The mill was transformed, from woodyard to effluent treatment

NOTHING LEFT TO CHANCE

Although a new paper machine will be the focal point of any project, the work Klinb did throughout the mill shows that the company has left nothing to chance. Beginning with the wood it uses through to the finishing, the mill was transformed.

The majority of the project was done on an EPC (engineering, procurement, construction) basis. Therefore, most technical aspects were decided before the deals were closed. This “froze” the project up front, Francisco Rizzolin, project director, says, so no major changes were needed during construction.

Work was on a tight time schedule: 22 months with startups and commissioning scheduled between September 2007 and January 2008. However, the suppliers held up their end of the bargain and they were able to meet the timeframes that Klinb gave them.

The labor, construction and delivery logistics were very complicated. The mill site is not spacious, tucked between the Harmonia River on the east and the Thagai River on the west. As well, the mill is built on a steep hill.

Therefore, how to find the space for a 360-m long paper machine building? The solution was to move the sheeting plant and build the new machine room on that site. About 60,000 truckloads (600,000 m³ of earth) had to be moved to the site.

MA-1100 project manager João Gomes Braga says that one of the aims of the project was not to implement unproven new technology. Most equipment is standard and has been tested on the market. One of the new technologies to this region is the circulating fluidized bed boiler that was chosen for its ability to handle a flexible fuel mix.

Klinb kept its existing woodyard that has two lines, one for pine and one for eucalyptus. Chips are either conveyed or blown to the pines. The conveyor is new and the mill will add another, removing the chip blower. This will help reduce chip damage as well as saving energy.

However, the big news in the woodyard is a new Metso Paper wood handling system with a capacity of 368 m³/hr (4,500 tonnes/day) of eucalyptus. The system consists of a GentleFeed deck, 5.3 m x 23 m feeding logs into the EasyTyre debarking drum, which is 35 m long and 5.5 m in diameter. It was the largest single piece of equipment delivered during the project.

The logs pass through a Camurra GS chipper and then are screened (EasyScreen CSE-1000). The GentleStore chip storage has a capacity of 43,000 m³ and ensures a first-in, first-out process. The chips are destined for the new chemi-thermo-mechanical pulp (CTMP) plant, but can also be sent to the continuous digesters.

Metso also supplied a Demuth bark crusher. The bark will be sent to the new power biomass boiler.

An extra chip conveyor — there are now three — was installed for the long ride to the various pulp mills. Chips go to one of six storage silos or may proceed directly to either a Kraft pulp mill or the CTMP plant. Of the six silos, four are for eucalyptus and two for pine.
There are two continuous digesters. The smaller of the two is an Esco model installed in 1976 with a capacity of 700 tonnes/day of eucalyptus pulp that is idealised. For the MA-1100 project, a knocker was installed before screening and a Delta (D10) Screen was installed in the primary stage.

The Kenmy digester was installed in 1986 and was rebuilt during MA-1100. Its capacity is now 2,200 tonnes/day of brownstock that is used for the brown layer of the mill's board. This digester handles both eucalyptus and pine, run in campaigns.

For the project, the feeding was changed to a Metso Compact feeding process. Changes were also made in the internal circulation system. Refining, washing and screening were increased. The screening process was lowered by 14 m in the process. A new Andritz 7-MW reject refiner was added to increase deairing capacity as was a twin roll press for washing. The cooking time has been reduced to 6-8 h from 9-10 h. Saltcake losses are expected to drop to 16-18 kg/tonne from 22 kg/tonne.

### SINGLE DISC SOLUTION

Andritz supplied what is the largest eucalyptus CTMP mill in the world: 140,000 tonnes/yr (420 tonnes/day). The 100% eucalyptus CTMP provides good bulk and good bending resistance at a lower specific energy consumption. Pulp from the new mill will be used on PMs 7 and 9 and some wet lap will be shipped to Klabin's Angatuba mill.

The process used was developed with the help of Klabin's researchers. The aim was to improve bulk and bending stiffness. Trials were done with eucalyptus and pine, but the best option was found to be 100% eucalyptus. This pulp is used in the middle layer of the mill's 3-ply LRB.

There are two 14-MW, 60-in. (150 cm) single-disc refiners. Conical disc refiners were too big for Klabin's needs. The new mill has a double-disc refiner as well but chose Andritz' single-disc design. There is also a smaller reject refiner. Andritz supplied the chip washing, impregnation, APMP (alkaline peroxide mechanical pulping) refining, washing, wet lap system and the mechanical vapor recompression (MVR) systems.

The mill worked with Andritz on plate design and two designs were chosen. The first has been used and works well. Plate life is expected to be 1,000-1,500 hours.

The goal for bulk was 3.2 but the mill is achieving 3.6. Freeeness is in the range of 330-390. Yield is in the 90% range.

Chips pass through the primary refiner and then go to the secondary refiner. The pulp goes to a latency chest and then into the screening process. Rejects from both stages pass through the reject refiner and then go back to the primary screen. After screening, the pulp goes to the washing system.

Monte Alegre's "Mr. Pulp" Jorge Mudri, fiber line and utilities manager, says washing is very important. "Liquid packaging board must have no resins." Therefore, there is a disc filter followed by a three-stage screw press washing system.

Although mechanical pulp is a new process for Monte Alegre, Mudri says his people have adapted well and that, "They are ready."

After pulping, the MVR system is used. Mudri explains that the CTMP effluent is only 1% consistency. It is evaporated to 20% and sent to the main evaporation basin.

To ensure that energy costs are kept in line, the CTMP mill will not operate between 6:00 and 9:00 p.m. from Monday to Friday. Capacity was planned on a 21-hour day.

Metso Paper also supplied the mill's new bleach plant (600 tonnes/day), including the Kajani analyzers. Originally, Monte Alegre had a totally chlorine-free (TCF) process, but has moved to elemental chlorine-free bleaching. Eka supplied the 15-tonne/d SVP-Lite chlorine dioxide plant but Klabin owns and operates it. Eka can also supply sodium chlorate (for ClO₂ production).

The old bleach plant was modified to house two lines of oxygen delignification. The move to ECF was made for many reasons. Mudri says ECF is an "international trend we see." Also, the mill wanted a higher quality pulp that had higher whiteness and lower variability while reducing energy use.

After many trials with suppliers, a DinotEOPDI sequence was chosen because of the properties it provides. The plan is to use 27 kg/tonne of active ClO₂. A small amount – 4 kg/tonne – of peroxide is used in the EOP stage. Final pulp brightness is 90 ISO. Bleached pulp is used on PM 7 and 9.
As well as the complete machine package, Volth also supplied the stock prep system for PM 9.
Metro supplied the coating kitchen for PM 3, which will also be used for PM 7.

In the converting ends, Klabin added two new MarQuip/Ward United sheeters as part of MA-1100. This brings sheeting capacity to 120,000 tonnes/yr as there is one MarQuip/Ward sheeter already installed. They will handle boxes from PM 7 and 9.

**THE BEST OPTION**

In the control end, Klabin went with its existing partner, ABB. The contract for the control system was worth $55 million. ABB has supplied an automation system based on the industrial IT System 800xA platform as well as upgrades to existing systems. "ABB was the best option for the mill," says Guilherme Sprung Filho, manager of energy and automation for the MA-1100 project. There are an estimated 30,000 control points in the new central control room (serving the fiber line including CTMP kraft pulping, bleaching and screening, and utilities).

"We consider it a state-of-the-art DCS," adds Sprung Filho. The training period included sessions with the IDEAS (Andritz) simulator. Refresher training was also done for the maintenance crews and operators in other areas to develop their skills so they could handle the new tools the system has.

Sprung Filho says that there were no problems integrating the automation upgrades in other areas. "Our experience with the system over the last 15 years shows that the operators have had no problems handling it."

Besides the automation end, ABB also supplied electrical systems such as a 69-kV substation, transformers, refinery motors and protection equipment, process electrification and paper machine drives.

**POWERING THE MILL**

CBC, Mitsubishi's Brazilian subsidiary, supplied the recovery boiler. Its capacity is 1,700 tonnes dry solids/day. It is scheduled to be one of the last pieces in MA-1,100 to start up: the first black liquor firing is expected in December.

At 100 bar pressure, the unit can generate about 220 tonnes/hr of steam. Black liquor from pine and eucalyptus is mixed to ensure that the liquor is sent to the recovery boiler is consistent.

There are three levels in the boiler with 12 firing guns (three per wall) on each level. Original capacity of the boiler was 1,100 tonnes dry solids/day, but Klabin decided to expand it before startup. This ensures that there will be no bottlenecks caused by the recovery boiler in the foreseeable future.

The new CBC unit has two electrostatic precipitators, the same as the existing recovery boiler. Emissions are fewer than 100 ppm of particulates, much less than the regulated standard of 150 ppm. Klabin believes it can achieve a level as low as 80 ppm.

Non-condensable gases, low and high concentrate, will be collected and burned in a new power boiler (producing 30 tonnes/hr of steam). IPE, a Brazilian company that specializes in this type of boiler that can burn non-condensable gases, is the supplier. These gases are collected from the pulping, causticizing and evaporation systems.

The current evaporator bunk was at its limit. A new effect was added; it is now a six-effect system with a capacity of 700 tonnes/day. A new flash tank and surface condenser were also added.

The new EL Smidth lime kiln was installed adjacent to the existing kiln. Its capacity is 300 tonnes/day and is scheduled to start up at the end of 2007. A green liquor cooler and filter as well as a white liquor tube filter were installed. The white liquor filter works in parallel with the existing white liquor filters. The white liquor can be fed to either digester.

With five smaller power boilers working, the mill is looking forward to being able to shut four of them when the new Babcock Power Espana (a subsidiary of Austrian Energy Group) unit comes online in January. As well, the remaining one will be rebuilt in May 2008.

As noted, this is one of the few pieces of equipment where Klabin decided to go with cutting edge technology. The circulating fluidized bed (CFB) boiler can burn a wide variety of fuels. In this respect it is much more flexible than a bubbling fluidized bed. It will burn biomass as well as sludge from the new ultrafiltration stage of the effluent treatment system. At 100 bar pressure and 500°C, it can generate up to 250 tonnes/hr of steam. It is the largest power boiler in the pulp and paper industry in Brazil.
With its flexibility to burn various fuels, Gomes Braga likened the boiler with the “flex” cars in Brazil that run on alcohol and gas oil.

Steam from the new power and recovery boilers will feed the new cogeneration plant. Pressure will be reduced to 12 and 4 bar to feed the paper machines. A smaller power boiler that can generate 30 tonnes/hr of steam at 15 bar is part of the cogeneration equipment (non-condensing gas system).

As a side benefit of the new power boilers, the mill will be able to reduce its greenhouse gas emissions by 65,000 tonnes/yr by shutting the older, oil-fired boilers. Klabin expects to reduce oil use by 20,000 tonnes/yr.

With the new CTMP plant consuming almost 25 MW of power, electrical consumption will increase. To alleviate this, Klabin is installing a new Siemens 72 MW, back pressure turbine. This will be the last piece to be commissioned, in January 2008.

It will generate about 100 MW from the cogeneration plant and the existing hydro plant. This existing hydro plant is old and cannot be expanded. Therefore, the mill will still need to buy 45-50 MW.

**CLEANING IT UP**

When Klabin applied for the environmental permits to allow the mill to expand, the company indicated that the expansion would be done without increasing emission limits despite the increase in production. Therefore, to allow for the increase in pulp and paper production, it had to reduce its BOD5 by 22% and its COD by 25% to reach its targets. That statement helped expedite environmental permits for the project.

The BOD5 limit is 3.8 tonnes/day (15 ng/l). However, down the line, the mill hopes to reduce this to 2 tonnes/day. The COD target is fewer than 12 tonnes/day.

Staying at the same limits necessitated a virtual duplication of the effluent treatment plant, costing about $150 million. The new capacity is 4,000 m³/hr. A new primary clarifier, aeration lagoon, secondary clarifier and a tertiary stage of treatment were added. The tertiary stage is an ultrafiltration process, the first major application in an integrated pulp and paper mill.

The effluent moves from a primary clarifier to an aeration lagoon to the moving bed filter chambers (four chambers in all: two parallel lines of two chambers each) to the secondary clarifier and into the ultrafiltration stage.

Ultrafiltration allows Klabin to remove all particles larger than 0.005 microns. By doing this, it can send much of the cleaner water back into the mill. However, not counting this, the mill still hopes to reduce fresh water consumption from 38 m³/tonne to 30 m³/tonne. This will be achieved by better washing at the pulp mills and in bleaching. The CTMP process is almost closed and PM 9 also has low water use.

Centroprojekt of Brazil handled the expansion of the effluent treatment plant. To ensure that the entire project ran smoothly, Klabin chose Pöyry to provide engineering, procurement and construction management.

**STAYING IN TOP SHAPE**

To keep this giant of a mill running in top condition, Klabin has about 300 maintenance staff. There are three main areas: woodyard and fibre line, utilities, and paper machines. The teams are further divided into mechanical and electrical and instrumentation (E&I). There is also a centralized engineering maintenance group that works throughout the mill.

Klabin makes use of the latest automated monitoring equipment to ensure the paper machines are running as required. The systems are also predictive. There is a crack detection system on the recovery boilers as well as continuous monitoring in the other equipment such as refiners and pumps. Metso Automation supplied a number of on-off control valves and a FieldCare system for 300 tags for predictive maintenance for field instrumentation as well as valves.

There is some outsourcing: civil works such as painting; cleaning security and some internal transport (solid waste removal). When the expansion is fully complete, there will be more maintenance outsourced. For example, ABB will take care of the automation system.

**Chemicals count**

Other than the coating chemicals, Kemira will supply the startup chemistry for PM 9, under an 18-month contract. This includes sizing, retention, drainage and fixation chemical.

Kemira has worked with the Monte Alegre mill for more than 10 years, starting with retention aids on a newsprint machine. In the past, it has also supplied its technology for liquid packaging to PM 7. This includes its hybrid sizing technology, Hydros Gamma.

In 2002, Kemira started up its paper chemicals plant in Tainanaco Poruba, very close to the Monte Alegre mill. The plant here makes sizing chemicals mainly, but also some AKD and resin. It also serves as a storage facility for other Kemira products delivered to Monte Alegre.

Kemira has also worked with Klabin on the new bleaching technology since the mill decided to switch to an ECF process. It can supply sodium chlorate from its new plant in Uruguay. Kemira’s local team, headed by project manager António Almeida, led the work done with Klabin and they were assisted by Kemira’s global expertise.
With the completion of the MA-1100 project, Razzolini says that there will be about 1,400 people working in the mill: 1,200 who are Klabin employees and 200 contractors. The number of new employees is 210.

In a developing region, jobs at Monte Alegre are coveted. Klabin developed an exam for prospective employees and it was probably no surprise to them when 2,500 people applied to take the test.

Klabin then chose 240 of the applicants for further training. This included a full year of studies at a local technical school (the pulp and paper program was developed by Klabin and the school). Klabin supported the trainees in this period with scholarships.

Of the 240, 210 were chosen for the mill. They then spent three months in the mill visiting all sectors. Following this, they were evaluated on the skills they had and where they fit in best during the three months of mill training. In mid-2007, they started at their new jobs. The mill could then release the workers who had been chosen to work on PM 9 or other areas such as CTMP to go to their new jobs.

All told, there were 60 people attached to PM 9, including eight on the wrapping line. The mill works an 8-hour shift system, with four teams. About 750 people work shifts.

The new jobs on PM 9 were open to all employees. Of the 60 working on PM 9, 16 are totally new to the industry. Of the others, 36 came from PM 7 crews.

The suppliers led most of the mill training. There were two phases: classroom and mill. For PM 9, Klabin purchased a program from Voith that is a computer model of the entire machine. The "students" could access the computer and follow the erection and commissioning of the machine.

In two areas where the mill had no experience — CTMP and the CFB power boiler — the IDEAS simulation package from Andritz was used. "This helped a lot for the operators to understand the process," Razzolini says.

PM 9 crews visited another Klabin machine that has a similar forming configuration but overall, the best example for PM 9 is PM 7. 

---

**Like our paper machines,**

**we never stand still.**

---

Voith Paper