

# Poplar Wood Processing and Utilization: Challenges and Opportunities

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# Background

- Poplar wood has been long considered of low quality and difficult to process;
- The quality of wood is determined by its suitability for specific end uses. Woods which are good for some applications could not be suitable for other applications;
- Knowledge of wood and technological advances led to the ease of poplar wood processing despite difficulties.

# Wood characteristics

# Aesthetic and microscopic features

- Poplar wood is soft, light in colour, straight-grained, and of a fine, uniform texture.
- It has a characteristic odour when wet, odourless when dry and no characteristic taste;
- Poplar wood is constituted of fibres (55%), vessels (34%) and rays (11%);
- Fibre length (1 mm) of poplars is short;
- Tension wood in poplars is common and is associated with drying and machining difficulties.

# Physical properties

- Poplar wood is soft; light in weight; specific gravity ranges from 300 to 450 kg/m<sup>3</sup>;
- Poplars have high moisture content (>100%), and wet wood is frequent ;
- Poplar wood is considered as stable;
- Tension wood in aspen tends to shrink excessively parallel to grain;
- Poplar wood has low natural durability, it decays rapidly under favorable conditions;
- Poplar wood is uniform.

# Chemical composition

- Lignin content is less than 20%;
- Cellulose content is more than 50%;
- Hemicelluloses are more than 20%;
- Total extractives are less than 5%;
- This chemical composition lends poplar wood well to pulping.

# Mechanical properties

- The wood of poplar has low mechanical properties compared to most native species:
  - Aspen modulus of rupture is 20% lower than black spruce;
  - Aspen modulus of elasticity is 25% lower than black spruce.
- Aspen and poplar mechanical properties are comparable to those of eastern white pine.

# Processing and technological properties

# Lumber processing and drying

- Lumber production from poplar is very easy and the yield is generally high;
- Poplar has not been favored for lumber production due to many factors:
  - High incidence of decay;
  - Drying difficulties;
  - Low wood mechanical properties;
  - Negative perception of users;
  - Poplar high value for other fibre and panel products.

# Lumber processing and drying

- Tension wood causes a high degree of warping and bowing in lumber drying;
- Wet wood increases drying costs and causes many drying defects; it requires up to 5 times more time to dry than sapwood;
- Sapwood can be dried easily and rapidly while heartwood is difficult to dry;
- High tangential to radial shrinkage ratio causes warping problems;
- Stain and decay reduce lumber value and marketability. They reduce strength and grade and increases manufacturing costs.

# Lumber processing and drying

- Better drying strategies will help overcome wet wood and tension wood problems. Recommended drying strategies to reduce or avoid drying defects include:
  - Good stacking practices;
  - Weight restraint;
  - Careful application of air pre-drying;
  - Slow drying (low dryer humidity and low initial temperature);
  - Use of the Saw-Dry-Rip (SDR) process.

# Treatability and impregnation

- Poplar sapwood is permeable and easy to impregnate with polymers & preservatives;
- Heartwood and wet wood are impermeable and difficult to impregnate;
- Impregnation of poplar wood gives opportunities for the development of high value products (composites, treated wood).

# Working properties

- In general, poplar wood machines easily with low energy requirements;
- Fuzzy surfaces (wooly finish) and torn grain are the main defects associated with poplar wood machining;
- To prevent wooly finish, sharp and thin knives are required for planing and cutting;
- Poplar sanding is perfect if new and sharp sanding belts are used;
- Screw holding is good and nail holding is satisfactory with little danger of splitting.

# Gluing properties

- Poplar wood has fair to excellent gluing properties. It bonds very easily with adhesives of a wide range of properties and under a wide range of bonding conditions with no staining problems;
- Poplar wood is quite absorptive of liquids, so rapid assembly after spreading the glue is required to avoid weak joint;
- The highly absorbent nature of poplar wood could result in some gluing difficulties due to formation of wet pockets.

# Finishing properties

- Poplar wood is among the best hardwoods for paint holding;
- It takes printing ink and stain very well;
- Both hot and cold spray lacquer perform well;
- To avoid uneven absorption, a wash coat or sealer application prior to staining is required;
- The highly absorbent nature of poplar wood might result in excess of finish consumption.

# Processing for pulp and paper

- The suitability of poplar for pulp and papermaking is well documented;
- Poplar is pulped with all processes either alone or in mixture with softwoods or hardwoods;
- Pulp strength properties of poplars are 30% to 50% lower than those of softwoods;
- Vessel elements enhance smoothness and opacity, making poplars suitable for fine printing papers.

# Processing for veneer & Plywood

- Large-size poplar trees are suitable for veneer production by all processes;
- Due to its uniformity and low density, poplar wood can be cut at room temperature;
- Tension wood results in fuzzy surface during cutting. This can be reduced by cooling the bolts and the use of hard and sharp knives;
- Tension wood and wet wood cause several drying defects;
- Poplar veneer requires longer drying times than average hardwood species;
- CSA standards for softwood plywood allow the use of poplar veneer in the core layers.

# Processing for OSB, OSL & Flakeboard

- Aspen is a preferred material for the manufacture of Oriented Strandboard (OSB); Oriented Strand Lumber (OSL) and flakeboard;
- The wood uniformity and low density make it easy to cut and to compress;
- The low extractives content in poplar wood is an advantage for gluing;
- The availability of this species at low cost is an advantage;
- These processes accept small diameter trees.

# Processing for MDF, PB & hardboard

- Sawmill poplar residues are used as a raw material for particleboard and MDF;
- In Canada, poplar is not the principal raw material for MDF and PB manufacture;
- As the capacity of MDF plants increases, and the available wood residues decreases, alternative sources of raw material must be found and poplar is a prime candidate;
- Poplar is suitable for hardboard production using high yield pulps.

# Challenges and Opportunities : Lumber

# Lumber grades and Value

In poplar processing for lumber we have the following scheme:

- 45 to 50% sawn lumber
- 40% to 50% chips
- 5% residual sawdust

Of the sawn lumber:

- 5% FAS and Select
- 10% no 1 Common
- 25% no 2 and no 3 common
- 60% pallet wood or construction material

# Lumber grades and Value

Poplar lumber is classified into two categories:

- Appearance-Grade :
  - Solid wood furniture
  - Millwork
  - Edge-glued panels
- Knotty Grade :
  - Pallet and crating Material products
  - Dimension and stud lumber

# Challenges for poplar use in furniture

- Availability of lumber grades;
- Customer perception of the wood;
- Drying difficulties;
- Limited strength of lumber;
- Requires sharp tools to avoid fuzzing;
- Requires a sealant to ensure consistent absorption when staining.

# Opportunities for poplar use in furniture

- Wood availability in several regions;
- Competitive and stable poplar price;
- Bright white in colour;
- Light weight;
- The current and future demand for furniture grade lumber is well above what north American poplar sawmills can produce.

# Millwork

- Mouldings
- Wall paneling
- Ceiling paneling
- Kitchen and bath cabinetry
- Door stock
- Interior fascia
- Stair components

# Challenges for millwork

- Have tendency to fuzz in machining;
- Consumer perception;
- Competition from MDF and other species;
- Competition from foreign countries;
- Marketing strategies.

# Opportunities for millwork

- Finger jointed moulding will take the fall down generated in the production of the solid lineal mouldings;
- Embossing ornate patterns onto poplar mouldings is easy due to its low density;
- Availability and price competitiveness;
- Light weight;
- Natural bright white look;
- Dimensional stability of the wood;
- Excellent as substrate for lamination.

# Edge-glued panels

## Challenges :

- Consumer perception;
- Machining difficulties (fuzzy surfaces)
- Marketing strategies (aspen vs yellow poplar)
- Competition from New Zealand, Chile, etc.

## Opportunities :

- Availability of the wood at competitive cost;
- Divers utilisation possibilities:
  - Furniture, snowboard, skis, Caskets, etc.
- Light weight is an advantage.

# Knotty grade applications

# Pallets and crating material

## Challenges :

- Competition for raw material;
- Keep and improve poplar market share;
- Better use of clear wood pallets;
- Overcome blue stain problems;
- Legislation to treat packaging material.

## Opportunities :

- Availability of wood at competitive price;
- Wood pallet and crating industry is the largest consuming sector of poplar wood;
- Market segment is in consistent increase.

# Dimension & Stud Lumber products

## Challenges :

- Market acceptance of poplar;
- Which industry is more profitable for poplar;
- Wood quality assessment of fast growing species;
- Competition for the raw material.

## Opportunities :

- Market of stud lumber is large enough to absorb any volumes the industry produce;
- Genetically improved material could overcome wood strength issues.

# Veneer and plywood

# Challenges

- Poplar peeler logs are difficult to find;
- High incidence of decay in large diameter logs;
- Cutting difficulties associated with the presence of tension wood;
- Drying problems associated with wet wood; tension wood and juvenile wood;
- Competition for high quality logs from the lumber industry.

# Opportunities for veneer & plywood

- Poplar veneer have potentiel use for a variety of products:
  - Core material in softwood plywood ; Core material for exotic hardwood plywood; Furniture; Thin plywood for hobby panels; LVL in structural an non-structural LVL beams
- Genetically improved material could give large logs after few years of growth
- Ease of veneering of poplar logs
- Price competitiveness

# Panel products

# Panel products

## Challenges

- Shortage of fibre supply;
- Competition from plywood and solid wood panels;
- Suitability of fast grown material for the industry (processing and product quality);

## Opportunities

- OSB and MDF are in consistent evolution;
- Ease of cutting;
- Shortage of raw material is an opportunity for fast grown species.

# Wood advanced processing

Several technologies are emerging for the production of high value-added products.

Among these technologies:

- Wood hardening technology is emerging and offers the possibility of producing high value added products (flooring, moulding);
- Thermal modification of the wood is an emerging technology to substitute treated lumber;
- Engineered wood products.

# Wood advanced processing

## Challenges

- Products standard requirements
- Consumer perception
- Marketing strategies
- Cost control

## Opportunities

- Properties improvement
- Ability to meet specific requirements
- Consistent evolution of the wood markets

# Concluding remarks

The main challenges for poplar use include:

- Insure sufficient supply for the various forest products industries;
- Change consumer perception, especially for high value applications;
- Overcome drying and machining difficulties;
- Wood quality assessment.

# Concluding remarks

Opportunities for poplar use include:

- Fast growth of poplar species and hybrids;
- The evolution of the wood markets;
- Technological advances;
- Ease of cutting ;
- Light weight ;
- Light colour of the wood.