Manufacturing Composites for Automotive Applications

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Automotive Industry Requirements

- Cost Efficient
- High production volume
- Shape complexity
- Mechanical performance
- Sustainability

Source: www.caranddriver.com/bmw/i3
Conventional Manufacturing Techniques

- Pre-preg preparation, lay-up and autoclave
- High quality parts produced
- Expensive, time consuming and geometric limitations
- Limited to F1 and luxury sports vehicles

Source: www.compositesworld.com/articles/fabrication-methods
Pre-preg Compression Moulding

- Increases productivity of pre-preg technique

Shape complexity can be improved by:
  i) Combination with short fibre techniques
  ii) Unidirectionally arrayed chopped strands

Source: Akiyama, K, Development of PCM technology, Mitsubishi Rayon Co. Ltd., 2011
Resin Transfer Moulding

- Inject resin into mould containing dry preform
- Cycle time needs to be reduced as far as possible
- New variants developed to improve the process

Source: www.core.materials.ac.uk/search/detail.php?id=3656
RTM Variants

- **Vacuum Assisted RTM**
  - Ensures proper preform wetting
  - Reduces formation of voids

- **High-Pressure RTM**
  - Undertake resin impregnation at higher pressures
  - Expensive

- **Compression RTM**
  - Combining with a compression step can aid fibre wetting
  - Can incorporate surface finish

Source: www.kraussmaffeigroup.com
Short Fibre Composites

- High volume production of more complicated shapes
- Produces components with inferior mechanical properties
- Compression and injection moulding widely used

Source: Bradish F., US 6508906 B1, 2003
3D printing

- Worlds first 3D printed car manufactured in September
- 13-20% $V_f$ carbon fibre in ABS thermoplastic matrix
- 44 parts fully assembled in 49 hours
- Applicable on a commercial scale?

Source: www.localmotors.com
Source: www.e-ci.com/baam
Summary

- No current manufacturing technique encompasses all requirements
- Techniques must keep advancing to facilitate higher FRP utilisation
Thank you for listening!

Any questions?