new technologies for hemp based advanced composites
New technologies for hemp based advanced composites

- applications for hemp based composites
- thermoset bio-based PTP™-resin
- various unidirectional HBS-products
- new separation of hemp stems
- harvested hemp stem bundles
- new harvesting technologies
- flow chart & basics
New technologies for hemp based advanced composites

Flow chart & basics

- Hemp plant
  - Blossom
  - Stem
    - Hemp bast stripes (HBS)
    - Degumming
    - Spinnable fibers
  - Hemp wood
    - Semi-finished HBS-products
    - Semi-finished stem-products
    - Semi-finished hemp-wood-products
  - PTP™ resin
  - Other semi-finished products...

- Seed food leaves, flowers
  - CBD
  - THC-medical

Advanced bio-composites

3/20/2016
hemp bast stripes - HBS
new harvesting technologies

new harvesting technologies

New technologies for hemp based advanced composites
harvested hemp stem bundles

harvested in August

harvested in September / October
new separation technology of hemp stems

→ absolutely non-destructive separation method
→ patented PCT/EP2014/002237 - US patent pending “Device and method for isolating bast bark and wood bodies from a bast-plant stem”

hemp wood

hemp bast stripes - HBS
various unidirectional semi-finished HBS-products
thermoset-resin based on renewable resources

PTP™ - resin
up to 95 % bio-based

B.A.M.

3/20/2016
New technologies for hemp based advanced composites
applications for hemp based composites (1)
applications for hemp based composites (2)
applications for hemp based composites (3)
applications for hemp based composites (4)

HempWich type A
applications for hemp based composites (5)

HempWich type B
## Comparison of Fiber Reinforced Composites

<table>
<thead>
<tr>
<th>Property</th>
<th>fiberglass unidirectional</th>
<th>natural fiber non-woven</th>
<th>hemp bast stripes - HBS unidirectional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexural modulus</td>
<td>30 ... 45 GPa, 4.35 ... 6.53 psi *10^6</td>
<td>4 ... 6 0.58 ... 0.87</td>
<td>35 ... 40 5.08 ... 5.80</td>
</tr>
<tr>
<td>Density</td>
<td>2.2 g/cm³, 0.079 lbs/in³</td>
<td>1.4 0.051</td>
<td>1.2 0.043</td>
</tr>
<tr>
<td>Energy demand</td>
<td>🌿🌿🌿</td>
<td>🌿🌿🌿</td>
<td>🌿🌿🌿</td>
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</tbody>
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3/20/2016
New technologies for hemp based advanced composites
hemp: one of the oldest cultivated plants of mankind still has huge untapped potential & can be planted almost anywhere on earth

stem: a brilliant example of an ingenious lightweight structure – optimized by nature

processing: requires sensitive approach in order to maximize properties given by nature

**our strategy:**

1. make use of primary structure of the stems  → **HempWich**
2. unidirectional embedded **hemp bast stripes (HBS)** – required for high tensile strength applications
3. absolutely non-destructive separation method needed to get most of the built-in properties of HBS and **hemp wood**
4. a series of unidirectional **semi-finished HBS-products** will be available shortly
5. advanced bio-composites make only sense in combination with **bio-based resins**

**ultimately**

→ to speed up the implementation of our vision we need to work together very closely