IEA Bioenergy
Technology Collaboration Programme

Industrial Process Heat: Case study 8

Process heat from forest residues for the battery industry in Austria

Task 32 project on industrial heat

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Preface

The use of biomass for energy in industry is growing rapidly in the last 15 years or so. Until about 2010, the use of biomass residues for process heat in industry was originally limited to industry sectors that had their own residues available to cover (some of) their own heat demand, e.g. sugar, palm oil, wood processing, pulp and paper, etc. By processing these residues, a waste problem could be avoided while generating useful heat at the same time.

With the increasing demand for cost effective renewable heat however, also other industries have recognized the opportunity for biomass based heat provision to reduce the carbon footprint of their processes. This is particularly the case in situations where there are suitable biomass resources and technologies available nearby. According to the IEA SDS scenario, the use of biomass to produce high temperature heat in industry will increase rapidly, from 8 EJ today to about 24 EJ in 2060.

While there is a large potential to displace fossil fuels with biomass fuels in the large and energy intensive industries (steel, cement, etc), there are also many small and medium sized process industries such as food industries, paper industries, etc. In contrast to the larger energy intensive industries where these case typically require that large volumes of biomass are shipped to an individual site, the heat demand in these smaller industries can often be better matched with the biomass resources that may already be locally available, resulting in smaller transportation distances.

This case study is part of a second series of reports on the use of bioenergy in industry to supply process heat. In 2021, five of the tasks involved in the IEA Bioenergy Technology Collaboration Programme collaborated to produce case studies and a policy synthesis report on biomass based industrial heat. In 2024, another 5 examples were prepared by Task 32 on application of biomass combustion in industry.

These additional cases represent a large diversity of applications and illustrate that biomass combustion can be a commercially attractive option for lowering the carbon footprint of companies. The examples also illustrate that the optimum configuration depends on local availability of biomass resources, characteristics of the heat demand, availability of space, capital, etc. The additional cases are:

6. Combustion of waste wood for electricity generation and process heat in two neighboring factories in the Netherlands
7. Combustion of wood chips in a dairy in Denmark
8. Process heat from forest residues for the battery industry in Austria
9. Process heat from forest residues for powder-coating process in Austria
10. Replacing coal with biomass at Golden Bay Cement, New Zealand

All reports are available on the project website
http://itp-hightemperatureheat.ieabioenergy.com/

Summary

Microporous in Feistritz in the province of Carinthia produces separator foil for lead-acid batteries. For the production of the separator foil process steam is required, which was produced with a fuel oil steam boiler until November 2022.

In 2019 the company Microporous approached Carinthia's largest private district heating provider, BC Regionalwärme Group from Köttmannsdorf, and a project was planned for the production of a process steam from biomass.

The biomass-based steam generation plant was then constructed from March 2022 to the beginning of November 2022 and went into operation on 08 November 2022. The grate-fired wood chip boiler produces process steam with an average pressure of 12 bar (up to 16 bar is possible), which then leaves the heating plant with a pressure of 6.8 bar. Through the 120 meters of steam piping to the production, a pressure of 6.5 bar arrives for use in the production of Microporous company.

The fuel used in the plant is exclusively forest wood chips from the region. These wood chips mostly come from storm wood, which usually cannot be used for any other refinement due to the breakage. Since Carinthia has a very high proportion of forest, about 60% of the land area, using forest chips as a renewable fuel source was an obvious choice.

The biomass steam generation plant has various plant components. These include, for flue gas cleaning, the multicyclone for the coarse dust particles, and an electrostatic precipitator for the fine dust particles. Two energy efficiency optimizers with grate cooling and the economizer are also installed in the plant system.

Another important plant component is the district heating outcoupling system, which supplies other customers in the Feistritz im Rosental industrial park with sustainable heat.

Index

Background

BIOENERGY IN AUSTRIA

In Austria, renewables account for approx 30% of Austria's total energy supply, with a 35% share in final energy consumption. Biomass constituted approximately 55% of this renewable energy. Bioenergy is primarily utilized for renewable heat, serving residential, commercial, and industrial sectors directly as well as through district heating systems. Biomass contributes to 50% of district heating, with biomass-based heat and combined heat and power (CHP) plants driving additions to district heating infrastructure over the past decade.

INTRODUCTION TO THE CASE

Microporous Ltd.

Microporous is an American company founded in 1934 and headquartered in Piney Flats, Tennessee. Microporous produces separator foils for lead-acid batteries and can be considered one of the leading independent manufacturers in this industry. In 2008, a second facility was opened in Feistritz im Rosental with three state-of-the-art production lines.

In this Feistritz im Rosental plant, Microporous requires a process steam supply 24/7 throughout the year for the production of the separators foil, except for a few maintenance days per year. This constant offtake enables an optimal supply of process steam produced from biomass, which makes it possible to stop the current production of fuel oil. This allows the company Microporous a CO_2-equivalent saving of 4,296 tons per year.

Microporous uses the process steam in the production of the separator film first for drying the solvent-impregnated film. In this process, the process steam is used to heat the air blown into the dryer. Two further consumers of the process steam are responsible for the recovery of the solvent. These are a distillation unit, which is heated with the process steam, and activated carbon columns, which first adsorb the solvent as it flows through the air-solvent mixture, which is then desorbed with the process steam. The resulting condensate, due to cooling in the activated carbon columns, is separated from the solvent and is then returned to the heating plant for renewed steam production together with the condensates from the other steam consumers.

The BC Regionalwärme Group

The BC Regionalwärme Group is a Carinthian group of companies, which was founded in 2007 by managing director Johann Hafner. In the same year, the first heating plant in Köttmannsdorf was built and put into operation. To date, this heating plant has been followed by over 20 other heating plants, which supply more than 8,500 households in Carinthia with district heating. The field of activity of BC Regionalwärme Group extends thereby over planning and the establishment of the heating stations, as well as also the start-up and the current enterprise of the plant.

In the year 2022 now the first biomass steam generation plant in the firm history of BC Regionalwärme Group was established. This steam generation plant is located in the industrial park of the market town Feistritz im Rosental and mainly supplies the company

Microporous with process steam. This process steam is generated in a 1.6 MW steam generation plant of the company Kohlbach and supplied to the company Microporous through underground pipelines. In addition to steam generation, district heating is coupled out, which can be used to supply heat to other customers in the industrial park.

Project timeline

The inception of the project began in 2019 with initial discussions between the management of both companies. After some delay to the prioritization of a river water cooling project from the Drau, construction of the heating plant finally commenced in March 2022. In May, the biomass boiler was delivered and installed, paving the way for the installation of other plant components and necessary piping and electrical connections. In August, a significant milestone was achieved with the laying of a 120-meter-long steam pipeline. The plant commenced operations on November 8, 2022, and has since been consistently supplying steam to Microporous.

The fuel

In the Microporous plant, only forest chips serve as fuel, sourced from the local region within a maximum radius of 50 km. Carinthia's abundant forest cover, constituting 60% of its total area, coupled with yearly storm wood occurrences, makes forest chips an optimal fuel for steam generation. The fuel standard EN 14961 categorizes forest chips into four grades, distinguishing them based on the tree parts utilized and chemical properties. Figure 1 and table 1 outline the specific raw material groups and their respective properties for quality assurance purposes.

Figure 1: Groups of raw materials according to EN 14961 (Source: Holzforschung Austria)

Table 1: Raw material groups of forest chips according to EN 14961.

Raw Material Group	**Origin and Source**	Fine Fraction, F	Ash Content, A	Nitrogen, N	Chlorine, Cl
	1.1.1.1 Whole trees without roots, hardwood 1.1.3 Trunkwood	F15	F15	F25	F25
C2	1.1.1.2 Whole trees without roots, softwood 1.1.4.3 Forest residue wood, hardwood (dry)	A2.0	A3.0	A5.0	A7.0
	1.1.1 Whole trees without roots 1.1.4 Forest residue wood 1.1.7 Sorted wood from gardens, parks, roadside maintenance, vineyards, and orchards	N0.3	N0.5	N1.0	N0.5
C4	1.1.2 Whole trees with roots 1.1.5 Stumps/roots 1.1.6 Bark (from forestry activities) 1.1.8 Defined and undefined mixtures	Cl0.02	Cl0.03	Cl0.07	Cl0.03

At the biomass steam generation plant in Feistritz im Rosental, only raw material groups C1-C3, boasting a water content ≤ 35%, are utilized as fuel. This selection is driven by the stringent quality demands for steam and the imperative for uninterrupted 24/7 operation. These raw material groups exhibit a moderate bark content, which, among the wood components, has the lowest calorific value, along with a low ash content. Annually, the plant consumes around 22,000 bulk cubic meters of wood chips, each carrying an average energy content of 0.6 MWh per bulk cubic meter.

Technical aspects

The technical structure of the biomass steam generation plant is first shown in the following two schematic figures.

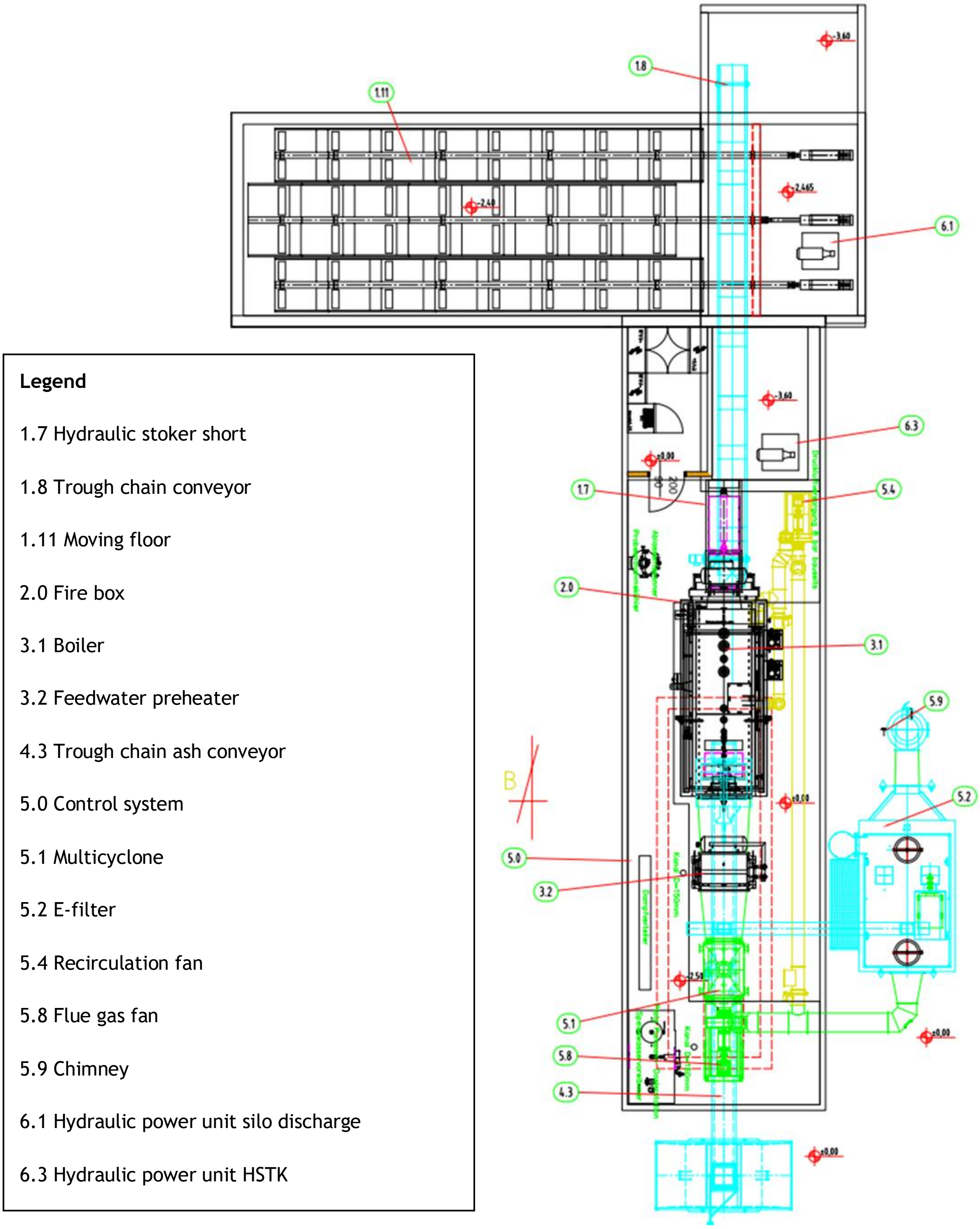

Figure 2: Boiler installation plan (Source: BC Regionalwärme Group)

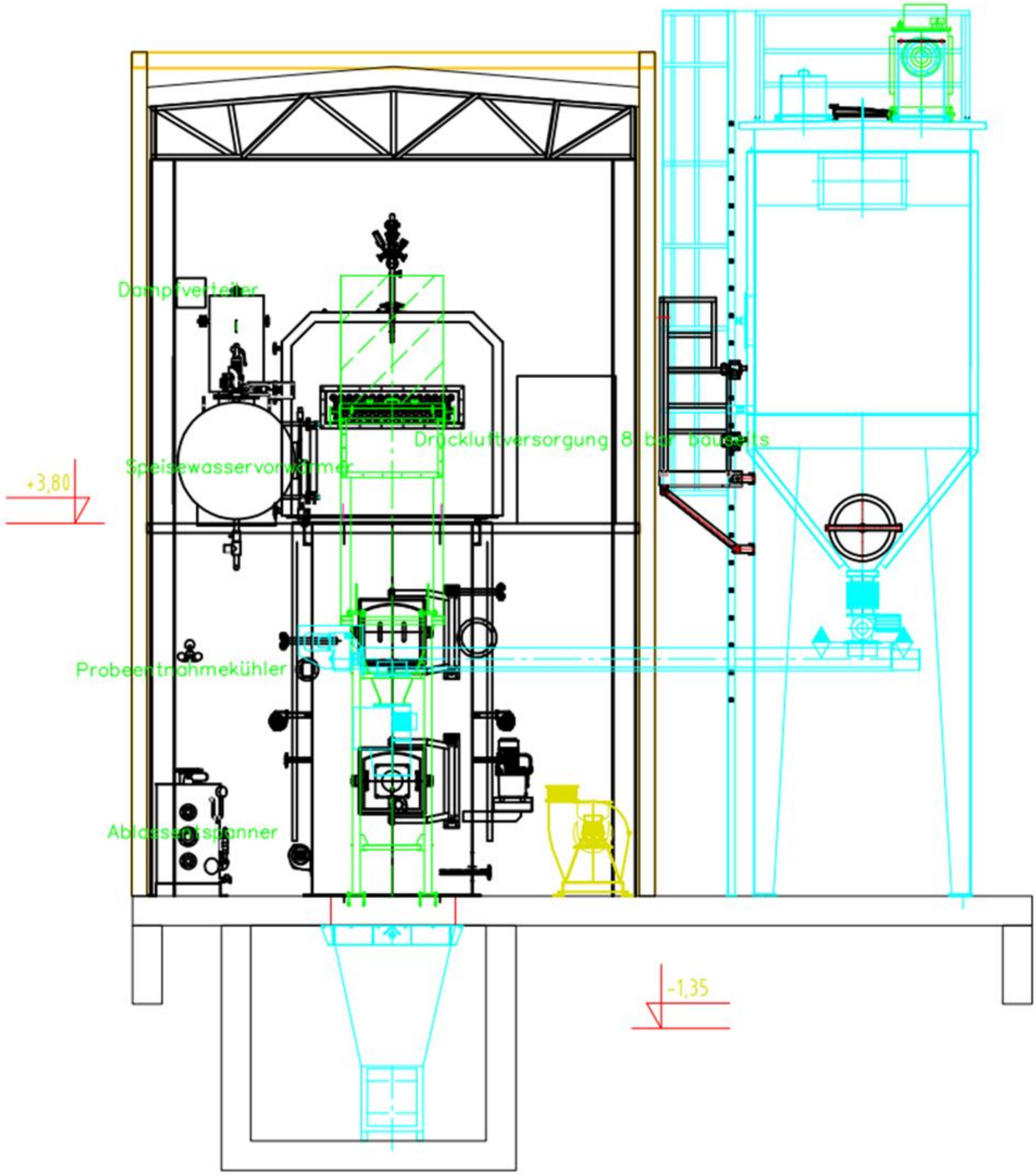

Figure 3: Cross-section of the boiler house (Source: BC Regionalwärme Group)

The forest chips are delivered by trucks or tractors and are usually placed directly on the moving floor (1.11). This has a capacity of approx. 300 m^3 and if this is not sufficient, the forest chips can be temporarily stored in the hall adjacent to the boiler house. After being discharged from the push floor, the forest chips are transported from the cellar to the boiler's infeed stoker (1.7) using a trough chain conveyor (1.8). This stoker is then used to feed the wood chips into the furnace (2.0).

Figure 4: Fuel (forest residues) on moving floor storage (Source: BC Regionalwärme Group)

The furnace operates as a grate furnace, with combustion gas temperatures reaching up to 950°C. These high temperatures effectively heat the feed water in the shell-type steam boiler, causing it to evaporate. Engineered to withstand pressures of up to 16 bar, the steam boiler transforms the evaporated water into steam. This steam, at approximately 180°C and reduced to 6.8 bar pressure, is then regulated by the steam control valve of the steam distributor. Presently, the facility generates a steam quantity of 2.5 tons per hour.

Figure 5: Furnace and steam boiler with chain conveyor (Source: BC Regionalwärme Group)

Figure 6: Furnace of the company Kohlbach (Source: BC Regionalwärme Group)

The flue gases, which have been cooled by heating the feed water in the steam boiler, exit the boiler at a temperature of 218°C and are then directed through a feed water economiser (3.2). In this economiser, the boiler's make-up water—previously thermally and chemically treated in the feed water tank—is conducted in a counterflow to the flue gases. Through this counterflow heat exchanger, the feed water is heated to 157°C, while the flue gases are further cooled to 195°C.

Figure 7: Economiser (front left), multicyclone (rear left), feedwater tank (rear right) and steam distributor (front right) (Source: BC Regionalwärme Group)

The flue gas is then cleaned by a multicyclone (5.1) and an electrostatic precipitator (5.2) in order to comply with the exhaust gas values prescribed by the authorities. In the multicyclone, the larger and heavier dust particles are first removed from the flue gas by centrifugal force. In the electrostatic precipitator, the finer dust particles are then filtered out by electrically charging the particles.

Figure 8: Electrostatic precipitator and chimney (Source: BC Regionalwärme Group)

Increasing energy efficiency

Two methods of increasing the energy efficiency of the entire plant have already been used at the Feistritz im Rosental plant. First of all, this includes the aforementioned Economiser, which is used to preheat the feed water. This preheating makes use of the thermal energy otherwise lost in the flue gases.
The second energy efficiency improvement is the grate cooling of the firebox. This grate cooling heats the cool condensate return from the Microporous process, again utilizing otherwise lost thermal energy. Another positive effect of grate cooling is the extension of the service life of the fire grates.
Further optimization possibilities, such as the use of the vapor, are being investigated during ongoing operation and, if necessary, also implemented.

Ongoing operation

The biomass steam generation plant is monitored and operated around the clock by the BC Regionalwärme Group. The monitoring is done via a visualization of the plant, which also allows remote maintenance of the plant at any time. In addition, there is an alarm signaling device at the plant, which immediately informs the technician on duty in the event of plant malfunctions.

Lessons learned

Supplying the industrial sector with renewable energy is becoming increasingly important due to rising fossil fuel costs as well as climate protection. For a continuous supply of process steam, only biomass can be considered as the only constant renewable energy source. For this reason, the project from Feistritz im Rosental is to be taken as an important realization that such a changeover can work.
As with other projects, it is also a realization in this project that various steps can be implemented more quickly in future projects due to the knowledge that is now available. This includes, for example, the very long planning phase of almost two and a half years, which should be shortened in future industrial projects.
Overall, this first biomass steam generation project of Regionalwärme can be used as a basis for further projects, which can then be adapted to the respective site conditions and required process steam parameters of the customers.

References

Working group biomass local heat; Conference manual heating plant operator day; Lambach training center; 05.November 2013.

Acknowledgements

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Further Information

IEA Bioenergy Website
www.ieabioenergy.com

Contact us:
www.ieabioenergy.com/contact-us/