ACCELERATED KILN DRYING OF SIX TIMBER SPECIES OF BANGLADESH

M. A. Sattar

One-inch planks of six indigenous timbers were investigated in a small kiln to develop optimum schedules for accelerated drying. Three schedules have been suggested. All of them were found to be significantly effective for drying timbers faster than the conventional kiln drying with acceptable degrades. It is recommended that timbers may be dried employing any one of these schedules depending upon the type of the timber, as well as, the drier.

INTRODUCTION

Kiln drying is a common practice in seasoning timbers all over the world. In Bangladesh, kiln drying of timber is employed by the timber complexes of the Bangladesh Forest Industries Development Corporation (BFIDC) and some government and private organisations. In order to facilitate the proper seasoning of timbers, kiln drying schedules have been developed at the Forest Research Institute, Chittagong (Ali, Sattar and Talukdar 1975; Sattar 1980). In conventional kiln drying, low temperature and high humidity are generally employed in the initial stages of drying, which ultimately make the process slow. The need for accelerated drying of timbers, without deteriorating the quality of the product itself, is thus felt. High temperature drying was first envisaged to alleviate the problem, but work could not be completed due to the limitations of the drier. Drying comparatively faster than in the conventional kiln was then investigated. The present paper reports the result of this investigation.

MATERIALS AND METHODS

Six species, Kadam (*Anthocephalus cadamba*), Simul (*Salmalia malabarica*), Banderhola (*Duabanga sonneratioides*), Uriam (*Mangifera sylvatica*), Civit (*Swintonia floribunda*) and Telsur (*Hopea odorata*) were used for the study. Three kiln charges were run for each species. About 0.42 cu m (15 cu ft) of green timber for each kiln charge were procured from the BFIDC timber depot at Kaptai in the form of logs. These were then converted into 3.2 cm x 20.3 cm x 1.4 m (1.25 in x 8 in x 60 in) dimension prior to charging the kiln.

A total of six representative boards, three from flat-sawn and three from quarter-sawn, were taken as kiln samples for each charge. Two strips measuring about 2.54 cm (1 in) were cut from at least 15.2 cm (6 in) apart from both ends of the samples for the initial moisture content determination by the oven-drying method. The final length of each sample after preparing moisture sections was thus 1.22 m (4 ft). The sample boards were end-coated with bituminous paint immediately after cutting the moisture sections. The initial weights of the samples were then taken in a balance to an accuracy of 1.0 g.

The investigation was conducted in a metal framed force-draft compartment type kiln, of about 0.8 cu m (30 cu ft) capacity.

Timber was dried employing three schedules (Table 1) in three separate kiln charges. Initially, six hours were allowed for warming the timber up in the charges of schedules

Table 1. Schedules for accelarated kiln drying of timbers

Schedules	Temperature				Relative humidity %	Equilibrium moisture content %
	Dry — bulb		Wet — bulb			
	°C	(°F)	°C	(°F)		
Schedule I						
Constant condition	75	(167)	70	(158)	80	12
Schedule II						
Warm-up (6 hours)	60	(140)	55	(132)	79	13
Drying	70	(158)	43	(109)	21	3
Conditioning (6 hours)	75	(167)	70	(158)	80	12
Schedule III						
Warm-up (6 hours)	71	(160)	65	(149)	75	11
Drying	77	(170)	49	(120)	24	3
Conditioning (6 hours)	82	(180)	78	(172)	83	12

Table 2. Comparative drying times of various species using different schedules

Species	Accelarated kiln schedule No	Accelarated kiln drying times from green to 12% m.c.		Conventional kiln drying times from green to 12% m.c. (hrs)	Reduction of accelarated drying time over conventional kiln drying time in hrs(%)	T-test of signifinicance between accelarated and conventional drying times
		Schedule wise (hrs)	Average (hrs)			
Kadam (*Anthocephalus cadamba*)	I	60				
	II	56	55	82	27 (33)	**
	III	50				
Simul (*Salmalia malabarica*)	I	70				
	II	60	62	90	28 (31)	*
	III	56				
Banderhola (*Duabanga sonneratioides*)	I	90				
	II	81	80	108	28 (26)	*
	III	69				
Uriam (*Mangifera sylvatica*)	I	99				
	II	90	90	132	42 (32)	**
	III	82				
Civit (*Swintonia floribunda*)	I	103				
	II	96	96	140	44 (31)	*
	III	88				
Telsur (*Hopea odorata*)	I	112				
	II	100	101	145	44 (31)	*
	III	91				

****Significant at 5% level; *Significant at 1% level**

Table 3. Summary of results of analysis of variance and Scheffe contrast test on accelerated kiln drying time

Species	Analysis of variance on drying times		Scheffe contrast test
	Species wise	Schedule wise	Drying time of schedule I = A, II = B, III = C
Kadam (*Anthocephalus cadamba*)		*	A–B = NS A–C = * B–C = *
Simul (*Salmalia malabarica*)		**	A–B = ** A–C = ** B–C = NS
Banderhola (*Duabanga sonneratioides*)	**	**	A–B = ** A–C = ** B–C = *
Uriam (*Mangifera sylvatica*)		*	A–B = ** A–C = ** B–C = *
Civit (*Swintonia floribunda*)		*	A–B = * A–C = ** B–C = *
Telsur)*Hopea odorata*)		*	A–B = * A–C = ** B–C = *

*Significant at 5% level ; **Significant at 1% level ; NS = Not significant

II and III. Drying was continued till the average moisture content of the wettest sample reached 12 percent. Finally, timber was conditioned for six hours. In charge 1 no such sequences of warming-up and conditioning were followed; one constant condition was employed throughout the entire period of drying. Based on these data and the calculated ovendry weights, the progress of drying was ascertained. At the end of drying, three moisture gradient specimens were prepared. Three stress specimens were also made from each sample board in order to test the intensity of case-hardening stress. Qualitative assessment of degrades was made visually at the conclusion of each kiln charge.

RESULTS

Total drying time of timber of different species from green to 12 percent moisture content condition were determined for each kiln charge. Drying times of each batch of timber were also determined by drying each duplicate batch of timber in a conventionl kiln. These are shown in Table 2. Analysis of variance and Scheffe contrast test were performed to note the effect of drying times on different species and schedules. The summary of the result is presented in Table 3. The result of the degree of the caschardening stress is summarised in Table 4.

DISCUSSIONS

It is observed that one-inch plank of Kadam dried most rapidly among the six species (Table 2). It took 55 hours to dry the timber from green condition to 12 percent moisture content. Telsur which was

Table 4. Results of degree of stress in sample of different kiln charges

Species	Degree of stress in samples of kiln charges		
	Charge I	Charge II	Charge III
Kadam (*Anthocephalus cadamba*)	1SF, 4MS, 1SS	6SF	6SF
Simul (*Salmalia malabarica*)	4MS, 2SS	4SF, 2MS	5SF, 1MS
Banderhola (*Duabanga sonneratioides*)	3SF, 3MS	6SF	6SF
Uriam (*Mangifera sylvatica*)	3SF, 3MS	4SF, 2MS	5SF, 1MS
Civit (*Swintonia floribunda*)	3SF, 2MS, 1SS	6SF	6SF
Telsur (*Hopea odorata*)	3SF, 3MS	4SF, 2MS	6SF

1 *to* 6, = *Number of samples ;* SF = *Stress free ;* MS = *Moderate stress,* SS = *Severe stress*

found to be the slowest in drying took 101 hours to attain that moisture content. The average drying times for other four species varied from 62 to 96 hours. It is thus apparent that there were quite appreciable variation in drying times among the species. This difference was also found to be statistically significant (Table 3).

The accelerated kiln drying schedules effected drying faster than that of conventional kiln drying in all species (Table 2). Compared to conventional kiln drying, the average reduction of accelerated kiln drying times ranged from 26 to 33 percent. The reduction is found to be statistically significant (Table 3). This reduction of drying times has implication in commercial operations since it may cut down the operation cost of drying timbers to about one–fourth to one-third.

The accelerated drying schedule III among the three schedules appears to be the most effective. It took least time to dry timbers of all the species. The schedule II seems to be better than schedule I in respect of rapid drying. The drying times of schedule III were significantly less than those of schedules I and II in almost all cases (Table 3). The reason for fastest drying time in schedule III may be attributed to the higher temperature than that of schedule II and the lower relative humidity than that of schedule I. The schedule I, although provided with higher temperature than the schedule II, has the drawback of higher relative humidity which adversely affects the drying rate. Thus inspite of lower temperature the schedule II was more effective than schedule I for its lower humidity.

Timbers dried under schedule III were mostly free from drying defects. No severe case-hardening stress was observed in timbers of schedules II and III in all species. On the other hand, moderate to severe stresses were noticed in all the six species of charge I (Table 4). The reason for development of such stresses may be due to the fact that no conditioning treatment was applied in timbers of charge I whereas timbers of charges II and III were subjected to conditioning treatment to relieve of the stresses. It was thus revealed that a 6-hrs' conditioning period was adequate to relieve of the stresses by promoting uniform distribution of moisture throughout the cross section of one inch plank.

CONCLUSIONS

The accelerated kiln drying schedule III was observed to be the best in respect of faster drying with minimum drying defects in timber. This schedule is thus recommended for drying soft and moderately soft timber of one-inch thickness. For refractory timber where slow drying is warranted, the schedule II may be applied. Schedule I may be used in kilns in which drying conditions in respect of temperature and humidity cannot be altered.

REFERENCES

Ali, M. O.; Sattar, M.A. and Talukdar, Y.A. 1975. Kiln drying studies on 1.1/4" planks of Bangladeshi species. Presented at First Ann. Bang. Sci. Conf., Dacca.10 pp

Sattar, M.A.1980. Kiln drying schedules for indigenous timbers of Bangladesh. Bull. 4 (Wood Seasoning Series), For. Res. Ins., Chittagong. 11pp.

M.A. Sattar, Divisional Officer, Forest Research Institute, Chittagong, Bangladesh