INDUSTRIAL EVALUATION FOR CONTINUOUS PRODUCTION OF ECF PULP AT BAHIA SUL CELULOSE

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ABSTRACT

Since the start up in 1992, Bahia Sul Celulose S.A. has been producing ECF pulp on a regular basis, which has increased lately due to customers' demands. Continuous production of ECF pulp, through the sequence ODEopDD, was limited by the capacity of the integrated chlorine dioxide plant, a factor that became crucial as long as the mill gradually increased pulp production from the designed 450,000 adt/a up to the present 570,000 adt/a. Studies and laboratory works were carried out in order to investigate the best cost effective alternative to produce ECF pulp continuously, considering the premise of neither expanding the chlorine dioxide plant nor changing the properties of the pulp. The core ideas involved were: 1) to take advantage of the benefits of a pressurized (PO) stage using medium to high hydrogen peroxide charges and operating under the following conditions: temperature around 90°C, retention time of an hour and pressure at the top varying from atmospheric to 5 bar; 2) the use of low kappa factor in the first stage and low chlorine dioxide charges in the final stages; and 3) to control the pH of the dioxide stages. The goals of the development were achieved and showed that full production of ECF pulp would be possible for an annual throughput of 515,000 adt, the basis on which the study was conducted, with a hydrogen peroxide charge of 5 kg/adt. For higher production figures, such as the present ones, the results indicated that larger charges of peroxide (9 kg/adt or even more) should be necessary. The purpose of this work was to present the industrial results achieved after the (PO) stage start up in the bleaching plant, which enabled sustained ECF pulp production with the sequence OD(Po)EDD, without investing in the chemical plant and keeping the physical properties of the final product unchanged.

INTRODUCTION

Until the end of 1998 Bahia Sul Celulose used to produce both standard and ECF bleached eucalyptus market pulp, using respectively the bleaching sequences O(Cd)EopDD and ODEopDD. The production of ECF pulp was carried out in campaigns, since the total amount of chlorine dioxide applied (about 50 kg/adt) was higher than the generation capacity of the chlorine dioxide integrated plant (16,5 t/d).

In order to achieve the goal of producing ECF pulp, a current market demand, in a sustainable way, studies and laboratory works were performed to develop a new bleaching sequence which could fulfill the following requirements: to avoid any expansion in the integrated chlorine dioxide plant, to be the best cost effective alternative and to keep the properties of the final product unchanged.

The main concepts of the study, supported by literature, were the intensification of the extraction stage through the introduction of a pressurized (PO) reactor to operate with medium to high hydrogen peroxide charges [1-7], the use of low kappa factor in the first stage (about 0.12) together with low chlorine dioxide charges (8 – 10 kg/adt) in the third stage [8,9] and pH control of the dioxide stages [10] making use of sulfuric acid.

The results found in laboratory were reported and concluded that the introduction of a pressurized (PO) reactor in the extraction stage of the bleaching plant together with the use of low kappa factor in the first stage allowed a significant decrease in the total chlorine dioxide charge. The findings of Santos et al [11] indicate that the total amount of chlorine dioxide charge, expressed as active chlorine, dropped from values of about 35 kg/adt to 20 kg/adt, that is, a reduction of 43%, for a dosage of 5 kg/adt of hydrogen peroxide.

These results, converted from laboratory to mill scale, demonstrated to be possible to produce ECF pulp continuously for a production rate of 515,000 adt/a. Moreover, they also showed that for larger productions higher dosages of hydrogen peroxide (7 to 9 kg/adt) should be necessary.

After a thorough evaluation by the operation, engineering and research teams, this development was submitted to the directory board of the company for approval, since the original premise, mentioned above, was preserved.

The industrial implementation of the pressurized peroxide (PO) bleaching technology in the existing sequence, OD(EOP)DD, thus converting to the ECF sequence OD(PO)/EDD, was then approved on a schedule of fifteen months, and its start up took place in October 1998, after a mill shutdown.

Although the start up of the plant was successful, some problems occurred, like the difficulty of adjusting the pH control loops of the stages and the fact that the sulfuric acid system was not completely ready. For these reasons, it was not possible to start producing ECF pulp since then.

In December 1998, after the definitive solution of the problems in the plant, the mill fulfilled the need of producing ECF pulp continuously,

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reaching the quality standards of market pulp in a production rate of 530,000 adt/a.

Afterwards, in May 1999, a industrial trial using higher hydrogen peroxide charges (12 to 14 kg/adt) was run, aiming for continuous production of ECF pulp for the present throughput of the mill, that is, 570,000 adt/a.

The purpose of this work was to present the industrial results achieved in the bleaching plant with the (PO) stage, not only after the start up but also for the present production rate, respectively 530,000 and 570,000 adt/a, and comparing them to average results from ECF production of 1998, when it used to be done in campaigns.

RESULTS AND DISCUSSION

For discussion of the results, the periods involved will be referred to as: a) reference: ECF bleaching sequence ODEopDD, average results from 1998; b) after start up: ECF bleaching sequence OD(Po)EDD, 530,000 adt/a, and c) present: ECF bleaching sequence OD(Po)EDD, 570,000 adt/a.

The features of the oxygen delignified pulps for each process condition mentioned above are shown in Table I below. The results indicated that pulp samples after the start up and for the present condition presented smaller viscosity and brightness values, besides higher kappa number. Such differences may be considered normal and are within the range of variation of the process.

Table II at the end shows the average conditions of the bleaching plant for the reference case and for the two situations of continuous ECF pulp production. For the reference, when ECF pulp was produced in campaigns, the consumption of chlorine dioxide, expressed as active chlorine, was 50 kg/adt, with 24 kg/adt only in the first stage, equivalent to a kappa factor of 0.25, which was necessary in order to keep the kappa number after the Eop stage not higher than 3.0 to avoid brightness problems.

TABLE I. PRE-O_2 PULP CHARACTERISTICS

Parameter	Reference	After Start up	Present
Viscosity, dm³/kg	978	890	950
Kappa Number	9.5	10.3	10.1
Brightness, %ISO	52.9	51.2	49.8

After the reinforcement of the extraction stage, through the introduction of the pressurized (PO) reactor, there was a significant drop in the chlorine dioxide consumption for both cases, as can be seen in Figure 1. After the start up the total chlorine dioxide charge decreased to 30.3 kg/adt, a reduction of 39% compared to the reference. For the present condition, the total chlorine dioxide charge decreased to 26.3 kg/adt, which corresponds to 47%. For both cases, the kappa factors used in the first stage were respectively 0.13 and 0.12, confirming the laboratory results [11], which had demonstrated that such low kappa factors enhanced the performance of a pressurized (PO) stage working under the following conditions: temperature around 90°C, retention time of an hour and pressure at the top in the range of 2 to 3 bar. The operational conditions of the (PO) stage after the start up and for the present situation are described in Table II at the end.

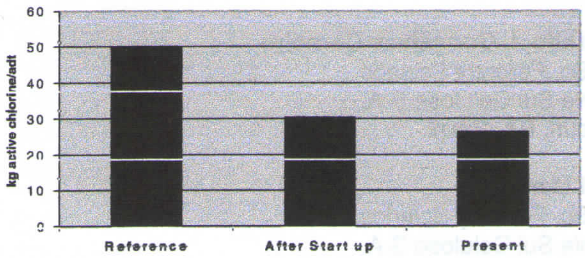

Fig. 1. Chlorine dioxide charges, kg/adt

When the two conditions with the (PO) stage are compared, it can be seen that there was a 4 kg/adt chlorine dioxide drop (13%) for the present case, which was attributed to the increase in the hydrogen peroxide charge from 9.0 to 12.6 kg/adt (40%) and allowed the continuous production of ECF pulp for 570,000 adt/a, without changes in the specification (brightness and viscosity) of the final product.

Pulp Quality

Figures 2 and 3 illustrate the evolution of the main properties of the pulp that characterize the quality for printing and writing paper.

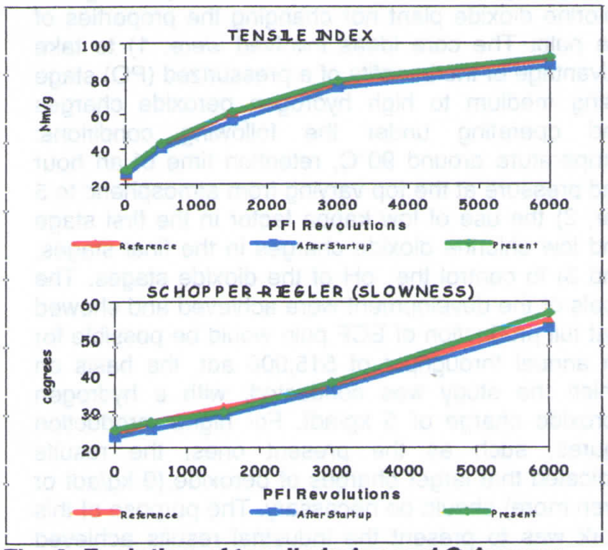

Fig. 2. Evolution of tensile index and Schopper-Riegler vs PFI revolutions

As shown in Figure 2 the amount of energy required to develop the same tensile index and Schopper-Riegler was similar to all samples of pulp, indicating that no difference in refining energy would be observed during further processing of the pulps.

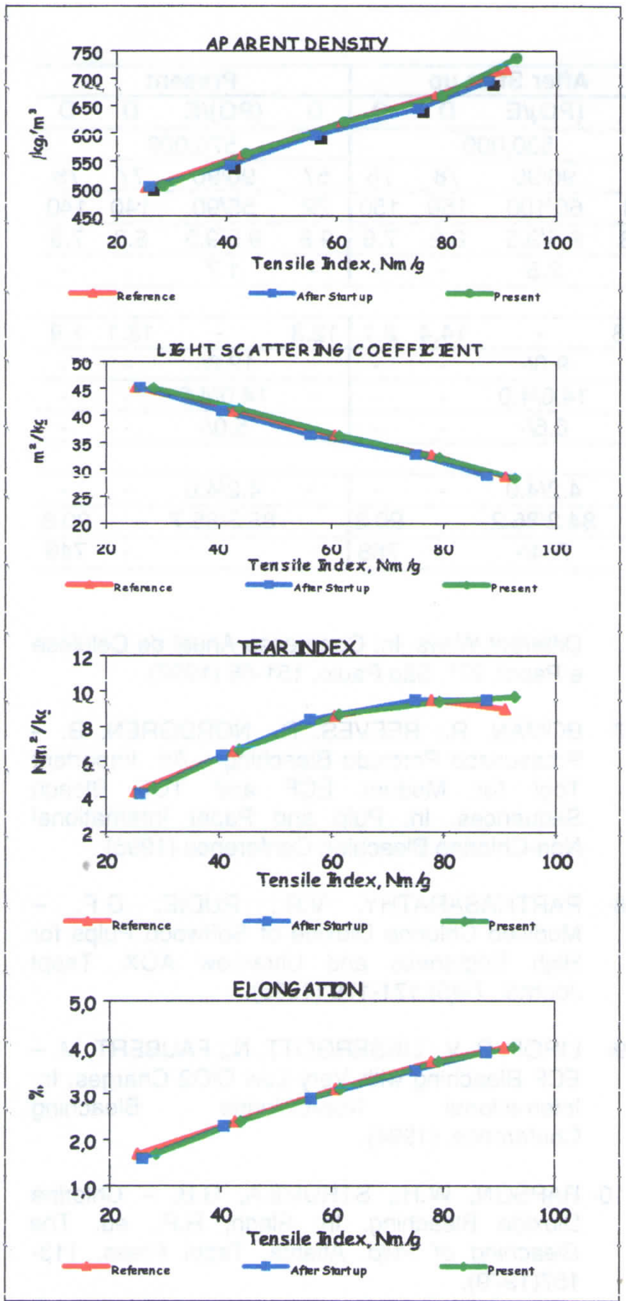

Fig. 3. Evolution of pulp properties vs tensile index

When the properties are compared to the same tensile index (Figure 3) the pulp samples showed similar behavior for apparent density, opacity (light scattering coefficient), tear index and elongation, again showing that the key parameters for evaluating pulp for printing and writing paper were not changed.

Effluent Characteristics

Table III below presents the results of the main effluents parameters that are continuously monitored in the mill: BOD_5, COD, AOX, color and suspended solids.

There were no major differences in the results, except for color, which turned out around 21.5% higher after the start up period compared to both reference and present conditions. Regarding the reference period, one possible reason for the lower effluent color might be the higher charge of chlorine dioxide applied in the bleaching, while for the present condition the higher hydrogen peroxide charge used may have compensated the reduction in chlorine dioxide, thus keeping the color in the same low level of the reference.

TABLE III. EFFLUENT QUALITY

Parameter	Reference	After Start up	Present
COD, kg/adt	6.2	6.8	6.0
BOD5, kg/adt	0.3	0.3	0.3
Color, kg/adt	18.6	22.6	18.8
AOX, kg/adt	0.2	0.2	0.2
Susp.Solids, kg/adt	0.3	0.3	0.3

CONCLUSIONS

The purpose of this work was to present the industrial results reached after the (PO) stage start up in the bleaching plant of Bahia Sul. These results allowed the following conclusions:

- The introduction of a pressurized (PO) reactor in the extraction stage of the bleaching permitted a significant drop in the chlorine dioxide consumption, which enabled Bahia Sul to produce ECF pulp continuously using the bleaching sequence OD(Po)EDD, without investing in the chlorine dioxide integrated plant.
- The new bleaching sequence OD(Po)EDD did not change neither the quality of the pulp nor the effluent characteristics of the mill.
- The studies and works carried out in laboratory were confirmed in mill scale operation.

TABLE II. BLEACHING CONDITIONS

Stages	Reference				After Start up				Present			
	D	(EOP)	D	D	D	(PO)/E	D	D	D	(PO)/E	D	D
Production, adt/a	*				530,000				570,000			
Temperature,°C	60	75	78	78	61	90/90	78	78	57	90/90	77	78
Retention Time, min	25	100	160	160	23	60/100	150	150	22	55/90	140	140
Consistency, %	9.9	9.5	7.4	7.0	9.6	9.5/9.5	8.2	7.6	9.8	9.5/9.5	8.3	7.9
Pressure, bar	-	-	-	-	-	2.5	-	-	-	1.7	-	-
Chemical Charge, kg/adt												
Chlorine Dioxide, as act Cl2	24.0	-	23.0	3.0	13.8	-	14.4	2.1	12.3	-	12.1	1.9
Hydrogen Peroxide	-	6.5	-	-	-	9.0/-	-	-	-	12.6/-	-	-
Caustic Soda	-	19.0	-	-	-	14.0/4.0	-	-	-	14.0/4.0	-	-
Oxygen	-	4.5	-	-	-	6.6/-	-	-	-	5.0/-	-	-
Average Results												
Kappa Number	-	3.0	-	-	-	4.2/4.0	-	-	-	4.2/4.0	-	-
Brightness, %ISO	-	82.0		90.1	-	84.2/85.2		90.3	-	85.3/85.7		90.8
Viscosity, dm³/kg	-	862		840	-	784/-	-	768	-		-	746

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