The Forum Composite Technology is made up of nine VDMA associations bringing together machinery manufacturers’ skills in the conversion of fibre composites. As central contact point for the industry, the forum is the interface to all firms, associations and institutes involved in the manufacturing or conversion process and the application of composites, offering all partners a platform for cross-technology exchanges.

The forum is closely concerned with:
- Markets and customers: cooperation and exchange between associations, clusters and other customer industry organisations
- Exhibitions policy: as sponsor of the COMPOSITES EUROPE trade fair, the Forum is establishing an important trade fair hub in Germany
- Understanding the process: fostering innovative ability based on a common understanding of the process along the entire supply chain
- Research: networking of research and industry to promote pre-competitive research
- Public relations: joint articulation of interests and concerted public relations activities
- Sourcing service: the Forum’s member companies present their range of products and the services they offer in the Composite Arena

Further flyer available on these topics:
- Resin transfer moulding (RTM)
- Thermoplastic compression moulding

Unlike thermoplastics, thermosetting fibre composites have a chemically cross-linked molecular structure. These links mean that thermosettings cannot be melted again, but they normally have a higher mechanical strength and their breaking behaviour is more brittle.

Typical applications include components for the electrical industry, sanitation, rail and utility vehicles and increasingly for aircraft and automotive industry. The thermoset matrix makes these components suitable for both higher and lower temperatures, unlike thermoplastics.

The basic principle of thermosettings manufacture is the separation of the impregnation process in the making of composite materials from the moulding process in the press or autoclave. More recent developments seek to bring the two stages together in order to reduce cycle time.

Combining thermosettings with carbon fibres offers better mechanical properties than using glass fibres, but is also markedly more expensive.

Process characteristics:
- Complex three-dimensional components possible
- Limited storage time for semi-finished products at room temperature
- Short cycle times
- Low shrinkage during manufacture
- Geometry limited by flowability of the semi-finished product
- Finishing (cutting, edge processing) required, but some may be integrated into the press
- Sophisticated plant technology (moulding press, autoclave)
- Manufacturing may be automated
- High temperature stability
- Low elongation at rupture
- Good surface quality on both sides (depending on tool)

Classification of thermosetting semi-finished product processing

<table>
<thead>
<tr>
<th>Process step</th>
<th>Description</th>
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<td>Molding</td>
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Machines for the production of textile structures
• Fibre placement lines
• Multiaxial warp knitting machines
• Flat knitting machines
• Preparatory machines for natural fibres
• Drafting systems for filaments and tapes

Fibre and textile manufacture
Manufacture of semi-finished products
• Fibre placement lines
• Multiaxial warp knitting machines
• Flat knitting machines
• Preparatory machines for natural fibres

Moulding
Thermosetting semi-finished products are processed by hot press moulding or else under pressure at high temperature in an autoclave. The high temperatures create an irreversible cross-linking of the material, which cannot be melted again. The good flow behaviour of semi-finished products made from cut fibres also means that highly complex geometries can be achieved. Prepregs on the other hand allow significantly higher fibre contents.

Alternatively, woven, non-crimp, warp-knitted, braided or knitted fabrics are made for use in the resin matrix. Assemblies and layered structures are possible. Particularly in the case of BMC (Bulk Moulding Compound), cut fibres are added to the resin to create an amorphous doughy mass which is further worked by press moulding.

Prepregs are made from pre-impregnated endless fibres (unidirectional fibres, non-crimp or woven fabrics, etc.) and are cured at high temperatures and under pressure in an autoclave or by hot press moulding. Large moulded parts (e.g. for aircraft manufacture) are processed in the autoclave under vacuum since for them press moulding is uneconomic.

The process chain for the manufacture of fibre-reinforced structures involves the following main stages:

1. Fibre manufacture
2. Textile preparation
3. Prepreg manufacturing
4. Prepreg processing
5. Moulding

Fibre manufacture
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The next stage is to process the textile reinforcement structures into semi-finished products. Fibers and geotextiles are added to the resin to obtain particular properties.

For finishing with high precision machine tools, a distinction is made between the introduction of functional geometries and fine surface finishing. For functional geometries, methods such as drilling, milling or laser beam and water jet cutting are used; while fine surface finishing is normally done by grinding and polishing.

The machining of fibre composites presents engineers with completely new challenges for tool development, since the familiar laws of metallurgy cannot simply be transferred. Unlike metallic materials, the properties of composites are determined chiefly by the direction of the fibres in the component. This means that fibre composite materials cannot be machined equally well in all directions.

If the composite consists of layers with the fibres in different directions or composite layers are combined with layers of metal, the machining process is even more complex.

Joining technology for composites

Handling technology
• Robots
• Other handling equipment
• Equipment for linking and transport

Measurement and test systems
• Test systems for fibres, yarns, fabrics, on-line
• Test devices for fibres and filament yarns, off-line
• Test devices for composites, off-line
• Gages and precision measuring equipment
• Measuring machines
• Machine vision and optical sensors
• Test devices for contaminant

Quality assurance is an essential aspect of measurement and testing technology. Quality assurance systems in the production process have many advantages for the user, such as lower production costs resulting from the better utilisation of resources. A high level of process reliability means less waste and hence ultimately lower costs arising from guarantee commitments and more satisfied end users.

Machines for composite processing/machining
• Heating and cooling technology
• Forming machines
• Cutting and splitting machines
• Machines for surface treatment
• Drilling and milling machines

Sourcing service: www.composite-arena.com