The global CFRP market 2016

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Experience Composites, Augsburg, September 21st 2016
BMW 7 series with **Carbon Core Technology**, estimated production rate in 2016: ~64,000 (IHS) ↔ i3 in 2015: ~24,000 (IHS), image source: BMW
Overview

1 The global Carbon Fiber market
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1 The global Carbon Fiber market

Processing of carbon fibers in Wackersdorf plant of SGL Automotive Carbon Fibers (ACF), source: BMW / SGL-ACF
1 The global Carbon Fiber market

Global demand of Carbon Fibers in thousand tonnes from 2010 to 2022 (* estimations)

\[ A(t_n) = A(t_1)(1 + \text{CAGR})^n \]

\[ \text{CAGR}(t_1, t_n) = \left( \frac{A(t_n)}{A(t_1)} \right)^{\frac{1}{n}} - 1 \]

Constant compound annual growth rate (CAGR) ca. 9-12%
1 The global Carbon Fiber market

1.1 By manufacturer

Annual, theoretical CF capacity by manufacturer in thousand tons (2015). \( \Sigma = 130.9 \text{ kt} \) (2014: 125 kt \( \rightarrow +4.7\% \))

- Toray + Zoltek: 27.1
- SGL: 15.5
- Toho: 12.0
- MRC: 11.5
- Form Plast Cor.: 10.1
- Hexcel: 8.8
- Solvay (Cytec): 7.3
- Zhongfu-Shenyng: 3.0
- Aksa: 4.0
- Hengshen Fib. Mat.: 4.0
- Hyosung: 3.6
- Cytec Piedmont extension: 3.0
- Hyosung Jeonju Ramp-up: 9.5
- SGL ACF Moses Lake Ramp-up: 15.5
- MRC Sacramento extension: 1.0
- Cytec Piedmont extension: 0.9

Yearly CF capacity
- Zoltek
- Growth 2015/2016

The global CFRP market 2016
The global Carbon Fiber market

Concrete
4,000,000 kT

Steel
1,578,079 kT

Plastics
299,000 kT

Aluminium
49,714 kT

Glass Fibre
4,700 kT

Titanium
192 kT

Carbon Fibre
41 kT

Aluminium
57,770 kT (2016)

CFR: 100 kT
CF: 64 kT (2016)

> x500 by weight
> x50 by revenues

Graphic source: Mutel, JEC
1 The global Carbon Fiber market

1.2 By region

Annual, theoretical CF capacity by regions in thousand tons (2015).

<table>
<thead>
<tr>
<th>Region</th>
<th>Capacity (kt)</th>
<th>Market Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>25.0</td>
<td>19%</td>
</tr>
<tr>
<td>USA &amp; Mexico</td>
<td>43.4</td>
<td>33%</td>
</tr>
<tr>
<td>China</td>
<td>13.3</td>
<td>10%</td>
</tr>
<tr>
<td>Taiwan</td>
<td>8.8</td>
<td>7%</td>
</tr>
<tr>
<td>South Korea</td>
<td>8.6</td>
<td>7%</td>
</tr>
<tr>
<td>Hungary</td>
<td>8.1</td>
<td>6%</td>
</tr>
<tr>
<td>Germany</td>
<td>5.8</td>
<td>4%</td>
</tr>
<tr>
<td>France</td>
<td>5.2</td>
<td>4%</td>
</tr>
<tr>
<td>Great Britain</td>
<td>4.0</td>
<td>3%</td>
</tr>
<tr>
<td>RoW</td>
<td>8.9</td>
<td>7%</td>
</tr>
<tr>
<td>Total</td>
<td>130.9</td>
<td></td>
</tr>
</tbody>
</table>

The global CFRP market 2016
The global Carbon Composites market

New Airbus Helicopter H160, source: Airbus Helicopters
Global demand of Carbon Composites in thousand tonnes from 2010 to 2022 (* estimations)

\[ A(t_n) = A(t_1)(1 + CAGR)^n \]

\[ CAGR(t_1, t_n) = \left( \frac{A(t_n)}{A(t_1)} \right)^{\frac{1}{n}} - 1 \]

Constant compound annual growth rate (CAGR) ca. 10-12%
2.1 By matrix

CC revenues in US$ billion by matrix (2015)

- Polymer: 11.6; 65%
- Thermoset: 8.7; 49%
- Thermoplastic: 2.9; 16%
- Ceramic: 1.7; 10%
- Metal: 1.3; 7%
- Hybrid: 0.8; 4%

Total: US$ 17.9 billion
2.2 By processes

With CFRP production processes generated amounts in thousand tonnes (2015)

- **Prepreg layup process with/without autoclave**: 39.1; 43%
- **Pultrusion and winding**: 24.6; 27%
- **Wet lamination & infusion process**: 9.6; 10%
- **Press and injection processes**: 10.6; 12%
- **Others**: 7.1; 8%

Total: 91 kt

The global CFRP market 2016
2 The global Carbon Composites market

2.3 By region

CC demand in thousand tonnes by region (2015)

North America; 44.3; 38%

Europe; 40.8; 35%

Asia & Pacific; 26.8; 23%

RoW; 4.6; 4%

Total: 116.5 kt
The global Carbon Composites market

Tips of 58.5 meter long rotor blades for Siemens SWT-3.6-120 wind turbines on a jack-up vessel, source: Siemens
2.4 By application

CC demand in thousand tonnes by application (2015)

- **Aerospace and Defence**: 35.2; 30%
- **Automotive**: 25.5; 22%
- **Wind Turbines**: 14.5; 13%
- **Sport & Leisure**: 13.9; 12%
- **Civil Engineering**: 5.6; 5%
- **Marine**: 1.5; 1%
- **Others**: 20.3; 17%

Total: 116.5 kt
2.4 By application

CC revenues in US$ billion by application (2015)

- Aerospace and Defence: 10.9; 61%
- Wind Turbines: 1.4; 8%
- Sport & Leisure: 1.3; 7%
- Automotive: 2.2; 12%
- Civil Engineering: 0.4; 2%
- Marine: 0.1; 1%
- Others: 1.6; 9%

Total: US$ 17.9 billion

<table>
<thead>
<tr>
<th>Application</th>
<th>Price (US$/kg)</th>
<th>Revenues (US$ billion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerospace &amp; Defence</td>
<td>310</td>
<td>10.9</td>
</tr>
<tr>
<td>Wind Turbines</td>
<td>97</td>
<td>1.4</td>
</tr>
<tr>
<td>Automotive</td>
<td>86</td>
<td>2.2</td>
</tr>
<tr>
<td>Sport &amp; Leisure</td>
<td>94</td>
<td>1.3</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td></td>
<td>0.4</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td>1.6</td>
</tr>
</tbody>
</table>

Aerospace & Defence: 310 US$/kg
Wind Turbines: 97 US$/kg
Automotive: 86 US$/kg
Sport & Leisure: 94 US$/kg
Automated production of the “Research Pavilion 2014-15” of University of Stuttgart’s Institute for Computational Design (ICD) and Institute of Building Structures and Structural Design (ITKE), source: Moritz Doerstelmann, ITKE
3 Trends and outlook

Estimated development of CC demand in thousand tonnes

\[ A(t_n) = A(t_1)(1 + CAGR)^n \]
\[ CAGR(t_1, t_n) = \left( \frac{A(t_n)}{A(t_1)} \right)^{\frac{1}{n}} - 1 \]

Total 2022: 245 kt

Total 2015: 117 kt

- Aerospace & Defence
- Automotive
- Wind Turbines
- Sport & Leisure
- Civil Engineering
- Marine
- Others

The global CFRP market 2016
Ariane 6 in 4 Booster configuration with CFRP Boosters presumably from MT Aerospace and AVIO, source: ESA
The global CF and CC market is and stays a promising business field with stable annual growth rates of 9-12% over several years.

The pressure of competition for CC increases due to hybrid lightweight material mixes (use of CC only where necessary and useful). Meanwhile CC settles its place in the material mix.

Cost savings in material and production costs will be essential for an increasing share of CC in future applications.

But: The market behaviour is more inertial than expected → positive as well as negative outliers not to be expected.

Stimulation by taxes and laws (e.g. in automotive, civil engineering and wind energy sector) can bring additional dynamics into the CF and CC market.
Thank you very much for your attention. Questions?

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