

Gasification helps mill go fossil fuel-free

Metsä Fibre's Joutseno mill tackled the last step in its quest to be free of fossil fuels. A biomass gasifier from ANDRITZ delivers sustainable, renewable fuel for the lime kiln, replacing natural gas.

◀ The ANDRITZ 48 MW gasification plant at Joutseno (foreground) includes biomass handling system, dryer, feed system, CFB gasifier, ash handling, and the gas burner for the lime kiln (background to left).



◀ Mill Manager Risto Joronen (left) with Kari Salo, Managing Director of Carbona.

The availability of low-cost biomass at this mill was a key driver for us choosing gasification technology," says Pertti Lehmonen, Metsä Fibre's Project Manager. "We have a woodyard, but no bark boiler at the Joutseno mill, so we have plenty of wood residuals available."

And the selection of ANDRITZ as the technology supplier? "This mill site has lots of equipment from ANDRITZ and also an ongoing service contract," Lehmonen continues. "We have worked together for a long time and have very good cooperation."

The drive for fossil fuel-free

"One of our company targets is to make all our mills carbon dioxide-neutral," says Metsä Fibre's Vice President and Joutseno Mill Manager, Risto Joronen. "The Joutseno mill was a good place to start. Similar development is underway at our other three mills in Finland."

Metsä Fibre is no stranger to bioenergy. It accounts for approximately one-fifth of all wood-derived electricity generated in Finland.

"The motivation for doing this is both environmental and economic," says Lehmonen. "We replaced natural gas with green energy from a very low-cost fuel source. It was a smart move for us now, but will appear even smarter when energy prices rise in the future."

Manageable risks

The project was designed to replace all the natural gas required for fueling the lime kiln (600 t/d capacity) with renewable, sustainable biofuel. The kiln was the remaining piece of production equipment running on natural gas. To this end, ANDRITZ proposed a complete 48 MW gasification plant – including the biomass handling system, a belt dryer, the feed system, circulating fluidized bed (CFB) gasifier, ash handling equipment, auxiliary systems, and a replacement gas burner for the existing lime kiln. "This was a complete delivery from the foundations up," says Kari Salo, Managing Director of Carbona, specialist in the gasification technology.

"The kiln burner is critical," Lehmonen says. "We thought this might be a risk area. The product gas (biofuel) burns differently and is delivered in higher volumes than natural gas." After start-up, Lehmonen says that the burner has performed quite well and there are no worries about its continued performance. "That was one risk that never materialized," he says.

As for the gasifier itself, Metsä Fibre was convinced that the ANDRITZ Carbona technology was not a risk. "Although it is the critical item in the plant in terms of production, we were quite comfortable with ANDRITZ's experience and knowledge," says Joronen.

The other big question at the beginning was how the non-process elements (NPEs) in the gasifier gas would affect lime quality or the entire chemical recovery loop. “The chemicals in a modern mill, including inorganics, are recirculated over and over,” Joronen explains. “These inorganics could build up and cause a dead load in the system. We didn’t know for sure if the small proportions of ash formed during gasification would cause us problems.”

According to Lehmonen, this risk also has been quite manageable. “Our lime is a slightly different color now,” he says, “but the quality is the same. For the NPEs, we just open up the loop a bit and everything seems to be in balance.”

In fact, if you look at charts showing operations before and after (natural gas vs. gasifier gas) there is virtually no change in lime kiln operations. Production rates, tempera-

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Project Manager
Metsä Fibre

tures, and residual carbonates are almost identical.

The gasification plant

Circulating Fluidized Bed is a state-of-the-art technology for the partial combustion of fuels of differing qualities (such as woody biomass). The gasifier operates at about 750-800° C. The turbulent intermixing in the fluidized bed compensates for fuel quality fluctuations, accommodating low-grade fuels with variable moisture and ash content. The management of nitric oxides (NO_x) and

sulfur oxides (SO_x) is easily accomplished without adding post-combustion cleaning equipment. ANDRITZ CFB gasifiers have been in operation since the 1980’s. The technology has been upgraded over the years to satisfy today’s demands for reliability and efficiency.

The biomass fuel at Joutseno is a combination of pine, spruce, and birch bark. Moisture content averages about 50% (maximum 60%). ANDRITZ delivered a complete biomass handling and conveying system, including the fuel receiving pocket, bark screen, and conveying system to the gasifier, as well as the feeding system to the dryer. The feed system conveys fuel to the dryer at a rate of roughly 22 t/h. This equates to 175,000 t/a of bark.

The bark is dried in a belt dryer from ANDRITZ, with an evaporation/drying rate of 12 t/h. Drying increases the calorific value

Wet biomass is dried in a belt dryer from ANDRITZ, with an evaporation/drying rate of 12 t/h. Drying increases the heating value of the biomass fuel. ▼



▲ Inside the CFB gasifier, which operates at about 750-800° C. The large duct on the left feeds air to the gasifier.



▲ The biomass is a combination of pine, spruce, and birch bark. ANDRITZ delivered a complete biomass handling and conveying system.

of biomass. The heat sources for the dryer are hot water (waste water from the mill’s processes) and also low-pressure steam from the mill. Wet biomass enters the dryer and is fed uniformly across the 8 m wide belt. Drying air is heated indirectly to about 95° C in heat exchangers arranged above the dryer belt. The warm air flows gently through the biomass without displacing it from the belt, and absorbs its moisture. Moisture is reduced from the 50% level to about 15% in the dryer. This equates to a fuel feed of about 11 t/h to the gasifier.

Develop and optimize

The plant was started up in 2012 and some modifications were made to the bark feeding system of the belt dryer. According to Joronen, the mill has been relying solely on the gasification plant to fuel the lime kiln for the last six or seven months.

Lehmonen says that the modifications in dryer bark feeding and particle size have improved the plant operation. The main challenge now is to improve the utilization of secondary heat in the bark dryer. “We can improve our economics considerably by using more of the hot water from the bleach plant instead of the more costly LP steam,” he says.

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Risto Joronen
Vice President and Mill Manager
Metsä Fibre



▲ Heikki Valtokari, Sales Manager, ANDRITZ Wood Processing

It seems that the small things are important, according to Salo. “The bark handling and processing is critical,” he says. “We have made adjustments to optimize the particle size, feed rates, and some other things to get the maximum performance.”

Targets met

“This is a new kind of fuel for our lime kiln and there are new things to learn about maximizing the secondary heat from our bleaching line,” Joronen says. “We didn’t have much experience about these things. But we are fast learners!”

According to Joronen, the new gasification plant improves the efficiency of renewable energy usage and further improves environmental performance. “Joutseno is the first carbon dioxide-neutral facility in Finland during normal operations,” he says.

Lehmonen lists the technical targets that have been met: replacing fossil fuels, using cheap biomass residue for fuel, controlling NPEs in the biogas, keeping kiln capacity at its high level, improving the kiln’s flame radiation and heat transfer, and keeping residual carbonate low, etc.

“And on the environmental level, we can say that we are reducing CO₂ emissions by about 200 t/d, or 72,000 tonnes per year. On top of that, we are realizing a short pay-back time on the investment.”

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