OPERATIONAL STUDIES OF A CHAIN FLAIL DEBARKER

In early April 2013 a productivity study of the Hooli mobile debarker was performed. Debarking took place at the terminal of UPM Kymmene in Östra Botnia, Finland. Raw material for the debarking was whole trees of pine without tree tops from first thinnings. Debarking was performed during two days. The debarker was run at 520/480 RPM the first day, and the second day at 280 RPM. The productivity of producing debarked logs and residues at 520/480 RPM was 14.7 OD t PW hour^{-1} of which residues represented 7.5%. The corresponding productivity at 280 RPM was 14.3 OD t PW hour^{-1} of which residues represented 35.0%. The bark content still attached to the debarked logs varied in a wide range from 0.3 to 14.7 % and it was in average 2.8 %. The minimum necessary terminal area to perform debarking was 0.8 ha, i.e. the space the machine needs to maneuver/operate.

MATERIALS AND METHODS

Debarking of whole trees of pine from the first thinning stands was carried out at a terminal of UPM Kymmene in Ostrobothnia, Finland. The study was performed at the beginning of April 2013. The debarking was performed with a mobile chain flail debarker manufactured by the company Hooli (Fig. 1). The debarked logs and bark within the terminal were moved away from the debarker by a Volvo L120E front-end loader equipped by both bucket and log grapple (Fig. 2).

The chain flail debarker had two drums, upper and lower, equipped with chains. Two different RPM settings of drums on the chain flail debarker were used. The first day the debarker was set to run at 520 RPM on the upper drum and 480 RPM on the bottom drum. The second day, due to problems with the hydraulic system, the machine was run at 280 RPM on both drums. Both debarked logs and bark were separated for each day and then scaled at a UPM pulp mill. A frequency time study was performed, with 10 seconds intervals for registering current work elements. Additionally, the fuel consumption was measured separately for each day. Quality of debarking was measured with a common sampling for both days. The quality of debarked logs was evaluated 1) by sampling a disc from the middle of a log, 2) by removing the bark from the disc and 3) by scaling the mass of each fraction (i.e. wood and bark). In total 72 logs were sampled and measured for the bark content and 22 logs for describing log properties during the trial. At the conclusion of the debarking trials, the total terminal area and the area occupied by debarking operation was measured with a Walktax distance finder.

RESULTS

The average log was 5 m long and its average diameter at breast height and volume was 9.8 cm and 42.2 dm^3, respectively. The total terminal area was 3.2 ha. The minimum area for the debarking process was 0.8 ha. Most of the necessary area for debarking was used for storing the debarked logs and for the front-end loader to operate. The productivity of the debarker, as debarked logs, was 13.6 OD t PW $hour^{-1}$ when machine was run at 520/480 RPM and it was 9.3 OD t PW $hour^{-1}$ when run at280 RPM. The corresponding productivity of produced residual bark and branches was 1.1 OD t PW $hour^{-1}$ at 520/480 RPM and 5.0 OD t PW $hour^{-1}$ at 280 RPM. The average time per crane cycle was 20.6 seconds and in average 3.7 logs was handled per crane cycle.

Table 1. Properties of the chain flail debarker and the biomass during the trials.

	Day 1	Day 2
RPM of Chain Flail Debarker, Upper/Lower Drum	520/480	280/280
Total Mass of Debarked Logs, OD t	62.2	61.7
Total Mass of Bark, OD t	5.0	14.5
Total Energy Value of Debarked Logs, MWh	343.1	324.8
Total Energy Value of Bark, MWh	27.7	77.0
Moisture Content, %	58	56
Productivity of Debarked Logs, OD t PW $hour^{-1}$	13.6	9.3
Productivity of Bark, OD t PW $hour^{-1}$	1.1	5.0
Fuel Consumption, l OD t^{-1}	1.9	2.0
EROEI (Energy Return on Energy Invested)	233.1	300.6

In 43% of the total work time crane movements and debarking were performed simultaneously. Most of the waiting times occurred when the debarked logs had to be removed from the side of the debarker and transported by the front-end loader to the landing area in the terminal. The bark content still attached to the debarked logs varied in a wide range from 0.3 % to 14.7 % and the average was 2.8 %.

LITERATURE/KEYWORDS

Debarking, bark, terminal, tree fractions

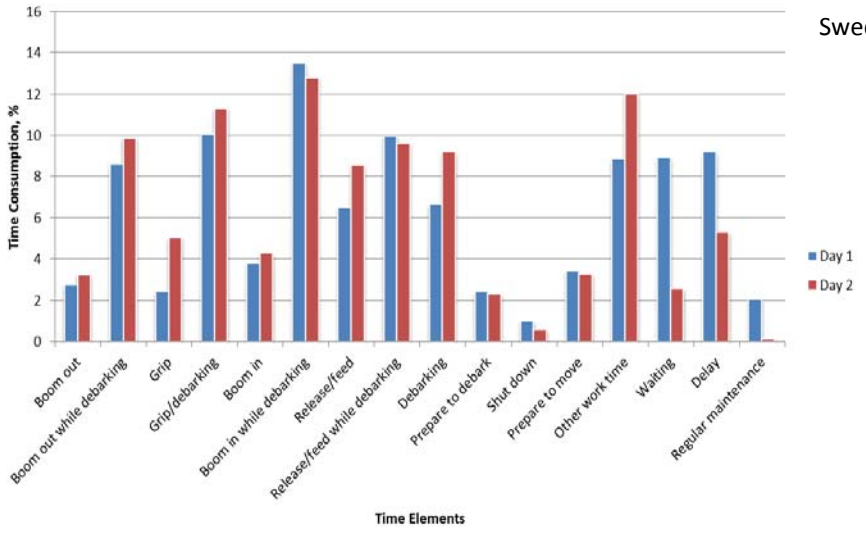

Figure 3. Distribution of work time elements in the chain flail debarking operation, including delay time.

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