Natural Fibre Reinforced Plastics and Solid Wood – A Comparison of Terrace Floorings using LCA

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  • Project content
  • Material: Wood Polymer Composties (WPC)

• LCA
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  • LCI: Wood fibres
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Introduction

Project content

1. Comparative LCA of **WPC deckings** and **wooden alternatives**

2. Enable WPC producers and manufacturers to **perform individual LCA results**

Aims:

- Benchmarking
- Life Cycle Management software
**Introduction**

**Material:** Wood polymer composites (WPC)

<table>
<thead>
<tr>
<th><strong>Matrix polymer</strong></th>
<th><strong>Natural fibre</strong></th>
<th><strong>Additives</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyethylene, Polypropylene or Polyvinylchloride</td>
<td>Wood fibres (usually spruce)</td>
<td>Stabilizers, Bonding agents, Colour pigments, Biocides/fungizides</td>
</tr>
<tr>
<td>30-70%</td>
<td>20-60%</td>
<td>&lt;5%</td>
</tr>
</tbody>
</table>
Introduction

Products

Source: NATURinFORM
Source: Werzalit
Source: jeluplast
Source: jeluplast
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Life Cycle Assessment

Scope: Production systems & system boundaries

Production phase

Solid wood
- Lumber production
- Sawing
- Technical drying
- Pressure treatment
- Terrace FU = 1 m²*

WPC
- Polymer production
- Wood fibre production
- Additive production
- Processing
- Extrusion
- Terrace FU = 1 m²*

Use phase

Maintenance

EoL

- Energy recovery
  - Excluded: Assembly, disassembly
- Recycling
  - Excluded: Assembly, disassembly

* FU: Production, 15 years of use and energy recovery of 1 m² of terrace
Life Cycle Assessment

**LCI:** Central topics

1. Life time of deckings
2. Maintenance behaviour
3. Wood fibres
Life Cycle Assessment

LCI: Wood fibres

Spruce, in forest → Lumber

Fresh wood (Motor saw)
+ barking, chaffing, drying, grinding

Fresh wood (Harvester)
+ barking, chaffing, drying, grinding

Sawing

Industrial restwood
+ chaffing, drying, grinding

Rough boards

Planing

Wood shavings
+ grinding

Planed boards
**Life Cycle Assessment**

**LCI: Wood fibres**

- Spruce, in forest
  - Fresh wood (Motor saw)
    - Not state-of-the-art
  - Fresh wood (Harvester)
- Lumber
  - Sawing
    - Industrial restwood
      - Allocated by-product
    - Rough boards
      - Planing
        - Wood shavings
          - Allocated by-product
        - Planed boards
**Life Cycle Assessment**

**LCI: Wood fibres**

- **Harvesting**
  - Standing tree
  - Harvesting
  - Stem wood
  - Barking
  - Stem wood debarked
  - Chaffing
  - Wood chaff
  - Drying
  - Dry wood chaff
  - Grinding
  - Wood flour

**System border**

- Wood off-cuts
- Chaffed bark

**Resources:**
- Harvester
- Forwarder
- Electricity
- Oil
- Steel
- Electricity
- Oil
- Steel
- Electricity
- Oil
- Steel
- Electricity
Life Cycle Assessment

**LCIA:** Benchmarking

1 m² terrace, lifetime 15 years
WPC: PE with 70% wood fibre

- **Production phase**
- **Use phase**
- **EoL**

Graph showing the life cycle assessment for Bilinga, Pine, WPC hollow, and WPC solid for different environmental indicators (GWP, ODP, POCP, AP, EP, CED).
**Life Cycle Assessment**

**Interpretation of LCA results**

1. Production phase is dominant
2. Maintenance is not relevant
3. EoL is less important (except GWP) – but Recycling is an option for WPC
4. Pine wood is best choice in all categories
5. WPC hollow chamber profile is advantageous to bilinga, except GWP & EP
6. With a 50% higher life-time than bilinga WPC hollow chamber profile would be absolutely advantageous to bilinga
7. With a 100% higher life-time than pine WPC hollow chamber profile would be comparable to pine wood (except GWP)
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<table>
<thead>
<tr>
<th>Dimensionen</th>
<th>Zusammensetzung</th>
<th>Transport</th>
<th>Fertigung</th>
<th>Reinigung</th>
<th>Kosten</th>
</tr>
</thead>
<tbody>
<tr>
<td>WPC-Decking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gewicht laufender Meter</td>
<td>kg</td>
<td>kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breite Decking</td>
<td>cm</td>
<td>cm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standardlänge Decking</td>
<td>m</td>
<td>m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mindestabstand zwischen zwei Deckings</td>
<td>cm</td>
<td>cm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Unterkonstruktion | |
|-------------------| |
| Konstruktions balken | |
| Gewicht laufender Meter | kg | kg | |
| Länge pro qm Terrasse | m | m | |
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