Recent Developments In Veneer Peeling Confront Quality Variables

Forest Products Laboratory of the USDA Forest Service examines peeling technology, focusing on block conditioning, knife angle, pitch and bevel, nosebar pressure, troubleshooting and quality control.

By Henry Spelter

The production of quality rotary-peeled veneer requires careful balancing of many variables. However, the economic necessity for high throughput too often conflicts with quality, resulting in veneer with defects such as those listed in Table 1. These defects are costly in lost material, wasted labor and degraded product performance. To minimize defects, one must be aware of their symptoms and understand their causes. Let's review the variables that affect veneer quality and look at technology developed to improve quality.

Good block conditioning is the starting point for quality veneer. The lathe operator is at the mercy of the conditioning system; if the blocks are not conditioned properly, adjustments to avoid some problems can lead to others. For example, increased nosebar pressure necessitated by cold blocks can lead to increased spinouts and shelling or shattering of the veneer. Blocks that are too cold (or dry) can lead to spinout and cause weakened, loose veneer with rough, corrugated surfaces. Blocks that are too hot result in veneer with fuzzy surfaces. Dry blocks occur most frequently when dead or fire-killed timber

TABLE 1–COMMON VENEER DEFECTS AND CAUSES

CAUSES	Loose veneer*	Rough veneer	Fuzzy veneer	Torn grain on tight side	Bulging knot on core	Thick & thin veneer across grain	Veneer thickness variation**	Veneer thickness variation#	Corrugated veneer surface	Spinout
Blocks too dry	■	■							■	■
Blocks too cold	■	■							■	■
Blocks too hot			■							
Block ends too hot/ centers cold										■
Knife dull			■	■						
Knife angle too low				■	■	■	■			
Knife angle too high									■	
Knife edge set too low									■	
Knife bevel angle too large	■	■								
Nosebar pressure too low	■	■					■			
Nosebar pressure too high				■	■					■
Nosebar (fixed) ground too sharp			■	■						
Looseness in lathe	■						■			
Grain direction skewed		■								
Block bends in lathe								■		
Heat expansion of knife								■		
Misaligned knife/ nosebar								■		

*Deep lathe checks
**Across grain (along sides of veneer ribbon coming off the lathe)
#With grain (across veneer ribbon coming off the lathe)

TABLE 2–DESCRIPTION OF ROLLER NOBEBAR TYPES

Diameter (in.) (mm)	Surface pattern	Vertical gap Recommended (in.) (mm)	 Ideal[a] (in.) (mm)
0.625 (15.9)	Smooth	0.085 (2.1)	0.084 (2.1)
2.375 (60.3)	Smooth	0.313 (8.0)	0.262 (6.6)
2.500 (63.5)	Diamond	0.375 (9.5)	0.275 (7.0)
3.000 (76.2)	Smooth	0.375 (9.5)	0.325 (8.2)
3.750 (95.3)	Fluted	0.625 (15.9)	0.402 (10.2)

[a] Ratio needed to achieve equal exit and horizontal gaps for 1/8 in. (3.2 mm) thick veneer with horizontal gap of 1/10 in.(2.5 mm).

is utilized, but if a batch is known to be consistently dry, a higher nosebar pressure can be set to compensate for the condition of the blocks.

Different methods are used to condition blocks. Steam vats, used in Western North America, are slower than other methods and achieve wide variability in the final temperature of the peeler logs, as shown in Figure 1. Hot water does the job faster and more uniformly. However, for low moisture species (such as Douglas fir), blocks tend to ride high on the surface, reducing the effectiveness of the system. Nevertheless, at least one U.S. West Coast mill has designed and uses hot water conditioning, and such systems are widespread in the South.

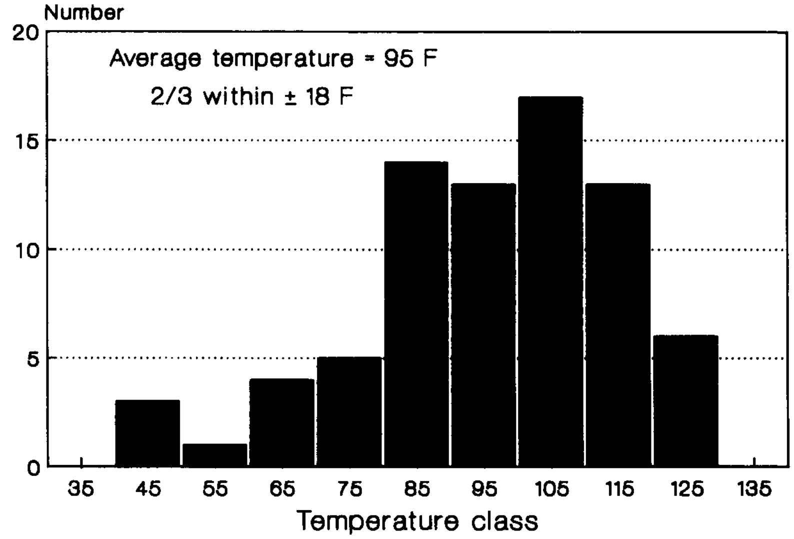
Whichever method is used, blocks should be separated by size to achieve temperature uniformity. Simulations show that a 10 in. (254 mm) loblolly pine block in a 175° F (79° C) bath achieves an average temperature of 144° F (62° C) after 7.5 hours, whereas 14 and 18 in. (356 and 457 mm) blocks average 114° F and 95° F (83° C and 35° C), respectively, during the same time.

Knife Angle

Correct knife angle during peeling is critical as target core diameters decrease. If the knife angle is fixed, the amount of contact between the receding block surface and the knife face decreases, changing the forces at the knifetip (Fig. 2). If the knife angle is too high (too much lead), the knife is alternatively forced into the block and springs back, resulting in rough, corrugated veneer. (Setting the knife edge too low relative to the spindle centers is effectively the same as having too high a knife angle). On the other hand, if the knife angle is too low (too much heel), the knife is pushed out of the block, resulting in torn grain and thickness variation (thick and thin veneer). Accordingly, the angle should change as block size decreases to maintain equilibrium.

In the past, when core sizes were larger, linear pitchways provided a sufficiently close approximation to the optimal, nonlinear knife angle path. When the block diameter approaches 6 in. (152 mm), however, the discrepancy becomes too great. Nonlinearly contoured ways are better, but the amount of change is limited by the retract rate of the carriage. With rapid retract rates (13 in. (330 mm) or more per second can be achieved with hydraulic carriage drives), too steep a rail pitch can cause the carriage to seize up.

Figure I--Temperature distribution of blocks conditioned in a steam vat.



Electronically regulated pitch angle adjustment is an alternative to contoured pitchrails. Change in the angle of the knife is achieved by a servo-motor with a temposonic cylinder (type Coe). The mechanism alters the knife from 1° lead to 5° heel at its maximum. Four profiles can be set, each consisting of 14 knife angles for given block diameters.

The angle of the knife bevel is another important variable, and its value is a compromise between the smoothest possible peel (small bevel) and the greatest possible resistance to knifetip damage (large bevel). For low and intermediate density species, the angle is usually 20°. For higher density and knotty species, the angle is 21° to 23°. When honing the knife, the bevel should not be undermined by too hollow a grind. The concavity should be limited to 0.002 in. (0.051 mm) or less by tilting the grinding wheel no more than 2° from the knife blade.

To further increase the durability of the knifetip, a microbevel of about 30° can be honed on the upper 0.02 in. (0.51 mm) of the knife back. This strengthens the knifetip while retaining the advantage of a narrower bevel over the main body of the knife.

Nosebar Pressure

Pressure on the block above the knifetip counteracts the tearing action of the knife. The thicker the peel, the more critical the pressure. Low pressure results in deeply checked, rough, uneven veneer. High pressure compresses the veneer, tears the grain, and stresses the block ends, causing spinout. Changes in nosebar design over the years have greatly affected these relationships.

(Continued on page 63)

Peeling

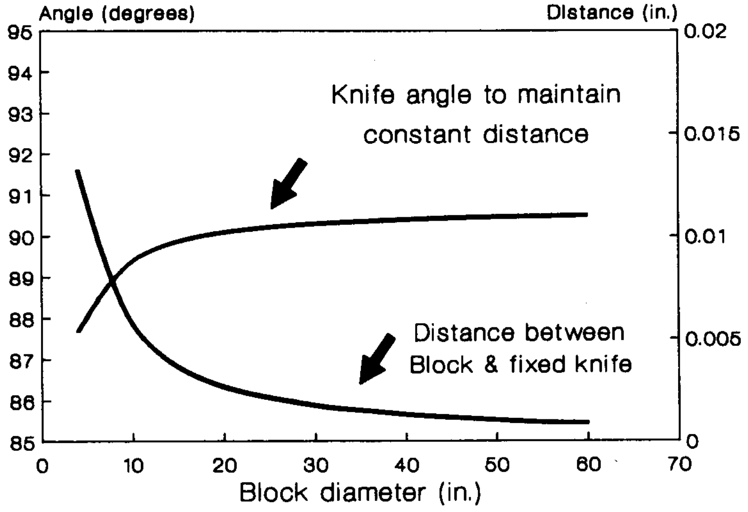
(Continued from page 55)

Fixed nosebars give the tightest peel because pressure can be concentrated closest to the knife. However, the tendency for debris to build up between the bar and the wood, damaging veneer and interrupting production, has led many mills to adopt roller bar systems as illustrated in Figure 3.

Over the course of a peel, for a given horizontal gap, the pressure on the block periphery depends on the following motions: (I) the forward thrust of the carriage, (2) the block rotation, (3) the roller bar rotation, and (4) the changing diameter of the block. The first three motions reinforce each other above the vertical gap (F in Fig. 3) and increase the pressure. Below F, the third motion reverses and begins to draw away from contact. The point of maximum pressure, therefore, occurs below F where the opposing motions cancel each other. Superimposed on these is motion 4, which draws the block surface away from the bar. As the block shrinks, the pressure systematically drops by an amount proportionate to the vertical distance from the knifetip. Thus, the effect of motion 4 increases with the size of the vertical gap V. Because large roller bars require larger vertical gaps to avoid excessively narrowing the exit gap (in which veneer could jam), there is a tendency for reduced pressure with these bars at smaller block diameters.

For various vertical gaps, the ratios of the horizontal gap are shown relative to the horizontal distance between the block periphery and line BD as diameter declines (Fig. 4). A value of 1 signifies

Figure 2–Knife angle required to keep constant distance between knife face and block. 1 in. = 25.4 mm.



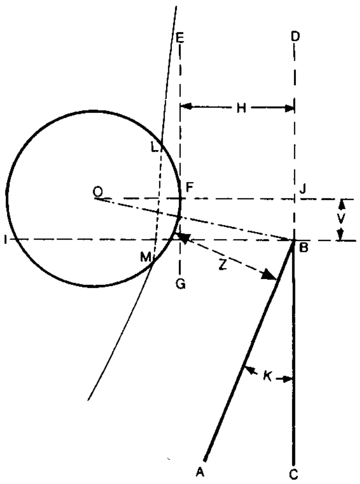
contact, a value above 1 indicates no contact, and a value below 1 indicates compression. These ratios are calculated at the vertical gaps recommended by several manufacturers. It's interesting to note the degree to which some settings are above the point where horizontal and exit gaps are equal. This occurs where the bar center lies on a ray bisecting the angle formed by the knife back and the vertical extension of the knife face (ABD in Fig. 3). Such positioning reduces the exit gap resistance and thus facilitates the removal of debris, but at the cost of diminishing pressure as the block shrinks. The resulting deterioration in veneer quality caused much consternation when these bars were first used.

To rectify this problem. later versions of the large diameter nosebar were made smaller (e.g., type Premier). More importantly, about five years ago, tracking mechanisms were developed to automatically adjust bar settings according to block diameter. A recent development has taken this one step further by additionally changing bar settings based upon block temperature readings (type Coe). An infrared sensor, placed near the middle of the block, takes readings every 300 ms and a servo-valve adjusts nosebar position accordingly. For every 2° F (11° C) change in temperature, a gap adjustment of 0.001 in. (0.03 mm) can be made.

Another variation (type Calvert) is based on the floating bar concept first examined by Feihl and Carrol at the Canadian Forest Products Laboratory (see October 1969 *Forest Products Journal*). Instead of the bar being fixed relative to the knife (position controlled), the bar floats according to the balance of forces bearing on it (pressure controlled). As the block surface retreats, the nosebar advances in proportion to the drop in resistance. The bar assembly requires a certain mass to resist whipsawing by irregularities such as knots. This system is now being tested and should be available this spring.

Japanese plywood lathe manufacturers have favored fixed nosebars because of the superior veneer quality obtainable from such lathes. To circumvent the problem of slivering, the nosebar is segmented. Disks, either spiked (type Meinan) or smooth (type Uroko), protrude between the segments at about 2 in. (51 mm) intervals. The disks drive slivers through the segments and, in the spiked roll variant, provide much of the turning power. Because the torque is supplied di-

Figure 3–Schematic representation of roller bar and knife.



ABC	Knife with cutting angle k
BD	Vertical line from knifetip
O	Roller bar center
EG	Vertical line tangent to roller bar at point F
OB	Line that bisects angle ABD and along which lies the center of the roller bar if exit and horizontal gaps are to be equal
IB	Horizontal line from roller bar to knifetip
H	Horizontal gap + horizontal distance between EG and DB
V	Vertical gap = vertical distance between IB and OFJ
Z	Exit gap = minimum distance between knife-back and roller bar
LFM	Zone of compression

Figure 4–Effect of vertical gap [VG] on roller nosebar pressure with change in block size. Vertical axis shows ratio of horizontal gap to horizontal distance between block periphery and knifetip. 1 in. = 25.4 mm.

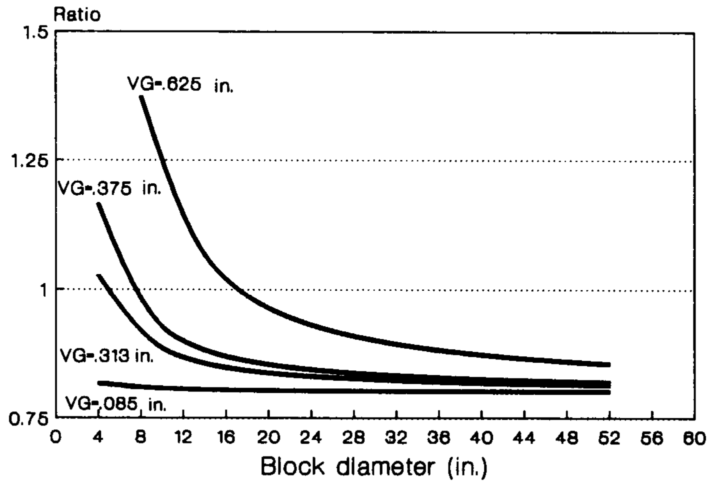
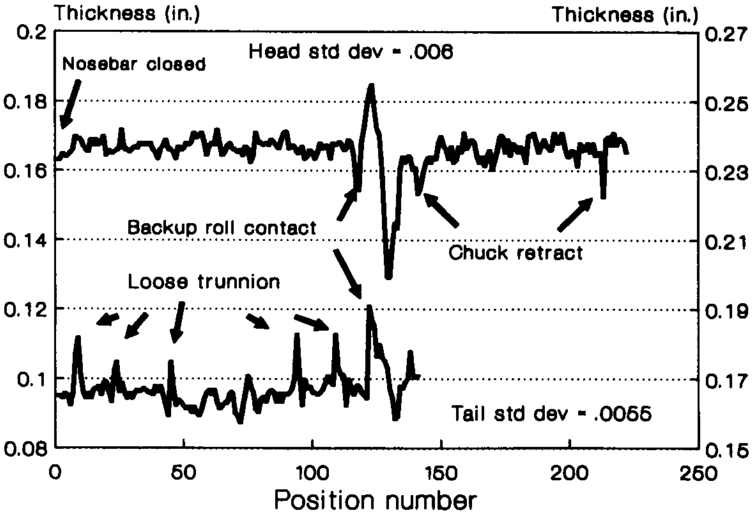


Figure 5–Thickness variation of a ribbon of veneer along two sides of the lathe. 1 in. = 25.4 mm.



rectly above the knife and spread out along the length, spinout is avoided (see March 1990 *Panel World*).

Quality Control

Before troubleshooting can start, using a chart such as that shown in Table 1, the operator must be aware of problems. Quality control procedures, such as those developed by the Forest Products Laboratory of the USDA Forest Service (Veneer Improvement Program) and North Carolina State University, provide feedback on lathe conditions. One key piece of information generated by such studies is the amount of variation in veneer thickness. Four to six thickness measurements are taken from the edges of a sample of sheets and analyzed. If the lathe setup is wrong or if block conditioning is inadequate, a problem will often be indicated by the analysis of thickness variation between and within sheets. As a point of reference, the average overall thickness variation found in 19 U.S. mills between 1984 and 1990 was about 0.006 in. (0.15 mm).

Wherever possible, such monitoring should be automated and conducted in real time to provide instantaneous feedback to the operator. Such an opportunity exists for veneer thickness measurements where on-line systems have been developed. The advantage of such an approach can be seen in Figure 5, which shows the variation along a ribbon of veneer at 2 in. (51 mm) increments. Such charts reveal patterns that yield more diagnostic information about the likely source of problems than does a single statistic such as the standard deviation.

On-line veneer thickness measurement systems come in two forms: contact and noncontact. At thicknesses common for veneer, noncontact devices are difficult to calibrate with conventional handheld micrometers because of microscopic surface irregularities in the typically small area of measurement. Such systems, however, may reflect variations caused by surface roughness better than do contact systems and may give a more accurate reading of the overall quality of the veneer. By contrast, contact measuring devices. using a 6 in. (152 mm) diameter roll, match conventional measurements well, but they may require more maintenance as a result of potential bias caused by a buildup of pitch and dirt on the roll.

Summary

Lathe changes in the early 1980s emphasized increased output. A byproduct of this was a deterioration in veneer quality. In the latter part of this decade, machinery manufacturers addressed the problems with quality. High output with better quality is now attainable as a result of improved peeling equipment coupled with quality control procedures. Emphasis on quality should pay dividends to veneer producers as more veneer is utilized in products where strength is critical, such as Laminated Veneer Lumber. To obtain tighter veneer, mills may want to modify their lathes with precision tools to dynamically adjust lathe parameters during the peel or consider reinstalling 5/8 in. (15.9 mm) diameter roller bars. •

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