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Total Free Pulping of Aspen Chips by the NSSC Process for Use in Corrugating Medium

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"TOTAL FREE PULPING OF ASPEN CHIPS BY THE NSSC PROCESS FOR USE IN CORRUGATING MEDIUM"

by

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ABSTRACT

The recent trend of industry toward materials cost savings and environmental control encourages research in the area of total-tree utilization. One possible way to utilize the whole tree is by harvesting with the Metro Chip Harvester. The development of the Metro Chip Harvester prompted this work which primarily was concerned with comparison of various blends of standard Aspen chips and Metro Harvester Aspen chips. One possible use for Metro Harvester chips is in the production of corrugating medium.

The results of this work indicate that there is a possibility that 25% Metro Harvester chips can be used in a corrugating medium furnish. Unfortunately the largest loss in strength occurs between 0 and 50% Metro Harvester chips. This work was accomplished without screening, hence, there is a possibility that more than 25% Metro Harvester chips can be used if proper screening is employed.

The use of Metro Harvester chips for Semi Chemical corrugating medium could be beneficial from an economic standpoint, but also from an environmental standpoint. This can be accomplished by utilizing bark and other wood wastes rather than burning them or using them for landfill.

INTRODUCTION

As pulp consumption in the United States increases, yearly, it becomes more and more imperative that the fiber yield per acre be increased. The reasons for the necessary increases are as follows: (1) to utilize the potential economic advantages, (2) to reduce the environmental hazards due to the burning of wood wastes and their utilization as landfill, and (3) to retard the potential depletion of our forests (1).

With the present economic situation in mind, it is obviously necessary to reduce material costs and processing costs. This reduction, however, must not be made at the expense of quality.

HISTORICAL BACKGROUND

In 1966, the total pulpwood consumption amounted to 65.2 million cords. The projected pulpwood consumption by 1985 is to be 125.6 million cords, an increase totaling 118% (2). These figures alone demand improvement in harvesting methods, to increase the fiber yield per acre.

One possible approach involves complete-tree utilization. This concept requires the chipping of the whole tree, including, bark, branches, leaves, trunk, etc. Such a system has the potential for increasing chip production, 30-50% per acre (3).

Morbark Industries Incorporated of Winn, Michigan, have designed and manufactured a harvester which chips the entire tree. The whole tree, trunk, branches, twigs, and leaves are all fed into the chipper. The equipment is known by its trade name, Metro Chip Harvester.

The Metro Chip Harvester is designed to receive entire trees, compress and feed them through a 75" chipper. The equipment can be efficiently operated by one man, and when coupled with an appropriate tractor, becomes a mobile unit (4).

The resulting chips are mixed with leaves, bark, and dirt. The leaves and some of the light-weight dirt and bark, can be separated from the chips with air, but removal of the heavy bark and dirt is a more serious problem.

Whereas complete bark removal seems to be the solution to the dirt problem, and although much research has been performed in that direction, perhaps some grades of paper can use pulps processed without bark removal.

Consolidated Bathurst Limited, Bathurst, New Brunswick, compared barked and unbarked chips as to their use for corrugating medium. This trial showed much better physical strength properties for the barked furnish. Also, chemical consumption was reduced and machine runnability was improved for the barked chips (5).

MacMillan Bloedel Research Limited compared conventional kraft cooking of barked and unbarked hemlock. It was resolved that unbarked hemlock chips showed lower strength values, excepting tear, lower brightness and yield, contained more dirt, and required a greater amount of chemicals (6).

S.D. Warren, however, reported using 1/3 chips from the Metro Chip Harverster along with 2/3 chips from the standard processing equipment. The resulting pulp seemed to be of adequate quality (7).

Recent studies of Metro Chip Harvester chips indicate that green chips were being delivered at a cost of approximately *$5.00 per ton. Tests also showed the fiber yield per acre, to be twice the fiber loss (8).

Thus, there seems to be hope for the use of the whole tree concept

*Note: Costs include equipment, maintenance, and trucking costs only.

in the future. Although much progress has been made in the area of bark removal, perhaps some pulps can be produced without bark removal and still be comparable to previous pulps. This may require additional screening and/or centri-cleaners.

OBJECTIVE

The objective of this study is to determine whether Metro Chip Harvester chips can be employed in corrugating medium furnishes, and if so, determine the maximum percentage that can be used without a significant loss in physical strength, and also determine whether more refining or more severe cooking conditions are necessary to obtain a comparable corrugating medium furnish.

PROCEDURE

In order to evaluate the usefulness of Metro Chip Harvester chips (often to be referred to as "total chips") as substitutents of corrugating medium furnishes, comparisons with a standard corrugating medium furnish must be accomplished. Considerations must involve the pulping of "total chips" and standard chips, together, at various ratios of one to the other.

In an attempt to investigate the possible uses of "total chips" regarding corrugating medium, the following furnishes were considered:

(1) 100% standards chips.

(2) 75% standard chips and 25% "total chips".

(3) 50% standard chips and 50% "total chips".

(4) 25% standard chips and 75% "total chips".

(5) 100% "total chips"

Furnish #1, 100% standard chips, was used as a means of comparison.

Standard NSSC cooks were made in laboratory bomb digesters. The use of bomb digesters to simulate actual commercial pulp production has been verified (9).

The % yield and amount of liquor consumed were determined for each cook. The chips were defiberized in a Bauer disc refiner and the resultant pulps were refined in a Valley Beater. Handsheets were made from the beaten stock at two different degrees of refining (C.S.F.).

The sheets were pressed, dried, and conditioned, prior to testing, at 70°F and 50% relative humidity. Physical tests included Basis Weight, Caliper, Tensile, Tear, Mullen, and CMT.

DATA AND DISCUSSION

Five cooks were made in laboratory bomb digesters. They are labeled as follows:

A.	100% Barked Aspen	0% Metro Harvester Aspen
B.	75% Barked Aspen	25% Metro Harvester Aspen
C.	50% Barked Aspen	50% Metro Harvester Aspen
D.	25% Barked Aspen	75% Metro Harvester Aspen
E.	0% Barked Aspen	100% Metro Harvester Aspen

The cooks will be denoted by letters, indicated above. The initial target yield was to be 80% yield. Preliminary work indicated that 21% total chemical and 170°C for one hour should be reasonable conditions. The actual conditions for cooks A-E are given in Table I.

Table I

COOKING CONDITIONS

Sodium Sulfite	14%
Sodium Carbonate	7%
Liquor To Wood Ratio	3:1
Temperature	170°C
Time	60 minutes

According to the preceding conditions, cooks A-E ranged from 76.5% - 81.2% yield. The chemical consumption ranged from 6.17% - 7.21%. The percent yield and percent chemical consumption data is given in Table II.

Table II

EFFECT OF FURNISH ON % YIELD AND % CHEMICAL CONSUMPTION

Cook	% Yield	% Chemical Consumption
A	81.2	6.17
B	79.8	6.45
C	78.9	6.66
D	76.5	7.02
E	76.7	7.21

These results indicate a decrease in yield, under constant cooking conditions, when additional percentages of "total chips" exist. The results also indicate that the chemical consumption increases as the furnishes consist of larger amounts of "total chips". Graphical representation of these results can be seen in Figure 1.

After defiberization in a Bauer refiner, the pulps were beaten in a Valley Beater. Samples were taken from each cook at 400 ml. C.S.F. 26#/1000 ft.^{2} handsheets were made and tested for physical strength. The results of those tests are given in Table III.

Table III

PHYSICAL STRENGTH AT 400 ML. C.S.F.

Cook	Tensile (#)	Tear (g)	Caliper (pts.)	Mullen (psi)	Ring Crush (lbs)	CMT (#)
A	58	60	10.8	67	64	80
B	55	64	10.6	63	61	71
C	50	58	11.8	56	63	67
D	52	58	12.2	56	58	67
E	48	59	12.4	55	66	66

These results indicate, as expected, that physical strength decreases as more "total chips" are present. Tear and Ring Crush were variable. Caliper increased, but Tensile, Mullen and CMT dropped significantly. The overall strength losses were 17.3% in Tensile, 17.9% in Mullen, and 17.5% CMT. These strength losses, however, occurred primarily between 0 and 50% "total chips". Graphical representation of the results in Table III are found in Figure 2.

The remainder of the pulp in the beater was further refined to 250 ml. C.S.F. Samples were again withdrawn and 26#/1000 ft.^{2} handsheets were made and tested. The results of these tests are given in Table IV.

Table IV

PHYSICAL STRENGTH AT 250 ML. C.S.F.

Cook	Tensile (#)	Tear (g)	Caliper (pts)	Mullen (psi)	Ring Crush (lbs.)	CMT (#)
A	65	51	10.6	73	60	81
B	58	48	10.8	67	53	75
C	55	58	11.4	61	64	75
D	56	56	11.8	60	62	70
E	53	56	11.8	59	64	68

The results in Table IV show that a significant strength loss is also present at 250 ml. C.S.F. Again, Tear and Ring Crush were variable. Caliper increased, while Tensile was reduced 18.5%, Mullen dropped 19.2%, and CMT showed a 16.1% strength loss. Figure 3 illustrates these strength losses graphically.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of this work, it seems that 25% "total chips" can be added to a corrugating medium furnish without a severe loss in strength. It also seems possible that perhaps even a greater percentage of total chips could be employed if sufficient screening and centri-cleaners are present.

Strength losses seem to occur primarily between 0 and 50% "total chips", whereas the additional 25-50% seems to have little effect on strength.

Since the yields decreased somewhat as percentage of "total chips" increased, the strength losses could very well be greater at constant yield.

The strength losses were less than 20% for Tensile, Mullen, and CMT, when considering 100% Barked Aspen vs. 100% "total chips".

Since there is still much to be done in the area of "total chips" usage, this author is suggesting the following for future work:

1. Evaluate pulps at constant yield.
2. Evaluate different blends other than those considered in this work.
3. Evaluate different wood species and also mixed hardwoods.
4. Evaluate "total chips" for use in other grades such as linerboard.

There seems to be a potential for materials cost savings as long as strength specifications can be met and machine runnability is adequate. The major concern, however, is to cause the increase in fiber yield per acre, by the usage of "total chips", to be more profitable than the non-profitability of increased chemical consumption, lower yield, lower strength, and additional screening and cleaners.

Effect of Furnish on % Yield and % Chemical Consumption

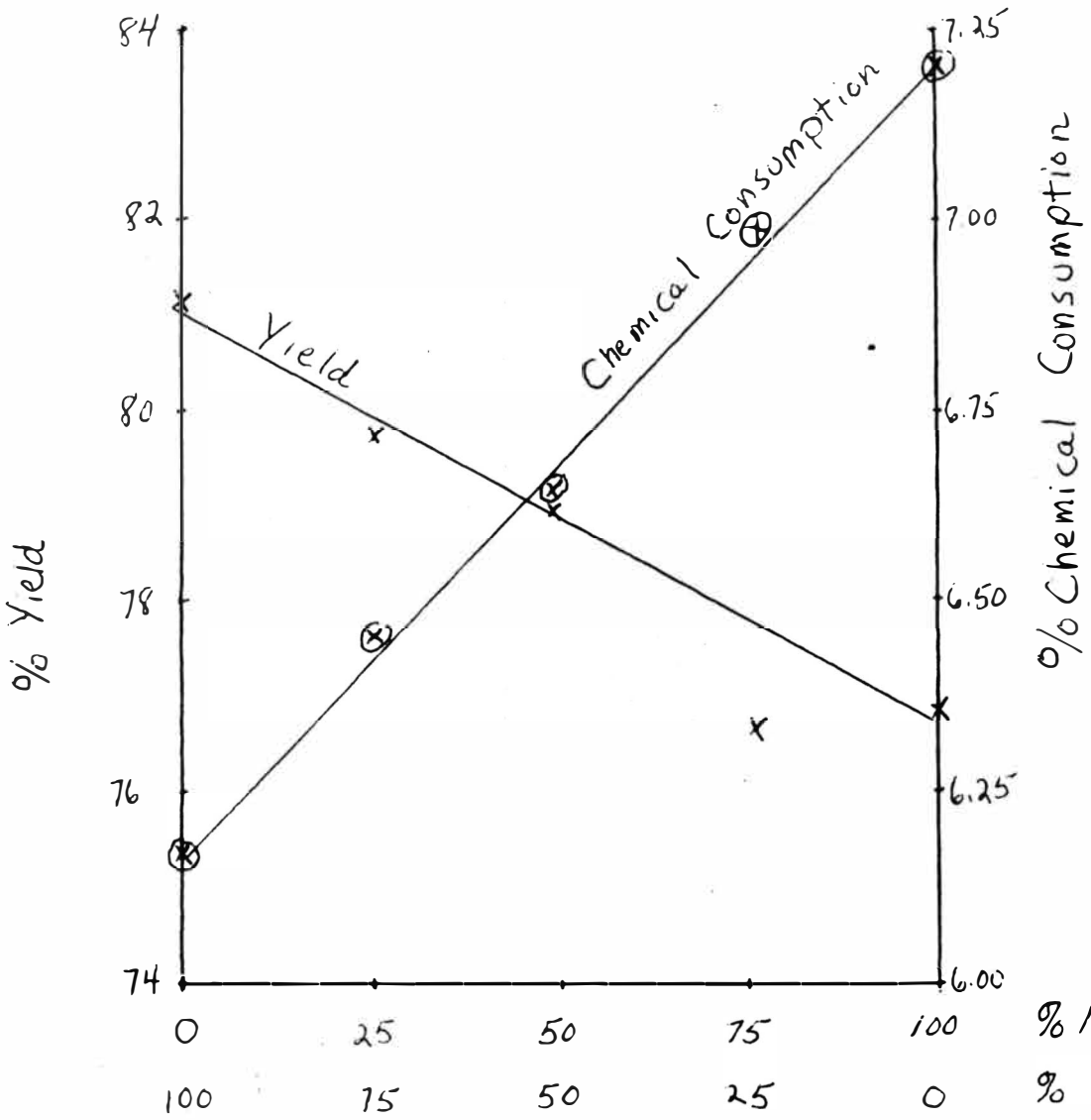
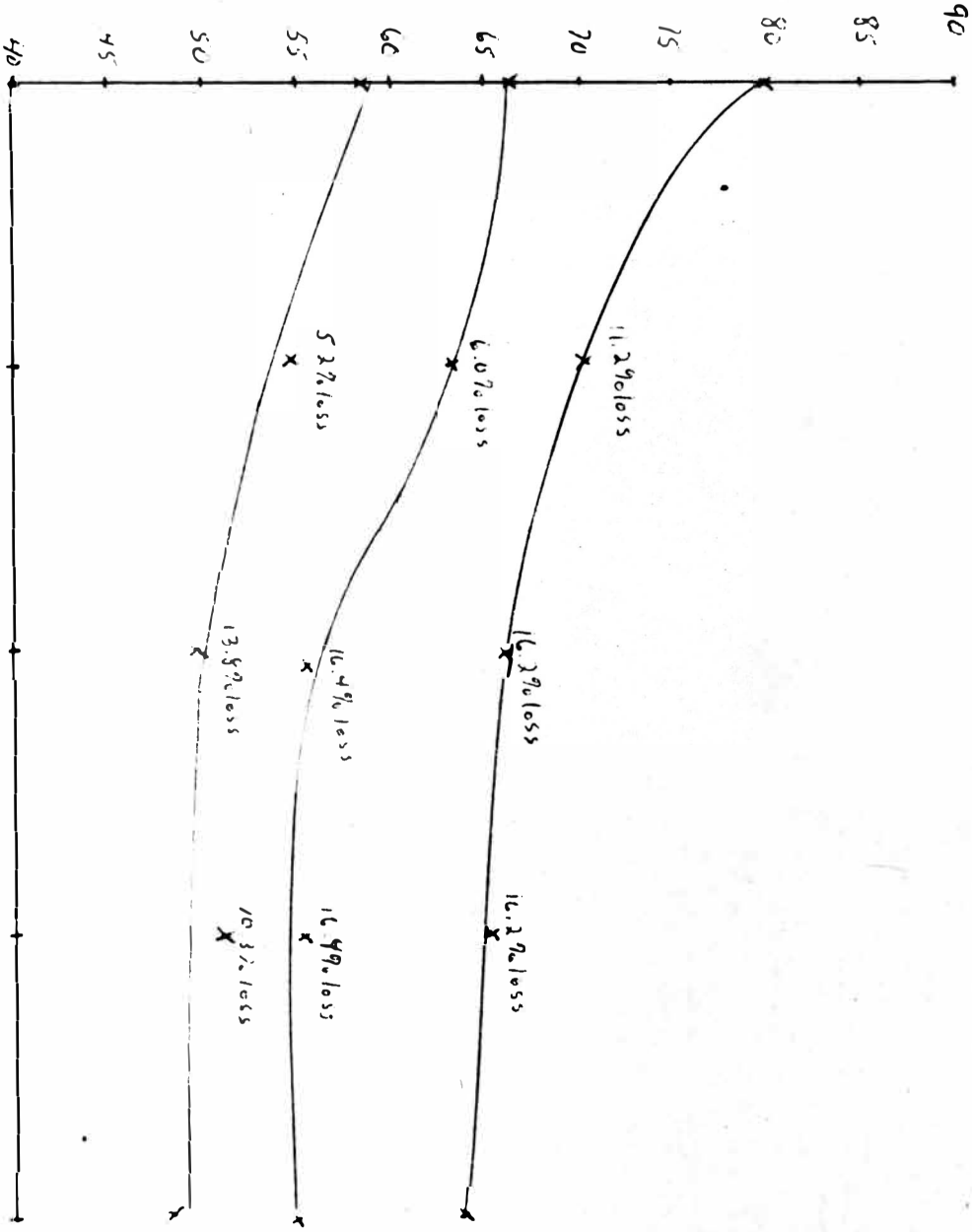


Figure 1

Effect of relative percentages of Barked and Metroharvester Aspen on Tensile, Mullen, and Concora



at 400 cc. C.S.F.

Figure 2

Effect of relative percentages of Barked and Metroharvester Aspen on Tensile, Mullen, and Concora

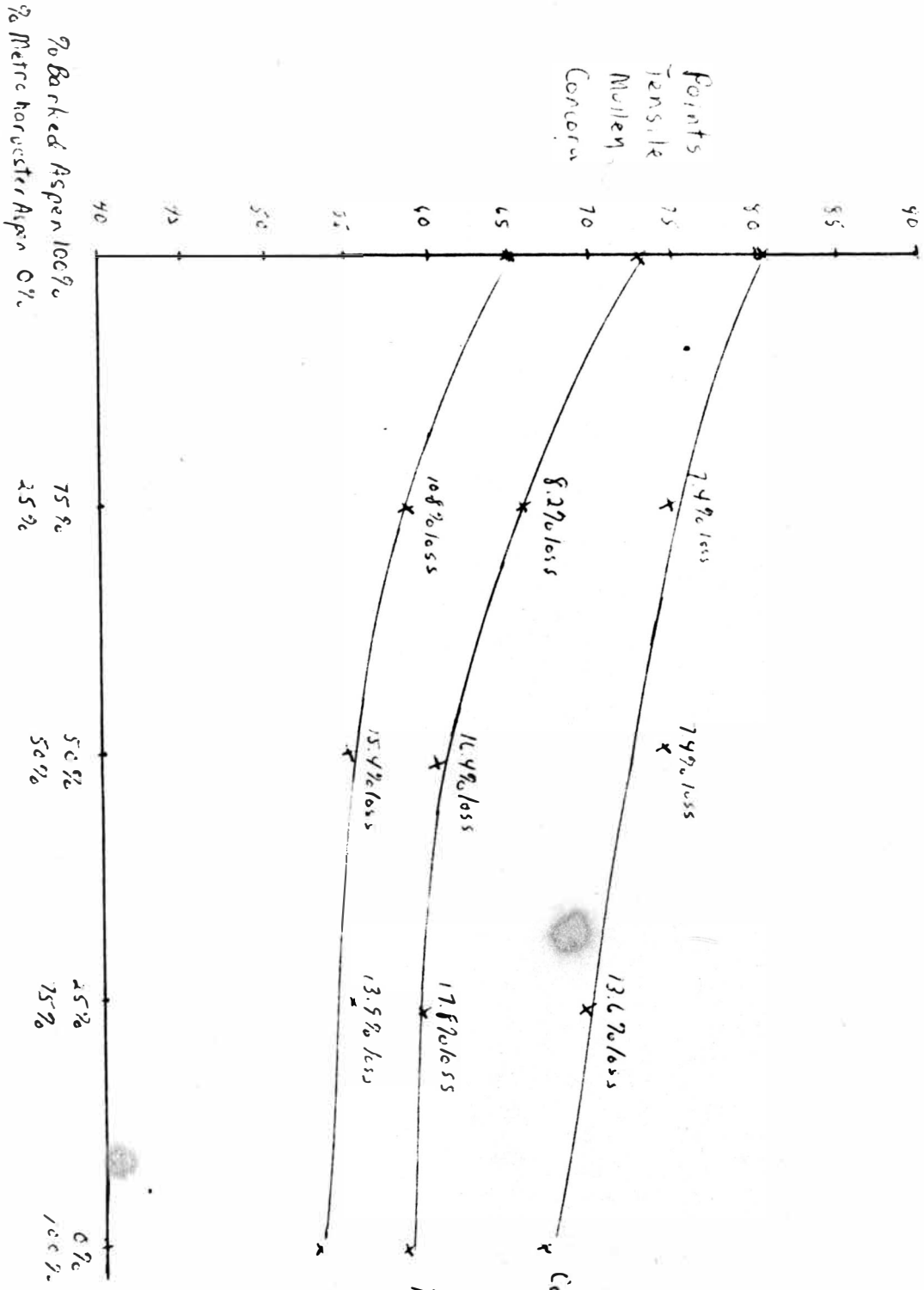


Figure 3

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