Issue **FOCUS:**

CHEMICAL PULPING/BLEACHING

Brazilian bleached paper and dissolving pulp producer installs medium consistency delignification stage to lower costs, increase production

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Riocell Simplifies O_2 Bleaching with "No Moving Parts" System

RIOCELL SA IS A MAJOR PRODUCER OF bleached paper and dissolving grade pulps from eucalyptus and acacia. The mill is located in the city of Guaiba, state of Rio Grande do Sul (RS), Brazil, and exports most of the pulp to foreign markets. The mill decided to install a new medium consistency oxygen delignification (MCOD) stage based on three main expected benefits—cost reduction, increase in production capacity, and lower organics content in the bleach plant effluent.

The cost reduction was accomplished by using lower-cost oxygen vs other, more expensive bleach chemicals and reducing the chemical consumption in the bleach plant. The increase in production resulted from the reduced kappa number going to the bleach plant, which ultimately unloaded the existing bleach plant diffusers. The reduction of organics in the bleach plant effluent was possible due to sending the organic discharge from the MCOD stage to the recovery boiler.

RIOCELL PROCESS DESCRIPTION. Riocell performs cooking in a continuous digester and the first stage of washing in an atmospheric diffuser. The diffusion washing is followed by pressure knotting and screening. Additional washing is applied in two vacuum filters before the pulp is sent to the new MCOD stage.

Post-oxygen washing is accomplished in two pressurized drum filters, and the pulp is sent to a five stage D/C-E-D-EH-D bleach plant. The mill currently produces 1,080 a.d.mtpd through this system. The process flowsheet is shown in Figure 1.

The MCOD stage (Black Clawson's StatOx tech-

Brazil's Riocell SA produces 1,080 a.d.mtpd of bleached paper and dissolving grade pulps from eucalyptus and acacia.

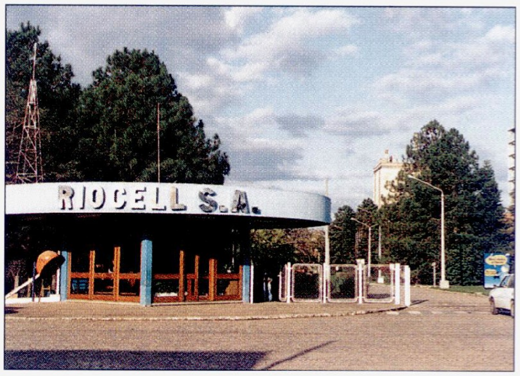
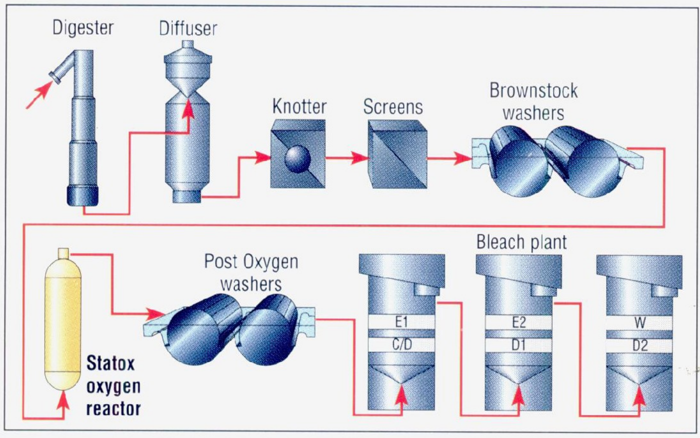


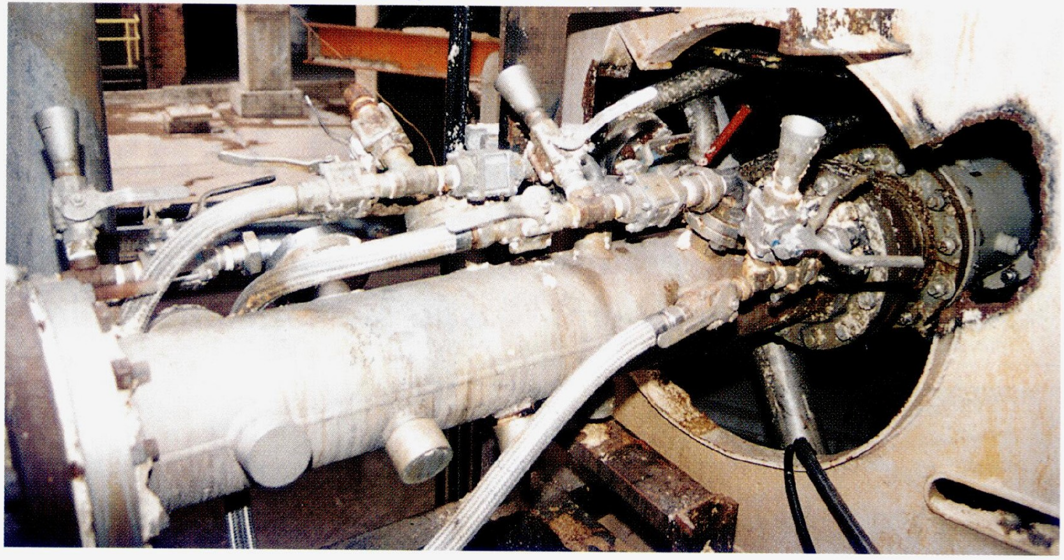
TABLE 1: *Design conditions for the Riocell medium consistency oxygen delignification stage.*

Nominal capacity	1080 a.d.mtpd
Hydraulic capacity	1188 a.d.mtpd
Power consumption	9.5 kwh/a.d.mtpd
NaOH/OWL consumption	13.6 kg/a.d.mtpd
Oxygen consumption	13.0 kg/a.d.mtpd
Entering Kappa number	14-16
Discharge Kappa number	9-10
Pressure at top of reactor	4 bar
Yield	98%
Operating temperature	95°C
Residence time	55 min
Entering pulp consistency	11.5%

FIGURE 1: *Process schematic of Riocell's 1,080 a.d.mtpd fiberline, including the medium consistency oxygen reactor.*



In Riocell's medium consistency oxygen delignification (MCOD) system, pulp enters the oxygen reactor (shown in photo) and is distributed evenly via a static inlet distributor. The pulp then flows through the reactor and is discharged with a unique static discharge system to a blowtank.



nology) is shown in Figure 2. Pulp is pumped from the drum washers at medium consistency to a holding tank before the reactor. Low-pressure steam is added in the standpipe and holding tank to preheat the pulp. The pulp is pumped out of the bottom of the holding tank with a centrifugal medium consistency pump and enters a spool piece containing the oxygen injector/diffusers.

After the oxygen injectors, medium-pressure steam is directly injected to trim the temperature as needed. The pulp enters the reactor and is distributed evenly via a static inlet distributor. The pulp flows through the reactor and is then discharged with a unique static discharge system to a blowtank.

Riocell selected the StatOx system for a number of reasons. First and foremost was the utilization of the unique "no moving parts" technology. This technology means lower investment and operating costs, as well as a simpler system to operate. The system also includes a larger number of items in the scope of supply. Table 1 shows the design conditions for the StatOx system.

In Riocell's MCOD system, pulp is pumped from a holding tank into a spool piece containing oxygen injector/diffusers (shown in photo). Following the oxygen injectors, medium pressure steam is directly injected to trim the temperature as needed before the pulp enters the reactor.

FIGURE 2: *Overview of the oxygen delignification process used at Riocell.*

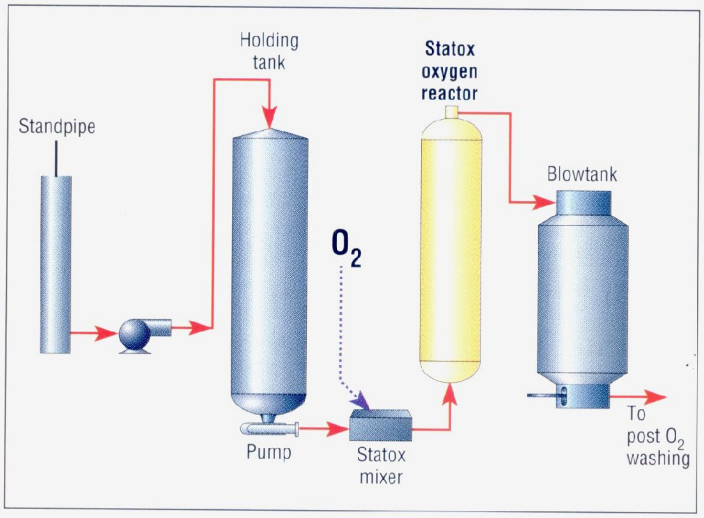
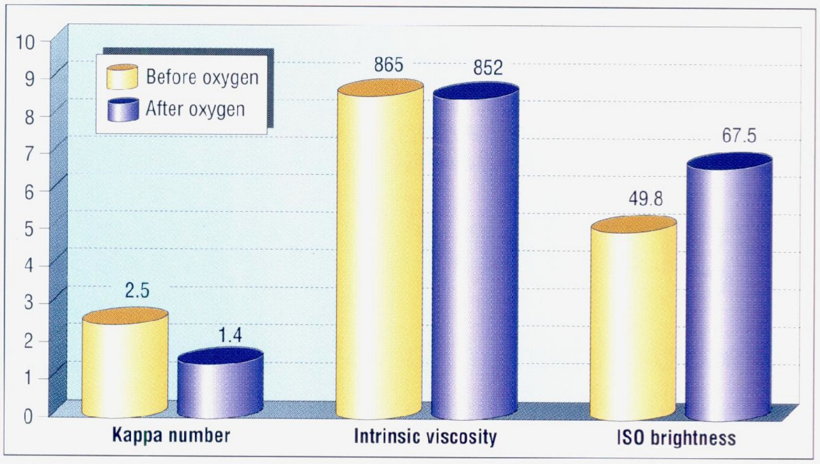


FIGURE 3: *Pulp quality characteristics after the alkaline extraction (E1) stage.*



OPERATING EXPERIENCE. Extensive process background testing began in the late 1980s and continued after the installation several years later, so the presented data is a two-year average before and after installation of the StatOx system.

Pulp properties after alkaline extraction following chlorination are shown in Figure 3. The extracted kappa number was reduced from 2.5 to 1.4, and the brightness increased from 49.8 to 67.5% ISO with virtually no loss in intrinsic viscosity.

Figure 4 details the specific use of bleaching chemicals per ton of pulp before and after the StatOx installation. The savings in bleaching chemicals are evident from this graph. A dramatic reduction in gaseous chlorine use was due to the MCOD and increased from 30 to 80% substitution in the D/C stage.

Even with increased substitution in the D/C stage, the overall applied chlorine dioxide was reduced. The reduction in sodium hydroxide was a result of the lower amount of active chlorine applied in the bleach plant.

Oxygen delignification did not seriously affect the drainage or beatability of the pulp. The tear index was improved slightly on both the raw pulp and the beaten stock.

A considerable amount of time and effort was spent evaluating the pulp properties before and after system installation. Figure 5 illustrates bleached pulp properties before and after the installation of the MCOD system. Oxygen delignification did not seriously affect the drainage or beatability of the pulp. The tear index was improved slightly on both the raw pulp and the beaten stock. The tensile index decreased little for the raw pulp, but after final bleaching, the results with and without MCOD are similar. This indicates that the MCOD system did not adversely affect the bleached pulp strength.

NEW DESIGN CONSIDERATIONS. The original system as installed at Riocell incorporated the latest "no moving parts" technology for a single stage system. This technology has now been used in the design of a two-stage MCOD system for higher delignification rates as well as operating flexibility.

Oxygen delignification is similar to other bleaching reactions in that there is a fast and slow reaction occurring. By utilizing a two-stage system, mills can have more flexibility to work with these two types of

FIGURE 4: *Comparison of specific use of bleaching chemicals per ton of pulp before and after the oxygen delignification stage installation.*

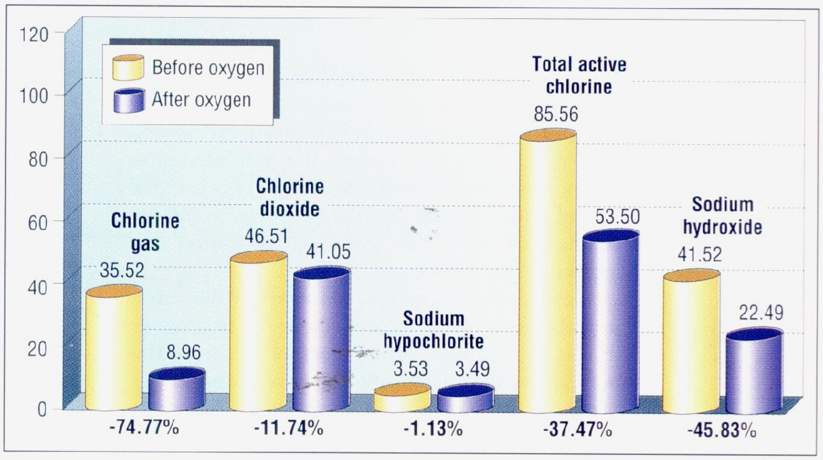
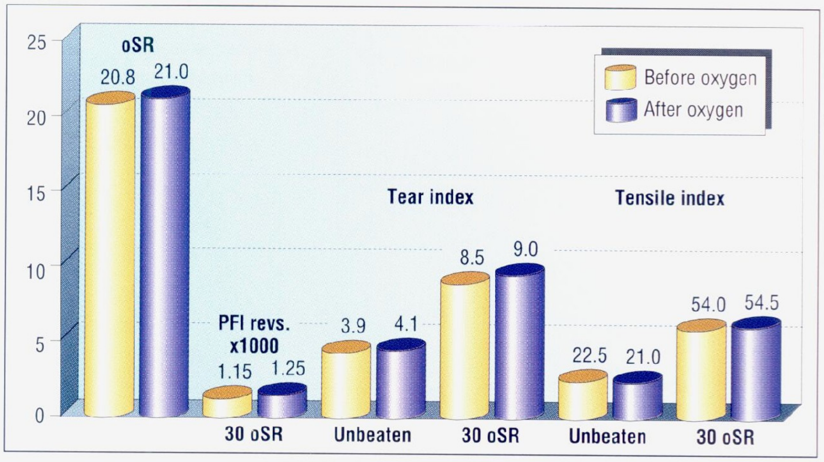


FIGURE 5: *Bleached pulp mechanical properties before and after installation of the oxygen delignification stage.*



reactions to push the system to achieve higher pulp delignification or make chemical and temperature adjustments to compensate for process upset conditions. Since pulp samples can be taken or continuously monitored after the first delignification reactor, temperature and chemical addition adjustments can be made to minimize chemical consumption and obtain the desired kappa reduction.

The benefit of a two-stage system is the ability to drive the system harder to obtain a maximum kappa reduction, and with a StatOx system ("no moving parts" for oxygen mixing or in the reactors) the capital cost and operating horsepower is kept to a minimum.

REACTOR DESIGN AND OXYGEN DIFFUSORS. Since the StatOx reactors have no moving parts, the cost of the reactor is simply the cost to fabricate an ASME pressure vessel with the addition of the patented "no moving parts" stock distribution system inserted in the tower. The reactor does not require any special housing for bearings and shaft supports, etc., which includes the following benefits:

- Reduction in maintenance cost for bearing repairs
- Reduction in downtime due to bearing and drive problems
- Allows more flexibility in tower design, since there are no scrappers and shafts.

Thus, with "no moving parts," reactor capital and maintenance costs are minimized, and there is more flexibility in reactor design to fit each individual and unique application.

In determining the size of reactors to use, the cost of the reactors was taken into consideration as well as the chemical consumption in optimizing the system. It was determined that overall, the mill needed to have approximately 60 min of retention. However, the question arose of what was the best way to split up this retention time from a reactor fabrication cost perspective?

Reactor costs were compared for two 30-min retention reactors and for a 20- and 40-min set of reactors. The cost for the two 30-min reactors was 5 to 10% more than for the 20-min and 40-min reactors.

From an operations and chemical consumption point of view, the 20-min and 40-min reactors provide the optimal flexibility in controlling the delignification process. The patented oxygen diffusion system, with no moving parts, provides a low-cost way to evenly disperse fine oxygen bubbles with the pulp at the beginning of each reactor stage.

This patented dispersion system translates not only into reduced capital costs but also into reduced energy requirements while accomplishing the required distribution of oxygen on pulp. This dispersion system has been proven in actual mill operations as can be seen by the results at Riocell.

The same pulp properties and process benefits as demonstrated at Riocell would apply equally or to a greater extent with a two-stage StatOx delignification system. The benefits of reduced capital cost and reduced energy requirements due to this new proven "no moving parts" technology, along with the flexibility in operation of a two-stage oxygen delignification system, make a very attractive option for oxygen delignification. ■

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