PEELING PROPERTIES OF *MORUS ALBA* WOOD SPECIES

by

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SUMMARY

A preliminary study was carried out to determine properties of mulberry wood. Effects of knife angle, log conditioning period and veneer drying temperature and time on the quality of veneer were studied. It was observed that mulberry logs produce good quality veneer of 1.0 *mm,* 2.0 *mm and* 2.5 *mm thickness, when they were conditioned in hot water for* 12 *to* 18 *hours before peeling. Knife angle of* 92° *was found to be optimum for cutting good quality veneer from logs of* 1.0 *to* 1.5 *feet diameter. Drying of the veneer was observed to be somewhat patchy and therefore, difficult to control. However,* 1.0 *mm,* 2.0 *mm and* 2.5 *mm thick veneers were dried at* 90°*C for* 60 *minutes without development of defects. The results of this study would be useful to the plywood industry in the country, which uses mulberry wood in the manufacture of commercial plywood.*

Introduction

Peeling properties of a wood species are determined by the quality of veneer produced. Quality of veneer is affected by cutting speed, knife angle, shape and arrangement of the nosebar, deformation of the nosebar cutting edge and log deflection during peeling. It is also influenced by the behaviour of wood during peeling, setting of tools and the condition of the machine(5).

The properties of veneer which depend mainly on peeling techniques are smoothness, freedom from peeler checks, tightness, and uniformity of thickness. These properties are important in the manufacture of Plywood and can effect production economy as well as the quality of the finished product. Smooth veneers require less sanding than rough veneers giving reduced wastage and operating cost. They also need less adhesive and give better bond strength. Tight veneer has greater strength across the grain than loose veneer

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and therefore, has better handling properties and produces tougher plywood with greater shear strength(*6*).

The cutting of good veneer can only be assured by a precise control of all lathe settings coupled with proper log conditioning. A primary aim of research in veneer cutting is to obtain information on optimum lathe settings for cutting various species and thicknesses of veneer(2).

Plywood industry in Pakistan was started in 1958. The quality of plywood produced is not good and needs to be improved considerably. This study was undertaken with the following objectives:

(*i*) To determine the suitable heating period for softening the mulberry logs in order to facilitate their peeling into different thicknesses.

(*ii*) To determine the optimum lathe settings for peeling mulberry wood into various thicknesses.

(*iii*) To determine drying properties of mulberry veneer.

(*iv*) To determine the yield of veneer from logs.

II. Terminology

The terms used in this article have been explained by B.M. Mc Combe, and J.W. Gottstein (6), Feil A.O. and V Godin (3). These are reproduced below and shown in Fig. Nos. 1, 2 & 3.

1. *Knife Angle.*—The angle between the knife face at the knife edge and the planes of the knife carriage ways.

2. *Knife Carriage.*—The main supporting casting for the knife.

3. *Knife Wedge Angle OR Knife Bevel Angle.*—The angle formed by the principal surfaces of the knife.

4. *Knife Face.*—The side of the knife presented to the log.

5. *Knife Back.* —The side of the knife opposite to the face.

6. *Peeler Checks OR Lathe Checks.*—Closely spaced shallow splits or fractures on the surface of the veneer. Peeler checks are always produced during peeling on the loose side of the veneer.

7. *Horizontal Nosebar Gap.*—The horizontal distance between the nosebar edge and the knife edge.

8. *Vertical Nosebar Gap.*—The vertical distance separating the nosebar edge and knife edge.

9. *Nosebar Bevel Angle.*—The angle formed by the principal working surfaces of the knife.

10. *Nosebar Pressure (Percent)*:

$$\frac{\text{Nominal Veneer Thickness} - \text{Horizontal Nosebar Gap}}{\text{Nominal Veneer Thickness}} \times 100$$

11. *Loose Side of the Veneer.*—The surface of the veneer facing or touching the back of the knife.

12. *Tight Side of the Veneer.*—The surface of the veneer opposite to the loose side.

13. *Rough Veneer.*—A veneer having shallow oblong cavities on the tight side and low oblong eminences on the lose side, following roughly the direction of the grain.

14. *Furry or Wooly Veneer.*—A veneer the surface of which contains minute heavy structures appearing in the form of furr or wool.

III. Experimental

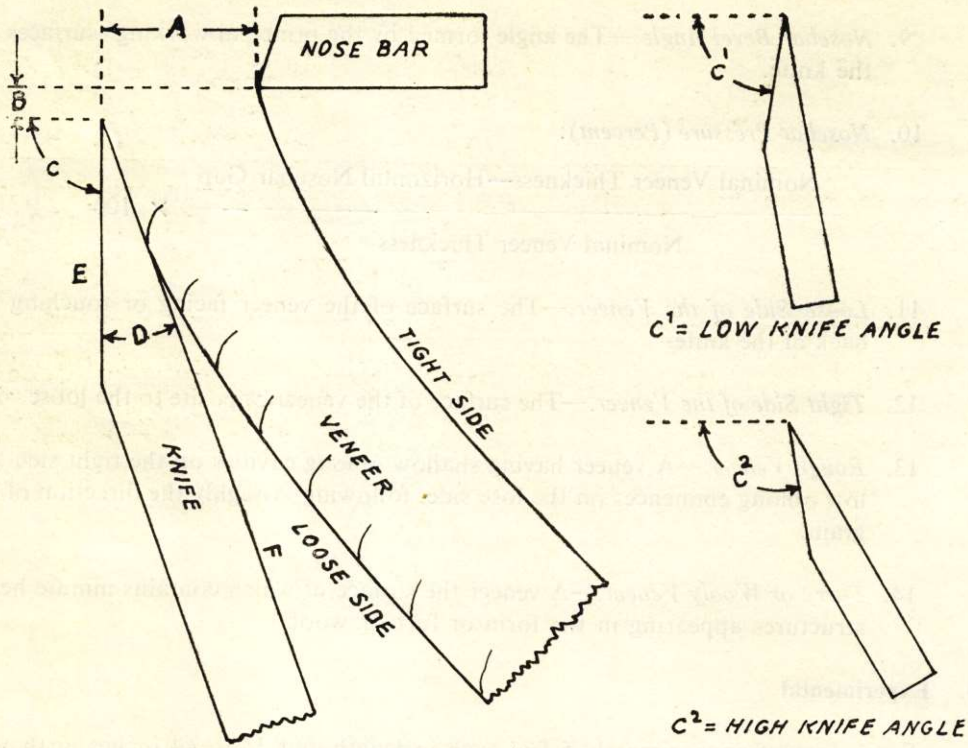
Seven logs of approximately 5 feet each in length and 35 to 44 inches girth with bark were obtained from Changa Manga irrigated plantation. The logs were slightly crook of apparently good appearance but contained few knots and considerably deep heart and radial shakes. These logs were marked as MV-1, MV-2, MV-3, MV-4, MV-5, MV-6 and MV-7. Each log was converted into two billets of approximately 28 inches each in length by cross cutting on a band saw machine. Description of individual billets is given in Table 1. Debarking was carried out with the help of hand debarkers. These billets were stored in an open water tank for six months before they were used. Following experiments were carried out on the different billets.

1. *Density Determination.*—One disc from each butt and top end of each log was cut for making 2″ × 1″ × 1″ test specimens used for density determinations. Density of the oven dry as well the green timber (fully soaked in water) was determined with the help of the following formula(1).

$$D = M/V$$

where
M = Mass of test specimen
V = Volume of test specimen
D = Density

Density of each log was determined separately. As the sap wood quantity in different logs was negligible, only the density of hard wood was determined and is shown in Table 2.



A : HORIZONTAL NOSE BAR GAP
B : VERTICAL NOSE BAR GAP
C : KNIFE ANGLE
D : KNIFE WEDGE ANGLE OR KNIFE BEVEL ANGLE
E : KNIFE FACE
F : KNIFE BACK
C^1 : LOW KNIFE ANGLE
C^2 : HIGH KNIFE ANGLE
G : LATHE CHECKS OR PEELER CHECKS

FIG. 1 : SKETCH; ILLUSTRATING DIFFERENT TERMS USED.

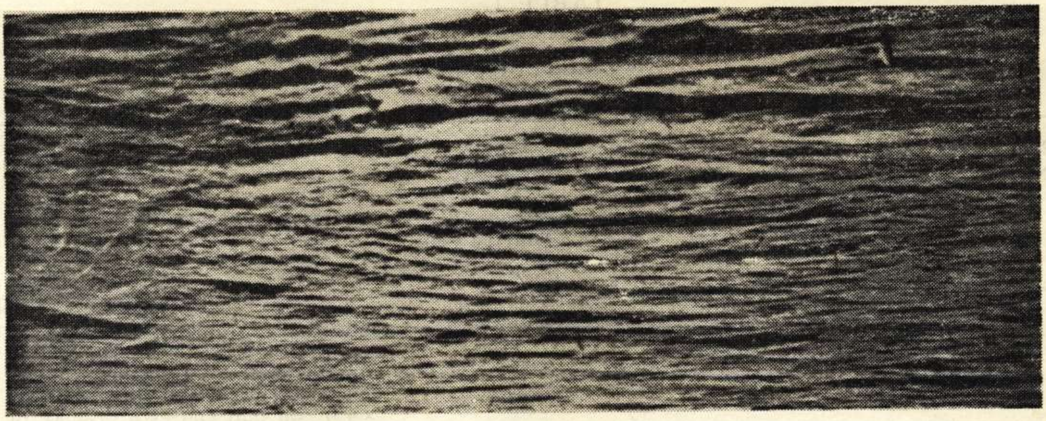


Fig. 2. Rough Veneer.

Fig. 3. Furry or woolly Veneer.

TABLE 1

Description of Billets

Billet No.	Length in inches	*Average girth under bark in inches	**Average diameter under bark in inches		Eccentricity in inches		Description of billet
			Top end	Butt end	Top end	Butt end	
I	26.5	38.5	11.4	12.4	0.75	2.75	Billet had two heart shakes 0.75" and 1.5" in length emerging out from the pith into opposite directions. One insect decay mark (2.8"×0.5" ×4") on butt end at a distance of 4" from the periphery in the tangential direction.
II	28.0	35.8	10.7	11.3	1.25	0.75	Billet had one radial shake 5" in length on butt end and two heart shakes 1.5" and 3" in length, emerging out in opposite directions on top end.
III	25.5	40.0	10.9	10.5	0	0.5	Butt end was irregular in shape and and had one insect decay mark 6"×0.5"×4" in the tangential direction. The top end had two heart shakes 2" and 2.5" in length emerging out in opposite directions.
IV	25.0	36.7	10.9	11.5	0.25	1.0	Top end had two heart shakes 2.5" each in length emerging out in opposite directions. The butt end had three heart shakes 1", 1.5" and 2.5" in length making a Y form.
V	26.0	37.7	11.0	11.9	0.25	0.5	The butt end had three heart shakes in the form of Y having 2.5", 4" and 2.5" long limbs. The top end had two heart shakes emerging out in opposite directions. The length of these heart shakes was 3.25" and 2.5".
VI	26.0	40.8	12.0	14.0	0.5	1.0	Butt end was semi-circular. Top end had four heart shakes in star shapes, having lengths of 1.5", 5.25", 1.0" and 3.0". The butt end had three heart shakes forming Y form having 3.5", 2.5" and 3.5" long limbs.

TABLE 1

Billet No.	Length in inches	*Average girth under bark in inches	**Average diameter under bark in inches		Eccentricity in inches		Description of billet
			Top end	Butt end	Top end	Butt end	
VII	27.0	38.6	11.3	12.4	0.75	0.5	Top end had three heart shakes forming form having 0.75", 1.75" and 3.25" long limbs. The butt end had one insect decay mark 8"×0.5"×8". in the tangential direction.
VIII	27.5	36.2	11.4	12.8	0.5	0.75	Top end had two heart shakes having 2.0" and 3.0" length. The butt end had one heart shake of 3" length.
IX	26.5	35.6	11.0	12:3	0.5	2.0	Top end had two heart shakes of 0.5" and 1.0" length emerging out from the pith in opposite directions. One insect decay mark 2.0"×0.5"× 4.5" on butt end in tangential direction.
X	27.0	35.9	11.2	12.8	0.75	0.5	Butt end had three heart shakes having 2.0", 4.6", and 3.0" length. The top end had one heart shake of 3.0" length.
XI	28.0	34.4	10.8	12.0	0.9	0.75	The butt end had two radial shakes of 5" and 4" length and one heart shake of 2" length on top end.
XII	27.5	36.5	11.5	13.2	0.75	1.0	Top end had three heart shakes having 2.0", 2.0" and 3.5" lengths. Butt end had one heart shake of 3.5" length.
XIII	26.0	35.0	11.5	13.2	0.9	0.5	Top end had two heart shakes of 2.5" and 3.0" lengths emerging out in opposite directions. The butt end had three heart shakes of 2", 2.5" and 3.0" lengths.
XIV	25.5	36.0	11.0	13.0	0.75	2.0	The butt end was quite irregular having one insect decay mark 5"× 0.75"×4.0" in the tangential direction. The top end had two heart shakes of 2.5" and 3.0" each in length.

*Girth figure is an average of thin, middle and thick end readings.
**Diameter figure is an average of three readings at different places.

TABLE 2

Density of Different Mulberry Logs Peeled into Different Thicknesses

Log Number	Density at 37% Moisture Content lbs./C.Ft.	Density of Oven Dry Wood lbs./C.Ft.
MV-1	48.6	34.7
MV-2	42.2	33.0
MV-3	47.0	38.7
MV-4	44.2	39.0
MV-5	44.5	33.0
MV-6	41.4	36.0
MV-7	47.8	38.7
Average	45.1	36.2
Standard Deviation	± 2.3	±1.6

Density of each log is an average of six readings.

The density of the green wood containing 37% moisture content varied from 41.4 to 48.6 lbs/C.Ft. while that of oven dry wood varied from 33.0 to 39.0 lbs/C.Ft.Average density of the green timber was 45.1 ± 2.3 lbs/C.Ft; while that of dry wood is 36.2±1.6 lbs/C.Ft.

2. *Veneer Cutting*.—There are a large number of peeling variables which affect the quality of veneer. In this study only the effect of knife angle and log heating time on the quality of 1.0 mm, 2.0 mm and 2.5 mm thick veneer was determined. Veneer quality was assessed by visual observations and feel. Peeling variables like horizontal nosebar gap, vertical nosebar gap and nosebar bevel angle and knife bevel angle were kept constant. Cutting trials were made on an IMA Italian lathe which could accommodate 51″×7″×9/8″ knife. Nosebar was of fixed type and could be moved as a whole in the forward and backward direction only. Vertical Nosebar Gap was adjusted with the help of feeler gauge. Horizontal Nosebar Gap adjustment was done with the help of special equipment manufactured in the Mechanical Engineering Workshop of Pakistan Forest Institute, Peshawar. Knife wedge angle measurements were made with bevel protector. Different adjustments of different lathe settings and the instruments used are shown in

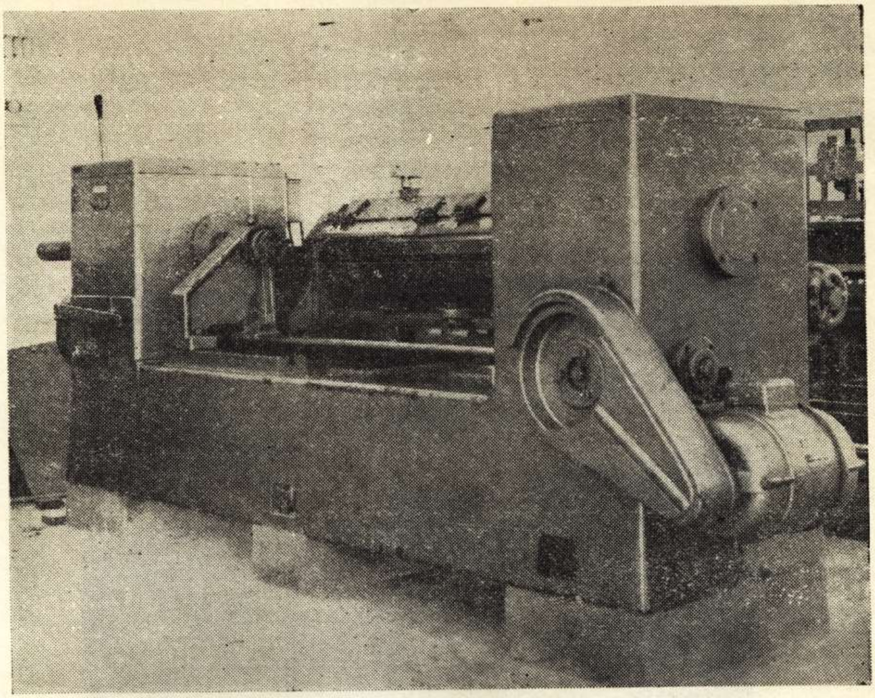


Fig. 4. Veneer Peeling Lathe.

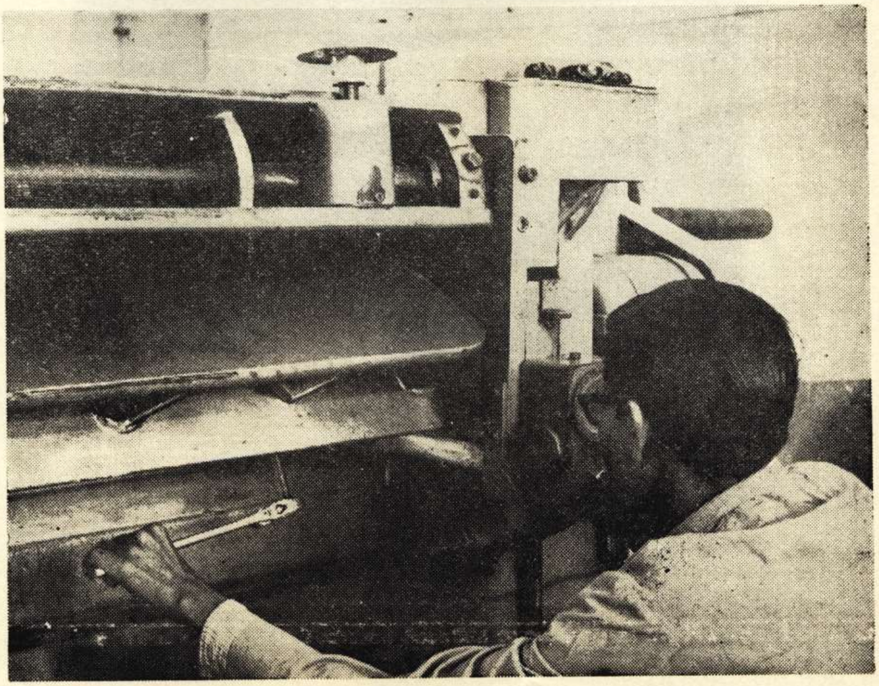


Fig. 5. Setting the height of knife by driving the screw at the bottom of the knife.

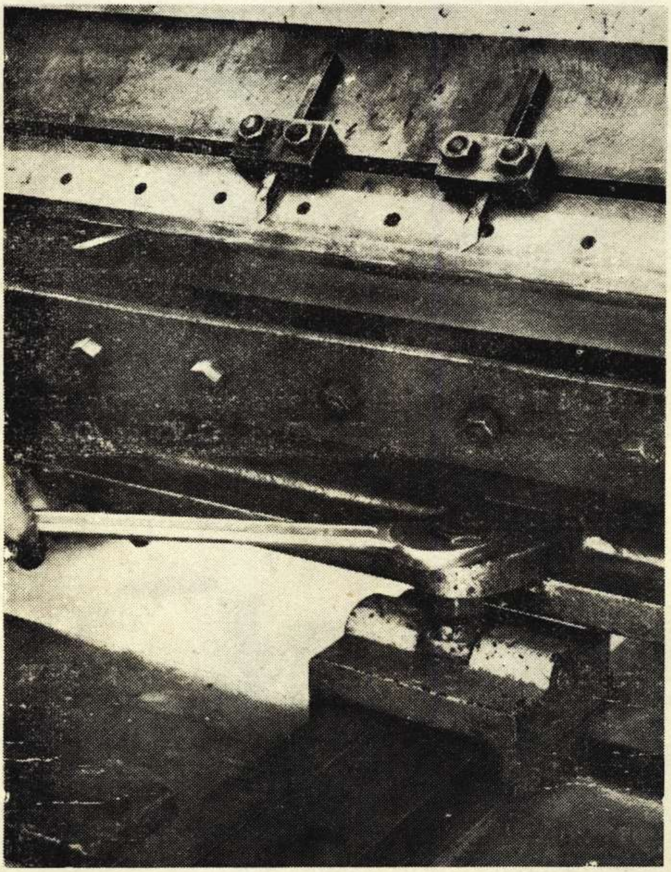


Fig. 6. Adjusting the vertical nosebar gap with the help of feeler gauge.

Fig. 7. Adjusting the knife angle with the help of bevel protector.

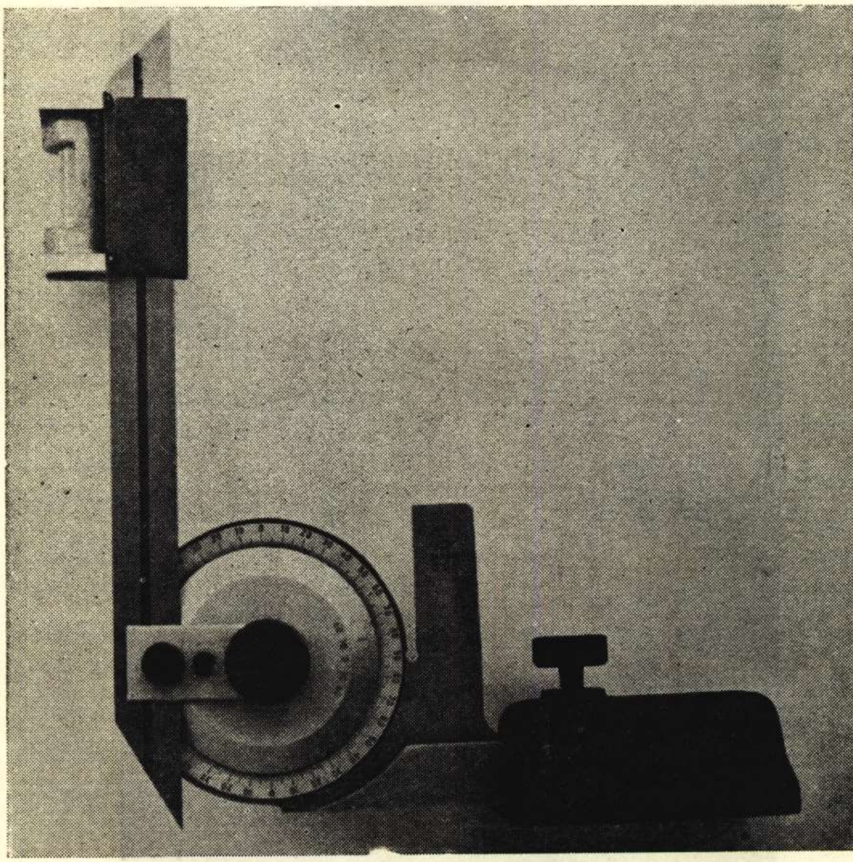


Fig. 8. Bevel protector fitted with laboratory designed spirit level.

Fig. 9. Setting the horizontal nosebar gap with laboratory designed Setting Gauge.

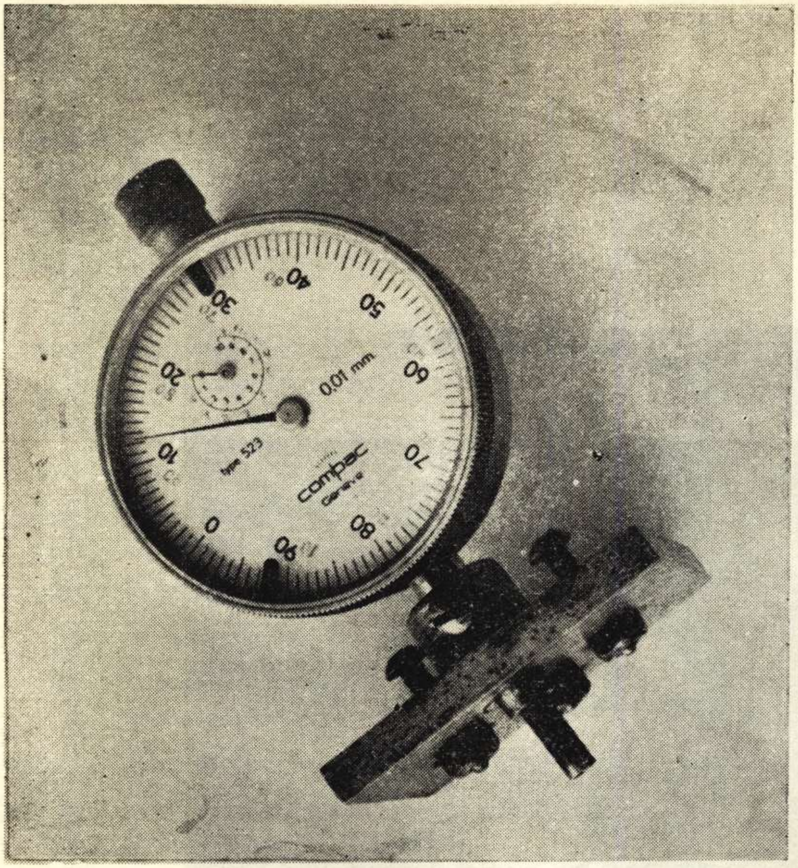
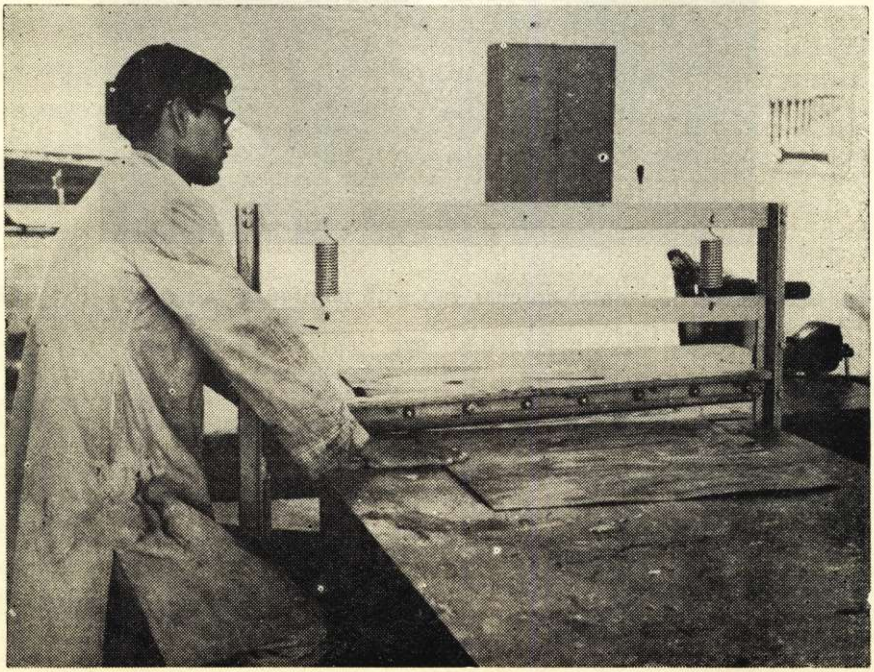


Fig. 10. Laboratory designed horizontal nosebar gap measuring gauge.

Fig. 11. Veneer clipping with maually operated locally manufactured veneer clipper.



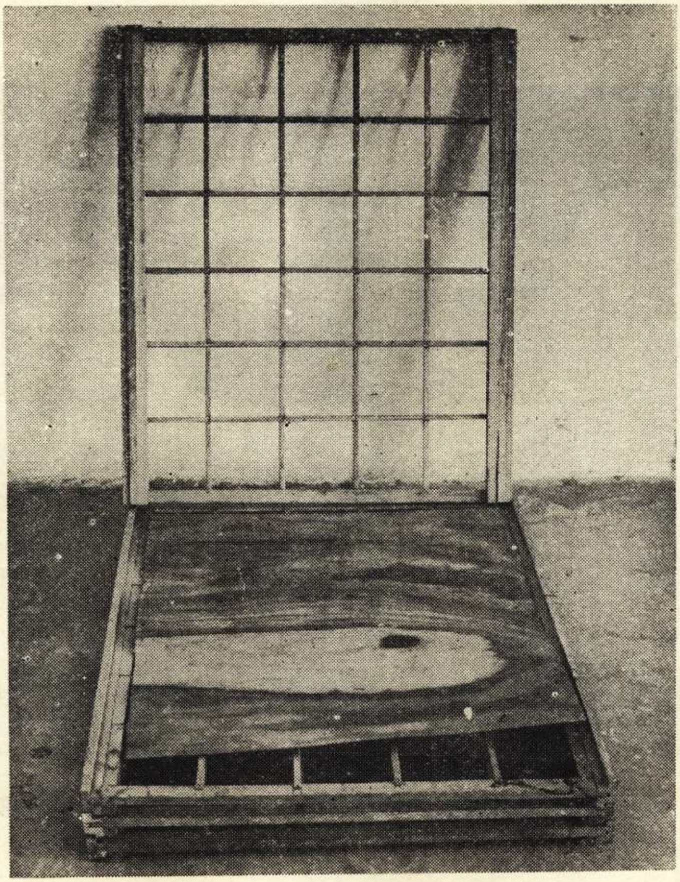


Fig. 12. Veneer rack containing veneer sheet.

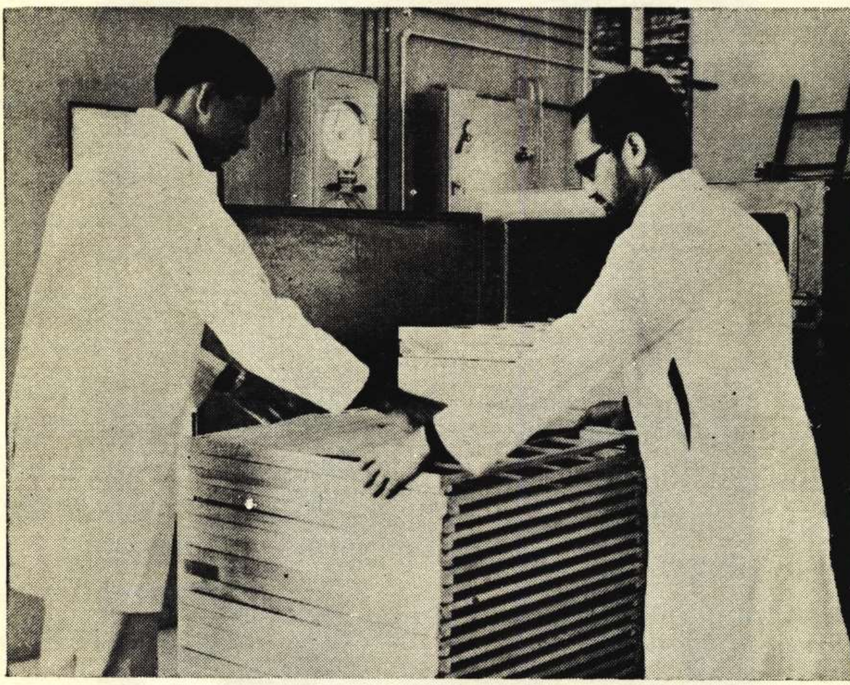


Fig. 13. Stacking the veneer in veneer racks for drying.

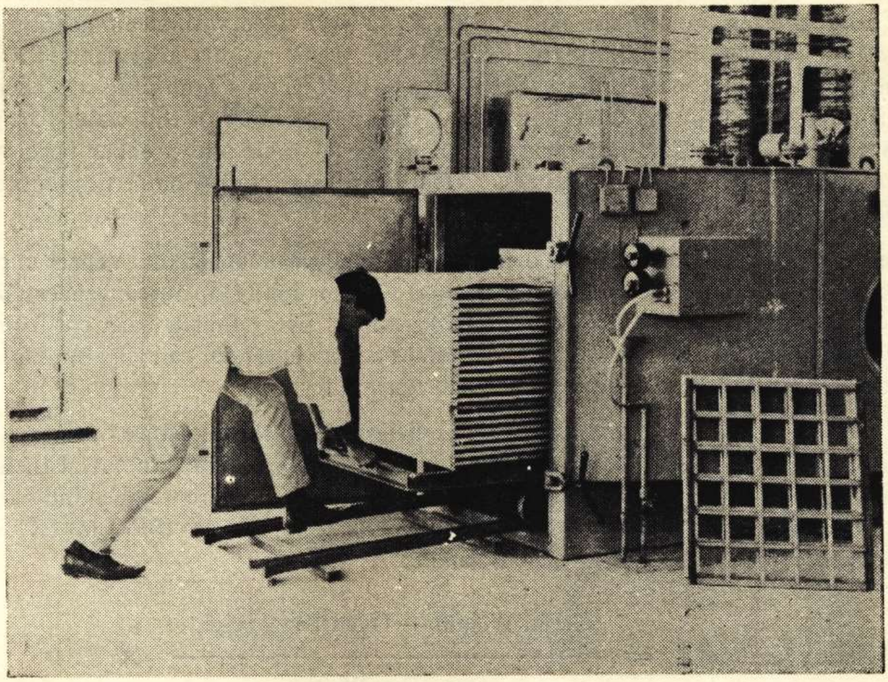


Fig. 14. Driving the trolley loaded with wet veneers into dry kiln.

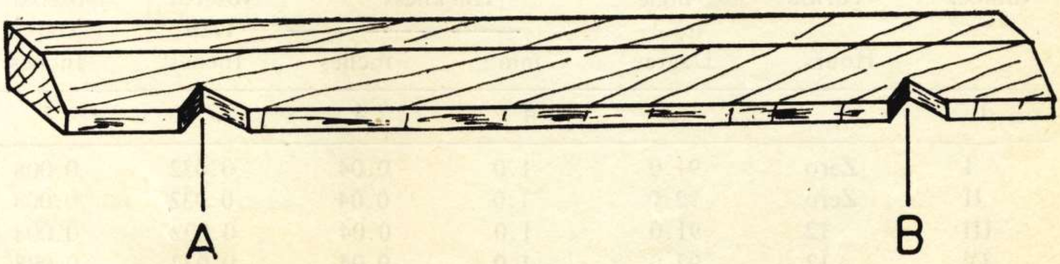


Fig. 15. Meter used for marking green veneer before drying.

Figs. 4 to 10. Peeling trials were carried on the billets immersed in water at room temperature at 30°C as well on the billets heated in hot water at 80 to 90°C for different intervals in a small heating tank of size 60″ × 35″ × 42″ provided with steam heating coils at the bottom and a wooden lid at the top. There were no arr angements for continucus heating, therefore, each billet was heated at 80 to 90°C for 4 hours and was then left over night for 29 hours in the same hot water. The temperature of this water dropped down from 90 to 40°C before next heating. Knife bevel angle and nosebar bevel angle used were 22.4°C and 76.6° respectively. Heating periods and lathe settings used for cutting veneer are given in Table 3.

The veneer clipped into 6 to 24 inches wide pieces was recovered. Veneer clipping was done with the help of locally manufactured and manually operated veneer clipper (Fig. 11). Veneer was scribed to a length of 24 inches. Every fourth sheet cut from the reelable veneer from the whole stock was selected as a test veneer for carrying out moisture content determinations in green veneer as well during drying.

3. *Veneer Drying and Shrinkage.*—For determining the moisture variation, one test specimen (4″ × 8″) was taken from each test veneer. Moisture content of these test specimens was determined by oven dry method i.e. test specimens were weighed individually in green conditions and then dried in an electrically heated oven at 105°C for 24 hours and reweighed. Moisture content was calculated as follows.

$$\text{Moisture Content\%} = \frac{\text{Green Weight} - \text{Oven Dry Weight}}{\text{Oven Dry Weight}} \times 100$$

TABLE 3

Lathe Settings and Heating Periods Used for Peeling Mulberry Billets Into Different Thicknesses

Billet Number	Heating Period Hours	Knife Angle Degree	Nominal Veneer Thickness mm	Nominal Veneer Thickness inches	*Horizontal Nosebar Gap Inches	**Vertical Nosebar Gap Inches
1	2	3	4	5	6	7
I	Zero	91.0	1.0	0.04	0.032	0.008
II	Zero	92.0	1.0	0.04	0.032	0.008
III	12	91.0	1.0	0.04	0.032	0.008
IV	12	92.0	1.0	0.04	0.032	0.008
V	18	91.0	1.0	0.04	0.032	0.008
VI	18	92.0	1.0	0.04	0.032	0.008
VII	12	91.0	2.0	0.08	0.064	0.016

1	2	3	4	5	6	7
VIII	12	92.0	2.0	0.08	0.064	C.016
IX	18	91.0	2.0	0.08	0.064	0.016
X	18	92.0	2.0	0.C8	0.064	0.016
XI	12	91.0	2.5	0.10	0.08	0.02
XII	12	92.0	2.5	0.10	0.08	0.02
XIII	18	91.0	2.5	0.10	0.08	0.02
XIV	18	92.0	2.5	0.10	0.08	0.02

* Horizontal Nosebar Gap was taken as 80% of the nominal veneer thickness

** Vertical Nosebar Gap was taken as 20% of the nominal veneer thickness.

Actual veneer drying operation was carried out in German Make, Hildebrand automatic dry kiln at 35 lbs/Sq. in. steam pressure. The green veneers were stacked in the dry kiln in veneer racks (Fig. 12-14) manufactured in the wood workshop of Pakistan Forest Institute, Drying temperatuıes used were 70, 80, 90 and 100°C /for each veneer thickness. Drying periods for each temperature were 30 and 60 minutes after which the test specimens were cut from the test veneer and their moisture content was determined. Veneer shrinkage along the grain was negligible and therefore, observations for shrinkage across the grain were recorded only. The veneer surface was marked with the help of a meter containing notches A & B at a distance of 18" from each other, for observing the shrinkage (Fig. 15). Distance between notches A & B was measured after drying and percentage shrinkage was calculated as below:

$$\text{Shrinkage Per cent} = \frac{D - d}{d} \times 100$$

Where D = Distance between notches A & B before drying.
d = Distance between notches A & B after drying.

4. *Veneer Recovery*. Each billet was peeled upto 4" core diameter. The veneer pieces which were not of full length and lesser than 6" in width were considered as rounding losses while those having width more than 6" but lesser than 24" were taken as reeling losses. The veneer wasted for cutting straight edges during peeling with scribers or scribing knieves was taken as scribing losses. Veneer recovery was calculated as follows:

$$\text{Veneer Recovery Per cent} = \frac{\text{Volume of Usable Dry Veneer}}{\text{Volume of Green Billet}} \times 100$$

5. *Veneer Quality Assessment*:—The quality of veneer was assessed on the basis of three of its main characteristics, viz., smoothness, tightness and regularity of thickness. Smoothness and tightness was determined through visual observations and feel of the

veneer. Thickness at different points in the veneer sheets was determined with the help of thickness measuring gauge. From veneer sheets of each billet, the best sheet selected visually and by feel was made a reference for assessing the quality of other sheets.

IV. Results and Discussions

1. *Effect of Heating Period on the Quality of Rotary-Cut Mulberry Veneer*

It was observed that when a mulberry billet fully soaked in water containing 37% moisture content at room temperature was peeled into 1.00 mm thick veneer, not only the quality of the veneer was poor but peeling was found to be fairly difficult due to high resistance and pressure exerted by the log against the knife.

The veneer obtained was brittle, difficult to handle and had conspicuous peeler checks which caused surface roughness. Although it was possible to peel the billet at lower lathe speed but the knife became blunt before completing of peeling of one billet. There was every danger of knife damage. At higher lathe speed these difficulties were more pronounced. This was all judged by the fact that power consumption was high and the speed of the machine got retarded due to high friction and pressure exerted by the nosebar against the log.

When the log was heated in hot water at 80 to 90 for 12 hours in a continual way consisting of three equal heating periods of four hours each and then peeled into 1.00 mm thick veneer, the quality of veneer was improved and the peeling was facilitated. The veneer produced was comparatively smooth, contained less pronounced peeler checks and had better handling properties. The peeling was easier both at low and high lathe speed. The moisture content of the log was found to be 81.4% after 12 hours heating.

For studying the further effect of heating period on the veneer quality, two other billets were heated at 80 to 90 in a similar way for 18 hours and peeled into 1.00 mm thick veneer. It was observed that the peeling was considerably easy and the veneer quality was further improved but a little furryness was created on the veneer surface. The moisture content was found to be 100 to 140% after 18 hours heating.

In case of 2.00 mm and 2.5 mm thick veneers it was observed that veneer obtained after 18 hours heating was more smooth, uniform in thickness, had negligible depth of peeler checks, smooth surface and was easy to handle as compared to veneer obtained after 12 hours heating. The peeling could be done easily both at low and high lathe speeds. It appears that by heating the wood is softened and the friction and resistance offered by the log against knife and the nosebar edge gets decreased. This results into better lathe speeds and ultimately the power consumption goes low. From the different experiments carried out for peeling the different thicknesses of veneer it was found that a veneer of considerably good quality comprising smooth surface, uniform in thickness, lesser depth of peeler checks and having good handling properties can be produced by using the following heating schedule shown in Table 4.

TABLE 4

Recommended Log Heating Schedule

Heating period	Log Diameter	Thickness of Veneer
12 Hours	1.0 to 1.5 feet	1.00 mm
18 Hours	—do—	2.00 mm
18 Hours	—do—	2.5 mm

2. *Effect of Knife Angle on the Veneer Quality*:

The selection of suitable knife angle for cutting good quality veneer depends upon wood species, temperature of wood, lathe and log diameter. A great deal of work has been done on determining the suitable knife angle for cutting specific thickness and the different wood species. Some of the workers have found that the suitable range of knife angle for cutting good quality veneer varies from 88 to 92 degree depending upon the diameter of the log(4). Some other workers found out that the suitable range of knife angle varies from 89 to 95 degree and depends upon the large number of factors like wood species, log conditioning and log diameter(9). It has also been found that on the laboratory lathe the optimum knife angle which ensures good quality veneer ranges from 81 to 92 degree provided the knife bevel angle is 20 degree.

These are the extreme values but the true angle which produces good veneer always has to be worked for the different woods peeled under different conditions. Soft woods such as radiata pine can usually tolerate several degrees of angle change without effecting the veneer quality. In hard woods of high density and thin veneers the tolerance in a knife angle change may be considerably less than 1 degree (7). Two knife angles most frequently used in the industry viz 91 degree and 92 degree were used in this study for cutting 1.0 mm, 2.0 mm and 2.5 mm thick veneers. No marked difference was noticed in the quality of veneer produced as a result of knife angle change. However, it was observed that at 91 degree knife angle, the knife became blunt frequently. This is possibly due to the reason that at lesser knife angle the maximum face area of the knife touches the log as a result of which the friction and the pressure exerted by the log against the knife becomes increased. On the other hand at 92 degree knife angle comparatively lesser portion of the knife face strikes the log and the decreased friction and pressure of the log against the knife helps in the prolonged cutting life of the knife. Therefore, it is recommended that for cutting 1.0 mm, 2.0 mm and 2.5 mm thick veneer from the mulberry logs of diameter ranging from 1.0 to 1.5 feet; 92 degree knife angle ensures better quality veneer provided the logs are heated according to the foresaid heating schedule.

4. *Veneer Drying*:

Drying of veneer was done at 70, 80, 90 and 100 for 30 minutes and 60 minutes. The results of drying are shown in Table 5. The moisture content of the test veneers was determined before drying and it was found to vary from 84 to 111% in 1.0 mm thick veneer and 100 to 130% in 2.0 mm and 2.5 mm thick veneer. This difference in the moisture content of the veneer was caused by a difference in log heating periods. From the results it can be seen that after 30th minute of drying at moisture content of 1.00 mm, 2.0 mm and 2.5 mm thick venee was found to vary from 11 to 15%, 13 to 17% and 15 to 20 % respectively. Although at this stage of drying no warping and end splitting was noticed but the moisture content was found to be high and the veneer required to be further dried.

A comparatively better quality dry veneer containing tolerable warping and no end splitting in each thickness of 1.0 mm, 2.0 mm and 2.5 mm was obtained after 60th minute of drying at 90 Moisture content in dry veneer of foresaid thicknesses, at this drying stage was found to vary from 4.4 to 8.0%, 4 to 8 % and 6 to 8% respectively.

It may be pointed out here that drying was carried out in a dry kiln where veneer was stacked in between the wooden racks specially designed for this purpose. Under these conditions the veneer was dried only by the circulation of hot air instead any hot surfaces in contact, therefore, the drying periods are a bit lengthy. In contrary to these conditions in the factories mostly endless veneer driers are used which consist of wire mesh belts, driven by metallic rollers heated by steam. In these veneer driers the veneer remains in close contact with the hot surfaces in addition to the hot air surroundings, therefore, fall in moisture takes place at a rapid speed. So with these foresaid mechanical driers, it is proposed that a temperature lower than 90 and lesser drying durations can produce better results.

5. *Veneer Quality:*

Veneer thickness in different sheets peeled from cold billets varied from 0.5 mm to 1.38 mm when the lathe was adjusted for cutting 1.0 mm thick veneer. It was found that at the start of peeling, variation in thickenss was found to be in the range of 1.0 mm to 1.07 mm on both edges but in the latter stages, the increase in friction and pressure exerted by the log against the knife edge resulted in the bluntness of the knife and ultimately loosened the lathe settings and produced a veneer having rough surface and highly irregular in thickness ranging from 0.5 mm to 1.38 mm. When the billets were peeled after heating in the hot water, a tolerable variation in thickness ranging from 1.0 mm to 1.04 mm was observed. However, it is concluded that a veneer of fairly good quality can be produced if the following lathe settings and log conditioning schedule shown in Table 6 is practiced.

TABLE 5

Drying Results of Mulberry Veneer

Veneer Thickness mm	Drying Temperature	Drying Time Minutes	Moisture Content before drying %	Moisture Content after drying %	Shrinkage Across the Grain %	Condition of Veneer After Drying
1.0	70	30	84 to 111	30 to 40	—	No warping and end splitting but high moisture content.
		60		20 to 25	4.0	
1.0	80	30	84 to 111	25.1 to 30.4	—	—do—
		60		8.7 to 10	7.0	—do—
1.0	90	30	84 to 111	11 to 15	—	—do—
		60		4.4 to 8.0	8.9	Moisture good enough. Tolerable warping and no end splitting.
1.0	100	30	84 to 111	8 to 10	—	Moisture good enough but considerable warping and end splitting.
		60		4.0 to 6.0	8.9	
2.0	70	30	100 to 130	50 to 55	—	No warping and end splitting but high moisture content.
		60		30 to 40	5.0	—do—
2.0	80	30	100 to 130	31 to 39	—	—do—
		60		11 to 15	6.0	—do—
2.0	90	30	100 to 130	13 to 17	—	Moisture content high, tolerable warping and no end splitting.
		60		4 to 8	8.0	Moisture good enough, tolerable warping and no end splitting.
2.0	100	30	100 to 130	10 to 15	—	Moisture good enough but considerable warping and end splitting.
		60		4 to 8	8.5	
2.5	70	30	100 to 130	50 to 56	—	No warping and end splitting but high moistuie content.
		60		30 to 40	5.0	—do—

Veneer Thickness mm	Drying Temperature	Drying Time Minutes	Moisture Content before drying %	Moisture Content after drying %	Shrinkage Across the Grain %	Condition of Veneer After Drying
2.5	80	30	100 to 130	30 to 38	—	—do—
		60		13 to 18	6.9	—do—
	90	30	100 to 130	15 to 20	—	Moisture content high. No warping and end splitting.
		60		6 to 8	8.0	Moisture content good enough. No end splitting but tolerable warping.
	100	30	100 to 130	14 to 18	—	Moisture content high. Considerable warping and end splitting.
		60		6 to 7	8.8	Moisture content good enough but considerable warping and end splitting.

TABLE 6

Recommended Lathe Settings and Log Conditioning Schedule

Heating Period	Log Diameter	Knife Angle	Nominal Veneer Thickness	Horizontal Nosebar Gap Inches	Vertical Nosebar Gap Inches
12 Hours	1.0 to 1.5 ft.	92°	1.0 mm	0.032	0.008
18 Hours	—do—	—do—	2.0 mm	0.064	0.016
18 Hours	—do—	—do—	2.5 mm	0.10	0.020

Knife bevel angle and nosebar bevel angle used were 22.4° and 76.6° respectively.

6. *Veneer Recovery* :—

Veneer recovery from different billets is shown in Table 7. Practically the billets were peeled up to 4 inches core diameter. Recovery for 8 inches core diameter was computed from results of 4 inches core diameter. This was done because in the industry in Pakistan, the logs are mostly peeled upto 8 inches core diameter. Veneer recovery excluding core, scribing, rounding and reeling losses is comparatively important because this gives information about the total usable veneer obtained from a log. On the other hand recovery excluding core, scribing and rounding losses gives the gross quantity of veneer comprising both usable as well as unusable veneer obtained from a log.

TABLE 7

Veneer Recovery from different Mulberry Billets

	8 inches Core Diameter		4 Inches Core Diameter	
Billet Number	Veneer Recovery Excluding Core, Scribing and Rounding Losses %	Veneer Recovery Excluding Core, Scribing, Rounding and Reeling Losses %	Veneer Recovery Excluding Core, Scribing and Rounding losses %	Veneer Recovery Excluding Core, Rounding and Reeling Losses %
I	45.4	40.8	67.8	63.2
II	57.3	50.7	83.3	76.0
III	52.7	42.2	71.9	64.9
IV	58.4	51.3	78.5	74.3
V	45.3	40.2	76.1	62.6
VI	62.2	40.4	80.6	59.2
VII	58.3	45.1	79.3	66.3
VIII	50.1	40.1	60.1	59.3
IX	45.4	40.6	71.8	55.8
X	55.4	49.2	74.2	60.0
XI	54.5	49.2	70.5	60.2
XII	58.7	50.2	62.7	60.2
XIII	56.8	52.6	64.4	6.8
XIV	49.4	40.7	61.4	52.3
Average	53.6	45.2	76.6	62.9
Standard Deviation	∓5.2	—5.0	±7.5	—6.4

Veneer recovery depends upon the general condition of the log i.e. the logs free of defects and having straight bole and larger diameter always give good recovery. From the results it can be seen that average recovery of usable veneer from mulberry logs of diameter ranging from 1.0 to 1.5 feet, is determined to be 45.2% for 8 inches core diameter and 62.9% for 4 inches core diameter.

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