

Success Story – UPM Kaipola

- horizontal fed biomass crusher

Developing an effective supply chain for stumps

As part of the EU's efforts to increase the share of energy from renewable sources, Finland has a national target to obtain 38% of its energy from such sources by 2020. This implies that annual use of wood-chips should more than double to some 13.5 million solid m³ by 2020 compared to 2010. Developments of efficient supply chains of biomass from the forest play a key role in reaching the target. UPM Kaipola represents a genuine success story that is contributing to achieve this target.

Background

UPM Kaipola is a paper mill located in central Finland, just south of Jämsä, some 200 km north of Helsinki. Three paper machines produce coated and uncoated magazine papers, directory and newsprint papers. Annual capacity totals 700,000 tonnes. The mill employs about 500 people. UPM Kaipola is part of the Finnish UPM-Kymmene Group, a global paper and forest products company with 22,000 employees and sales exceeding € 10 billion in 2012. UPM addresses them as “BioFore Company”, stressing the integration of bio and forest industries.

In 2005 UPM made the decision to modernize paper machines and to increase the use of biofuel at its Kaipola mill. The combined heat and power (CHP) boiler from 1991 was to be upgraded and would enable an increase in the share of biofuel to over 70% of the total volume of fuel used by the mill. The bubbling



fluidized bed (BFB) boiler featuring a capacity of 104 MWth and 26 MWe would produce heat and electricity by combusting peat, forest residues, stump and root wood in addition to bark and sludge collected from the paper production process. A fraction of the heat is supplied to the local district heating network.

The decision also included a new crushing line, which would enable a much greater use of stumps and root wood. The investment would reduce the mill's fossil carbon dioxide emissions by one third. Already in 1997, UPM Kaipola started to use forest residues with the aim to substitute 1/3 of its of peat use. Now, UPM Kaipola wants to take a giant step in using stumps and root wood and substitute peat even further. UPM's customers who have asked for years about the fuel used in the paper production process also triggered the decision.

Challenges

The major challenges were to develop and implement an effective supply chain for stumps with roots; harvesting, storing, transport and crushing. Further development work was to be

carried out in the forest, through use of advances in stump-lifting technology and transport as well as at the power plant. UPM Forest procurement district in central Finland started together with the power plants in Kaipola and in Jämsänkoski in pioneering development work in utilising stumps with roots in 2002.

“At the start in year 2002 we used mobile crusher for stumps with roots, located both road side in the forest and at our plant. However, we were searching for a low cost and more efficient alternative.” explains Esa Lahtela, Operational Supervisor at Kaipola.

Improving the supply chain concept was based on crushing in one process at the Kaipola plant. Roadside processing was estimated to be more expensive, but the transport can be more effective, since the stumps are no longer bulky. UPM realized the necessity of an effective large-calibre crusher. However, such a crusher was not available on the market at that time.

Harvesting methods and machines for lifting the stumps in the forest was to be developed. In the beginning, simple crabs were used by excavators. Aggregates that lift and split stumps were developed by UPM together with local actors as well as appropriate processes for storing and transport. Stumps are harvested mainly from spruce regeneration areas since spruce stumps have a high wood content and are more loosely anchored in the ground. The same lifting aggregate can also perform land preparation and reduces the cost of land preparation by half.



Proper storage process improves stump quality even further. Rain and snowfall wash out impurities and moisture decreases. After summer seasoning at the roadside, stumps are transported to the power plant by truck units, which were specifically developed for stumps. UPM Forest has noted that harvesting stumps has several positive effects on silviculture: improved conditions for mechanised planting, reduced breeding ground of Hylobius weevil and preventing root-rot.

Solution

At the time, UPM had gained experience in various crushing technologies at some of its other facilities; slow rotating crusher and high-speed crusher, the latter made by Saalasti. However, none of these models met the requirements, big volume, great capacity and high efficiency in crushing the stumps with roots into the specific fractions and also processing properly forest residues, thinning wood and logs. The crusher line would also be built at a limited layout area.

In 2006 UPM decided on the concept and selected the technology offered by Saalasti. The offer was based on Saalasti's long experience and profound expertise in stationary crushers meant developing a machine into a dedicated “Stump Crusher” considering operation circumstances at the Kaipola mill.

“We had already become aware of the market demand for stationary stump crushers and we

had developed a pilot machine. We developed it further according to UPM Kaipola's needs. It was a real challenge to us and we succeeded. It was a learning process for all involved." says Juha Kettunen, Chief Engineer at Saalasti Oy.

The core of the crusher is two phase process; pre-crushing with upper and lower rotors and secondary crushing with the very heavy main rotor. Horizontally fed material is crushed by the cutter bars and then processed to final particle size in the small gap between the cutter bars and the grate under main rotor.



Slow rotating crusher option would have required more crusher units meaning more costs and more space including a line with two consecutive crushers.

Results

Today the crusher has been in operation for a couple of years and results are visible:

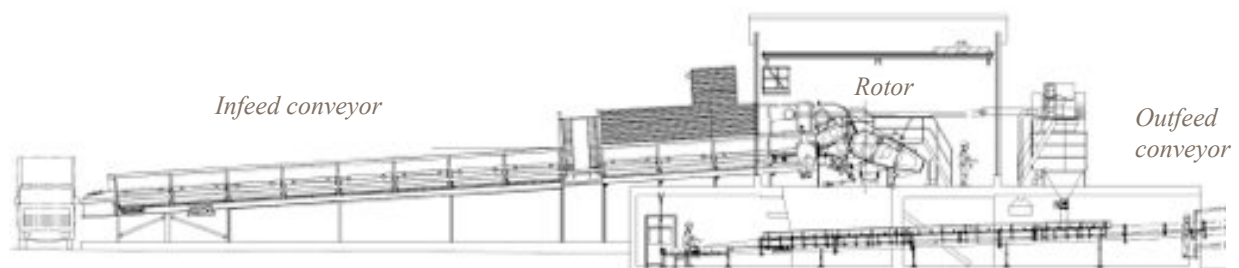
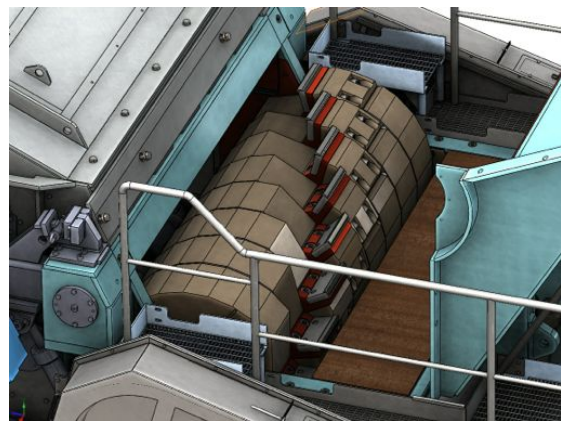
"We are satisfied with the Saalasti crusher. During the running in period Saalasti made some modifications and the crushing process was further improved. The boiler needed a

fuel of very special grade. The crusher is very good in crushing stumps and roots." explains Esa Lahtela, Operational Supervisor at Kaipola.

"The machine was in prototype phase, when delivered to Kaipola but after modifications and developments it turned out to be the real stump crushing solution. Now it works well. It is not an easy task to crush everything you have in one machine." explains Matti Suominen, Maintenance Supervisor at Kaipola.

Stumps and roots were the main input at the start. The flexibility of the crusher enables other categories of input.

"During winter season stumps with roots are mainly used, due to high heating value. In summer season forest residues are mainly used, since it's easier to handle it after outdoor drying. During storage stumps do not absorb water as rapidly as forest residues." explains Esa Lahtela, Operational Supervisor at Kaipola.



Long length wood has increased its share during the last years and the mix of biofuel is: stumps with roots 60%, long length wood 20% and forest residues 20%.

Some 40% of total boiler fuel consumption passes through the Saalasti crusher and the balance is made up of bark, sludge, peat and roadside forest chips. UPM Forest supplies stumps with roots and uses five to six subcontractors for deliveries. Trucks deliver 24 hours a day seven days a week and most is unloaded directly on to the biomass feeder and fed into the crusher, a process which takes about 30 minutes. Almost all stumps are harvested within a 150 km radius. Average transport distance is 30 – 50 km. In winter season, supply also comes from longer distance by rail.

Due to this type of material, which contains stones and dirt, 10 – 20%, and the high volume, wear and tear is inevitable.

“Stumps are tough but the crusher is good in handling it. In winter season, we operate about 2 weeks of crushing stumps before we change the cutter bars. Design of the crusher makes it very easy to change the cutter bars. It goes very quickly, in just about two hours.” says Esa Lahtela, Operational Supervisor at Kaipola.

The crusher has provided a favourable operating economy and UPM Kaipola has reached low crushing costs. Comparative studies between mobile and stationary crushers made by the Finnish Forest research company Metsäteho Oy (2011) show a processing cost of 1.27 € / MWh of the Saalasti Stump Crush 1224 HF, including operation and depreciation costs. Mobile units had processing cost of 1.6 – 2 € / MWh depending on brand and model. Stationary crushing affords a superior cost-efficient supply chain at distances shorter than 70 km, even for whole stumps, and favourable at medium distances up to 100 km.

In addition to Kaipola, UPM has invested in a number of Saalasti Stump Crush HF crushers at several of its plants in Finland and the UK.

Harvest rate of stumps in the region of Kaipola has been growing and is among the highest in Finland. The share of stump harvesting was some 20 % of all clear cutting areas in 2010, compared to 10% in the whole country. Supply chains with stationary crushing have increased within in the industry. About 70% of stump chips produced in Finland are crushed at the plant and about 30% in terminals. Almost 25 % of all logging residues and 70% of large-sized round wood for energy are stationary crushed. Chips derived from stumps with roots in Finland totalled a 16% share in 2010 and some 200 excavators were used for stump lifting.

Saalasti Stump Crush 1224 HF – Kaipola

Horizontal infeed of biomass	
Rotor diameter x width	1200 x 2400 mm
Infeed opening height x width	2000 x 2400 mm
Total motor power	n. 1150 kW
Production capacity	
- stumps with roots	45 t (dry)/h
- thinning wood	30 t (dry)/h
- particle size P45, loose vol.	200 – 290 m ³ /h



UPM-Kymmene Oyj Kaipola

Address:

Tehtaankatu 1,
FI-42220 Kaipola, Finland

Phone: + 358 204 16 161

E-mail: info.kaipola@upm.com



Saalasti Oy

Juvan teollisuuskatu 28, 02920 Espoo, Finland

Tel +358-9-2511550

info@saalasti.fi www.saalasti.fi

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