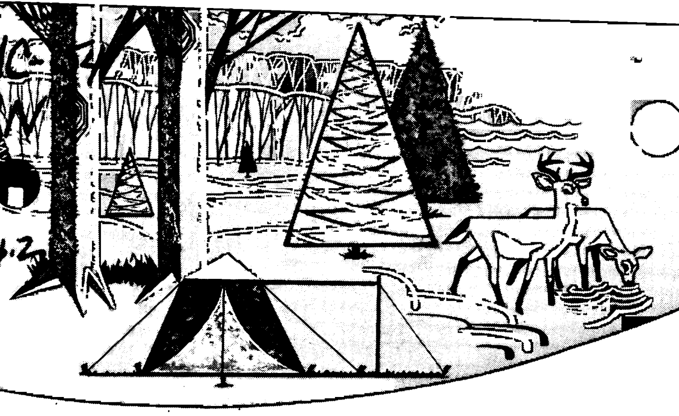

U. S. FOREST SERVICE

RESEARCH NOTE NC-54

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Bark Separation During Chipping With a Parallel Knife Chipper

ABSTRACT. — Five winter-cut northern species were chipped in a frozen and unfrozen condition with a parallel knife chipper. The degree of bark separation during chipping and a relative gradation of chip size are reported.

Bark is normally removed from pulpwood in the roundwood stage. This means that crooked tops and limbs are not used because barking, handling, and transporting such material is not feasible with present harvesting machines and systems. But a method of chipping in the woods and removing and segregating the bark during or after chipping would allow utilization of large tops and limbs which are presently left in the forest to rot.

The primary objective of the study reported here was to determine the degree of bark separation while chipping frozen and unfrozen winter-cut wood. (We chose winter-cut wood because we believed it had maximum adhesion of bark to wood.) If an adequate degree of separation occurs during chipping, then segregation of bark from wood after chipping becomes the primary target of research. Two processes, the Hosmer[1] and Vac-sink,[2] have been developed for segregating bark after chipping but have had only limited success. The results from this study provide additional basic information to help in the solution of the bark segregation problem.

Tests

A parallel knife chipper[3] was chosen for this study since it is the lightest construction of all the types of pulpwood chippers and appears suitable for *portable* remote chipping. The particular machine for this study was installed at a Lake States pulpmill.

The five test species selected were hard maple (*Acer saccharum*), soft maple (*Acer saccharinum*), eastern hemlock (*Tsuga canadensis*), quaking aspen (*Populus tremuloides*), and spruce (*Picea glauca*). For each species five frozen and five unfrozen logs were chipped. The tests on unfrozen logs were run in December; those on frozen logs in February. The mean maximum ambient temperature for several days preceding the December test was 34.4° F. whereas the mean maximum temperature in February was 19.8°. The day prior to chipping in February the temperature was down to −22°.

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[1] *Blackford, J. M. Bark extraction techniques bring bush chipper closer, Canad. Forest Ind. 86(1): 50-53, 1966; Harvesting wood via felchip, Pulp and Paper 39(19): 83-85, 1965; and Separating bark from wood chips, Forest Prod. J. 11(11): 515-519, 1961.*

[2] *Anonymous. Vac-sink or debarking by vacuum, Pulp and Paper 35(10): 55, 1961. Wesner, Adam L., Method of separating wood chips from bark chips, U.S. Patent 3032188, 1962; and Vac-sink for recovery of pulpwood chips from wood-bark waste, Pulp and Paper 37(17): 61-65, 1962.*

[3] *A chipper where primary cutting action is parallel to the wood grain.*

As each log was chipped, 40 to 50 pounds of chips were removed from the discharge system of the chipper and stored in polyethylene bags in an unheated building to retain maximum moisture until analyzed. (Two months was the maximum storage time before analysis.)

Analysis of Data

For the bark separation analysis, the total sample for each log was dumped in a pile from the polyethylene storage bag, the pile was quartered, each quarter was halved, and three of these halved portions were chosen at random for analysis. The free wood, free bark, tight bark (chips with adhered bark), and fines (bark and wood) were sorted by hand, and each class of material was weighed on a beam balance. In addition, the bark from the fraction of chips containing tight bark was removed to obtain a measure of the total percent of bark in the sample.

A secondary objective of the study was to screen a sample of chips from each log to obtain a relative gradation of chip sizes. For this analysis a volume of chips equivalent to a quartered section (approximately 10 pounds) was chosen at random from each log and placed in a Gilson square-mesh testing screen with the following screen elements: 1-inch, .75-inch, .50-inch, .25-inch, and pan. Each sample was agitated in the Gilson screening machine for 4 minutes. The fractions remaining on each screen were weighed on a conventional beam-type scale.

Results

Chipped frozen wood had a higher percentage of free wood, bark, and fines, and a lower percentage of bark bonded to wood (tight wood) than chipped unfrozen wood (table 1). Chips produced from frozen wood also showed a significant increase in fines and small chips compared to chips produced from unfrozen wood (table 2). Although chip length was quite constant at 1-¼ inch, the greatest concentration of chips occurred on the .50-inch mesh screen since the chip width was random. The only exception was hemlock where over 50 percent of the chips produced from both frozen and unfrozen hemlock remained on the .25-inch mesh screen or pan.

Table 1. — Percentages of free wood chips, bark, fines, and chips with bark

Item	Hard maple		Soft maple		Spruce		Aspen		Hemlock	
	Unfrozen	Frozen	Unfrozen	Frozen	Unfrozen	Frozen	Unfrozen	Frozen	Unfrozen	Frozen
Free wood	82.32	85.22	81.35	85.70	73.81	79.84	77.77	82.13	76.27	77.89
Bark	6.26	9.00	5.47	6.84	2.04	7.65	7.12	7.56	5.60	7.90
Fines	1.72	1.70	1.04	1.92	1.24	3.43	2.35	3.29	3.50	7.99
Tight bark	9.70	4.08	12.14	5.54	22.91	9.08	12.76	7.02	14.63	6.22
All bark as a percent of total material[2]	9.7	11.0	10.7	9.6	11.9	12.5	14.2	13.7	14.0	14.2
Unloosened bark as a percent of total material[3]	2.6	1.2	4.7	1.8	9.2	3.1	5.9	4.5	6.7	2.3

1/ Each tabulated value is the mean percentage from three samples from each of five logs. The percentages are based on green weight. The first four figures in each column add to 100 percent.

2/ The bark was removed from those chips that still had the bark on and was weighed. This weight of bark was added to the weight of free bark and one-half the weight of fines.

3/ Bark adhering to wood chips.

Table 2. — Percentage of chips retained on each screen[1]

Sieve size, (inches)	Hard maple		Soft maple		Spruce		Aspen		Hemlock	
	Unfrozen	Frozen	Unfrozen	Frozen	Unfrozen	Frozen	Unfrozen	Frozen	Unfrozen	Frozen
1.0	14.2	3.7	6.2	1.5	9.7	2.9	1.6	1.3	1.3	0.6
.75	19.7	13.4	15.5	9.3	12.5	10.5	8.9	8.5	5.7	3.4
.50	44.2	49.4	49.9	51.2	40.2	43.0	48.7	45.9	38.0	28.8
.25	16.3	25.1	21.8	29.3	28.7	32.4	30.0	32.1	39.1	46.7
Pan	4.1	6.1	5.2	6.3	7.2	8.8	9.0	9.5	14.4	18.5
Total	98.5	97.7	98.6	97.6	98.3	97.6	98.2	97.3	98.5	98.0

1/ The percentage of each fraction was determined from the total initial sample size. A small part of each sample was lost during screening and weighing, as indicated by final percentages.

Discussion

Specifications as to the amount of bark allowed in wood chips vary with the pulping process and individual mill using a given pulping process. Sulfite mills, which have nearly 28 percent of the pulping capacity in the Lake States, have the strictest requirements on bark removal. Often no bark is allowed. The remaining mill capacity could probably accept higher bark contents in varying degrees.

This study has shown that, except for unfrozen spruce, 51 to 89 percent (varies with species and whether frozen or not) of bark is separated from the wood during chipping. Thus, economical "after-chipping" bark removal methods might be realistically devised to allow some bark impurities and still be suitable for a significant portion of the pulpwood market. Under these conditions remote chipping could then be considered as a reliable means of supplying increasingly larger portions of the market.

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