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Leaf consolidation

Every autumn large amounts of different types of leaves fall and these have to be cleared from parkland, roads and public or private ground surfaces. Consolidating these leaves in the leaf collection machine is important for reducing necessary transport. The machines on the market up until now, however, only lightly consolidate or chop the leaves. An increase in transport density of the leaves would lead to higher efficiency in the whole process from collection to carrying-off. The requirements for the development of a suitable leaf consolidation system were investigated in Brunswick.

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Keywords

Compaction technique, foliage

If autumn leaf collection did not take place in parkland, soil air exchange would be restricted and thus growth of following vegetation impeded. Wet leaves on roads also represent a substantial safety risk. Because of the requirements in the areas where leaf collectors work (low ground pressure, many objects to be avoided) current machines are light, small and manoeuvrable. These have a limited collection capacity and must therefore be driven often to the interim dumping point for emptying. From an economic point of view the frequent emptying journeys are not practical and lead to undesired ground compaction. A reduction of these journeys can only be achieved through increasing the transport density of the collected leaves directly in the collection machine.

Preliminary investigations

Recognised systems for increasing density of agricultural material and leaves are compacting and chopping. Chopping can increase the density of beech leaves by a factor of 1.9 to 3.5 compared with unchopped leaves [1]. However, the required cutting equipment means chopping demands substantial technological input has a high energy requirement. Also, there's high damage susceptibility through foreign bodies such as metal cans and bottles. Such demands are not environmentally, technologically or economically justifiable. There's also the point that the chopping process is not necessary from a biological aspect as bacteria would degrade the leaves anyway after sufficient time.

Available for compaction are the normal system and the radial pressure process. The normal system utilises the compaction forces created by an oscillating piston.

In this action the piston forces increase over-proportionately during the forward movement of the piston giving an irregular action of the required drive momentum [2]. The peak forces which are created in a compactor working according to the normal pressure principle require a strongly-built machine.

In the radial pressure system rotating elements are used for compacting. Current machines have a comparatively gentler action

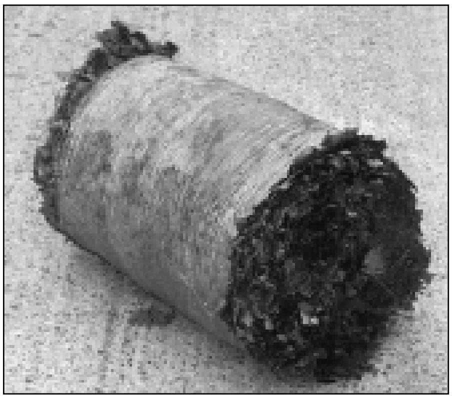

Fig. 1: Foliage compacted in a roll bale

and the demands on the machine from power peaks, as well as noise stress for humans, are small [2]. Through the advantageous relationship with the roundbaling system, manufacturing input and power requirements can be kept within limits. Because of its gentle action, leaf compaction through the radial pressure procedure is a very promising system. Suitable machinery can be built light, small and manoeuvrable and perform well with the limited power of the draught vehicle (communal tractor). The principle functional ability of the machine for compacting leaves into round bales has already been demonstrated at the Institute for Agricultural Machinery and Fluid Technology in Brunswick. There, leaves were round-baled with a stationary baler used for compaction of recycling basic materials *(Fig. 1)*.

This baler featured a chamber formed by two circulating rubber transporting belts. This helps avoid loss of broken material which occurs where leaves are compacted with a baler with a chamber formed by rollers.

Compaction chamber trial for investigating compaction functions

Up until now only a few investigations have concerned themselves concretely with the theme of leaf consolidation. The first material reactions for leaf compaction were investigated with compaction chamber trials [1]. Here uncompacted material was placed into a container and then pressed together with a compaction piston *(fig. 2)*.

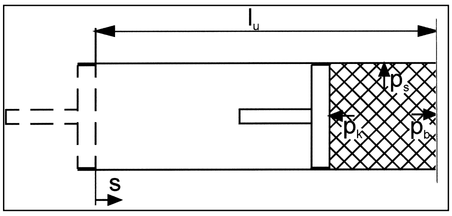

Fig. 2. Recorded characteristics in the compaction chamber trials

The density and volume change for different types of leaves were tested at various moisture contents. The potential of leaf compacting was underlined by the trials where leaf consolidation of up to 85% was achieved. In that up until that point there were only results available from a very limited number of trials into the compaction behaviour of leave, further compaction chamber trials were carried out in Brunswick during autumn 2000. Here, the investigations were more detailed and looked especially into the performance of different types of leaves at different moisture contents in order to investigate as fully as possible the physical laws involved in the compaction of leaves. Compaction curves were created by carrying compaction piston pressure over material density in doubled logarithmic measurements. In *figure 3* compaction curves for different types of leaves at different moisture content U are presented. For comparison reasons compaction curves for hay and unchopped straw are additionally illustrated. Tendentially, the behaviour of the leaves is similar to that of straw materials in investigations already carried out in detail.

Planned trial stand

Characteristic parameters for the compaction of leaves into round bales were investigated with a trial stand. The influences of the leaf reactions during collection, various methods for transporting the leaves into the chamber as well as the drive power required were evaluated. Featured was a fixed chamber baler filled from above *(fig. 4)*. Except for the filling opening the compaction chamber was fully enclosed. The chamber consisted of a bar chain covered with a type of belt. To enable a dependable start to bale forming, a round baler form has to exist at the beginning of the procedure. For this the chain is from the beginning forced to form a round chamber by a guide track (shaded in illustration) fitted on the bar chain bearing.

Outlook

The planned investigation was aimed at further development of the radial pressure procedure towards achieving perfect functioning. The principle aim here was reducing broken material losses to zero if possible. Basic information on compaction behaviour of leaves differing from that of the usual, and sufficiently investigated straw types with regard to pick-up and wrapping behaviour, as well as basic concepts for leaf compactor design were to be looked into. At the same time the communal technical requirements of ground pressure, manoeuvrability and limited power were considered.

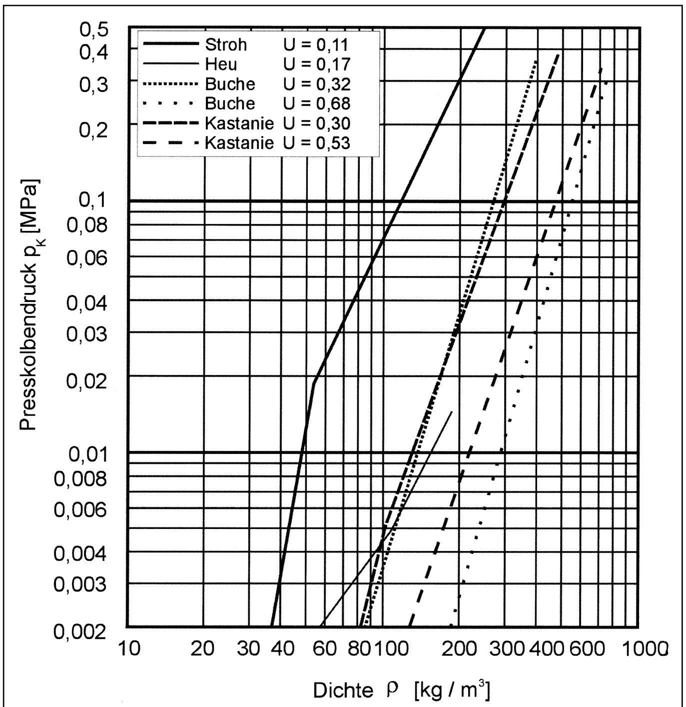

Fig. 3: Compaction graphs for straw, hay and foliage

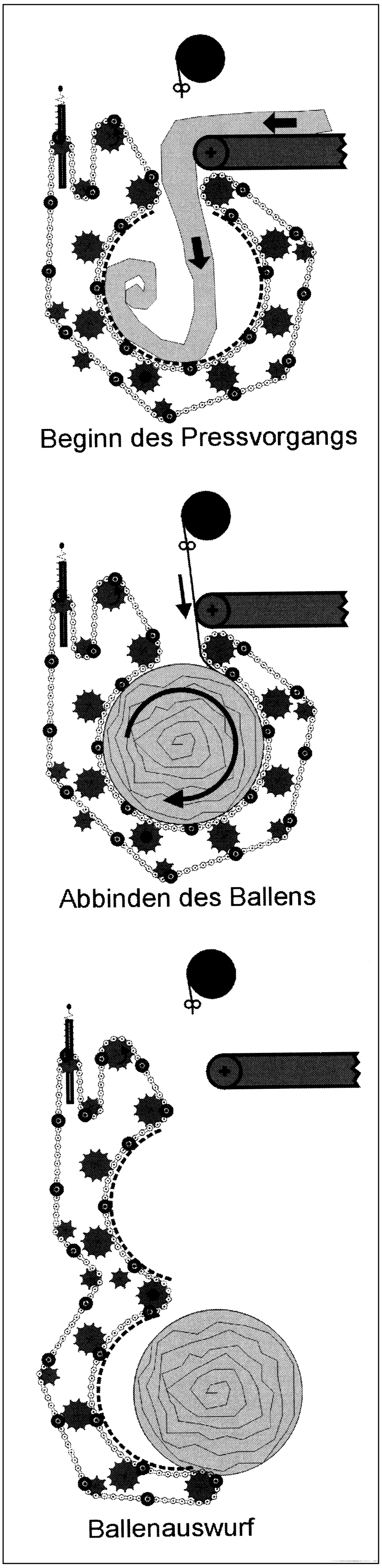

Fig. 4: Sketch of the planned test rig