Poplar Wood Related Research in Hungary

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Wood Products based on
Poplar/willow Wood
León, Spain
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Introduction

Tree species distribution of Hungary

- Poplar: ca. 200,000 ha

![Bar chart showing tree species distribution in Hungary]

- Conifers
- Other broadleaves
- Indigenous poplar
- Improved poplar
- Black locust
- Hornbeam
- Beech
- Turkey oak
- Oak

- Area, %: 100% = 1.903,4 Mio ha
- Growing stock, %: 100% = 351.9 Mio m³

Poplar: ca. 200,000 ha
Introduction

Gross annual increment

Poplar: ~1.7 million m$^3$

Total: 13.1 million m$^3$

- Black Locust
- Oak
- Poplar
- Conifers
- Other hardwood
- Turkey oak
- Beech
- Other soft deciduous

Poplar: ~1.7 million m$^3$
Fellings by tree species

- Black locust: 16.6%
- Improved poplars: 20.3%
- Indigenous poplar: 13.1%
- Turkey oak: 13.2%
- Conifers: 12.5%
- Beech: 9.9%
- Hornbeam: 4.6%
- Other soft-broad-leaved: 4.3%
- Other hard broad-leaved: 2.8%
- Oak: 2.6%

Total: 7,024 million m³
• Utilization of poplar wood has a long tradition in Hungary
• Reasons for diversified utilization of poplar wood
  • several indigenous poplar species in Hungary
    • *Populus alba*,
    • *Populus nigra*,
    • *Populus tremula*

• intensive work in Hungary to breed new varieties (clones) with very different physical and mechanical properties
  • number of officially accepted varieties with hungarian origin: ~50
  • mostly cultivated varieties:
    • Pannonia, Koltay, Kopecky, Sudár, Aprólevelű
"Traditional" utilization fields:
- packaging material,
- crates,
- pallets,
- plywood,
- blockboard,
- wood-cement composites (insulation)
- paper- or cellulose production,
- frames for upholstered furnitures,
- matches,
- etc.
Introduction

• „New” (non traditional) utilization fields:
  • furniture production
• „New” (non traditional) utilization fields:
  • wooden architecture

Glulam structure made of poplar wood in Hungary (1975)
Research fields related to improve its properties:

- energy production as renewable raw material - energy plantations
- different wood modification techniques
- glued poplar products like LVL or glulam elements
• Fast growing species
  • poplar, willow or robinia (altogether ~35% of the Hungarian forest area)

• High production rate of dry matter
• High sprouting capability
• Short harvesting cycles

Profitability & fast return of investments

• To maximize the occupancy of the plantation fields, species and variety have to be chosen fitting the best for the given conditions.
Case study – importance of different sites and varieties

• Three production sites in Hungary:
  • Celldömölk (forest soil)
  • Sárvár (clay soil)
  • Borjád (sandy and wet soil)

• Varieties:
  • ‘I-214’
  • Kopecky
  • a new variety bred by ERTI (Forest Research Institute)
• Calorific value of the different poplar varieties at different production sites

No significant difference by weight between the calorific values of the investigated varieties.
There was a huge difference by volume → density
• Calorific value of the different poplar varieties per hectare

Possible two times higher energy yields per hectares
(variety/site conditions)
• Enhance the surface hardness

Parameters of the different THM process schedules
Thermomechanical treatment

- Colour change

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<th>180 °C</th>
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Control
• Change of surface hardness

Thermomechanical treatment

Maple

Brinell-Mohr hardness (MPa)

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Thermomechanical treatment

- Densification rate as a function of distance from the surface
• Changes in the wood tissue

control 40% densified
• Typical failures of poplar wood as a result of THM treatment
• Treatment medium:
  • Linseed oil
  • Rapeseed oil
  • Sunflower oil
• Treatment time:
  • 2, 4 and 6 hours
• Treatment temperature:
  • 160 and 200°C
• Very intensive treatment → shorter treatment period
• Not all wood species are suitable for this treatment
• ASE values after OHT in linseed oil (T = 20°C, φ = 65%)
• Changes in moisture content of OHT and untreated poplar wood at normal climate (T= 20°C, φ= 65%) as a function of time
• Density of water vapour flow rate for untreated and oil-heat-treated (OHT) wood material in tangential and radial directions
• Colour change
POPLAR-BASED GLULAM ELEMENTS

- Possible substitution of spruce wood (only from import available in Hungary)
- Lamellae dimensions 20×70 mm
- Lamellae graded by a non-destructive equipment (EN 338)
- Lamellae length of 2000 mm
- Fibre reinforced one component polyurethane glue
- 5 layers of lamellae
- External layers: mechanical classes C27 and C30
- Middle layers C22 and C24
• Modulus of elasticity of the prototypes: 11316 Mpa
• Bending strength: 45,9 Mpa
The aim of the poplar-related research work in Hungary is
- Breeding new varieties (for given end uses or prod. site conditions)
- Enhancing the technical performance of the poplar wood material

There are some disadvantageous properties like low mechanical strength, low surface hardness, and nevertheless the unexciting texture and appearance

By upgrading the unfavourable properties of poplar wood new and very promising applications could be defined

The energetic use of poplar wood is a common way for poplar utilization
Conclusions

• Several wood modification methods like thermal treatments and thermo-mechanical treatments are a good opportunity to increase aesthetical and mechanical performance of poplar wood applications could be defined.

• However, poplar wood is traditionally not used as a material for load bearing elements, according to the mechanical performance of several poplar varieties it is also possible.
Thank you for your attention!