

## ECF BLEACHING SEQUENCES FOR EUCALYPTUS

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The increasing number of environmental and marketing constraints are leading the pulp mills to change their bleaching sequences in order to reduce the impact over environment, specially the amount of chlorinated organics produced in the bleach plant.

Votorantim Pulp and Paper (VCP) is business group that have two pulp mills where are produced bleached eucalyptus pulp (610.000 adt/year) for paper for printing and writing using a C/D Eop D bleaching sequence. This bleaching sequence leads to a bleached eucalyptus pulp with brightness 88 - 90 ISO.

In order to continue attending the needs of its customer and to keep aligned with the modern technologies VCP is changing its conventional bleaching sequence to a ECF bleaching one.

Considering its actual sequence (C/D Eop D) the substitution of the C/D stage to a total D stage would be the most feasible choice.

Nowadays, at the VCP pulp mills, there is a limitation in chlorine dioxide generation in order to allow the production of ECF bleached pulp with 89 ISO brightness. Considering the increasing pulp production capacity projects (880.000 adt/year in 1997) the brightness required for the pulp and determination of do not increase the chlorine dioxide generation a research were developed in order to establish alternative bleaching sequences involving stages with ozone, oxygen, atmospheric and pressurized hydrogen peroxide, chelant and acidification. In this research were evaluated 20 different bleaching sequences.

## I Alternative bleaching sequences for eucalyptus pulp

Sequence	ClO <sub>2</sub> kg/adt	H <sub>2</sub> O <sub>2</sub> kg/adt	O <sub>2</sub> kg/adt	O <sub>3</sub> kg/adt	MgSO <sub>4</sub> kg/adt
D-Eo-D	13.7	---	5.0	---	---
D-Eop-D(1)	17.5	5.0	5.0	---	---
D-Eop-D(2)	21.3	10.0	5.0	---	---
D-Eop-D-P <sub>p</sub> (1)	9.0	6.5	4.0	---	4.5
D-Eop-D-P <sub>p</sub> (2)	9.0	6.5	4.0	---	---
D-Eop-D-Q-P <sub>p</sub>	9.0	6.5	4.0	---	---
D-Ep <sub>p</sub> -D	9.0	9	---	---	---
D-Q-Ep <sub>p</sub> -D	9.0	9	---	---	---
P-D-Eop-D	9.0	10.5	4.0	---	5.0
P <sub>p</sub> -D-Eop-D	9.0	10.5	4.0	---	5.0
Q-P-D-Eop-D	9.0	10.5	4.0	---	5.0
q-P-D-Eop-D	9.0	10.5	4.0	---	5.0
q-P <sub>p</sub> -D-Eop-D	9.0	10.5	4.0	---	5.0
Q-P <sub>p</sub> -D-Eop-D	9.0	10.5	4.0	---	5.0
Q-PO-ZD	8.8	5.0	4.0	2.9	5.0
QP-ZQ-D	6.5	5.0	---	3.0	---
DZ-FOP-D	10.6	2.0	4.0	2.8	3.0
D-Eop <sub>p</sub> -D	9.0	10.0	5.0	---	5.0
Q-D-Eop <sub>p</sub> -D	9.0	10.0	5.0	---	5.0
DQ-Eop <sub>p</sub> -D	9.0	10.0	5.0	---	5.0

On the previous table the symbols mean:

- D - chlorine dioxide stage
- E/Eo/Eop/Eop<sub>p</sub> - extraction stage reinforced with oxygen (Eo), with oxygen and hydrogen peroxide (Eop) and also in a pressurized situation (Eop<sub>p</sub>);
- P<sub>p</sub> - pressurized hydrogen peroxide stage;
- Q - chelating stage;
- q - semi-chelating stage (conducted in not ideal conditions);
- Z - ozone stage

For the development of ECF sequences some topics were considered:

- do not increase the ClO<sub>2</sub> generation capacity
- easy transformation of the existing bleaching plant
- easy conversion for TCF bleaching sequence
- final brightness 88-89 ISO and high pulp quality
- economic viability for the transformation and low production costs

Considering the pulp production capacity (digester) and ClO<sub>2</sub> generation capacity, there is disposability is of 9 kg of ClO<sub>2</sub>/adt of pulp. For achieve the quality parameters established, the Eop stage should be reinforced with a greater charge of hydrogen peroxide

The sequence D Eop D, with higher charges of peroxide lead to the production of bleached pulp with characteristics desired. On the other hand, this sequence can not be easily transformed to a TCF sequence.

In order to reach the topics established for the ECF project, some alternative bleaching sequences were evaluated.

The pulps obtained after each bleaching sequence showed distinct characteristics specially final brightness (from 88,1 to 90,5 ISO) and viscosity (from 11 to 23,8 cP).

## II. Brightness and viscosity of eucalyptus ECF bleached pulps

Sequence	Brightness (%ISO)	Viscosity (cP)
D-Eo-D	88.1	13.5
D-Eop-D(1)	89.1	13.2
D-Eop-D(2)	89.8	12.6
D-Eop-D-P <sub>p</sub> (1)	90.2	15.7
D-Eop-D-P <sub>p</sub> (2)	89.3	11.0
D-Eop-D-Q-P <sub>p</sub>	90.5	19.8
D-E <sub>p</sub> -D	88.1	15.7
D-Q-E <sub>p</sub> -D	88.8	16.3
P-D-Eop-D	88.1	23.1
P <sub>p</sub> -D-Eop-D	88.4	21.3
Q-P-D-Eop-D	89.7	21.4
q-P-D-Eop-D	88.5	23.8
q-P <sub>p</sub> -D-Eop-D	88.7	23.6
Q-P <sub>p</sub> -D-Eop-D	90.4	22.8
Q-PO-ZD	88.5	16.0
QP-ZQ-D	89.0	16.5
DZ-EOP-D	89.0	13.6
D-Eop <sub>p</sub> -D	88.6	13.5
Q-D-Eop <sub>p</sub> -D	88.8	14.4
DQ-Eop <sub>p</sub> -D	87.1	14.3

Among the sequences evaluated, the sequence DZ Eop D was the one that best fit to topics established for the ECF project; it can easily transformed to a TCF bleaching sequence (Z Eop P) and the pulp have a high quality .

In order to improve the DZ Eop D bleaching sequence efficiency, the oxygen pre-bleaching stage (O) was also modified to a two stage pre-delignification - a single oxygen stage (O) and a oxygen reinforced with pressurized hydrogen peroxide (PO).

Considering the ECF bleached pulp characteristics, the existing bleaching plants, feasibility for TCF bleached pulp production and the economics aspects involved the ECF bleaching sequence adopted by Votorantim Pulp and Paper was O-PO-DZ-Eop-D.

### References

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