Beetle-killed spruce utilization in the Kenai peninsula

GARY M. SCOTT, DAVID W. BORMETT, NANCY ROSS SUTHERLAND, SAID ABUBAKR. AND EINI LOWELL

Application: Beetle-killed spruce can be used as a fiber source for papermaking. The presence of sap rot is a key indicator of pulpability, but other factors may also be important.

INFESTATION OF THE *DENDROCTONUS RUFIPENNIS* BEETLE HAS resulted in large stands of dead and dying timber on the Kenai peninsula in Alaska, with white spruce (*Picea glauca* (Moench) Voss) and hybrid lutz spruce (*Picea lutzii* Little) the primary species affected. Tests were conducted to evaluate the value of the beetle-killed material as pulpwood.

EXPERIMENTAL PROCEDURE

Trees were harvested from six locations and classified by visual inspection into four deterioration classes:

1. Tree green or untested; needles green, but attacked by beetles.
2. Tree recently dead; red-brown needles; retention of fine branches and twigs; bark still tight.
3. No fine branches and twigs; gray crown; tight bark or at least 90% of bark remaining; small weather checks.
4. Tree dead for a long time; some large branches broken off; bark loosened and more than 10% sloughed away; large weather checks apparent in many trees.

Twelve logs, three from each class, were shipped to the Forest Products Laboratory in Madison, WI, where they were debarked, chipped, screened, bagged, and stored at 5°C. The chips were pulped in a stainless-steel digester with pumped liquor circulation and indirect steam heating.

Each log was pulped to two kappa levels: nominal 30 and 80 kappa. For each cook, the temperature was ramped from 80°C to 170°C over a period of 90 to 100 min. For the high kappa level, the cook was held at a constant temperature for 40 min. For the low kappa level, the cook was held at constant temperature for 90 to 100 min. The liquor was drained, and the chips were washed in the digester and then fiberized in an atmospheric refiner. The pulp was screened in 0.3 mm slotted plates, dewatered, shredded, and stored. Screened yield and kappa number were determined by Tappi Test Method T 236. Table I shows average pulp yield and kappa results for the high and low kappa cooks.

H-factor	Deterioration class	No. of samples	Net vol., %	Yield, %[a]	Kappa no.[a]
611[b]	1	2	58.2	53.9 (0.1)	71.9 (3.4)
	2	3	84.1	53.9 (2.9)	75.0 (10.0)
	3	4	74.9	51.9 (2.1)	86.1 (10.3)
	4	3	87.1	54.7 (0.8)	75.8 (8.4)
1375[c]	1	3	55.5	48.5 (0.6)	26.5 (1.2)
	2	3	84.1	47.6 (2.5)	25.5 (1.2)
	3	3	75.6	45.1 (2.6)	30.5 (1.0)
	4	3	87.1	47.1 (1.3)	25.5 (0.8)
1528c	1	2	58.2	47.4 (3.8)	22.8 (0.1)
	2	2	76.1	46.9 (2.6)	22.3 (1.2)
	3	1	85.9	45.9 (NA)	26.1 (NA)

[a]Numbers in parentheses indicate standard deviation
[b]High kappa number
[c]Low kappa number

I. Average pulp yield

EXPERIMENTAL RESULTS

Results indicate that beetle-killed spruce can be pulped effectively with the kraft pulping process. Pulp yield from deteriorated logs were similar for high and low kappa levels. Extent of log deterioration has little effect on pulping. Refining energy is the same or slightly less for pulp produced from more deteriorated wood. Decay does reduce wood yield, especially in chipping, where a greater percentage of fines and pin chips are produced.

Log deterioration has mixed effects on paper properties. In general, tear strength was slightly lower and tensile strength slightly higher for the more deteriorated wood. Burst and tensile strength were strongly dependent on the amount of log decay, as measured by the net cubic volume of sound wood. Tear strength was strongly dependent on fiber length, which tended to be shorter in the more severely deteriorated wood. However, strength properties were still of an acceptable quality when compared to the control. **TJ**

Scott is assistant professor, Faculty of Paper Science and Engineering, at the State University of New York, Syracuse, NY. Bormett is chemical engineer, Sutherland is general engineer, and Abubakr is supervising chemical engineer with the USDA Forest Service, Forest Products Laboratory, Madison, WI. Lowell is research forest products technologist, USDA Forest Service, Pacific Northwest Station, Portland, OR. Address correspondence to Scott by email at gscott@esf.edu.