SAW-LOG BARKERS

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Introduction

Bark and wood have long been considered separate and distinct raw materials. The sawmill industry has always disposed of bark by slabbing logs and edging boards. Until recent years, little consideration has been given to the amount of wood that was discarded with the bark, but considerable effort is now being expended to utilize wood formerly discarded. This is being done to solve economic problems and to supply the increasing demand for wood.

This situation has brought about the development and increasing use of saw-log barkers. A survey of sawmill and logging operations made by the Forest Products Laboratory 10 years ago revealed no saw-log barkers in the eastern part of this country and only a few in the Northwest. These were hydraulic barkers installed at a cost that

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2Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

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exceeded the total value of a moderately large sawmill. Early machines, however, started a trend that was responsible for the development and use of present day mechanical barkers. To understand the reasons for the shift from hydraulic to mechanical barkers, it is necessary to know the composition and needs of the sawmill industry.

Sizes of Sawmills

In the United States there are approximately 60,000 sawmills. These can be roughly divided into large and small mills. The total lumber production is about equally divided between the two groups, but less than 5 percent can be considered large mills. All of these mills, regardless of size, produce slabs, edgings, and bark. Barking equipment is used mainly to remove the bark from the wood, so that slabs and edgings can be utilized. The bark itself is frequently used for fuel but several firms are using it for other products.

Efficient removal of bark from wood is very important to full utilization of the wood resources of this country. The 60,000 sawmills produce an estimated 1.7 billion cubic feet of slabs and edgings as a byproduct per year. These sawmills vary considerably in size, and the timber processed by them likewise varies in size as well as species. This situation materially affects the size, production rates, and cost of equipment required by the industry. The range in size of sawmills is shown in table 1.
Table 1.--Size of sawmills in United States

<table>
<thead>
<tr>
<th>MM Board-feet</th>
<th>M Board-feet</th>
<th>M Board-feet</th>
<th>Percent of sawmills</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 0.9</td>
<td>0 - 4</td>
<td>0 - 0.5</td>
<td>87.52</td>
</tr>
<tr>
<td>1 - 2.9</td>
<td>4 - 12</td>
<td>0.5 - 1.5</td>
<td>8.70</td>
</tr>
<tr>
<td>3 - 4.9</td>
<td>12 - 20</td>
<td>1.5 - 2.5</td>
<td>1.32</td>
</tr>
<tr>
<td>5 - 9.9</td>
<td>20 - 40</td>
<td>2.5 - 5</td>
<td>1.24</td>
</tr>
<tr>
<td>10 - 14.9</td>
<td>40 - 60</td>
<td>5 - 7.5</td>
<td>.47</td>
</tr>
<tr>
<td>15 - 24.9</td>
<td>60 - 100</td>
<td>7.5 - 12.5</td>
<td>.36</td>
</tr>
<tr>
<td>Over 25</td>
<td>Over 100</td>
<td>Over 12.5</td>
<td>.39</td>
</tr>
</tbody>
</table>

1-Based on 250 working days per year.
2-Based on 1 shift of 8 hours.

Status of Barkers in Sawmills

Although sawmills vary in size, their basic requirements for barking equipment can be considered in three categories. The first includes very large mills that require equipment capable of handling large volumes and mills with specialized problems, such as those encountered with redwood. Such mills generally require special engineering services or specially designed equipment.

Mills in the second category, which includes a major portion of the industry, require equipment of standard design that can be mass produced to keep costs within the economic reach of these sawmills. No special engineering services should be required other than those necessary for installation.

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The remainder of the industry cannot economically afford log-barking equipment, but it can utilize less expensive slab and edging barkers. These machines may be used by an individual sawmill, or located so that slabs and edgings from several mills can be processed at a central concentration point.

Economic factors, including expanding chip markets, improved barking equipment, and other developments, have steadily changed the size class of sawmills in each category. A few years ago, sawmills with an annual production of 5 million board feet or less were considered in the last category. Today a number of mills of this size use log barkers. Likewise, very few large mills are designing special equipment but are installing commercially available equipment. Thus, the number of mills in the second category is increasing, while the number in the other two is decreasing. Present status of the industry is:

<table>
<thead>
<tr>
<th>Yearly production</th>
<th>Mills with barkers</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM B M</td>
<td>Percent</td>
</tr>
<tr>
<td>0 - 0.9</td>
<td>0</td>
</tr>
<tr>
<td>1 - 2.9</td>
<td>0</td>
</tr>
<tr>
<td>3 - 4.9</td>
<td>4</td>
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<tr>
<td>5 - 9.9</td>
<td>10</td>
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<tr>
<td>10 - 14.9</td>
<td>12</td>
</tr>
<tr>
<td>15 - 24.9</td>
<td>12</td>
</tr>
<tr>
<td>Over 25</td>
<td>37</td>
</tr>
</tbody>
</table>

Approximately 71 percent of these barker installations are in the East, and 29 percent are in the West. More than half of all
installations are in the Southeastern States. Oregon has more than any other State, followed closely by Arkansas. This is a drastic change from a few years ago, when the only saw-log barkers were located in two States, Washington and Oregon.

The major factors influencing this change have been developments in mechanical barkers and increasing markets for chips. In general, mechanical barkers have lower production rates than hydraulic barkers. Even so, the production rate is often greater than the sawmill requires. Production rates required by sawmills of different sizes are shown in figure 1.

Relation of Timber Size to Barker Capacity

Next in importance and closely associated with production rate requirements is the size of timber to be barked. Most saw logs vary from 8 to 32 feet in length. To obtain lumber of highest quality from trees, they are bucked into logs of various lengths. Barking equipment, therefore, should be able to accommodate these various lengths, preferably up to full tree lengths. Minimum saw-log diameters are generally from 6 to 10 inches, depending upon utilization standards. The trend, however, is toward more complete utilization by logging to a 3- or 4-inch minimum top. After the tree length is barked, the portion less than 8 inches in diameter is cut off and diverted to fiber or other wood products besides lumber. Barking
machines, therefore, should be capable of handling these small diameters.

The maximum diameter of sawtimber varies considerably with timber stands and is generally greater in the West than in the East. Eastern softwood timber is, on the average, smaller than hardwood timber. In the West, softwoods are larger than hardwoods. Only a small percentage of eastern saw logs exceed 36 inches in diameter, and most are less than 26 inches. Corresponding maximum diameters in the West are about 60 inches for conifers and $\frac{4}{8}$ for hardwoods. Redwood and some old-growth Douglas-fir average even larger.

In addition to size limitations, other timber factors must be considered. Both the wood and bark of softwoods, as a group, differ from those of hardwoods, and there are also differences among the species in each group. The one thing in common is the bond between the bark and the wood, known as the cambium layer. The primary function of a barker is to destroy this bond, thus separating the two materials. All its other features have to do with handling the logs.

Perhaps the major difference between softwoods and hardwoods is the straightness and size of limbs. Because of these variations, it is desirable to move logs forward without rotation to reduce complications.

**Pulp-Chip Quality Requirements**

An important factor influencing installation of barking equipment is the demand for pulp chips. These chips are processed into a
vast variety of products and, in general, the end product has a greater influence on chip requirements than the process used. Bark can be digested in the sulfate process, which is widely used to make pulp for such products as milk containers. These products, however, cannot tolerate bark or dirt specks regardless of the pulping process used. On the other hand, fiberboard roofing felt and similar products can tolerate considerable percentages of bark.

The pulp-refining process used by a particular mill also influences the percentage of bark allowable. Many mills have pulp cleaners of recent design. This equipment, or a special bleaching process, makes it possible for some mills to accept chips with a higher percentage of bark than others. Many southern pulp mills specify a bark content of not more than 1 or 2 percent in the chips they buy.

Because of these variations, there are no standard specifications for chips. Sawmill operators must, therefore, agree upon specific requirements with the chip purchaser. Many specifications for chips have been arrived at more or less arbitrarily and further quality control studies are needed to set up requirements for chips to be used under specific sets of conditions.

Although the pulp industry is the major market for sawmill chips, the new, rapidly expanding particle board industry is starting to compete for this raw material in some areas. Bark limitations are less restrictive for this product than for pulp.
Barking Machines

Practically all of the barkers used by sawmills are producing logs or slabs that are clean enough to make chips meeting purchasers' requirements. Difficulties are being experienced only under unusual conditions.

Most machines in use at sawmills are of three types, hydraulic, cambium shearing, and chain flail. There are a few knife and other types of machines in use. A few years ago hydraulic barkers predominated, but now the cambium-shearing machines are more numerous.

The primary requirement of a hydraulic barker is an adequate water supply. Only a small percentage of the thousands of sawmills can meet this requirement. High-pressure streams of water are required, and these necessitate expensive pumps with high power requirements. These factors raise costs beyond the economic limits of all except very large sawmills.

Power requirements for the barking mechanism of mechanical barkers are roughly only one-tenth those of hydraulic barkers. Both the price of the machine and its operating cost are therefore much less. Although other factors are involved, these are the major reasons for the rapidly expanding use of mechanical barkers.

The number of cambium-shearing barkers at sawmills far exceeds the total of all other types. These machines exert tangential forces that shear the bark from the wood at the cambium layer. Standard

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models are available in sizes that take logs from \( \frac{1}{4} \) to 72 inches in maximum diameter. The minimum usable log length is less than 8 feet, and since barking is continuous, there is no limit on maximum length if the conveyor system is adequate. In many cases, feed rates exceed sawmill requirements.

These machines cost from $17,000 to $70,000. Operating costs vary considerably depending upon size of timber, volume of production, and other variables. However, sawmills with an annual production as low as 8 million board feet are profitably using these machines. One southern sawmill cutting between 4,000 and 4,700 board-feet per hour has been profitably recovering chips worth $8 per thousand board-feet of lumber sawn.

The use of chain-flail barkers, particularly by smaller sawmills, is steadily increasing. These machines use chain flails to pound the bark off the logs. The quality of barking varies according to the season of the year, as with other machines, but in general it is not considered as high as that obtained with the cambium-shearing barkers. However, chip producers using these machines are having no serious difficulty meeting purchasers' requirements.

These barkers cost from $13,000 to $20,000. They are being used by sawmills cutting from 2 to 12 million board-feet a year.

In addition to round-log barkers, an increasing number of mechanical slab barkers are being used. These are of three types,
cambium shear, hammer, and chain flail. These machines cost from $5,000 to $10,000. A number of sawmills with round-log barkers have added slab barkers. Slabs are bought from surrounding small mills, thus increasing chip production. Slabs from the small percentage of logs too large for the round-log barker are also being processed. This practice thus makes barking and chip-production facilities available to very small sawmills.

**Future Trends**

There is little doubt that the existing program of barking and chipping just outlined will continue. Although most of the present activity is confined to softwood timber, similar development is expected in hardwoods. Improvements are constantly being made on existing machines to improve efficiency and quality of barking. Only a small percentage of the sawmill industry is now utilizing its slabs and edging byproduct. Bark utilization must await development of products and markets.

Minor consideration is now being given to logging byproducts, such as tops and limbs. Portable chippers are being tested, as well as processes for separating and segregating bark from the chips. Whether this approach or portable barkers will solve this problem remains to be determined.

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Figure 1.—Method of determining barking machine capacity per hour, according to log diameter and rate of feed per minute. Example: To bark 5 thousand board-feet of 22-inch logs per hour, a machine must have a production rate of 4 lineal feet per minute.