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COMPARISONS OF WET AND OVENDRY ANALYSES OF COMPRESSION DEBARKING TESTS ON WOOD CHIPS

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ABSTRACT.--Compares the level of bark removal from chips and resultant wood losses when measured on both a wet and ovendry basis with several chip debarking trials for quaking aspen, jack pine, and sugar maple cut at different times of the year.

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When evaluating any potential chip debarking method, pulp and paper mills need to ascertain the ultimate yield during pulping. Such analyses requires ovendry weights. However, individuals from numerous mills have expressed concern how wet analyses compares to ovendry analyses.

Consequently, we evaluated the level of beneficiation achieved on both a wet and an ovendry weight basis using chips from quaking aspen (*Populus tremuloides* Michx.) jack pine (*Pinus banksiana* Lamb.), and sugar maple (*Acer saccharum* Marsh.).

Our objectives were to determine (a) the magnitude of net differences between experimental results based on wet and dry analyses for each species, (b) whether the wet analyses gave high or low bark removal, and (c) whether the results from a practical standpoint differed grossly.

The compression debarking method and two conditioning treatments that we use in our continuing research on bark removal from pulp chips, including those produced from residues have been detailed in Hillstrom (1973), Arola (1973), Arola and Erickson (1973), and Arola and Hillstrom (1972). Briefly, these involve comparative tests of (1) compression debarking (C), (2) compression debarking followed by drubbing (CD), and (3) steaming before and drubbing after compression debarking (SCD).

METHODS

Random samples of the output and reject material were sorted manually for bark and wood. The sorted fractions were weighed wet and then ovendried to obtain the dry weights, which were used in the following formulas to individually calculate measures (or indicators) of the level of beneficiation--the input and output bark contents, debarking ratios, and wood losses.

$$\text{Bark input (percent)} = \frac{\text{wt. input bark}}{\text{wt. input bark + wood}} \times 100.$$

$$\text{Bark output (percent)} = \frac{\text{wt. output bark}}{\text{wt. output bark + wood}} \times 100.$$

$$\text{Debarking ratio} = \frac{\text{percent bark out}}{\text{percent bark in}}.$$

$$\text{Wood loss (percent)} = \frac{\text{wt. lost wood fiber}}{\text{wt. input wood fiber}} \times 100.$$

The best measure is the debarking ratio, which is a decimal indicator of the residual bark in the processed chips. The ratio for a particular test multiplied by the actual input bark content gives the expected output bark content. Ideally, a ratio of zero would indicate there is no residual bark in the output; conversely, a ratio of one would indicate that the output bark content equals the input bark content. The net effect of this indicator is to normalize the variances in input bark content for individual tests. For example, if an average input bark content of 15 percent were established over the long run and if the debarking ratio for a particular test were equal to 0.20, the expected output bark content of the processed chips would be 3.0 percent.

RESULTS

In general, for purposes of evaluating the overall merits of relative success of the three chip debarking treatments, the results of the wet analyses differed only slightly from those of the dry analyses (table 1). We didn't attempt to determine whether these differences were statistically significant--only to determine whether the differences were of any practical significance.

Regardless of species or whether the analyses were based on wet or dry weights, the most effective treatment was the SCD combination and the second most effective was the CD treatment in terms of bark removal (level of beneficiation achieved).

For all species, the wet weight analyses indicated that the bark contents of the input and output material was higher than those indicated by the dry analyses. However, for quaking aspen the wet analyses indicated that less bark was removed than what was indicated by the dry analyses. For jack pine, the opposite was indicated, whereas the results for sugar maple were mixed.

With quaking aspen, the debarking ratios for the SCD treatment ranged between 0.16 to 0.41 on a wet basis and between 0.15 to 0.40 on a dry basis--the lowest were recorded for June-cut quaking aspen and the highest for November-cut quaking aspen. The lower ratios for jack pine and sugar maple also were recorded for summer-cut wood.

For jack pine, the wet analyses gave slightly lower ratios than did the dry analyses; this indicates that more bark was removed than actually was. The differences in the ratios for jack pine only ranged between 0 to 0.10. This means that an output bark content of 3.7 percent would have been reported on a wet basis rather than of 3.5 for the September-cut jack pine for process SCD (table 2).

For sugar maple, the ratios derived from the wet analyses also were close to those derived from the dry analyses. However, unlike the bark of the jack pine and of the quaking aspen, the bark of the sugar maple was dry and corky, which indicated that our results for the sugar maple were not biased by moisture.

For quaking aspen the wood fiber losses based on the wet analyses gave values slightly lower than did the dry analyses. The largest difference in wood loss between the wet and dry analyses was observed with jack pine--as high as 3 percentage points. Thus, the wet analyses yielded wood losses slightly greater than dry analyses. The wood fiber losses for sugar maple were both slightly high or slightly low but no obvious trend could be defined.

The compression tests were all run at a pressure of approximately 1400 pounds per lineal inch of roll face width. At this pressure, moisture is squeezed from the wood and bark during passage between a 0.020-inch nip spacing of the smooth and the knurled rolls. A considerable amount of moisture was carried off by surface adhesion to the smooth roll and collected with the smooth roll rejects. Moisture did not adhere to the knurled roll; thus, the reject from the knurled roll had a lower moisture level than the smooth roll reject (table 2).

Table 1.--*Comparisons of wet and ovendry analyses of compression debarking tests on quaking aspen, jack pine, and sugar maple wood chips*

Month cut	Test code[1]	Input Bark: Wet	Input Bark: Dry	Input Bark: Diff.	Output Bark: Wet	Output Bark: Dry	Output Bark: Diff.	Debarking Ratio: Wet	Debarking Ratio: Dry	Debarking Ratio: Diff.	Wood Loss: Wet	Wood Loss: Dry	Wood Loss: Diff.
QUAKING ASPEN													
		Percent			*Percent*						*Percent*		
May	SCD	21.3	19.7	+1.6	6.9	5.7	+1.2	0.32	0.29	+0.03	4.5	4.5	0
June	C	22.5	21.1	+1.4	12.1	10.7	+1.4	0.54	0.51	+0.03	2.1	2.2	-0.1
	CD	22.4	21.0	+1.4	9.2	7.9	+1.3	0.41	0.37	+0.04	3.0	3.2	-0.2
	SCD	22.2	19.9	+2.3	3.6	3.0	+0.6	0.16	0.15	+0.01	4.6	4.7	-0.1
Oct.	C	22.1	21.3	+0.8	16.3	15.0	+1.3	0.74	0.70	+0.04	0.9	0.9	0
	SCD	21.2	18.9	+2.3	7.6	6.4	+1.2	0.36	0.34	+0.02	2.6	2.8	-0.2
Nov.	SCD	20.7	20.7	0	8.4	8.1	+0.3	0.41	0.39	+0.02	3.0	3.7	-0.6
JACK PINE													
March	C	10.4	7.7	+2.7	6.1	4.9	+1.2	0.59	0.64	-.05	7.9	6.3	+1.6
	CD	9.8	6.5	+3.3	5.4	3.8	+1.6	0.55	0.59	-.04	10.9	8.7	+2.2
	SCD	11.8	7.2	+4.6	2.9	2.0	+0.9	0.27	0.32	-.05	11.4	8.1	+3.3
July	C	14.5	10.3	+4.2	4.0	3.7	+0.3	0.28	0.36	-.08	7.7	6.5	+1.2
	CD	14.3	9.9	+4.4	3.4	2.9	+0.5	0.24	0.29	-.05	8.1	6.6	+1.5
	SCD	16.7	10.7	+6.0	3.5	2.5	+1.0	0.24	0.24	0	9.7	8.4	+1.3
Sept.	C	13.1	9.5	+3.6	4.9	4.1	+0.8	0.37	0.43	-.06	7.6	6.2	+1.4
	CD	12.4	8.5	+3.9	3.4	3.0	+0.4	0.28	0.35	-.07	7.3	5.9	+1.4
	SCD	14.0	9.6	+4.4	3.7	3.5	+0.2	0.26	0.36	-.10	7.6	6.1	+0.6
SUGAR MAPLE													
Feb.	C	9.6	9.8	-0.2	6.2	6.3	-0.1	0.65	0.64	+.01	3.1	3.2	-0.1
	CD	9.8	9.9	-0.1	4.6	4.5	+0.1	0.46	0.45	+.02	3.8	4.0	-0.2
	SCD	9.6	8.5	+1.1	3.9	4.1	-0.2	0.41	0.48	-.07	6.3	5.0	+1.3
July	C	12.6	12.4	+0.2	4.8	4.4	+0.4	0.38	0.35	-.03	9.2	10.5	-1.3
	CD	11.2	10.9	+0.3	4.1	3.8	+0.3	0.37	0.35	+.02	8.8	9.8	-1.0
	SCD	13.3	12.4	+0.7	4.5	4.0	+0.5	0.34	0.32	+.02	8.1	8.7	-0.6
Aug.	C	12.7	12.0	+0.7	4.9	4.5	+0.4	0.38	0.37	+.01	11.2	11.7	-0.5
	CD	11.5	10.6	+0.9	3.5	3.1	+0.4	0.31	0.29	+.02	10.5	10.5	0
	SCD	11.4	9.6	+1.8	3.0	2.5	+0.5	0.26	0.26	0	10.7	10.3	+0.4
Oct.	C	9.6	8.6	+1.0	6.0	5.5	+0.5	0.63	0.64	-.01	2.4	1.9	+0.5
	CD	8.9	8.4	+0.5	4.4	4.3	+0.1	0.50	0.51	-.01	2.9	2.8	+0.1
	SCD	9.8	9.1	+0.7	4.3	4.1	+0.2	0.44	0.45	-.01	5.6	5.7	-0.1

[1] C=compression debarking
CD=compression debarking plus drubbing
SCD=steaming, compression debarking, drubbing

Table 2.--*Moisture contents (percent) of components of quaking aspen, sugar maple, and jack pine chips following steaming, compression debarking, and drubbing.*[1]

Component	Quaking aspen		Sugar maple		Jack pine	
	Mean	Range	Mean	Range	Mean	Range
Input Material						
Wood Bark	50	47-54	36	31-39	46	37-53
Bark	42	42	38	33-41	54	52-62
Accept Material	44	43-46	32	29-35	45	42-47
Reject Material						
Smooth Roll	58	54-60	41	38-45	69	64-74
Knurled Roll	43	40-46	34	32-36	60	57-64
Fines	41	34-45	40	36-42	53	50-54

[1] $M.C. = \left(\frac{\text{Wet wt. - dry wt.}}{\text{Wet wt.}}\right) \times 100$

Consequently, the moisture levels of the accept chips were lower than the levels of the input wood chips. Although the tabulated moisture levels should not be taken as conclusive, they can be used to evaluate the potential of the reject material for use as fuel.

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