EXPERIMENTAL KILN SCHEDULES FOR 4/4 PHILIPPINE MAHOGANY

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Introduction

Kiln drying schedules for Philippine Mahogany have been published by several sources; among these are the Forest Products Laboratory in Madison, Wisconsin, and the Forest Products Institute of the Philippines. (1) (2) These schedules are, for the most part, mild and require lengthy drying periods (four to seven days of drying from twenty to six percent moisture content; twelve to fifteen days of drying from green to six percent). (1)

The objective of recent kiln drying studies in the Wood Utilization Laboratory at the University of Idaho was to decrease the drying time of 4/4 Philippine Mahogany with a minimum of seasoning degrade (e.g., collapse, honeycombing, twist, bow, crook, cup). The study consisted of five kiln charges of lauan (charges 1-5) and one charge of apitong (charge 6). Each kiln charge was different in that the temperature settings were variable as was the frequency of changing the settings. A two-hour period of presteaming and poststeaming was used on each schedule.

Kiln Schedules and Results

Due to a limited supply of test material (lauan and apitong), these studies were planned to initiate the program with an established commercial drying schedule and gradually increase the drying severity until collapse and honeycomb occurred. A summary of each schedule is presented in Table 1.

The established commercial schedule which we used as schedule 1 was outlined by the 1968 Kiln Conference at the College of Laguna in the Philippines. (2) The initial drying temperature settings were 150° F. dry bulb and 142° F. wet bulb, preceded by a two-hour steaming period and two hours of poststeaming for conditioning purposes. This schedule produced degrade-free lumber of 5 to 6 percent moisture content (MC) in six days. (Initial moisture content range was 20 to 60 percent.)

After the presteaming period of schedule 2, the dry bulb and wet bulb temperatures were set at 160° F. and 152° F., respectively (12.7 percent EMC). These temperature settings were maintained for 24 hours to establish moisture and temperature gradient throughout the lumber. The temperature settings henceforth were adjusted to an

EMC of about 8 percent, which was the desired final moisture content. Higher than normal dry bulb temperatures were used to provide the driving force required for drying. Since heat was being used as the driving force, higher than normal wet bulb temperatures could be used. These wet bulb temperatures tended to follow the dry bulb in a progressively rising stepwise fashion. The schedule produced degrade-free lauan lumber in five days. This type of schedule is commonly used for the drying of redwood. (3)

Schedules 3 through 5 followed a similar concept of higher initial dry bulb settings and progressively rising wet bulb temperatures. The figures at the end of this report give the exact schedules used. Although the lauan lumber had been partially air dried by the time it went into the kiln, it was found that rather severe drying schedules could be used. Schedule 4 ended at 200° F. dry bulb and 188° F. wet bulb. Some warp, bow, and crook did occur, but these were generally associated with sawing practice used on the board.

By this time there was enough lauan for one more charge, so we "went-for-broke" and used a very severe schedule which started at 180°/168° and ended at 220°/207°. The degrade that resulted indicated that the drying limits of the lumber had been exceeded. Collapse and honeycomb did occur via schedule 5, and a considerable amount of twist and cup also developed.

The apitong had an initial moisture content range of 40 percent to greater than 65 percent. The schedule used in drying the apitong resembled schedule 2 for the lauan. Presteaming of the lumber was done at a 140° F. dry bulb temperature for four hours as a means of reducing the moisture content of the wettest boards. From the recorded weight values of 2 ft. long kiln sample boards, this did not appear effective. The initial drying of apitong was started with a 150° F. dry bulb temperature and a 5° wet bulb depression, compared to the initial 120° F. and 6° wet bulb depression recommended by the Forest Products Institute of the Philippines. (1) The dry bulb temperature was progressively increased throughout the run to a maximum of 205° F. with a 14° wet bulb depression. The desired final moisture content of 9 percent was used for the EMC value in selecting wet bulb depressions, but was not used for the first third of the run to prevent checking.

The apitong was dried down to 7-9 percent moisture content in 160.5 hours. There was no external evidence of honeycombing or collapse; however, honeycombing showed up in one board when it was planed and resawn. Some boards displayed one or more dimensional changes in crook and twist. For the most part, the lumber was in good shape.

Conclusion

Partially air dried 4/4 mahogany (lauan and apitong) showed little kiln degrade until subjected to elevated temperatures. The use of higher temperatures (therefore, more heat energy) and relatively low wet bulb depressions seemed to develop fewer stresses causing surface checks, honeycombing, and case hardening. By maintaining the desired moisture content as the EMC setting when increasing dry bulb temperature, little conditioning of the mahogany was required at the end of a schedule. The only conditioning used was steaming periods of two to four hours. These steamings reduced the moisture gradient within the majority of boards to less than 2 percent.

Some of the degrade due to dimensional changes was associated with the manner in which the boards were sawn. Boards having a transition from flat sawn to quarter sawn had more cup and twist than boards with uniform grain angle throughout. In most cases, such boards were subjected to dimensional changes at the grain discontinuity.

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REFERENCES

1. Edward F. Rasmussen; Dry Kiln Operator's Manual, Agriculture Handbook No. 188, March, 1961, U. S. Government Printing Office, Washington, D. C.

2. Kiln Drying Course, 1968; (University of the Philippines Forest Products Institute, College Laguna, Philippines, 1968).

3. Manson, Byrne C.; The Drying of California Redwood, Research Report No. 1, California Redwood Association; 1949.

Table 1. Experimental Kiln Schedules for Lauan and Apitong.

Kiln Schedule	Hour	Dry Bulb °F	Wet Bulb °F	E.M.C. %	PERCENT MOISTURE CONTENT (Calculated)		
					Heavy	Medium	Light
1	0	150	154	steam	69	50	21
	3	150	142	13.0	72	53	25
	18	150	135	9.5	52	36	14
LAUAN	30	150	132	8.6	44	28	10
	43	160	140	7.9	37	22	8
	56	180	150	5.7	27	14	6
	138	180	190	steam	6	5	6
	143	end			6	5	6
2	0	165	170	steam	54	39	29
	3	160	152	12.7	54	40	31
	28	160	144	9.0	29	16	17
LAUAN	42	170	151	8.0	22	9	12
	71	180	162	8.1	14	7	10
	89	190	172	7.9		6	8
	110	190	195	steam		4	7
	114	end				8	10
3	0	165	170	steam	17	16	14
	3	160	152	12.7	19	18	17
	13	160	148	10.6	12	13	12
LAUAN	23	170	154	9.0	11	12	11
	37	180	162	8.1	8	9	8
	49	190	172	7.9	6	7	6
	62	180	190	steam	5	6	6
	67	end			8	9	8
4	0	180	185	steam	34	28	16
	3	180	168	10.2	34	29	18
	14	190	175	8.9	20	16	12
LAUAN	22	200	183	8.4	14	10	9

Table 1. Continued

Kiln Schedule	Hour	Dry Bulb °F	Wet Bulb °F	E.M.C. %	PERCENT MOISTURE CONTENT (Calculated)		
					Heavy	Medium	Light
4	46	200	188	9.8	7	7	7
LAUAN	61	180	190	steam	7	7	6
	65	end			8	8	7
5	0	180	190	steam	38	32	28
	4	180	168	10.2	40	35	33
	19	190	175	8.9	21	22	15
LAUAN	30	200	186	9.1	13	17	10
	40	210	196	9.0	8	14	8
	46	220	207	8.9	7	12	8
	63	180	190	steam	7	8	7
	67	end			7	8	8
6	0	140	150	steam	53	49	47
	4	150	145	15.5	60	53	51
	22	150	141	12.4	45	40	40
APITONG	39.5	160	147	10.1	34	31	32
	48.5	170	158	10.4	30	28	28
	63	170	155	9.2	24	21	23
	70.5	180	165	9.0	21	19	20
	93	190	175	8.9	13	11	14
	112	195	175	7.3	10	9	11
	119	200	180	7.2	8	8	9
	135	205	191	9.1	7	7	7
	158.5	190	200	steam	6	6	6
	160.5	end					