

BIOMETHANOL FORMING A CIRCULAR BIOECONOMY AT PULP MILLS

Over recent times pulp mills have become much more than simply “tonnes per year” in terms of revenue. First came the added extra of energy and district heating, then extracts of tall oil and turpentine, now all sorts of areas for extra revenue are being identified at pulp mills. As a clear example – and with the help of ANDRITZ – Swedish market pulp giant, Södra, recently started up the world’s first biomethanol plant at its Mönsterås mill in Sweden.

This was a concept full of pioneering, trailblazing activity; to extract raw methanol from the pulp process, refine it into high-end biomethanol and sell it on the open market as a premium product. This was a very complex and difficult process to achieve. Therefore, with much acclaim, the first plant of its kind in the world was started up late last year using ANDRITZ’s A-Recovery+ concept at Södra Cell’s Mönsterås pulp mill in southern Sweden.

But this world-first is only a part the story which originally began in another of Södra Cell’s three pulp mills, Mörrum. Leif Sjöblom, Senior Project Manager during the execution of the project explains, “We had some very curious process experts working for Södra at Mörrum that were very interested in the possibility of extracting biomethanol from the pulp

process and began by setting up a small laboratory. They saw some successful results and were so positive about their discoveries they formed their own company, Invico Metanol AB and patented the technology.”

The discovery was all about the complex ways of removing the sulfur content that would leave a clean enough product to become commercially viable biomethanol. Like all good ideas, creating biomethanol at pulp mills had been tried before, but had fallen down at the extraction process hurdle and had been abandoned. The process the former Södra experts experimented with leaped over that hurdle by introducing paraffin oil for extraction. The oil is then purified using steam and can be used again and again, creating a truly circular concept.



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SEE PAGE 3





"Other attempts at the extraction process stage had failed, so the Södra experts came up with their own solution, and quickly proved that it was possible to achieve really good final product quality using their unique solution," says Sjöblom.

SCALING UP TECHNOLOGY

The exciting new development continued as a feasibility study project of Södra's, working with Invico Metanol as consultants and a pilot plant was built at the Mönsterås mill to further develop the process. "We built a container solution for the pilot plant next to the mill," says Sjöblom. "And added three small columns for the refining and extraction process. It was soon proved that this was a viable enterprise, and the decision was taken in 2016 to industrialize the process and make our own biomethanol at the mill for commercial purposes."

One of the crucial phases in moving from successful demonstration apparatus into full commercialization is the scaling up of the technology. Södra initially planned to carry out the project on its own, however this period coincided perfectly with the purchase of Invico Metanol's patents for biomethanol extraction technology by ANDRITZ.

"This was a crucial point," says Sjöblom. "We could have taken the whole project on by ourselves, but now with ANDRITZ involvement we knew we



Biomethanol is delivered by truck to the customer, where it can be used e.g. in biodiesel production.

had a partner that could take on the whole project and deliver the complete plant."

After a lot of discussion and planning a contract was finally set in March 2018 and work began. "This was a really exciting, but also demanding phase of the project, we were all learning as we went along such was the new, uncharted territory we were venturing into.

There was a lot of learning taking place as we progressed, both on the ANDRITZ side and with our project team."

Södra took responsibility with the building and ANDRITZ with the scaling up of the technology as well as designing and building the process equipment for the project. All parties involved with the project utilized 3D design technology, Södra, ANDRITZ, and the construction company involved and it was soon realized that the existing building was not big enough for the upscaled technology.

"We had to change the design and expand the building, which caused us a short delay," adds Sjöblom.

Joakim Johansson, ANDRITZ Commissioning & Start-up Manager, says, "I came to take over the project for commissioning and start-up in August 2019, and there was still some design changes going on at that stage. This was a time when ANDRITZ engineers and Södra operators were working very closely together, and we were learning a lot.

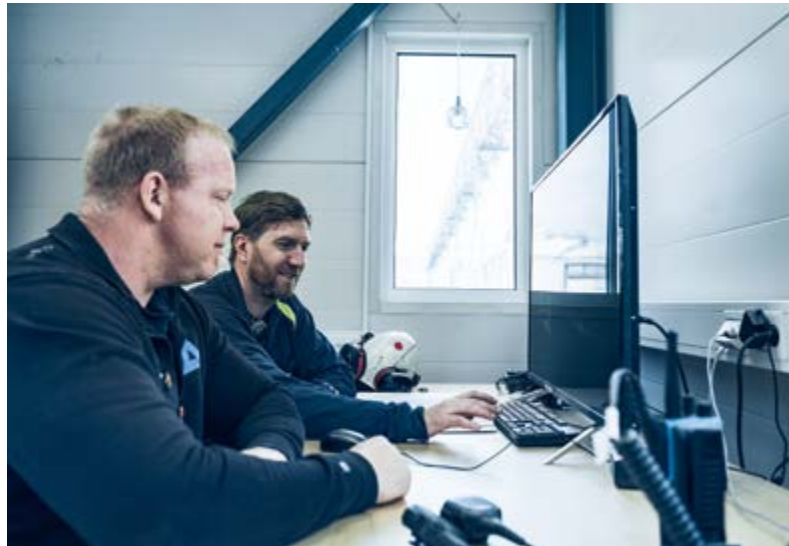
"Obviously with a new concept like this there were parts of the operation and problems we could not foresee until we actually tried them. But we overcame the challenges



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LEIF SJÖBLOM
Senior Project Manager,
Södra Cell Innovation
and New Products





Joakim Johansson, Site Manager, ANDRITZ, and Johan Blom, Operator, Södra, in the control room.

as they arose and together made it work. This was a real cooperation success between the operators and ANDRITZ."

The first start-up of the biomethanol plant with raw methanol being introduced into the plant was in November 2019, and all went remarkably well considering it was a totally new concept. "It all went quite smoothly considering the task at hand, there were a lot of different disciplines converging in one place.

"After a short break at Christmas, and a few teething problems when starting up in January, we very soon saw good quality biomethanol coming out of the plant. Like all plants of this kind, they are built to run,

and its only by continuous running that you achieve the stability desired," says Sjöblom.

Egon Paltmann, Project Manager, ANDRITZ, responsible for the biomethanol plant project at Mönsterås, says, "This was no normal project and there were no previous examples to follow. This biomethanol plant is a totally new concept from top to bottom, so we had something of a rollercoaster ride during the project, with lots of learning and some ups and downs on the way.

"However, we had a small group of people constantly working on this project, and it was the total dedication of this team – both from Södra and ANDRITZ – that made this project a success."

A FOREST RESIDUE PROCESSED PRODUCT

Using the A-Recovery+ concept from ANDRITZ the plant has a capacity now to produce 6.3 million liters of biomethanol which will be sold as a substitute for fossil-based methanol in the transport sector. Viktor Odenbrink, Sales Manager at Södra Cell Bioproducts, says, "This is a very exciting area we are entering into, with a lot of incentives for producers of biofuels to add even more sustainability into their own products.

"We will mostly be supplying our biomethanol to be used as a platform for chemical or biochemical industries to pull out the substances within rapeseed oil that are currently being processed by using fossil-based fuels. We have a unique selling point in that our biomethanol is categorized as a "forest residue processed product", which is very attractive when it comes to financial incentives.

The first commercial batches of biomethanol produced by the plant were delivered in February 2020. The plant was handed over to Södra in March 2020 and despite early challenges and some ongoing optimization, the plant has been in commercial operation during 2021. All biomethanol produced at the plant is sent to Danish company Emmelev and used for biodiesel production.

Lauri Pehu-Lehtonen, Director of A-Recovery+ at ANDRITZ, says, "The A-Recovery+ concept actually starts with a very simple

idea; to make pulp mills more resource efficient. Already over the years and decades we have closed chemical cycles and improved processes dramatically, but there are still side streams that are underutilized, and that is where A-Recovery+ comes in.

"Our idea is to look at all chemical cycles and the pulp mill as a whole, and look closely at where we can further reuse, recycle or refine different side streams for the production of new bioproducts. From our point of view, we would like to see our customers buying less chemicals, discharge less waste, and create new revenue streams."

In addition to biomethanol production, A-Recovery+ from ANDRITZ also produces sulfuric acid from odorous gases, recovers lignin for the use in advanced bioproducts, and is constantly looking for new opportunities to further improve climate performance of pulp mills.

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GETTING TECHNICAL



The methanol purification first cleans the odorous raw methanol (MeOH) from the operation to be free from nitrogen and most sulfur.

The clean methanol is ideal low NOx biofuel for use in the lime kiln, and the byproduct ammonium sulphate is an ideal nutrient for the biological effluent treatment plant.

If the mill decides to produce commercial grade biomethanol, then the clean methanol can be further purified.

At the end of this process, the biomethanol can either be used internally at the mill for chlorine dioxide generation, or be sold on for additional revenue.

