North American Developments in Kiln Drying

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Outline

- Background
- Main drives for advancing *drying technology*
- Developments & trends
- Future focus
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Main Objective

To illustrate how the present challenges will stimulate advances in drying technology
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**Background**

*Today’s situation (main factors):*

- the Canadian experience
  - decrease in sales to the Japanese Market
  - increased world timber supply
  - over-capacity
    - Canada (& USA) // 24.5% reduction // 1,311 to 900 mills
  - housing market
  - mountain pine beetle (epidemic)
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MPB attack

Cumulative Percentage of Pine Killed

1999 Data

* Byrne 2007
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MPB attack

Cumulative Percentage of Pine Killed

2008
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Mount Swanell
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Eutsuk Peak
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MPB attack

Annual Volume of Pine Killed on the Timber Harvesting Landbase

~90 million in 2007

Projected Kill
Observed Kill

DryTech 08
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Typical BC mill
250 MMfbm
Despite all current challenges…

• return of the demand for traditional residential lumber products,
• growing remodelling market
• potential expansion of non-residential markets
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Main drives

1. Skill Set Development
   • how to attract young generation?
   • curricula review
     • science, technology, business practices, problem solving

2. Environment
   • reduction of CO₂ released to the atmosphere from kilns
3. Cost Reduction

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**Electricity costs (industrial customers)**
North America (avg values)

- Gas costs over time (Canadian Industrial Sector)
- Electricity costs over time (North America avg values)

Source: Natural Resources Canada
4. Customer demand

Equilibrium Moisture Content - EMC(%)
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5. Competition from other materials
   • plastic
   • steel
   • composites

6. Challenges associated with current species

Wet pockets
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7. Alternative species (species substitution)
   • world timber supply availability

8. Potential new products and applications
   • Chinese market (construction and value-added products)

9. Phyto-sanitary requirements (worldwide)
   • 56 °C + 30 min

10. Technology adaptation & innovation
    • sensor technology, neural networks
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In summary...

1. skill set development
2. increased pressure from the environment movement
3. growing customer demand for better quality
4. growing pressure for reducing processing costs
5. competition from other materials
6. challenges associated with current species
7. utilization of alternative species
8. potential new products and applications
9. stringent international regulations (performance and phytosanitary issues)
10. technology adaptation & innovation
Developments & Trends

• Products & Markets
  ✓ despite current housing market → significant market for residential construction
  ✓ China was the largest exporter of furniture, hardwood flooring and plywood → BUT it cannot supply its own needs
  ✓ markets for lower grades
  ✓ for Canadians → export of mountain pine beetle wood
  ✓ MC ≤ 19% will no longer be good enough // laminated products – 12 ↔ 14%
Developments & Trends

- Wood species and special products
  - subalpine fir (*Abies lasiocarpa*) // volume prod will increase // difficult to dry
  - special products (thickness > 4 inches (10.1 cm))
Developments & Trends

• Kilns types and process
In general...

Heat & Vent kilns (conventional drying)
- variable speed drives
- electronic wet-bulb sensors
- multi-zone controlled systems
- moisture content gradient sensors
- temperature drop across the load
- in-kiln moisture content sensors
## Development & Trends

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<th>Energy Source</th>
<th>Heat Transfer Fluid</th>
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<td>Vacuum Drying</td>
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### Key Manufacturers
- Catellini Industries
- Valera Drying Systems Inc.
- Södermanland Drying Systems AB
- The Dryer Company Ltd.
- Wood Drying Technologies
- Western Canada Drying Systems Inc.
- WoodMax Canada West
- US Dry Kilns
- Kiln drying systems & components
- American Wood Dyes

### Notes
- Information from consultation with manufacturers
- Manufacturer's promotional information (internal)
Future Focus

- Needs:
  - operator level
  - ✓ wood technology
  - ✓ trouble shooting
  - ✓ schedule development
  - university program
    - ✓ wood science & technology
    - ✓ business
  - engineering
    - ✓ design
    - ✓ process optimization
Future Focus

Drying Process

• development of more sophisticated drying schedules
• evaluation of air drying for certain products, species & season
• combination of drying techniques
• re-drying sorted lumber
Future Focus

Kiln Equipment

• control systems that use artificial intelligence (neural networks)
• use of progressive kilns
• SS/V & R/F drying for specialty products
• intensive use of in-kiln moisture meters
• high air velocity fans (v > 1,200 ft/min [> 6 m/s])
• utilization of heat recovery systems
Future Focus

Energy Systems

• replacement of traditional energy sources → co-generation systems
• direct-fired kilns (using biomass)
• use of biomass in thermal oil and steam kilns
Future Focus

Sorting Technologies

• sorting prior to drying:
  ✓ weight, MC, electrical properties, gamma radiation, dry-ability parameter
• post sorting
  ✓ re-drying
• species sorting
Future Focus

Process Control

• temperature across the load
• multi-zone systems
• exiting air temperature control

Heat Treatment

• Schedule development
**Future Focus**

**Drying Research**

- high temperature drying (Canadian western species)
- Monitoring drying stresses
- log drying
- wood-moisture relations
- quality control
- heat treatment
- energy modelling
- physical properties of wetwood (subalpine fir & hemlock)
Future Focus

Drying research cont’d

• high temperature drying (Canadian western species)
• 3-D simulation of drying and stress development
• sorting prior to drying
• radio-frequency
• high temperature heat pumps
• sorting and drying mountain pine beetle
• energy modelling
• pre-sorting and post-sorting strategies
Opportunities for process optimization

In British Columbia (Canada) a typical mill dries:

950 to 1,150 kiln charges per year

A lot of data!!!

Opportunity: key performance indicators for lumber drying
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Thank you