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STEAMING CHIPS FACILITATES BARK REMOVAL

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ABSTRACT.--Whole tree chipping is a productive and economical harvesting system. The resultant product, however, is barky chips. This paper outlines a promising method for removing the bark particles from whole tree chips.

OXFORD: 821:825.71. KEY WORDS: barking, whole tree chipping.

Logging residues in the United States total more than 3.5 billion cubic feet annually. Recovery of this valuable fiber could supply more than half our annual pulpwood requirements. These residues have not been utilized because of the high cost of harvesting by conventional logging methods and the lack of effective and economical methods for removing enough bark to make them suitable for pulping.

In general, the bark on most residues cannot be removed with conventional debarking methods. Most of the residues can, however, be chipped at reasonable cost if they can be concentrated at a central woods landing economically. We undertook some research to provide a means of removing bark after chipping.

We have published several articles on methods for removing bark from wood chips. This paper deals with a complementary process developed to increase the bark removal efficiency of the chip compression process (Arola and Erickson 1974). The improvement includes steaming the unbarked chip mass before the compression treatment followed by a light mechanical attrition and screening.

STUDY VARIABLES

The main variables considered for the chip debarking study were species, season chipped, steam pressure, and steaming time. Observations during testing indicated that we should also consider variation in bark removal and wood loss due to compression roll surfacing (smooth and knurled) and bark removal in each size class of chips.

In addition to steaming before debarking, we also submitted the output chips to a light mechanical attrition to break the bark remaining with the chips into fines. Mechanical attrition is beneficial because the bark remaining after compression is very friable and is readily subject to further breakdown. The selective breakdown in bark size allowed additional bark to be removed by screening. There are many attrition methods, so we decided to begin a new study dealing only with attrition methods. A separate report has been published on the results of that study (Mattson 1974).

Three major northern pulpwood species were tested; aspen (*Populus tremuloides*), sugar maple (*Acer saccharum*), and jack pine (*Pinus banksiana*).

Bark removal is affected by season of the year trees are cut and chipped: it is easier to debark during the growing season than during the dormant season. The efficiency of bark removal from chips also varies within season. So, over a 2-1/2-year period tests were made during several dormant and growing season months (table 1).

Table 1.--*Cutting and chipping month schedule for bark removal tests*

Month	Aspen	Jack pine	Sugar maple
January	X		
February	X	X	X
March	X	X	
April	X		
May			X
June	X	X	X
July	X	X	
August	X	X	X
September	X	X	X
October	X		X
November	X	X	
December	X		X

TEST PROCEDURE

All material was cut in Baraga County and chipped at Michigan Technological University's Ford Forestry Center near L'Anse, Michigan. The chipping was performed with a Morbark Chip Pac.[1]

After chipping, the sample material was brought to the Forest Engineering Laboratory in Houghton, Michigan. The barky chips were then screened using a Sweco Classifier[1] to remove fines (-3/16 inch) and oversized chips (+1-1/8 inch). The fines and overs were discarded. (In a mill situation the oversized material could be rechipped and recycled over the screens but they were discarded in these tests because a rechipper was not available.)

Next, the chips were steamed. Steam pressures and steaming times tried were 2 to 14 lb/in.^{2}g and 1 to 10 minutes, respectively. Then chip mass was run through the compression debarker. Finally, the material was screened again to remove the waste and classify the chips by size.

RESULTS

Steaming the chips improved bark removal but adversely affected wood loss for all three species, but expecially for aspen and sugar maple (tables 2 and 3).

[1]*Mention of trade names does not constitute endorsement of the products by the USDA Forest Service.*

Table 2.--*Residual bark factor*[1] *for varying steam times and pressure compared to unsteamed for three northern species in growing and dormant seasons*

Species and steam time	Tests	Growing season: Steam pressure 2	8	14	Tests	Dormant season: Steam pressure 2	8	14
	No.	*Lb/in.^{2}g*			*No.*	*Lb/in.^{2}g*		
Aspen								
1 min.	6	0.24	0.23	0.18	14	0.54	0.47	0.41
5 min.	6	.25	.21	.18	13	.51	.42	.34
10 min.	6	.23	.18	.18	14	.48	.39	.33
Unsteamed	16		.51		15		.71	
Sugar maple								
1 min.	6	.42	.44	.40	6	.54	.53	.45
5 min.	6	.38	.46	.39	6	.54	.48	.42
10 min.	6	.45	.41	.40	6	.54	.41	.44
Unsteamed	4		.50		4		.64	
Jack pine								
1 min.	6	.25	.25	.26	5	.37	.36	.32
5 min.	6	.24	.24	.26	5	.35	.27	.28
10 min.	6	.25	.26	.26	5	.35	.30	.28
Unsteamed	7		.29		6		.52	

[1]Use of residual bark factor--assume 10 percent input bark. Predict output bark by multiplying 10 percent times residual bark factor.

Table 3.--*Expected wood loss (percent) during compression debarking of wood chips at varying steam pressures and time vs. unsteamed chips*

Species and steam time	Growing season				Dormant season			
	Tests	Steam pressure			Tests	Steam pressure		
		2	8	14		2	8	14
	No.	*Lb/in.^{2}g*			*No.*	*Lb/in.^{2}g*		
Aspen								
1 min.	6	4.3	4.1	4.7	14	4.3	3.7	4.2
5 min.	6	3.8	4.8	5.0	13	4.1	3.9	4.1
10 min.	6	3.6	4.5	4.8	14	4.3	4.1	4.2
Unsteamed	16		2.8		15		3.1	
Sugar maple								
1 min.	6	7.7	8.4	8.8	6	3.9	4.6	4.2
5 min.	6	7.8	7.8	8.8	6	4.0	4.0	4.4
10 min.	6	8.7	8.8	8.6	6	4.1	3.8	4.7
Unsteamed	4		5.8		4		2.4	
Jack pine								
1 min.	6	7.8	7.4	7.2	5	8.2	9.5	9.0
5 min.	6	7.4	6.8	7.0	5	10.4	10.2	10.9
10 min.	6	6.9	7.8	7.4	5	9.7	10.5	10.8
Unsteamed	6		7.0		6		9.4	

Increased steam pressure seemed to improve bark removal in dormant wood, so we made further tests at higher pressures. Separate bark removal tests at 10 lb/in.^{2}g and 30 lb/in.^{2}g were compared with tests run without steam treatment. The bark removal was significantly better as steam pressure increased (fig. 1).

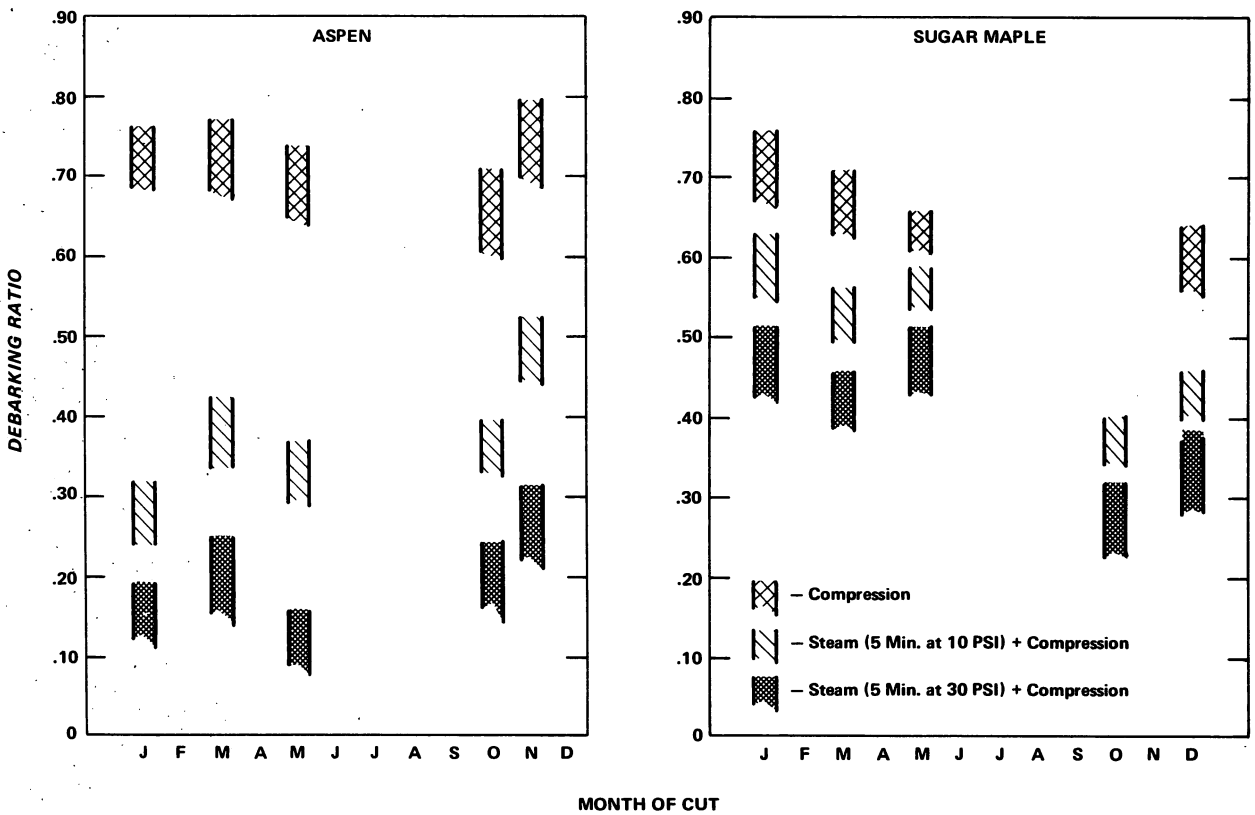

Figure 1.--*The effect of chip steaming to improve bark removal with the compression debarking process.*

Minimizing wood loss is important in any barking system, so an analysis was made of the wood loss along with the bark removal from the two different rolls--smooth and knurled. The knurled roll was used to ensure that the wood chips would be pulled through the nip spacing. It was found that the bark removal was nearly the same from both rolls while the wood loss in most cases was significantly greater from the knurled roll (table 4).

For all species the bark content in fractions exceeding a 3/8-inch round hole screen was very low (1 to 3 percent). The chips passing a 3/8-inch screen and held on a 3/16-inch screen (about 10 to 15 percent of the output) contained a considerable amount of bark. This 3/16-inch chip fraction can either be scalped for use as fuel or furnish for other lower grade fiber products, or processed further to remove more bark.

Table 4.--*Bark removal and wood loss by roll surface*
(In percent)

Species	Growing season				Dormant season			
	Smooth roll		Knurled roll		Smooth roll		Knurled roll	
	Bark removed	Wood loss	Bark removed	Wood loss	Bark removed	Wood loss	Bark removed	Wood loss
Aspen	49	33	51	67	55	52	45	48
Sugar maple	42	5	58	95	47	28	53	72
Jack pine	53	39	47	61	61	43	59	57

In view of these results, we decided to use two smooth rolls instead of one smooth and one knurled roll for future laboratory and pilot plant testing. To overcome feeding problems that can occur with some species, two smooth rolls with clearing slots machined the width of the roll have been tested with good results.

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