Carbon Fibre - the Future Material for Automobile
Danu Chotikapanich

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THIS IS A CARBON FIBRE
TOW: SEVERAL THOUSAND FIBRE
LIGHT & STRONG
BIGGEST POTENTIAL IS IN CHASSIS

Car weight by type of part

<table>
<thead>
<tr>
<th>Repartition of total car weight (in %)</th>
<th>Decrease in weight possible</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>Chassis ≅50%</td>
</tr>
<tr>
<td>90%</td>
<td></td>
</tr>
<tr>
<td>80%</td>
<td>20-25%</td>
</tr>
<tr>
<td>70%</td>
<td>10-15%</td>
</tr>
<tr>
<td>60%</td>
<td>≅10%</td>
</tr>
<tr>
<td>50%</td>
<td>≅50% (of which engine 25-30%)</td>
</tr>
<tr>
<td>40%</td>
<td></td>
</tr>
<tr>
<td>30%</td>
<td>Functional parts ≅5%</td>
</tr>
<tr>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td>Interior ≅0%</td>
</tr>
<tr>
<td>0%</td>
<td>≅20%</td>
</tr>
</tbody>
</table>

Source: JEC
LA FERRARI

- 27% more torsional rigidity, 22% more beam stiffness, and 20% lighter than Enzo Ferrari
- The seat structure was made part of the chassis
- Multiple material
  - Carbon T800
  - Carbon T1000
  - Kevlar (Aramid)

BMW I3

- Multiplier effect: engine and battery size/weight
- Drive Module: 150 parts 1/3 of conventional body
- 50% shorter production line
MOULDING COMPOUND

AUTOMOBILI LAMBORGHINI's
SESTO ELEMENTO CFRP CHASSIS

Passenger cell (formed in one piece, using discontinuous (1 to 2-inch/25.4 to 50.8-mm) fibers and cured out of the autoclave

CFRP passenger “tub,” a monocoque structure made via FORGED COMPOSITES technology

CFRP exhaust exit port (seen from back of car)

High-temperature capable CFRP- and ceramic exhaust system

First CFRP crash box structures in a high-performance sports car

CFRP suspension frame members (first use of composite suspension arm components in a sports car)

Suspension control arms (four per each front wheel) are 30 percent lighter than same components in aluminum

DESIGN RESULTS

- Replaced a design that features prepreg parts attached to a metal spaceframe with a CFRP monocoque.
- Increased monocoque production rate from 100 units per year to 1,000 units per year.
- Reduced car weight and tailpipe emissions by 40 percent, and improved power-to-weight ratio from 2.6 kg/hp to 1.7 kg/hp (5.7 lb/hp to 3.8 lb/hp).

By 2018-2019, carbon fibre should be competitive for 40,000 chassis/year.

Source: JEC
RESIN TRANSFER MOLDING

• SURFACE-RTM: This process uses Zoltek's Panex 35 carbon fiber and a polyurethane (PU) resin system to create a premium and paintable surface quality composite part, directly out of the mold.

• www.surface-rtm.com
THERMOPLASTIC

• Thermoplastic suspension arm

• Short cycle time: Minutes

• Moulding and bonding

• Reduce weight from 2,400g to 1,050g

DIFFERENT PROCESSES ARE SUITABLE FOR DIFFERENT REQUIREMENTS

Source: JEC
RECYCLING

![Diagram showing recycling prospects for different types of fibres and resins.](Source: JEC)
RECYCLING

- **Disposal**
  - Incineration / Acid digestion

- **Re-use**
  - Grinding
  - The matrix and the fibre are crushed (mostly glass fibre)

- **Recycling**
  - Pyrolysis
    - The resin is burnt with limited oxygen and thus separated from the fibre
  - Fluidised bed
    - Chopped, put into a fluidised bed of sand and thermally separated.
  - Solvolysis
    - Chemical separation of the material with a solvent

- **Recyclates / End products**
  - None
  - Usable residue
  - Fibre (reprocessed)
  - Fibre (reprocessed)
  - Fibre and resin (reprocessed)

- **Energy recovery from resin**
  - No
  - No
  - Yes
  - Yes
  - NA

- **Description**
  - Environmentally unfriendly but cheap
  - Low-cost process and the end product may be used as filler or for cement. Mostly used for glass fibre
  - Mostly used for carbon fibre, retaining properties well
  - Mostly used for glass fibre, retaining properties well. Very efficient elimination of additives
  - Purer recyclates than other processes. Possible future re-use of the resin.

Source: JEC
SUMMARY

• The 21st Century will be a “Composites Century”

• Carbon fibre will play a significant role in weight reduction for automobiles

• Technologies are developing to reduce cycle time and cope with recyclability

• Function Integration, Lay up design, Multiplier effect, and other techniques will need to be mastered to get Carbon Fibre further integrated

• Car designers, Automotive Engineers, Composites Experts, Material suppliers and Part Fabricators will need to work much closer together to achieve optimum benefit from Carbon Fibre applications in Automobile
THANK YOU