A new peat production concept – results of the development work during 2004-2007

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Summary

This paper describes the results of development work carried out during 2004-2007 in order to test a new peat production concept. The primary motivation for the initiation of such work was an objective to reduce the overall environmental impacts of peat production. The impacts include run-off waters, dust emissions and noise. Furthermore, the greenhouse gas emissions were also measured and compared with the emissions from the existing production methods. The new method consists of a raw peat excavating machine, a pumping unit with pipeline, a separate drying field, and a new raw peat spreading machine. The dry peat was collected with a normal mechanical bin harvester equipped with a front ridger. The product was called "quick sod peat", illustrating the drying velocity of the peat. The production capacity was 4500-6500 MWh/drying field hectare/season. There was a large variation in weather conditions between the test years. The concept has proceeded to the demonstration phase.

Key index words: New peat production concept, reduction of environmental impacts, high production yields

Introduction

In the light of the meteorological data, peat production should not be possible in Finland, or at least it should be very difficult. Sometimes neither statistics nor theory can tell the whole truth, but practical tests bring final evidence of the conditions for real work. The typical precipitation in Finland during the peat production period of mid May, June, July and mid August is about 250 mm, and the evaporation is in the same order of magnitude. Despite the availability of a very sophisticated weather service system, the distribution and the number of rainy (or sunny) days cannot be forecasted precisely. A good example of the different weather conditions are summers 2006 and 2007: 2006 was a record year for peat production, while 2007 represented a near disaster. How summers will evolve in the future is not clear, but dependence on weather in peat production will remain a fact.

Another important issue is the increasing awareness of the environment. For a number of years now run-off waters have been the major concern of the peat industry, but recently also other topics, such as dust and noise emissions and greenhouse gas emissions, have come into the environmental picture. The peat industry has made a lot of effort to solve the problems arising from these impacts and gained significant progress in reducing them. The responsible authorities have frequently participated in the research and development work with the industry, and the results have been implemented with mutual understanding. The demands to reduce environmental impacts have, however, become more and more stringent, and permission procedures have sometimes become painfully long and expensive. Since the role of peat is and will be very important in Finnish energy procurement, alternative ways to excavate and dry peat are actively under consideration.

Materials and Methods

Since milled peat is the most price-stable fuel in the world, it was important to remain steady while thinking of the new concept. The focus was on environmental aspects, but economical and technical limits could not be neglected. The following constraints and goals were therefore set:

- Minimising the environmental impacts (eliminating dust, noise and water impacts, reducing greenhouse gas emissions)
- Maximising the utilisation of solar energy and minimising the weather sensitivity
- Current cost level
- Improving the product quality

Initially two drying fields of 3200 square metres each were established. The fields were coated with asphalt, and one of the fields had heating pipelines under the asphalt, connected to solar collectors. Additionally, there was a 1.5-hectare area coated with asphalt. It was an old peat loading area formerly used for railway transportation of peat. The area was re-profiled and repaired for drying purposes. The raw material was excavated from a site which was in a nearly natural state with old forest ditches.

The peat was CS peat with a degree of humification of H6-7 in the von Post scale. The moisture of the material ranged between 79-88 % of the weight. The ash content was 5.6 % of the weight of dry matter. The lower heating value of the dry matter was 21.24 MJ/kg. The area was about two hectares and located slightly over 300 metres from the edge of the nearest drying field. A Fiat-Hitachi excavator with Allu SM sieving bucket was used for excavation. Next a pipeline for the transportation of wet peat to the drying area was constructed. The diameter of the pipeline was 125 mm (5 inches). The peat was pumped with a Putzmeister KOS 1050 piston pump equipped with a Putzmeister THS 332 LIB feeding unit. The whole pumping unit was powered with a Putzmeister HA 55 hydraulic unit.

The input power of the system was 38-42 kW and it could also be operated with a diesel aggregate if direct electricity was not available. After some trials, a commercially available trailer (Fliegl) was selected as the frame for the wet peat spreading unit. A separate spreading kit was attached to the back wall of the trailer. The trailer had a moving front wall to move peat to the spreader. All the functions of the trailer, the rotation of the nozzles, the macerating screws, and the movement of the front wall were controlled automatically by means of a logic unit operated by separate hydraulic circuits. The dry peat was ridged with a JEK-6HP front mounted ridger. The final collection of the dry sods was done with a JMK-40 mechanical bin wagon. Both of these devices can be attached to a tractor to operate simultaneously.

One of the most important parameters studied throughout the project was the drying rate of different sods in different weather conditions. The moisture content of the sods was determined by using a standard heating cabin with circulated air and a laboratory balance for weighing the sods. The weather data was recorded by using Davis Vantage Pro2 weather stations. The study of the environmental impacts, including the greenhouse gas emission measurements, was performed by the Finnish Forest Research Institute. The principle of the whole production concept is illustrated in Figure 1.

Results

Before making any investments on field research, a drying simulation test was performed in the weather chamber of VTT (The State Technical Research Centre). The results gave preliminary information on the production potential in realistic weather conditions. Furthermore, the field load, i.e. the weight (kg) of wet peat per square metre was estimated, as well as the shape and size of an individual sod in varying conditions. The results of the simulator tests were positive, and the planning of a field research project was accordingly initiated.

After many difficulties and drawbacks, preliminary drying tests were carried out in late summer 2005. During the test period, whereas the conventional production system was able to harvest one cycle the test managed five cycles. This encouraged the continuation of the development work further in 2006. Since solar radiation is very intense at the Finnish latitudes in late March and entire April, the tests were started in late March. Normally the production season in Finland starts in May. The night frost, however, damages the sods since freezing breaks the structure. The problem can be solved by storing the sods in a separate stockpile. As summer 2006 was extremely good for peat production, there was an occasional shortage of contractors: they preferred their main jobs when the conditions were favourable.

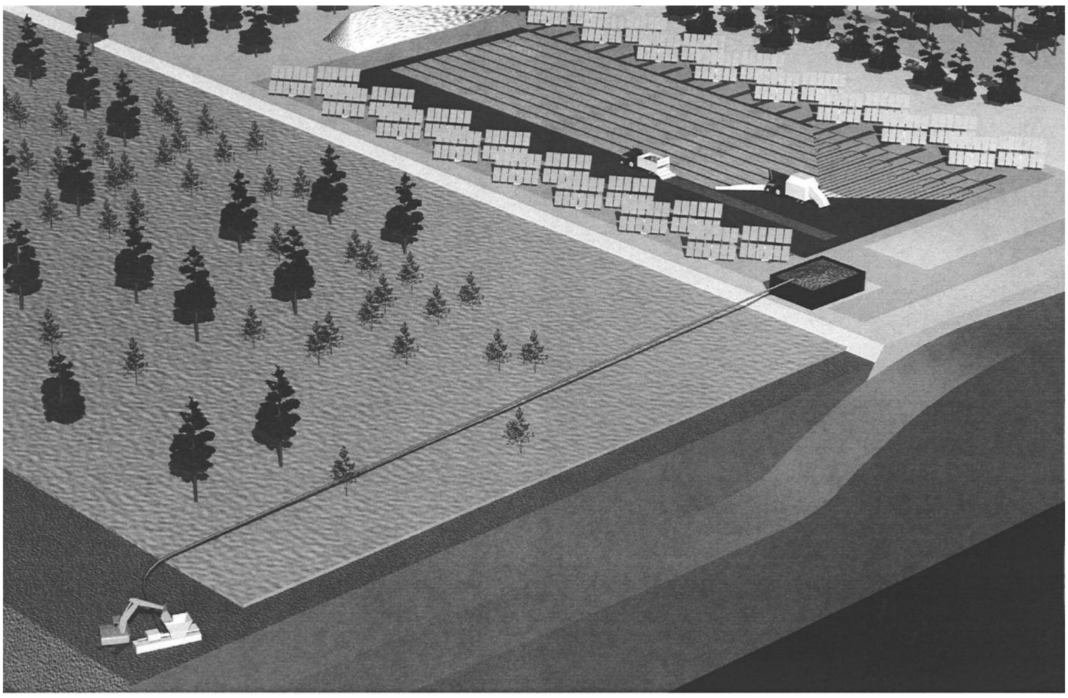

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Figure 1. Schematic picture of the new peat production concept

Table 1. Schematic picture of the new peat production concept

Aitoneva research field 2006

	Target		Actual
	50	40	harvest
	200	164	MWh/harvest
	80	83	%, initial moisture
	60	51	%, ridging moisture
	30	32	%,final moisture
	10000	6560	MWh/ha/season

Speculation, what IF

Field load for 200 MWh/harvest	7400	MWh/ha
Less modification and maintenance (3 extra harvests)	+600	MWh/ha
Spreading peat during the day (Loss of 3 harvests)	+600	MWh/ha
Initial moisture from 82,5 to 80 %	+1700	MWh/ha
	10300	MWh/ha

The extra drying effect of the heat produced by the solar collectors was measured. With the best field arrangements, the collectors effected about 17-20 % faster drying than direct radiation alone. Since the investment cost in collectors is so high that it would never pay back with such a low improvement in drying, further development of the collectors was abandoned. The production cycle was planned so that the initial field load was about 20 kg of wet peat per square metre. The moisture of the peat had to be as close to 80 % as possible because the drying time was very sensitive to the initial moisture. Peat was allowed to dry for 2 days, reaching the moisture of 60 %. Then it was ridged and allowed to dry down to 30 % final moisture. This corresponded to 200 MWh/hectare yield. Not only the initial moisture but also the ridging moisture was very critical, because sods with 63 % or higher moisture content tended to block the ridger.

High production efficiency can be achieved by utilising evaporation as completely as possible. About 95 % of evaporation takes place between 8.00 a.m. and 8.00 p.m. The best hours are 1.00 p.m. and 4.00 p.m. because 33 % of the total evaporation occurs then. This means that wet peat should be spread by 9.00 p.m. All unnecessary operations on the field should be avoided when drying is in progress. The timing of the operation sequence is probably the biggest challenge in this new method. The quality of the dry sods is excellent, the sods are very hard due to the maceration effect during pumping, and they have a high heating value, about 3.8-4.1 MWh/tonne or 1.6-2.0 MWh/loose cubic metre. This means that the bulk density is 460-490 kg/cubic metre.

As expected, the environmental impacts were small, because the operation took place on a solid field that did not emit greenhouse gases. The rain water was collected, and any solid peat particles were removed. The water on the excavating area of raw peat was treated by using settling ponds or surface filtration, depending on the situation. The greenhouse gas emissions were highest in the excavation area, but in this method the cycle is faster (2-3 years), after which the area can be reclaimed or restored. Therefore the duration of the emissions and other impacts is much shorter than in the conventional method. Sphagnum has been cultivated in the exhausted areas using local species.

One of the targets was cost efficiency. It should be possible to reduce the cost of the biggest investment, the asphalt field, by using cheaper substitute materials. Pumping, spreading and collection costs fall into the same category as the costs in normal sod peat production. However effectiveness still has to be improved and costs reduced in order to compete with the conventional peat production systems, especially with milled peat. But this goal is not impossible.

Discussion

As to weather, the best summer was the summer of 2006. Table 1 summarises the production in the test field and speculates the possible reasons why the target was not achieved. The method has been expanded into a demonstration phase by constructing four drying fields in different places in Finland. Establishing the real costs of the method is the current target. Since customers have been satisfied with the product, this new method will gradually be implemented where it is advisable. Since the environmental impacts of this method are considerably less than the impacts of the current methods, it is hoped that this will have a positive influence on the production permit procedure.

The advantages and disadvantages of the new peat production concept are as follows:

- Minimising the environmental impacts
- Extension of the production season (April - September, normally May -August)
- Optimal utilisation of the weather conditions
- Production efficiency 20 times higher than current production
- Increased amount of exploitable peat resources
- Rapid restoration of the production area back to a carbon sink
- The method is still expensive
- Production intensity requires new ways of thinking among the contractors

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