New development, new products, new markets.

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Abstract

Reykjavik Energy (RE) is continuously exploring innovative opportunities and developing new potentials for the use of geothermal energy. RE is (and has been) partner on several projects, a few of them will be introduced in the paper. By re-designing the water-retting process for flax and installing automatic control, using modern technology and handling equipment, the process results in higher quality and is economical. The geothermal water is used direct in the process. Preliminary prawn-farming experiments have been conducted in Iceland, using farming technology developed in New Zealand. The Icelandic studies have however implemented this technology under more difficult environmental conditions using geothermal heat as energy source. Project where 100°C geothermal water is used in processing veneer for parquet production. Planks are boiled prior to slicing and veneer (face and industrial) are dried following slicing. RE’s future vision involves Thermator devices as a crucial link in a future hydrogen society. Thermator can be installed as a part of hydrogen production unit in a private house producing hydrogen for the family fuel-cell car, where geothermal hot water and fresh cold water are the only sources.

Keywords: *water retting, prawns, veneer, hydrogen society.*

1 Introduction

Through decades harnessing of geothermal energy in Iceland has primarily been for space heating, greenhouses and electricity production. Geothermal water has although been used in industrial processes in a smaller scale, like wool washing, drying etc. Reykjavik Energy (RE) is continuously exploring innovative opportunities and developing new potentials for the use of geothermal energy

In this paper 3 projects and 1 future prospect are described. Two of the projects, Water retting and Prawn farming, are already in execution phase, the third is in a funding phase.

2 Water retting

When the Vikings settled in Iceland more than one thousand years ago they brought with them knowledge of flax cultivation, from various parts of the world. Evidence is found in the Sagas that flax was grown on Viking farms in some parts of Iceland and evidently the fibre was used for clothing. However centuries passed without any mentioning of this activity in the Icelandic history. Cultivation trials were made again in the 1950´s but it’s not until four years ago that new systematic trials started with agricultural and industrial activity in mind.

The conventional field- or dew retting has several shortcomings and various uncontrollable factors, which can affect the final quality of the fibre, although the bulk of available linen has been treated in this way. By controlling the retting conditions and the bacterial attack of the straw and fibre bundles the ultimate fibre quality can be improved to large extent and be made consistent, as far as this is possible with natural fibres. Controlled retting removes the non-cellulose substances such as pectin and lignin evenly and effectively leaving the ultimate fibres soft and clean and of high quality.

Soon the focus was set on the geothermal water as a source for treating the crop in order to turn it into industrial raw material of stable and high quality. Geothermal water is abundant in Iceland and therefore it is possible to supply the vast quantities of warm water needed for water retting at a low price as well as using geothermal steam for drying and after treatment. This eliminates the need for expensive fuel or power to heat the water and air to the desired temperature for retting and drying. This investigation resulted in the formation of the company Feyging Ltd. in 1999.

Water retting was widely practised in Europe several decades ago. However this method gradually disappeared as it was found to be too labour intensive, too costly and having ill effects on the environment. This, together with water shortage, made farmers turn again to the dew-retting method although the risk of obtaining lower fibre quality or loosing the harvest was higher. Gradually this has been accepted by the textile industry as “the standard method” to produce quality fibre as extensive fibre blending can compensate for the varied quality grades supplied by producers in different areas.

2.1 New technology

The technique employed by Feyging Ltd is based on the old water retting method. By re-designing the retting process and make it automatically controlled, using modern technology and handling equipment the process can be made economical as long as the end users appreciate the higher quality. However the process still depends on a stable water supply. The process is controlled by computers and is integrated into a continuous production line i.e. retting–rinsing–drying–scutching and can be extended with hackling process and sliver formation for spinning or integrated with nonwovens processes.

The company has carried out systematic water retting trials in a co-operation with research institutes in Iceland and abroad. The aim is to develop a process based on utilisation of geothermal water in order to stabilize and maximise the quality of linen fibres. The flax is taken from the fields and packet in rolls of 3-400 kg and packet in plastics. In that way the quality and humidity of the flax is kept stable over a longer period and therefore timing of the retting process is not critical. In fact the flax can be kept for months without loosing quality. Under the retting-rinsing-drying process the flax stays in the rolls and are processed in a special built tanks. The temperature of the water in the retting is 40-45°C and the process last about 2-3 days. The same water stays in the tank through out the process and the yeast removes the non-cellulose substances such as pectin and lignin evenly and effectively. In the rinsing the water is 20-25°C where all substances are effectively rinsed away. In the drying air is blown through the flax rolls with a temperature up to 60°C. The total length of the process (retting – rinsing – drying) is 4-5 days leaving the ultimate fibres soft and clean for scutching. All the time the flax stays in the tanks and are not moved, that is important in gaining the highest fiber quality. Processing 1 roll needs 3-4 m^3 of 80°C water. The company has in the trial phase been retting locally grown flax as well as imported flax straw from traditional flax growing countries in Europe. This year 400 ha flax is growing in the South and West side of Iceland; the goal is to expand to 800 ha within 2-3 years and up to 1.600 ha in the future. The harvest on each ha is 7-8 ton flax which returns 1,5-2 ton fibers after retting–rinsing–drying–scutching process. This enables the company to keep a constant supply of quality fibre in large quantities.

In general, the demand for linen in textiles and nonwovens is subject to pricing, availability, fashion trends, product development, etc. Quality is playing an increasingly important role and becoming a major criterion. The industry requests better quality and higher productivity. The market is more segmented than ever before and new niches are constantly appearing. New market development for natural fibres largely depends on research of improved quality, efficient processing and competitiveness with other fibres, synthetic and man-made. Price for fiber of good and consistent quality is high and stable. The objective of Feyging Ltd is to work constantly on improving the properties, quality and handle of linen fibres for use in textiles and other applications and be leading in supply of fibre with consistent quality. Linen is a dignified material and certainly will keep its outstanding position amongst natural fibres in the future.

By using natural resource as the geothermal water Feyging Ltd is retting flax in eco-friendly manner maximising the linen quality and making it consistent. In this way the company will meet the requirements of industries and markets in the new millennium, where comfort and elegance of natural fibres and concern about our environment will be the big issue.

3 Prawn farming

New Zealand Prawns Limited, Taupo, New Zealand, has through 15 years been operating a prawn farm by using geothermal waste heat from the Wairakei power-generating field. In the beginning giant Malaysian freshwater prawns (Macrobrachium Rosenbergii) were imported from Malaysia in 1988 and since then the farm has expanded up to 7 ha of pounds and other facilities such as a restaurant. New Zealand Prawns has developed an optimum process for the prawn farming with best possible quality and highest growth rate.

The aim of the prawn-farming experiment in Iceland is to "copy" the know-how and experience from Taupo Prawn Park with necessary adjustments for the Icelandic environment. Results will confirm whether it is possible to farm this specie of freshwater prawn in Iceland.

The life cycle of the prawns start with the breeding tanks, the larvae are then moved to nursery ponds (salted water) for about 4 months and the prawns are transferred to the outdoor growth ponds (fresh water) for their final growth of a further five months. In the Icelandic trial the first stage (breeding and start of nursery) will be in Taupo Prawn Park but in the first period of the nursery the prawns are transported from New Zealand to Iceland and the nursery period will be finished there (ca 3 months). At the fin of nursery the prawns are transferred to the outdoor growth ponds for their final growth of a further five months. At the end of the five months, the growth ponds are drained and the prawns picked up manually. The harvesting takes place after 9-10 month from breeding.

The temperature for the pounds are 28°C, the growth will decrease with lower temperature and stop around 20-22°C, it turns out that the prawns will die in 14°C water.

In Þorlákshöfn three small pounds (25x12x1, 2m) have been built for the farming and one supplementary (44x18m) pound for the depositing and draining. In the area is a well giving 110°C and for the three pounds the maximum effect is 12 l/s based on extreme Icelandic climate condition. In the primary circuit the heat exchanger cools the 110°C water down to 50°C, in the secondary circuit (fresh water) the temperature in the pounds is controlled by the outgoing water from the growth pounds, 27-28°C, under extreme conditions it is estimated to circulate 30 l/s water. The water in the secondary circuit (ponds) is circulated, about 10% loss (vaporization etc.) have to be supplemented. The ponds are built as natural as possible taken in count the different substances in the ground.

The main target of this project is to verify if the methods used in Taupo Prawn Park are suitable in Iceland and clarify which parameters needs to be changed to optimise the farming under Icelandic environmental and whether conditions. There are many areas in Iceland who could fulfil requirements regarding geothermal hot water and land for prawn farming. In future aspects the breading and nursery will be in one place but growth ponds could be situated where there is enough hot water and land.

4 Veneer production

Veneer is an important link in the production of parquet, doors, furniture etc. and production sides have been closely connected to areas where there are wood resources and/or energy for the process. There has never been a veneer production in Iceland, here is no timber but energy is in place and the prices are competitive. Caused to change in market prices and development in processing technology veneer production could be profitable in Iceland.

The project is based on importing selected planks (of different types of wood) of a certain quality from Canada and USA. The production process starts by boiling (cooking) the planks in water (80-100°C) prior to slicing. The duration of heating is determined by their species, size and structure, but is usually between 24 and 36 hours. The cooking processes softens the timber and makes slicing easier resulting in a superior finish. After slicing the veneer is dried in two steps, the first using a effective, heavy air-dryer with water 80-100°C over a short time and the second step using a soft air-dryer with water 0-80°C over a longer time period to have the veneer dried with the required humidity. The final products, face-veneer (0,3-0,9 mm) and industrial veneer (1-6 mm) are exported to Europe to be used in different products (doors, furniture, parquet etc.).

The business-case shows competitive advantage in number of factors in the process. Drying costs are very low, less investments on the energy side, customs are low for veneer into Europe and feasible location as regards to transport.

The output of the projected production unit will be 400.000-500.000 m^2 of veneer, power requirements are 1.500 MW heat (water 80-100°C) and 200 kW electric power.

The business-plan for the veneer production unit has been presented and the project is now in the funding phase.

5 Hydrogen society

As described in another paper on this conference, thermator is a generator that produces electrical energy by using temperature difference. Interesting part is that there are no moving particles in the generator. This is a very promising technology, which will be further developed in the future. Thermator is already used for supplying electricity for circulation pumping for new heating installations in holiday homes where there is no connection to electricity grid.

Thermator has also been tested as a neat source of electrical power for electrolysis in fuel cell demonstration sets, andt he result where positive. This is a demonstration in a small scale but in the next 10 to 20 years the development will proceed, efficiency will become higher and the thermator smaller.

Certain metal alloys have the ability to absorb hydrogen by accommodating the hydrogen atoms within its molecular lattice. Surprisingly, more hydrogen can be stored this way per unit volume than in liquid hydrogen. Using the metal hydrides for hydrogen storage has many interesting advantages, especially in stationary applications where the weight of the absorbing metal is not a major issue. Foremost among the advantages is the easily attainable and safe temperatures and pressures required as compared to the other prominent storage technologies, namely cryogenic liquid or ultrahigh compression. This technology will be further developed in the future.

This future development leads to a possible new end use for the geothermal hot water (and fresh water) in residential areas. In general the geothermal heating system is delivering hot water 74-78 °C into the houses and the fresh water is around 5-7 °C. By installing a thermator at the water inlet, the thermator generates electricity using the temperature difference between the hot and cold water, using energy from 78°C down to 70°C (in the hot water) and after that the water continue into the heating system of the house. The electrical power is used for electrolysis to produce hydrogen, which then is stored in metal alloy storage. This production will be regulated to be stable all the day around all the year. Before you leave the house in the morning, you fill up your hydrogen car and drive to work. By this the geothermal heating system is delivering not only the heating energy for the house but also the energy for the car. Future development will reveal whether this way of producing electricity in a small scale is competitive to using the electrical net directly.

This alternative use of geothermal water directly for electricity production in a smaller scale gives a quit new aspects into the future. This opens up new definitions for the future use of Reykjavik Energy geothermal heating system. We have to define a new alternative role for geothermal energy in the hydrogen society.

6 Conclusions

Reykjavik Energy's owners have put forward the goal that the company shall be active in developing new possibilities for the core businesses, that is selling and servicing hot water, cold water and electricity and look for new markets for its products. This also supports the objective to encourage new industrial opportunities.

The paper features examples of projects supporting these goals.

7 References

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