Powerful composite solutions for demanding needs
Powerful solutions for demanding needs

The VORAFORCE™ composite systems developed by Dow Formulated Systems, a business unit of The Dow Chemical Company (Dow), are tailored to help satisfy the demanding needs of different industries facing complex challenges. The epoxy-based formulated systems exhibit exceptional thermo-mechanical properties and compatibility with carbon fiber reinforcement, while the polyurethane-based systems demonstrate excellent toughness and fast curing. In addition, the entire VORAFORCE range is characterized by low VOC emissions during production.

In Dow Formulated Systems, our deep understanding of chemistry, material science and modeling (with DOW™ e-CURE modeling suite) and experience of fabrication technologies such as pultrusion, filament winding, long fiber injection (LFI), resin transfer molding (RTM), and infusion enable us to provide solutions for many industries. Our formulations are widely used in wind power generation, transportation, construction, infrastructure and leisure. This diverse and holistic approach coupled with our R&D centers in Europe, Asia and the United States, enables continuous innovation to meet our global customers’ growing needs.

Our VORAFORCE systems demonstrate the knowledge, experience and technology innovation Dow offers its composites customers.
Support Services
At Dow Formulated Systems, we care about our customers. Our specialists work closely with them to support their profitable and sustainable business development, process simplification and efficiency improvement. Based on the combined offering of epoxy and polyurethane technologies, we develop innovative solutions for some of the most critical industrial projects and applications.

Global Coverage and Localization Support
Our network of 30 Systems Houses across the world allows us to provide our customers with global technology expertise and local technical support. We are always close to our customers: from early testing and sampling to mass production and launch. Our local Systems Houses enable us to provide our customers with fast response to most requirements.

Reliable Delivery of Goods and Quality
At Dow Formulated Systems, we are committed to ensuring reliable delivery of goods on time and meeting our customers’ schedules and deadlines through global service and logistics teams.
Pressure Vessels

<table>
<thead>
<tr>
<th>Technology System</th>
<th>Filament Winding Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry</td>
<td>VORAFORCE TW 100 series</td>
</tr>
<tr>
<td></td>
<td>Epoxy</td>
</tr>
</tbody>
</table>

Benefits:
- Outstanding impact resistance through FORTEGRA™ toughening technology
- Allows for production optimization through DOW™ e-CURE modeling
- Excellent fiber wetting for high mechanical strength

VORAFORCE systems are ideal for CNG and LPG cylinders and water purification tanks
High Performance Pipe

<table>
<thead>
<tr>
<th>Technology</th>
<th>System</th>
<th>Chemistry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filament Winding</td>
<td>VORAFORCE TW 100 series</td>
<td>Epoxy</td>
</tr>
</tbody>
</table>

Benefits:
- Outstanding impact resistance through FORTEGRA™ toughening technology
- Ability to meet a wide range of temperature requirements (Tg)
- Excellent fiber wetting properties for high strength
Electrical Infrastructure

<table>
<thead>
<tr>
<th>Technology System</th>
<th>Pultrusion System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry</td>
<td>VORAFORCE TP 200 series</td>
</tr>
<tr>
<td></td>
<td>Epoxy</td>
</tr>
</tbody>
</table>

**Benefits:**
- High pultrusion speed
- Excellent processing properties
- Ability to meet high temperature requirements (Tg)
### Construction

<table>
<thead>
<tr>
<th>Technology System</th>
<th>Pultrusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>VORAFORCE TP 200 series</td>
<td>Epoxy, polyurethanes</td>
</tr>
<tr>
<td>VORAFORCE TP 1200 series</td>
<td></td>
</tr>
</tbody>
</table>

### Benefits:

- Excellent processing properties
- Strength and toughness through novel polyurethane systems
- Expandable for lower densities
Construction Technology LFI – Long fiber injection
System VORAFORCE TL 1600 series
Chemistry Polyurethanes

Benefits:
- Fast cure for short cycle times
- Suitable for glass contents up to 40% for high strength structural composite parts
Consumer Durables

<table>
<thead>
<tr>
<th>Technology</th>
<th>Composite Spray</th>
</tr>
</thead>
<tbody>
<tr>
<td>System</td>
<td>VORAFORCE TS 1700 series</td>
</tr>
<tr>
<td>Chemistry</td>
<td>Polyurethanes</td>
</tr>
</tbody>
</table>

Benefits:
- Low investment and tooling costs
- Rheology optimized for easy processing
- Suitable for glass contents up to 20%
Transportation

Technology
- LFI – Long fiber injection
- VORAFORCE TL 1600 series
- Polyurethanes

Chemistry
- Polyurethanes

Benefits:
- Excellent mechanical properties
- Lower investment and tooling costs
- High surface quality
## Systems Overview

<table>
<thead>
<tr>
<th>Product family*</th>
<th>Fabrication Technology</th>
<th>Description</th>
<th>Key Benefits</th>
</tr>
</thead>
</table>
| VORAFORCE TW 100 series | Filament Winding | Epoxy systems particularly suited for filament winding process. Typical applications include pressure vessel and high performance pipe. | – Excellent fiber wetting properties for high mechanical strength  
– Outstanding impact resistance through FORTEGRA™ toughening technology  
– Wide range of Tg |
| VORAFORCE TP 200 series | Pultrusion | Epoxy systems developed for pultrusion process in power transmission, infrastructure and other high performance applications. | – High pultrusion speed  
– Excellent processing properties  
– Capable of very high Tg |
| VORAFORCE TF 300 series | Infusion | Epoxy systems for production of large and complicated composite parts through infusion technology. | – Low viscosity  
– Low exotherm  
– Excellent anti-wetting properties |
| VORAFORCE TH 400 series | Hand Layup | Viscosity adjusted Epoxy systems for hand lay up process. Selection of optimum pot life by a variety of Hardeners. | – Low exotherm  
– Excellent anti-fatigue performance |
| VORAFORCE TR 500/1500 series | Resin Transfer Molding (RTM) and SRIM | Epoxy and Polyurethane based systems for high pressure closed mold injection using glass and carbon fiber mat reinforcements. | – Fast cure for short cycle times  
– Excellent wetting for highest strength and impact resistant parts  
– Suitable for thin wall design |
| VORAFORCE TL 1600 series | Long Fiber Injection (LFI) | Polyurethane systems for LFI technology compatible with in-mold coatings or film technology. Exist in combustion modified versions and with internal mold release. | – Fast cure for short cycle times  
– Suitable for glass contents up to 40% resulting in very high strength composite parts |
| VORAFORCE TL 1700 series | Composite Spray | Spray polyurethane system comprising full density and expanded formulations suitable for reinforced single layer or multilayer structures. | – Rheology optimized for easy processing  
– Suitable for glass contents typically up to 20% resulting in medium strength composite parts |
| VORAFORCE TJ 1800 series | Reinforced RIM (RRIM) | Polyurethane or Polyurea based systems for high pressure closed mold injection using short-fiber reinforcements and compatible with various types of filters. | – Very short cycle times through fast cure and IMR technology  
– High surface quality meeting class A standards |
| VORAFORCE TN 1900 series | Light Weight Spray Preg | Family of spray polyurethane system for very light weight composites with honeycomb core reinforced with fiber glass mats. | – Short cycle times due to very fast cure and IMR technology  
– Excellent impregnation of fiber glass reinforcement |

* For physical properties, please refer to specific product datasheets.
NOTICE: Any photographs of end-use applications in this document represent potential end-use applications but do not necessarily represent current commercial applications, nor do they represent an endorsement by Dow of the actual products. Rather, these photographs are for illustrative purposes only and are not intended for an endorsement or sponsorship of any other manufacturer for a specific potential end-use application or for Dow, or for specific end-use applications marketed by Dow.

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