COUNTER-FLOW CONTINUOUS DRY KILN

Bob Pope
December 2, 2015
USNR 204’ Counter-Flow Continuous Kiln
C-F-C Kiln Milestones

- First Lumber CFC Pollard Lumber 2005
- First Pole CFC T.R. Miller 2006
- First Steam CFC Georgia Pacific 2010
- ~85 CFCs have been sold to date in N. America
- USNR has sold 26 to date
- 7 Manufacturers have built a version of CFC
- Majority have been Green Fuel Burners
- Approximately 25% are Steam driven
## C-F Kiln User’s List

<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
<th>Year(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pollard Lumber</td>
<td>Appling, GA</td>
<td>2005</td>
</tr>
<tr>
<td>T.R. Miller</td>
<td>Brewton, AL</td>
<td>2006</td>
</tr>
<tr>
<td>Rex Lumber (2)</td>
<td>Graceville, FL</td>
<td>2007/8</td>
</tr>
<tr>
<td>Claude Howard</td>
<td>Statesboro, GA</td>
<td>2009</td>
</tr>
<tr>
<td>Morgan Lumber</td>
<td>Red Oak, VA</td>
<td>2010</td>
</tr>
<tr>
<td>Suwannee Lumber</td>
<td>Cross City, FL</td>
<td>2011</td>
</tr>
<tr>
<td>Canfor New South</td>
<td>Conway, SC</td>
<td>2012</td>
</tr>
<tr>
<td>Rex Lumber</td>
<td>Bristol, FL</td>
<td>2013</td>
</tr>
<tr>
<td>Canfor New South</td>
<td>Darlington, SC</td>
<td>2012/3</td>
</tr>
<tr>
<td>West Fraser (2)</td>
<td>Newberry, SC</td>
<td>2013/4</td>
</tr>
<tr>
<td>West Fraser (2)</td>
<td>Augusta, GA</td>
<td>2014/5</td>
</tr>
<tr>
<td>Georgia Pacific</td>
<td>Dudley, NC</td>
<td>2013/4</td>
</tr>
<tr>
<td>Deltic Timber</td>
<td>Waldo, AR</td>
<td>2013/4</td>
</tr>
<tr>
<td>Balfour Lumber</td>
<td>Thomasville, GA</td>
<td>2014</td>
</tr>
<tr>
<td>Canfor New South</td>
<td>Camden, SC</td>
<td>2014</td>
</tr>
<tr>
<td>JP Price Sawmill</td>
<td>Monticello, AR</td>
<td>2015</td>
</tr>
</tbody>
</table>
Double Track Continuous Drying Process
USNR  Counter-Flow Continuous Kiln
CFC Kiln - Features & Benefits

• Constant Temperature, therefore constant heat demand
• Ideal for Heat Challenged Boiler Systems
• Better Lumber Quality
  • Minimize defects caused by extended High Temperatures
    • Less Warp and Splits
    • Easier & Faster Planing
• Equalizes Load MC
  • Less Wets --- Maximize opportunity for No. 2 & better
  • Less Over-drying
  • Lower Standard Deviation of Moisture Content Range
Hydraulic Package Advance System
Hydraulic Power Unit

- Capable of pushing 1,500,000 lbs
- Rated for 3000 PSI
- Pressure Relief Valves
- Temp & Level Switches
- Visual Gage on Unit
- Located away from loading area
Encoder Wheel
One CFC Main Chamber

- Equipment & Enclosure resemble Batch Loaded Kiln
- Middle section --- just greater than 1/3 of Overall Length
  - Steam or Direct Fired Hot Air supply ducts: Fan Area & Downspouts
- Operating Temperature: 235+ degF Dry Bulb
  80-100 Btu/BF
- Wet Bulb Temperature: not ‘controlled’!
- High Airflow: 1100 - 1200 FPM
  30 – 40 HP motors
- Vents only used for start-up and maintenance!
- Series of Access Man-Doors
Two CFC Secondary Chambers

Pre-Heat & Pre-Dry “In-Coming” Green Packages

Capture Heat from Hot Lumber

PreHeat  \[\rightarrow\]  PreDry

Dry Bulb Temps:  170 degF +/-  190 degF +/-

Airflow thru stickers:  475 FPM (10 HP)  750 FPM (20 HP)
CFC Kiln - Section Plan

**EQUALIZE**  **POSTDRY**  **MAIN CHAMBER**  **PREDRY**  **PREHEAT**

- **170°**  **190°**  **215°**  **235°**  **215°**  **190°**  **170°**
Two CFC Secondary Chambers

Post-Dry & Equalize “Out-going” Dried Packages

Capture Moisture from Green Lumber

Post Dry → Equalize

Dry Bulb Temps: 190 degF +/- 170 degF +/-

Airflow thru stickers: 750 FPM (20 HP) 475 FPM (10 HP)

** Adds moisture (equalizes MC) to over dried lumber
** Continues to dry wetter lumber
Aluminum Secondary Chambers
Aluminum Baffle Floor and Rigid Baffle
Exhaust Venting
Trams and Bunks
Top Layer Weight Restraints
CFC Kiln Operation

• DB set point for Main Chamber; No Control for WB!
• Fan Reversal times are adjustable for each of 3 Chambers
• Travel Speed and Increment Time for Pusher
• Exit Air Temperature ‘Override’ for Pusher Operation
• Must keep tracks full / empty of lumber!! One 16’ tram will take 2 to 3 hours to move it’s length.
• Monitor MC of lumber coming out to adjust Travel Speed
• Can mix products in CFC Dry Kiln, Run tracks at different speeds
Control System

• Allen-Bradley PLC with desktop PC interface
• Monitors main chamber and secondary chambers:
  • 20 Dry Bulbs and 2 Wet Bulbs - Typical
  • Entering and Exiting DB temperatures measured
  • May switch between Entering and Exit air control

• Load advancement based on time - Feet per Hour
  • Modify distance per set time increment
  • Air Temperature ‘override’ capability
  • Independent Track Control

• Diagnostic Screen to help Operator with Troubleshooting
Continuous Kiln with Moisture Measurement

Tuesday, April 28, 2009

Operator installs two S.S. plates into package. Attaches wireless moisture sensor transmitter to top plate.

Packages travel along kiln length until reaching a moisture reading station.

Wireless range (~8ft radius) of reading station

Reading station

Direction of Travel

Operator removes S.S. plates and wireless moisture transmitter.

Sensors in range of the reading station transmit the moisture content using wireless technology.
Why build a CFC Kiln?

- Want better quality Lumber
- Can’t or won’t add additional heat source
- Hourly Production (MBF/Hr) Increase of 50% to 55%
- Fuel requirement (per MBF) Decrease of 18% to 28%
- Less warp, twist, cracks due to lower temperatures
- Less moisture content variation due to Equalizing zones
- Lumber is easier to plane
What can your 244’ CFC Kiln Produce?

Stack: 8’ wide x 66 layers ( @ 7/4) = 2,028 BF/ foot of length

CFC Length: 72’ + 72’ + 100’ main chamber length = 244’ long

Holding Capacity: 244’ x 2,028 BF / foot = 494,800 BF / CFC Kiln

Residence Time: = 41 hours : 12 Preheat + 17 Main + 12 Equalize

Rate of Travel: 244’ total travel / 41 hours = 5.95 feet per hour

Production: 2,028 BF/foot x 5.95 ft / hr = 12,067 BF per hour

= 289,600 MBF per day

= 99.9 MMBF per year

(345 days @ 95% uptime)
CFC Kiln Maintenance

- Minimum 13 week intervals – Quarterly
- Fan Bearings have S.S. grease lines to sidewalls
- Tram Wheels must be greased regularly
- Check Spring-Loaded Vertical Baffles frequently
- Pusher wheels and lugs must be greased periodically
- Visual check of Indexing Wheels
- Check fan bolt torques and belts at each shutdown
- Inspect structure and panel system quarterly
CFC Fire Prevention

• Known fires started for a variety of reasons
  – Burner ran out of fuel
  – Operator Error
  – Taking down the burner
  – Loss of Fuel Plug
  – Extended period between clean-out
  – Undeterminant means

• Deluge System is a must – Right nozzle, right location

• Continuous Personnel & Operator Training

• Evacuation System in place
  – Double Cable System with Lift Trucks
  – Relocate Pusher to other end
USNR Counter-Flow Continuous Kiln
Thank You

Bob Pope
(802) 229-5677
bob.pope@usnr.com