COST Action FP1407

1st Conference “Life Cycle Assessment, EPDs and modified wood”

Life cycle impacts of modified wood products

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Wood water behavior

Changes in dimensional stability, strength, and biological durability
Wood modification

Water-molecules bond with the accessible OH-groups (in hemicellulose, amorphous cellulose and lignin)

During thermal modification part of the OH-goups are degraded leading to less interaction between wood and water
ThermoWood process

1. **Temperature raising** to 100°C, with steam injection (to inhibit cracking, etc), **wood drying** -> 130°C (wood MC 0%)

2. **Temperature raising + thermal modification** at 185-230°C for ~2-3 h (depending on wood species and desired properties)

3. **Cooling and stabilisation** at 80-90°C (with steam) to final moisture content ~4-7 %.
Environmental Product Declaration

- EN 15804 – Environmental declaration for building products
- Define system boundary for the assessment
- Declare emissions to air, ground and water

<table>
<thead>
<tr>
<th>A1-3</th>
<th>A4-5</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRODUCT</td>
<td>CONSTRUCTION</td>
<td>USE</td>
<td>END-OF-LIFE</td>
<td>ADDITIONAL</td>
</tr>
<tr>
<td>A1 Raw material supply</td>
<td>A4 Transport to site</td>
<td>B1 Use</td>
<td>C1 Deconstruction</td>
<td>Benefits and loads beyond system boundary</td>
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<tr>
<td>A2 Transport to factory</td>
<td>A5 Construction work</td>
<td>B2 Maintenance</td>
<td>C2 Transport</td>
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<td>A3 Manufacturing</td>
<td></td>
<td>B3 Repair</td>
<td>C3 Waste processing</td>
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<td></td>
<td></td>
<td>B4 Replacement</td>
<td>C4 Disposal</td>
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Coverage of an EPD

Cradle to gate

Cradle to gate with options

Cradle to grave

(Kuittinen & Linkosalmi, 2015)
Life cycle assessment

- Definition of goal and scope
- Inventory
- Impact assessment
- Interpretation of results

(Kuittinen & Linkosalmi, 2015)
System boundary for assessment

Forest → Transport → Processing → Transport → Use → End-of-life

Maintenance → Repair → Replacement → Refurbish

System boundary
Life cycle impacts

Environmental impacts
Economical impacts
Social impacts

Forest → Transport → Processing → Transport → Use → End-of-life

15–25% increase in primary energy demand
Possibility to influence with modified wood
## Primary energy need in production stage

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<tbody>
<tr>
<td></td>
<td>kg/m$^3$</td>
<td>420</td>
<td>420</td>
<td>413</td>
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<tr>
<td>MC</td>
<td>%</td>
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<td>PERE</td>
<td>MJ</td>
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<td>853</td>
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<td>2761</td>
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<td>PENR</td>
<td>MJ</td>
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<td>330</td>
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<td>POCP</td>
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<td>0,0486</td>
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<td>AP</td>
<td>kg SO$_2$ -e</td>
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<td>EP</td>
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<td>MJ</td>
<td>623</td>
<td>1390</td>
<td>318</td>
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</table>

Conclusions

• Primary energy need increases by approximately 15–25% in heat treated timber compared to kiln dried sawn timber in production phase
• This primary energy needs to be gained back in later life cycle phases (use phase)
• Emissions are always energy production related
• More specific data from use stage is required to make meaningful comparison of the whole life cycle
References


