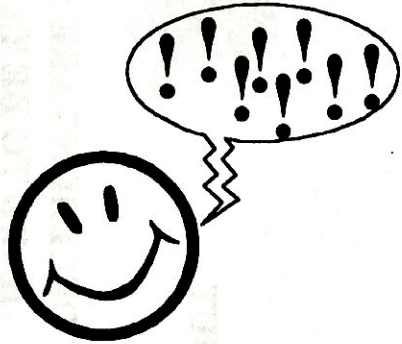
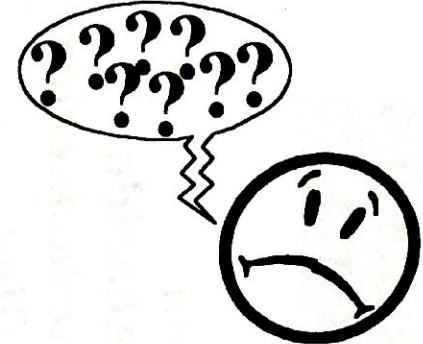


WHATS AND HOWS



IN



TCF BLEACHING

Celso Foelkel
RIOCELL S.A.

**AND THE TEAM OF RIOCELL'S
TECHNOLOGICAL CENTER:**

*Vera Sacon
Rodrigo Almeida
Sandra Rodackievicz
Jeferson Dias
Sérgio Menochelli*

THE TIME IS RIGHT ...

THE NEED IS CLEAR ...

**THE KNOWLEDGE IS
ABUNDANT ...**



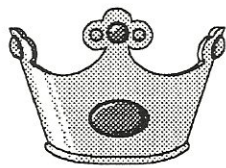
BUT



**DECISIONS ARE STILL
HARD TO BE TAKEN**

TECHNICAL ISSUES

**HOW TO BE SURE
ABOUT THEM?**



**DO YOU WANT TO TAKE
THE LEADERSHIP?**

CHAPTER II



IN CONTINUATION OF PAST YEAR SPEECH

**DON'T FORGET: OUR EXPERIENCE IS WITH HARDWOOD
(EUCALYPTUS AND ACACIA WOODS)**

QUESTION 14:

**HOW IMPORTANT IS PULPING
FOR TCF BLEACHING?**

FUNDAMENTAL ISSUES:

- KAPPA NUMBER LOW AND UNIFORM
- LIGNIN REPRECIPITATION IS A POISON
- GOOD IMPREGNATION

EVERYBODY KNOW, BUT FEW DO

THUS:

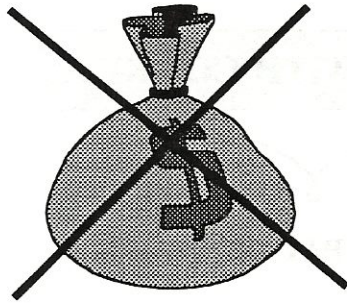
ALL CARE WITH WOOD CHIPS

- IMPROVE CHIPPER OPERATION
- IMPROVE CHIP SCREENING

**FIND A SUITABLE USE FOR
OVERSIZED AND FOR PIN
CHIPS**

**REJECT MORE
OVERSIZED CHIPS**

**AS FUEL FOR
EXAMPLE**



RE-CHIPPERS ARE, IN MOST OF THE CASES, SAWDUST MAKER MACHINES

TRY TO VERIFY IF YOU DON'T BELIEVE ME



JUST TO ILLUSTRATE:

CASE A: 2 mm HAND MADE CHIPS

CASE B: MILL CHIPS, SCREENED, 2 - 8 mm THICKNESS

SAME EUCALYPTUS WOOD, SAME ALKALI CHARGE

AFTER DIGESTER

	KAPPA NUMBER	BRIGHTNESS
CASE A:	12,5	45,0
CASE B:	16,0	35,0

AND ...

ALL CARE WITH COOKING

ALKALI AND TEMPERATURE PROFILE

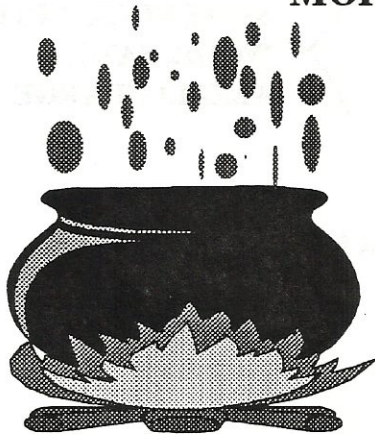
**IT'S VERY VERY COMMON TO HAVE POOR
ALKALI PROFILE INSIDE THE DIGESTER**



LIGNIN REPRECIPITATION

STEAMING / IMPREGNATION:

**ONLY STEAM IS NOT SO EFFICIENT TO GIVE
MOISTURE TO CHIPS**



**WE NEED TO SOAK CHIPS
AT THE SAME TIME WE
HEAT THEM**

AND ...

IMPREGNATION IS A FUNCTION OF:

- TIME
- AVAILABLE FREE LIQUOR TO PENETRATE
- WOOD DENSITY
- WOOD CHIPS QUALITY

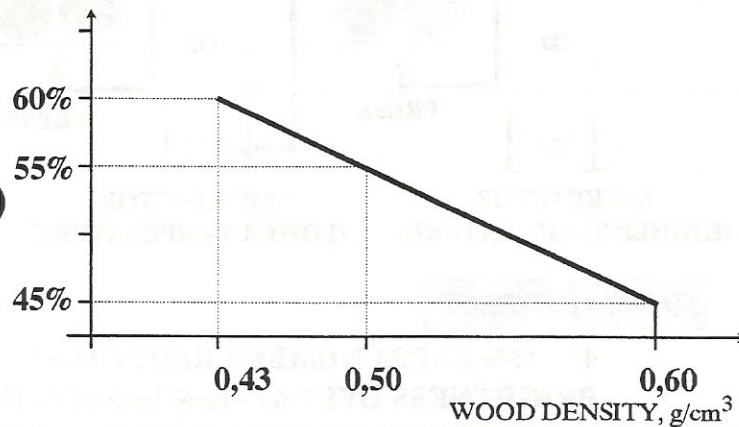


WOOD DENSITY

DENSER THE WOOD, SMALLER THE VOLUME TO HOLD LIQUOR AND MORE DIFFICULT IS TO BE IMPREGNATED

MOISTURE AT THE MAXIMUM MOISTURE CONTENT

$$\left(\frac{\text{WATER WEIGHT}}{\text{TOTAL WEIGHT}} \times 100 \right)$$



QUESTION 15:

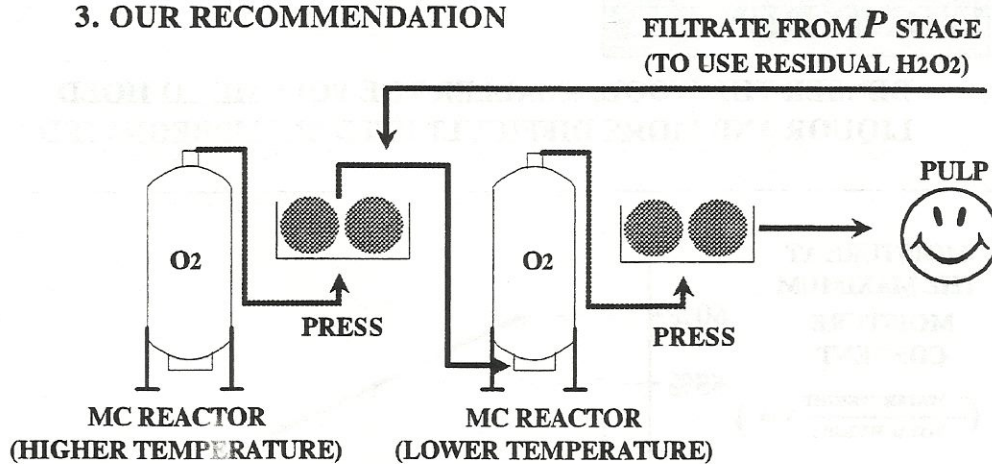
HOW TO DESIGN THE OXYGEN DELIGNIFICATION?

THERE ARE LOTS OF IMPORTANT POINTS:

- 1. HIGHER TEMPERATURES (105 - 110°C) PROVIDE BETTER EFFICIENCY BUT CREATE PROBLEMS FOR OZONE OR ENZYME TEMPERATURE CONTROL**
- 2. TWO-STAGE OXYGEN DELIGNIFICATION WITHOUT INTERMEDIATE WASHING IS BECOMING A CHOICE,**

**BOTH: THEORETICALLY ADVISABLE
TECHNICALLY FEASIBLE AND
ADVANTAGEOUS**

3. OUR RECOMMENDATION



YOU MAY EXPECT:

**45 - 55% KAPPA NUMBER REDUCTION
BRIGHTNESS OVER 60 - 65% ISO FOR HARDWOOD PULPS**

QUESTION 16:

COULD AIR REPLACE OXYGEN AT THE OXYGEN DELIGNIFICATION (S)?

FOR SURE YES

- ◆ IT'S EVEN MORE ADVISABLE WHEN YOU HAVE MORE THAN ONE O₂ STAGE
- ◆ DELIGNIFICATION RESULTS ARE THE SAME
- ◆ REQUIRED PRESSURE MAY BE HIGHER (ABOUT 9 - 10 kgf/cm²)

QUESTION 17:

WHAT SPECIAL CARE IN WASHING OPERATION?

THIS IS THE REAL WEAK POINT

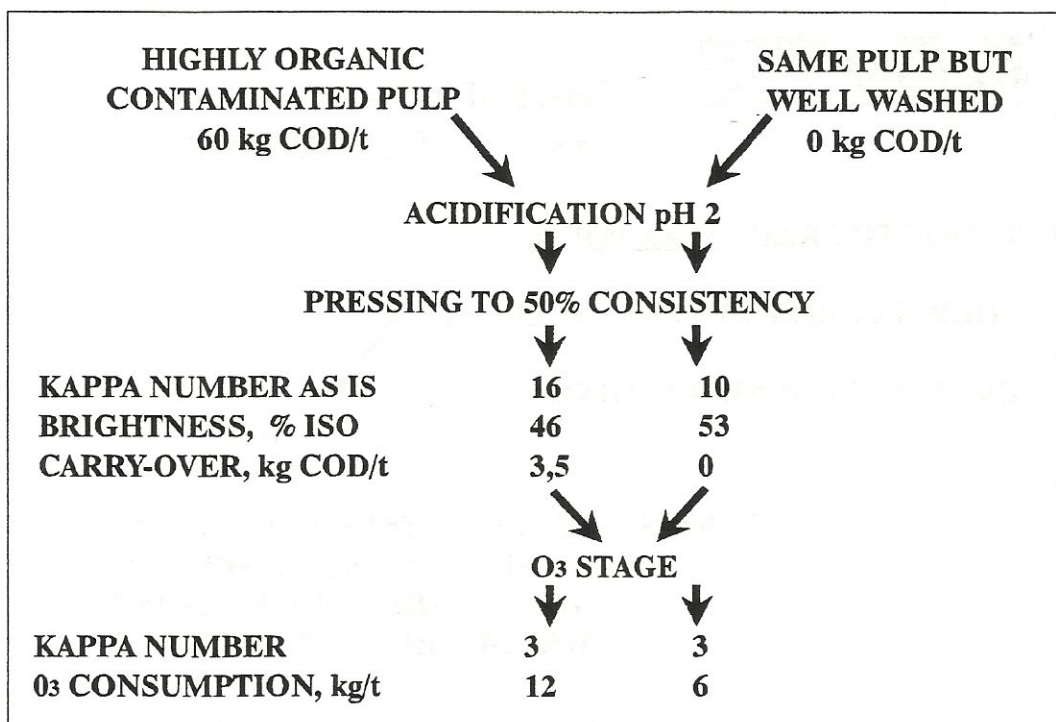
YOUR WASHING MUST BE EXCELLENT

CARRY-OVER MINIMUM MINIMUM

WHY ?

**OBVIOUS: REPRECIPITATION OF LIGNIN.
MOST OF OZONE BLEACHING
STUDIES ARE BEING MADE WITH
WELL-WASHED PULPS.**

**REPRECIPITATED LIGNIN
AVOIDS YOU TO REACH
REQUIRED BRIGHTNESS
AND INCREASES YOUR
OZONE CONSUMPTION**



QUESTION 18:

HOW TO GET RID OF METAL IONS?

THIS IMPORTANT ISSUE IS NO LONGER A PROBLEM.

SOURCES OF CONTAMINANTS:

WOOD (INTERNAL CONTENT)

WOOD (SOIL CONTAMINATION)

LIMESTONE

CHEMICALS

MATERIALS (EQUIPMENTS)

QUESTION 18:

HOW TP GET RID OF METAL IONS?

- ◆ **IMPROVE LOG WASHING**
- ◆ **IMPROVE CONTROL OF RAW MATERIALS**
- ◆ **EVALUATE PROPERLY THE EQUIPMENT MATERIALS, INCLUDING YOUR LAB EQUIPMENTS.**

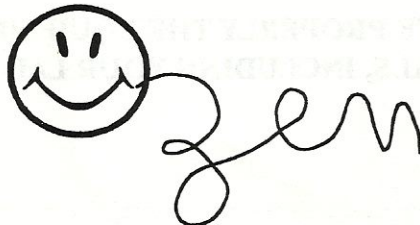
**METHODS TO PURGE
IRON/MANGANESE FROM SYSTEM**

- ◆ FILTRATION OF GREEN AND/ OR WHITE LIQUORS
- ◆ CONTINUOUS PURGE OF LIME MUD OR BURNT LIME
(YOU MUST FIND CUSTOMERS AND SUPPLIERS)
- ◆ ACIDIC WASHING OF PULPS
- ◆ CHELATION
- ◆ REVERSE OSMOSIS: VERY EFFICIENT TO REMOVE
IRON, MANGANESE AND OTHER METAL IONS FROM
FILTRATES (OVER 95 - 97% EFFICIENCY)

QUESTION 19:

**IN CASE OF USING ENZYME (XYLANASE),
WHAT'S THE BEST POSITION IN THE
BLEACHING SEQUENCE?**

- X Z → THE ENZONE PROCESS
- Z X → THE OZEN FOELKEL'S PROCESS



ADVANTAGES OF OZEN:

- ✓ **EASIER CONTROL OF TEMPERATURE**
- ✓ **SIMPLE CONTROL OF pH**
- ✓ **ENZYME PLUS CHELANT (X_Q) IS AN OPPORTUNITY FOR IMPROVEMENTS**
- ✓ **NO WASHING REQUIREMENTS AFTER Z**
- ✓ **HEMICELLULOSES ARE MORE ACCESSIBLE**
- ✓ **BETTER BRIGHTNESS DEVELOPMENT
(0,5 - 1% HIGHER FOR SAME XYLANASE CHARGE)**

AS A RESULT:

O A (Z X_Q) (E₀ P)

**IS AN IDEAL SEQUENCE FOR 90% ISO
BRIGHTNESS HARDWOOD PULP**

QUESTION 20:

HOW TO INTERPRET HEMICELLULOSE LOSSES IN TCF BLEACHING?

- ◆ **1,5 - 2,0 % LOSSES IN S₅ FROM UKP TO FULLY BLEACHED**
- ◆ **S₅ (OR SIMILAR) MUST BECOME A CONTROLLED QUALITY
PARAMETER**
- ◆ **WHEN COOKING BETTER, YOU MAY GIVE TO BLEACHING A
HIGHER S₅ CONTENT (OVER 10%)**
- ◆ **WHEN OVER COOKING, YOU MAY DAMAGE YOUR PULP
TOO MUCH ALONG BLEACHING
AS CONSEQUENCE: POOR BONDING PROPERTIES**
- ◆ **WE RECOMMEND FINAL S₅ ABOVE 8,5% FOR HARDWOOD
EUCALYPTUS**

QUESTION 21:

**IS PULP YIELD LOWER FOR TCF
BLEACHING IN COMPARISON TO ECF?**

D Eo D	x	A (ZQ) (EoP)
90% ISO		90% ISO
97,5% YIELD		96,5% YIELD

Δ YIELD = 1% IN FAVOR OF ECF

QUESTION 22:

**HOW COMPARABLE ARE BRIGHTNESS
AND BRIGHTNESS REVERSION IN TCF
AND ECF BLEACHING?**

**IN BOTH CASES, GOOD AS FAR AS YOU HAVE
PEROXIDE AS FINAL STAGE IN TCF BLEACHING.
REVERSION IS MINIMUM IN A WELL-BLEACHED
TCF PULP.**

QUESTION 23:

IS VISCOSITY AN IMPORTANT ISSUE?

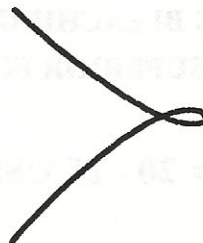
ANSWER IS ALWAYS YES. HOWEVER YOU ARE DEALING WITH DIFFERENT FIGURES.

GOOD MIXING / GOOD SHREDDING ARE ESSENTIAL TO AVOID OVER BLEACHING WITH VISCOSITY DAMAGE.

QUESTION 24:

WHAT HAPPENS TO PHYSICAL PROPERTIES OF TCF BLEACHED EUCALYPTUS PULP?

**BULK
OPACITY
WATER ABSORPTION
POROSITY
SMOOTHNESS
SOFTNESS**



**NO
DIFFERENCES**

QUESTION 25:

WHAT HAPPENS TO MECHANICAL PROPERTIES OF TCF BLEACHED EUCALYPTUS PULP?

**TEAR
STRETCH**



NO DIFFERENCES

**TENSILE
BURST**



ABOUT 10% LOWER FIGURES

BUT NOT OPTIMIZED

NO DOUBTS THEY MAY BE EQUALIZED

QUESTION 26:

**ARE ECONOMICS WELL-COVERED
IN TCF BLEACHING?**

**MOST OF PAPERS ARE CONCENTRATED ON
SHOWING BLEACHING COSTS. THEY ARE, UP
TO NOW, SUPERIOR FOR TCF.**

$$\Delta = 20 - 25 \text{ US\$ / t}$$

A TOTAL EVALUATION IS REQUIRED.

QUESTION 27: WHAT'S MY FAVORITE
TCF SEQUENCE?

THERE ARE SEVERAL GOOD OPTIONS:

A (Z X_Q) (E_o P)

A (Z X_Q) P

A (Z Q) (E_o P)

A Z Q P

Q Z Q P

X_Q Z Q P

X_Q Z P

ALL FOR 90% ISO

**OTHER QUESTIONS FOR NEXT
INCB CONFERENCES:**

BABY QUESTIONS:

- SHALL I DISCARD SILICATES?
- SHALL I USE OR DON'T USE MAGNESIUM?
- CARRY-OVER AND INFLUENCE ON ACID AND OZONE CONSUMPTION
- HOW TO MINIMIZE ALKALI AND ACID CONSUMPTIONS?
- WHAT'S THE BEST CHELANT?

**OTHER QUESTIONS FOR NEXT
INCB CONFERENCES:**

BABY QUESTIONS:

- HOW TO IMPROVE OXIDIZED WHITE LIQUOR QUALITY?
- EXTRACTIVES AND PITCH IN TCF PULPS
- TIME AND TEMPERATURE IN THE PEROXIDE STAGE?
- LOW, MEDIUM OR HIGH CONSISTENCY FOR OZONE STAGE?
- DIRECT OXIDATION OF WHITE LIQUOR AT THE OXYGEN DELIGNIFICATION REACTOR

MACRO-QUESTIONS

- OVERALL ECONOMICAL EVALUATION?
- TCF x ECF EFFLUENTS TOXICITY?
- TEF MILL CONCEPT?
- PULP CHARACTERISTICS ALONG TCF BLEACHING (STAGE BY STAGE)
- EFFLUENT CHARACTERISTICS ALONG TCF BLEACHING (STAGE BY STAGE)