Birch - properties and utilisation

Henrik Heräjärvi
Finnish Forest Research Institute Metla
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BIRCH, species

• Ca. 40 Betula species are known
• Deciduous hardwoods
• Two industrially utilised species in Europe
  • Silver birch, Betula pendula Roth.
  • European white birch, Betula pubescens Ehrh.
BIRCH, tree appearance

- Maximum height ca. 30 m
- Maximum dbh for forest trees ca. 40 cm
- Volume of grown-up trees 0.5-1.0 m³
- Saw log percentage approximately 40-60
  - Defects causing rejecting log-sized timber into pulpwood include: stem form (sweep, crooks, forks), heart rot and large/vertical branches
  - Silver birch has better stem form, growth and final cutting size than white birch => silver birch makes up the majority of logs used by the wood product industries
- Birch is a popular species not only in forestry but also in urban environment improving the landscape as well as the biological diversity
Species differences

• Silver birch grows predominantly on mineral soils, whereas white birch occupies both mineral soils and peatlands

• Generally, silver birch represents more desirable quality attributes:
  • Larger achievable stem size
  • Straighter stem form
  • Growth rate even two times higher
  • Slightly higher wood density => slightly better mechanical properties
  • Natural deterioration starts at later age

• No morphological or physiological differences of practical relevance exist between the species

=> identical end uses
BIRCH, supply in Finland

- White and silver birch are, respectively, the third and fourth most abundant tree species in Finland, total volume 316 Million m³
- Annual increment ca. 14 Million m³
- Annual cuttings ca. 9 Million m³
- White birch grows practically throughout the country, silver birch south from 65° N.L.
- Ca. 90% of saw and veneer logs are purchased from the “lake area” in central Finland
- The same species grow practically throughout Northern and Central Europe
BIRCH, harvesting

- Nowadays most of the timber is harvested mechanically
- The best veneer and plywood logs are still harvested using manual cutting in order to avoid defects caused by the delimming blades and rollers of the harvester grapple
Timber

- Previously, only logs with diameter more than 18 cm were used for production of knot free lumber
- Nowadays the markets approve sound knotted products => smaller logs are sawn down to approximately 14 cm top diameter
BIRCH, wood properties

• Diffuse porous hardwood
• Wood material naturally light-coloured, often slightly yellowish after drying
• Relatively easy to saw, veneer, carve, plane, turn, nail, screw, paint, varnish and glue
• Appropriate species for heat-treatment
  • New potential end-uses
• Reaction wood (tension wood) is common => challenges in lumber drying
• Birch is susceptible to colour defects caused by a stem miner *Phytobia betulae*
• Actual heartwood does not exist
• Wood material near the pith is often darkened by decay, when the age of the tree exceeds ca. 70-90 years
BIRCH, wood properties

- Wood density clearly increases from the pith to the surface and slightly decreases from the stump upwards

- Bending strength, stiffness and most of the other mechanical properties vary similarly in comparison to the density

- Ca. 1±0.5 mm long fibres (beech: 1±0.3) build up 75% (40%), vessels 18% (40%) and rays 7% (16%) of the total tree volume

- Cellulose content of birch wood material 50±5% (beech: 40±5), hemicellulose content 25±2% (21±4), lignin content 23±3% (16±4)
Within-stem density profile

Betula pendula

Stump height

Upper heights

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Brinell hardness

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## Properties, beech vs. birch

<table>
<thead>
<tr>
<th>Property</th>
<th>Beech</th>
<th>Birch</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Min-average-max</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic density (kg/m³)</td>
<td>490-580-880</td>
<td>460-500-800</td>
</tr>
<tr>
<td>Brinell hardness (MPa) ⊥</td>
<td>…34…</td>
<td>20-22-49</td>
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<tr>
<td>Modulus of elasticity (GPa) II</td>
<td>…16…</td>
<td>10-14-20</td>
</tr>
<tr>
<td>Modulus of rupture (MPa) II</td>
<td>74-123-210</td>
<td>75-110-150</td>
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<td>Shrinkage from FSP to dry (%)</td>
<td></td>
<td></td>
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<tr>
<td>Longitudinal</td>
<td>0.3</td>
<td>0.6</td>
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<tr>
<td>Radial</td>
<td>4-6</td>
<td>5</td>
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<td>Tangential</td>
<td>9-12</td>
<td>8</td>
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<tr>
<td>Volumetric</td>
<td>18</td>
<td>14</td>
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</tbody>
</table>


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BIRCH, wood material

Sawn wood, A-quality

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BIRCH, wood material

Sawn wood, B-quality

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BIRCH, wood material

Birch veneers, rotary cut
BIRCH, wood material, specialities

Flame birch veneer, rotary cut

Curly birch veneer, rotary cut

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BIRCH, utilisation

- Some 2/3 of the harvested birch is used in chemical pulping, mechanical pulping soon possible
- Wood product industries use ca. 1.3 million m³ of high-quality birch logs annually
  - Plywood and veneer industries ca. 1.1 million m³
  - Saw mills 0.25-0.3 million m³
- Most of the sawn wood is used in furniture and cabinetry manufacturing and floorings
- Other end uses for birch: particle board industry, firewood, xylitol, household equipment, birch bark handicrafts, sap beverages, sauna equipment…

Bath whisk

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Past and current research projects at Metla

• Biology of birch fly *Phytobia betulae* 1996-2000 (Tiina Ylioja)
• Silver birch wood structure and chemistry, drying discolouration 1995-2001 (Riikka Piispanen)
• Prediction of growth and quality of birch 1998-2002 (Pentti Niemistö)
• Mature birch as a raw material for sawmilling and further processing 1998-2002 (Henrik Heräjärvi)
• Thinning birch as a raw material for sawmilling and further processing 2000-2003 (Jari Lindblad)
• Diversification of hardwood utilisation 2002-2006 (Heräjärvi)
  • Mature birch (wood material studies)
  • Imported birch (project under preparation)
  • Birch pruning, wood quality and work feasibility analysis
• Growing high-quality silver and curly birch 2004-2006 (Risto Hagqvist, Niemistö, Heräjärvi)

*More information: Henrik Heräjärvi, www.metla.fi*
Past and current research projects, Other institutions

- Influence of site, felling season and storing time on the discolouration and dimensional changes of birch lumber during drying, 1998-2001 (Katri Luostarinen, University of Joensuu)
- Quality of dried birch wood from cultivated forests, 1999-2001 (Veikko Möttönen, University of Joensuu)
- Bleaching and machining of birch veneers, 2002-2003 (Möttönen, University of Joensuu)
- Further processing and final products of domestic birch, aspen and alder, 1998-2001 (Jari Kivistö, University of Helsinki)
- Drying of hardwood lumber, 2001-2004 (Kivistö, University of Helsinki)
Research needs

Current and prospective research needs?

- Improving the quality of current and future growing stock by silviculture and tree breeding
  - Stem form, branchiness, decay resistance
- Protection of seedlings from animal damages (esp. elk)
- Improving the quality of dried lumber
  - Discolouration, deformation, fracture behaviour
- Wood modification
  - Heat treatment
  - Steam bending
  - Compressing and other surface hardness improving treatments
  - Impregnation (furfuryl alcohol, etc.)
  - Wood-based composites made of birch
- ?

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Contact

Henrik Heräjärvi

Finnish Forest Research Institute
Joensuu Research Centre
P.O. Box 68
FIN-80101 Joensuu, Finland

Tel. +358 10 211 3037
henrik.herajarvi@metla.fi
www.metla.fi