

# NYLE SYSTEMS

Kiln Drying & Demo

# HOW DO KILNS WORK?

## Presentation Agenda:

- What is Kiln Drying?
- What components are needed to dry lumber?
- What are the different types of kilns?

# HOW DO KILNS WORK?

## What is Kiln Drying?

In kiln drying, lumber is placed in a **chamber** where **airflow**, **temperature**, and **humidity** are controlled to provide as rapid drying as can be tolerated by the lumber without increasing defects.



# HOW DO KILNS WORK?

What components are needed to dry lumber?

- A kiln chamber for lumber to be dried.
- A way to load and unload the lumber inside the chamber.
- Heat source
- Fans for creating air flow over and through the lumber stacks
- Baffling systems
- Water removal
- Spray system
- Temperature and RH controls

# HOW DO KILNS WORK?

## Kiln Chambers

- The chamber can be built from wood, concrete block, steel, aluminum, or almost any combination of these materials.
- It is important that the chamber be tight and insulated
- It needs to be able to maintain a set of conditions regardless of the weather outside
- It must prevent damage to the lumber.

# HOW DO KILNS WORK?

## Fork Lift Style Kiln



Exhaust  
Vents

Overhead  
Fans

Heat Source

**nyle**  
systems

# HOW DO KILNS WORK?

Large Track Kiln Chamber



# HOW DO KILNS WORK?

POWER VENT  
(EXHAUST)  
INSTALLED ON  
FRONT LEFT

CUT 10 ¼" X 10 ¼"  
OPENING FOR VENTS.  
SEAL WITH SILICONE  
OR SPRAY FOAM

POWER VENT  
(INTAKE)  
INSTALLED ON  
REAR RIGHT





# HOW DO KILNS WORK?

## Heat Sources

- **Hot Water or Steam** using Gas, Oil or Wood Fired Boilers
- **Gas Furnace** (Direct or Indirect Fired)
- **Recycled Heat** generated as a bi-product of using a refrigeration system
- **Solar Heat**
- **Electric Resistance Heat**

# HOW DO KILNS WORK?

Boiler System with Dedicated Employee

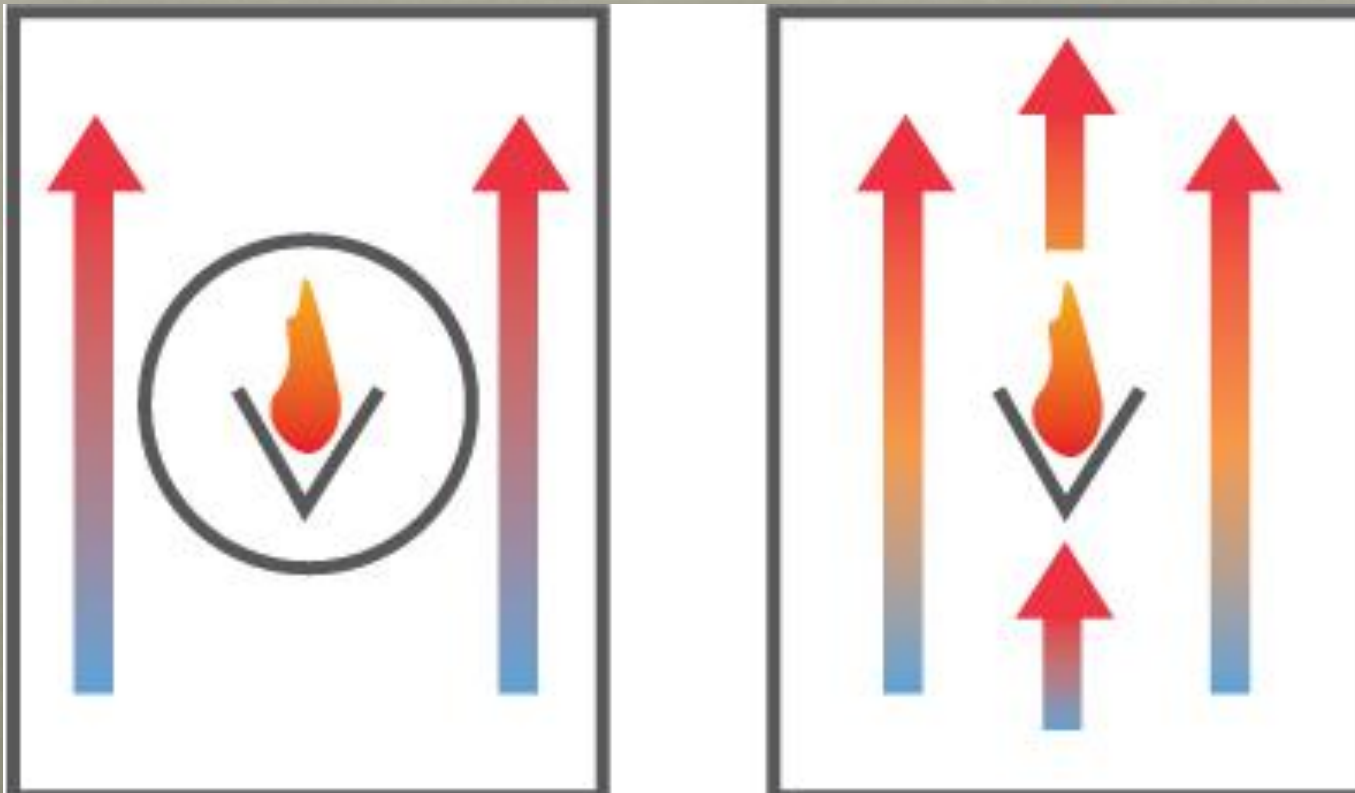


# HOW DO KILNS WORK?

Indirect Fired

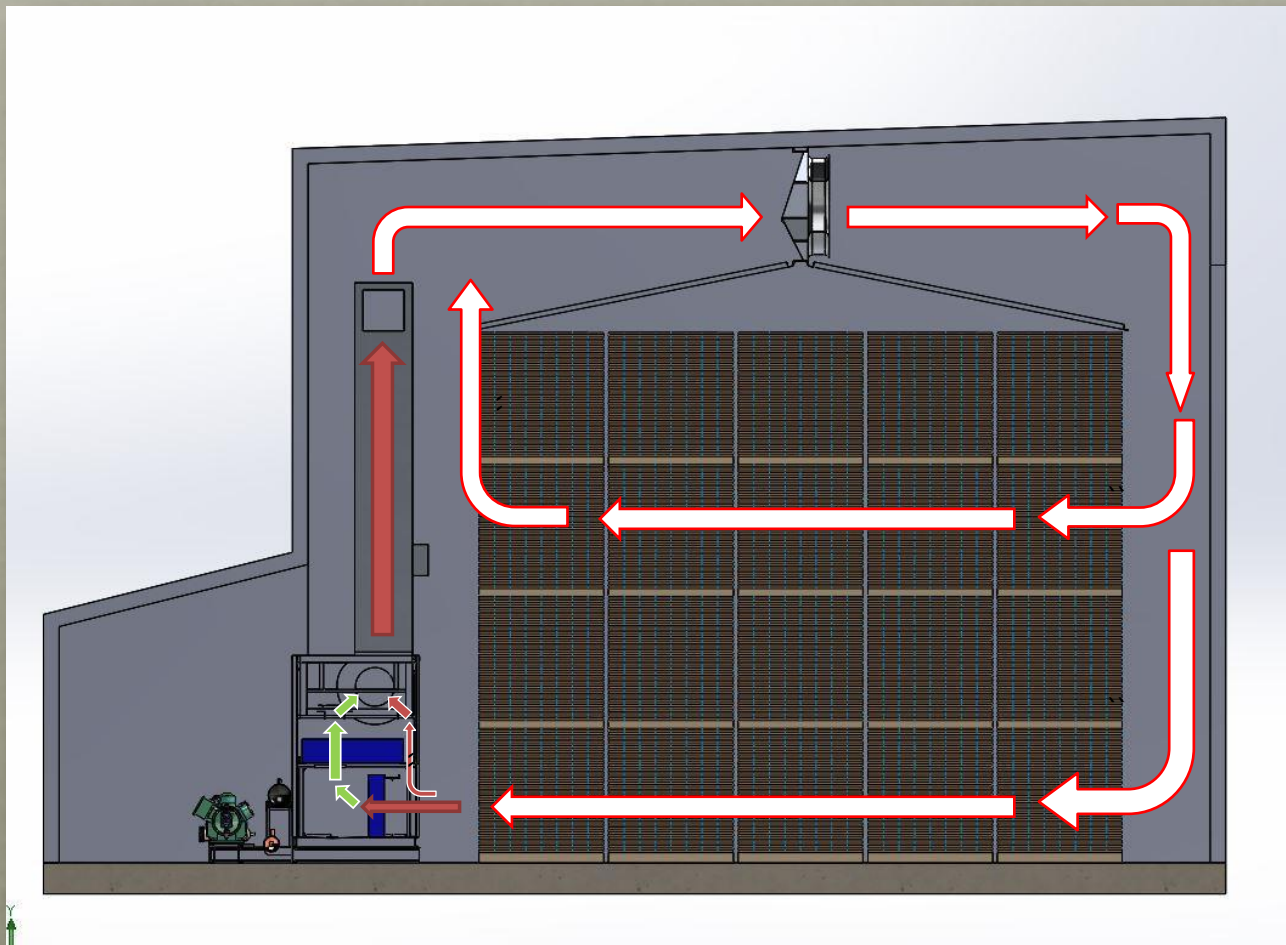
VS

Direct Fired Heat



# HOW DO KILNS WORK?

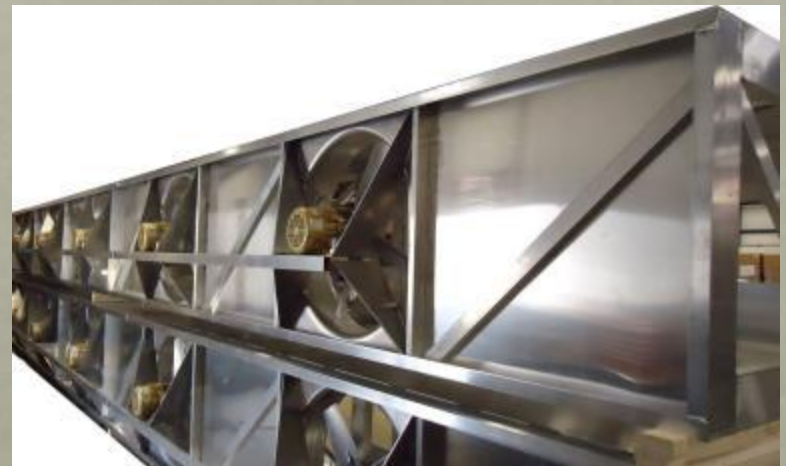
Recycled Heat Generated from using a Dehumidification System



# HOW DO KILNS WORK?

## Air Flow in the Kiln Chamber

- Air is the **medium** used to absorb and remove the water from the lumber
- Air velocity in the kiln must be adequate for the **species** and **thickness** of the lumber you are drying.
- Wetter lumber typically requires a **higher velocity** of air through lumber to ensure that water is removed off the surface of the lumber and avoid staining

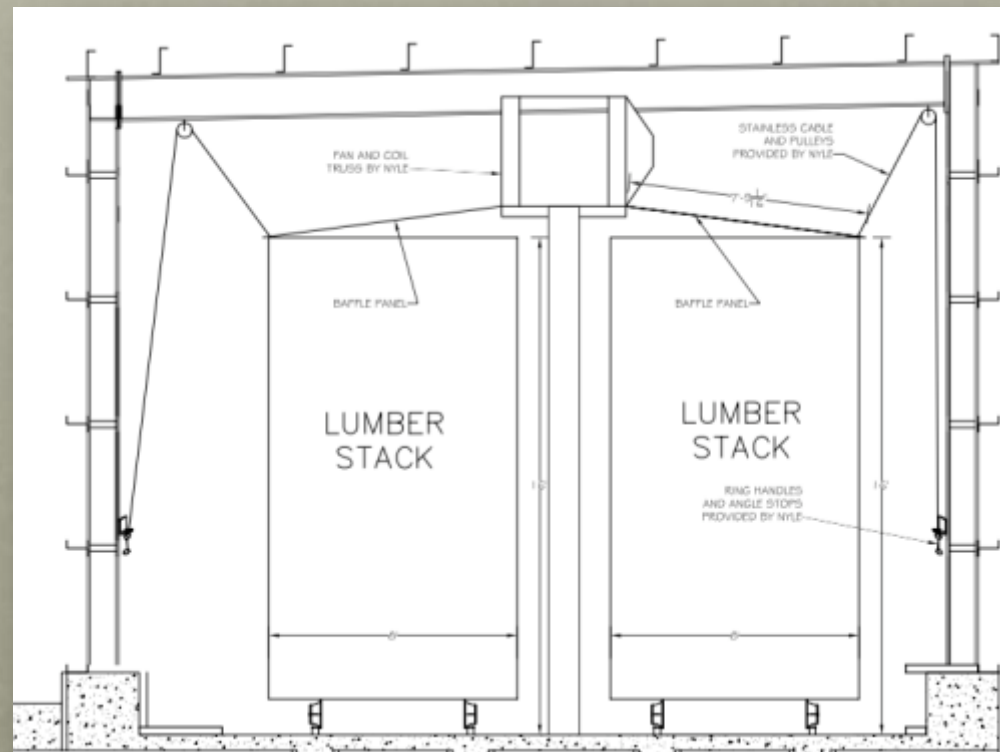


# HOW DO KILNS WORK?

## Air Baffling the Lumber Stack

- Top Baffles
- Side Baffles
- Baffling between bolsters

Baffling prevents air from traveling around the lumber instead of pushing through the stacks in a kiln.



# HOW DO KILNS WORK?

## Water Removal

- Conventional Kilns - Vents are used to release heated air out of the kiln after it has absorbed the water from the lumber stacks.
- Dehumidification Kilns - Condenses the water out of the air and leaves the heat in the chamber. Vents are used only when over heating occurs.
- Solar Kilns - Vents are used to release heated air out of the kiln after it has absorbed the water from the lumber stacks.
- Vacuum Kilns - Vents are used to release heated air out of the kiln after it has absorbed the water from the lumber stacks.

# HOW DO KILNS WORK?

## Spray System

- Conditioning is adding moisture back to the surface of the lumber to relieve any stress
- Stress can also occur because of how the lumber is sawn or where the tree grew.
- This stress remains after the lumber is dried, and if it is not relieved it can cause the wood to deform, especially when it is being worked.

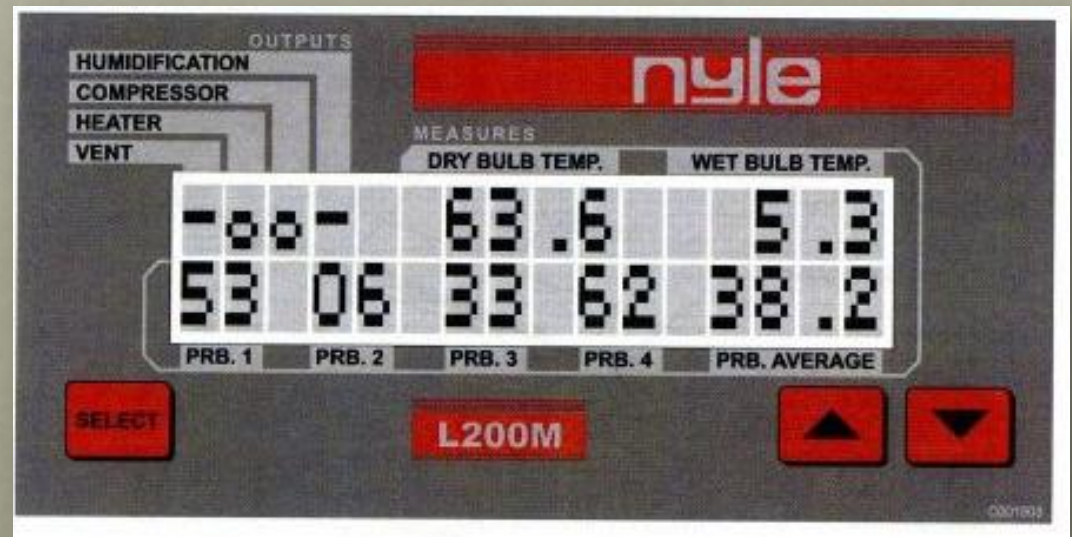




# HOW DO KILNS WORK?

## Temperature and RH Controls

- Control Methods: (WB/DB, Depression, EMC, RH/DB, Percentage Timer, Rising Dry Bulb, Conventional Kiln Mode)
- Controller Types: (Recorder Controls, Digi Packs, Full Touch Screen w/PLC)
- Controller Brands
- Controller Capabilities



# HOW DO KILNS WORK?

		Wet Bulb Depression [Dry Bulb - Wet Bulb] °F															
Dry Bulb °F		2°	4°	6°	8°	10°	12°	14°	16°	18°	20°	25°	30°	35°	40°	45°	50°
30°	RH	78	57	36	17												
	EMC	15.9	10.8	7.4	3.9												
	DRI	0.0	0.1	0.1	0.1												
35°	RH	81	63	45	28	11											
	EMC	16.8	11.9	8.8	6.0	2.9											
	DRI	0.0	0.1	0.1	0.1	0.2											
40°	RH	83	68	52	37	22	8										
	EMC	17.6	12.9	9.9	7.4	5.0	1.9										
	DRI	0.0	0.1	0.1	0.2	0.2	0.2										
45°	RH	85	72	58	44	31	19	6									
	EMC	18.3	13.7	10.7	8.5	6.5	4.2	1.5									
	DRI	0.0	0.1	0.1	0.2	0.2	0.2	0.3									
50°	RH	86	74	62	50	38	27	16	5								
	EMC	19.0	14.4	11.5	9.4	7.6	5.7	3.9	1.5								
	DRI	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.3								
55°	RH	88	76	65	54	44	34	24	14	5							
	EMC	19.5	15.1	12.2	10.1	8.4	6.8	5.3	3.6	1.3							
	DRI	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.4							
60°	RH	89	78	68	58	48	39	30	21	13	5						
	EMC	19.9	15.6	12.7	10.7	9.1	7.6	6.3	4.9	3.2	1.3						
	DRI	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.5	0.5						
65°	RH	90	80	70	61	52	44	36	27	20	13						
	EMC	20.3	16.1	13.3	11.2	9.7	8.3	7.1	5.8	4.5	3.0						
	DRI	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.5	0.5						
70°	RH	90	81	72	64	55	48	40	33	25	19	3					
	EMC	20.6	16.5	13.2	11.6	10.1	8.8	7.7	6.6	5.5	4.3	0.7					
	DRI	0.1	0.1	0.2	0.3	0.3	0.4	0.4	0.5	0.6	0.6	0.7					
75°	RH	91	82	74	66	58	51	44	37	31	24	10					
	EMC	20.6	16.8	14.0	12.0	10.5	9.3	8.2	7.2	6.2	5.1	2.3					
	DRI	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.6	0.6	0.7	0.8					
80°	RH	91	83	75	68	61	54	47	41	35	29	15	3				
	EMC	21.0	17.0	14.3	12.3	10.9	9.7	8.6	7.7	6.8	5.8	3.5	0.3				
	DRI	0.1	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.7	0.7	0.9	1.0				
85°	RH	92	84	76	70	63	56	50	44	38	33	20	9				
	EMC	21.2	17.2	14.5	12.5	11.2	10.0	9.0	8.1	7.2	6.3	4.3	1.7				
	DRI	0.1	0.2	0.3	0.4	0.4	0.5	0.6	0.7	0.8	0.8	1.0	1.1				
90°	RH	92	85	78	71	65	58	52	47	41	36	24	13	3			
	EMC	21.3	17.3	14.7	12.8	11.4	10.2	9.3	8.4	7.6	6.8	4.9	2.8	0.9			
	DRI	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.8	0.9	1.1	1.2	1.4			
95°	RH	92	85	79	72	66	60	55	49	44	39	28	17	8			
	EMC	21.3	17.4	14.9	12.9	11.6	10.5	9.5	8.7	7.9	7.1	5.3	3.6	1.9			
	DRI	0.1	0.2	0.3	0.5	0.6	0.7	0.7	0.8	0.9	1.0	1.2	1.4	1.5			
100°	RH	93	86	80	73	68	62	56	51	46	41	30	21	12	4		
	EMC	21.3	17.5	15.0	13.1	11.8	10.6	9.6	8.9	8.1	7.4	5.7	4.2	2.8	0.7		
	DRI	0.1	0.3	0.4	0.5	0.6	0.7	0.9	0.9	1.0	1.1	1.4	1.5	1.7	1.9		
105°	RH	93	87	80	74	69	63	58	53	48	44	34	24	16	8		
	EMC	21.4	17.5	15.1	13.2	11.9	10.8	9.8	9.0	8.3	7.6	6.1	4.6	3.3	1.8		
	DRI	0.2	0.3	0.4	0.6	0.7	0.8	0.9	1.1	1.2	1.3	1.5	1.7	1.9	2.1		
110°	RH	93	87	81	75	70	65	60	55	50	46	36	26	19	11	4	
	EMC	21.4	17.5	15.1	13.3	12.0	10.8	9.9	9.2	8.4	7.7	6.3	4.8	3.8	2.5	1.1	
	DRI	0.2	0.3	0.5	0.6	0.8	0.9	1.0	1.2	1.3	1.4	1.7	1.9	2.1	2.3	2.5	

# HOW DO KILNS WORK?

## What is a Conventional Kiln ?

- A conventional kiln uses heat provided by either **steam** or **hot water coils** or a **furnace** to heat the kiln chamber and remove water from the wood.
- The water removed from the wood is turned into water vapor by evaporation, and then exhausted from the kiln with the heated air.
- To remove one pound of water from the lumber, a conventional kiln has to draw in about 400 cubic feet (or 12 cubic meters) of air, heat the air, and then exhaust it with the evaporated water.
- Energy consumption is high.

# HOW DO KILNS WORK?

## Conventional Kiln with Gas Furnace

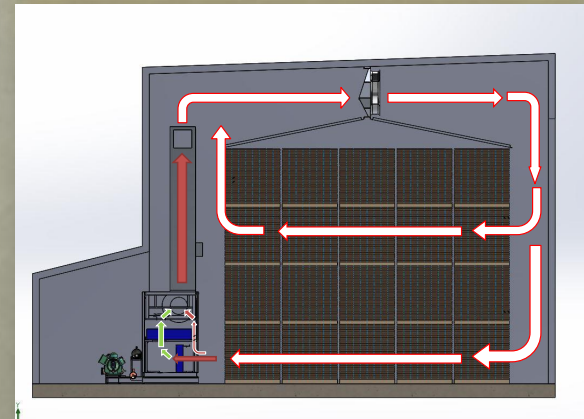


# HOW DO KILNS WORK?

## What is a Dehumidification Kiln?

- A dehumidification kiln uses a heat pump system to remove the water from lumber.
- Heat is recycled continuously instead of venting away heated air
- The air passes over the cooling coil, the evaporated water in the air condenses into a liquid and flows out the drain.
- Air going out is hotter than the air coming in.

Insert  
GREEN



# HOW DO KILNS WORK?

## What is a Solar Kiln?

- Solar kilns rely on one of the many types of solar collectors to provide the heat energy that evaporates the water in the lumber.
- Drying times in a solar kiln are dependent upon the weather and location.
- Solar kilns often use electric powered fans to circulate air through the lumber.



# HOW DO KILNS WORK?

## What is a Vacuum Kiln ?

- Changes the atmospheric pressure to make water boil at a lower temperature
- Chambers are typically smaller so only smaller quantities can be dried
- Electric blankets, heat coils or microwaves are used to continuously heat the chamber



# PRODUCT LINE

## Products Currently from Wood-Mizer



### KD 150

300 – 1500BF

4/4 Green Oak (65%-8%)  
35 Days

4/4 Green Pine (65%-10%)  
12 Days

450kWh for 1MBF  
Hardwood

350kWh for 1MBF  
Softwood

110VAC, 20A



# PRODUCT LINE

## Products Currently from Wood-Mizer



### KD 250

1500 – 4000BF

4/4 Green Oak (65%-8%)  
35 Days

4/4 Green Pine (80%-10%)  
12 days

450kWh for 1MBF  
Hardwood

350kWh for 1MBF  
Softwood

220VAC 1 Phase, 40A

# PRODUCT LINE

## Products Currently from Wood-Mizer



### KD 450

4000 – 15000BF

4/4 Green Oak (65%-8%)  
28 Days

4/4 Green Pine (80%-10%)  
8 days

450kWh for 1MBF  
Hardwood

350kWh for 1MBF  
Softwood

220/460/575, 1 & 3 Phase

# PRODUCT LINE

## Products Currently from Wood-Mizer



### KD 550

10000 – 35000BF

4/4 Green Oak (65%-8%)  
28 Days

4/4 Green Pine (80%-10%)  
8 days

450kWh for 1MBF  
Hardwood

350kWh for 1MBF  
Softwood

220/460/575, 1 & 3 Phase

# HOW DO KILNS WORK?

- Questions?

