StatOx™, The Low Energy Oxygen Delignification System

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INTRODUCTION

Riocell S.A. is a major producer of paper and dissolving grade pulps from Eucalyptus and Acacia mearnsii woods. The mill is situated in the city of Guaiba, state of Rio Grande do Sul (RS), Brazil and exports most of the pulp to foreign markets. In late 1988, the mill decided to install Medium Consistency Oxygen Delignification (MCOD) based on the three expected benefits: cost reduction, increase in production capacity, and lowered organic material content in the bleach plant effluent. As expected, the cost reduction was attained by using lower cost oxygen instead of more expensive chemicals and reducing the overall chemical consumption in the bleach plant. The increase in production rate resulted from the lower kappa number going to the bleach plant which ultimately unloaded the existing bleach plant difflusers. The amount of organic material in the bleach effuents was reduced due to sending the effluent discharge from the oxygen stage to the recovery boiler.

MILL PROCESS DESCRIPTION

The mill performs cooking in a continuous digester and the first washing stage in an atmospheric diffuser. The diffusion washing is followed by pressure knotting and screening. Additional washing is performed in two vacuum filters before the pulp is sent to the oxygen delignification stage. The post oxygen washing is performed in two pressurized drum filters. The oxygen delignified pulp is sent to the five stage C/D-E-D-E_H-D displacement bleach plant, which produces 1080 ADMT of pulp per day. The process schematic is shown below.

StatOx PROCESS DESCRIPTION

Riocell selected the StatOX™ medium consistency oxygen delignification system because it had a number of significant advantages over competitive systems. First and foremost was the utilization of the unique, "no moving parts" technology. This technology meant lower investment, energy, maintenance and operating costs, as well as a simpler system to operate. The StatOx ™ system also had a larger number of items in the scope of supply.

The StatOx™ medium consistency oxygen delignification process schematic is presented on next page. Pulp is pumped from the drum washers at a medium consistency to a holding tank before the reactor. Low pressure steam is added in the standpipe and the holding tank to preheat the pulp. The pulp is pumped out of the bottom of the tank and enters a spool piece. containing the oxygen and steam diffusers, where oxygen and steam are injected to the pulp. The pulp enters the reactor where it is distrubuted evenly by a static inlet distributor. It flows through the reactor and is discharged to a blowtank via a unique static discharge system.

The StatOx™ medium consistency oxygen delignification for the mill in question was designed for the hardwood pulp with a kappa number of 14-16. The system had to produce 1100 ADMT per day of pulp with a kappa number of 9-10 using 13.6 kg/ADMT caustic and 13.0 kg/ADMT of oxygen. Power consumption was designed at 9 kWh per

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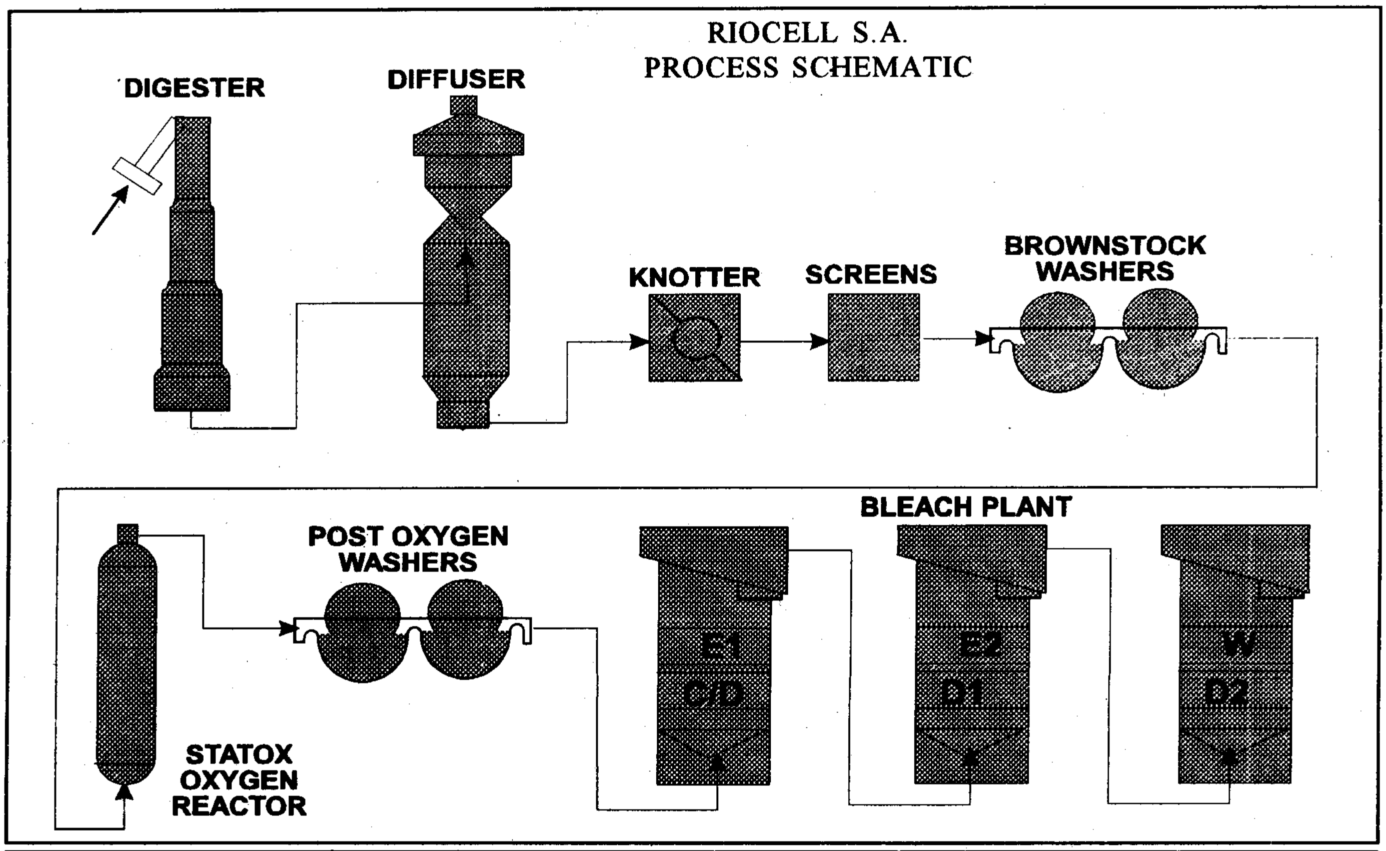
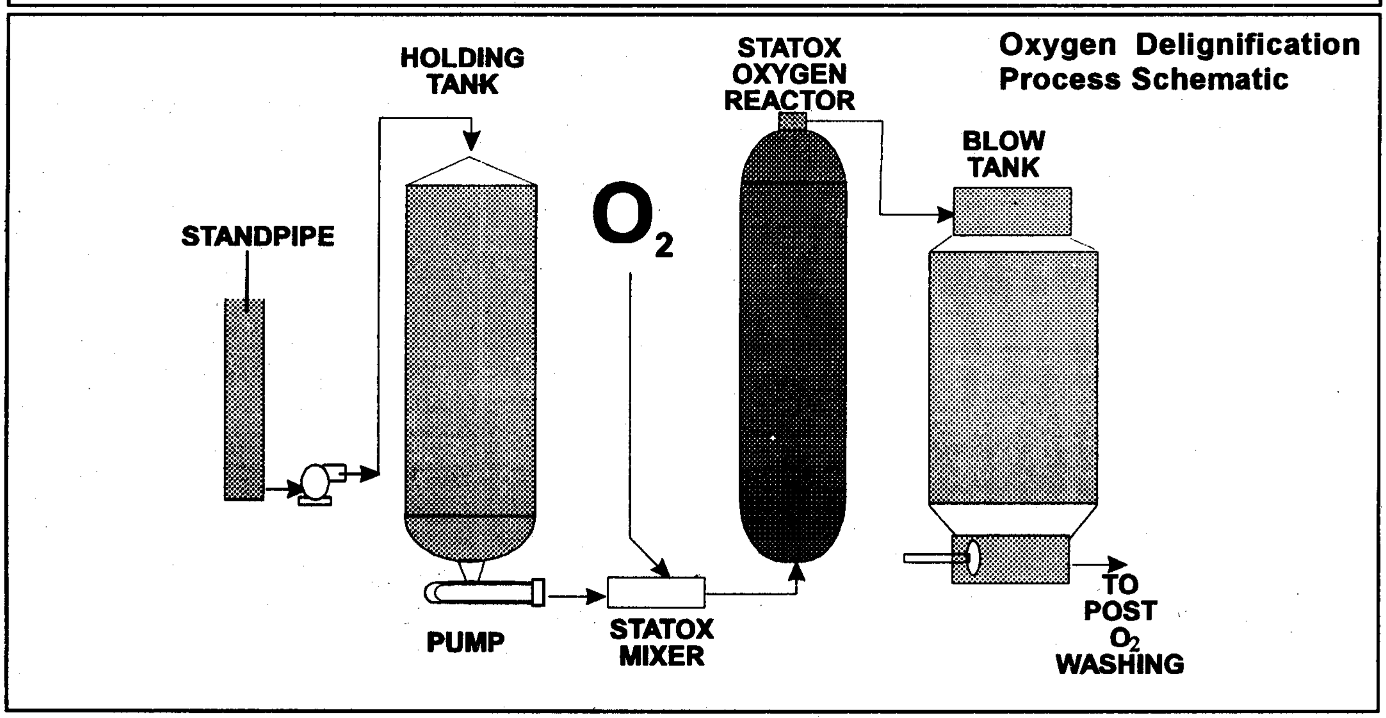




ADMT. The detailed design conditions are presented in the Table. The mill decided to purchase a white liquor oxidation (WLO) system as a source of alkali for the StatOx medium consistency oxygen delignification. The Oxypro™ WLO system has not only a very high sulfide efficiency conversion and low operating costs, but is also environmentally friendly.

OPERATING EXPERIENCE

Start-up of the StatOx™ system took place in April of 1990. The data presented in this paper are a two year average before and after installation of the StatOx system.

The medium consistency oxygen delignification at Riocell has been producing 1250 ADMT/D of pulp with 10 kappa number and 918 cm^3/g viscosity. The caustic and oxygen consumptions met the design specifications.

Figure 1 depicts per stage chemical consumption and Figure 2 total chemical consumption as kg/ADMT. Before the StatOx™ system was installed, the mill used the C/D-E-D-E_H-D sequence to bleach the hardwood pulp to 89% ISO brightness. A total

FIGURE-1
PER STAGE CHEMICAL CONSUMPTION (kg/ADMT)

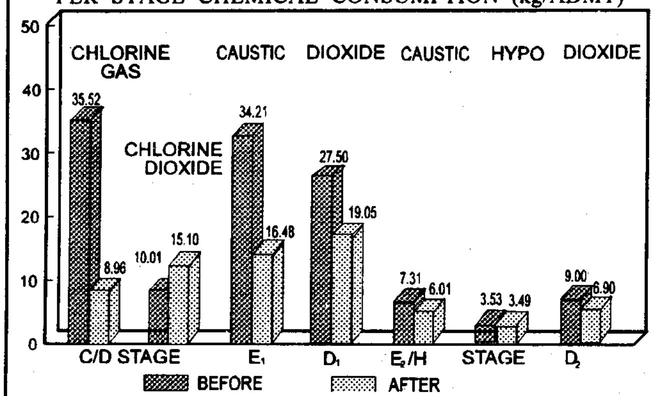


FIGURE-2
TOTAL CHEMICAL CONSUMPTION (kg/ADMT)

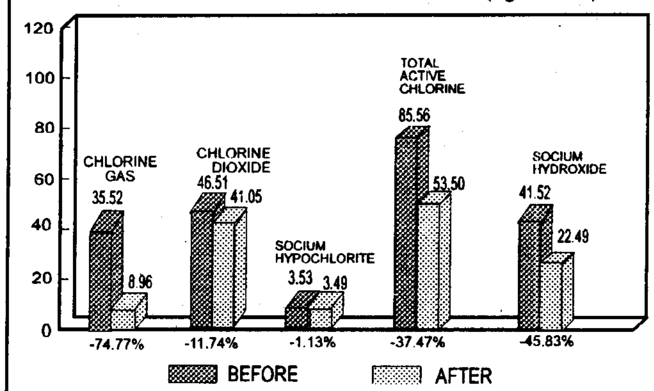


FIGURE 3
PITCH COUNTS
#2 BROWN STOCK WASHER FILTRATE

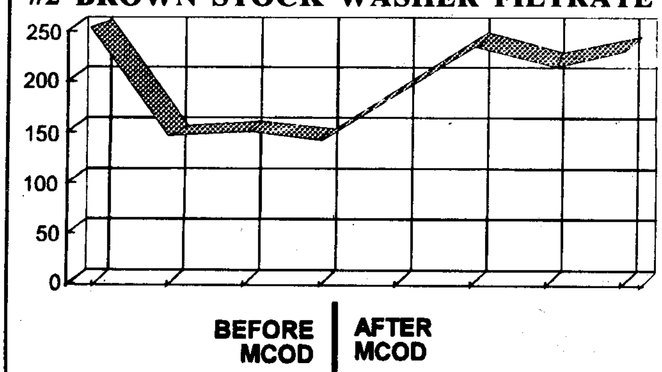


FIGURE 4
PITCH COUNTS
FINAL BLEACH WASHER FILTRATE

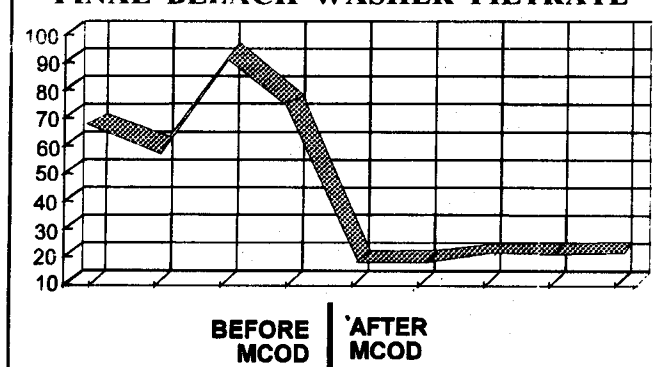


FIGURE 5
BLEACHED PULP
OPTICAL PROPERTIES AT 30°SR

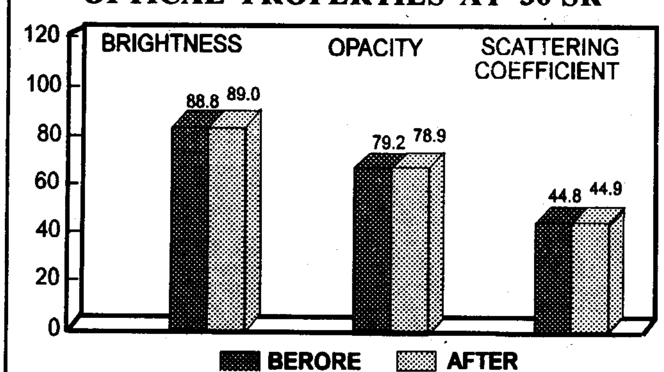
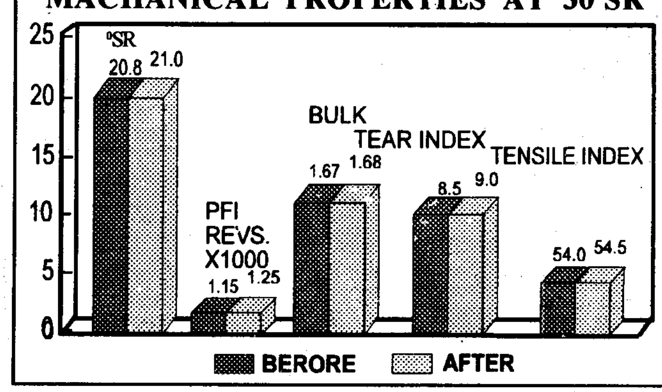


FIGURE 6
BLEACHED PULP
MACHANICAL PROPERTIES AT 30°SR



amount of 85.6 kg/ADMT active chlorine and 41.5 kg/ADMT of caustic were applied. kg/ADMT chlorine dioxide (as active chlorine) was used in the chlorine dioxide stages. The StatOx™ medium consistency oxygen delignification reduced the kappa number going to the bleach plant by 38%. As a result, the pulp required significantly less chemicals to be bleached to the target brightness of 89% ISO. The amount of active chlorine decreased to 53.5 kg/ADMT and caustic to 22.9 kg/ADMT. The mill had enough chlorine dioxide to increase the substitution level from 30 to 80% in the chlorination stage, which substantially improved the quality of the filtrates discharged from the bleach plant. Figures-3 and 4 show the increase in pitch particles in the filtrate of the second stage brownstock washer and the reduction of particles in the filtrate of the last bleaching stage. The various effluent parameters were tested to check the effect of the system on the contaminates in effluent. The results are shown in the Table.

The improved delignification also made it possible to increase the production of bleached pulp. Unbleached pulp output was reduced to near zero, but oxygen delignified pulp Oxicell™, without further bleaching, is still produced for special orders. The optical and strengths properties of the hardwood pulps bleached with C/D-E-D-E_H-D and O-D/c-E-D-E_H-D sequences are presented in Figure 1 and Figure 2. As expected, the use of oxygen did not adversely affect the properties of the final product.

The StatOx of oxygen delignification system installed at Riocell incorporated the latest "no moving parts" technology for a single stage. The same technology has now been used to design a two stage owygen delignification for higher delignification

StatOx MCOD
DESIGN CONDITIONS

Nominal Capacity, ADMT/D	1080
Hydraulic Capacity, ADMT/D	1188
Power Consumption, kWh/ADMT	9.5
Pulp Consistency, %	11.5
Temperature, °C	95
Retention Time, min	55
NaOH/OWL Charge, kg/ADMT	13.6
Oxygen Charge, kg/ADMT	13.0
Pressure at Top Reactor, kPa	448
Entering Kappa Number	14-16
Discharge Kappa number	9-10
Yield, %	98

StatOx MCOD
OPERATING RESULTS

PARAMETER	AVERAGE	MAXIMUM	MINIMUM
Production, ADMT/D	1125	1205	1043
Entering Temperature, °C	92.2	93.0	90.0
Alkali Charge, kg NaOH/ADMT	13.4	13.5	12.5
Oxygen Charge, kg/ADMT	13.0	13.0	13.0
Pressure at Reactor Top, kPa	480	488	471
Kappa Number before Reactor	15.7	16.8	15.0
Kappa Number after Reactor	10.0	10.6	9.0
Viscosity berore Reactor, cm³/gm	1122	1168	1080
Viscosity after Reactor, cm³/gm	918	1053	839

AVERAGE VALUES OF TREATED EFFLUENT

PARAMETER	BEFORE		AFTER		REDUCTION (%)	
	mg/l	kg/ADMT	mg/l	kg/ADMT	mg/l	kg/ADMT
Na+, as NaOH	744.1	55.81	601.1	40.04	19.22	28.26
COD	131.2	5.69	116.0	4.89	11.59	14.06
BOD	8.7	0.40	7.4	0.36	14.94	10.00
Dissolved Oxygen	6.9	0.30	7.0	0.26	(1.45)	13.33
pH	6.4		6.7			

rates as well as operating flexibility. Since pulp samples can be taken or continuously monitored after the first delignification reactor, temperature and chemical adjustments can be made to minimize chemical consumption and obtained the desired kappa reduction.

CONCLUSIONS

The StatOx System at Riocell has been performing very well within the design specifications. The equipment is achieving delignification levels equal to other oxygen systems. The mill has achieved definite savings in bleaching chemicals. The reduction in effluent load has allowed for future expansion of the plant.

This low cost, low energy StatOx oxygen delignification system would be very suitable for mills in India, where power costs are relatively high. It would be also the logical choice for non-wood pulps, which are susceptible to mechanical action.

ACKNOWLEDGEMENTS

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