ARALDITE® PRODUCTS FOR RAILWAY
ARALDITE® PRODUCTS FOR RAILWAY
Huntsman Corporation

Revenue 2014: $ 11.6 b – Adjusted EBITDA 2014: $ 1.3 b

Polyurethanes
- MDI
- Polyols
- PO/MTBE
- TPU
- Systems

Performance Products
- Performance Specialties
- Performance Intermediates

Advanced Materials
- Base Resins
- Formulated Systems
- Specialty Components

Textile Effects
- Apparel & Home Textiles
- Specialty Textiles

Pigments
- Titanium Dioxide

Advanced Materials
ARALDITE® PRODUCTS FOR RAILWAY
Investing in new technologies

Americas
Synthesis: new epoxies, new molecules
Waterborne products

Europe
Composites
Curing Agents

APAC
Casting & Encapsulation (E-mobility)¹

Creating new technology platforms
Addressing global market needs
With dedicated resources and funding
Technology transfer to regional product development teams for commercialization
ARALDITE® PRODUCTS FOR RAILWAY
The Araldite® Brand
## ARALDITE® PRODUCTS FOR RAILWAY

### The portfolio

<table>
<thead>
<tr>
<th>ADHESIVES</th>
<th>COMPOSITES</th>
<th>CASTING SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Epoxy</td>
<td>• New Thermoset system</td>
<td>• Epoxy</td>
</tr>
<tr>
<td>• Polyurethane</td>
<td>• Benzoxazine</td>
<td>• Polyurethane</td>
</tr>
<tr>
<td>• Methyl Methacrylate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Phenolic</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Advanced Materials
ARALDITE® PRODUCTS FOR RAILWAY
The portfolio

ADHESIVES
• Epoxy
• Polyurethane
• Methyl Methacrylate
• Phenolic

COMPOSITES
• New Thermoset system
• Benzoxazine

CASTING SYSTEMS
• Epoxy
• Polyurethane
• Typical mechanical properties – chemistries comparison
ARALDITE® ADHESIVES
Araldite® AW 146 / Hardener HV 957

Technical Features

• Self-levelling
• Good adhesion on a wide variety of substrates
• Good fatigue and dynamic loading resistance
• Very good thermal performances

Customer Benefits

• Easy to apply on large surfaces
• Reliable bond, suitable for multi-materials assemblies
• Suitable for structures subjected to loading and vibrations
• Suitable for assemblies with service temperatures from -40°C to 80°C.
ARALDITE® ADHESIVES
Araldite® AW 146 / Hardener HV 957

- Lamination of sandwich panels for floors, side panels and roofs
- Aluminium, PVC, PET foams
Technical Features

- Gap filling
- Non-sagging
- High resistance to vibrations

Customer Benefits

- Able to compensate tolerances, suitable for large parts
- Vertical application possible
- Prevents damages or deformations, suitable for parts subjected to heavy dynamic loads
ARALDITE® ADHESIVES
Araldite® 2013

- Assembly composite locomotive cabin
- GRP

- Bonding of inserts in sandwich panels
- Aluminium

- Bonding and sealing of traction transformers
- Asia
- Stainless steel, ferrites
Technical Features

• Gap filling
• Non-sagging
• Toughened and resilient
• Excellent environmental resistance

Customer Benefits

• Able to compensate tolerances, suitable for large parts
• Vertical application possible
• Can be used for parts subjected to vibrations and impacts
• Suitable for bonding external parts
ARALDITE® ADHESIVES
Araldite® 2015

• Assembly of driver compartments
• Aluminium

• Assembly sandwich panels and profiles
• Aluminium

• Bonding vibration dampers to train body
• Italy
• Aluminium
• Bonding window edges
• Glass, painted metal

• Assembly of door
• Aluminium

• Table laminate assembly
• Aluminium, plastics
ARALDITE® ADHESIVES
Araldite® 2031

Technical Features
- Gap filling
- High hardness / black colour
- Good adhesion to a very wide spectrum of substrates
- Toughened and resilient

Customer Benefits
- Able to compensate tolerances, suitable for large parts
- Can be sanded after cure for a smooth finish
- Universal adhesive suitable for many different applications
- Can be used for parts subjected to vibrations and impacts
ARALDITE® ADHESIVES
Araldite® 2031

- Bonding / sealing between panels of the floor (perimeter and crosswise)
- Aluminium
Technical Features

- Fast curing
- Non-sagging
- Good adhesion to a very wide spectrum of substrates
- Toughened and resilient

Customer Benefits

- For rapid assemblies and high volume runs
- Suitable for vertical assemblies
- Universal adhesive suitable for many different applications
- Can be used for parts subjected to vibrations and impacts
ARALDITE® ADHESIVES
Araldite® 2021 / Araldite® 2022

- Bonding profile to windscreen
- PVC, Glass
- Reinforcement on roofs
- Aluminium
- Toilet module components
- Thermoplastics
- Cameras
- Steel, plastic
ARALDITE® ADHESIVES
Araldite® 2021 / Araldite® 2022

• Bonding interior components and furniture
• Metals, GRP, Thermoplastics

• Shelves in wagon
• GRP
ARALDITE® ADHESIVES
Araldite® AW 2101 / Hardener HW 2951

Technical Features

- Fast curing
- Good environmental resistance
- Gap filling

Customer Benefits

- For rapid assemblies and high volume runs
- Suitable for external parts
- Able to compensate tolerances
**ARALDITE® ADHESIVES**

**Araldite® AW 2101 / Hardener HW 2951**

- Bonding hinges for trap doors
- Steel, GRP

- Bonding housing of electronic systems
- Aluminium, GRP
**ARALDITE® ADHESIVES**
Araldite® 2029-1

### Technical Features
- Gap filling
- High elongation at break
- Good adhesion to a very wide spectrum of substrates

### Customer Benefits
- Able to compensate tolerances, suitable for large parts
- Suitable for flexible substrates and dissimilar substrates
- Universal adhesive suitable for many different applications
• Joints in floors
• Rubber
<table>
<thead>
<tr>
<th>Technical Features</th>
<th>Customer Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Excellent lap shear strength and peel strength</td>
<td>• Enables a design with an optimized bonding area</td>
</tr>
<tr>
<td>• Excellent dynamic loads resistance</td>
<td>• Suitable for part subjected to dynamic loading</td>
</tr>
<tr>
<td>• Very good fatigue resistance</td>
<td>• Ensures high durability of assemblies</td>
</tr>
</tbody>
</table>
ARALDITE® ADHESIVES
Araldite® AW 4858 / Hardener HW 4858

- Bonding aluminium rail for fixing seats
- Aluminium
Araldite® 2033 – FST adhesive

Technical Features

• Flame retardant
• High lap shear strength
• Excellent environmental resistance

Customer Benefits

• Tested according to EN 45545-2 Ranking HL1 (R23)
• Suitable for structural applications
• Suitable for interiors and exterior parts
ARALDITE® PRODUCTS FOR RAILWAY
The portfolio

ADHESIVES
• Epoxy
• Polyurethane
• Methyl Methacrylate
• Phenolic

COMPOSITES
• New Thermoset system
• Benzoxazine

CASTING SYSTEMS
• Epoxy
• Polyurethane
ARALDITE® COMPOSITE SYSTEMS
Araldite® FST 40002 / 40003

- Phenolic Prepreg
- Phenolic Liquid Process
- Polyester
- Epoxy Liquid Process
- Epoxy prepreg
- Thermoplastic organosheets
- Araldite® FST 40002 / 40003
Advanced Materials

ARALDITE® COMPOSITE SYSTEMS
Araldite® FST 40002 / 40003

Technical Features

• Inherently flame retardant
• Unfilled, low viscosity, latent
• Fast cure & low exothermic reaction
• High mechanical properties

Customer Benefits

• Complies with EN 45545-2 without using fillers
• Suitable to manufacture complex parts
• High productivity for small & medium parts and high thicknesses possible
• Efficient production of interior structural CFRP / GFRP with maximized weight savings

ARALDITE® COMPOSITE SYSTEMS
Enriching lives through innovation
## ARALDITE® COMPOSITE SYSTEMS
### Araldite® FST 40002 / 40003

<table>
<thead>
<tr>
<th>Fiber type</th>
<th>GFRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resin Volume %</td>
<td>50</td>
</tr>
<tr>
<td>Thickness (mm)</td>
<td>1.15</td>
</tr>
</tbody>
</table>

### Spread of flame

<table>
<thead>
<tr>
<th>Standard EN 45545-2 (R1 / R7)</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFE (kWm-2)</td>
<td>24.3</td>
<td>HL3</td>
</tr>
<tr>
<td>MARHE</td>
<td>75</td>
<td>HL2</td>
</tr>
</tbody>
</table>

### Heat release

<table>
<thead>
<tr>
<th>Standard EN 5660-1 50 kWm-2</th>
<th>MARHE</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
<td>HL2</td>
</tr>
</tbody>
</table>

### Smoke density and toxicity

<table>
<thead>
<tr>
<th>Standard EN 5659-2 50 kWm^2</th>
<th>Ds(4)</th>
<th>VOF4 (min)</th>
<th>CIT_G (8 min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>321</td>
<td>643</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>207</td>
<td>145</td>
<td>HL3</td>
<td></td>
</tr>
<tr>
<td>HL1</td>
<td>Max</td>
<td>0.13</td>
<td></td>
</tr>
</tbody>
</table>

### Thickness dependency:
- **1.15 mm GFRP**: HL1
- **4.15 mm GFRP**: HL2
ARALDITE® PRODUCTS FOR RAILWAY
The portfolio

ADHESIVES
- Epoxy
- Polyurethane
- Methyl Methacrylate
- Phenolic

COMPOSITES
- New Thermoset system
- Benzoxazine

CASTING SYSTEMS
- Epoxy
- Polyurethane
### ARALDITE® CASTING RESINS
Systems qualified for R23 criteria (interior)

<table>
<thead>
<tr>
<th>System</th>
<th>Chemistry</th>
<th>Limit Oxygen index ISO 4589-2</th>
<th>Smoke opacity density ISO 5659-2</th>
<th>Smoke toxicity at 600°C NF X 70-100</th>
<th>Ranking EN 45545-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CY 5622 HY 1235 DY 062 Silica flour</td>
<td>EP Hot</td>
<td>32%</td>
<td>131.1</td>
<td>0.11</td>
<td>HL3</td>
</tr>
<tr>
<td>XB 5829 XB 5830 Aluminium hydroxide</td>
<td>EP Hot</td>
<td>44.9%</td>
<td>35.4</td>
<td>0.24</td>
<td>HL3</td>
</tr>
<tr>
<td>CW 1302 HY 1300</td>
<td>EP Cold</td>
<td>36.1%</td>
<td>237.9</td>
<td>0.81</td>
<td>HL2</td>
</tr>
<tr>
<td>CW 2243-2 HY 842</td>
<td>EP Cold</td>
<td>29%</td>
<td>273.3</td>
<td>0.91</td>
<td>HL1</td>
</tr>
<tr>
<td>XB 2252 XB 2253</td>
<td>EP Cold</td>
<td>30.2%</td>
<td>336.3</td>
<td>0.99</td>
<td>HL1</td>
</tr>
<tr>
<td>CW 2250-1 HY 2251</td>
<td>EP Cold</td>
<td>30.3%</td>
<td>417</td>
<td>1.05</td>
<td>HL1</td>
</tr>
</tbody>
</table>
## ARALDITE® CASTING RESINS
### Systems qualified for R24 criteria (exterior)

<table>
<thead>
<tr>
<th>System</th>
<th>Chemistry</th>
<th>Limit Oxygen index ISO 4589-2</th>
<th>Smoke opacity density ISO 5659-2</th>
<th>Smoke toxicity at 600 degC NF X 70-100</th>
<th>Ranking EN 45545-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CY 5622 HY 1235 DY 062 Sentica flour</td>
<td>EP Hot</td>
<td>32%</td>
<td>131.1</td>
<td>0.11</td>
<td>HL3</td>
</tr>
<tr>
<td>XB 5829 XB 5830 Aluminium hydroxide</td>
<td>EP Hot</td>
<td>44.9%</td>
<td>35.4</td>
<td>0.24</td>
<td>HL3</td>
</tr>
<tr>
<td>CW 1302 HY 1300</td>
<td>EP Cold</td>
<td>36.1%</td>
<td>237.9</td>
<td>0.81</td>
<td>HL3</td>
</tr>
<tr>
<td>CW 2243-2 HY 842</td>
<td>EP Cold</td>
<td>29%</td>
<td>273.3</td>
<td>0.91</td>
<td>HL2</td>
</tr>
<tr>
<td>XB 2252 XB 2253</td>
<td>EP Cold</td>
<td>30.2%</td>
<td>336.3</td>
<td>0.99</td>
<td>HL2</td>
</tr>
<tr>
<td>CW 2250-1 HY 2251</td>
<td>EP Cold</td>
<td>30.3%</td>
<td>417</td>
<td>1.05</td>
<td>HL2</td>
</tr>
<tr>
<td>CW 5620 HY 5610</td>
<td>PUR</td>
<td>35.3%</td>
<td>644.9</td>
<td>0.63</td>
<td>HL1</td>
</tr>
</tbody>
</table>
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For more information

www.aralditeadhesives.com
advanced_materials@huntsman.com

Europe
Huntsman Advanced Materials (Switzerland) GmbH
Klybeckstrasse 200
P.O. Box - 4002 Basel
Switzerland
Tel. +41 61 299 20 41
Fax +41 61 299 20 40
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