Mechanical pulping at a crossroads

It seems we are at a crossroads – a turning point – in the development of mechanical pulping. While mechanical pulp has many benefits (yield and optical qualities being at the top), the competitiveness of mechanical fibers declines as energy costs rise. We spoke recently with Jan Hill and Peter Kaiser of nsiFOCUS, two experts with lifetimes of experience in mechanical pulping, about the role of ANDRITZ's new *ATMP* technology in helping the industry through this critical time.

In order to meet the challenges facing mechanical pulp producers, ANDRITZ developed an Advanced TMP (*ATMP*) process – to produce mechanical pulps with high quality while significantly reducing energy consumption.

The *ATMP* process encompasses several patented ANDRITZ technologies, according to Marc Sabourin, Global Director of Process Development for ANDRITZ's mechanical pulping business. By 2002, the key building blocks of RTS refining, RTPressafiner chip destructuring, and RTFibration were in place. "As a next step, we investigated using chemical treatment to enhance pulp strength further, while reducing the energy consumption of the TMP process," Sabourin says. "Our preliminary trials with chemical treatments were very encouraging."

Necessity is the mother of invention

The impetus for further development was spurred by commercial pressures, according to Peter Bräuer, Director of Technology & Processes of ANDRITZ. "It started in the early 2000's when Norske Skogindustrier (NSI) announced it would build a new newsprint machine at their Jaguariaiva (Pisa) mill in Brazil," he explains, "and would also invest in a new 600+ t/d pulping line to feed the new machine."

The problem (for ANDRITZ) was that NSI favored a pressurized groundwood (PGW) process at the time, due to the energy savings over traditional TMP. "We did not offer a PGW process, and we wanted very much to be part of NSI's expansion," says Johann Aichinger, Director of Technology & Processes. "But it looked as if we would be shut out. It seemed an opportune time to discuss our *ATMP* design plans and see if we could forge a way together with NSI."

The missing link: chemical treatment

Jan Hill, formerly an R&D Manager for NSI but now recently retired, recalls well the situation in 2003 when Aichinger came to a meeting with NSI. "Johann brought to our attention some research," Hill recalls, "that showed good results with chip destructuring prior to primary refining, good results with high-intensity refining, and good results with sodium bisulphite application. He floated the idea of combining the existing ANDRITZ technologies with chemical treatments in the same line. Though he said he couldn't promise anything, he asked if we would fund some pilot work together. We agreed to his proposal."

Jan Hill, formerly an R&D Manager for NSI (left) and Peter Kaiser, Manager of Fiber and Pulp for nsiFOCUS. ▼

"We now know how to produce pulp with the same characteristics as traditional TMP, but with 30% reduction in energy demand."
Jan Hill, R&D Manager for NSI (recently retired)

"We knew we were on to something good," Aichinger recalls, "if we could just develop it further. Having Norske Skog involved made the effort more valuable and allowed us to explore the full potential of this project."

With RTFibration, ANDRITZ had a means of better separating the dominant tasks of primary refining – chip defibration and fiber fibrillation – into two distinct steps. Now, with NSI's interest, there was a concerted effort to target the application of chemicals at the right point in the process. Working in partnership, ANDRITZ and NSI were able to better understand the effect of the different process components behind what is now *ATMP*.

"We ran the trials and the results were more than additive," Hill says. "You might expect 10% plus 10%, but we actually got something more than 30% reduction in energy demand. It was projected that with TMP at Pisa we would expend about 3.6 MWh/t. So a reduction in demand of 30%, which is nearly 1 MWh/t, is huge!"

Another thing that became apparent was the improvements in fiber characteristics. "We immediately obtained a pulp with higher bonding strength and brightness, along with significantly reduced energy consumption," Sabourin says.

In July of 2007, NSI ordered what would have been the first *ATMP* system in the world. But in March 2008, due to cost overruns of the PM2 construction, the project was stopped cold. "It is disappointing to invest time and personal energy into an exciting project like Pisa and then have it cancelled, but that's life and we move on," Hill says.

The project may have been cancelled, but the work did not stop. Pilot plant work was performed on all the different wood species used by NSI mills – from Northern Spruce to Southern Pine – in anticipation of the next opportunity. NSI also ran mill trials in Norway, Australia, and Brazil. By Hill's count, they have run about 160 pilot trials. "The mill trials for *ATMP* correlated very well," he says.

ATMP represents the single largest investment by ANDRITZ in any softwood mechanical pulping technology.

Innovation and coincidence

"When you hear someone speak about innovation, you hear about a 10-year sequence of events from initial idea to success," Hill says. "If you want to shorten that somehow, you need some good coincidences along the way. The Pisa mill was running about 10% Araucaria (an evergreen coniferous tree native to Brazil which produced a very good fiber) with the Pinus Radiata. The mix of the two species had a very strong positive impact on fiber quality."

Then, the Brazilian government decided that the native Araucaria forests should not be used for papermaking.

"This was our coincidence and our opportunity at Pisa," Hill says. "We got investment money to install what I can call a 'hybrid' *ATMP* with Impressafiner treatment and chemical addition, but without a fiberizer or high-intensity refining. We were able to maintain quality of the pulp strength without adding Araucaria and we were able to reduce energy demand by 300-400 kWh/t."

▲ The use of LC refining for the secondary stage or rejects processing contributes to overall energy savings. Shown above is the world's largest LC refiner – the TwinFlo 72.

"Every time we work with external companies, we learn something we can apply to our core business."
Peter Kaiser, Manager of Fiber and Pulp for nsiFOCUS

In addition to the Pisa hybrid, some *ATMP* modules were installed in mills in Norway. “But we never got the complete system in any one location,” Hill laments. “We need a running mill to get out the last percentages.”

Limited opportunities – until now

NSI and ANDRITZ entered into an agreement to further evaluate and optimize the *ATMP* process for commercial application. There have not been many opportunities to put in a complete new line for softwood, which is the reason there is only one complete *ATMP* system operating today, and it has just started up.

“We have complementary, but different targets,” says Peter Kaiser, Manager of Fiber and Pulp for nsiFOCUS. “We want to make good paper at the lowest cost. ANDRITZ wants to develop machines and processes. Our core business is not to develop refiners, so it makes a good partnership.”

nsiFOCUS was formed in 2009 as a wholly-owned daughter company of NSI. It combines the resources for technical development, continuous improvement, and troubleshooting. According to Kaiser, its primary “customer” is NSI, but they also consult to outside companies (including a salmon farming project that is particularly interesting to Kaiser). “Every time we work with external companies, we learn something we can apply to our core business,” he says.

“We have had many ideas, separately and together, which we tested in our Springfield (Ohio USA) pilot plant,” Sabourin says. “We have incrementally reduced energy consumption and improved pulp quality from the initial design at the Pisa mill.”

“I have seen a lot of pilot plants, but Springfield is the best facility I have seen on the TMP side,” Kaiser says. “It is well organized, the people are very experienced, and very effective.”

Pieces of a puzzle

“We are looking for pieces of a puzzle,” Hill says. “We stare at our puzzle and begin looking for missing pieces. ANDRITZ has their puzzle and is also looking for missing pieces. It turns out that we have some of the pieces that ANDRITZ needs and they have some of our missing pieces. Together, we come very close to completing the puzzle. And, what we’re missing, we can find together.”

While the puzzle is not complete, “We now know how to produce pulp with the same characteristics as traditional TMP (single-disc refiner operating at normal speed and with a fairly low intensity segments) with about 30% reduction in energy demand,” Hill says.

“We have made substantial progress over the years in disintegrating wood into fibers,” Hill continues. “But we have not made as much progress developing these

The MSD Impressafiner (shown below) and a Fiberizer delaminate the wood chips into loose fiber bundles which are perfect for targeted chemical treatment. ▼

fibers for papermaking. The free fibers we created were stiff, rather thick-walled, and not very prone to swelling or making surfaces that bond well. Still, we have come a long way.”

“A unique aspect of *ATMP* is its modularity,” Bräuer says. “Components can be implemented in a step-wise fashion that meets the logistics and economics of a particular mill. In certain situations, it may not be practical to install all components of the process.

Hill remembers as a young man learning that wood costs were by far the largest cost in the mill. “By 2009, energy costs exceeded wood costs on a global scale. Our analysis of virgin softwood pulps produced at our mill locations on four continents shows that no region of the world is significantly cheaper than another when it comes to combined energy and fiber costs. Energy is a big, big issue.”

“Yet, it is very difficult to justify an investment on energy savings alone,” Kaiser. “You need energy combined with quality improvements, or energy plus a production increase in order to meet the guidelines for the rate of return. As an industry, we still have work to do, and I think UPM will bring the process further at Steyrermühl.”

“All in all, our timing is good,” Sabourin says. “With rapidly rising electricity costs, TMP mills are eager to take action. Since *ATMP* can be implemented step-wise, and can deliver paybacks for each step, it is a very viable approach.”

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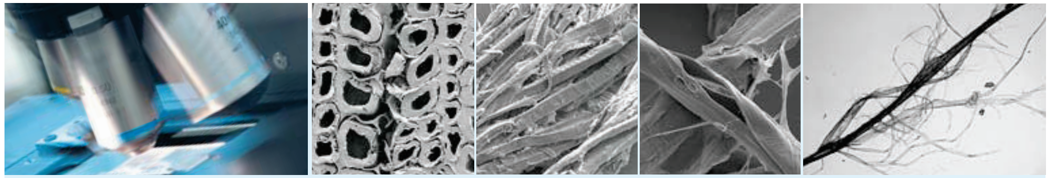

ADVANCED TMP

The *ATMP* process is suitable for most softwood species and is outstanding with various pines. Due to its modular design, it can be implemented in stages during the rebuild of a conventional TMP plant.

Considerable research has been directed to the fundamentals of wood breakdown – specifically defibration (breaking the chips into fiber bundles) and fibrillation (creating the bonding surfaces) – to reduce energy consumption and improve the fiber bonding.

A traditional TMP plant attempts to accomplish defibration and fibrillation in the same primary refiner. The *ATMP* methodology demonstrates that these two tasks need different conditions in order to succeed. It is better to separate the two steps.

In the *ATMP* process, the first stage (RT-Fibration) is performed in a pressurized Impressafiner and a fiberizer (low specific energy refiner) to delaminate the wood chips into loose structures of fibers. With a large surface area, these bundles are perfect for a targeted chemical treatment to attack the secondary fiber walls and improve the bonding characteristics in the next stage (high-intensity RTS refining). A 300-800 kWh/t energy saving for a given pulp tensile strength has been confirmed at mills running the combination of chemicals and mechanical treatment alone.

The high energy efficiency and pulp quality at lower freeness in the primary stage requires less refining energy in the secondary and/or reject refining stages. Modern mills are using energy-efficient LC refiners which further reduces specific energy consumption of the entire production line.

In March 2011, UPM Kymmene Austria GmbH located in Steyrermühl, started up the last modular step of their TMP system after a major rebuild. This creates the first commercial installation of a complete ATMP system, which opens a path for energy-efficient mechanical pulp production at Steyrermühl in the future.