SODA PULPING OF NEW ZEALAND BEECH

S. R. CORSON*

SYNOPSIS

Results of a project which examined the feasibility of pulping the New Zealand beech species by the soda process indicate that a good quality pulp suitable for the manufacture of medium paper grades can be obtained. A low pressure impregnation stage was required to penetrate the wood satisfactorily and the consumption rate of soda was about 8% based on oven-dried wood.

Pulps were evaluated in their unscreened state and physical properties of a representative pulp are: 140 Canadian standard freeness, 3470 m breaking length, 4.5 tear index, 1.7 burst index, 1.96 bulk, 28.7 brightness and 99.5 opacity.

INTRODUCTION

A series of trials was performed to determine the feasibility of pulping mixed chip samples of the New Zealand beech species (*Nothofagus* spp.) by the cold soda process. This note outlines the main findings from this work.

**Cold Soda Process**

The cold soda process was developed by the U.S. Forest Products Laboratory, Madison, for the pulping of hardwoods at yield of 85 to 95%. This simple process requires that the chips be soaked in a solution of sodium hydroxide under atmospheric conditions for 1 to 2 hours. The softened chips are then defibred in a disc refiner to produce pulp suitable for corrugated board, sanitary tissue and medium quality printing paper. Soda pulps are usually blended with other pulps to obtain the desired properties.

The strength of the treating solution is in the range 2 to 10% depending on quality and yield requirements. Corresponding chemical consumption is 5 to 8% based on oven-dry fibre. The process removes some hemi-cellulose but there is little or no loss of lignin or alpha-cellulose.

The energy required to defibre the softened chips is about 350 to 550 kWh/tonne. This compares favourably with the 1600 to 1900 kWh/tonne required to refine untreated softwood chips.

A major advantage of the process is that it does not use the sulphur compounds required for the other common semi-chemical or kraft processes. Thus the characteristic pulp

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mill odours are avoided. Although many soda mills do not recover their waste liquors, this may be done by the recently developed Zimmerman wet-oxidation process. This process converts the organic compounds extracted from the wood to carbon dioxide and water and the sodium compounds to salts for recovery. However, while the capital cost of a minimum sized mill is very much lower than that of a kraft mill of minimum economic size, it is unlikely that the pulp could be sold in its raw state and it would probably be necessary to have a paper machine associated with any pulping operation. This would increase the total investment.

**EXPERIMENTAL**

The wood sample used comprised a mixture of red, silver, hard and mountain beech from the Nelson, Lewis Pass and West Coast areas. As these species all have similar paper-making properties, the use of a mixture rather than pure samples was justified. The chips had a moisture content of 45% based on wet chip weight.

Samples of 450 g oven-dry equivalent fibre were individually steeped in the sodium hydroxide solution in a Haato Oy stainless steel laboratory digester.

Two laboratory disc refiners were used to defibre the chips. A 12 hp, 8 in. diameter Bauer disc refiner fitted with breaker plates of Pattern No. 8818/8819 was used, when necessary, to reduce the whole chips to matchstick chips. The main refining work was done with a 40 hp, 12 in. diameter Sprout-Waldron disc refiner fitted with plates of Pattern No. 17804-E.

The refined pulp was beaten in a standard laboratory PFI mill, which makes the fibres more flexible and allows better bonding in the resulting sheet of paper.

The physical properties of the pulps were examined. Properties determined were the Canadian standard freeness (CsF), which is a measure of the rate of drainage of water from the pulp on the paper machine, tear, burst, tensile strength, bulk, porosity, brightness, and opacity. Fibre size distribution was determined using a Clark classifier fitted with screens of mesh no. 30, 50, 100 and 150.

**Liquor Penetration**

The degree of penetration of the sodium hydroxide liquor into the chips, which was studied initially, was determined visually after treatment by examining chips which had been split along their grain. Fastest penetration time was achieved with the following method:

1. Evacuate the chips at 90 kPa (absolute pressure) for 10 minutes.
2. Draw in the soda solution under vacuum over a 5 minute period.
3. Apply a static pressure of 600 kPa (absolute pressure) for 2 hours.
Concentration of the soda used in these impregnation trials was 25%. With lower concentrations of about 5 to 10% soda, chips in the large size range were often not impregnated to their centres. However, because of the high cost of impregnation at 25%, a large number of trials using rates in the range of 5 to 20% were used in succeeding work. A 6:1 liquor to wood ratio was used to ensure that the chips were completely immersed in the cooking liquor.

Faster penetration rates could be achieved at lower liquor concentrations when the chips were broken down to "match-stick-size" chips prior to impregnation. The brittle fractures which occur in producing these smaller chip sizes were, however, considered to have a detrimental effect on the fibre quality and this technique was not used. As heavy duty equipment can perform this operation more gently, the problem would not occur in a commercial installation.

In spite of the relatively high liquor concentration required for effective impregnation and pulp quality development, the alkali consumption was only about 7.75% based on oven-dry wood weight. The excess liquor was available for re-use.

### TABLE 1: PHYSICAL PROPERTIES OF REPRESENTATIVE PULPS

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<tr>
<th></th>
<th>Pulp Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<th>A2</th>
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<tr>
<td>Pre-steamed</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>NaOH concn (%)</td>
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<td>15</td>
<td>15</td>
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<td>10</td>
<td>10</td>
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<tr>
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<td>0.13</td>
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<td>7.9</td>
<td>9.3</td>
<td>9.3</td>
<td>8.4</td>
<td>8.4</td>
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<td>Freeness (Csf)</td>
<td>250</td>
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<td>140</td>
<td>60</td>
<td>105</td>
<td>50</td>
<td>150</td>
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<td>4380</td>
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<td>1.96</td>
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<td>Porosity</td>
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<td>89</td>
<td>55</td>
<td>51</td>
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<td>Opacity</td>
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<td>99.0</td>
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<td>Scattering coeff.</td>
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<td>451</td>
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<td>292</td>
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Fibre class (%):

+30     | 7.7 | 4.6 | 4.0 |
+50     | 37.4 | 32.3 | 32.6 |
+100    | 28.8 | 30.7 | 24.9 |
+150    | 10.8 | 11.4 | 18.2 |
fines   | 15.3 | 21.0 | 20.4 |

Refining Conditions

A series of different refining conditions was used. The pulps were treated individually to achieve the desired freeness values. In general, it was found necessary to refine the treated chips in at least two stages, first to reduce the chips to coarse fibre bundles between the breaker plates fitted to the Bauer refiner and the second to reduce these bundles to individual fibres in the Sprout-Waldron.

RESULTS AND DISCUSSION

Physical properties of six representative pulps are detailed in Table 1. It should be noted that four of these pulps were produced from chips which had been steamed at 600 kPa (absolute pressure) for 30 minutes. This treatment was found to give significant improvements in pulp quality but might not be necessary in a commercial system.

Pulps of freeness of about 50 to 60 Csf which had been beaten in the PFI mill had breaking lengths of 4380 m and 3490 m for soda concentrations of 15 and 10%, respectively. An unbeaten pulp which had a freeness of 140 Csf and which had been impregnated with liquor at 15% NaOH concentration had a breaking length of 3470 m, a tear index of 4.5, burst index of 1.7, and bulk of 1.96. Brightness and opacity values were 28.7 and 99.5, respectively.

For comparison two eucalypt pulps obtained by other workers in similar laboratory trials have been included in this table. These have higher strength properties but also a greater bulk which results in a thicker sheet being formed. It should be noted, however, that these pulps were refined in a nine-stage operation and heavily beaten. It is likely that similar quality could be achieved for the beech pulps if given the same treatment.

Thus, it can be concluded that pulps with good strength properties can be produced from the New Zealand beech species when they are pulped by the cold soda process. Some difficulties were experienced with the liquor impregnation stage but these were overcome by performing the operation under a static pressure of 600 kPa (absolute pressure). A two-stage refining process was required to defibre the impregnated chips satisfactorily. This factor is, however, heavily dependent on the type of disc refiner used, and a commercial system may require only a single stage. It is also important to note that all pulps were evaluated in an unscreened state and could be expected to yield higher physical properties when screened.