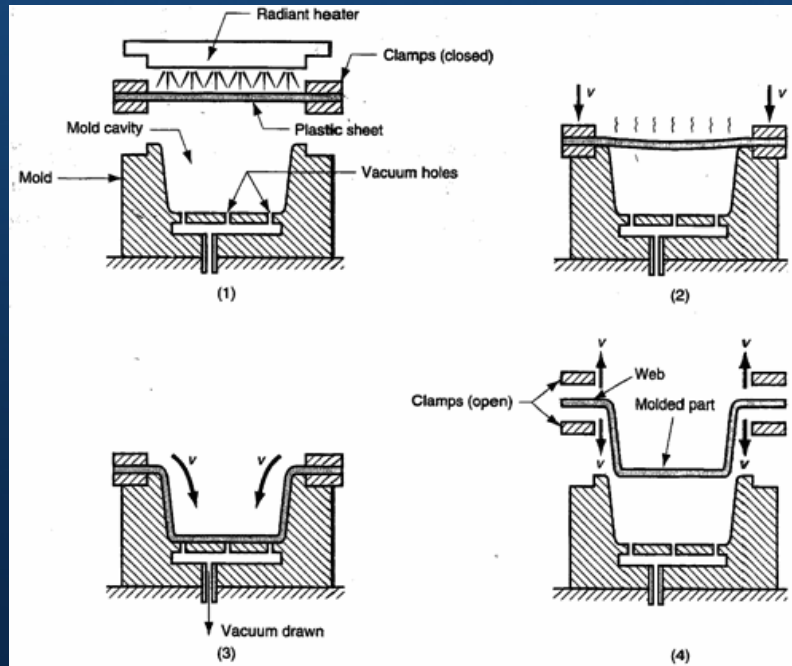
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- Versatile process
- Simple to complex components
- Large parts
- Low cost moulds allow cost efficient production of small and medium series
- Freedom of design
- Through coloured sheets/parts



# Vacuum Forming

- Vacuum draws the part against the mold “cavity”

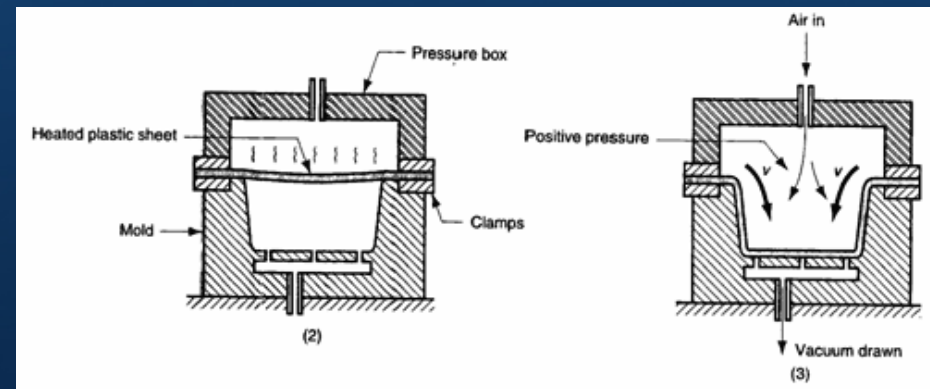
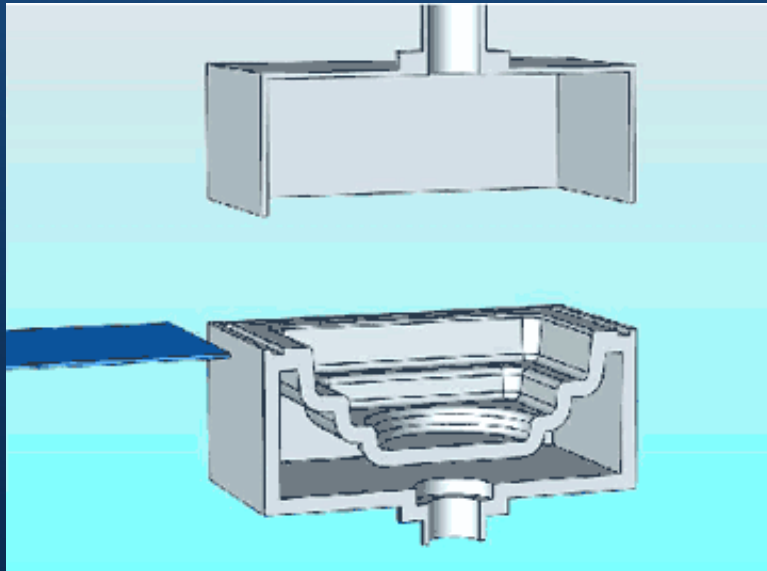


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# Pressure Forming

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



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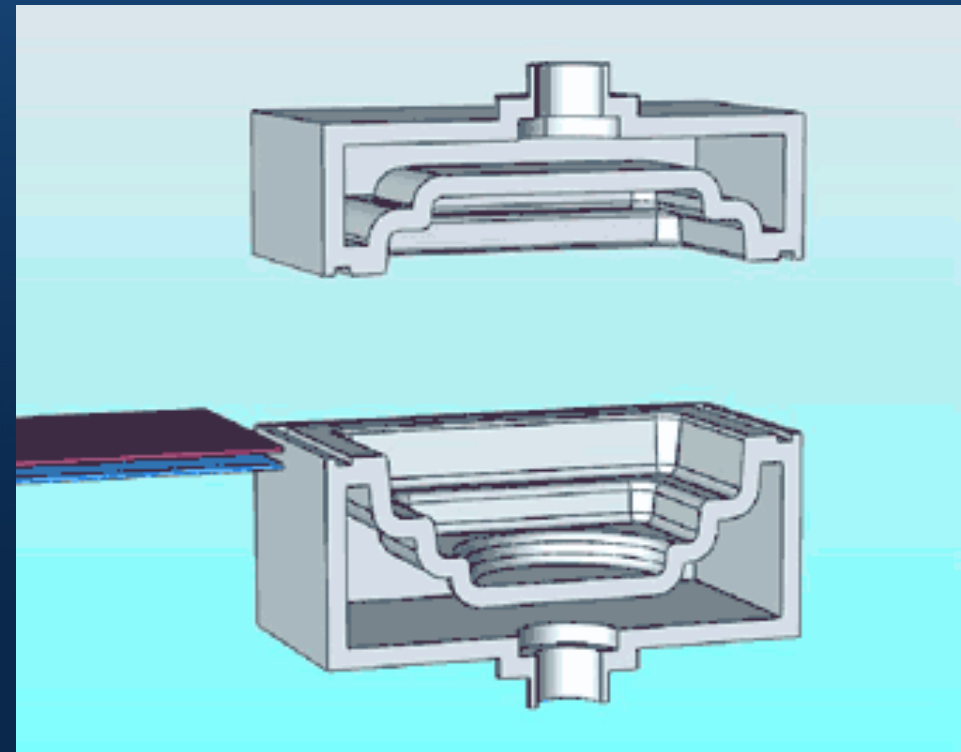
# Twin Sheet Thermoforming

- Thermoforming of two sheets simultaneously
- Multiple colors or textures



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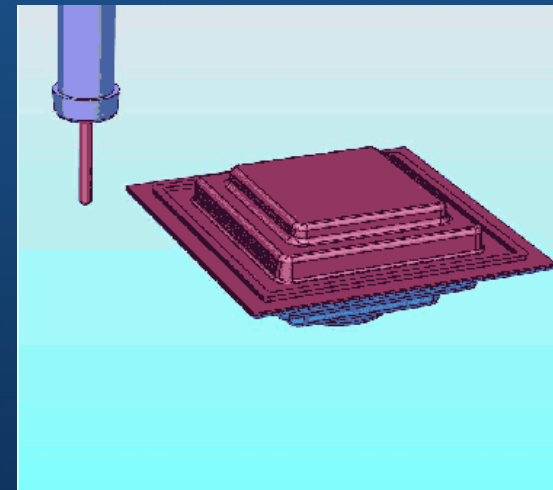
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# Finishing

- Trimming



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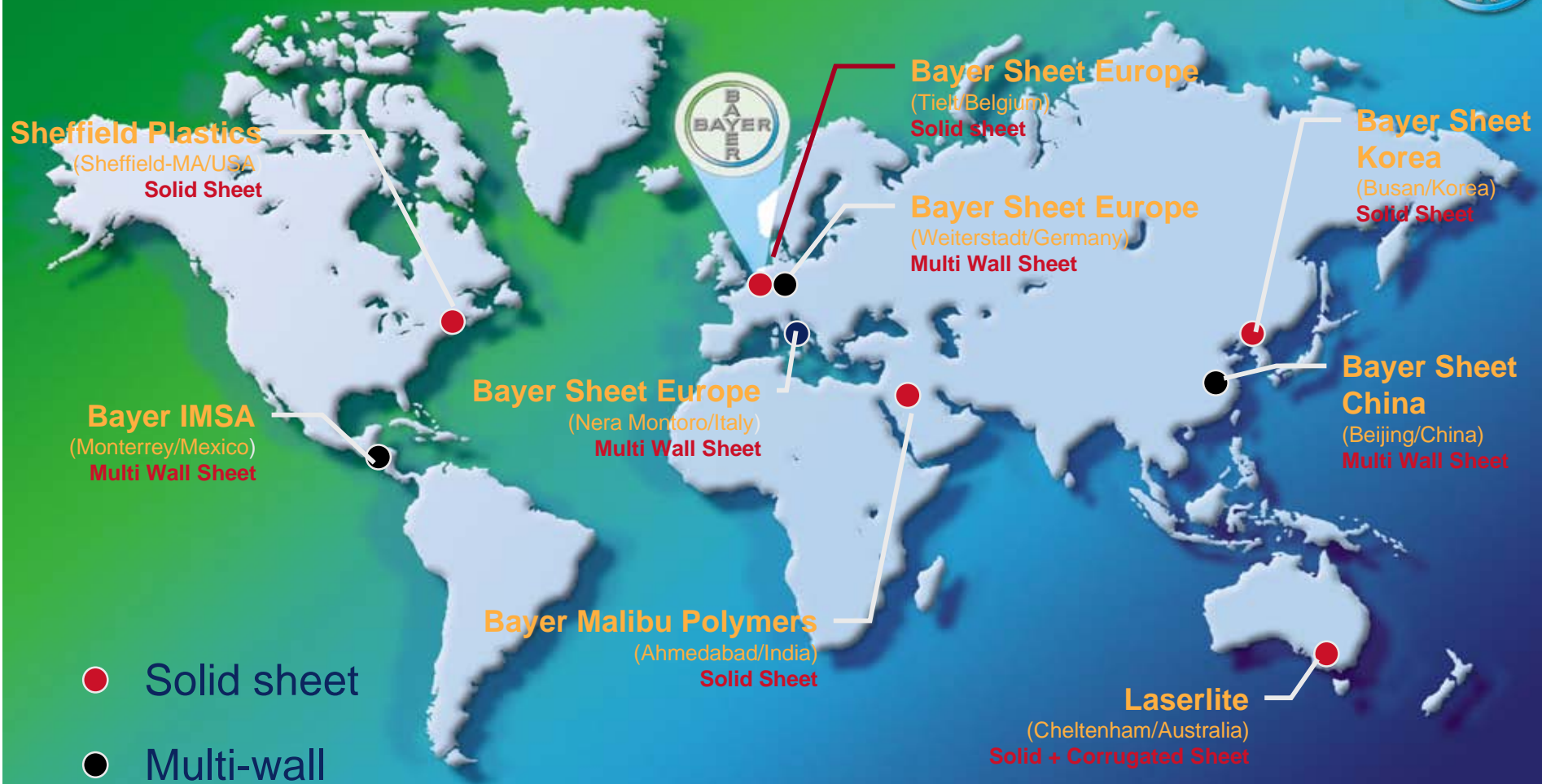
# Applications



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# Locations SFP



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