EMERGING TECHNOLOGIES: HOW TO MAKE THE NEW WHITE
(AND TO BE INCIDENTALLY HAPPY)

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BY

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WHITE MARTINS GASES INDUSTRIAIS
BRAZIL

WHEN YOU ARE IN THE FRONTIER OF THE KNOWLEDGE ...

YOU SHOULD NOT CONSIDER THAT THE DAY AFTER WILL FOLLOW THE TODAY'S PATTERN

OR BETTER SAYING

EVERYTHING IS ALLOWED

THUS, ...

WE REALLY HAVE LOTS OF QUESTIONS TO BE ANSWERED

BY US

OR

BY SOMEBODY ELSE

QUESTION 1:

IS IT POSSIBLE TO BLEACH TO ROUGHLY 89-90% ISO BRIGHTNESS WITH GOOD STABILITY AND OTHER OVERALL PROPERTIES WITHOUT THE USE OF CHLORINATED COMPOUNDS?

QUESTION 2:

IS BLEACHING AN INDIVIDUALIZED OPERATION OR IS IT WELL CONNECTED TO THE OTHER KRAFT PULPING OPERATIONS?

QUESTION 3:

IS IT TRUE THAT

- *ENZYMES*
- *CHELANTS*
- *PEROXYDES*
- *OXYGEN*
- *CAUSTIC SODA*

COULD GIVE ME A PULP AS WHITE AS IT'S MANUFACTURED TODAY?

QUESTION 4:

DOES IT MAKE SENSE TO GO TO EXTENDED DELIGNIFICATION AT THE DIGESTER?

EMCC PERFORMANCE (FINAL BLEACHED PULP)

Δ BRIGHTNESS	= +2% ISO
Δ REVERTED BRIGHTNESS	= +2% ISO
Δ POST COLOR NUMBER	= -0.18
Δ INTRINSIC VISCOSITY	= +55 cm^3/g
Δ S_5	= -0.63%

IN COMPARISON TO STANDARD COOKING

QUESTION 5:

DOES IT PAY GOING TO MORE DRASTIC CONDITIONS AT THE OXYGEN DELIGNIFICATION?

DRASTIC OXYGEN DELIGNIFICATION

PERFORMANCE IN COMPARISON TO STANDARD PROCEDURE

Δ BRIGHTNESS	= +2.3% ISO
Δ REVERTED BRIGHTNESS	= +2.5% ISO
Δ POST COLOR NUMBER	= -0.22
Δ INTRINSIC VISCOSITY	= +26 cm^3/g
Δ S_5	= -0.34%

QUESTION 6:

DOES IT MAKE SENSE TO USE CHELANTING AGENTS BEFORE BLEACHING?

WHAT ABOUT ENZYMES?

PERFORMANCE OF CHELANT IN COMPARISON TO ACID WASHING

△ BRIGHTNESS	= +1% ISO
△ REVERTED BRIGHTNESS	= +1.1% ISO
△ POST COLOR NUMBER	= -0.08
△ INTRINSIC VISCOSITY	= +8 cm^3/g
△ S_5	= -0.08%

PERFORMANCE OF XYLANASE IN COMPARISON TO ACID WASHING

Δ BRIGHTNESS	**= +1.6% ISO**
Δ REVERTED BRIGHTNESS	**= +1.6% ISO**
Δ POST COLOR NUMBER	**= -0.09**
Δ INTRINSIC VISCOSITY	**= -6 cm^3/g**
Δ S_5	**= -0.2%**

PERFORMANCE OF XYLANASE PLUS CHELANT IN COMPARISON TO ACID WASHING

Δ BRIGHTNESS	= +2.45% ISO
Δ REVERTED BRIGHTNESS	= +2.75% ISO
Δ POST COLOR NUMBER	= -0.22
Δ INTRINSIC VISCOSITY	= -3 cm^3/g
Δ S_5	= -0.45%

QUESTION 7:

ACID WASHING PRIOR TO BLEACHING ... DOES IT WORK?

IT DEPENDS ON

PULP CONTAMINANTS

pH

AT pH 3.0 REMOVAL OF MANGANESE REACHES 85% BUT IRON ONLY 50%

BETTER USING pH BELOW 2.0

QUESTION 8:

WHAT IS THE ROLE OF AN ENHANCED CAUSTIC EXTRACTION (WITH OXYGEN) BETWEEN OZONE STAGES?

IT COULD BE CONSIDERED DROPPABLE IN MOST CASES

BETTER TO USE A PEROXIDE STAGE OR AN (EoP) STAGE

QUESTION 9:

SHOULD WE USE OR NOT USE SILICATES IN PEROXYDE STAGE?

IT´S SURELY BETTER, BUT IN SOME CASES, DISCARDABLE.

IT DEPENDS ON HOW EFFICIENT WAS THE REMOVAL OF METAL IONS AND HOW AVAILABLE ARE HYDROXYL GROUPS FROM NaOH.

QUESTION 10:

HOW TO GET RID OF METAL IONS IN THE KRAFT PROCESS CYCLE?

BY FILTERING ALKALINE LIQUOR (WHITE OR GREEN) AS IT HAS BEEN PROPOSED BY FILTER MANUFACTURERS

•
•
•

WE SOLVE PARTIALLY THE PROBLEM

WE STILL NEED BETTER ANSWER

FILTRATION OF WHITE LIQUOR

FILTERED RESIDUE:

0.84%	ORGANIC MATTER
5.07%	CARBONATES (BURNT CO_2)
55.64%	SILICA
30.90%	ANALYSED METAL IONS
7.55%	OTHER IONS, SULFUR, ETC.

FILTRATION OF WHITE LIQUOR

EFFICIENCY ON REMOVAL OF METAL IONS:

CALCIUM	*96%*
IRON	*91%*
ZINC	*63%*
MANGANESE	*16%*
NICKEL	*8%*
MAGNESIUM	*7%*
COBALT	*3.5%*
COPPER	*2.6%*
ALUMINUM	*0.9%*
CHROMIUM	*0.4%*

QUESTION 11:

FINAL Z STAGE

OR

FINAL P STAGE

WHAT´S BETTER CONSIDERING PULP BRIGHTNESS STABILITY?

IT´S CLEARLY EVIDENT THAT FINAL Z STAGE BRINGS A LOT MORE BRIGHTNESS REVERSION.

BETTER TO AVOID FINAL Z AND TO HAVE A P STAGE (EVEN A MILD ONE) ENDING THE SEQUENCE.

QUESTION 12:

DOES SO_2 WASHING AFTER A Z STAGE HELP AT THE END OF THE BLEACHING?

PERFORMANCE OF SO_2 WASHING AT THE END OF THE BLEACHING

Δ BRIGHTNESS	= +0.25% ISO
Δ REVERTED BRIGHTNESS	= +0.77% ISO
Δ POST COLOR NUMBER	= -0.17
Δ INTRINSIC VISCOSITY	= +10 cm^3/g
Δ S_5	= -0.02%

QUESTION 13:

WOULD YOU RECOMMEND TO GO TO THIS WONDERFULL ADVENTURE OF MAKING TCF PULP 89-90% BRIGHTNESS, EVEN CONSIDERING THE RISKS OF A NEW AND GROWING TECHNOLOGY?

IT´S A NEW WORLD

THERE ARE NO KNOWN-RULES

EVERYTHING IS CHALLENGING US

BUT REMEMBER

DON´T LET YOUR COMPANY BROKEN

WE ARE HERE TO MAKE MONEY IN THE MARKET (AND THE MARKET IS OUR WEAKER POINT TODAY)

OTHER QUESTIONS TO BE EVALUATED:

- √ *HOW TO RECYCLE ALL BLEACHING EFFLUENTS?*

  EFFLUENT FREE BLEACHING

- √ *HOW TO GET RID OF METAL IONS? DO THEY REALLY NEED TO BE REMOVED PRIOR TO OZONE STAGE?*

- √ *WHAT HAPPENS TO THE OPTICAL AND TACTILE SOFTNESS PROPERTIES OF EUCALYPTUS PULPS WHEN BLEACHED WITH THESE EMERGING TECHNOLOGIES?*

- ✓ *WHAT HAPPENS TO THE PAPERMAKING PROPERTIES OF THE PULPS?*
- ✓ *IS BLEACHING PULP YIELD ACCEPTABLE WHEN USING THESE NEW EMERGING SEQUENCES?*
- ✓ *IS IT POSSIBLE TO USE OXIDIZED WHITE LIQUOR INSTEAD OF CAUSTIC SODA IN BLEACHING? HOW TO IMPROVE IT?*
- ✓ *WHAT'S THE CARRY-OVER EFFECT IN BLEACHING CHEMICAL CONSUMPTION?*
- ✓ *WHAT CONSISTENCY IS BETTER TO PERFORM OZONE STAGE?*

- ✓ *WHAT COULD BE THE BEST BLEACHING SEQUENCE?*
- ✓ *HOW MANY* **Z** *STAGES? HOW MANY* **P** *STAGES? IN WHICH WAY TO COMBINE THEM?*
- ✓ *WHAT ABOUT* **Q Z_1 Z_2 P_1 P_2** *?*
- ✓ *OR* **Q Z_1 P_1 Z_2 P_2** *?*
- ✓ *HOW TO MAKE* **TCF** *PULP AT REASONABLE BLEACHING COSTS? HOW TO SAVE CHEMICALS?*

EXPERIMENTAL

WOOD

BLEND OF

Eucalyptus saligna	72%
Eucalyptus tereticornis	13.5%
Acacia mearnsii	14.5%

KRAFT PULPING (LAB)

EXTENDED ISOTHERMAL COOKING
AND
KRAFT BATCH COOKING
(STANDARD PROCEDURE)

COOKING

	EMCC	*STANDARD BATCH*
ACTIVE ALKALI CONSUMPTION, %	17.4	17.6
SULFIDITY, %	20	20
TIME, min	300	105
MAXIMUM TEMPERATURE, °C	153	170
GROSS YIELD, %	50.1	50.8
REJECTS, %	<0.1	0.4
KAPPA NUMBER	14.4	17.8
INTRINSIC VISCOSITY, cm^3/g	1273	1129
BRIGHTNESS, % ISO	40.4	42.1
S_5 - 5% CAUSTIC SOLUBILITY OF PULP, %	9.3	10.4

OXYGEN DELIGNIFICATION

TWO DIFFERENT CONDITIONS APPLIED TO BOTH UNBLEACHED PULPS

	O_2 STANDARD	DRASTIC O_2
TEMPERATURE, °C	95	105
TIME, min	45	60
% NaOH	1.5	1.8
PRESSURE, kgf/cm^2	7	7
CONSISTENCY	10	10

OXYGEN DELIGNIFICATION RESULTS

EMCC PULP

	O_2 STANDARD	*DRASTIC O_2*
FINAL pH	11.8	11.3
KAPPA NUMBER	10.3(Δ=28.5%)	7.5(Δ=47.9%)
INTRINSIC VISCOSITY	1151	1075
BRIGHTNESS, % ISO	51.6	56.6
S_5, %	9.5	9.6

STANDARD BATCH

	O_2 STANDARD	*DRASTIC O_2*
FINAL pH	11.2	10.6
KAPPA NUMBER	12.6(Δ=29.2%)	10.8(Δ=39.3%)
INTRINSIC VISCOSITY	957	841
BRIGHTNESS, % ISO	53.4	58.3
S_5, %	10.0	10.0

BLEACHING SEQUENCES

OVER THE FOUR DIFFERENT OXYGEN DELIGNIFIED PULPS, THE FOLLOWING BLEACHING SEQUENCES WERE TESTED:

Z P

A Z P

Q Z P

X Z P

X Q Z P

Q Z_1 E_O Z_2

Q Z_1 E_O Z_2 SO_2

Q Z_1 (E_O P´) Z_2

Q Z_1 (E_O P´) Z_2 SO_2

Q Z_1 P Z_2

Q Z_1 P Z_2 SO_2

BLEACHING CONDITIONS

A	pH = 3 2% consistency 65 °C 15 minutes
Q	pH = 5 - 6 2% consistency 65 °C 15 minutes 0.2% DTPA
X	2 U xylanase/g pH = 5 10% consistency 50 °C 90 minutes

BLEACHING CONDITIONS

Z	0.55 - 0.60% ozone pH = 3 45% consistency room temperature (30 ^{o}C) 2 - 4 minutes
P	1.5% H_2O_2 1.2% NaOH 2.0% silicate pH = 10.5(initial) 10.3(final) 90 minutes 80 ^{o}C
Z1	same as Z, except ozone = 0.45 - 0.47% time = 1 - 2 minutes

BLEACHING CONDITIONS

Z2	same as Z, except ozone = 0.15 - 0.17% time = 20 - 40 seconds
Eo	10% consistency 60 minutes 90 ^{O}C 3 kgf/cm^2 $NaOH$ = 1.5% pH = 11.4 (initial) 11.2 (final)

BLEACHING CONDITIONS

(EoP′)	SIMULATING UP FLOW O_2 AND DOWN FLOW P TOWERS NO WASHING BETWEEN EO AND P′
a) Eo	10% consistency 15 minutes 80 °C 3 kgf/cm^2 pH = 11.4 (initial) 11.2 (final)
b) P′	same as P, except H_2O_2 = 1% and time was 45 minutes

SO_2	5% consistency 15 minutes room temperature (30°C) 0.25% SO_2

BLEACHING RESULTS: STANDARD BATCH COOKING + STANDARD O_2

SEQUENCE	BRIGHTNESS	REVERTED BRIGHTNESS	POST COLOR NUMBER	INTRINSIC VISCOSITY	S_5
Z P	81.8	78.4	0.95	525	9.3
A Z P	81.3	77.9	1.00	452	9.4
Q Z P	82.7	79.2	0.92	489	9.5
X Z P	84.0	80.0	0.98	475	9.2
X Q Z P	84.5	81.6	0.65	466	9.2
Q Z_1 E_O Z_2	80.1	74.5	1.90	492	8.9
Q Z_1 E_O Z_2 SO_2	80.4	74.7	1.90	511	9.0
Q Z_1 (E_O P´) Z_2	84.3	78.1	1.60	393	9.1
Q Z_1 (E_O P´) Z_2 SO_2	84.5	77.6	1.80	377	9.3
Q Z_1 P Z_2	86.0	79.5	1.50	426	9.0
Q Z_1 P Z_2 SO_2	86.0	79.8	1.40	483	8.8

BLEACHING RESULTS: STANDARD BATCH COOKING + DRASTIC O_2

SEQUENCE	BRIGHTNESS	REVERTED BRIGHTNESS	POST COLOR NUMBER	INTRINSIC VISCOSITY	S_5
Z P	84.4	80.6	0.88	542	8.8
A Z P	85.8	81.9	0.82	537	8.6
Q Z P	85.2	81.6	0.79	525	8.6
X Z P	86.7	83.2	0.68	511	8.7
X Q Z P	86.9	83.3	0.69	504	8.2
Q Z_1 E_O Z_2	83.8	77.2	1.80	505	8.6
Q Z_1 E_O Z_2 SO_2	84.1	77.4	1.80	525	8.4
Q Z_1 (E_O P´) Z_2	84.8	78.8	1.50	411	8.6
Q Z_1 (E_O P´) Z_2 SO_2	85.7	79.7	1.40	414	8.6
Q Z_1 P Z_2	87.4	81.1	1.30	427	8.7
Q Z_1 P Z_2 SO_2	87.6	81.6	1.20	435	8.5

BLEACHING RESULTS: EMCC PULP + STANDARD O_2

SEQUENCE	BRIGHTNESS	REVERTED BRIGHTNESS	POST COLOR NUMBER	INTRINSIC VISCOSITY	S_5
Z P	83.7	80.6	0.75	579	8.3
A Z P	83.5	80.3	0.79	535	8.5
Q Z P	84.4	81.0	0.79	559	8.3
X Z P	84.0	80.8	0.76	512	8.2
X Q Z P	86.2	83.0	0.64	598	8.0
Q Z_1 E_O Z_2	84.3	76.9	2.00	513	8.3
Q Z_1 E_O Z_2 SO_2	84.2	78.4	1.50	527	8.3
Q Z_1 (E_O P′) Z_2	86.5	78.8	1.80	413	8.3
Q Z_1 (E_O P′) Z_2 SO_2	86.1	79.9	1.40	411	8.5
Q Z_1 P Z_2	88.1	79.3	1.90	504	8.3
Q Z_1 P Z_2 SO_2	88.4	82.5	1.10	502	8.1

BLEACHING RESULTS: EMCC PULP + DRASTIC O_2

SEQUENCE	BRIGHTNESS	REVERTED BRIGHTNESS	POST COLOR NUMBER	INTRINSIC VISCOSITY	S_5
Z P	86.4	82.9	0.69	565	8.7
A Z P	86.1	82.3	0.78	579	8.7
Q Z P	88.6	85.0	0.59	562	8.5
X Z P	88.3	84.7	0.61	581	8.2
X Q Z P	88.9	85.5	0.54	524	8.0
Q Z_1 E_O Z_2	85.0	79.6	1.30	554	7.9
Q Z_1 E_O Z_2 SO_2	85.3	79.8	1.30	579	7.9
Q Z_1 (E_O P′) Z_2	88.2	81.5	1.30	492	8.1
Q Z_1 (E_O P′) Z_2 SO_2	88.6	82.2	1.20	488	8.1
Q Z_1 P Z_2	88.6	83.0	1.00	534	7.9
Q Z_1 P Z_2 SO_2	89.3	83.9	0.90	543	8.0

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Please Note: *Submission of a paper was not a requirement of session panelists. If a paper was submitted, it is included in section 21.*

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Brazil - Dr. Celso Foelkel, director of technology and environment, Riocell SA
Canada - Hasan Loutfi, corporate technical manager, Irving Pulp & Paper Ltd.
India - Shailendra K. Jain, senior executive president, Grasim Industries Ltd.
Sweden - Dr. Jiri Basta, head of bleaching chemicals, research and development, Eka Nobel AB
USA - Walter Kleinberg, manager, pulp and paper processes, Airco Gasses; Dr. Malcolm Beaverstock, director, advanced technology, Automation Technology; Troy Wilks, Weyerhaeuser Co., Newborn Mill

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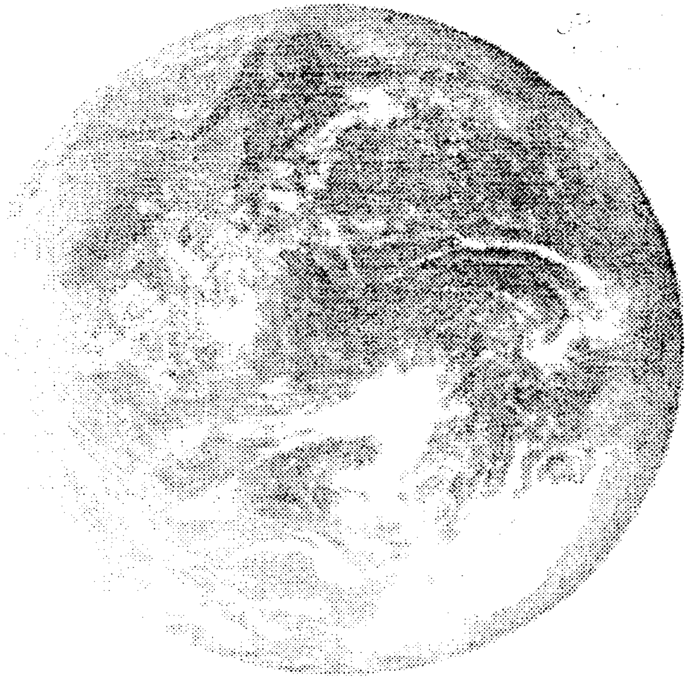
Please Note: *Submission of a paper was not a requirement of session panelists. If a paper was submitted, it is included in section 45.*

NON-CHLORINE BLEACHING CONFERENCE PROCEEDINGS



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