Windsor Continuous Drying Kilns
CDK – technology today

Review 2 of the 3 Windsor CDK designs

CDK – D
dual pass

CDK – S
single pass

Some information is omitted due to commercial sensitivity
CDK-D dual pass

- No roof vents
- No doors
- Indirect heated or direct fired
- Standard lumber stacks – double track
- Hydraulic stack advancer system
Main drying section

- Heating coils
- DryTrack Echo
- Full fan set

Saturated cooling and equalizing sections

- No heating medium
- “Hot” and “Cold” timber
- Reduced fan set
Production Capacity

Stack: 2.4m(w) x 3.6m(h) x 5m(L)
Chamber: 3 x 25m long double track = 75m
Stacks per kiln: 5 stacks x 3 x 2 tracks = 30 stacks
Holding capacity: 870m³ of 50mm boards

Temperature set-point = 110/77°C DB/WB

Schedule:
- Pre-Heat: 13 hours
- Drying: 13 hours
- Equalizing: 6 ½ hours
- Saturated cooling: 6 ½ hours

Total: 39 hours including the auto advance

Drying hours per year:
= 365 days x 24 hours x 95% utilization
= 8322 hours
Production Capacity

Auto advance rate = 960mm every 30 minutes per track

Kiln output rate = 2 x 5m stacks every 2.7 hours
= 58m$^3$ every 2.7 hours

Production = 8322hr ÷ 2.7hr x 58m$^3$
= 179,000m$^3$ per year

CDK - D dual pass thermal efficiencies

- Steam/hot air from the drying section pre-heats “cold” stack
- Transfer of energy from “hot” to “cold” stacks - preheating
- Release of water/steam from “cold” stacks and steam from centre section conditions/equalizes “hot” stacks
- Constant energy loads i.e. smaller heat plant – no peak
### Batch kiln – Thermal energy split

<table>
<thead>
<tr>
<th>Process</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat up kiln/foundation/carts/weights</td>
<td>7%</td>
</tr>
<tr>
<td>Heat lumber</td>
<td>6%</td>
</tr>
<tr>
<td>Heat water in lumber</td>
<td>10%</td>
</tr>
<tr>
<td>Evaporate water in lumber</td>
<td>69%</td>
</tr>
<tr>
<td>Roof vent losses</td>
<td>8%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

**Potential energy savings = 31%**

**Drying energy**

### Thermal efficiencies

#### Batch

**Thermal energy usage**

#### CDK – D dual pass

**Thermal energy usage**

You get:
- a thermal energy efficiency gain of 30% to 35%
- a “smaller” lower cost heatplant - no peak demand
- heat plant with a constant running load
Pollard Lumber CDK-D x 3 x 25

Pollard batch kiln was drying:
• 105,000 m$^3$/year
• with a 15 mm BTU/hr burner

Pollard CDK-D is now drying:
• 179,000 m$^3$/year
• with the 15 mm BTU/hr burner

This equates to:
• a 70% increase in production
• with no increase in heat plant capacity

Drying quality – CDK-D at Pollard's

<table>
<thead>
<tr>
<th></th>
<th>Boards 9% to 22% MC</th>
<th>Boards 13% to 18% MC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average MC = 15.5%</td>
<td>98%</td>
<td>66%</td>
</tr>
</tbody>
</table>

At Pollard the SD was >3.5% and is now = 2.1%
### Electrical energy usage

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Batch kiln schedule</strong></td>
<td>= 23 hours (105,000 m³/year)</td>
</tr>
<tr>
<td>Installed fan motor power</td>
<td>= 8 x 22 HP</td>
</tr>
<tr>
<td></td>
<td>= 176 HP = 132 kW</td>
</tr>
<tr>
<td>At say 9c/kWhr</td>
<td>= $0.94/m³</td>
</tr>
<tr>
<td><strong>CDK-D system schedule</strong></td>
<td>= 39 hours (179,000 m³/year)</td>
</tr>
<tr>
<td>Installed fan motor power</td>
<td>= 8 x 22 HP + 16 x 11 HP</td>
</tr>
<tr>
<td></td>
<td>= 352 HP = 264 kW</td>
</tr>
<tr>
<td>At say 9c/kWhr</td>
<td>= $1.07/m³</td>
</tr>
</tbody>
</table>

But this is offset by electrical savings on the smaller heat plant fans and pumps etc.

### CDK- S single pass

- No roof vents
- No doors
- Indirect heated or direct fired
- Standard lumber stacks – single track
- Hydraulic stack advancer system
Pre-heating section

- No heating medium
- Reduced fan set
Main drying section

- Heating coils
- DryTrack Echo
- Full fan set

Saturated cooling and equalizing section

- No heating medium
- Reduced fan set
- Cold water sprays
- Sometimes steam bath
**Production Capacity**

**Stack:** 2.4m(w) x 3.6m(h) x 5m(L)

**Chamber:** 3 x 25m long double track = 75m

**Stacks per kiln:** 5 stacks x 3 x 1 tracks = 15 stacks

**Holding capacity:** 435m$^3$ of 50mm boards

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**Temperature set-point = 140/100°C DB/WB**

**Schedule:**

- Pre - Heat: 11 hours
- Drying: 11 hours
- Cool/condition: 11 hours

**Total:** **33 hours** including the auto advance

**Drying hours per year:**

= 365 days x 24 hours x 95% utilization

= 8322 hours
Production Capacity

Auto advance rate = 1140mm every 30 minutes per track

Kiln output rate = 1 x 5m stack every 2.2 hours
= 29m³ every 2.2 hours

Production = 8322hr ÷ 2.2hr x 29m³
= 110,000m³ per year

CDK-S thermal efficiencies

- Steam/hot air from the drying section pre-heats “cold” stack
- Steam from the drying section conditions the “hot dry” stack
- Energy in the “hot dry” stack, carts and weights is captured by the fan/water sprays for conditioning and cooling
- Constant energy load i.e. smaller heat plant – no peak
**Batch kiln – Thermal energy split**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat up kiln/foundation/carts/weights</td>
<td>6%</td>
</tr>
<tr>
<td>Heat lumber to WB temperature</td>
<td>7%</td>
</tr>
<tr>
<td>Heat water in lumber to WB temperature</td>
<td>11%</td>
</tr>
<tr>
<td>Evaporate water in lumber</td>
<td>74%</td>
</tr>
<tr>
<td>Roof vent losses</td>
<td>2%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Potential energy savings = 26%

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**Thermal efficiencies**

**Batch**

![Graph: Thermal energy usage]

**CDK – S single pass**

![Graph: Thermal energy usage]

You get:
- a thermal energy efficiency gain of 25 to 30%
- a “smaller” lower cost heat plant
- Heat plant runs at a constant load – no peak demand
Control systems

We use Dryspec™ and DryTrack™ Echo for:

- Kiln temperature, humidity and alarms control
- Kiln stack advance rate
- Heatplant operation
- Management reporting
DryTrack Echo

Well proven:
• Installed and operating on 35 kilns
• Systems in operation for a number of years now
• On ultra high temperature kilns i.e. reliability paramount
CDK unique design aspects

- Better investment - lower $/m³ production
- Automated in terms of:
  - End-point - DryTrack Echo
  - Control - Dryspec
  - Loading
- High thermal energy efficiency gains – about 30%
- No kiln doors – door seal and maintenance advantages
- No access required into kiln – safety advantage
- Heat plant runs on constant load – no peak demand
- Similar yard footprint to a batch kiln
- Better yard utilization – same space, more production
- An easy retrofit to existing batch kilns

IP ownership

CDK – D:
- IP owned by Andy Pollard in the USA
- Windsor has a world wide licence

CDK – S:
- Patent owned by Windsor
Thermal modification kilns

Vacuum kilns

Heat treatment systems

- Kiln waste water treatment
- Water harvesting

Thank you for your attention.

Any questions?