



# PELLET*time*

## Wood Shavings as Animal Bedding in Stables



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HÉRAÐS- OG AUSTURLANDSSKÓGAR

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August 2008





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## Introduction

This paper is written for the “Herad & Austurlandsskogar” reforestation project in the east of Iceland. The reforestation project consists of 140 private landowners who have been planting commercial timber forests since 1990. As the earlier plantations are now entering the first thinning stage, the project is now concerned with marketing its timber products, especially low grade timber from first thinning. In order to do so, Heradsskogar has joined forces with other European organizations under the auspices of the EU-funded NPP (Northern Periphery Projects).

The purpose of this paper is to investigate the production of animal bedding as a potential market for domestic timber in Iceland; to get an overview of products, production technology and the market in Iceland.

# Bedding in stables

Bedding denotes any material strewn in an animal's enclosure (e.g. a stable). Bedding should have certain properties. The bedding material should have a high absorbency of the animal's urine. As implied by the word, bedding should also provide for a soft bed to prevent the animal from getting bed-sores. More functions of bedding are to isolate downwardly and to provide a nonslip ground for the horse to stand on. The bedding should not contain harmful substances. To some extent dust can be harmful to the animal respiratory system, as well as mould, which can cause allergies. Sharp items can cause trouble for bigger animals. The most common bedding in stables is straw. Although regarded as "the most natural bedding" by many farmers, it has certain disadvantages. Its absorbency of 200 % (compared with dry matter) is moderate compared with other materials and urine is drained rather than absorbed. The animals may also eat the straw, which often contains fungal spores and which, blended with excretions, often causes colic. Additionally, straw often contains a great deal of dust and needs a lot of storage space.

## Wood products as bedding

Because of the shortcomings of straw, horse owners have looked for better bedding materials. Wood products are the most common bedding alternatives to straw, including sawdust, wood shavings and granulated wood shavings. Sawdust can generally be obtained from sawmills, whereas wood shavings and their granulated form are delivered from producers in bales. What is important for all three products is that they originate from untreated wood. The main reason for the use of wood bedding is that the majority of horses in stables have allergies stemming from fungal spores and bacteria in straw bedding. While sawdust still contains a lot of dust, dust extracted wood shavings are suitable for horses with respiratory problems. They also have a higher absorbency than straw, ranging from 260% to 420%. In granulated form wood shavings can absorb even more liquid. For sawdust and wood shavings there are additions available which contain enzymes and bacteria that feed on ammonia: thus, the wet spots do not have to be removed but can stay where they are, because the bacteria bind the potentially harmful ammonia.



# Products and producers

The Austrian company Johann Pabst Holzindustrie GmbH produces two different beddings: AlpenSpan and AlpenSpan exquisite. Both are made of dedusted spruce shavings and contain no additives (Fig. 1 and Table 1). In the stable AlpenSpan is used in the following way: several bales are used to cover the previously cleaned ground; horse droppings and wet places have to be removed daily and the removed bedding has to be replaced. The complete bedding has to be removed after three months. The second product, AlpenSpan exquisite, is enriched with enzymes and bacteria. The enzymes bind ammonia, keeping it from escaping into the air. Thus the bedding has to be removed only twice a year and constitutes a good fertilizer afterwards. Both products come precisely packed in heat-sealed bags, and are delivered on wrapped Euro-Pallets, which require little storage space.

Table 1. Technical data for AlpenSpan and AlpenSpan exquisite bedding by the Johann Pabst Holzindustrie GmbH.

	Alpenspan	Alpenspan exquisite
Bag size in cm	80x40x40	80x40x40
Weight	20.5 kg	20 kg
Packaging volume	120 l	120 l
Scattering volume	430 l	500 l
Water content	Max. 11 %	Max. 11 %
Consumption per horse per week	Approx. 1,5 bales	Approx. 1 bale
pH value of the dung	7.8	7.8
Used raw material	Untreated spruce	Untreated spruce
Absorbing capacity	Min. 300 %	Min. 300 %
Nitrogen	Max 0.3 %	Max 0.3 %
Factory price per bale	5,40 €	7,20 €



Fig. 1 & 2. AlpenSpan bales and the machine used to shave the wood.

The American company Woody Pet, which according to its homepage is the largest and most reliable bedding supplier in the US, sells granulated wood shavings under the name Professional animal bedding. During the production process most of the resins, oils, tars and acids are extracted from the wood fiber, leaving the wood fiber in sterile granulated form. The product has an absorbency of over 300 % and comes in two different sizes: while the smaller bags weigh 30 pound (13.6 kg), the bigger bags are

delivered on 100 x 120 cm pallets (see figures 3 & 4). One 30 pound bag costs 3.33 Canadian Dollar in the online store (not including shipping costs); the suggested retail price is \$6.95.



Fig. 3 & 4. Woody pet professional animal bedding in large and small bags.

Another producer in North America is Canada-based Horse country bedding Inc. Their product Magnum pellets is made of pine and spruce scrap. During production it is dried, compressed and formed into small eraser-sized bits, resulting in sterilized, pleasant smelling, and soft-to-touch pellets. Among the advantages of its product, according to the company's website, their product contains less dust, bacteria (than straw) and toxins (than hardwood), high absorbency and reduced storage space. Pictures of the product are shown in Figures 5 & 6.



Fig. 5 & 6 Magnum pellets in 40 lb bags and stored on pallets.

sifting and dedusting. Bales have a weight of 27 kg, a compressed volume of 135 liter (80x40x40 cm bale size) and a volume after dispersion of 600 l. A bale costs around €9 ex factory and for a 12 m<sup>2</sup> stable about 60 bales are needed per horse, per year (€540 per horse per year). Maintenance of the bedding consists of removal of the horse droppings. The horse's urine is absorbed by the bedding and the moist shavings provide a mattress. The basic product comes with some variations: Allspan Minispäne, which contains finer shavings and sawdust for enhanced absorbency; and Allspan Fichte/Douglasie, which includes wood shavings from Douglas fir (and larch), giving the blend a reddish color. Allspan bioaktiv, like Alpenspan exquisite by Johann Pabst Holzindustrie GmbH (see above), is enriched with enzymes and bacteria, binding ammonia. Bale consumption per horse and year is less than for the basic product and one bale costs about €9.50 ex factory (Fig. 4).



Fig. 7 & 8. Allspan in stable and Allspan classic bale



Allspan, a bedding producer from Germany, sells wood shavings both with and without added enzymes and bacteria. The basic product Allspan classic is made from spruce and fir wood. The shavings are processed in contained facilities by drying,



# Wood shaving mills

For production of wood shavings there is a range of different machinery and technology on the market. Some of the bigger ones can even produce shavings from coarsed chips. The technical principle for a small-scale shaving mill is simple. A hydraulic arm moves a planer (which can have many blades) back and forth, shaving the round wood to the desired thickness. Alternatively the blade is bolted, where the wood is moved back and forth over it, giving the same result. The shavings are usually fed into a hammer-mill unit to break the shavings into the desired size before drying.



Fig. 9 Wood shaving mill by Jackson Lumber Harvester Co., Inc.

Jackson Wood Shaving Mills					
Model	16D4	30D6H	30D6HL	30D10H	30D10HL
Wood Diameter	2" - 12" (5 - 38 cm)	2" - 24" (5 - 60 cm)	2" - 24" (5 - 60 cm)	2" - 24" (5 - 60 cm)	2" - 24" (5 - 60 cm)
Wood Length	3'0" - 4'6" (90 - 135 cm)	3'0" - 4'6" (90 - 135 cm)	7'0" - 8'6" (213 - 260 cm)	3'0" - 4'6" (90 - 135 cm)	7'0" - 8'6" (213 - 260 cm)
Rated Output Per Hour	70 - 240 ft <sup>3</sup> (2.0 - 6.8 m <sup>3</sup> )	120 - 400 ft <sup>3</sup> (3.4 - 11.3 m <sup>3</sup> )	120 - 400 ft <sup>3</sup> (3.4 - 11.3 m <sup>3</sup> )	200 - 700 ft <sup>3</sup> (5.7 - 19.8 m <sup>3</sup> )	200 - 700 ft <sup>3</sup> (5.7 - 19.8 m <sup>3</sup> )
Cutter Heads	4" (10.2 cm) 3 knives	6" (15.2 cm) 4 knives	6" (15.2 cm) 4 knives	10" (25.4 cm) 8 knives	10" (25.4 cm) 8 knives
Cutter Heads Drive	*30HP (22 kW) electric or *50HP (37 kW) PTO/ gas or *80HP(60 kW) diesel	*50HP (37 kW) electric or *75HP (56 kW) PTO, gas or *115HP (86 kW) diesel	*50HP (37 kW) electric or *87HP (65 kW) PTO/gas or *115HP (86 kW) diesel	*75HP (56 kW) electric or *104HP (78 kW) PTO/gas or *115HP (86 kW) diesel	*75HP (56 kW) electric or *115HP (86 kW) PTO, gas, or *115HP (86 kW) diesel
Hopper Box Drive	15 HP (11 kW) hydraulic system (pump drive included on PTO, gas, or diesel)	15 HP (11 kW) hydraulic system (pump drive included on PTO, gas, or diesel)	25 HP (18 kW) hydraulic system (pump drive included on PTO, gas, or diesel)	15 HP (11 kW) hydraulic system (pump drive included on PTO, gas, or diesel)	25 HP (18 kW) hydraulic system (pump drive included on PTO, gas, or diesel)
Overall Size	5' (1.5m) W 15'10" (4.8m) L 7'2" (2.2m) H*	6'5" (1.95m) W 15'10" (4.8m) L 7'2" (2.2m) H*	6'5" (1.95m) W 24'4" (7.4m) L 7'2" (2.2m) H*	6'7" (2m) W 15'10" (4.8m) L 7'2" (2.2m) H*	6'7" (2m) W 24'4" (7.4m) L 7'2" (2.2m) H*
Approx. Weight	4000 lbs (1800 kg)	8000 lbs (3600 kg)	10,000 lbs (4500 kg)	9500 lbs (4300kg)	12,000 lbs (5400 kg)
	* Height of mill without optional elevated base.	(Please note that these specifications may change without notice.)	 Where Ideas Are In Production JACKSON LUMBER HARVESTER COMPANY, INCORPORATED	<a href="http://www.jacksonlbrharvester.com">www.jacksonlbrharvester.com</a>	830 N State Rd 37 Mondovi, WI 54755 USA  1-715-926-3816

Table 2. Technical data for wood shaving mills by Jackson Lumber

Jackson Lumber Harvester Co., Inc., based in Wisconsin produces wood shaving mills of different sizes. The technical data for the smaller machines can be seen in table 2 and a picture of a shaving mill in figure 9.

In Germany the company Hombak also produces shaving mills of different sizes. Among them is one shaving mill constructed

especially for animal bedding. The smallest version weighs 29 tons and processes up to 6 t dry matter per hour, and thus might be too big for Iceland. The company produces another much smaller shaving mill, called ZOA 18, not especially for animal beddings, though.

# Drying equipment, high temperature dryers

As mentioned earlier, the shavings have to be dried before they can suit their purpose. There is a vast array of dryers, but most shaving equipment producers recommend the use of rotary drum dryers for light materials like shavings. The most common drum dryers are simple pass and triple pass drum dryers. Simple pass drum dryers consist of a rotating horizontal drum of varying length and diameter (lengths vary from 4 to 12 m and diameters from 1 to 3 m). The drum rotates with 1 to 5 rotations per minute and exhaust fumes from a connected firing are led through the drum. The shavings enter the slightly inclined drum through a paddle and stay inside for app. 20 to 30 minutes. The shavings are constantly lifted by shovels and the construction form of the drum provides that the bigger shavings stay longer inside the drum. The drying takes place by convective heat transfer and the heated drum parts.

The triple pass drum dryer is most suitable for very light materials. The difference to the simple pass dryer is that the triple pass dryer consists of three concentric cylinders, which are mechanically interlocked to rotate at the same speed (see Fig. 8 and 9). The shavings are repeatedly carried to the top of each cylinder by internal and external flights so they are constantly showered through the hot gas. Moisture is given off continually as they move along the hot air stream. Heavier, wetter particles move slower than fine particles forward through the center cylinder (red), back through the intermediate cylinder (orange) and again forward through the outer cylinder (blue) to the fan at the discharge end. The warm damp exhaust gases are separated from the dried product in the primary cyclone collector, and fall out the bottom onto a shaker screen to remove fines.

There are a big number of producers of drum dryers both in Europe and in North America.

Producer	Country	Remark
Allgaier Werke GmbH	Germany	Also sells used equipment
Stela Laxhuber GmbH	Germany	
Dieffenbacher group	Germany	
Onix corporation	U.S.	Also sells used equipment, has dryers in many different sizes and their homepage features a tool to calculate the right size for individual purposes
Energy unlimited	U.S.	Also sells used equipment and sawdust burners
Jackson lumber harvester wood shaving mills	U.S.	Also sells used equipment and suiting burners
Aaron equipment company	U.S.	Is a market for used equipment, offering 20 used drum dryers at the time of writing

Table 3. Producers of drum dryers

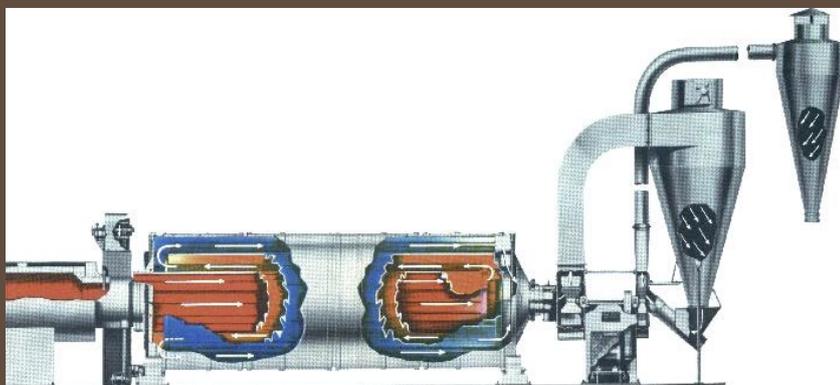


Fig. 10 & 11. Triple-pass drum dryer



# Low temperature drying

Drying of shavings normally takes place at temperatures above 100 °C. The higher the drying temperature the faster and more energy consuming the drying process. Medium sized wood shavings in a dryer working with 200 °C are dry (moisture content below 11 %) after app. 30 minutes. Nevertheless shavings can be dried at temperatures below boiling point. Besides less energy consumption, drying with lower gas temperatures has the advantage that no hydrocarbons or other chemical contaminants are released during the drying process. The Swedish company Svensk Rökgasenergi AB (SRE) produces a dryer for wood shavings that operates with 70 °C hot air (Fig. 10). The Renergi LTK Dryer is based on the counter-flow principle. Material is fed from the top of the dryer and removed at the bottom, while the air intake is at the bottom, meaning that the air is passed against the material flow, thus achieving a high degree of efficiency in the drying process (Fig. 11). Often the Renergi LTK Dryer is installed together with a conventional drum dryer (the energy-rich gas from the drum dryer is fed to a condenser, which reclaims heat that is transferred via an air battery to the fresh air, which reaches a temperature of about 70°C; the now dry and heated air is used in the Renergi LTK Dryer) in order to increase productivity or save energy. The Renergi LTK dryer can also be used without a drum dryer. The basic configuration of this setting is shown in Fig. 12. The dryer is often run with waste energy from conventional drying processes or the energy content found in flue gases from bio-fueled boilers.

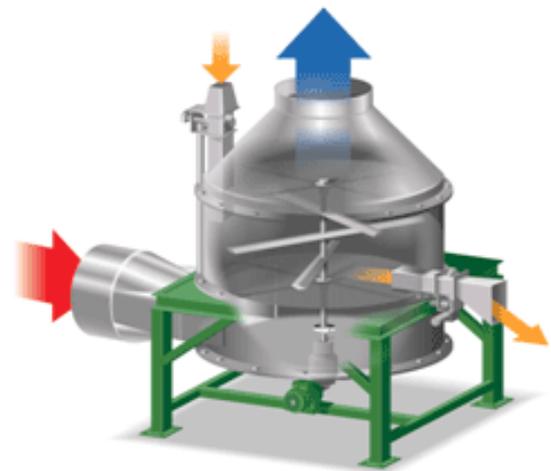
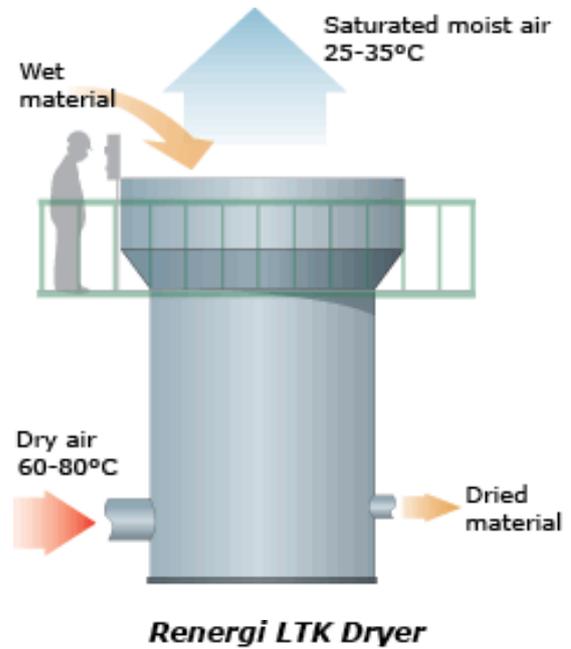


Fig. 12 & 13. Renergi LTK dryer

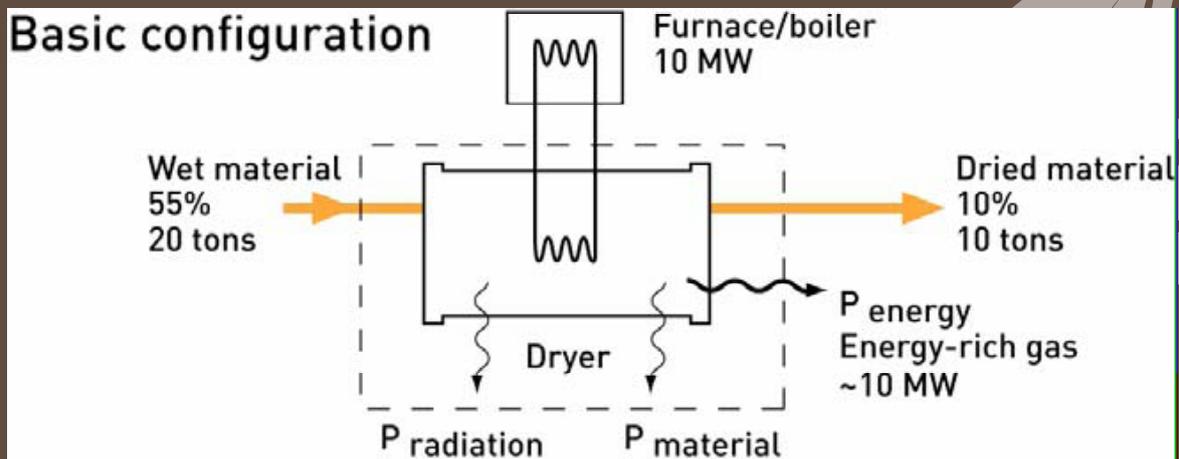


Fig. 14. Basic configuration of drying with Renergi LTK dryer. Input is wet material and hot dry gas, output is dried material and energy rich wet gas.



Fig. 15. Lumber Jack planer at Hestalist

## Hestalist ehf

In Mosfellsbær, the company Hestalist ehf produces wood shavings as bedding for chicken and horse farms. When the company was started in 2000, the raw material for the bedding consisted mainly in scrap from carpenters and DIY stores (=shavings and sawdust). Though still used during summer, when the demand for bedding is smaller, as most horses are grazing outdoors, scrap is not the main raw material source anymore. The reason for the reduction of the scrap share is that big suppliers of it, e.g. Byko, moved their production abroad. For the shaving-machine, the raw material can basically be any kind of timber that is shaveable. During winter, when the demand for bedding is higher, the company has been importing about 90 m<sup>3</sup> of round wood per week from Europe and Russia. Preferred tree species have been spruce and pine. When available, cardboard is mixed with the wooden substance. The cardboard must be clean of any dirt. Therefore they only accept leftovers from the packing industry but not second hand cardboard from consumers. Industrial waste timber from the construction industry cannot be used because of nails and such that will damage the blades and being unwanted in the product. The shavings can be mixed with paper and with shavings and sawdust from traditional wood processing industries. Wood chips would probably not work in the Hestalist product process, but has as yet not been tried. Except for occasionally cardboards, no other substances are added to Hestalist product.

At arrival logs are cut to length at the factory. For the planing machine logs can be at maximum 1.3 m long. The logs are then manually laid in the planer one by one. The planer (a lumber jack, electrical unit) has 6 blades and can process 30 m<sup>3</sup> per 12 hour shift. On average it can run 30 hours between sharpening the blades, but this depends on the raw material. If it is dry it wears the blades more, thus they have to be sharpened more often. Wet material is better for the blades, but the disadvantage is that it requires more energy in the drying process. The shavings leaving the planer have an approximately palm sized area but are only 1 to 2 mm thick. Moving on a conveyor belt the strands enter a hammering unit where they are chopped into smaller bits. For chicken bedding the shavings can be larger, whereas for horse bedding they have to be finer.

After the hammering unit, the shavings enter an oil fired triple pass drum dryer where they are dried and sterilized at 270-300 °C (can be as high as 400 °C). The dryer was originally built for drying grass-pellets as livestock nutrient addition, but was rebuilt by "Vélaverkstæði Sindra" for drying wood shavings. During the drying process air is abducted to keep it from condensing again. The capacity of the dryer is twice that of the lumber-jack planer or 60 m<sup>3</sup> per 12 hour shift. Because of the rise in oil prices Hestalist intends in near future to change the oil burner to a wood based burner and they estimate that it will increase the demand for wood by about 10%. After leaving the dryer



Fig. 16. Raw material from Icelandic forest



Fig. 17. Packing unit

the shavings are left to cool for at least a few hours before it is moved to the packing unit by a small Bob Cat. The packing unit compresses the shavings into a rectangular plastic bale, each containing 0.1 m<sup>3</sup> and weighing 30 kg. The finished product is easy to stack and transport. The moisture content is varying from 12 -18%.

Annual production is approximately 80.000 bales pr. year and the buyers are big poultry farms (35.000 bales annually) and horse farms (35.000 bales annually) and others for other uses 10.000 bales pr. year. The company estimates the domestic market to be around 200.000 -220.000 bales used pr. year and growing whereas most of it is used for horse bedding. Their market strategy is to produce 120.000 bales pr. year and thus dominate the market.

Round wood imported from Europe and Russia has been the main raw material during the last years. Recently the company has been shifting its attention to Icelandic forests as a source

of raw material supply. There are several reasons for this development. One is that prices for round wood reached historic heights last year and are likely to stay high or rise even more: Russia has put an export tax of €15 on round wood leaving the country and is probably going to raise the tax to €50, being tantamount to a ban on export of round wood. Adding to the cost of imported wood is the drop in the Icelandic Crown. Another reason for the interest in Icelandic timber is that round wood entering the country has to be debarked, which means extra handling and extra cost compared to domestic raw material. The bark has no damaging effect on the product. And finally there is an argument that using domestic timber enhances the image of Hestalist's product. It is worth noting that low grade timber (for example from first thinning, small diameter and crooked form) is usable in the process.

# Conclusion



The Aim of this paper has been to get an overview of the production, technology and market of wood shavings as animal bedding in Iceland and raises more questions than it answers.

There is clearly a market for timber (even for low grade- and small dimension timber) for domestic use of animal bedding. Already there is one factory, Hestalist ehf, in South West Iceland that is producing a substantial part of the domestic animal bedding market (chicken and horses). This should give nearby forest owners a good opportunity for selling their timber as Hestalist is now considering using more domestic raw material in their production. For other forest owners, e.g. in the North East of Iceland, the situation is more doubtful. Logistics are likely to be very expensive due to long road transport of timber. But it is worthwhile to investigate this further, and especially:

- For large enough quanta, might boat transport be possible?
- As the transport vehicles usually drive half empty from East to South, perhaps it could be possible to negotiate a lower road transport price?

It is our conclusion that quality, of at least some of the European and North-American products, is higher than Hestalist's especially in regard to moisture content, but also to granulating, dust cleaning and enriching the product with nitrogen absorbent bacteria. In price comparison, Hestalist is doing well. It is worth noting that the company has a unique market advantage as it also cleans out many of the big stables in the South-West of Iceland and is therefore already "inside" the market.

Another possibility for forest owners in the North-East is to put up their own production line locally. How big such a factory should be depends mostly on logistics, as the local market is probably quite small. All other things being equal, a fac-

tory in North-East Iceland (compared to South-West Iceland) could have a market advantage in the East and North of Iceland and possibly the Faroe Islands. Transport of the finished product compared to raw material timber should be cheaper as it is compressed in easy to handle bales that can be stacked on Euro pellets as normal transport goods and the fact that there is no real infrastructure for timber logistics in Iceland. It is worth noting that the strength of the North East region is raw material supply compared to other parts of Iceland. This refers to the quantity of harvestable timber in the near future as well as the capability of forest operations.

As the production unit-cost is largely influenced by the price of energy in the drying process, new and less energy demanding technologies should be investigated. For example the Swedish Renergy LTK low temperature dryer runs on 60-80 °Celsius. This opens the possibility of using cheap geothermal water for drying.

It should also be noted that the market situation is not clear. This refers both to the existing market and especially future development. A more detailed market survey would be useful for estimation of present status and future possibilities. Such a survey should include buyer's preferences to quality and price levels. This could be done in cooperation with an educational/research institution such as the agricultural universities at Hvanneyri and/or Hólar where trials of different qualities of bedding could be rated and evaluated.

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Egilsstaðir, August 2008

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