WOOD HARVESTING
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# SOUR FELLING IN ALBERTA

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## Abstract

During June and July 1989 the Forest Engineering Research Institute of Canada (FERIC) undertook a project to determine the extent of moisture loss in felled trees in east-central Alberta. This project was funded by Alberta Forestry, Lands and Wildlife and Alberta-Pacific Forest Industries.

## Introduction

In 1989, Alberta Forestry, Lands and Wildlife and Alberta-Pacific Forest Industries Inc. requested that the Forest Engineering Research Institute of Canada (FERIC) initiate a study to monitor the moisture reduction in sour-felled trees. Sour felling is a means of reducing moisture content in tree stems by retaining tree foliage for extended periods after felling. Other names used to describe this drying process are transpirational drying, delayed bucking, leaf seasoning, leaf felling, and biological drying (McMinn 1986).

The principle of sour felling is simple. Trees absorb water and minerals through their root systems. These minerals are transported, in solution, up the stem. Some minerals are absorbed en route and the rest of the solution travels to the foliage (leaves/needles) where it is released through transpiration. Although felling removes the tree from its water source, nutrients already in the system continue to travel in the stem until the stem's moisture content is depleted. At this point the foliage wilts or dies off, i.e. the stem "sours."

The cooperators requested that FERIC investigate sour felling to determine if log density can be reduced by this method. Several benefits would be expected if moisture content in felled trees could be reduced through sour felling. First, the reduction in log weight would increase the payload volume capacity of logging trucks. This is of particular concern in Alberta during periods of warmer weather when log-hauling roads are not stabilized by frost. Secondly, the milling residue would provide drier material for fuel. Finally, the lumber produced would be drier and require less kiln time.

Initially, FERIC responded to the cooperators by proposing a two-year project be undertaken to analyze the potential of using the sour-felling technique through all four seasons, and to evaluate the influence of drying on hauling costs, debarking, and pulping quality. However, the cooperators asked FERIC to begin with a short study to test the concept and to refine the methodology. At the specific direction of the cooperators, FERIC undertook a 14-day pilot study during June and July 1989 in east-central Alberta. The objectives of the pilot study were to:

- Determine the magnitude of moisture reduction, and therefore weight reduction, of sour-felled trees.
- Determine if a longer-term study on moisture content, pulp quality, and debarking of sour-felled trees is warranted.

FERIC conducted moisture evaluations near Athabasca, Alberta on felled stems of trembling aspen (*Populus Tremuloides Michx*), balsam poplar (*Populus Balsamifera L*), lodgepole pine (*Pinus Contorta Dougl.*), and white spruce (*Picea Glauca [Moench] Voss*).

## Study Methodology

The area in Alberta selected for the study (Figure 1) was north of Athabasca, between Calling Lake and Rock Island Lake. Two locations approximately 1 km apart were selected. Twenty aspen, five pine, and five spruce trees were felled at the first site and twenty poplar trees were felled at the second site. Tree lengths, butt diameters, and diameters at the core-sampling points were recorded for each felled tree.

A 5-mm diameter increment borer was used to extract sample cores daily from two locations along the felled stems (at 20% and 80% of the merchantable length of the stem) (Figure 2). The purpose of sampling in two

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*Figure 1. Study location.*

*Figure 2. Extracting sample core with increment bore.*

locations on each stem was to account for variation in the moisture-retention properties of the mature fibre (butt) and juvenile fibre (top). The extracted sample cores were immediately encapsulated in screw-cap test tubes for transport to a portable laboratory in Athabasca for moisture analysis. The boreholes were plugged with caulking material to prevent moisture from entering or leaving the stem.

In the field laboratory, each test tube, complete with its sample core, was weighed and the core's net weight was calculated (tare weights were previously recorded for each test tube). Cores were placed on drying trays (Figure 3), heated to 105°C for approximately 20 h in a small drying oven, and then reweighed. Moisture content was calculated by dividing the weight loss by the wet core weight.

## Results and Discussion

The sample trees ranged in butt diameter from 21.0 to 72.0 cm, and from 10.7 to 27.0 m in length (Table 1).

*Figure 3. Sample cores on drying trays.*

Rot was present in the butt and top sections of both deciduous species. With the aspen, rot was observed in 95% of the butts and 35% of the tops while the poplar had 50% and 25% respectively. Although, these levels of rot were not ideal for evaluating sour felling as a means of drying, they did reflect the normal stand conditions for this forest district.

Figure 4 illustrates the weather data recorded at noon daily by the Alberta Forest Service at Rock Island Lake (6 km from the study sites). Temperature averaged 15.4°C, relative humidity 68%, and precipitation 0.95 mm daily over the 14 days of data collection. Wind data are not presented because the sample trees were felled in standing timber and were relatively protected from the drying influence of any breezes.

As illustrated in Table 2, there was a minor net moisture loss in the deciduous samples and a negligible moisture gain in the conifer samples over the 14-day study (based on measurements of first-day and last-day moisture contents). The aspen and poplar lost approximately 4% and 5% respectively and the spruce and pine both gained about 1% (Table 3). Differences this small can be attributed to experimental error and preclude statistical analysis.

The maximum and minimum ranges of the moisture contents (Table 3) show pine fluctuating the least at 3.9%, followed by spruce, aspen, and poplar at 4.1%, 4.4%, and 6% respectively.

Figure 5 plots the average daily moisture content for each species. When this information is compared to that in Figure 4, the rise and fall of the stem moisture content appears to be influenced by the relative humidity and temperature.

The lack of observed moisture reduction may have resulted because:

- The evaluation period was too short. Liss (1986), in a Swedish sour-felling study, found the moisture content in May-felled spruce and aspen dropped 16% after one month and then increased slightly over the second month. By the end of FERIC's 14-day evaluation, no permanent wilting was observed on the

*Table 1. Average Dimensions of Sample Trees*

| Species | Butt diameter |  | Tree length on ground |  | Diameter at sample point: Butt section |  | Diameter at sample point: Top section |  |
|---|---|---|---|---|---|---|---|---|
|  | Average (cm) | Range (cm) | Average (cm) | Range (cm) | Average (cm) | Range (cm) | Average (cm) | Range (cm) |
| Lodgepole pine | 46.5 | 39.4 - 51.2 | 23.1 | 20.9 - 24.7 | 35.6 | 28.0 - 41.2 | 21.2 | 17.1 - 22.9 |
| White spruce | 44.5 | 29.5 - 56.0 | 20.6 | 14.1 - 27.0 | 30.7 | 21.5 - 39.2 | 15.6 | 13.3 - 17.0 |
| Trembling aspen | 45.5 | 21.0 - 72.0 | 19.4 | 10.7 - 23.1 | 32.2 | 15.2 - 43.1 | 19.3 | 10.6 - 27.0 |
| Balsam poplar | 32.8 | 23.5 - 45.5 | 17.7 | 13.9 - 20.0 | 25.2 | 18.7 - 33.0 | 15.0 | 12.1 - 19.6 |

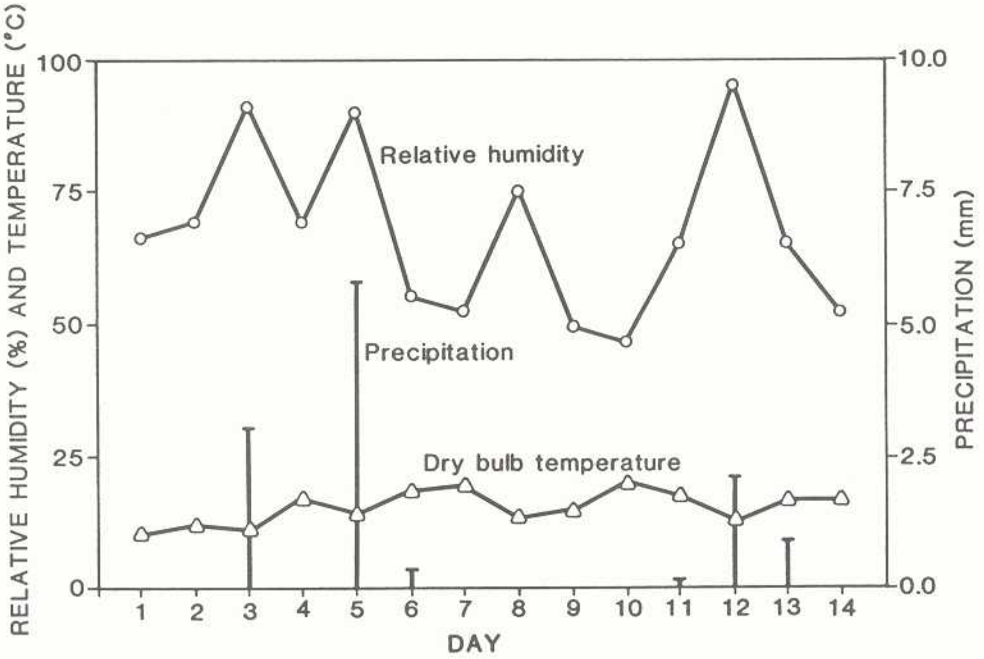

*Figure 4. Weather data recorded during the sour-felling study. (Source: Alberta Forest Service, Rock Island Lake Weather Station.)*

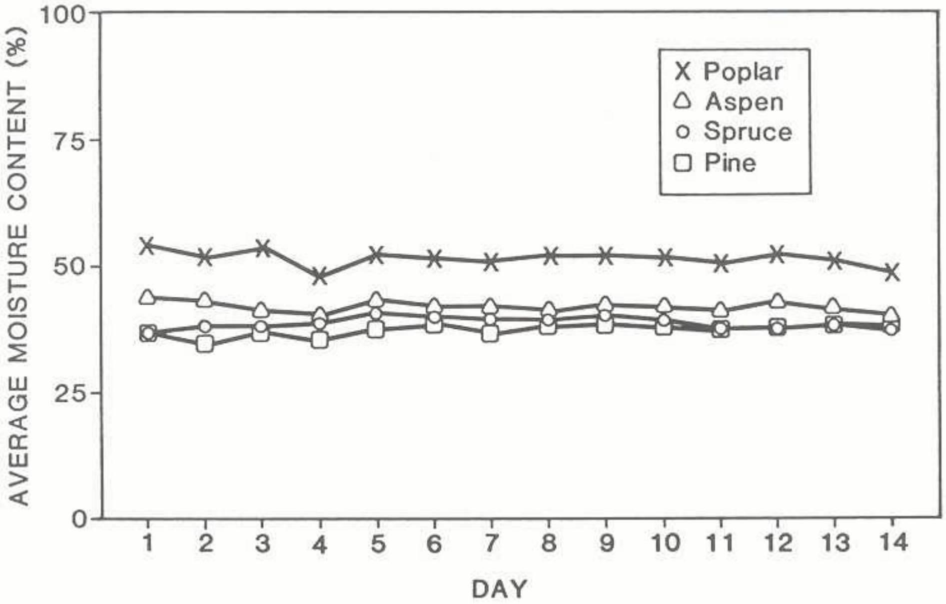

*Figure 5. Average daily moisture content for each species.*

*Table 2. Average Daily Moisture Content of Sample Trees*

| Day | Spruce (%) | Pine (%) | Aspen (%) | Poplar (%) |
|---|---|---|---|---|
| 1 | 36.0 | 36.2 | 43.5 | 53.9 |
| 2 | 37.8 | 34.2 | 42.9 | 51.7 |
| 3 | 37.7 | 36.3 | 40.7 | 53.4 |
| 4 | 38.0 | 35.0 | 39.9 | 47.9 |
| 5 | 40.1 | 36.8 | 44.0 | 51.9 |
| 6 | 39.4 | 37.9 | 41.6 | 51.3 |
| 7 | 38.8 | 36.2 | 41.5 | 50.8 |
| 8 | 39.2 | 37.4 | 40.6 | 51.8 |
| 9 | 39.9 | 37.6 | 41.7 | 52.0 |
| 10 | 39.0 | 37.4 | 41.0 | 51.4 |
| 11 | 36.8 | 36.4 | 40.1 | 50.3 |
| 12 | 37.3 | 37.2 | 42.0 | 51.7 |
| 13 | 37.6 | 38.1 | 41.1 | 51.0 |
| 14 | 36.9 | 37.5 | 39.6 | 48.7 |

*Table 3. Variation in Average Moisture Content*

| Moisture content | Spruce (%) | Pine (%) | Aspen (%) | Poplar (%) |
|---|---|---|---|---|
| First-day moisture content | 36.0 | 36.2 | 43.5 | 53.9 |
| Last-day moisture content | 36.9 | 37.5 | 39.6 | 48.7 |
| Moisture content reduction | (0.9) | (1.3) | 3.9 | 5.2 |
| Maximum moisture content | 40.1 | 38.1 | 44.0 | 53.9 |
| Minimum moisture content | 36.0 | 34.2 | 39.6 | 47.9 |
| Range of moisture fluctuation | 4.1 | 3.9 | 4.4 | 6.0 |

foliage of the sample trees, indicating the stem had yet to endure any moisture stress.

- The evaluation was undertaken during that part of the year when the moisture content in the stem was already low. Gibbs (1958) found that moisture content of eastern Canadian hardwoods and softwoods was highest in winter and lowest in summer.
- Rot fungus in the stems may have enhanced moisture retention (Liss 1986).
- A moisture differential between the foliage and the atmosphere must exist for any substantial transpiration to occur (Society of American Foresters 1984), i.e. relative humidity should be much less than the stem's moisture content. As depicted in Figure 4, the average relative humidity throughout the trial was 68% while the maximum moisture content in the sample stems was 54% (Table 2).

The duration, timing, and general location of the pilot study were specified by the cooperators.

## Conclusions

The insignificant stem moisture reduction observed as a result of this 14-day pilot study alone would suggest there is little opportunity for improving log-hauling payload through sour felling. However, the influence of three factors on sour-felling performance requires further evaluation before this process can be discounted. Firstly, what is the effect of the season of felling on the initial moisture content in the stem? Secondly, to what extent do weather conditions during the drying period control the rate and magnitude of moisture reduction? Finally, how can the optimum duration of sour felling be determined?

FERIC recommends a second, longer phase of this pilot study be undertaken to clarify the relative importance of season, weather, and other factors such as rot, in determining the potential for the sour-felling process in Alberta forests.

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