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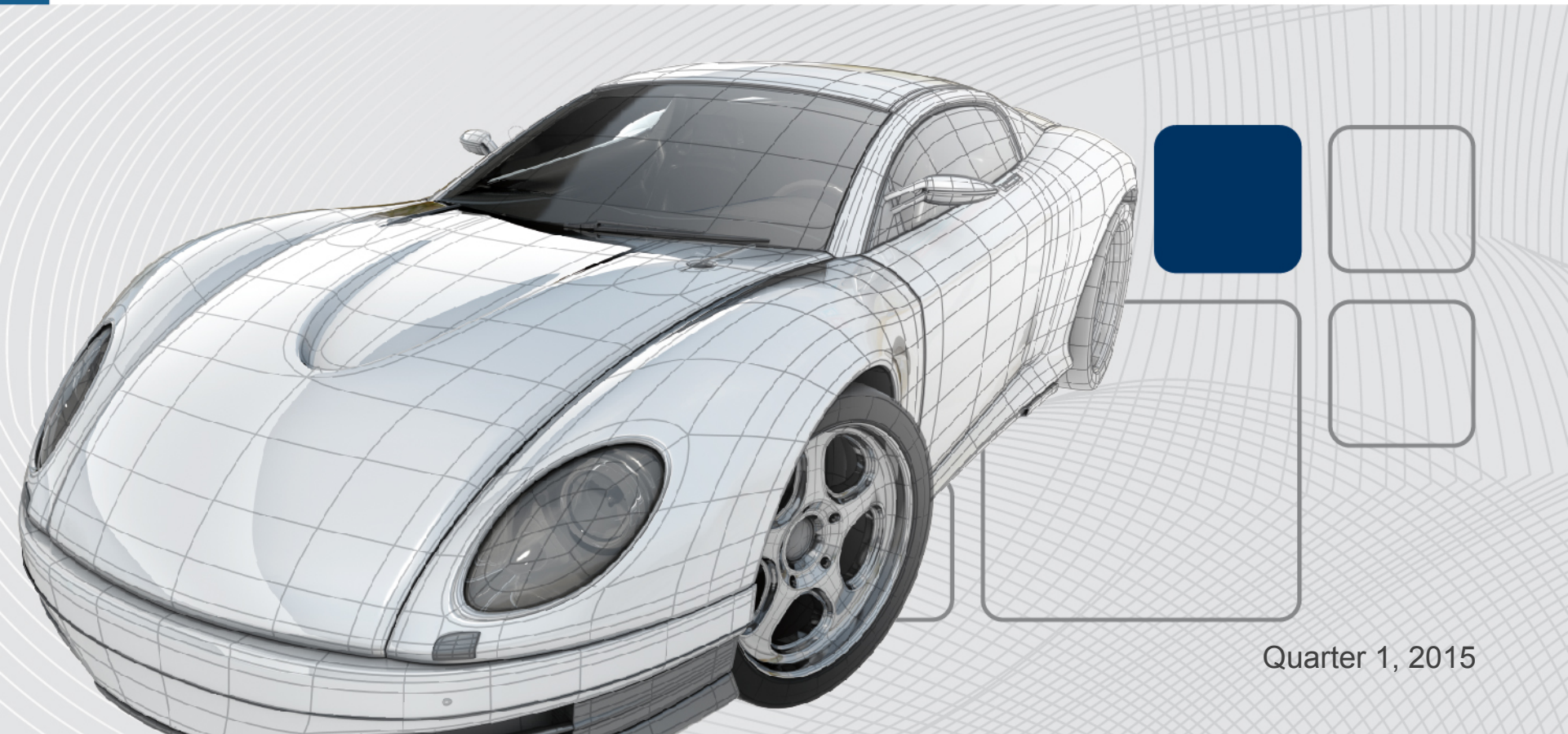
Advanced Materials

A new step forward in composites mass production



Quarter 1, 2015

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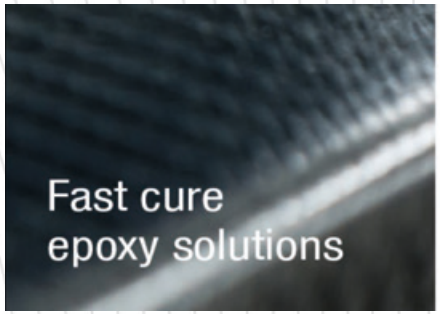

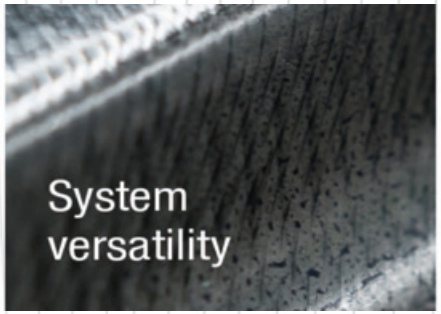

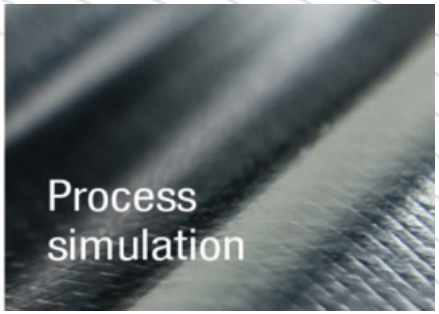

Huntsman Advanced Materials brings the next step change in composites technology, allowing part production time in 1'30 min or less.

With the release of a new global offer for the automotive industry, Huntsman meets demands for faster processing and reduced composite production cycles.

Fast cure epoxy solutions

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Building on BMW “i” experience

The new epoxy solutions are built on the first generation Araldite® LY 3585 / Hardener XB 3458 and Araldite® LT 3366, qualified for the first mass produced automotive carbon composites application (BMW «i» program).

Araldite® LT 3366 preforming solution

Epoxy binder qualified for mass production of powdered fabrics and preforms

- High softening point preventing ply-to-ply adhesion during storage
- Fast preforming cycle

Softening point	ca. 150°C
DSC Tg mid-point	75 – 85°C
Typical preforming cycle	20 ±10 sec at 180 ±20°C + cold stamping

Typical preforming conditions: cold pressing after infra-red heating

Fast cure epoxy solutions

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Araldite® LY 3585 / Aradur® 3475 injection solution

	HP-RTM process		Wet Compression Molding (WCM) process	
	Araldite® LY 3585 / Aradur® 3475	**Araldite® LY 3585 / Hardener XB 3458** (1)	**Araldite® LY 3585 / Aradur® 3475**	**Araldite® LY 3585 / Hardener XB 3458** (1)
Preform / fabric lay-up set (2)	20-30”	20-30”	20-30”	20-30”
Mold temperature	115°C	100°C	140°C	140°C
Injection	0’20 - 0’60 min (small to large part)	0’20 - 0’45 min (small to medium part)	No injection	No injection
Cure	2’00 min	5’00 min	1’00 min	2’00 min
Demolding	0’5 min	0’5 min	0’5 min	0’5 min
Part production time (2)	2’45 - 3’30 min 	5’45 - 6’15 min 	1’30 min 	2’30 min 

(1) First generation solution qualified for the first CFRP mass production application BMW “I” Program
(2) Includes preform / fabric lay-up set, mold closure and vacuum

Fast cure epoxy solutions

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Araldite® LY 3585 / Aradur® 3475 injection solution

Very fast curing epoxy system designed for highly structural applications

- High latency during mold filling
- Very fast cure and demolding stiffness development
- High tensile elongation at break

		Araldite® LY 3585 / Aradur® 3475	Araldite® LY 3585 / Hardener XB 3458 (reference)
Tensile modulus	ISO 527-2 on neat resin	2 700 - 2 900 MPa	3 000 - 3 100 MPa
Tensile strength		75 - 80 MPa	75 - 80 MPa
Tensile elongation		8 - 10 %	4 - 6 %
DMA Tg onset (1)	ISO 6721 on CFRP	105 - 115°C	93 - 103°C
ILSS (2)	ASTM D2344 on CFRP	58 MPa	60 MPa

Data generated with 2phr internal release agent
(1) Torsion mode, 2°C/min, only Tg assessment on composites relevant since neat resins exotherm in molds
(2) 50K UD, TVf 50%

System versatility

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The ideal reactivity for each part

Composition adjustments

The resin system reactivity can be adjusted to optimize part production time, tailoring to part size and process:

- HP-RTM: injection time optimization to different part size
- WCM: very fast cure (no injection latency required)
- Prototyping: using low temperature molding (standard RTM)

One solution for all

Slight adjustments to the Araldite® LY 3585 / Aradur® 3475 system enable reactivity to be optimized for part size and process, but do not influence mechanical performance, enabling qualification of only one system to meet all production requirements.

System versatility

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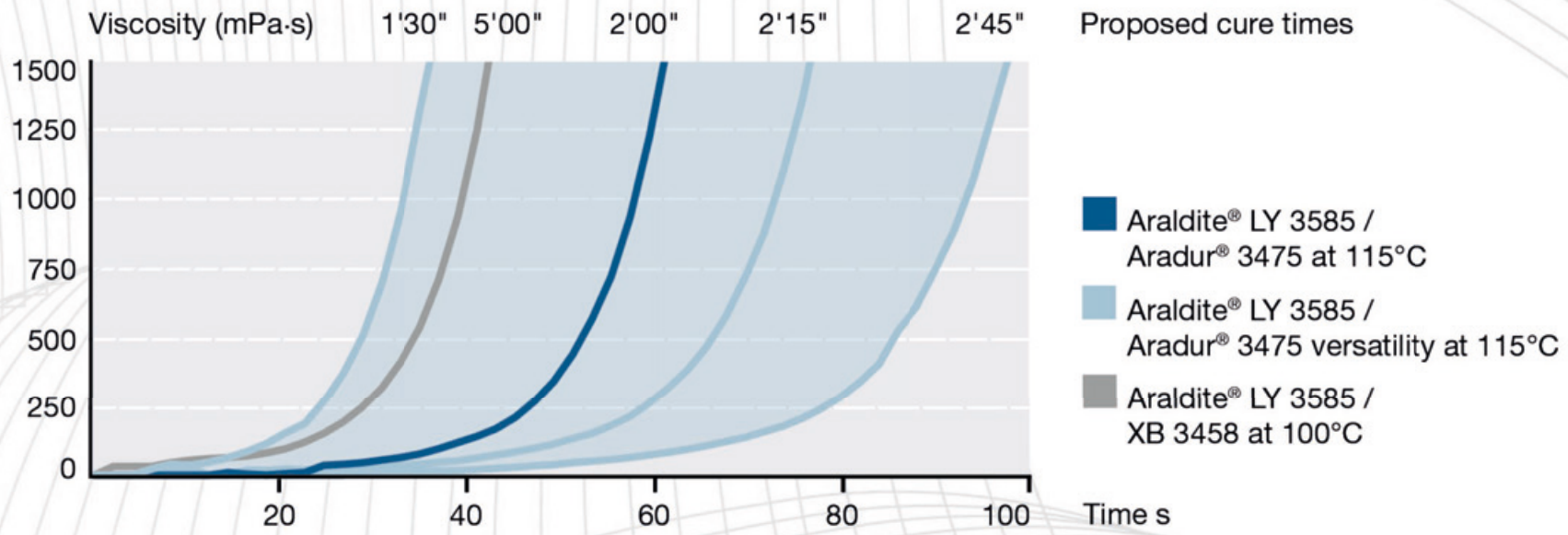
HP-RTM: optimization of reactivity to part size

Process optimization, matching injection window and part size



System versatility

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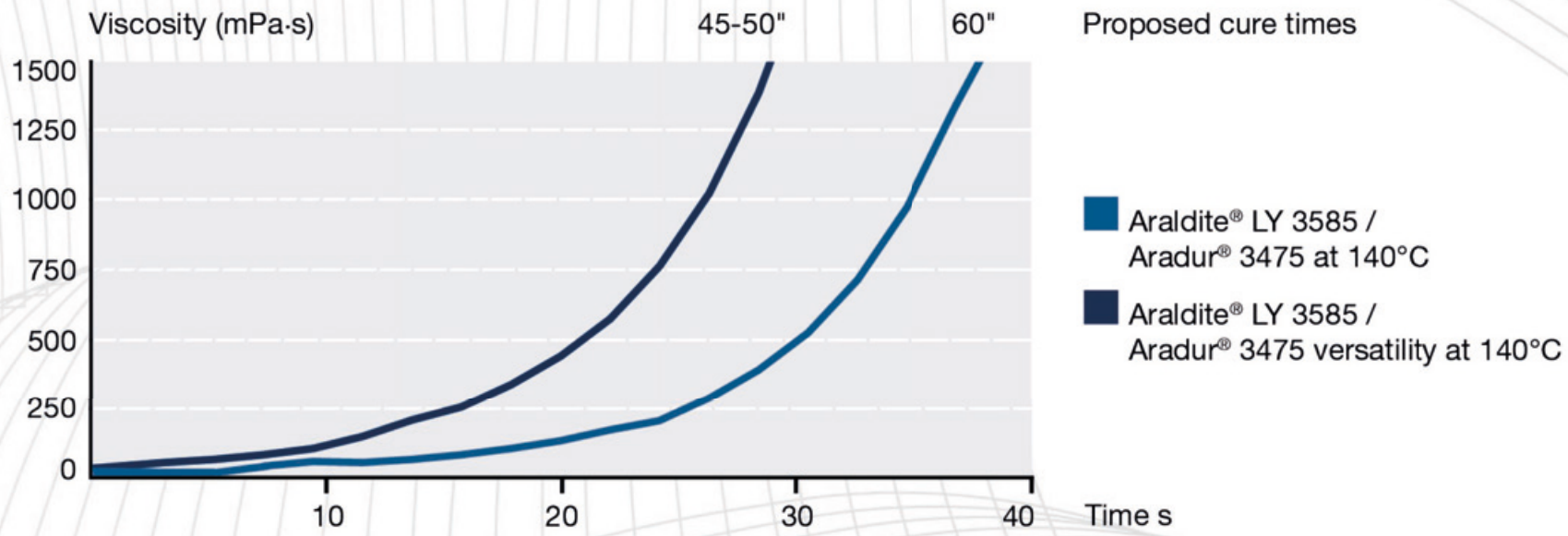
WCM: cure time optimization

Optimization for WCM. The process time is independent of part size as there is no injection step.



NEW DFCM process

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Simple and fast, the Dynamic Fluid Compression Molding (DFCM) process bypasses the injection step and brings composite production cycle to less than 1’30 min.

Combining a novel process and fast-cure Araldite® epoxy solutions, highly structural parts with outstanding properties can be produced in less than 1'30 minute.

This process is simple, fast and cost effective, requiring low pressure (typically 30 bar) and often removing the need for a fiber preform. Exceptional benefits versus standard compression molding: outstanding mechanical performance thanks to fiber volume content up to 65% in a low wastage process. Void-free parts are produced consistently straight from the mold.

Play the video >

Simple and fast

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Autoclave quality in 1'30 min

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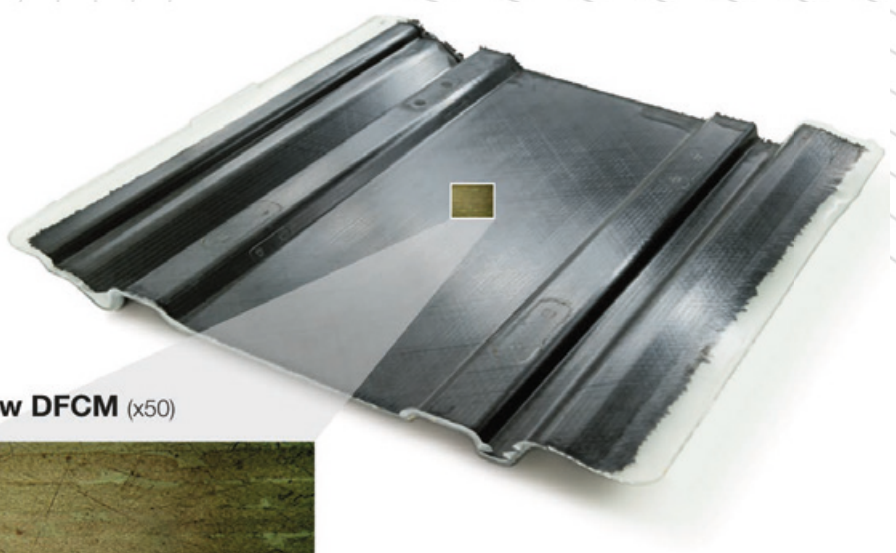
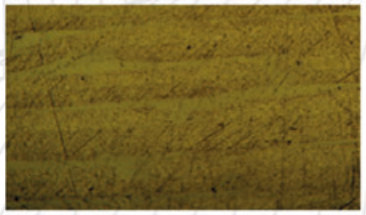
Void-free parts are produced consistently straight from the mold

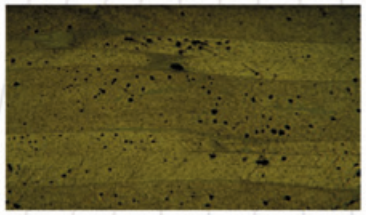


HP-RTM (x50)



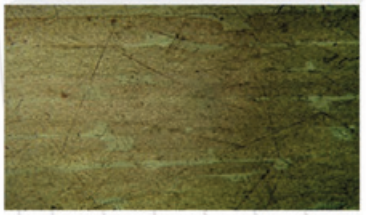
Low porosity, medium FVC (50%)

Standard WCM (x50)



High porosity, high FVC (60%)

New DFCM (x50)



Low porosity, high FVC (60%)

HP-RTM vs DFCM

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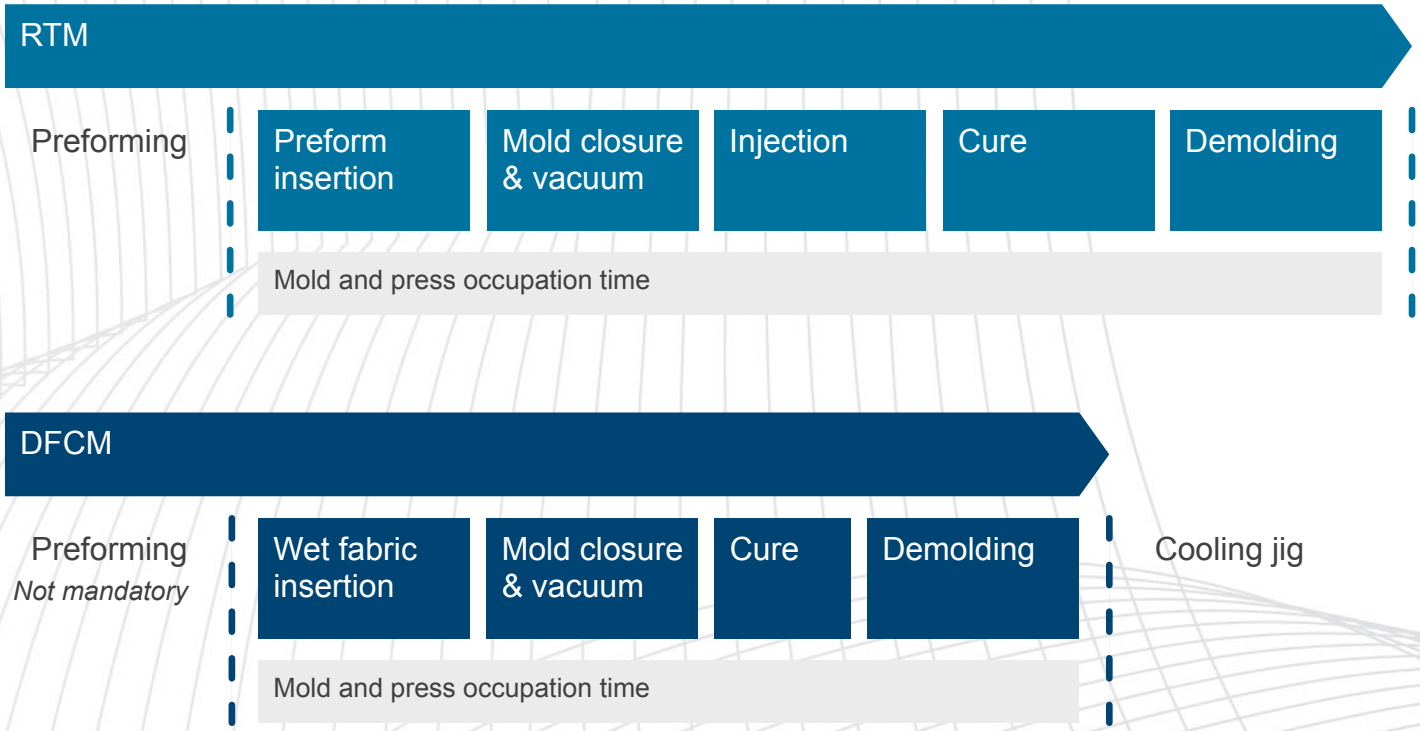
DFCM process bypasses the injection step



HP-RTM vs DFCM

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RTM process

- High design freedom (deep draw or 3D)
- Fiber preform mandatory to avoid fiber misalignment
- Pressure during injection up to 150 bar

NEW exclusive DFCM process

- Fiber volume content up to 65%
- Void-free parts
- Faster process vs. RTM
- Pressure only 30 bar
- Fiber wash eliminated
- Low equipment investment
- Reduced waste
- Fiber preform not mandatory
- Complex parts possible (medium draw or 2.5+D)
- Consistent part quality

HP-RTM vs DFCM

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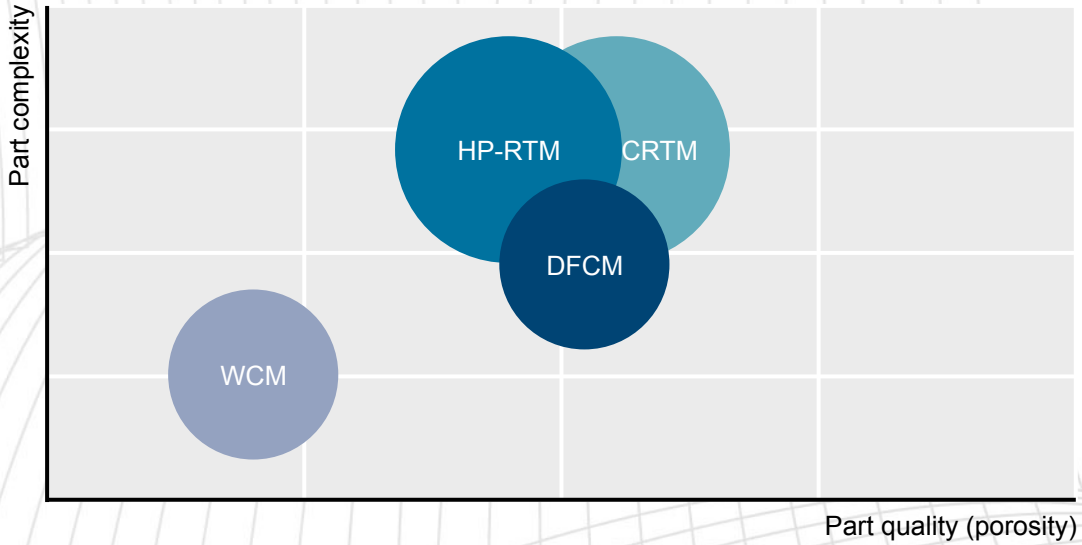
Mass production processes comparison

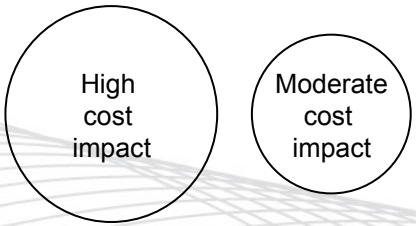
for typical state-of-the-art automotive composite parts

Porosity



- Dynamic Fluid Compression Molding
- High Pressure RTM
- Compression RTM
- Wet Compression Molding

Process cost
(capital investment, cycle time, fiber preform)



HP-RTM vs DFCM

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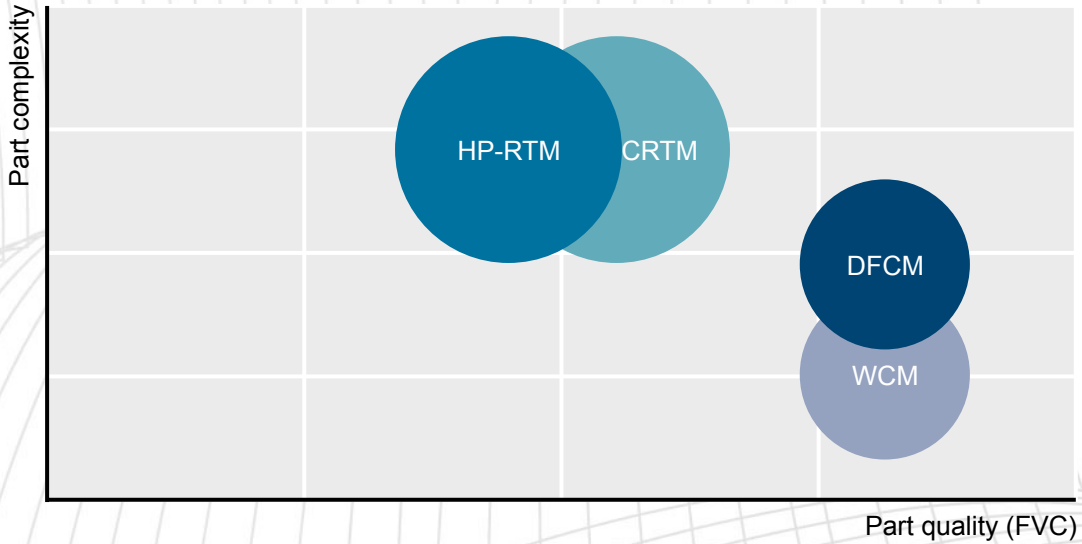
Mass production processes comparison

for typical state-of-the-art automotive composite parts

Fiber volume content



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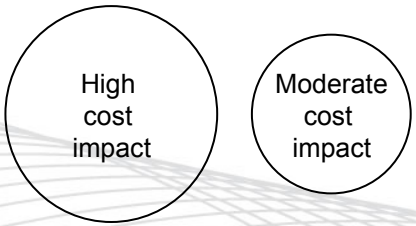

Composites process simulation

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Virtual process cycles are carried out to refine process design, ensure optimized mold layout and quickly identify ideal processing parameters.

Play the video >

The shortest possible manufacturing time

Resin selection, flow pattern, injection concepts and cure schedule: in our Composite's Centre of Excellence in Basel, advanced composites process simulation is used to design a production process tailored to each part.

Material models

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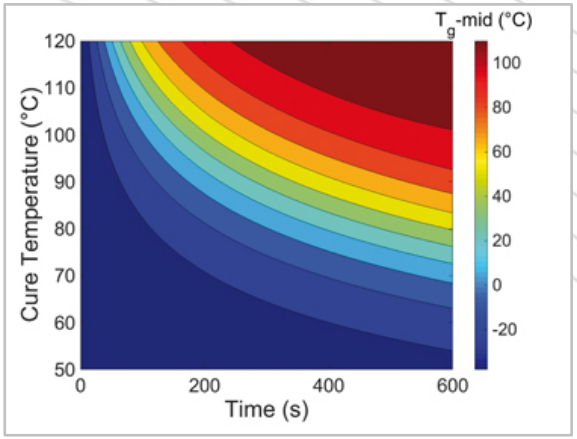
Predictions through accurate material models

Precise descriptions of the resin are used to generate material models which are projected onto the CAD data. This enables prediction of the material behavior during the injection and curing process at each point on the composite part.



Material model
Example of a resin processing map

Cure simulation

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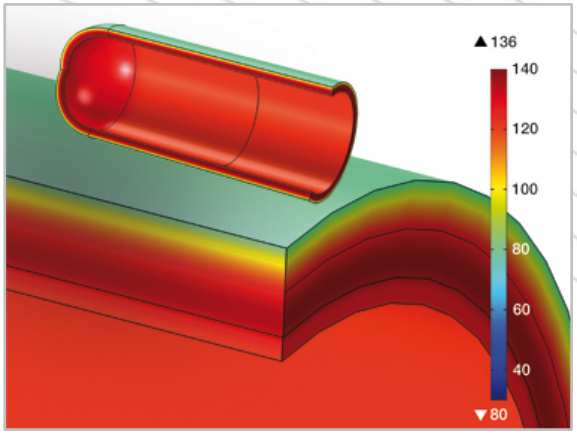
Reduce part development time

Resin cure is essential to overall process performance and cure simulation can substantially reduce part development time.
During processing of thick-walled structures, temperature builds up due to the exothermic reaction. Using cure simulation, exotherm peaks can be predicted, simplifying process engineering and enabling selection of the correct resin system and process parameters.

For all composites processes

Predict	Support
> Cure cycle time	> Process parameter determination
> Exotherm temperature	> Resin system selection
> Evolution of Tg and conversion	> Process safety



Exotherm prediction
Example of a pressure vessel curing

Temperature evolution in vessel

Flow simulation

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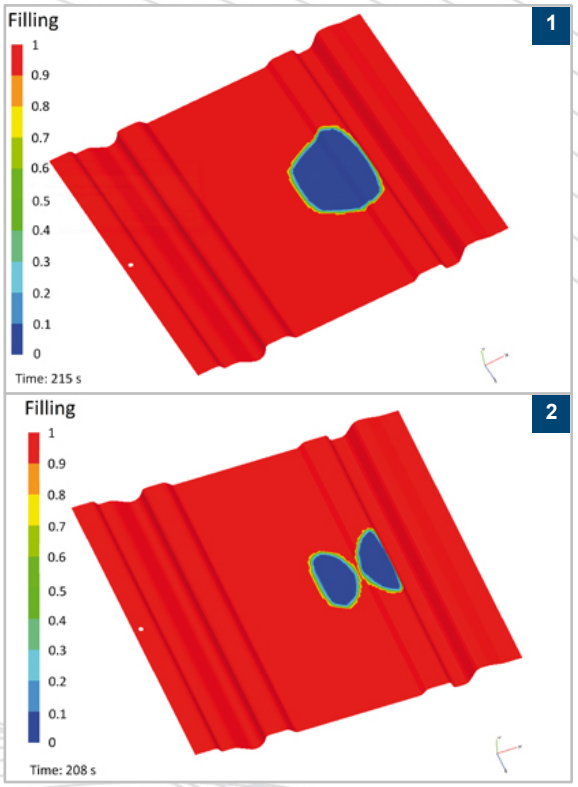
Ensure complete filling of the part

In liquid composite molding, void free parts are key to maximum part performance. By applying flow simulation we support process engineers to evaluate injection strategies and to find optimum processing parameters to ensure complete filling of the part.

For RTM / Compression RTM / Resin infusion processes

Predict	Support
> Low front evolution	> Injection strategy
> Filling time	> Inlet / outlet position
> Pressure evolution	> Early stage process design
> Process induced filling variability (e.g. preferential flow channels, inserts)	



Effect of process induced variation
Example of a thin curved part

1. Area to be considered for venting strategy
2. Analysis of influence of possible runners created by textile forming

Pioneer in structural composites

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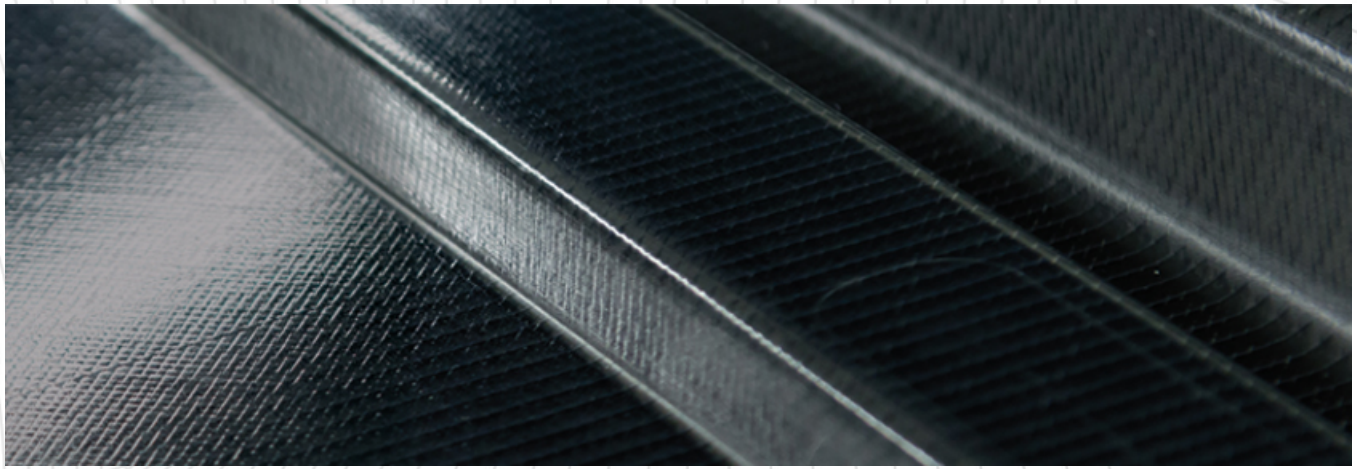

Since 1990

- 1990 - 2015 : Pioneer in structural composites (Lamborghini, McLaren, Mercedes SLR, BMW Z1)
  Supplier of non structural solutions for mass production of indoor panels
- 2013 : First supplier qualified for structural composite parts mass production (BMW «i»)

Sustainable footprint

- Bio-based feedstocks utilization
- Best-in-class energy management

Araldite® case stories

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BMW M3 roof parts
with Araldite® XB 3523 / XB 3458

Benefits

- Low weight, high stiffness and high dimensional stability
- Fashion / aesthetics due to carbon look
- Class A finish
- Low shrinkage

Araldite® case stories

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Lamborghini Aventador LP700-4's chassis
with Araldite® XB 3518 / Aradur® 22962

Benefits

- Low viscosity during injection, sufficient pot life
- Low shrinkage (surface quality)
- High mechanical properties (good balance Tg / Toughness)
- Good hot / wet properties

Araldite® case stories

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CSL C218 indoor panel, produced by Boshoku Automotive GmbH (Europe)

with Araldite® expandable epoxy system with natural fibers

Benefits

- Very short production cycle, less than 1 min (45 s at 150°C)
- Parts with high impact strength
- Rigid, very light and dimensionally stable parts

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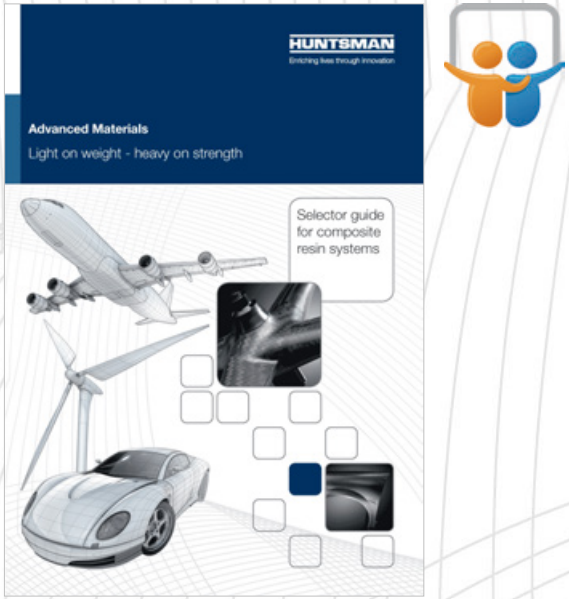

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Select immediately the right composite formulated system for your specific need and contact a distributor.

For more information

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