BACKGROUND

Waste Disposal Background

The 100% family owned subsidiary **CFK Valley Stade Recycling** takes over the waste disposal service and sustainable recovery of carbon fiber materials.

carboNXT sells high-quality recycled carbon fibres and develop jointly with our customers new applications for the lightweight industry.
WASTE DISPOSAL PROBLEM
CARBONFIBER - FUTURE MARKET

- Demand (1,000 to. per year)
- 30% Production Waste (metric to. per year)

CFK Recycling

Weltweit sind es erst einige wenige Recyclinge

Zwei neue Projekte für das CFK-Recycling gestartet

October 16, 2013

Boeing, Oracle Team USA Recycle America's Cup-Class Yacht

Boeing and Oracle Team USA, winner of the 34th America's Cup, are collaborating to recycle 7,000 pounds of carbon fiber of USA-71, a yacht built for training during the America's Cup campaign in 2003.

The hull and mast of the racing yacht will be processed and repurposed, a first-of-its-kind effort for what will likely be the largest carbon structure ever recycled, according to Boeing and Oracle Team USA.

The two organizations, working with research partners, will use a technique developed to recycle composite materials from Boeing's fuel-efficient 787 Dreamliner, which is 50 percent composite by weight. Composite materials allow a lighter, simpler structure, which increases efficiency, and do not fatigue or corrode. In yachts, composite construction also provides the ability to develop a lighter vessel that is stronger and stiffer at the same time.
RECYCLING ROUTES

- Pyrolysis
- Shredding
- Milling / Grinding
- Energy Recycling
- Supercritical fluids
- Thermal bed flow
- Solvolytic / Hydrolysis
WASTE DISPOSAL PROBLEM

- About 10,000 to p.a. CFRP waste are expected
- Increasing of “End of Life” parts in the near future
- Landfill of CFRP is prohibited
- Incineration of CFRP waste is problematical and expensive
- Disposal of CFRP Waste is a critical issue
PRETREATMENT OF CFRP WASTE

- rest of C-fabrics
  e.g. Rovings, woven & unwoven structures

- Prepreg Waste

- defective
cured materials
  pure C-Fibre or hybrid

- End-of-Life parts
CARBON FIBER – THE BLACK GOLD?
100% RECYCLING
THE SOLUTION
LAUNCH INDUSTRIAL PLANT 01/2011

capacity: 1,000 to./year

CFRP Recycling - business opportunity © Tim Rademacker · SEPTEMBER 2018

carbonXT

DEUTSCHER ROHSTOFF
Effizienz Preis
CFRP RECYCLING PROCESS

01 pretreatment waste

02 pyrolysis

03 post treatment

04 cutting

05 final product
EoL - WASTE DISPOSAL PROBLEM
RESULTS OF CFRP RECYCLING
100% PURE
THE QUALITY
THE QUALITY

resin residues

charred residues

pittings

class 1 recycled fibres

CFRP Recycling - business opportunity © Tim Rademacker · SEPTEMBER 2018
100% CUSTOMIZED
THE APPLICATION
CLOSED LOOP CONCEPT

- **eco efficient**
- and certified waste - logistic
- longterm disposal security

- **optimized pyrolysis**
- recycling process and fibre treatment

- **high quality**
- recycled carbon fibre products

- CFRP production waste and
- “end of life” parts

- **new applications**
- supply of best-priced carbon fibres
- customer orientated product development
CFRP PROCESS CHAIN

- Recycling
- carboNXT chopped & milled

RAW MATERIAL SUPPLIER

- compounds
- wet-laid veil
- airlay non-woven
- ...

SEMI PART PRODUCER

- injection mould
- BMC
- RTM / Infusion
- ...

PART PRODUCER / FIRST TIER

- Aviation
- Automotiv
- Industry
- ...

END USER / OEM
SALES PARTNERSHIP

- Constant Qualities
  (no damage, no char)
- Customized products
- Consistency in supply
- Innovative lightweight applications
LONG FIBRE RECYCLING
CHOPPED AND MILLED
CHOPPED AND MILLED

In der Heckschürze und im Frontstoßfänger des neuen Mercedes AMG GT R wurden recycelte Carbonfasern eingearbeitet.

Recycelte Carbonfasern verstärken Mercedes AMG GT R
NON-WOVEN MATERIALS
APPLICATION WITH „ADDED VALUE“
APPLICATION WITH „ADDED VALUE“
## VINYLESTER

<table>
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<th>rCF content</th>
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### Flexural test

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<th>Breaking stress</th>
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<tr>
<td>Elastic modulus</td>
<td>&gt; 23,000 MPa</td>
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<td>Impact test (Charpy)</td>
<td>33 kJ/m²</td>
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NON - WOVEN MATERIALS
## Non-Woven Materials

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<tr>
<th>Fiber Type</th>
<th>Resin</th>
<th>Virgin CF</th>
<th>carbonNXT rCF</th>
<th>Metal</th>
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<tr>
<td>Destiny</td>
<td>g/cm³</td>
<td>PP 1.2</td>
<td>PC 1.4</td>
<td>Nylon 1.3</td>
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<tr>
<td>Tensile strength</td>
<td>Mpa</td>
<td>260</td>
<td>250</td>
<td>270</td>
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<td>Flexural strength</td>
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<tr>
<td>Flexural modulus</td>
<td>GPa</td>
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APPLICATIONS FOR rCF
Bauteilentwicklung
Vorgaben durch OEM
Naturfaser 50%
PP Bindefaser 40%
Carbonfaser 10%
APPLICATION WITH „ADDED VALUE“
APPLICATION WITH „ADDED VALUE“
INJECTION MOULDING - PA6

Quelle: Kunststoff Institut Lüdenscheid

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<th>Material</th>
<th>vgl. Neuware*</th>
<th>PA 6 GF 10 (tr.*)</th>
<th>vgl. Neuware*</th>
<th>PA 6 GF 20 (tr.*)</th>
<th>vgl. Neuware*</th>
<th>PA 6 GF 30 (tr.*)</th>
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<tr>
<td>CarbonNXT Rezyklat</td>
<td>7.800</td>
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<td>13.200</td>
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Zug E-Modul [MPa]
CARBONFIBER — FUTURE MARKET

CarbonFil™

A product by Formfutura
### BENEFITS & UNIQUES

- **CFRP Recycling**
  - Business opportunity © Tim Rademacker · SEPTEMBER 2018

**Sales partnership in Japan, USA, Europe**

**Installed ARLAY machinery with > 200,000 spm**

**Waste disposal**

**Application know-how**

**Market access**

**Waste treatment**

**Recycling technologies**

**Customer added value**

**Wide range of semi-finished products**

**Supplier contracts for wet-laid & compound production**

**Access to waste**

**10 years experience in CFRP Recycling**

**PATENTS & installed capacity of > 1,000 to.**
BENEFITS & UNIQUES

- Closed loop for carbon fibers
- Experts in efficient Logistics and Transportation
- Experts in international Right of Waste Treatment (e.g. REACH)
- Solution for all CFRP Materials & “End of life” parts
  (requirement for a closed life cycle, renewal of life cycle)
- Aerospace and Automotive certified processes
- Highest standard for process design
- Energy efficiency and emission reduced Recycling process
  (zero waste process, eco efficiency)
- Best Product quality - 100% Carbon Fiber Recovery as a requirement for new applications in lightweight industries
- Cost savings by sustainable CFRP Recycling solutions
100% CUSTOMISED
100% PURE
100% RECYCLED