AD-A038 928 FOREST PRODUCTS LAB MADISON WIS F/G 11/12
STORAGE OF ASPEN WHOLE-TREE CHIPS UNDER LABORATORY CONDITIONS.(U)
1976 L L ZOCH, E L SPRINGER, G J HAJNY

UNCLASSIFIED FSRP-FPL-288 NL

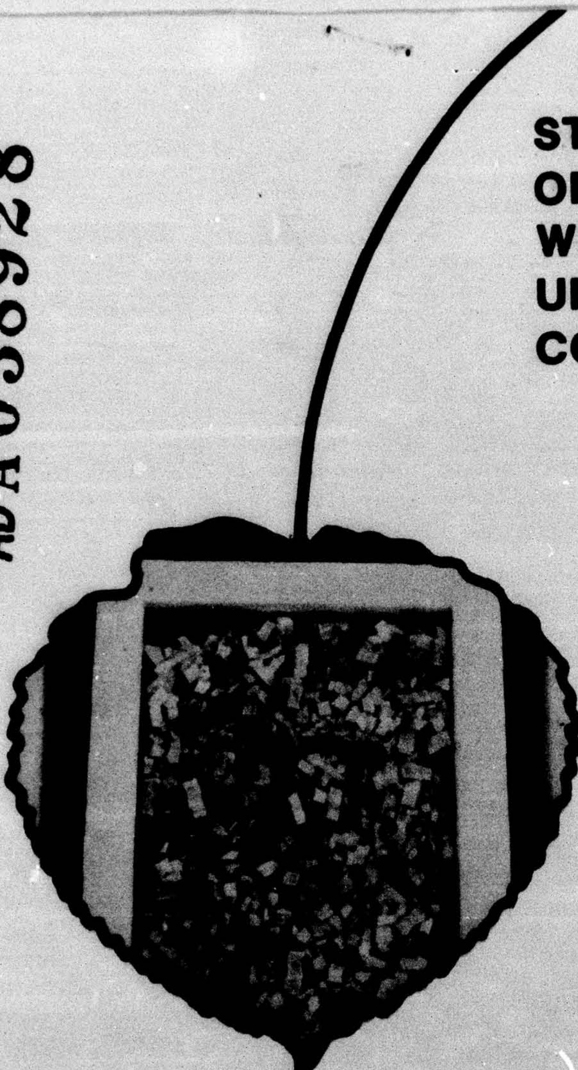
1 OF 1
AD
A038928

END
DATE
FILMED
5-77

STORAGE OF ASPEN WHOLE-TREE CHIPS UNDER LABORATORY CONDITIONS

13

B.S.



USDA Forest Service
Research Paper
FPL 288
1976

U.S. Department of Agriculture
Forest Service
Forest Products Laboratory
Madison, Wis.

Abstract

Screened aspen clean-wood chips and unscreened aspen whole-tree chips were stored in insulated boxes supplied with humidified air. Two series of tests were made: one with a single box of clean-wood chips and two boxes of whole-tree chips, all stored for 96 days; the other with two boxes of each type of chips, each box containing three weight loss sample bags, and all stored for 180 days.

Similar temperature profiles for the first 96 days of storage were obtained in both series. Cleanwood chip temperatures were never more than 14° F -- and usually less than 7° F -- above ambient, whereas the whole-tree chip temperatures reached 42° F above ambient much of the time during the first 85 days of storage.

Weight losses of ovendry wood substance averaged 3 percent for the clean-wood chips and 19 percent for the whole-tree chips after 180 days of storage.

6

STORAGE OF ASPEN WHOLE-TREE CHIPS UNDER LABORATORY CONDITIONS,

By

10

L.L./ZOCH, JR., ~~Chemist~~

E.L./SPRINGER, ~~Chemical Engineer~~

~~and~~

G.J./HAJNY, ~~Chemist~~

Forest Products Laboratory,[1] Forest Service

U.S. Department of Agriculture

14 FSRP-FPL-288

9 Forest Service research paper, 11 1976 12 9p.

Introduction

Pulpwood used to be stored almost exclusively in log form; now it is an almost universally accepted practice to store much of it as chips in large outside piles. Despite its broad acceptance, outside chip storage (OCS) is not trouble free. Self heating occurs in almost all chip piles and, in cases, spontaneous ignition has resulted in large losses (*1, 5 - 7*).[2] While such large losses are rather rare, other losses such as wood substance, pulp yield, strength, and brightness, as well as tall oil and turpentine, also occur during storage. The various types of deterioration associated with OCS are well known. The literature on the deterioration and other aspects of OCS has been reviewed (*8, 11*).

Rough-wood chips became of interest to kraft mills because of their increased fiber yield and favorable economics (*2, 4*). The storage of unbarked hardwood chips, too, has caused problems and a fire (*7*). Since 1970, the concept of whole-tree utilization, because of an impending fiber shortage, has come under close study by many forest products companies (*3, 9, 10*). Again, as with storage of other types of chips, the storage of whole-tree chips has its problems and there have been reports of rapid deterioration and of fires in piles of these chips (*9*).

The study reported here is a laboratory comparison, using the insulated box technique (*12*), of the heating and losses that occur on storage of screened clean-wood and of unscreened whole- tree aspen chips.

Material and Methods

Screened aspen clean-wood chips and unscreened aspen whole-tree chips (*Populus tremuloides Michx.*) were stored in 4 - cubic - foot insulated boxes supplied with humidified air. Two series of tests were made: one with a single box of clean-wood chips and two boxes of whole-tree chips, all stored for a period of 96 days; the other with two boxes of each type of chips, each box containing three weight loss sample bags, all stored for 180 days.

For the first series, aspen trees about 5 inches in diameter were cut from the same site in central Wisconsin in early June 1975. The trees for the second series were cut 3 weeks later.

Boles for the clean-wood samples were debarked by hand with a drawknife, and chipped by a four-knife Carthage chipper to 5/8 inch along the grain. Chips were passed through a 1-1/4-inch top screen and those that remained on a 1/4-inch bottom screen were accepted. For whole-tree samples, everything above the stump was put through the chipper.

[1]Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

[2]Numbers in parentheses refer to Literature Cited at the end of this report.

141700

Some twig-type material was put through several times to obtain a more uniform size material. The whole-tree chips were not screened.

Each sample was thoroughly mixed before storage in the insulated boxes. Moisture determinations for all seven boxes were made on grab samples obtained while the boxes were being filled or emptied. Three weight loss sample bags of nylon mesh each containing 300 grams of fresh chips were located near the center of each of the four boxes in the second series. All samples were processed within 24 hours of felling the trees.

Water-saturated air was metered to each box through a flowmeter. The exit gases were analyzed for carbon dioxide content using a Model 29 Fischer-Hamilton Gas Partitioner, calibrated by a standardized gas sample. The weight of carbon dioxide was calculated after the volume was corrected to standard conditions.

Temperatures were recorded daily by a thermocouple located in the center of the chip mass of each box.

After storage, the boxes were opened and the colors of the chips were visually compared.

Results and Discussion

Center temperature profiles of the stored chip masses were recorded for two series of runs. Because they were no more than 3° F apart throughout the run of 96 days, the temperatures of the two whole-tree chip boxes were averaged and are shown as a single curve (fig. 1). Temperature profiles from the second series for 180 days were also averaged (fig. 2). The profiles for the two series were similar except for the greater drop in temperature between the first and second heating peaks of the second series with the unscreened whole-tree chips. This type of profile is not unusual with stored chips and the first short heating period and peak may not always attain the highest temperature. The second heating period is usually much longer than the first one. Such fluctuations in temperature are probably caused by changes in the number and types of micro-organisms of the chips.

Weight loss data, carbon dioxide produced, maximum temperature attained, and initial and final moisture contents of the chips are shown in tables 1 and 2. For the second series of boxes, carbon dioxide production was calculated after 90 and 180 days. For the whole-tree chips, weight loss as determined by carbon dioxide production and direct weighing are in good agreement. For the clean chips, the agreement between the carbon dioxide produced and direct weight loss is much less satisfactory. The reason for this discrepancy is unclear. Average weight loss by direct weighing after 180 days of storage was 3.0 percent for the clean-wood chips and 18.8 percent for the whole-tree chips.

After 96 days of storage, the first series of boxes was opened, and the color of the chips visually compared (fig. 3). The dark color of the whole-tree chips indicates deterioration and qualitatively supports the weight loss data. The appearance of the chips in the second series of boxes, after 180 days of storage, was similar.

This test using unscreened aspen whole-tree chips may not be typical of the practice of many large mills where screening is used to remove grit and fines. However, from our preliminary results comparing stored screened and unscreened whole-tree chips of both hardwoods and softwoods, screening may not always lower the maximum temperature attained but only delay the maximum peak temperature.

Conclusions

Large differences were found in the temperatures attained and the weight losses that occurred during storage, under laboratory conditions, of aspen clean chips and whole-tree chips. These probably represent the minimum temperatures and weight losses that might be expected in industrial storage of aspen chips. In large industrial piles of aspen clean chips, temperatures are much higher than reported here and weight losses are two to three times as great. In large piles of whole-tree chips, weight losses would be expected to be even greater than the 18.8 percent reported here and temperatures could rise to the point where spontaneous ignition is a possibility.

Temperature and carbon dioxide data suggest that much of the weight loss occurs within the first 90 days of storage. For unscreened whole-tree chips, it is obvious that storage times must be as short as possible.

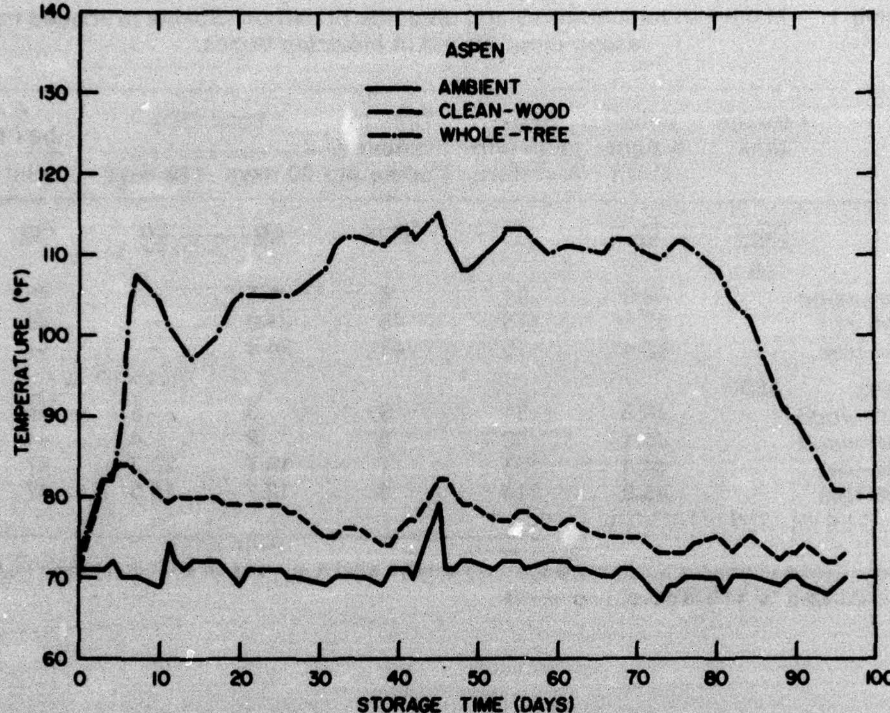


Figure 1. -- Center temperature profiles of aspen chips stored for 96 days in 4-cubic-foot insulated boxes.

M 144 611

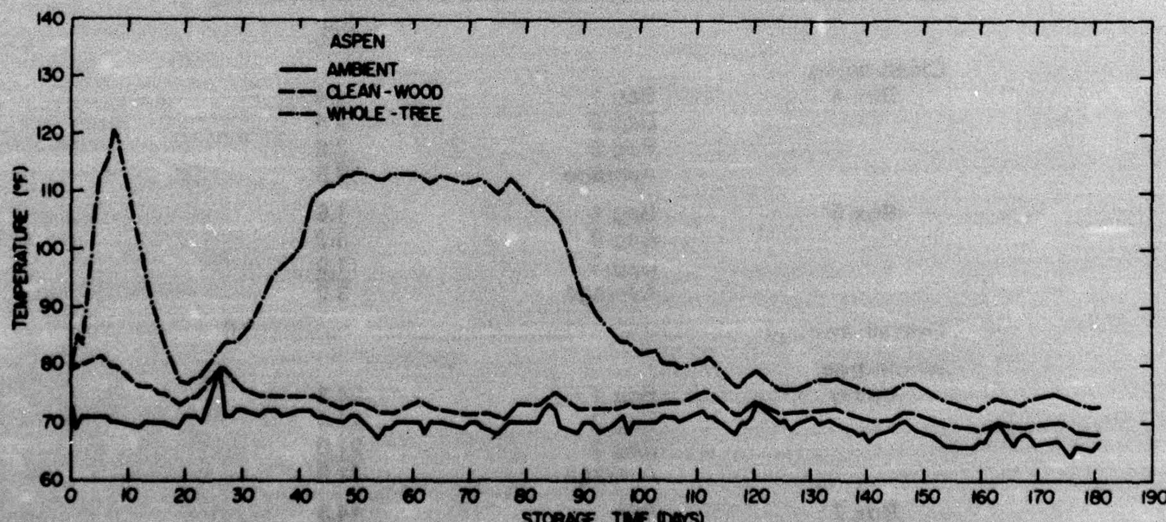


Figure 2. -- Average center temperature profiles of aspen chips stored for 180 days in 4-cubic-foot insulated boxes.

M 144 612

Table 1. -- Maximum temperatures and amounts of carbon dioxide produced from aspen chips stored in insulated boxes.

Chips[1]	Storage time	Initial weight (O.D.)	Maximum temperature	Time to maximum temperature	Total CO_2 90 days	Total CO_2 180 days	Average box moisture Initial	Average box moisture Final
	Days	Lb	°F	Days	Lb	Lb	Pct	Pct
First series	96							
Box 1. Clean-wood		46.3	84	6	1.1	--	45	44
Box 2. Whole-tree		52.1	115	45	24.8	--	44	39
Box 3. Whole-tree		52.4	115	45	24.9	--	44	37
Second Series	*180*							
Box 4. Clean-wood		45.3	81	5	.3	.5	44	41
Box 5. Clean-wood		41.1	82	5	.2	.4	44	41
Box 6. Whole-tree		44.4	121	7	16.7	20.3	47	40
Box 7. Whole-tree		45.0	119	8	13.7	15.5	47	39

[1]Clean-wood = Debarked wood of 5/8-in. chips screened through a 1-1/4 in.-, and on a 1/4-in.-, square mesh screen.
Whole-tree = Chipped "as is" and stored unscreened.

Table 2 .-- Weight loss of aspen chips after 180 days of storage in insulated boxes.

Chips		Weight loss (O.D.)
		Pct
Clean-wood		
Box 4	Bag 1	4.4
	Bag 2	3.4
	Bag 3	3.6
	Average	3.8
Box 5	Bag 1	1.6
	Bag 2	3.2
	Bag 3	1.9
	Average	2.2
Overall average		3.0
Whole-tree		
Box 6	Bag 1	24.3
	Bag 2	20.4
	Bag 3	21.0
	Average	21.9
Box 7	Bag 1	14.3
	Bag 2	17.2
	Bag 3	15.2
	Average	15.6
Overall average		18.8

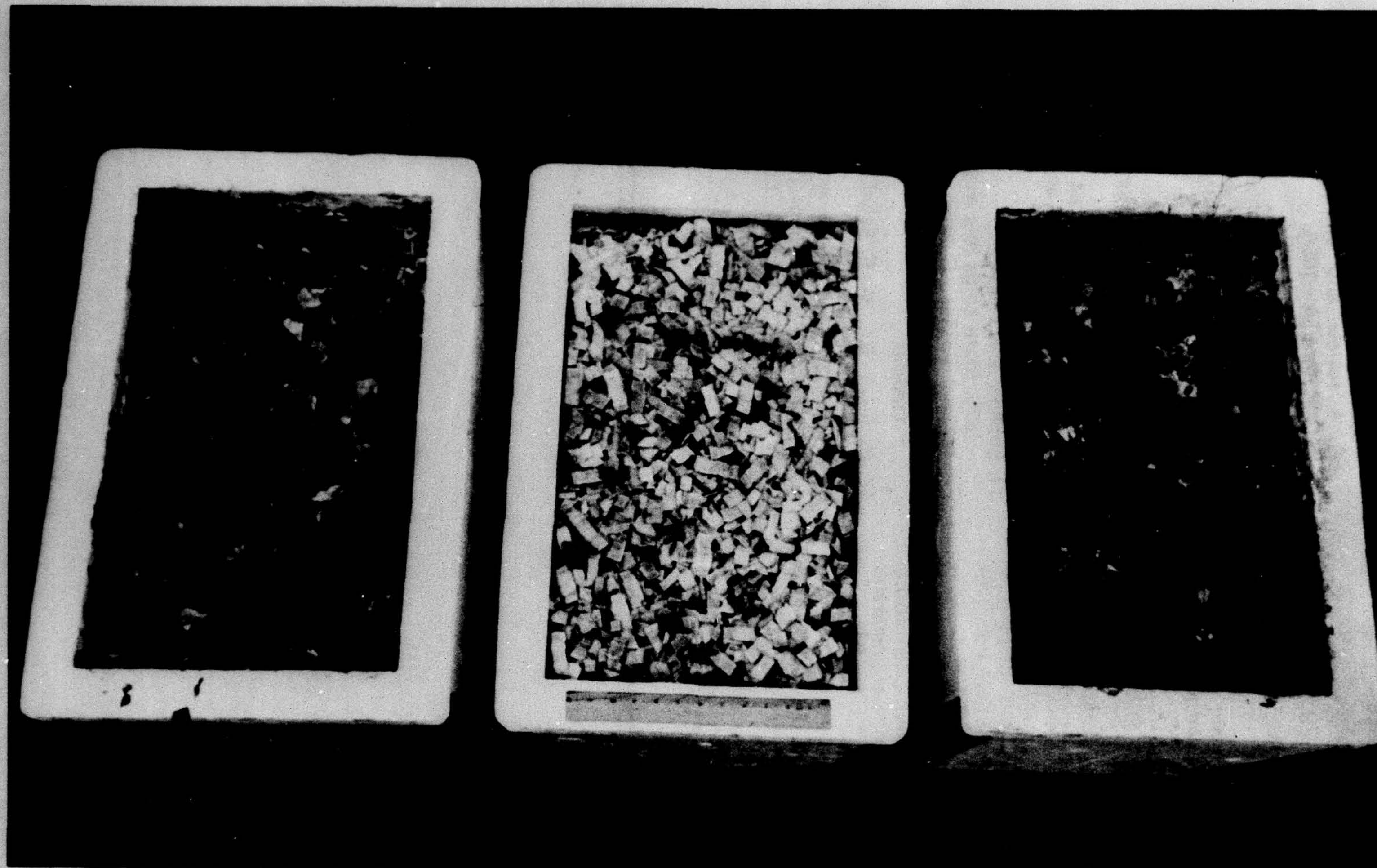


Figure 3. -- Clean-wood aspen chips (center) after 96 days' storage darkened only slightly. Whole-tree chips (left and right) darkened considerably, an indication of deterioration.

M 143 734

Literature Cited

1. Allen, D. E.
   1968. Fire in the chip pile! What to do. Pulp & Paper 42(27): 33, 34.

2. Auchter, R. J.
   1972. Pulping without barking increases fiber yield. Forest Industries 99(6): (Pulp & Paper/Forest Industries Pulpwood Annual) 6 - 7, June.

3. Auchter, R. J.
   1975. Whole-tree utilization: Fact or fantasy. Tappi 58(11): 4 - 5.

4. Auchter, R J., and R. A. Horn
   1973. Economics of kraft pulping of unbarked wood. Paper Trade J. 157(26): 38 - 39, June.

5. Bergman, 0.
   1974. Thermal degradation and spontaneous ignition in outside chip storage. Svensk Paperstidning 18: 681 - 684.

6. Blackerby, L. H.
   1963. Separating chips lowers fire risk. Pulp & Paper 37(19): 89 - 90.

7. Cole, A. H.
   1972. Chip pile fire. Pulp & Paper Mag. Can. 73(c): 137 - 140 (T93 - T96).

8. Hajny, G. J.
   1966. Outside storage of pulpwood chips. A review and bibliography. Tappi 49(10): 97A - 105A.

9. Moran, J. S.
   1975. Kraft mill experience with whole tree chips. (Speech) [Presented at Annual Meeting, New York, N. Y., February 24.] Technical Association of the Pulp and Paper Industry, Atlanta, Ga.

10. Powell, L. N., J. D. Shoemaker, R. Lazard, and R. G. Barker
    1975. Whole-tree chips as a source of papermaking fiber. Tappi 58(7): 150 - 155.

11. Shields, J. K.
    1976. Store chips this way -- and reduce your losses. Bulletin LD7E. Eastern Forest Products Laboratory, Ottawa, Ontario.

12. Springer, E.L., W. E. Eslyn, L. L. Zoch, Jr., and G.J. Hajny
    1969. Control of pulp chip deterioration with kraft green liquor. USDA For. Serv. Res. Pap. FPL 110, For. Prod. Lab., Madison, Wis.

U.S. GOVERNMENT PRINTING OFFICE: 1977-750-027/15

U.S. Forest Products Laboratory.

Storage of aspen whole-tree chips under laboratory conditions, by L. L. Zoch, Jr., E. L. Springer, and G. J. Hajny. Madison, Wis., FPL, 1977. 6 pp (USDA FS Res. Pap. FPL 288)

Stored whole-tree chips had a much higher temperature profile (reaching 42° F above ambient) than stored clean-wood chips in 85 days of storage in insulated boxes. Weight losses for whole-tree chips averaged 19%, and for clean-wood chips, 3%, after 180 days' storage.

KEYWORDS: <u>Populus</u> <u>tremuloides</u> Michx., storage, whole-tree chips, weight loss, temperature, heating, pulpwood, deterioration, carbon dioxide.

U.S. Forest Products Laboratory.

Storage of aspen whole-tree chips under laboratory conditions, by L. L. Zoch, Jr., E. L. Springer, and G. J. Hajny. Madison, Wis., FPL, 1977. 6 pp (USDA FS Res. Pap. FPL 288)

Stored whole-tree chips had a much higher temperature profile (reaching 42° F above ambient) than stored clean-wood chips in 85 days of storage in insulated boxes. Weight losses for whole-tree chips averaged 19%, and for clean-wood chips, 3%, after 180 days' storage.

KEYWORDS: <u>Populus</u> <u>tremuloides</u> Michx., storage, whole-tree chips, weight loss, temperature, heating, pulpwood, deterioration, carbon dioxide.

U.S. Forest Products Laboratory.

Storage of aspen whole-tree chips under laboratory conditions, by L. L. Zoch, Jr., E. L. Springer, and G. J. Hajny. Madison, Wis., FPL, 1977. 6 pp (USDA FS Res. Pap. FPL 288)

Stored whole-tree chips had a much higher temperature profile (reaching 42° F above ambient) than stored clean-wood chips in 85 days of storage in insulated boxes. Weight losses for whole-tree chips averaged 19%, and for clean-wood chips, 3%, after 180 days' storage.

KEYWORDS: <u>Populus</u> <u>tremuloides</u> Michx., storage, whole-tree chips, weight loss, temperature, heating, pulpwood, deterioration, carbon dioxide.

U.S. Forest Products Laboratory.

Storage of aspen whole-tree chips under laboratory conditions, by L. L. Zoch, Jr., E. L. Springer, and G. J. Hajny. Madison, Wis., FPL, 1977. 6 pp (USDA FS Res. Pap. FPL 288)

Stored whole-tree chips had a much higher temperature profile (reaching 42° F above ambient) than stored clean-wood chips in 85 days of storage in insulated boxes. Weight losses for whole-tree chips averaged 19%, and for clean-wood chips, 3%, after 180 days' storage.

KEYWORDS: <u>Populus</u> <u>tremuloides</u> Michx., storage, whole-tree chips, weight loss, temperature, heating, pulpwood, deterioration, carbon dioxide.