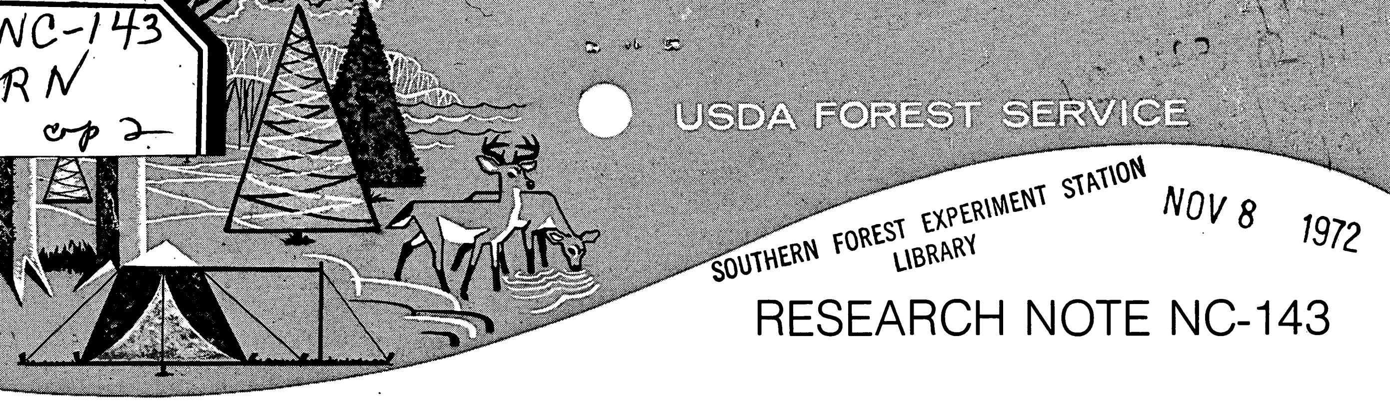

RESEARCH NOTE NC-143

NORTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE — U.S. DEPARTMENT OF AGRICULTURE
Folwell Avenue, St. Paul, Minnesota 55101

Compression Debarking of Branchwood Chips from Finland

ABSTRACT.—Discusses the results of tests to remove bark and needles from spruce and pine branchwood chips that had been previously subjected to micro-organic action in aged storage piles. Various combinations of methods were used to accomplish beneficiation.

OXFORD: 821:825.71(471.1):174.7. KEY WORDS: bark removal, chip storage, micro-organic action.

Efficient utilization of the wood resource is an objective of the forest industry in the United States as well as in other countries of the world. In Finland, where forest resources are a dominant part of the economy and raw material is presently in short supply, full utilization is a matter of serious national concern.[1]

At the Forest Engineering Laboratory in Houghton, Michigan, we have devoted a major portion of our research toward bark removal after chipping, and encouraging results have been obtained.[2] This prompted a large Finnish paper company to send samples of chips produced from spruce and pine branchwood to us for bark removal tests. Their primary interest was to determine if the compression debarking process was an efficient method for removing bark and needles from branchwood chips that had been previously subjected to extended pile storage and micro-organic action (biological treatment to loosen the bark). The test results obtained from the material from Finland are summarized below.

MATERIAL

The chips received were produced from both spruce and pine branchwood and were classified as follows: (1) moist spruce from the top section of a 12-month-old storage pile, (2) dried spruce also from the top section of the pile, (3) air-dried spruce from the outer base of the pile, (4) moist pine from the upper section of a pile simulator,[3] and (5) dry pine from the bottom sections of the pile simulator. The pile simulator chips were 5 months in storage.

The spruce chip pile was completely irrigated after construction and then covered with water-repellent cardboard (with provisions for passage of air at the top and bottom). The pine chips in the pile simulator were irrigated periodically because of excessive drying in the bottom of the simulator.

The wood fiber content in the "as-received" spruce was extremely low—approximately 30 percent. The moist spruce was so blackened (presumably from the micro-organic action) that wood fiber was hardly recognizable. The "as-received" pine chips had 70 to 75 percent wood content—considerably higher than spruce.

TEST TREATMENTS

Several treatment combinations involving compression debarking were tested to remove bark and needles

[1] *Hakkila, Pentti. Coniferous branches as a raw material source. A sub-project of the Joint Nordic Research Programme for the Utilization of Logging Residues. Helsinki, 1971.*

[2] *Arola, R. A., and J. R. Erickson. Compression debarking of wood chips. N. Cent. For. Exp. Sta. (Manuscript in preparation.)*

[3] *Springer, E. L., and Zoch, L. L. A simulator of an outside chip pile. TAPPI 53(1): 1970.*

Table 1.—Percentages (wet-weight basis) of wood and waste before and after compression debarking of branchwood chips from Finland

Test number	Process code[1]	Number of passes	Input[2] Wood	Input[2] Waste	Output[3] Wood	Output[3] Waste: Bark	Output[3] Waste: Needles	Wood loss[4]
MOIST SPRUCE								
1587	C	1	28.4	71.6	48.7	5.1	46.2	2.8
1588	C	2	--	--	73.5	3.7	22.8	1.4
1589	C	3	--	--	84.1	1.1	14.8	0.9
1590	SCD	1	33.6	66.4	88.2	3.9	7.9	8.1
1586	ASCD	1	50.2	49.8	96.0	2.8	1.2	[5] 10.6
MOIST PINE								
1592	C	1	80.8	19.2	90.2	7.5	2.3	7.0
1593	C	2	--	--	96.0	3.0	1.0	8.4
1594	C	3	--	--	96.6	2.1	1.3	5.8
1595	SC	1	82.6	17.4	94.0	5.8	0.2	7.4
1591	ASC	1	89.6	10.4	96.7	3.2	0.1	[5] 7.5
DRY PINE								
1596	C	1	74.4	25.6	78.7	19.0	2.3	10.4
1597	C	2	--	--	84.6	13.9	1.5	7.6
1598	C	3	--	--	87.3	11.5	1.2	10.8
1599	SC	1	68.2	31.8	83.8	12.9	3.3	13.5

1/ A = air flotation; C = compression debarking; D = drubbing; S = steaming.
2/ Material composition before the compression process.
3/ Material composition after the process.
4/ Expressed as a percent of input wood fiber.
5/ Excludes wood loss during air flotation.

from wood chips. These treatments were classified as either processing or conditioning. Processing treatments remove primarily waste material (nonwood), whereas conditioning treatments only aid the processing treatments by making the waste more susceptible to removal. The treatments included in the tests on the Finnish spruce and pine are briefly summarized and coded (for reference in table 1).

Compression debarking (C) is a processing treatment in which the bark and wood chip mass is passed between two equal-diameter steel compression rolls with a clearance of less than the chip thickness.[2] Some of the bark is removed by adhesion to the roll surfaces from which it is scraped into waste containers, or the bark is broken up into small pieces and screened out. Single or multiple passes of the material between the compression rolls is optional—up to three passes were tested. Although the nip spacing between the compression rolls, nip pressure over the roll face width, roll speed, and bulk feed rate can be varied, all material processed through the compression debarker for these tests was at a nip spacing of 0.020 inches and nip pressure of 1,400 pounds per lineal inch. Surface speeds of the 24-inch diameter rolls and feed conveyor were held constant at 740 and 620 surface feet per minute (SFM), respectively. Bulk feed rate was limited to approximately 1 cubic foot per minute.

Air flotation (A) is a processing treatment that segregates particles having distinct differences in specific gravity, shape, or size. For some test combinations, this method was used to remove high concentrations of needles prior to compression debarking.

Steaming (S) of the bark-chip mass is a conditioning treatment prior to compression debarking. Earlier research revealed that steaming causes a subsequent increase in the amount of bark that is removed by adhesion to the compression rolls—particularly with aspen and with wood cut and chipped during the dormant season.[4] The Finnish material was steamed in a small autoclave under 10 pounds per square inch gauge for 5 minutes.

[4] *A study to investigate steaming and abrasion for improving compression debarking of unbarked chips. North Central Forest Experiment Station Study 72-1, Forest Engineering Laboratory, Houghton, Mich.*

Drubbing (D) is a conditioning treatment in which the compressed material is tumbled for 10 minutes in an improvised rotating drum outfitted with impact hammers. The nip action of the compression rolls causes the bark to become very friable and subject to further break-up under a light mechanical abrading or drubbing action. After drubbing, the material is fractionated for further analysis on a Williams round-hole classifier and the fines (primarily bark) removed (material passing the 3/16-inch screen).

RESULTS

The important bark-plus-needle figures of the three-pass system (tests 1587-1589) for moist spruce are the waste input of 71.6 percent and output of 15.9 (1.1 percent bark plus 14.8 percent needles, table 1) after the third pass.

A large increase in waste removal with moist spruce over just a single pass (test 1587) resulted when the material was presteamed, compression debarked, and drubbed (test 1590). The most notable reduction was in the needle content—it was only one-sixth of that remaining after compression alone.

A further refinement resulted when air flotation was employed to remove needles, followed by steaming, compression debarking, and drubbing (test 1586). Total waste was reduced to 4.0 percent, of which 2.8 percent was bark. Practically all of the bark was stripped from even the smallest moist spruce twigs during the compression process. A slight increase in wood loss resulted with the addition of air flotation.

Based on the results of test 1586 a material-flow is presented for an assumed 1,000 pounds of moist spruce (fig. 1). After the combination of air flotation, steaming, compression debarking, drubbing, and screening, the output product can be divided into the three size fractions shown. The chip mass that originally contained 664 pounds of waste material would contain only 9 pounds of waste after treatment and 208 pounds of wood fiber would be recovered out of 336 pounds of input fiber. All calculations were based on wet weight.

The results with moist pine were not as good as with moist spruce (table 1). However, because the pine had an input bark-plus-needle content considerably less than the spruce, the output bark-plus-needle content was also less. Considerable chip damage after the third pass was observed with moist pine (based on visual observation and not pulping tests). The best results with moist pine (test 1591) were obtained with air flotation followed by steaming and compression debarking. The dry pine had a considerably higher residual bark content in the output than moist pine. The tests with dry spruce were terminated early because of poor results and are not tabulated.

CONCLUSIONS

Bark removal was better from moist spruce branchwood chips that were aged in storage piles and subjected to micro-organic action than from dry spruce. Bark removal from moist pine chips stored in a pile simulator was also greater than from dry pine chips from the simulator.

Of the treatment combinations tested, a three-pass compression debarking process resulted in the least residual bark contents in moist spruce, moist pine, and dry pine (1.1, 2.1, and 11.5 percent). However, multipass compression systems may be objectionable due to wood losses and loss in pulp quality. The aged moist spruce, which had a very high input needle content, still contained 14.8 percent needles after the third pass. The residual needle content for the multipass system with both moist and dry pine was just slightly greater than 1 percent. Wood loss was higher for the pine than the spruce with a three-pass system.

A single-pass compression system used in conjunction with conditioning treatments (steaming and drubbing) removed more bark and needles than merely a single pass through the compression process. Further beneficiation resulted when air flotation was used to remove needles prior to the steaming, compression debarking, and drubbing.

An analysis of test results indicated that 1,000 pounds of aged, moist spruce branchwood chips (two-thirds waste) would technically yield approximately 200 pounds of wood fiber containing only 4 percent residual bark and needles.

The processed chips were returned to Finland for evaluation and pulping.

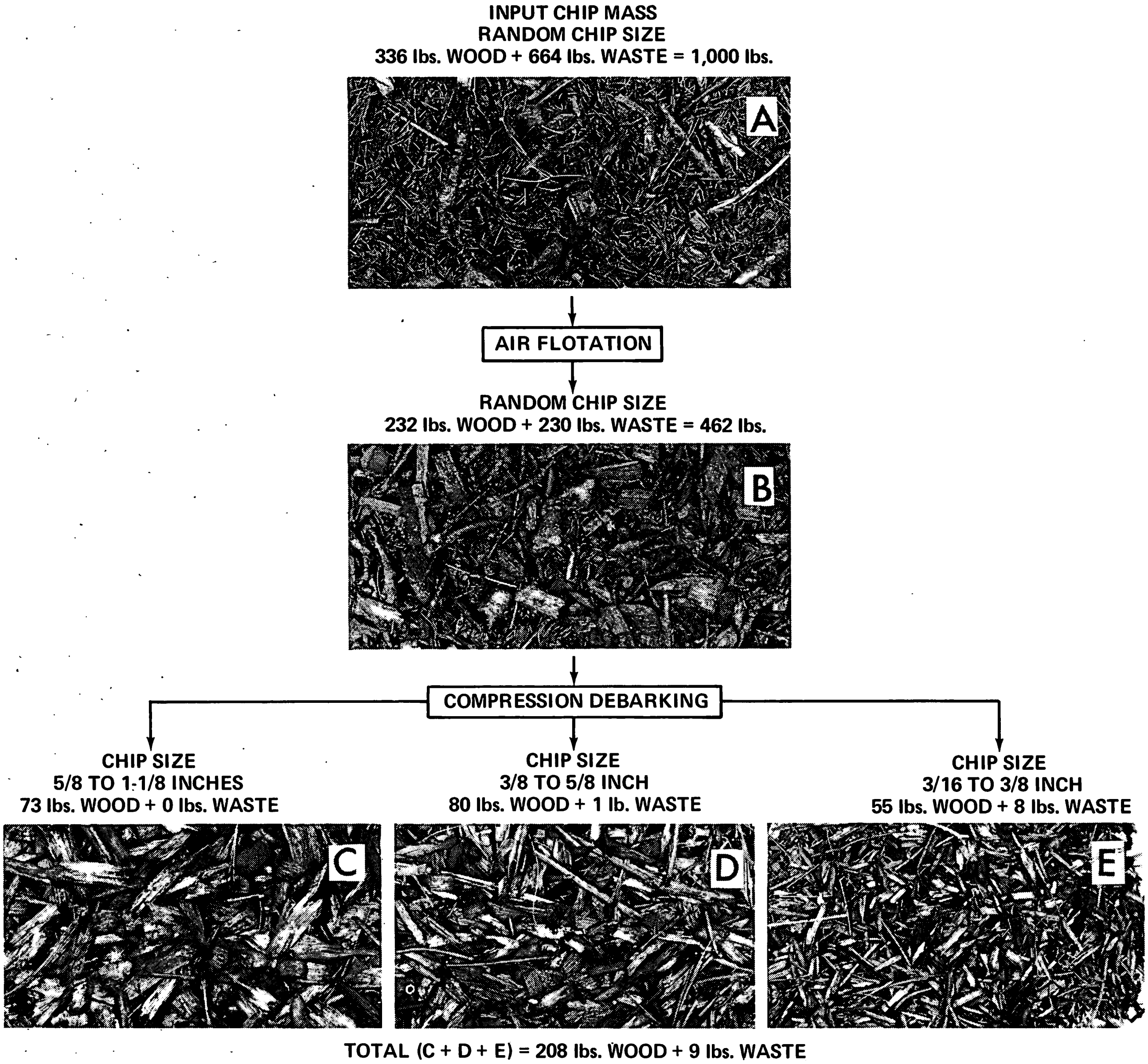

Figure 1.—Calculated material flow and photographic record for 1,000 pounds of moist spruce (test 1586).

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