

The impact of steel and rubber lifters on whitewood loss in a pair of debarking drums

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ABSTRACT: *The woodyard at Georgia Pacific's Cedar Springs, GA, mill offers an opportunity to compare the effects of rubber lifters to steel lifters in a debarking drum. Georgia Pacific's yard has two identical Manitowoc drums operating side by side, one with rubber lifters and one with rounded, steel lifters. A study was conducted to test the hypothesis that rubber lifters will decrease the amount of whitewood in the bark rejects and decrease the production of pins and fines through a reduction in end-brooming, while still achieving a desired level of bark removal.*

During each of three trials, approximately 275,000 kg of southern yellow pine logs were run through each drum. All of the reject material that passed through the drum slots was collected in dump trucks and weighed. Samples of the debarker rejects from each drum were hand-separated to determine the percentage of whitewood. Chip samples were collected prior to screening, and the proportion of pins, fines, accepts, and overs were analyzed using a Gradex classifier. The results showed rubber lifters decrease whitewood losses but not the production of pins and fines.

KEYWORDS: *Drum barkers, lifting equipment, losses, pinus, rejects, rubber, steel, wood handling.*

Minimizing fiber losses from debarking increases the amount of wood that is available for chipping. In the past, average fiber loss during

debarking has been estimated at approximately 2% of the gross volume (1). Rubber lifters in the debarking drum may be one way to improve wood

utilization. The Fiber Recovery and Utilization Group at Mississippi State University attempted to quantify differences between a drum with rubber lifters and one with steel lifters. The hypothesis tested was that rubber lifters improve wood utilization, in comparison with steel lifters, in three ways: (a) they decrease loss of whitewood fiber, (b) they decrease the production of pins and fines, and (c) they maintain a low level of bark in chips.

The study was carried out at the Georgia Pacific mill located in Cedar Springs, GA. The mill offered an opportunity to directly compare the above performance measures. Located on the softwood fiberline are two 3.7 m x 23 m steel trunion-mounted Manitowoc drums, operating side by side at 7 rpm. They are identical, except one has rubber lifters and the other rounded, steel lifters.

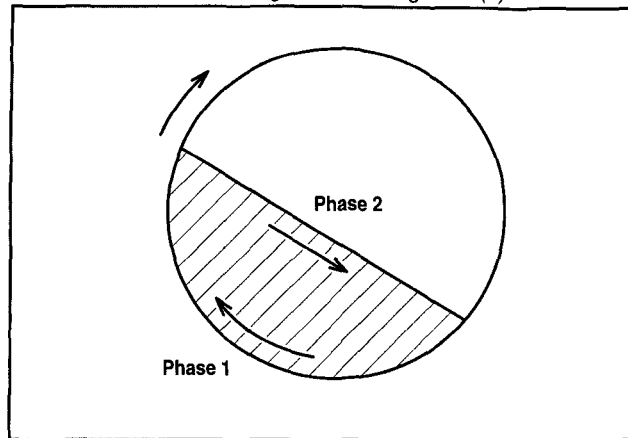
Background

A drum debarker allows shortwood logs to roll and slide freely, impacting each other and the sides of the drum. The impact and the abrasive action between logs causes breakage of the wood-to-bark bond, beginning at sites where the edge of the bark is exposed (2). Once the bark has been removed from a particular site, continued impact can cause damage to the wood fiber. Rubber has six times the absorption capability of steel, which

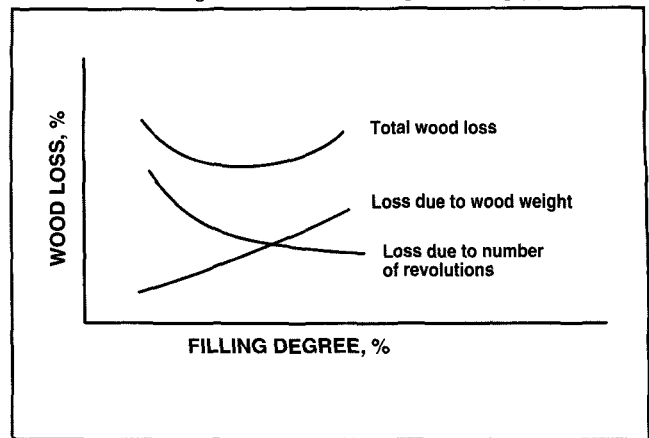
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Debarking

1. Phases of rotation of a log in a debarking drum (4)



2. Factors influencing wood loss in tumbling debarking (4)



should substantially decrease the forces absorbed by the logs (3).

According to a study carried out in 1990 by Hedenberg and the Swedish Forest Products Research Laboratory (STFI) using a pilot drum, tumbling debarking has two phases (4). In the first phase, the log, because of the lifters, follows the side of the drum to the upper part of the wood pile (Fig. 1). In the second phase, the log falls along the surface of the pile, striking other logs, and eventually the log end strikes the side of the drum.

Hedenberg also observed that the number of revolutions made by the logs is a function of the fill level of the drum. A low degree of filling allows the logs to fall sooner during rotation of the drum than with a high degree of filling. Therefore, wood loss caused by rough treatment of the logs striking the side of the drum decreases as the number of log revolutions decreases, although he also points out that breakage increases as the weight of the overlying wood increases (Fig. 2).

Hedenberg's study shows that the optimal filling level is between 40% and 50%. At that level, whitewood loss was reported at approximately 0.1% of the initial quantity of wood. However, he notes that the low values are a result of the light treatment of the logs in the pilot drum compared to that received in a full-scale drum.

A study, similar to the one described in this paper, was carried out by SCA Teknik AB in Sweden in 1981. It com-

pared the differences in whitewood losses between steel and rubber lifters under both summer and winter conditions. Wilhelmson found that the rubber lifters reduced roundwood losses by 0.6–0.8% (5).

Methods

The first phase of the study was carried out in January 1993. To ensure that both drums were operating in a similar manner and to determine the duration of the test, the average retention time for a log was found for each drum. Both ends of a log were painted before being placed in the flume. Entry time and exit times were recorded for each painted log; 37 logs were identified coming out of the steel-lifter drum and 25 from the rubber-lifter drum.

Eight rail car loads of predominantly slash and loblolly pine short wood (*pinus elliottii* Engelm. and *pinus taeda* L.) were designated for the test (four loads for each drum). Gross and tare weights for each car were obtained to calculate the net weight in the drum (approximately 275,000 kg). Each load was assigned to a drum, keeping the total weights and range of log sizes as equal as possible.

Prior to beginning the test, the drums were emptied as much as possible. The four loads assigned to the rubber-lifter drum were placed in the flume at the same rate as was typical during normal woodyard operations. The target fill rate was between 40%

I. Average percentage of bark in chips

	Bark in chips	
	January	March
Rubber lifters	1.60%	0.19%
Steel lifters	1.50%	0.20%
p value	0.69	0.85

and 50%, although there were some fluctuations during the course of the study. The entire volume of the debarker rejects was diverted to dump trucks, which were weighed on the woodyard scales. Fifteen 10-L samples were collected during the test. Additionally, thirty-four 3000-g chip samples were collected prior to screening. All samples were bagged and labeled for transport to the chip laboratory at Mississippi State University.

Upon completing the test with the rubber-lifter drum, the identical procedure was followed for the drum with steel lifters. The same test (omitting the retention time trial) was repeated at the end of March 1993 and again in early July 1993 (omitting both the retention time measurement and the collection of chip samples).

Results and discussion

Retention time trial

The purpose of the time trial was to determine if the retention time was

II. Average chip distribution percentages

	<i>Fines</i>		<i>Pins</i>	
	<i>Jan.</i>	<i>March</i>	<i>Jan.</i>	<i>March</i>
Rubber lifters	1.4%	2.0%	4.3%	5.1%
Steel lifters	1.3%	2.1%	4.2%	5.0%
<i>p</i> value	0.55	0.53	0.80	0.88
	<i>Accepts</i>		<i>Overs</i>	
	<i>Jan.</i>	<i>March</i>	<i>Jan.</i>	<i>March</i>
Rubber lifters	77.6%	77.2%	16.7%	15.7%
Steel lifters	79.1%	75.6%	15.4%	17.2%
<i>p</i> value	0.25	0.43	0.33	0.50

III. Total debarker rejects as a percentage into the drum

	<i>Total rejects, %</i>		
	<i>January</i>	<i>March</i>	<i>July</i>
Rubber lifters	7.81	9.10	7.34
Steel lifters	9.08	9.98	7.46

the same for both drums and to determine the average retention time. No significant difference was found in the retention time of logs between the drums ($p = 0.16$). Therefore, using the average retention time, each trial was halted 15 min after the last log entered the drum.

Chip analysis

A Gradex particle size classifier was used to determine the chip distribution based on the following categories:

- Chips passing through a 3-mm round hole: fines
- Chips passing through a 2-mm bar: pins (sometimes referred to as thins)
- Chips passing through an 8-mm bar: accepts
- Chips passing through a 45-mm round hole: overthick
- Chips retained on a 45-mm round hole: overlength.

After classification by the Gradex, the entire sample was put through a Price chip classifier, which physically sepa-

rated the sample into its components. The percentage of bark in the acceptable and oversized chip fractions was determined through hand separation.

The statistical analysis showed no significant differences between the rubber-lifter and steel-lifter drums for the percentage of bark in chips (Table I) during either the January or March trials. However, the differences between the two trials were quite pronounced, most likely because by the end of March, the bark had begun to slip.

The analysis of the chip distribution found no significant differences between the two types of lifters (Table II). An analysis of variance was done between drums, combining the data from both studies. Again, no significant differences were found between the rubber and steel lifters (p values of 0.98, 0.63, 0.92, and 0.87, respectively, for fines, pins, accepts, and overs).

The chip analysis was expected to show a decrease in the percentage of pins and fines for the rubber-lifter drum because of a decrease in end-brooming. Although visually it appeared that there was less damage, the hypothesis was not supported by the subsequent chip analysis. Two possible explanations for this are that (a) the sampling location was not ideal, making it difficult to ensure that a truly representative sample was always collected and (b) although there appeared to be increased damage in the drum with steel lifters, these differences may have been so small that the inherent

variability of the resource overwhelmed them in the analysis.

Bark analysis

Total rejects from the drum slots, as a percentage of the total weight into each drum, are listed in Table III. It was expected that, while the steel lifters may cause more fiber damage, they would also be more effective in removing bark. Observation of the debarking action of both drums revealed that the rubber lifters carried the logs higher up the side of the drum than the steel lifters. The rubber lifters are made of 70-durometer styrene-butadiene rubber, which has a coefficient of friction for wood that is six times that of steel (3). A drum debarker relies on the impact of the logs during tumbling to break the interface between the bark and wood. The force upon impact and thus the abrasive action is increased when the logs are carried higher up the drum.

The whitewood and bark from each debarker reject sample were separated by hand and weighed, and the percentage of whitewood in each sample was calculated. A subsample of the drum rejects was oven dried at 104°C for 24 hours. Average moisture content (on a green basis) was 51% and 55% for the rubber-lifter and steel-lifter drums, respectively, for the January study; 50% and 49% for March; and 46% and 43% for July. No significant differences were found (p values of 0.24, 0.69, and 0.22, respectively). This check was done to establish that the differences in the debarker reject weights were not due to a higher proportion of water in the samples.

Finally, the amount of whitewood in the debarker rejects was consistently less from the drum with rubber lifters. Table IV lists the average percentage of whitewood in the debarker rejects, while Table V gives the results as a percent of gross roundwood input to the drum. There were significant differences between the drums for both the January and March studies. However, in July the differences in whitewood losses between the two drums were less pronounced.

IV. Average percentage of whitewood in the debarker rejects

	Whitewood			
	January	March	July	Overall
Rubber lifters	2.4%	2.5%	5.3%	3.2%
Steel lifters	5.9%	12.9%	8.5%	7.8%
p value	0.0002	0.04	0.14	0.0

V. Fiber loss as a percent of gross weight input to each drum

	Lifter type	Gross wt., kg	Rejects wt., kg	Fiber, %	Percent of gross
Jan.	Steel	306,515	27,827	5.9	0.54
	Rubber	321,678	25,123	2.4	0.19
Mar.	Steel	252,610	25,221	12.9	1.29
	Rubber	279,322	25,426	2.5	0.23
July	Steel	258,465	19,277	8.5	0.63
	Rubber	252,673	18,554	5.3	0.39
Ave.	Steel	817,591	72,325	7.8	0.69
	Rubber	853,673	69,103	3.2	0.26

The level of whitewood loss was consistent for the drum with rubber lifters for the first two repetitions, but more than doubled for the July trial. Apparently, when the bark is more firmly attached to the bole, the rubber lifters cause minimal whitewood loss while still allowing a desired proportion of the bark to be removed. However, when the bark is more readily removed, the rubber lifters do not afford as much protection to the logs. As Pigott and Thompson noted, wood loss becomes especially significant after 90% of the bark has been removed (6).

The steel lifters showed a great deal of variability throughout the entire study. In general, steel lifters are more aggressive on the log surface and therefore demonstrate greater variation in whitewood losses as the condition of the log changes. During the spring and summer, the bark is more easily removed, thus leaving the whitewood exposed to the steel lifters for a longer period of time.

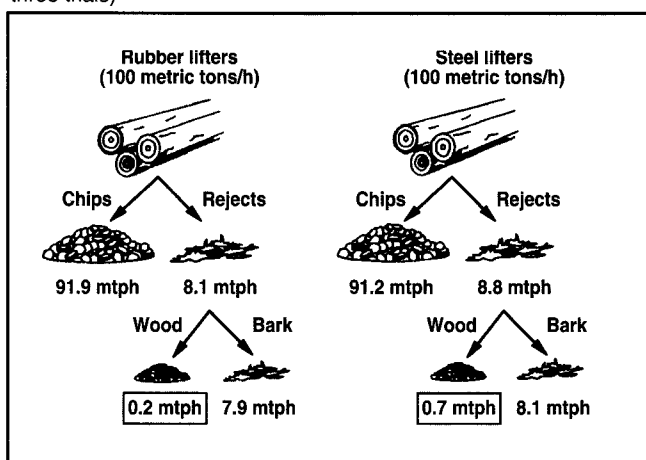
Since the purpose of this study was to quantify the amount of usable fiber lost during debarking drums, it may be beneficial to look at the percentages in Table IV in terms of throughput. Figure 3 shows an example of roundwood broken down into its components, based on the overall results of the three trials carried out at the Cedar Springs, GA, mill. One hundred metric tons per hour of throughput translates into a potential increase in usable fiber, going to the chipper, of between 0.2 and 1.1 metric tons per hour; the average is 0.5 metric tons per hour.

Conclusions

At this mill, the data supported the hypothesis that rubber lifters in the debarking drum decrease the loss of whitewood, particularly in the winter months. This translates to an increase in the amount of usable fiber going to the chipper. Although the percent of bark in chips was substantially higher during the January trial, both drums performed at the same level of bark removal efficiency. The analysis failed to show a decrease in the production of pins and fines from wood processed through the drum with rubber lifters.

The data show that alternative lifter designs have an impact on the degree of whitewood losses. Rubber lifters are one option that could be considered, although other configurations, not addressed in this report, may also be effective. Other items to be considered are the impact of lifter design on drum shell life, capital and maintenance costs, and how these balance with the potential increase in wood utilization, all of which will be unique for a given woodyard. ■

3. Breakdown of roundwood into components (overall values for the three trials)



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