SOUTHERN PINE TDAL: A COMPUTER PROGRAM TO SIMULATE LUMBER DRYING IN A KILN

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What the program does.

The program allows the user to simulate the drying of southern pine lumber in a dry kiln. Various key factors of the drying process can be manipulated and the effects of these manipulations on lumber drying can be observed. The following six factors can be altered in the simulation in order to observe their impacts on the dry bulb temperatures and moisture content of the drying lumber.

1. Air velocity
2. Sticker thickness
3. Pile width
4. Initial MC
5. Lumber thickness
6. Lumber specific gravity

Input data.

Table 1 is an example of the input for those factors relating to the kiln and the lumber. Table 2 is an example of the steps for entering the kiln schedule that will be used in the simulation.

Example of the Output.

An example of the type of output from the program is shown in Table 3. The extreme left-hand column is the number of hours the lumber has been drying while the extreme right hand column is the step number in the dry kiln schedule. The remaining five columns refer to locations with respect to the width of the lumber pile: the front edge, 1/4 the total distance from the front edge, one half the distance from the front edge, 3/4 the distance from the front edge, and the back edge. For a 6 foot wide pile, the distances would be as follows: the front edge, 1.5 feet from the front edge, 3 feet from the front edge, 4.5 feet from the front edge, and the back edge. For three 8-foot wide stacks (24 feet total width), the distances would be as follows: front edge of the first stack, 6 feet from the front edge of first stack, 12 feet from the front edge of first stack (or the middle of the second stack), 18 feet from front edge of the first stack (or 2 feet from front edge of the third stack), and the back edge of the third stack.

The output data associated with each of these five locations are as follows: (1) line 1 is the moisture content of the lumber at that location and (2) line 2 is the dry bulb temperature. For example, in Table 3 for the second hour of drying in step one of the schedule the moisture content of the lumber at the front edge of the lumber pile is 77.3 percent with a dry bulb temperature of 240 degrees F. At the back edge of the pile the moisture content is 80.9 percent with a dry bulb temperature of 219 degrees F. Air is entering the lumber pile through the front edge in these data. When fans reverse, it will enter from the back edge.

The program will display a screen of data and ask the operator whether to continue the simulation or terminate the program. If the operator continues, the next set of data is displayed.

Some Sample Runs.

Table 4 is part (hours 9 and 10) of two sample runs to compare the effects of two different air velocities on the drying of southern pine lumber. All other variables in the simulations were held constant. Note that by the ninth hour, the lumber drying under a 700 fpm air velocity had a moisture content at the front edge of the pile of 44.4 percent. However, the lumber subjected to a 1200 fpm air velocity had a moisture content of 38.9 percent by the ninth hour of drying.

Tables 5 and 6 are similar examples showing sample output for comparing two sticker thicknesses and two pile widths, respectively.

Availability of the Program.

The program is written in BASIC and is uncompiled. In order to run the program, you will need a version of BASIC or BASICA. The program is available without charge from Virginia Tech. To obtain a copy, send a blank disk to the author at the Department of Wood Science and Forest Products, Brooks Center, Virginia Tech, Blacksburg, VA 24061.

Table 1. Example of kiln and lumber input data.

1.	Actual Lumber Thickness (IN)... 1.75
2.	Sticker Thickness (IN)... .875
3.	Width Of Lumber Pile (FT)... 6
4.	Air Velocity Through Pile (FT/MIN)... 900
5.	Initial Lumber MC(%)... 90
6.	Velocity Reversal Interval (HOURS) (Must Be Integer).. 2
7.	Typical Specific Gravity... 0.48

Table 2. Example of the input data for a kiln schedule.

1.	How Many Schedule Steps Are There : 1
2.	For Step 1, Enter Dry Bulb Temp.. 240
3.	Wet Bulb Temp.. 180
4.	And EMC.. 2.
5.	These Conditions Are For MC's Above ... %MC 16

Table 3. Example of the output from the program.

MC'S AND DRY BULBS						
HR	LOCATION					
	EDGE	1/4	1/2	3/4	EDGE	STEP
1.0	83.6	84.1	84.5	85.0	85.4	1
	240.0	234.1	228.7	223.6	219.0	
2.0	77.3	78.2	79.1	80.0	80.9	1
	240.0	234.2	228.8	223.8	219.2	

Table 4. Sample output comparing two air velocities.

MC'S AND DRY BULBS						
HR	LOCATION					
	EDGE	1/4	1/2	3/4	EDGE	STEP
			Air Velocity = 700 fpm			
9.0	44.4	45.4	45.8	46.2	46.4	1
	240.0	234.8	230.0	225.5	221.3	
10.0	39.8	41.0	41.7	42.3	42.8	1
	240.0	235.2	230.7	226.5	222.5	
			Air Velocity = 1200 fpm			
9.0	38.9	39.7	39.9	40.1	40.2	1
	240.0	237.2	234.5	231.9	229.4	
10.0	34.7	35.6	35.9	36.3	36.5	1
	240.0	237.5	235.1	232.7	230.4	

Table 5. Sample output comparing two sticker thicknesses.

MC'S AND DRY BULBS						
HR	LOCATION					
	EDGE	1/4	1/2	3/4	EDGE	STEP
			Sticker Thickness = 3/4 inch			
13.0	29.2	30.3	30.6	30.8	30.8	1
	240.0	236.4	232.9	229.5	226.4	
14.0	26.1	27.2	27.7	28.0	28.2	1
	240.0	236.8	233.6	230.6	227.6	
			Sticker Thickness = 1 inch			
13.0	27.9	28.7	28.9	29.1	29.1	1
	240.0	237.4	234.9	232.4	230.1	
14.0	25.0	25.8	26.1	26.4	26.5	1
	240.0	237.7	235.4	233.2	231.0	

Table 6. Sample output comparing two pile widths.

MC'S AND DRY BULBS						
HR	LOCATION					
	EDGE	1/4	1/2	3/4	EDGE	STEP
			Pile Width = 6 feet			
5.0	62.0	62.7	63.2	63.6	64.0	1
	240.0	234.5	229.3	224.5	220.2	
6.0	56.2	57.3	58.1	58.9	59.6	1
	240.0	234.7	229.7	225.1	220.8	
			Pile Width = 16 feet			
5.0	66.4	68.6	70.1	70.6	70.5	1
	240.0	225.8	214.4	205.5	198.7	
6.0	60.4	63.6	66.2	67.6	68.2	1
	240.0	226.2	214.9	206.0	199.1	