The global CFRP market 2016

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BMW 7 series with Carbon Core Technology, estimated production rate in 2016: ~64.000 (IHS) ↔ i3 in 2015: ~24.000 (IHS), image source: BMW
1 The global Carbon Fiber market

Processing of carbon fibers in Wackersdorf plant of SGL Automotive Carbon Fibers (ACF), source: BMW / SGL-ACF
Global demand of Carbon Fibers 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. 9-12%
1 The global Carbon Fiber market

1.1 By manufacturer

Annual, theoretical CF capacity by manufacturer in thousand tons (2016). \( \sum = 130,9 \text{ kt} \) (2014: 125 kt \( \rightarrow +4,7\% \))

The global CFRP market 2016

- **Tosay + Zoltek**: 27.1
- **SGL**: 12.0
- **Toho**: 11.5
- **MRC**: 10.1
- **Form Plast Cor.**: 8.8
- **Hexcel**: 7.3
- **Solvay (Cytec)**: 4.0
- **Zhongfu-Shenyang**: 4.0
- **Aksa**: 3.6
- **Hengshen Fib. Mat.**: 3.0
- **Hyosung**: 13.6
- **SGL ACF Moses Lake Ramp-up 9 (+ 6 = 15) kt/a**
- **Cytec Piedmont extension**
- **MRC Sacramento extension**
- **Hyosung Jeonju Ramp-up 2,5 \( \rightarrow 14 \text{ kt/a} \) (2020)**

Yearly CF capacity
- **Zoltek**
- **Growth 2015/2016**
1 The global Carbon Fiber market

1.2 By region

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

- USA & Mexico; 43.4; 33%
- Japan; 25.0; 19%
- China; 13.3; 10%
- Taiwan; 8.8; 7%
- South Korea; 8.6; 7%
- Hungary; 8.1; 6%
- Germany; 5.8; 4%
- France; 5.2; 4%
- Great Britain; 4.0; 3%
- RoW; 8.9; 7%

Total: 130.9 kt
2 The global Carbon Composites market

New Airbus Helicopter H160, source: Airbus Helicopters
2 The global Carbon Composites market

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 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
The global Carbon Composites market

### 2.2 By application

CC revenues in US$ billion by application (2015)

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

Total: US$ 17.9 billion

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

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3 Trends and outlook

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

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

The global CFRP market 2016
4 Conclusion

Ariane 6 in 4 Booster configuration with CFRP Boosters presumably from MT Aerospace and AVIO, source: ESA
4 Conclusion

Core messages and forecast

- 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?