Breaking the limits of bioplastics – using degradable glass fiber as reinforcement
6.2.2019

Arctic Biomaterials Oy
Tomi Kangas, Sales Director
GENERAL COMPANY INFO

Founded 2014
35 professional persons and over 200 years of biopolymer experience
Manufacturing and R&D sites at Tampere, Finland
New manufacturing site under construction in Asia
GLOBAL CARBON CYCLE

Carbon cycle
bio-plastics: approx. 10 years

Carbon cycle
fossil plastics: approx. 1.000.000 years

Bio-plastics

Fossil plastics

Biomass

Carbon dioxid
NEW ERA OF BIODEGRADABLE COMPOSITES

Biodegradable composites which can be processed as current glass fiber reinforced polymers

Polymer matrix chosen from commercially available bioplastics

Reinforcing bioglass fiber that degrades in controlled environment.
ABM TECHNOLOGY

ABM technical materials can be divided into three platforms:

- Bioglass reinforced composites,
- Unreinforced compounds
- Partially bio-based composites and compounds

Composite technology is based on proprietary bioglass fiber and thermoplastic long fiber pultrusion technology (LFT)

Matrix polymer is bio-based and biodegradable or partially bio-based

These grades can be processed with standard injection moulding machines and tools
BIODEGRADABLE GLASS FIBER

Biodegradable glass fiber has similar properties (TEX1200, tensile strength 2200 -2400 Mpa and Modulus 65-68 Gpa) with technical E- or ECR-glass fibers.

Glass degradation is a surface erosion phenomena and degradations products are alkali-, earth alkali- salts or hydroxides and silicic acid.
ABM ADHESION (SIZING) TECHNOLOGY

The adhesion needs to be tailored for each polymer matrix to ensure good adhesion and mechanical properties
BIOGLASS FIBER REINFORCED PRODUCTS

<table>
<thead>
<tr>
<th>Material</th>
<th>IZOD Impact notched [kJ/m²]</th>
<th>Tensile Strength [MPa]</th>
<th>Flexural Strength [MPa]</th>
<th>HDT B (0.45 Mpa) [°C]</th>
<th>Elastic Modulus [MPa] sec. axis</th>
</tr>
</thead>
<tbody>
<tr>
<td>BGF40-B1004</td>
<td>128</td>
<td>115</td>
<td>155</td>
<td>9800</td>
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<tr>
<td>BGF40-B1005</td>
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<td>11550</td>
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<tr>
<td>PP - GF40</td>
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<td>154</td>
<td>180</td>
<td>1550</td>
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<tr>
<td>PA12 - GF30</td>
<td>180</td>
<td>155</td>
<td>8700</td>
<td>155</td>
<td>18</td>
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<tr>
<td>PA6 - GF30</td>
<td>155</td>
<td>160</td>
<td>1520</td>
<td>155</td>
<td>18</td>
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</table>
Glass fiber length in the final product is directly proportional to the mechanical properties of the final product.

Typical fiber length in ABM LFT products is between 8-12mm.
ABM has developed PLA-based biodegradable glass fiber composites with high mechanical properties (flex and impact) and good temperature resistance without need of in-mould annealing as traditionally with PLA enabling fast cycle times.

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<tbody>
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<td>10540</td>
<td>129</td>
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<td>10733</td>
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<td>129</td>
<td>1.3</td>
<td>13000</td>
<td>14</td>
<td>162</td>
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</table>
COMPOUNDED BIO-BASED PRODUCTS
VALUE-ADDED: ANTIMICROBIAL

Testing according to ISO 22196 and Jis Z 2801 (Measurement of antibacterial activity on plastics surfaces) against E.Coli and S. Aureus

<table>
<thead>
<tr>
<th>Number of Living Bacteria E.Coli</th>
<th>Antimicrobial activity value</th>
<th>Reduction %</th>
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</thead>
<tbody>
<tr>
<td>Start (per cm²)</td>
<td>24 hours (per piece)</td>
<td>24 hours (per cm²)</td>
</tr>
<tr>
<td>Blank</td>
<td>$1.8 \times 10^4$</td>
<td>$6.2 \times 10^6$</td>
</tr>
<tr>
<td>ABM</td>
<td>$1.8 \times 10^4$</td>
<td>500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Living Bacteria S.Aureus</th>
<th>Antimicrobial activity value</th>
<th>Reduction %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start (per cm²)</td>
<td>24 hours (per piece)</td>
<td>24 hours (per cm²)</td>
</tr>
<tr>
<td>Blank</td>
<td>$7.2 \times 10^3$</td>
<td>$7.8 \times 10^5$</td>
</tr>
<tr>
<td>ABM</td>
<td>$7.2 \times 10^3$</td>
<td>$&lt;100$</td>
</tr>
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</table>

Combined effect of glass composition containing oxides and ions
APPLICATION AREAS

Houseware
- Microwave
- Dishwasher
- Creep
- Food approval

Automotive
- Temp resistant
- High impact
- High stiffness

Electronics
- Dimensional stability
- Flatness
- Weld line strength

Healthcare
- Medical approved
- ISO certified manufacturing
- Continuous fiber products
END OF LIFE OPTIONS

- Recycling
- Incineration
- Composting
- Chemical Recycling (depolymerisation back to monomer)
DIN CERTCO recognized third-party testing organization for testing according to EN 13432

“Packaging - Requirements for packaging recoverable through composting and biodegradation”.
ANALYTICAL SERVICES

- Molecular weight GPC (triple detection)
- Viscosity (inherent, intrinsic, dynamic)
- Monomer Residues GC
- Thermal properties DSC
- Particle size LS
- Identification ATR-FTIR
- Heavy metals and catalyst residues AAS, SEM-EDX
- Mechanical properties (tensile, bending, compression, shear, torsion, impact)
- Surface properties SEM-EDX
- Solvent residues GC
- Long term weatherability and UV testing
- MFR/MFI
- HDT A/B and Vicat
SUMMARY

- Degradable glass fiber as reinforcement
- New level of performance for biopolymers
- World class analytical and technical service
CONTACT DETAILS

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