FOREST ENGINEERING RESEARCH INSTITUTE OF CANADA
Eastern Division

INSTITUT CANADIEN DE RECHERCHES EN GÉNIE FORESTIER
Division de l'est

November 1990

Field Note N°: Processing-22
Previous Reference Sheet N°: None

MALENFANT PROTOTYPE CHAIN FLAIL DELIMBER-DEBARKER: PRODUCTIVITY AND CHAIN WEAR

INTRODUCTION

Chain cost is one of the major concerns on chain flail delimbing-debarking equipment. A rule-of-thumb estimate of $1/m^3 is often used when evaluating the cost of chain replacement on this type of equipment. In September 1989, FERIC studied a prototype home-made chain flail delimber-debarker. Since the configuration of this machine was generally similar to other commercial chain flails, the opportunity was taken to conduct some chain wear measurements during the week-long study of the unit.

MACHINE DESCRIPTION

The mobile flail delimber-debarker was built by Les Copeaux Malenfant Ltée of East Angus, Que. The prototype machine consisted of a Barko live-heel knuckleboom loader, one upper moveable and one lower fixed flail drum, an infeed and an outfeed conveyor, along with two side-discharging debris conveyors. The flail unit was mounted on a frame having a tandem-axle suspension, and the whole unit weighed just under 50 tonnes (Figure 1).

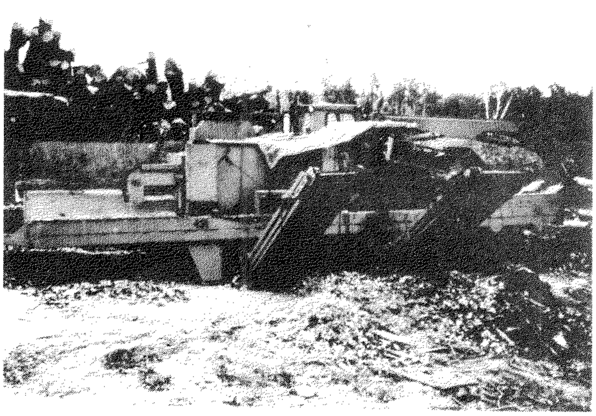

Figure 1. Malenfant prototype flail delimber-debarker.

The machine was operating on the limits of Canadian Pacific Forest Products Ltd., La Tuque division, Que. to produce 5000 tonnes of wood chips from tree-length hardwood. The mobile flail was operating in conjunction with a Morbark model 27 chipper along a cold-deck inventory in a yard. Tree size averaged 26 cm in butt diameter, or 0.20 m^3/tree. Moisture content of the inventoried wood was down to 35% (green weight basis) which resulted in the bark being tightly adhered to the tree stems.

PERFORMANCE

During the FERIC study, productivity averaged 29.5 mgt/PMH, or 19.3 odt/PMH (162 trees/PMH). Productive chipping time averaged 44.1 minutes/van load. Delays for van positioning averaged 10.5 minutes to give a total time per load of 54.6 minutes. This figure does not include delays resulting from moving the system after every two to three van loads were filled. The company reported that the bark content of the chips produced during the study averaged 2.2%.

CHAIN WEAR ANALYSIS

A study of flail chain wear was undertaken whereby selected flail chain links were measured at regular intervals to determine the rate of wear. Each flail drum had six rows of chains, each with nine lengths of 13-mm diameter Grade 80 alloy chain attached. Flail chains were measured at the end of each shift over five days. The measurements were taken on each of the outermost four links of three specific chains on each drum.

The first factor examined was the rate of wear according to link location (averaged for all chains sampled). An analysis of the end thickness of each link showed the most severe wear occurred on the third link from the outer end (Figure 2). The degree of wear after 21 loads of chips were produced averaged 12.5% (i.e., link thickness was 87.5% of original size). The fourth from last link sustained minimal wear (2.9%).

This accelerated wear on the third link was already recognized 15 years ago by operators of chain flail delimbers. Operators extended chain life by cutting off

143 Place Frontenac, Pointe Claire, Québec, Canada H9R 4Z7 (514) 694-1140 Fax: (514) 694-4351

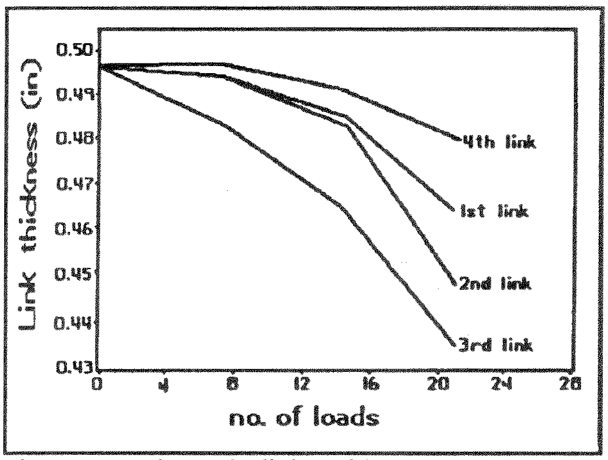

Figure 2. End wear by link position.

the outermost link when wear on the third link became apparent. Although this shortened the link set slightly, chain wear was shifted to the next link and chain life was effectively doubled. An alternative approach would be to reverse the chain to expose the other end to wear.

Wear on the sides of each link was minimal, which suggests that a different shape of link may be desirable. For example, the use of round link chains would distribute the wear uniformly around the link and possibly lengthen chain life. However, further research is needed to ascertain if round links would be aggressive enough for *debarking* purposes.

The second factor examined was wear as a function of the position of the chain on the drum. Analysis of the end thickness of links showed more severe wear on chains in the centre of the drum after 21 loads (10.1%), compared to those on the outside of the drum (1.2%) (Figure 3). Exchanging chains between the centre and the outside of each drum should therefore lengthen overall chain life.

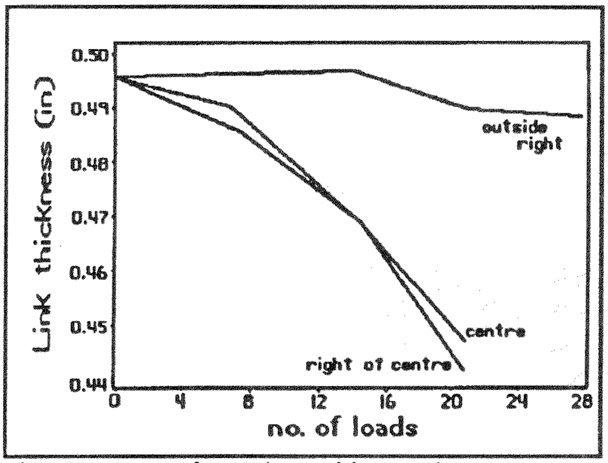

Figure 3. Rate of wear by position on drum.

The third factor examined was the difference in rates of chain wear between the top drum and the bottom drum (Figure 4). Tree stems came into contact with the top drum first, resulting in greater wear on the upper chains compared to those on the bottom drum (12.3% vs. 6.6%).

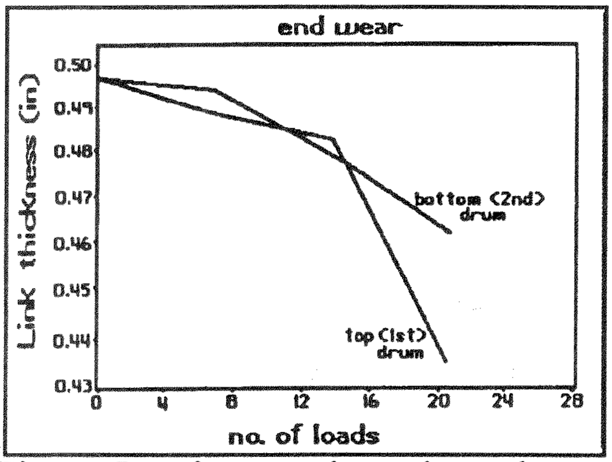

Figure 4. Rate of wear: top drum vs. bottom drum.

CONCLUSIONS

The study duration was not long enough to determine the exact rate of wear or the life of the chain links during normal operation. After 28 loads, no individual links or groups of links had broken off, but some entire link sets were missing since the anchoring device at the drum had failed.

However, this preliminary study helped to further define the characteristics of chain wear in chain flail delimber-debarker applications. Such information is essential to develop operational strategies or alternative flail designs or materials to reduce the overall chain cost of these systems. FERIC intends to continue working in the area of chain flail improvement and modification.

DISCLAIMER

This report is based on limited field observation and is published solely to disseminate information to FERIC member companies. It is not intended as an endorsement or approval by FERIC of any product or service to the exclusion of others that may be suitable.

Keith A. Raymond, exchange researcher
LIRA, Rotorua, N.Z.

Gordon S. Franklin, senior researcher
Wood Harvesting, Eastern Division