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Transport and handling of forest energy bundles—advantages and problems

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Abstract

Bundling is a technology used to create a compressed and uniform handling unit from logging residues and other small size energy wood. The bundles may be handled and transported with the same equipment that is used for conventional roundwood. Bundles also offer other advantages such as "cool systems", good storing characteristics etc. This study deals with some advantages and problems of transport and handling bundled small size energy wood as an alternative to chips.

Transport cost, from stump to consumer, is calculated. Two types of material were included in the analysis: bundles and fuel chips.

Transport alternatives included transports directly to consumer as well as transports of bundles via a terminal for drying and chipping, and then, in the form of fuel chips directly to consumer with a bulk cargo truck.

The study shows that bundles (especially if dry) are cheaper to transport than fuel chips in road transport bins. The useful cargo space is the limiting factor for trucks when transporting dry material. Transport cost decreased until the moisture content reached the critical levels, below 40.9% for chips in road transport bins and below 44.7% for bundles on timber truck. However, there are also other advantages with a dryer material.

Chipping cost is lowest in the terminal alternative and highest in the system with chipping loose logging residues in the stand. However, transport via terminal sharply increases the total costs, due to handling and increased transportation work, especially on shorter distances.

Transport of uncovered bundles on conventional log trucks can be dangerous because of the risk for pieces of wood falling off. Bundles may also disintegrate during handling. The risk increases if the bundles are not reinforced with e.g. long tops and small trees, or if the strings are damaged during storing. Sisal strings deteriorate and lose their strength after a relatively short period. Thus, they are less suitable than strings of, e.g. polypropylene.

Cost savings in transport and chipping indicate an allowed cost for bundling of approximately 4–5 Euro/MWh for short to medium transport distances, to be competitive to the chip alternative. Cost estimates of bundling and covering of stacks with paper indicate that the handling cost is about the same as for chips for short to medium transport distances. However, for longer transport distances and through other advantages such as possibilities for return transports, a dryer and more storable material, cooler systems etc. may increase acceptable bundling-cost substantially.

Keywords: Bundle; Forest fuel; Main hauling; Terminal; Timber truck; Road transport; Road transport bins; Transport cost; Wood chips

1. Introduction

Forest fuel assortments (e.g. logging residues, small trees and "tree sections", i.e. undelimbed , crosscut trees) are characterised by low weight per volume and low homogeneity [1]. The relatively low value of forest fuel assortments makes transport costs critical for profitability. Björheden and Eriksson [2] concluded that "optimising forest fuel supply essentially means minimising transport costs". Besides high transport costs, the assortment could also contain dirt, and could have problems connected to storing [1].

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The need for large load volumes and compression of the residues was identified early [3,4]. In most cases transport vehicles were equipped with side covers [4,5]. Part of the development concerned specially loader-designed grapples for residues. The next step was the development of special "load containers", and different types of compaction devices mounted on the vehicles. Hefty loaders and other mobile compressing equipments were also developed [6]. Transportation of "tree sections" by rail is an alternative for long distances as described by Alexandersson [7]. The tree section-method does not exist today although Jonsson [8] thought that it could improve the possibility to carry out thinning. Other transport solutions were bulk transport trucks with up to 140 m^3 cargo space, e.g. in a whole tree chipping system [9], road transport bins (typically three 30 m^3 bins for a truck and trailer) used in residue chipping [10]. In Finland e.g., Hakkila [11] reports of vehicles specially designed for transportation of logging residues.

The use of terminals has been seen as a way of increasing quality of fuel and security of delivery. Logistically, terminals often present problems due to the increased handling and transportation necessary, as shown for a Swedish wood fuels terminal by Björheden and Eriksson [2] and from Finland in a simulation of a chipping terminal [12].

Chipping is a way of processing woody material into an acceptable fuel and simultaneously improving bulk volume, homogeneity and handling characteristics of fuel raw materials from the forest. Today, forest energy-transports to heating plants in Sweden normally concern wood chips from logging residues, transported in road transport bins. The chipping is performed in the forest, at the landing (most common), or close to the landing. Logging residues are only rarely transported on road. But there are also disadvantages of chipping. Storability is negatively affected, i.e. once the material is chipped it is important to use the fuel as soon as possible to prevent excessive microbial activity causing health hazards through spore emission, energy losses and even self ignition of the chipped material.

A possible alternative to improve forest fuel-logistics is to make bundles. The bundles may form a relatively uniform handling unit, allowing full load capacity if compression is enough. Other possible advantages are efficient handling in loading, processing, etc. if size is optimal. Bundles can be assumed to offer good storing characteristics. At the same time use of conventional timber trucks offer good possibilities for "return loads" and long-term planning.

Bundling can be done in different ways. Johansson [13] performed trials with a simple, manually fed test rig (Fig. 1). Berglund et al. [14] describe a continuous bundling method using a flow through the machine with compression, tying and cutting into desired lengths (Fig. 2). Instead of compressing, a feeding mechanism with rollers can be used for large bales (Fig. 3).

Two of the existing bundling machines are the Wood Pac and the Fiberpac—now Timberjack, 1490 D Slash Bundler (Fig. 4). The bundling follows different technical principles for the two machines. With the Wood Pac two driven "gables" and eight driven cylinders, similar to handrolling a cigarette, compress and form the bundle in a batchwise operation. The bundle length depends on the distance

Fig. 1. A simple, manually fed test rig for making bundles.

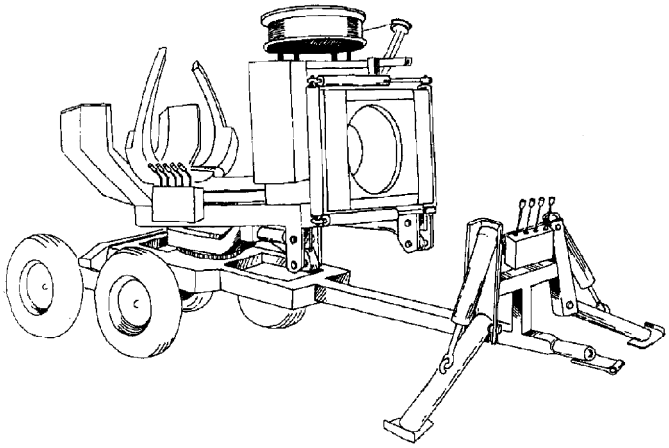

Fig. 2. The long-bundler (prototype), continuous bundling using a flow through the machine.

Fig. 3. Machine for baling of logging residues (Bala Press).