Advantage

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A comparison of production systems for aspen veneer logs in northern Ontario

Abstract

This summary report presents the main findings of a study of systems for the production of aspen veneer logs in northern Ontario. The case studies, which took place in 2001 and 2002, covered four types of operations: in-woods chipping, satellite yards, roundwood merchandizing at roadside, and roundwood production at the stump. The advantages and disadvantages of each system for the production of veneer logs are given, along with production cost estimates for each system. A report presenting further productivity and quality data, and a detailed cost analysis (in an Excel spreadsheet) are available to FERIC members and partners on request.

Keywords:

Aspen, Veneer production, In-woods chipping, Satellite yards, Merchandizing, At-the-stump processing, Roadside processing.

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Introduction

In 2001, several Ontario member companies asked FERIC to study the production of aspen veneer logs in northern Ontario. The veneer volumes allocated by the Ontario Ministry of Natural Resources are not always recovered, mainly because some potential producers believe that it is too costly to sort out veneer logs and that their recovery may increase the production cost of other products.

FERIC concentrated on documenting "best practices" and comparing costing scenarios for various production systems for veneer logs. Thirteen operations were studied between December 2001 and August 2002. This summary report presents only the main findings and a costing summary for the scenarios we observed. A full documentation report and a detailed cost analysis in the form of an Excel spreadsheet are also available to members and cooperators on request.

The case studies covered four supply scenarios for aspen veneer logs:

- In-woods chipping at roadside with a delimber-debarker-chipper (DDC);
- Tree-length hauls to a satellite merchandizing yard;
- Roundwood production at roadside;
- Roundwood production at the stump.

Productivity and log-quality studies focused on those machines most involved in veneer merchandizing. The results relate mainly to production studies conducted on contractor (non-unionized) operations. All costs are based on the actual machine productivity levels measured during our field studies, but adjusted to an average of 0.50 m³/stem and a 15% veneer content to facilitate comparison; a FERIC costing spreadsheet was developed to produce "generic" costs. The costs presented in this report represent only direct costs of the products loaded on trucks, excluding stumpage, haul costs, profit margins, overhead, indirect costs, road costs, etc. Although most of the operations recovered both hardwoods and softwoods, only the hardwood (aspen) product costs are provided here.

In-woods chipping systems

The main challenge with in-woods chipping at roadside is to extract the veneer logs from a system that is highly production-driven, with the skidding and chipping phases closely linked. We studied two approaches:

- Veneer removal integrated with the chipping phase: a worker located near the chipper infeed extracts the logs and piles them with a small skidder (Figure 1A).
- Veneer removal not integrated with the chipping phase: a slasher extracts the logs from cold decks of tree-length aspen ahead of the chipping operation (Figure 1B).

Table 1 presents the advantages and disadvantages of both approaches. In addition, the option of using a cutoff saw mounted near the chipper is discussed, although this option was not studied.

Another issue related to veneer extraction involves the possible productivity and quality losses that occur at the chipper. A comparative trial in January 2002 involved chipping four loads of tree-length aspen: two without removing the veneer, and two after veneer removal. Despite a smaller average volume per stem in the approach with veneer removal, chipping productivity was not affected. Favreau and Franklin (1993) obtained similar results. However, contaminant levels such as bark, rot, and knots in the chips increased by about one-third (from 7% to 9.3%) in the chip samples where veneer had been removed.

Table 2 presents supply costs for the veneer logs produced by the in-woods chipping scenarios. The impact of possible variations in chip quality was not analyzed.

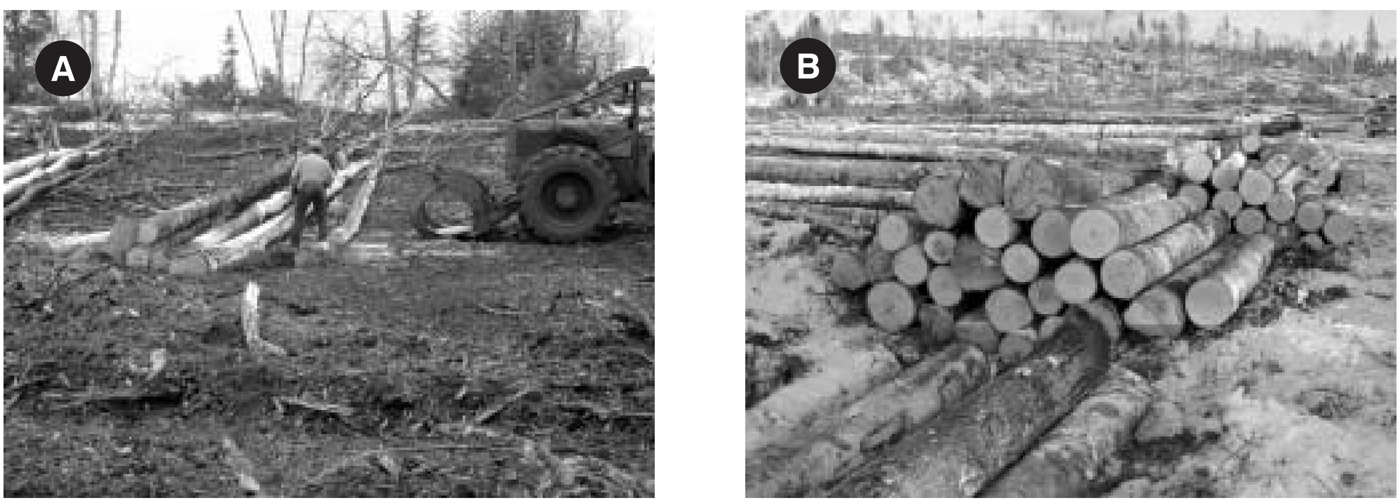

Figure 1. Extraction of veneer logs: (A) Manual bucking and piling with a small cable skidder. (B) Piles after mechanized extraction with a slasher.

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Table 1. Advantages and disadvantages of different veneer-extraction options for in-woods chipping operations

Advantages	Disadvantages
1. Extraction with manual bucking and piling using a small skidder working at the DDC	
• High quality of product, virtually free of damage. • Moderate production costs. • Good log recovery when the operator is available at the site.	• Possible interference with chipping and skidding phases (e.g., potential chipper productivity losses when the operator must wait for the worker to complete his task). • High accident risk. • Poor log recovery if: – The operator is not at the site (sickness, night shift, etc.) or the skidder is unavailable. – Excessive material accumulates around the infeed. – Truckers are lined up and impatient.
2. Extraction with a slasher working ahead of the DDC	
• Good quality of product. • Very good log recovery because every stem is handled and considered individually.	• High cost, since this phase is inserted solely for veneer log production.
3. Cutoff saw on chipper (not observed)	
• No extra worker required. • Anticipated low production costs.	• Possible reductions in chipper productivity and log recovery. • Possible problems with length quality. • Increased work for the skidders feeding the DDC to pile the veneer logs.

Table 2. Cost analysis for the in-woods chipping systems

	Total cost onboard the truck ($/m³)		
	No veneer logs extracted before chipping	Extraction by a worker on the ground	Extraction by a slasher
Hardwood chips	10.61	10.61	12.65
Veneer logs	n.a.	15.82	22.27
Combined total – all products	10.61	11.39	14.10
Cost increase of all products charged to veneer volume only[a]	n.a.	5.21	23.26
Cost increase charged to total volume	n.a.	0.78	3.49

[a] 15% veneer content assumed here and in subsequent tables.

Costs for the extraction by a worker on the ground were calculated based on the use of a new skidder. Using an old skidder, as was the case during the studies, would decrease costs, especially since the machine does not work particularly hard and should thus have low operating costs.

With non-integrated extraction of veneer logs by slashers, chip production costs are higher because an additional skidding phase feeds the DDC after slashing and a more expensive machine (the slasher) is used for merchandizing. However, although this approach is more costly, it is also much safer and recovers more veneer logs because the merchandizing phase is separated from the high-pressure chipping phase.

The use of a grapple saw or a cutoff saw mounted beside the field chipper warrants further investigation because it offers the potential for lower production costs then either option we studied, though possibly at the expense of reduced log recovery efficiency.

Satellite merchandizing yards

Satellite merchandizing yards offer a controlled processing environment and may thus improve merchandizing efficiency compared with in-woods chipping systems. In addition, it becomes possible to trim defective sections out of stems to maximize veneer production without incurring the penalties associated with fiber underutilization in the forest (Figure 2).

The main disadvantages of bringing tree-length material to a yard are the extra handling and hauling costs. Also, processing in a yard imposes an extra cost because the trees must be delimbed and topped prior to hauling, whereas a processor working in the woods can perform both functions simultaneously.

We studied a single-grip processor producing veneer and other log products in a satellite yard in January 2002 (Figure 2A). The advantages and disadvantages of satellite yards are given in Table 3. Time studies

Figure 2. (A) A single-grip processor working in a satellite yard.
(B) Rotten sections trimmed from veneer logs.

of the processor focused on the machine's normal production mode (producing veneer logs and two pulp products), but a brief trial also studied the processor producing only 8-ft OSB bolts.

Table 4 presents the cost summary based on these trials. The total costs reflect the fact that the stems are felled, skidded, delimbed, loaded, and then unloaded in the yard, after which they are processed and veneer logs are loaded on trucks for hauling to their final destination. Given that production costs are higher than at roadside (see Table 6), log recovery would need to be much higher than what could be achieved at roadside to offset this extra cost. However, the flexibility to trim logs at will could greatly enhance the recovery of veneer logs, and this may compensate for the additional costs. Additional information on log production in satellite yards can be found in Favreau (1995).

Table 3. Advantages and disadvantages of using satellite yards for veneer production

Advantages	Disadvantages
• Veneer recovery is potentially maximized because merchandizing takes place away from all other production phases. • Defective sections can be removed before processing a log without incurring the penalties of fiber underutilization that occur in the forest. • The yard can be established in a veneer mill's yard to prevent a second re-handling and trucking phase. • Easier to monitor veneer quality and detect low-quality products before large volumes are produced; also easier to transmit changes in product specifications to the operators.	• Costs may be increased because the veneer portion is handled and hauled twice.

Table 4. Cost analysis for the satellite yard system

	Total cost onboard the truck ($/m³)	
	Producing OSB only	Producing pulp and veneer
Hardwood pulp or OSB	14.41	14.93
Veneer logs	n.a.	16.57
Combined total – all products	14.41	15.18
Cost increase of all products charged to veneer volume only	n.a.	5.09
Cost increase charged to total volume	n.a.	0.77

Roundwood production at roadside

Another option for producing veneer involves roadside merchandizing with delimbers and slashers, or with processors (Figure 3). Table 5 presents the advantages and disadvantages of both approaches for veneer log production. Some trials of slashing and processing with and without veneer production were done to estimate the incremental costs of veneer extraction (Table 6).

Roadside processing provided the lowest production costs of all the scenarios we considered. The processor-based system cost less than with a slasher, especially when producing an assortment of veneer and other products, mainly because of the potential for eliminating a separate delimbing phase. If no delimbing is necessary (which is sometimes the case), about $2/m³ could be subtracted from the cost of the slasher system, thereby making this option as attractive as the processor-based system.

The potential veneer recovery is higher with processors, but log quality (length accuracy and surface damage) may be lower with feed-roller processors than with slashers. Length accuracy with feed-roller heads can vary depending on the mechanical condition of the head, operator skill, and tree form. Processors such as the Marquis or the Hornet/Target heads, which use butt plates, can have excellent length accuracy. Slashers produce high fiber losses, mainly in the form of short ends and long trim sections. Processors can more easily extract an extra 8-ft log at the top of the tree because the stems have not been topped prior to processing. With slashers, the temptation to process multiple stems simultaneously may reduce veneer recovery. It should also be noted that slasher productivity decreases more rapidly than processor productivity in stands with a high veneer content (see "Other factors" on page 10 for details).

Figure 3. Merchandizing with (A) a roadside slasher and (B) a processor.

Table 5. Advantages and disadvantages of roadside merchandizing with slashers and processors for veneer production

Advantages	Disadvantages
1. Merchandizing with slashers	
• Good veneer recovery potential because the butts are clearly visible so the operator can make proper merchandizing decisions for each stem; also, it is easy to check both ends for rot when off-loading bolts. • Good length measurements because of the use of butt-plate systems. • A powerful, long-reach loader can stack the veneer and other products.	• Some risk of losing veneer logs when the operator processes multiple stems to increase productivity. • Possible but time-consuming to trim rotten sections before processing a log. • Some risk of diagonal cuts if stems shift sideways during the cut. • May require an upstream delimbing phase, depending on branchiness.
2. Merchandizing with processors	
• High veneer recovery potential because each stem is handled individually and operators can make optimal bucking decisions for each stem. • Easy to trim rotten sections before processing a log; furthermore, trimmed section can be quite short, thus minimizing fiber loss. • With processors that use a butt plate, length accuracy can be excellent. • Low production cost for producing veneer logs because they are well integrated into the stream of other products. • Unlike slashers, processors don't require a delimbing phase, and this facilitates logistics and possibly reduces costs.	• Potential damage to the outside of the logs caused by feed rollers (spikes or spinouts). • With systems that use a measuring wheel, length measurements become variable if the head is in poor operating condition or if the stems are very crooked or branchy. • Some risk of breakage of large logs ("barber chairs") if the saw is not sharp. • Pile management may become difficult, especially if there are more than two products, and in some cases, piling room may become problematic, especially with high proportions of veneer logs.

Table 6. Cost analysis for the "roundwood at roadside" systems

	Total cost onboard the truck ($/m³)			
	Slasher		Processor	
	No veneer	With veneer	No veneer	With veneer
Pulp/OSB logs	11.25	12.27	9.44	10.12
Veneer logs	n.a	12.75	n.a	10.60
Combined total – all products	11.25	12.34	9.44	10.19
Cost increase of all products charged to veneer volume only	n.a.	7.28	n.a.	5.01
Cost increase charged to total volume	n.a.	1.09	n.a.	0.75

Roundwood production at the stump

Cut-to-length (CTL) systems are becoming widespread in eastern Canada and more recently in Ontario. Aspen veneer can be merchandized at the stump along with the other hardwood and softwood products. There are two possible CTL approaches:

- A two-machine system using a single-grip harvester and a forwarder (Figure 4A).
- A three-machine system using a feller-buncher, a processor, and a forwarder (Figure 4B).

Table 7 presents the advantages and disadvantages of both approaches for veneer production. Some trials of harvesting and processing with and without veneer production were done to estimate the incremental costs of veneer extraction (Table 8).

Based on the assumptions used in this analysis, the CTL system cost more than the roadside processing scenarios onboard the truck. With low veneer content and a forwarder that can extract the veneer logs simultaneously with other products, the cost difference decreases because roadside piles built by forwarders are larger and more concentrated, thus reducing loading costs for the trucks (see Figure 7). The costs of harvester-based CTL systems are a bit lower than with processors, but veneer recovery may decrease because visibility of the log ends during processing is lower. With large stems (>0.75 m^3), processor systems are even more attractive because feller-bunchers are more capable than harvesters of felling these large stems, and processors are typically more powerful than single-grip harvesters.

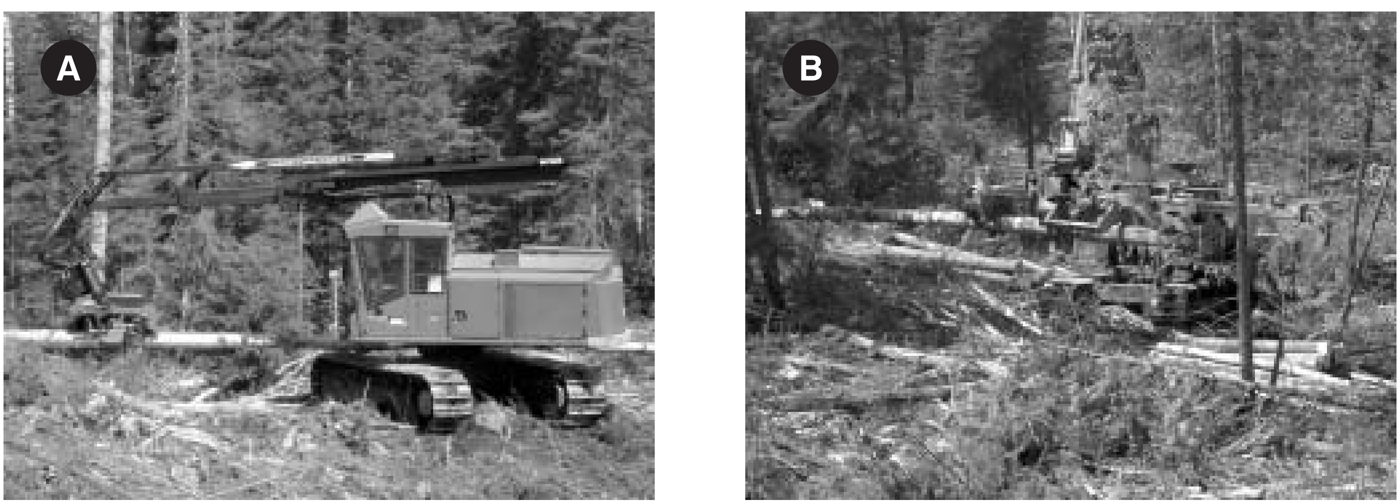

Figure 4. At-the-stump merchandizing using (A) a single-grip harvester and (B) a processor.

Table 7. Advantages and disadvantages of at-the-stump merchandizing with two CTL systems for veneer production

Advantages	Disadvantages
1. Two-machine CTL with single-grip harvesters	
• Each tree is handled individually, so the operator can make appropriate bucking decisions. • Rotten sections are easily trimmed before processing a log. • Trim length can be quite short. • Low production cost for the manufacturing of veneer logs because they are well integrated in the stream of other products. • Forwarder operators can confirm the veneer sort as they load and unload, and can correct mistakes by the harvester operator (e.g., veneer in the pulp pile and vice-versa). • Roadside piles are more concentrated, thereby enhancing loading productivity and reducing the effect of low veneer proportions on loading efficiency.	• Some risk of feed roller spinout leading to surface damage on the logs. • Some risk of breakage of large logs (barber chairs) if the saw is not in perfect condition. • It may be difficult to properly see the log ends and make the best decision on whether a log is veneer grade. • Length accuracy is subject to head calibration and is more sensitive to proper use of the head by the operator. • Dangle heads are usually not robust enough to handle very large stems (>0.75 m^3/stem).
2. Three-machine CTL with feller-bunchers and processors	
• See Table 5 for comments on processor advantages. • Forwarder operators can double-check the veneer sort as they load and unload, and can correct mistakes by the harvester operator (e.g., veneer in the pulp pile and vice-versa). • Roadside piles are more concentrated, thereby enhancing loading productivity and reducing the effect of low veneer proportions on loading efficiency. • In general, the feller-buncher/processor team can handle and merchandize larger stems than harvesters can handle.	• See Table 5 for comments on processor disadvantages, except for the comment on pile management.

Table 8. Cost analysis for the "roundwood at the stump" systems

	Total cost onboard the truck ($/$m^3$)			
	CTL with harvesters		CTL with processors	
	No veneer	With veneer	No veneer	With veneer
Pulp logs	13.01	14.26	13.99	15.18
Veneer logs	n.a.	14.37	n.a.	15.29
Combined total – all products	13.01	14.28	13.99	15.19
Cost increase of all products charged to veneer volume only	n.a.	8.45	n.a.	8.05
Cost increase charged to total volume	n.a.	1.27	n.a.	1.20

Other factors

Veneer content in the stand

The proportion of veneer-quality logs in the stand affects processing productivity because merchandizing veneer requires operators to evaluate stems and make bucking and sorting decisions. Some machines, such as slashers, are strongly affected by this factor because high proportions of veneer greatly decrease opportunities for highly productive processing of multiple stems simultaneously. Figure 5 illustrates the impact of veneer content on slasher productivity based on our studies.

Machines such as processors and harvesters are less affected by veneer content because they only handle one stem at a time (Figure 6). With high veneer proportions, productivity reductions result from the decision-making required during sorting and time increases caused by the production of short logs (2.5 m) rather than longer lengths.

The hardwood proportion in mixedwood stands and the veneer content within the hardwood component of these stands both affect pile concentration at roadside, and thus influence loading times for trucks. Field data collected on veneer loading operations were used to generate a loading productivity model (Figure 7). The results illustrate that veneer contents below 10% increase distances between piles and can dramatically decrease loading productivity in a stand containing similar volumes of aspen and softwoods. The forwarders used in CTL systems have the advantage of consolidating product piles at roadside, and the larger piles greatly decrease the impact of low veneer content on truck loading times.

Impact of producing short logs

The production of short logs (e.g., 2.5 m) decreases the productivity of most machines, including harvesters, processors, slashers, and forwarders. Producing 2.5-m veneer logs takes more processing time, and veneer logs rejected because of factors such as excess rot are downgraded to pulp or OSB logs. Since some OSB mills request long logs so as to maximize their productivity, they are concerned

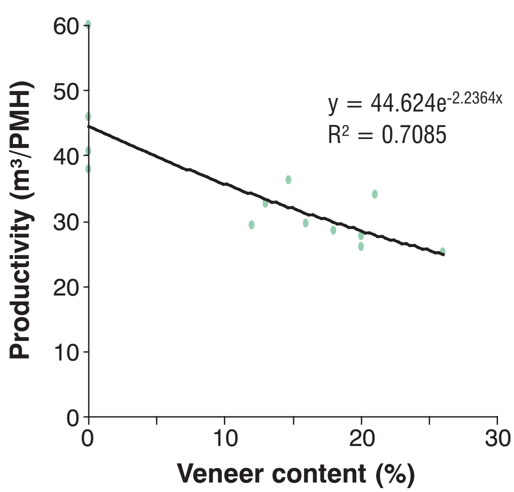

Figure 5. Impact of veneer content on slasher productivity.

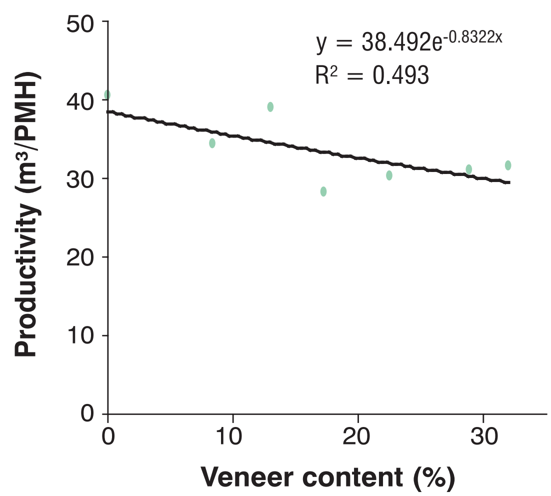

Figure 6. Impact of veneer content on processor productivity.

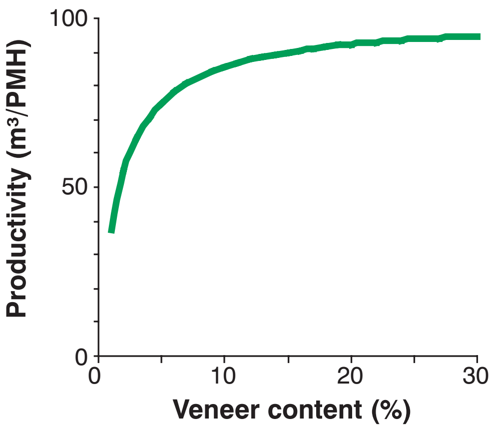

Figure 7. Impact of veneer content on loader productivity.

about this downgrading of veneer logs. Légère (2000) reported that for processors, a 20% increase in the number of short logs reduced productivity by an average of 1.7 m^3/PMH. In one slasher operation we studied, productivity was 36% lower (in m^3/PMH) when producing 2.5-m OSB bolts rather than 4.3-m OSB bolts under similar operating conditions. This is consistent with results from Gingras and Favreau (2002), who found a 16% productivity reduction for a harvester producing a 50:50 mix of short (2.5-m) and long (5-m) logs compared with 5-m logs only.

Trimming

Provincial regulations allow trimming to remove stem sections with excessive rot. However, trimming of butt sections with rot levels below what is allowed by the scaling regulations can enhance the recovery of veneer logs, at the expense of slightly increased fiber loss. This loss is relatively small and should be weighed against the value gains associated with the production of extra veneer logs. For example, with an average volume of 0.50 m^3/stem, trimming a 20-cm section from 20% of the stems would only represent about 0.5% fiber loss.

Feed-roller heads on processors and harvesters permit more effective trimming than with slashers because stems are handled one at a time and can be quickly fed backwards or forwards by a short length. With slashers, trimming is more time-consuming and it is more difficult to position the stem to remove very short sections because handling the loader and grapple requires considerable skill.

Implementation

- With in-woods chipping, there are no clear "best practices" for extracting veneer logs prior to chipping. Manual bucking and piling of veneer logs with a skidder can provide good log recovery, but is clearly dangerous because of the proximity of the chipper infeed. It's also difficult to ensure that the worker will be on-site during all chipping hours. Extraction with slashers or processors prior to chipping would provide the best and safest recovery, but at a higher cost because of the additional phase. The use of a grapple saw or a chipper-controlled cutoff saw should be investigated as a possible means to extract an acceptable proportion of veneer logs at low cost.
- Satellite yards can be an attractive option for consolidating veneer at one location to reduce subsequent loading and haul costs, especially if the yard is located between the supply area and the mill. This approach can offer very good recovery because of increased opportunities for trimming and the ability to work in a controlled environment. Monitoring veneer quality and operator

supervision are easier than in the forest. However, the cost can increase because of the extra handling and reloading of some of the volume, and this must be offset by greater veneer recovery for the approach to be economically viable.

- Roadside merchandizing of veneer and other products with slashers or processors usually offers the lowest costs of all the roundwood options we considered, as well as very good log recovery. Slashers produce high-quality veneer logs, but can experience reduced recovery levels because of the limited trimming possibilities and the reduced productivity when producing high proportions of veneer logs. Processors can provide good recovery levels, but quality must be supervised closely because of the risk of length variability. With low veneer contents, loading trucks from piles created by slashers or processors is costly because of the dispersed piles.
- Cut-to-length systems using single-grip harvesters or processors working behind feller-bunchers are more costly than roadside alternatives for veneer production. With low veneer content, however, they are attractive systems because veneer merchandizing has relatively little effect on productivity, while forwarding enhances sorting quality and allows consolidation of the volumes at roadside, thus resulting in more cost-effective truck loading. Feed-roller heads must be monitored closely to ensure length consistency. Some processor measuring systems use butt plates that produce consistently accurate lengths.
- Trimming maximizes veneer recovery. Although some fiber loss results, this may be offset by the greater net value of the products.
- The Excel spreadsheet that complements this report provides detailed productivity and cost information. In particular, it can be used to calculate the relative cost differences between systems as a result of variable proportions of veneer in a stand. To request the spreadsheet, please contact the author (jf-g@mtl.feric.ca).

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