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REsidual soft WOOD conversion
to high characteristics drop-in bioFUELS

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**Deliverable D2.8 - Delivery of first larger volumes (tons) of sugar
of Residual Wood hydrolysate to WP3**



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Document Abstract

This deliverable is a demonstration report with the purpose to update the public that the REWOFUEL project has demonstrated that large amounts of residual wood hydrolysate from the Biorefinery Demo Plant in Sweden has succeeded with the project plan to yield large amounts of residual wood hydrolysate accordingly to downstream specifications on purity and concentration.

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Delivery of first larger volumes (tons) of sugar of Residual Wood hydrolysate

1. Background

Biomass is frequently considered as an alternative feedstock to fossil oil to address the issues of climate change and resources depletion as well as energy independence of European nations. However, such substitution is far from trivial and innovative processes are needed to efficiently convert residual biomass into drop-in intermediates and end products.

Wood sugar hydrolysate will play an important role in our effort to replace products that today are made from fossil sources. Wood hydrolysates can be an intermediary product that can serve as wide base for different products such as green chemicals, biofuels, ethanol, butanol, aviation fuels and biobased materials.

The present project, gathering renowned industrialists from various fields, aims at developing new value chains from low value renewable feedstocks towards bio-isobutene and eventually to advanced biofuels and valuable coproducts such as bitumen and animal feed. By adopting world class technologies and by creating new partnerships, the project will set the foundations of a first-of-a-kind biorefinery converting residual wood to high performances drop-in renewable gasoline and jet fuel.

Sekab E-Technology AB, has been focused on development of technology to convert cellulose to sugars, ethanol and other biobased materials since the last 15 years. Sekab operates the GMM certified Biorefinery Demo Plant, in Örnsköldsvik. Sekab has developed certain know-how, patents, processes and proprietary technologies for the production of fermentable sugars, lignin and ethanol from lignocellulosic biomass, which can be licensed for commercial scale production. The processes and technologies are commercialized through the technology platform called CelluAPP®

2. General working principle Biorefinery Demo Plant

The demonstration and production facility for the crude sugar and crude lignin production within the REWOFUEL process chain begins with softwood residues entering Sekab's Biorefinery Demo Plant (BDP) located in Örnsköldsvik, Sweden. The BDP facility processes around 1-2 tons of dry matter lignocellulosic feedstock per day. The BDP facility operates continuously 24/7 during the year, with some planned stop for maintenance. The operators are working in pairs to handle the different process units. The Biorefinery Demo Plant (BDP) has been in operation since 2004.

The process units present in the BDP are shown in Figure 1, but not all units are used within the REWOFUEL project.



- 1 Raw material intake
- 2 Feeding vessel
- 3 Steaming and impregnation
- 4 Pretreatment
- 5 Neutralisation and inhibition control
- 6 Enzymatic hydrolysis and fermentation
- 7 Yeast propagation
- 8 Distillation
- 9 Product tank
- 10 Filter press
- 11 Solid material to incineration
- 12 Liquid to incineration / biogas production
- 13 Evaporation Equipment

Energimyndigheten 

Figure 1. Overview of the Biorefinery Demo Plant, operated by Sekab.

The main process units for the crude sugar and crude lignin production are:

- Intake of feedstock (no 1)
- Pretreatment incl. hydrolysate separation (no 4)
- Enzymatic hydrolysis (no 6)
- Solid fraction separation (no 10)
- Evaporation unit (no 13)

To exemplify the capacity, during a four-week period a production of 3000 kg BD (bone dry) sugar can be demonstrated for softwood forest residues (50 m³ correspond to around 3.5 tons DM sugar). The ingoing softwood residues chips or sawdust will enter the BDP at the intake and go through a steam explosion pretreatment using an acid catalyst, normally the wood is pretreated with sulfuric acid or sulphur dioxide. The need for a catalyst in the pretreatment is dependent on the feedstock but since the structure in wood requires some loosening to enable the surface area for the enzymes in the hydrolysis step, the pretreatment is very important. The pretreated material can then be separated using a decanter or filter press unit and the separation of a C5 stream can be managed prior the enzymatic hydrolysis step. During the hydrolysis the structural carbohydrates are converted by enzymatic digestion to monomeric sugars, mainly glucose. The feed is then pressed and the crude sugar liquid is separated and the remaining fraction, mainly hydrolysate lignin, is washed. This lignin fraction can then be used in other applications depending on how it is further processed.

3. Delivery of large volumes of RWH within the REWOFUEL value chain

In the Biorefinery Demo Plant trials conducted during the first 18 months of the REWOFUEL project the total sugar yield from available sugars in the raw material has varied between from 70% up to around 85% dependent on how the process in the BDP has been optimized. The target yield has been above 80% for a certain quality from wood to sugar which has now been achieved. The residual wood hydrolysate produced was concentrated accordingly to the required specification. The product specification defined within the project has been fulfilled and a sugar stream with a satisfying concentration has been delivered.

Within the Rewofuel project between 2018 and 2019 also minor quantities, approximately 80-100 L of residual wood hydrolysate (~100 g/L sugar concentration) and around 50 kg of evaporated sugar syrup (~300-500 g/L sugar concentration) have been sent to downstream partner Global Bioenergies (GBE) for further processing in lab scale trials.

Two cubic meters of vacuum evaporated sugars corresponding to approximately 580 kg sugars was then sent to GBE for larger fermentation trials in March 2019.

The latest delivery from Sekab was in the volume of two cubic meters of vacuum evaporated residual wood hydrolysate with sugar concentrations above 500 g/L. This corresponds to over 10 tons of residual wood hydrolysate. This latest shipment was sent in November 2019.

Conclusion

With the last delivery to downstream project partners Sekab has now demonstrated during the project that large volumes of residual wood hydrolysate sugar have been produced in the Biorefinery Demo Plant in Örnsköldsvik. The sugar quality of the large volumes is within the current product specification defined by down-stream partner for further valorization towards drop-in biobased gasoline and jet fuel.