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MULTI-STEM DELIMBING/DEBARKING WITH A DOUBLE CHAIN FLAIL

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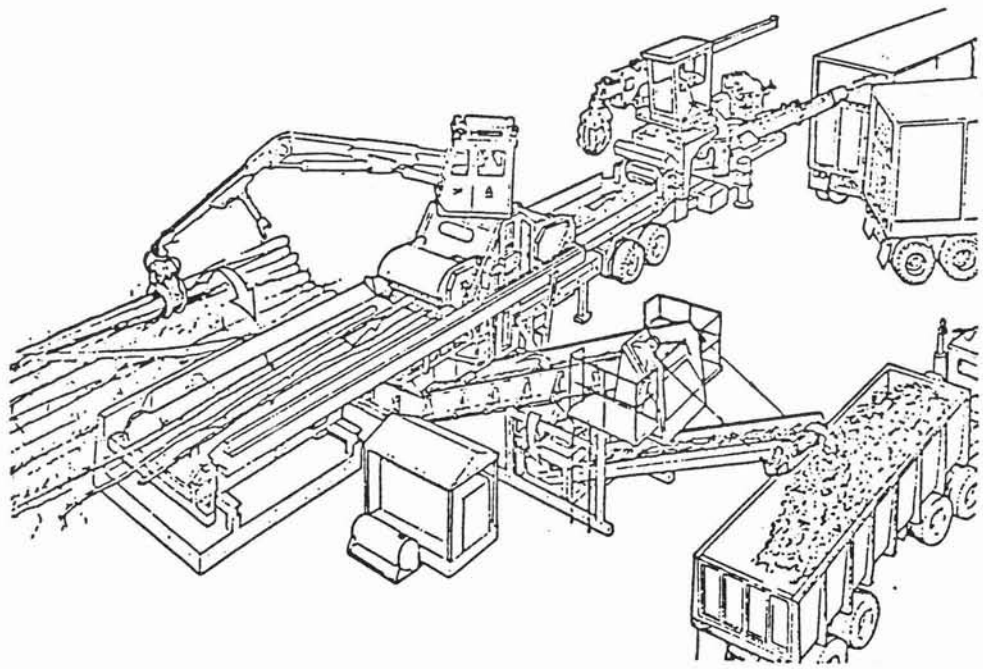

Figure 1 - Semi-mobile DFDD system

INTRODUCTION

In 1981 the Weyerhaeuser Company began developing an inexpensive system for producing clean wood chips from whole-tree thinning material. At that time, the barrier to using small-stem material as a chip source was the high cost of delimbing and debarking. Drum delimbing and debarking required high capital and decreased the productivity of the wood yard. Delimbing small stems in the woods was also quite costly, especially the labour costs associated with traditional single-stem methods.

A way was needed to batch-delimb and debark stems before they were conveyed into the chipper. During tests of mobile flail delimbers, it was noticed that much of the bark was removed from the portion of the stem that was exposed to the chains. This led to the development of Weyerhaeuser's current double-flail delimber/debarker system (Figure 1).

DEVELOPMENT PROCESS

System development of the double-flail delimber/debarker (DFDD) included three major phases :

(1) Initial trials of an experimental machine

(2) Design and development of a large prototype mobile system, and

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(3) Modification to develop a semi-mobile production unit.

The experimental chain flail machine tested the effect of chain size spacing and length, drum spacing diameter and speed, etc. on wood of different species, age, diameter and season.

The prototype mobile system was developed with the intent of mounting it in front of a mobile chipper to remove bark as well as limbs at the roadside. The aim was to eventually develop an entirely mobile, integrated delimber/debarker/chipper system with the capability of producing hogged fuel as a by product.

When the prototype mobile system was built, tests showed it to have an unexpectedly high productivity, over 73 green tonnes per hour. Instead of struggling to keep the unit fully utilised at an individual logging site, it became more economical to use it in a satellite yard. The modification of the DFDD to a stationary or semi-mobile unit was done to minimise unit costs by assuring an adequate wood supply.

With the increasing productivity of the unit over design specifications, the built-in shredder-slinger became a production bottleneck. In the semi-mobile system, the shredder-slinger was removed and replaced by a separate hogged fuel processing system which had a greater capacity and higher tolerance for passing worn chain. A simple drag chain feeds the hogged fuel system, uncoupling the shredder and the flail, and strong magnets were installed to collect worn chain links ahead of the shredder.

SYSTEM CONFIGURATION

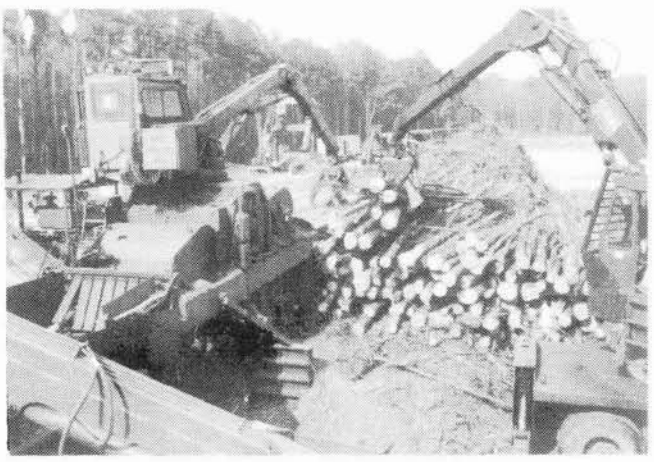

Figure 2 - DFDD flail infeed

The current delimber/debarker system includes a flail, a chipper, two loaders, and three trucks. Whole trees are hauled to the flail directly from the logging sites. They are then unloaded, decked, and fed to the flail by loaders (Figure 2) where they are delimbed, debarked and run directly into the chipper (Figure 3). The chipper blows the clean chips into waiting chip vans that are shuttled to the mill chip dump.

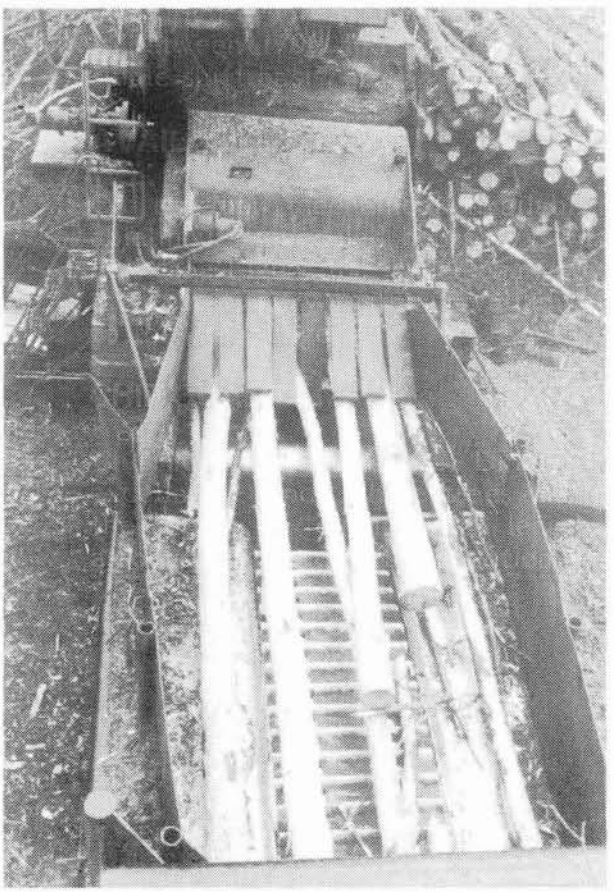

Figure 3 - DFDD chipper infeed

Residual limbs and bark drop from beneath the flails and from between the flail and chipper on to a drag chain conveyor system. This residue material is deposited into a drop feed shredder and then conveyed to an open-top dump truck (Figure 4).

The flails are driven hydraulically from a diesel power supply and the three drag chain conveyors and shredder are electrically driven. The two flail drums are offset to eliminate interference problems. Chains can be changed in about 20 minutes. The chipper is a standard 22 inch Morbark. Though never moved, the unit is semi-mobile and it is estimated that a site change could be made in a week to ten days.

Figure 4 - Drop feed shredder system

The current flail operation employs eight people :

1 operator to run the flail-chipper combination
3 truck drivers for two chip trucks and one hogged fuel dump truck
1 mechanic
2 loader operators, one for unloading trucks and one for feeding the flail
1 lead man

PRODUCTIVITY

The flail has been used with piece sizes ranging from 0.08 to 0.34 m^3 averaging close to 0.14 m^3. It will handle a maximum diameter of 51 cm. The trees are plantation thinnings of 14 to 22 year old Loblolly pine. Production rates have ranged from 257 to 586 green tonnes per 8 hour shift. The current year-to-date average is 485 green tonnes or 535 m^3 of clean chips per shift (see Figure 5). Planned weekly chip output is between 1700 and 2800 green tonnes on a single shift basis.

AVAILABILITY

On startup, mechanical availability (available hours/scheduled hours) was often below 60% (see Figure 6). After changeover to the more stationary system, availability climbed to the 80% range.

CHIP QUALITY

Chip quality from the DFDD system is excellent. Since whole trees are processed, the cost of cutting to length and its associated chip quality reduction are avoided.

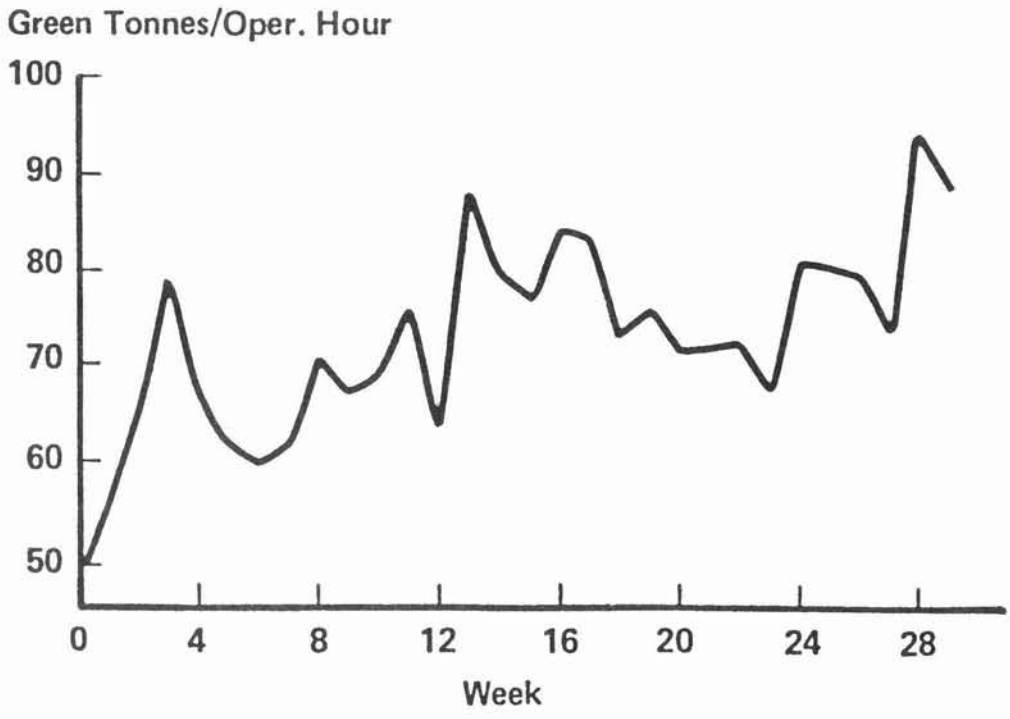

Figure 5 - DFDD productivity

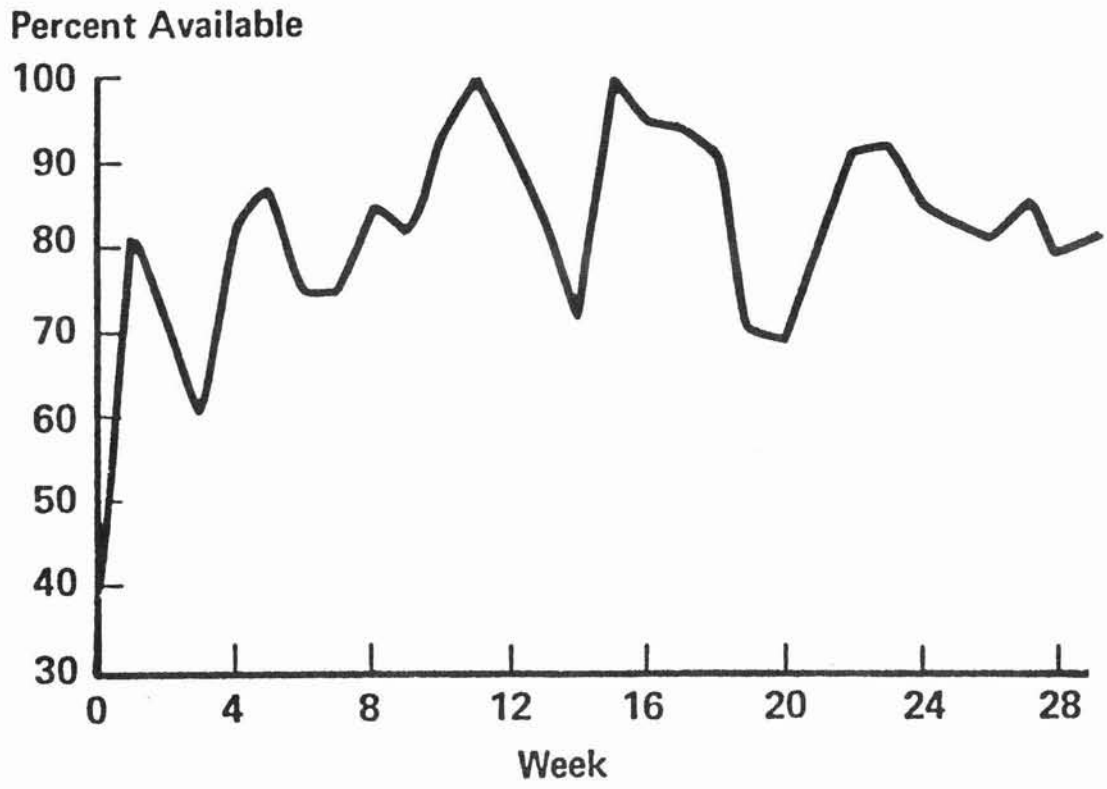

Figure 6 - DFDD availability

Chip accepts run between 75 and 80%, which is comparable to a conventional wood room using drum debarkers. Bark content varies with the production level and the season. Pushing production tends to increase the bark content. Winter wood is tougher to debark, but even during the winter, bark content has been consistently under 1%. The flail can be adjusted during tight bark conditions to maintain production rates.

COSTS

Throughout the development of the DFDD, chain wear and the consequent metallic debris have been critical problems. As expected, chain costs have been a large fraction of operating costs. Much development work has been aimed at reducing chain costs by experimenting with spacings, speeds, lengths, sizes, metallurgy, and attachment techniques. Since 1985, chain modifications reduced chain costs from over $100 per productive machine hour to a low of $20/pmh.

Capital costs for the DFDD are very favourable. Estimates for a green field 470 green tonne per shift facility show that it would take more than twice the capital to build a drum debarker system with an equivalent chip output from whole-tree thinning material.

FUTURE PLANS

Our current plans are to continue to improve chain maintenance, and to build a stationary, electrically powered system for our pulp mill in Plymouth, North Carolina.

The Double Flail Delimber/Debarker is an exciting new concept. We have just begun to understand its possible applications. It is possible that before the end of the decade, a mill could operate solely with chips from logging sites and satellite operations, rather than depending on high capital, high labour cost, fibrewood rooms at the mill site.

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