AR No. 2

Convert Scragg Saw

Recommended Action

Mills using circular saws typically achieve 50% conversion of raw materials into lumber products. Installing a band saw mill with a thinner kerf blade can increase lumber yield to 57%, leading to a 7% profit increase.

Assessment Recommendation Summary			
Wood Waste (ft^3/yr)	Cost Savings	Implementation Cost	Payback (years)
101,569	$253,000	$145,450	0.6

Background

Saw kerf is a measure of the thickness of a saw blade and determines the width of the path that is cut by the saw. Saw kerf averages 21% of the wood waste for circular sawmills and as low as 12% for high production band sawmills. A typical circular sawmill will convert 50% of a log into primary product, while a typical band sawmill will reach conversion of around 57%.

Anticipated Savings

The difference in kerf between a circular saw and band saw can be used to estimate the wood savings in converting from circular to a band saw. The scragg saw at your mill has a kerf (K_C) of 0.190 inch, while current band saw headrigs can achieve kerfs (K_B) below 0.140 inch. So the kerf wood fiber savings (KFS) are calculated as follows:

$$
\begin{aligned}
KFS &= K_C - K_B \\
&= 0.190 \text{ in} - 0.140 \text{ in} \\
&= 0.050 \text{ in} \\
&= 0.00417 \text{ ft}
\end{aligned}
$$

The scragg saw set up consists of 6 saw blades. The middle two cut 4-inch lumber (3.630” rough green) and outer four make 2-inch lumber (1.630”rough green). This is shown in Figure 1.

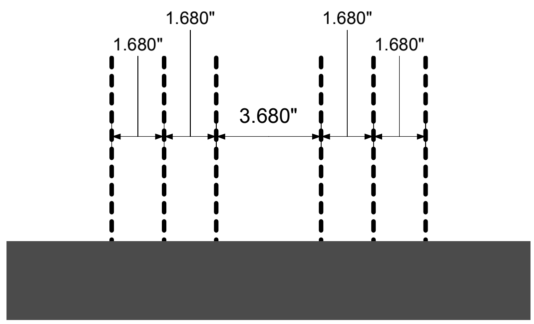

Figure 1. scragg saw set-up

We will estimate savings from the production data we were given on our plant visit. This data shows that over a three-month period the average production through the scragg (P_{avg}) was 526 logs/hr. On our plant visit we were informed that the scragg has a capacity of 20 logs/min, 1,200 logs/hr, while a particular band saw that you were considering had a capacity of 15 logs/min, 900 logs/hr. Since the average production is below the capacity of the band saw, conversion to this band saw will not decrease throughput. Production data also shows that the average log diameter (D_{avg}) was 8.13 inches, and the average log length (L_{avg}) was 9.26 ft for logs processed through the scragg. Assuming that the logs are consistently centered on the scragg, the log savings are calculated from the dimensions in Figure 2 as follows.

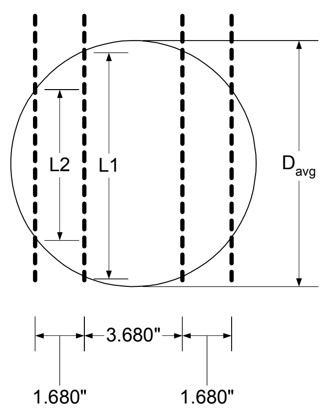

Figure 2. average sawing pattern

$$
\begin{aligned}
L1 &= 2[(D_{avg}/2)^2-(3.680/2")^2]^{1/2} \\
&= \text{ inches} \\
&= \text{ ft} \\
L2 &= 2[(D_{avg}/2)^2-(3.680"/2 + 1.680")^2]^{1/2} \\
&= \text{ inches} \\
&= \text{ ft}
\end{aligned}
$$

and,

$$
\begin{aligned}
KS &= KFS \times 2\,(L1 + L2) \times L_{avg} \times P_{avg} \times OH \\
&= 0.00417ft \times 2(0.606ft + 0.360ft) \times 9.26ft/log \times 526logs/hr \\
&\quad \times 2{,}560hr/yr \\
&= 100{,}457\ ft^3/yr
\end{aligned}
$$

Using the above method, we can accurately estimate the amount of wood sawdust saved from a thinner kerf. Accurately calculating yield improvement is more complicated, and requires data that we could not obtain on our plant visit. This includes information on the bend in the logs and the actual roundness (or aspect ratio) of the logs processed at your plant. Since we do not have this information we must estimate yield improvement with the assumption that the logs processed are very straight and round in diameter.

A reduction in saw kerf, will result in a reduction in sawing variation. Sawing variation can be expressed with standard deviation. For softwoods, circular saws typically have a standard deviation (S_{TC}) between 0.030 and 0.050 inches while band saws have a standard deviation (S_{TB}) between 0.020 and 0.030 inches. In our analysis we will assume the maximum standard deviation for each. To find the actual wood fiber savings we need to calculate the sawing allowance. The circular sawing allowance (SA_C) and the band sawing allowance (SA_B) are found by multiplying each standard deviation value by 1.645. These sawing allowances take into account the thickness that must be added to the rough green size in order to insure that less than 5 percent of the boards are undersized (Philip).

$$
\begin{aligned}
SA_C &= 1.645 \times S_{TC} \\
&= 1.645 \times 0.050\ in \\
&= 0.08225\ in
\end{aligned}
$$

and,

$$
\begin{aligned}
SA_B &= 1.645 \times S_{TB} \\
&= 1.645 \times 0.030\ in \\
&= 0.04935\ in
\end{aligned}
$$

The sawing variation wood fiber savings (VFS) is the difference between the two sawing allowances:

$$
\begin{aligned}
VFS &= SA_C - SA_B \\
&= 0.08225\ in - 0.04935\ in \\
&= 0.0329\ in
\end{aligned}
$$

This value can be used to find the reduction in rough green sizes of the lumber cut by a band saw. Monetary savings will occur if lumber can be marketed at a reduced rough green size. Assuming that that buyers will appreciate the new sawing accuracy the lumber sizes can be reduced as follows:

$$
\begin{aligned}
RG_{B,4} &= 3.630\ in - VFS \\
&= 3.597\ in
\end{aligned}
$$

$RG_{B,2}$ = 1.630 in - VFS
= 1.597 in

where,

$RG_{B,4}$ = new 4 inch lumber rough green
$RG_{B,2}$ = new 2 inch lumber rough green

The increase in yield from these reduced rough green sizes depends on the dimensions of the boards made. The smaller the board dimensions the greater the improvement in yield will be. Since about 70% of the lumber produced at your mill is 2x4 we will calculate yield improvement based on 2x4 dimensions. The new smaller rough green size improves yield because it allows an additional 2x4 to be produced for certain log diameters. For each log diameter the total 2x4 count is found by adding the 2x4 count for each section that is cut (the 4" section in the middle and the two 2" sections on the sides): The circular saw count (C_B) is found as follows:

$$C_B = [(D/2)^2-(3.630/2")^2]^{1/2}/RG$$

The log data that we obtained on our plant visit shows that the logs processed through the scragg show diameters that are fairly normal in distribution. So the percentage of logs that have certain diameters are calculated based on the normal distribution.

Monetary savings from the increase in yield depend on whether you decide to reduce log purchases and keep production the same, or increase production while keeping the amount of logs purchased the same. We will assume that the components in your mill after the scragg can keep up with an increase in production. For each diameter with an increase in 2x4 count the increase in production (PI) is calculated as follows:

$$PI = \%Logs \times Count\ Increase \times L_{avg} \times P_{avg} \times OH$$

where,

%Logs = the percentage of logs with a specific diameter
Count Increase = the number of additional 2x4's that can be produced for a specific diameter with the new rough green size

A computer spreadsheet was used to find the log diameters that will result in additional 2x4's. The increases in production that will occur for logs with specific diameters are summarized in the following table.

Production Increase Summary Table			
Diameter Range (in)	Count Increase	%Logs	PI (ft/yr)
6.15 - 6.20	1	0.61%	76,072
7.70 - 7.80	2	1.94%	483,803
9.10 - 9.15	1	1.00%	124,691
10.00 -10.05	2	0.64%	159,609
10.60 - 10.75	2	1.15%	286,790
Total		5.34%	1,130,952

The above table shows that the total increase in production (PI_{tot}) is 1,130,952ft of 2x4's, 753,368 board feet of lumber each year. The cost savings from this increase in production is calculated as follows:

CS = avg. selling price x PI_{tot}
= $0.335 / board feet x 753,368 board feet/yr
= $253,000 /yr

Implementation Cost

Implementation will include the purchase and installation of a 6-ft band headrig for the scragg mill. Estimated cost for the necessary equipment is summarized in the following table (Philip).

Implementation Cost Summary Table	
Item	Cost
Band Headrig (6')	$92,000
Filing Room Equipment	$31,050
Installation Costs	$12,650
Sawblades Initial Costs	$4,000
Sawbrake	$5,750
Total	$145,450

A total implementation cost of $145,450 will result in a savings payback of 0.6 years.

Log Diameter (in)	Average 2x4's/log	Typical Daily Production											
		8ft Length			9ft Length			10ft Length			12ft Length		
		Count	# 2x4's	mbf	Count	# 2x4's	mbf	Count	# 2x4's	mbf	Count	# 2x4's	mbf
5	2	79	158	0.8	78	156	0.8	36	72	0.4	22	44	0.2
6	2.5	385	961	5.1	418	1,046	5.6	250	624	3.3	155	389	2.1
7	3	461	1,383	7.4	575	1,726	9.2	450	1,349	7.2	202	607	3.2
8	6	573	3,438	18.3	1,043	6,260	33.4	785	4,711	25.1	249	1,494	8
9	7	195	1,367	7.3	378	2,643	14.1	285	1,995	10.6	78	547	2.9
10	9	139	1,255	6.7	260	2,344	12.5	156	1,406	7.5	51	462	2.5
11	12	222	2,666	14.2	280	3,364	17.9	230	2,758	14.7	64	763	4.1
12	12	100	1,204	6.4	90	1,075	5.7	79	947	5	41	496	2.6
Sum		**2,155**	**12,432**	**66.3**	**3,123**	**18,615**	**99.3**	**2,270**	**13,862**	**73.9**	**863**	**4,802**	**25.6**