

## **PAPTAC BLEACHING COMMITTEE**

### **FALL 2014 MEETING MINUTES – KIMBERLEY, BC October 6-8, 2014**

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4. SUBCOMMITTEE MEETINGS
5. TECHNICAL SESSION PRESENTATIONS
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7. PROBLEMS & OPPORTUNITIES SESSION



PAPTAC Bleaching Committee, Fall 2014 Meeting  
Hosted by Skookumchuck Pulp, Kimberley BC (Oct. 6-8, 2014)

**PAPTAC Bleaching Committee**  
**Section 2 - ATTENDANCE LIST**  
 Kimberley, BC – October 6-8, 2014

	Name	Mill / Company	Job Title
	Doug Reid	Akzo Nobel	Sr. Process Engineer
	Mark Cameron	Skook Pulp Inc	Process Specialist
	LARIER MARISETTE	TEXO	PROC CONTROL ENG.
	ALISON ROWAT	WEYERHAEUSER	MANUFACTURING SERVICES MGR.
5	AL LAGINSKI	DOMTAR	ASST. SUPERINTENDENT
	TIFF REID	HOWE SOUND P&P	PROCESS ENGINEER
	Brent Desrocher	Howe Sound P&P	Technical Manager
	Mona Henderson	Valmet	Business Manager
	Kent Robarge	Weyerhaeuser	Manuf Services Director
10	MICHEL EPINEY.	AIR LIQUIDE	APPLICATION SPECIALIST
	Coby Stone	BTH America	Regional Manager
	Dan Davies	Evoink Canada	Applications Manager
	MICHAEL KSERULF	SOLENIS	APPLICATIONS MANAGER
	John Shao	Skookumchuck Pulp Inc	Process Engineer
15	Heather Friesen	Hinton Pulp / West Fraser	Jr. Process Engineer
	stephane Messier	CANEXUS	TECHNICAL SERVICE MANAGER
	Sabrina Burkhardt	Econotech	Pulping & Bleaching Supervisor
	WALT LINDSEY	Chem Stone	Technical Support
	SCOTT CHARBAN	CHEMSTONE	ACCOUNT MANAGER
20	David Trzil	Clearwater Paper	Sr. Process Engineer
	TED TAM	Cariboo	Sr. Process Eng
	Craig Simon	Darshowa Marabeni Int	Fiberline Day Lead
	Almer Fetichovic	DMI Peace River	Process Specialist
	Greta Caron	DMI Peace River	Panel operator
25	Lars Eric Myrman	Eurocon Eng / Modsys	Hqr. Process / Sr. Process Eng.

## PAPTAC Bleaching Committee

### Section 2 - ATTENDANCE LIST

Quesnel, BC – October 21-23, 2013

	Name	Mill / Company	Job Title
26	DENNIS FROATS	ERCO	TECH SERVICE
	Rick Wasson	Irving Pulp & Paper	Bleach Plant Supt.
	Honey Nampak	Harmac Pacific	Process Engineer
	JAMES GOLDMAN	METSO	Product Manager
30	GUY NORMANDEAU	METSO	Western Service Manager
	GOPAL GOYAL	International Paper	Chief Scientist
	Wally McDonald	Verso Paper	Director Pulp / Power
	Brian La Brash	Verso Paper Quinnesec	Process Engineer
	JACK THOMAS	NALCO	Pulping Tech Consulting
35	Ken Nylan	Catalyst Paper Cotton	Operations Specialist
	ANDRÉ AUDET	FPInnovations	Principal Technologist
	SHRÉE PRAKASH MISHRA	FPInnovations	Scientist
	Paul Earl	Paul Earl Consulting	Consultant
	<del>Shree Pr</del> Chung-Li Lee	FPInnovations	Researcher
40	CHRIS ROBERTS	SPARTAN CONTROLS	CONTROLS ENGINEER.
	DAN KAKNEVICIUS	CANFOR NORTHWOODS	PROCESS ENGINEER.
	MEREDITH KAKNEVICIUS	CANFOR INTERCON	PROCESS ENGINEER
	Kenny Tam	Canfor PG	Process Engineer
	Alice Obermayer	Canfor Pulp Innovation	research technologist
45	DAVE WILLIS	PEROXY CHEM	TECHNICAL ACCOUNT Mgr.
	Colin McIntosh	Northern Pulp NS	Process Engineer
	Jonathan Sarson	Northern Pulp NS	operator
	Bhupender Kumar	Mackenzie Pulp	Process Engineer
	Kribehe Harry	Mackenzie Pulp Mill	Process Engineer
50	Art Meuse	CHEMSTONE	?

## PAPTAC Bleaching Committee

### Section 2 - ATTENDANCE LIST

Quesnel, BC – October 21-23, 2013

	Name	Mill / Company	Job Title
51	Bryce Wilson	Skookumchuck Pulp Inc	Process Engineer
	Harveer Dhillon	Skookumchuck Pulp	Process Eng.
	Xu Chen	Skookumchuck Pulp	Process Eng
	ROGER SUAR	" " "	PROCESS SPECIALIST
55	Moch Ayuen	" " "	Process Engineer
	ARIEL MAGPANTAY	" "	PROCESS ENGINEER
60			
65			
70			
75			

# **PAPTAC Bleaching Committee**

**Fall 2014 Meeting**

**Hosted by Skookumchuck Pulp, Kimberley, BC – Oct. 6-8, 2014**

## ***Technical Program: Bleaching Chemistry***

**General Bleaching Chemistry – Shree Prakash Mishra (FPIInnovations)**

**E1 Optimization – Doug Reid (AkzoNobel)**

**Chlorine Dioxide Generation Chemistry – Dennis Froats (ERCO Worldwide)**

**Improved Bleaching from Simple Vacuum Drum BSW Improvements – Brian  
La Brash (Verso Quinnesec)**

**Extended D0 Stage and Eop Chemical Usage – Alison Rowat (Weyerhaeuser)**



## General pulp bleaching chemistry

PAPTAC Bleaching Committee Meeting Fall 2014

Shree Prakash Mishra  
October 06, 2014

### Purpose of pulp bleaching

- Increase Pulp brightness
- Improve brightness stability
- Suitability for end product grades
  - Printing, writing, photo, absorbent, cellulose derivatives
- Improve cleanliness of the pulp (shives, metals and dirt removal)
- Etc.

## Target components

- Residual lignin (3.5-5.5% SW; 1.5-3.0% HW)
- Hexenuronic acids (0.15-0.45% SW and 0.5-0.9% HW equivalent to lignin)
- Extractives (0.1-0.3% SW and 0.5-1.0% HW)
- Shives

## Favorite Components

- Cellulose
  - Hemicellulose (some grades)
- Naturally white; no need to bleach

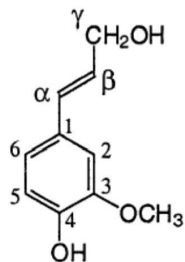
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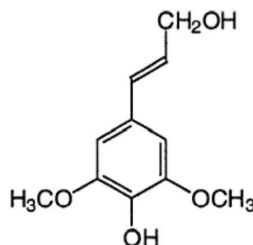
## Lignin

- Basic unit phenyl propane ( total 9 carbons)



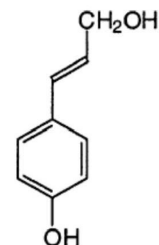
*trans*-Coniferyl alcohol

Predominantly SW; a small amount in HW



*trans*-Sinapyl alcohol

HW



*trans*-*p*-Coumaryl alcohol

Compression wood

Ref.: Alen, R., In: *Forest products chemistry*, (Stenius, P., ed.), Fapet Oy, Finland Book-3, p.11-57 (2000)

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# Phenolic hydroxyl groups in different lignin fractions

Lignin type	OH-groups/100 C9
Wood	13
Residual	27
Dissolved	50-60

Ref.: Gellerstedt, G., and Lindfors, E., *Svensk. Papperstidn.* (1984)

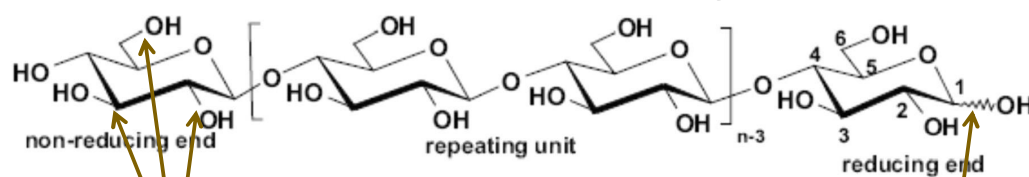
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## Cellulose

- Cellulose is a **linear polymer** ( $\beta$ -(1 $\rightarrow$ 4) link)
- DP 10,000 in wood
- DP 1000-2000 in paper making pulps



Site for oxidation;  
carbonyl and  
carboxyl formation

Site for the peeling  
reaction

Ref.: Koch, G., *Handbook of pulp* (Sixta H. ed.), (2006)

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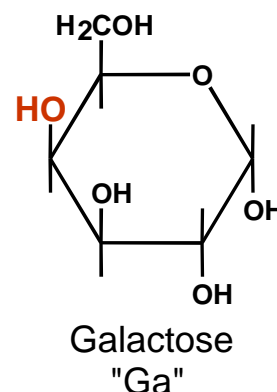
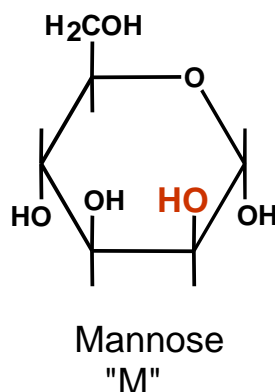
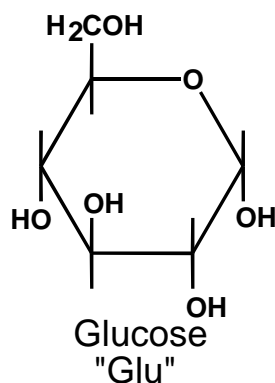
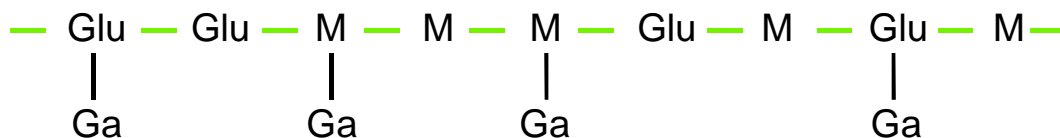
# Hemicelluloses

- Hemicelluloses are chemically and physically different than cellulose :
  - Heteropolymer (different types of sugars)
  - Shorter chain (DP 100-200)
  - Open structure
  - Presence of carboxylic acid groups
  - Presence of acetyl group
  - Generates hexenuronic acid during pulping

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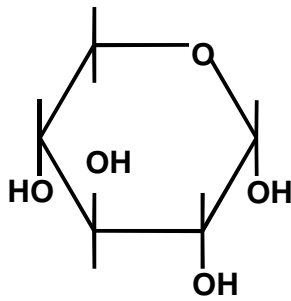
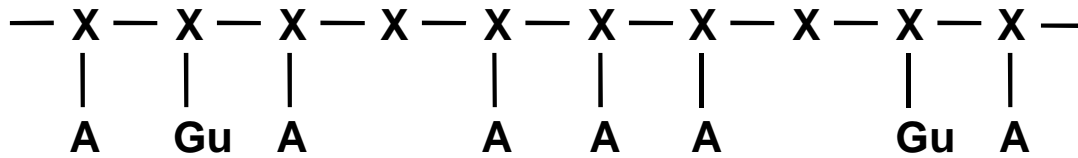
## The Main Hemicellulose in Softwoods: Galactoglucomannan



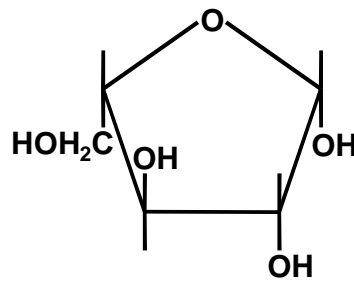
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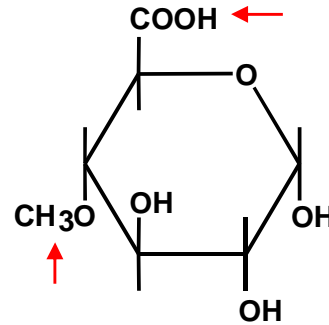
# The Main Hemicellulose in Hardwoods: Xylans



D- xylose  
" X "



L- arabinose  
" A "

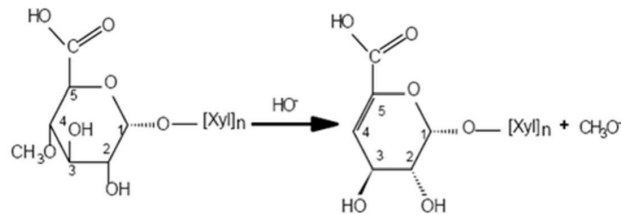


4-O-methyl  
glucuronic acid  
"Gu"

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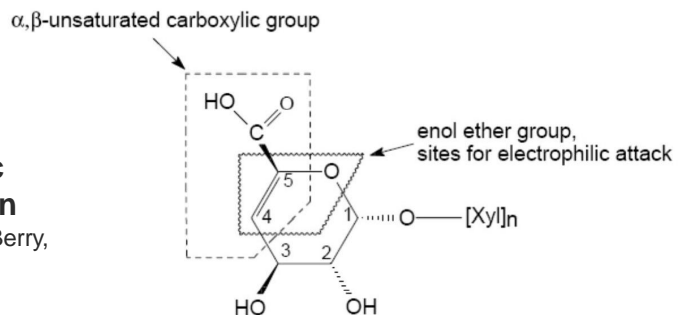
## Hexenuronic acid



**The conversion of 4-O-methylglucuronoxylan to hexenuronoxylan during kraft pulping** (Ref.: Clayton, D.W., *Svensk Papperstidn.*, 66, 115-124 (1963))

### Functionality of hexenuronic acid groups attached to xylan

(Ref.: Jiang, Z.-H., Van Lierop, B. and Berry, R., *Tappi J.*, 83(1), 167-175 (2000))



## Extractives

- Families of compounds
  - Terpenes and terpenoids
  - Resin Acids (Softwood)
  - Fatty Acids
  - Polyphenols
- May be problematic (deposit, pitch)
- Softwood kraft: Tall oil and turpentines
- HW: Large amount of neutral components (difficult to remove during pulping)

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## Classification of bleaching chemicals with regard to their reactivity towards lignin and carbohydrate structures.

Parameters	Category		
	I	II	III
Bleaching chemicals			
Chlorine containing	Cl <sub>2</sub>	ClO <sub>2</sub>	NaOCl, ClO <sub>2</sub> <sup>-</sup>
Chlorine free	O <sub>3</sub>	O <sub>2</sub>	HOO <sup>•</sup> , H <sub>2</sub> O <sub>2</sub>
Type of reaction	Electrophilic	electrophilic	nucleophilic
pH level	acid	Acid/alkaline	alkaline
Reaction sites in lignin structures	Olefinic and aromatic	Free phenolic groups and double bonds	Carbonyl groups, conjugated double bonds
Reaction sites in Carbohydrate structures	Hexenuronic acids	Hexenuronic acids only ClO <sub>2</sub>	

Ref.: Lachenal, D. and Muguet, M., *Nord. Pulp Pap. Res. J.*, 6(1), 25-29 (1992).



# Standard reduction potential of common bleaching chemicals

- Ozone is a very strong oxidizing agent and a powerful bleaching agent for lignocelluloses (Rice, R.C., handbook 1982)

Chemicals	Oxidation reaction	Std. red. potentials (eV)
O <sub>3</sub>	$O_3 + 2H^+ + 2e^- \rightarrow O_2 + H_2O$	+2.07
H <sub>2</sub> O <sub>2</sub>	$H_2O_2 + 2H^+ + 2e^- \rightarrow 2H_2O$	+1.78
HClO <sub>2</sub>	$HClO_2 + 3H^+ + 4e^- \rightarrow Cl^- + 2H_2O$	+1.56
HOCl	$HOCl + H^+ + 2e^- \rightarrow Cl^- + H_2O$	+1.49
Cl <sub>2</sub>	$Cl_2 + 2e^- \rightarrow 2Cl^-$	+1.36
ClO <sub>2</sub>	$ClO_2 + H^+ + e^- \rightarrow HClO_2$	+1.15
O <sub>2</sub>	$O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$	+0.40

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## How to Measure Bleaching Efficiency

We measure:

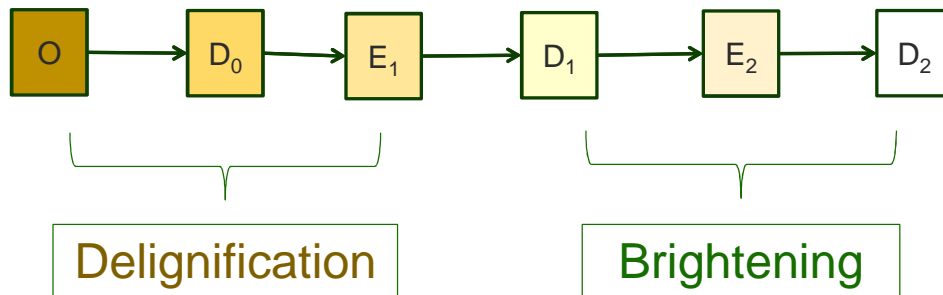
- Kappa Number (Residual lignin)
- Viscosity (Cellulose chain length)
- Brightness (reflectance of visible blue light centered at 457 nm)

$$\text{Selectivity: } \frac{\Delta \text{ Kappa}}{\Delta \text{ Viscosity}}$$



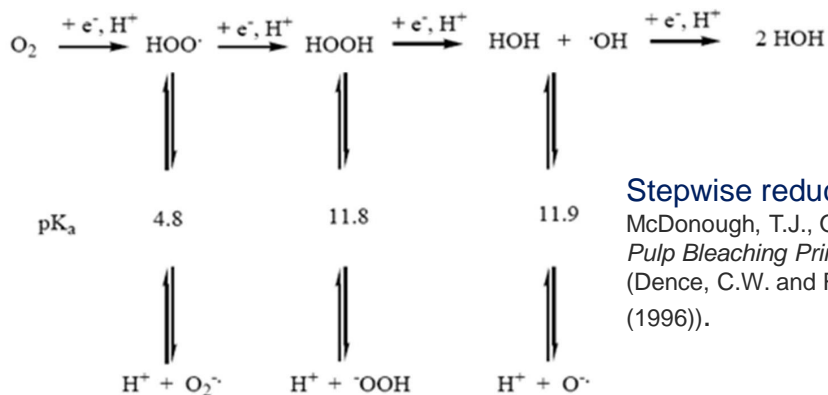
# Bleaching chemistry through stages

- Multi-stage ECF bleaching sequence



## Oxygen delignification

- Oxygen - abundant, cheaper
- O-stage filtrate is part of the recovery process (Environment friendly)

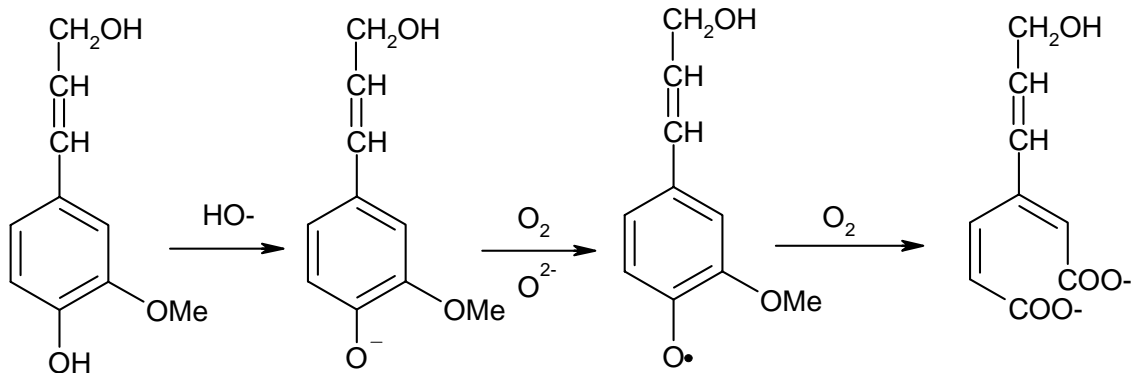


Stepwise reduction of oxygen (Ref.: McDonough, T.J., Oxygen delignification, *Pulp Bleaching Principles and Practice*, (Dence, C.W. and Reeve, D.W., eds.), (1996)).

Both the HOO<sup>•</sup> and HO<sup>•</sup> radicals (or their corresponding bases) have higher oxidation potential than their parent oxygen

# Steps in the mechanism of oxygen bleaching

- Oxidation proceeds via several intermediates, e.g., peroxides, organic radicals and hydroxyl radicals.
- These intermediates are non specific oxidative agents, and hence oxygen is not as selective for lignin removal as the chlorine-containing compounds



(Ref.: McDonough, T.J., Oxygen delignification, *Pulp Bleaching Principles and Practice*, (Dence, C.W. and Reeve, D.W., eds.), (1996)).

Muconic acid derivatives

# How MgSO<sub>4</sub> helps improve selectivity

Hypothesis:

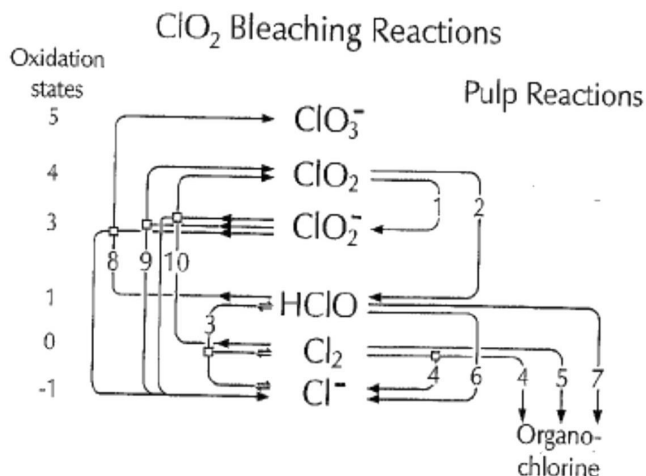
- Formation of Mg<sup>2+</sup> carbohydrate complex which stabilizes oxidized glucose units and inhibits chain scission by alkaline β-elimination
- Less likely – Inactivation of transition metals by co-precipitation with Magnesium hydroxide (metals catalyze the formation of hydroxyl and oxyl anion radicals from hydrogen peroxide)

# Chlorine dioxide bleaching

- Chlorine dioxide selectively reacts with lignin and hexenuronic acids; Does not react to any significant extent with carbohydrates
- Can be used to achieve high brightness and is also extremely effective in bleaching particles.
- Considered essential to the manufacture of strong, stable, clean, high-brightness kraft pulp

## Reactions of chlorine dioxide with pulp during delignification and bleaching

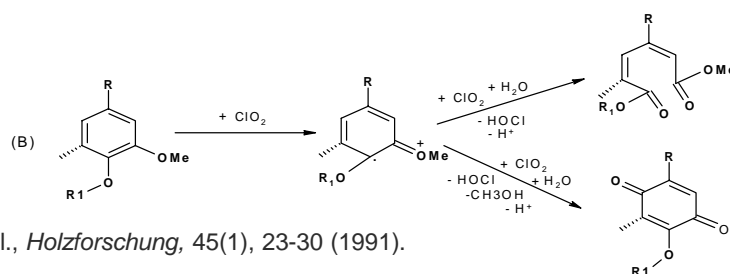
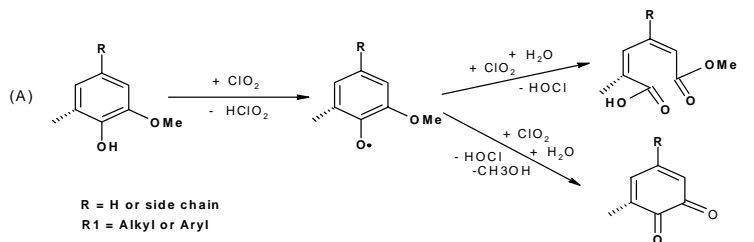
- $\text{ClO}_2$  accepts 5 electrons to completely reduce to chloride ion  
$$\text{ClO}_2 + 4\text{H}^+ + 5\text{e}^- \rightarrow \text{Cl}^- + 2\text{H}_2\text{O}$$
- Chlorine dioxide is reduced through a series of steps involving several intermediates before chloride ion is produced



Ref.: Kolar, et.al., *Wood Sci. Technol.*, 17, 117-128 (1983).

# Sequences for the reaction of chlorine dioxide with phenolic and non-phenolic rings in lignin

- Chlorine dioxide is an electrophile and as such preferentially attacks electron-rich lignin sites e.g. phenolic and non-phenolic rings and ring conjugated ethylenic groups
- End products are the same; However,
- Reaction with phenolic lignin is much faster than non-phenolic lignin



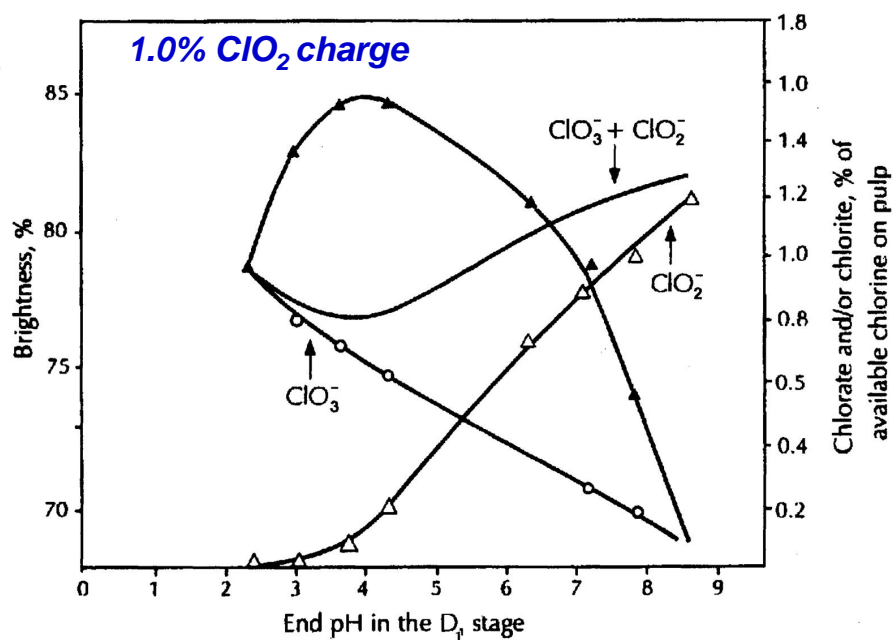
Ref: Brage, C. et al., *Holzforchung*, 45(1), 23-30 (1991).

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## Change in active $\text{ClO}_2$ species with pH



Rapson and Anderson, CPPA Trans. Tech. Sect., 3(2): TR52 (1977)

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## Near neutral final chlorine dioxide brightening (NNB)

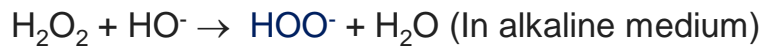
- Optimum pH is dependent upon the amount of chlorine dioxide applied and pulp species (Hart, Tappi fall conf., 2006)
- Final pH should be close to neutral when a typical chlorine dioxide charge is applied and that chlorite is the key brightening agent under near neutral conditions (Jiang and Berry, CA 2643093 A1. 2007)

## Hydrogen peroxide

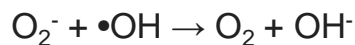
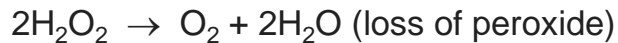
- $H_2O_2$  is used in both mechanical and chemical pulp bleaching under alkaline conditions
- Able to react with various coloured carbonyl-containing structures in lignin and carbohydrates
- May function as both de-lignifying (MINOX, LIGNOX and Peroxide reinforced oxygen) and bleaching agent (Lachenal, D. et.al., *Tappi J.*, 63(4), 119-122 (1980))
- As a bleaching agent hydrogen peroxide is normally applied in the final bleaching stages to achieve higher brightness (>92% ISO) and improved brightness stability

# Reactive species in hydrogen peroxide bleaching

- $\text{HOO}^-$  anion is a strong nucleophile and is primarily responsible for the bleaching effect of alkaline hydrogen peroxide

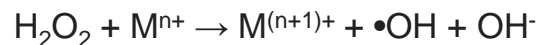


- Decomposition products



Lignin oxidation and degradation;  
Cellulose degradation

- Formation of unselective hydroxyl radicals is also catalysed by transition metal ions



Ref.: Agnemo, R. and Gellersted, G., *Acta Chem. Scand.*, B33(5), 337-342 (1979)

# How to prevent peroxide decomposition

- Decomposition of hydrogen peroxide can be controlled by:
  - Using mild alkaline bleaching conditions,
  - Stabilizing the hydrogen peroxide by magnesium sulphate and sodium silicate addition
  - Removing transition metals from the pulp by chelation etc.

## Alkaline extraction

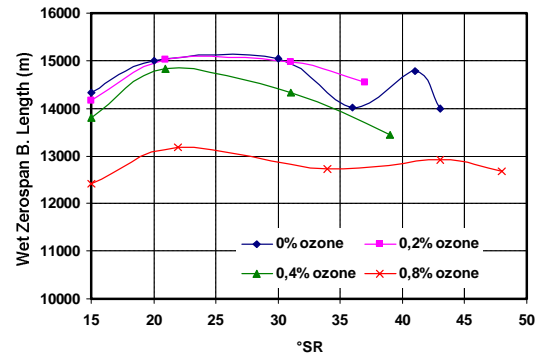
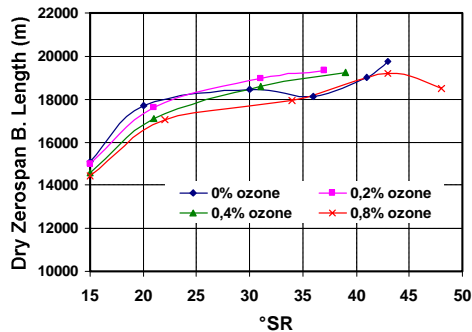
- Generally follows oxidizing stages conducted under acidic conditions and is most commonly performed with NaOH
- Neutralization of the partially degraded acidic fragments resulting in increased solubility of the lignin fragments
- Reactivates the pulp to allow for further oxidation stages.  
Chlorinated pulp + NaOH = Na<sub>2</sub>CO<sub>3</sub> + NaCl + activated lignin  
(Berry, R.M., Holzforschung 41(3),:177(1987))
- Removal of chlorine from lignin by nucleophilic displacement reaction in which a chlorine atom is replaced by a hydroxyl group

## Bleachability with ozone

Parameter	DEDD*	ZDED		
Ozone charge (%)	0	0.2	0.4	0.8
ClO <sub>2</sub> charge (%)	2.40	1.73	1.00	0.24
NaOH charge (%)	1.65	1.65	1.65	1.50
Z stage				
Brightness (%ISO)	49.0	59.4	67.5	81.8
Final pulp				
Brightness (%ISO)	90.6	90.2	90.9	91.5
Viscosity (mPa.s)	25.0	21.6	19.6	12.1

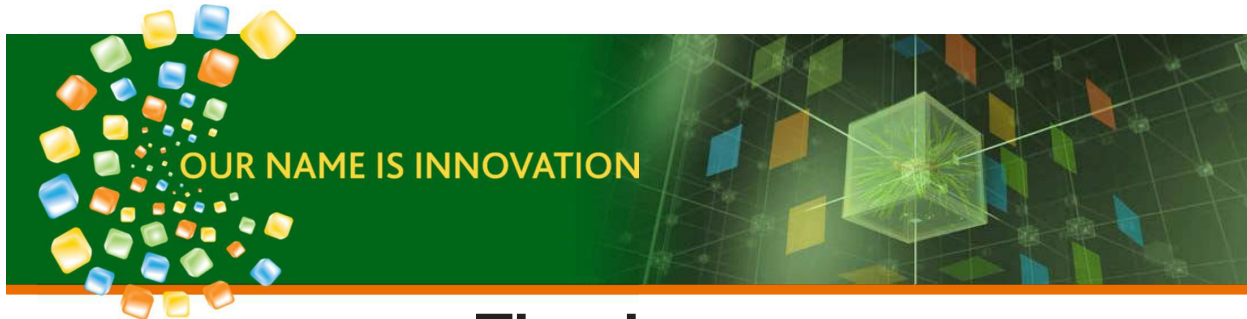
\*O stage eucalyptus pulp  
Ref: Lachenal, D. IPBC 2011

# Dry and Wet zerospan tensile strength vs °SR of fully bleached O-eucalyptus pulp



Wet zerospan tensile strength correlates with the low viscosity pulps

Ref: Lachenal, D. IPBC 2011



## Thank you

Shree Prakash Mishra, Ph.D.; Scientist / Chercher,  
 Chemical Pulping / Mise en pâte chimique  
 Market pulp / Pâte Commercial  
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## FIRST EXTRACTION STAGE DEDED

Doug Reid  
Sr. Process Engineer  
AkzoNobel Pulp & Performance Chemicals

**AkzoNobel**

## OUTLINE

- Extraction Stage Basics
- E Stage
- EO Stage
- EOP Stage

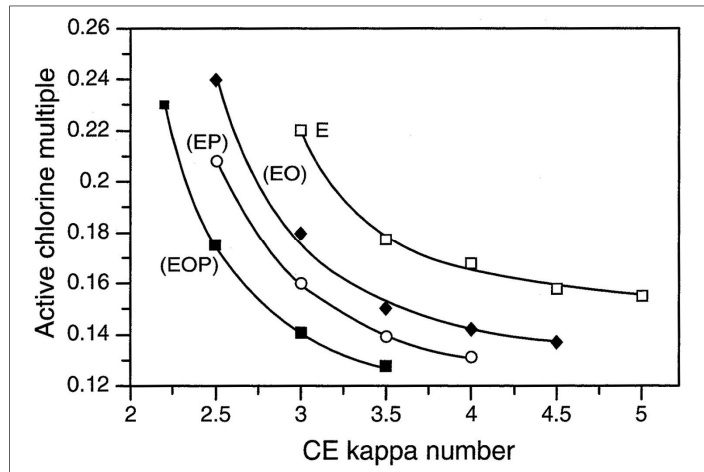
## PURPOSE OF THE FIRST EXTRACTION STAGE

- Solubilize chlorinated and oxidized lignin and other colored components (and remove by washing)
- Additional delignification/brightening if reinforced with O<sub>2</sub> and/or H<sub>2</sub>O<sub>2</sub>

## EVOLUTION OF THE EXTRACTION STAGE IN N. AMERICA

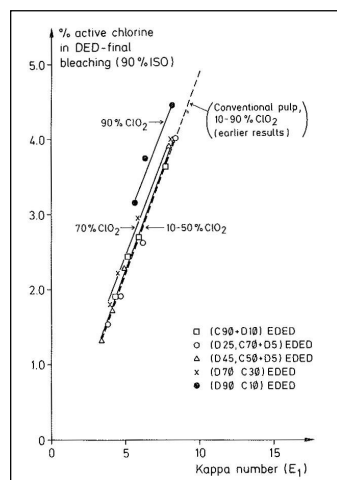
- E (1900's to current) → EO (1980's to current) → EOP (1990's to current)
- Newer options include pressurized stages:
  - (OO), (OP), (PO)
  - Few installations in N. America
- EOP is most common
  - But there are still E, EO, and EP stages in operation

## HIERARCHY OF DELIGNIFICATION EFFICIENCY IN ALKALINE EXTRACTION

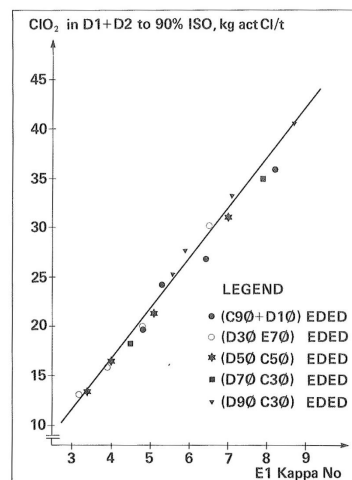


Reference: Pulp Bleaching – Principles & Practice, edited by Dence and Reeve  
Original work by Carmichael *et al*, 1986 TAPPI Journal

## E1 KAPPA IS A GOOD INDICATOR OF ClO<sub>2</sub> DEMAND IN FOLLOWING STAGES



Reference: Germgård, "Optimized Prebleaching of Softwood Kraft Pulps of Low Kappa Numbers," Proceedings of 1984 TAPPI Pulping Conference

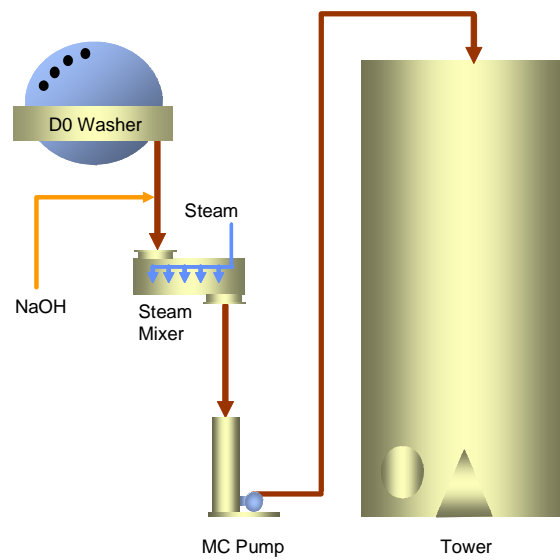


Reference: Axegård, "Effect of ClO<sub>2</sub> Substitution on Bleaching Efficiency and Formation of Organically Bound Chlorine," Proceedings of 1984 TAPPI Pulping Conference

## OUTLINE

- Extraction Stage Basics
- E Stage
- EO Stage
- EOP Stage

## CHEMICAL ADDITION IN E CONFIGURATION



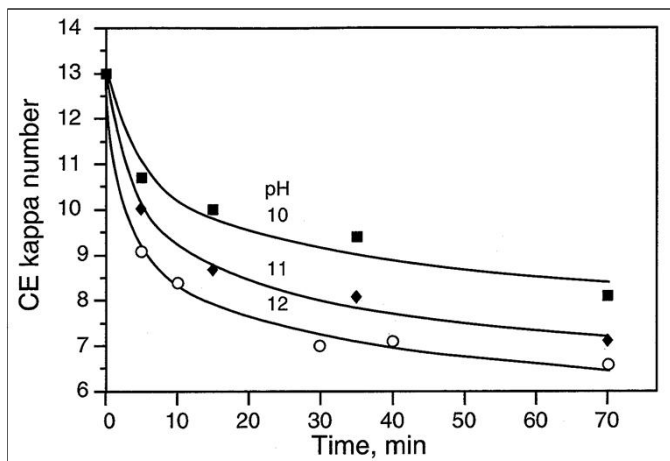
## **REACTIONS IN THE EXTRACTION STAGE**

- Solubilization and removal of the major portion of chlorinated lignin through reaction with alkali
- Saponification of fatty acids and resin acids present in the pulp
- Removal of the hemicellulose from the fiber
- Degradation of the chain length of the polysaccharin content of the fiber

## **PROCESS VARIABLES AFFECTING EXTRACTION STAGE PERFORMANCE**

- Caustic application (pH)
- Temperature
- Time
- Consistency

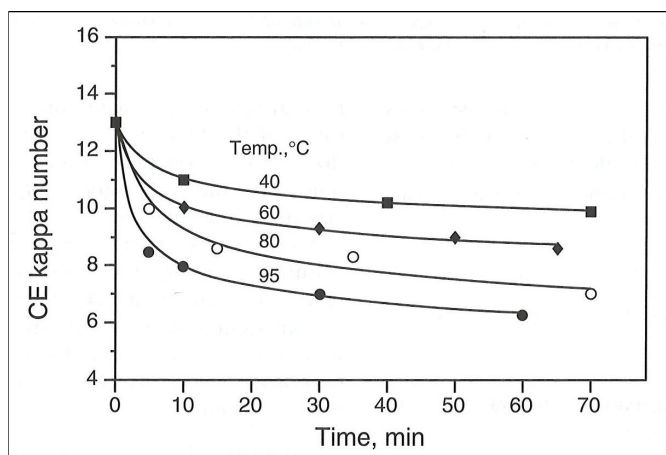
## EFFECT OF pH ON ALKALINE EXTRACTION



Note: All pH values are measured on a cooled sample at 25 C

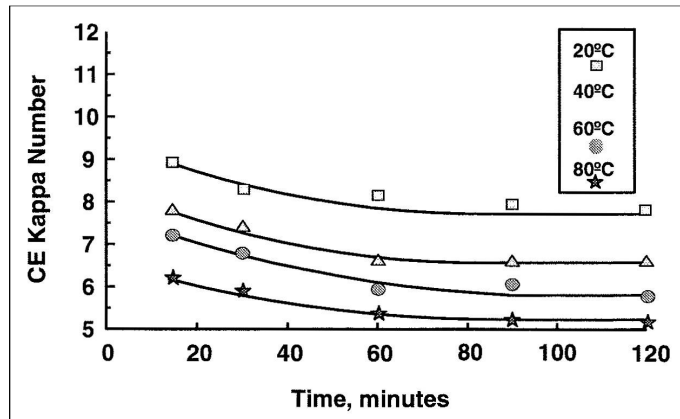
Chlorinated Softwood Kraft Pulp  
Reference: *Pulp Bleaching - Principles and Practices*, Dence & Reeve  
Original Work by Axegård, 1979 Svensk Papperstidn

## EFFECT OF TEMPERATURE ON REACTION RATE DURING ALKALINE EXTRACTION



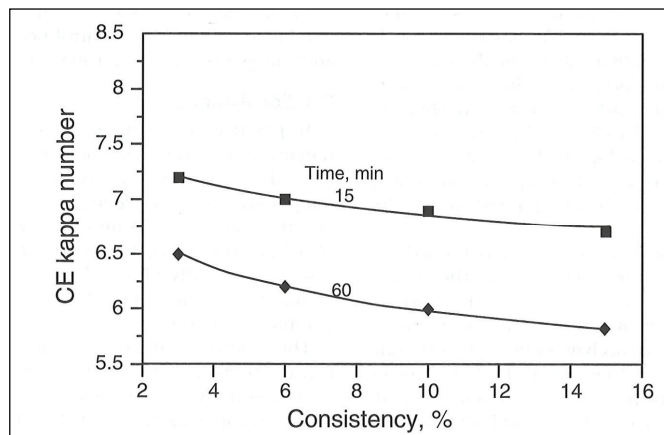
Chlorinated Softwood Kraft Pulp  
Reference: *Pulp Bleaching - Principles and Practices*, Dence & Reeve  
Original Work by Axegård, 1979 Svensk Papperstidn

## EFFECT OF TIME AND TEMPERATURE ON ALKALINE EXTRACTION



Reference: Berry, "Extraction and Peroxide," 2001 TAPPI Pulp Bleaching Course Notes

## EFFECT OF CONSISTENCY AND TIME ON ALKALINE EXTRACTION



Softwood Kraft Pulp  
Reference: *Pulp Bleaching - Principles and Practices*, Dence & Reeve  
Original Work by van Lierop et al, 1986 Pulp and Paper Canada

## CONDITIONS FOR ALKALINE EXTRACTION

- Typical time = 60 – 90 minutes
- Typical temperature = 75 - 85° C
- Typical pH = 10 – 10.5 (@25° C)
- Typical consistency = 10 – 12% AD

## OUTLINE

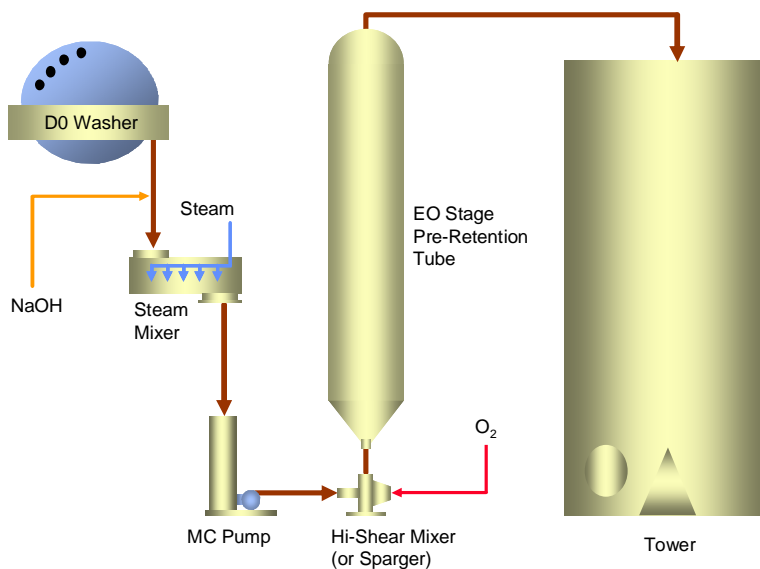
- Extraction Stage Basics
- E Stage
- EO Stage
- EOP Stage

## REASONS FOR OXYGEN REINFORCEMENT

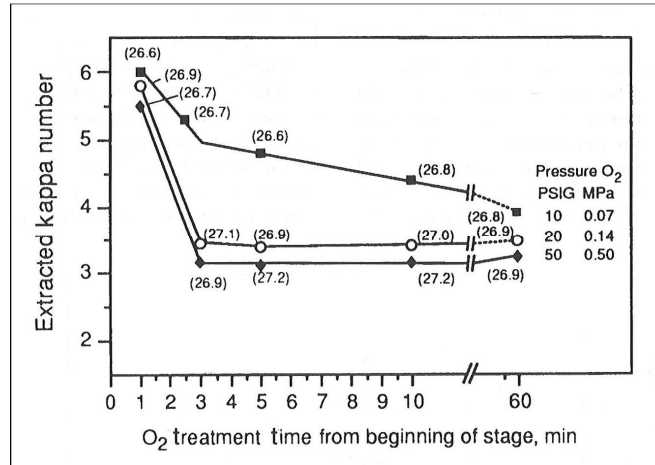
- Oxygen is inexpensive compared to other bleaching chemicals  $\Rightarrow$  Cost savings
  - Secondary reasons:
    - Environmental
    - Compensate for limited  $\text{ClO}_2$  capacity
- Fairly easy and low capital upgrade
- Rule of thumb: 5 kg  $\text{O}_2$  in Eo saves  $\sim$  3 kg  $\text{ClO}_2$  in D1\*
  - BUT: Highly oxidized pulps are less responsive to  $\text{O}_2$
  - “Leave something for the oxygen to work on”
- Most mills use oxygen reinforcement (with peroxide)

\* Reference: *Pulp and Paper Manufacture, Volume 5 – Alkaline Pulping*, edited by Grace and Malcolm

## CHEMICAL ADDITION IN EO CONFIGURATION

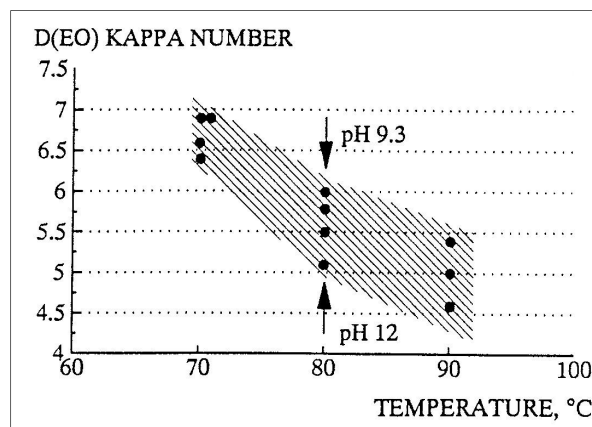


## EFFECT OF PRESSURE AND TIME ON THE EO STAGE



Softwood Kraft Pulp  
 Reference: *Pulp Bleaching - Principles and Practices*, Dence & Reeve  
 Original Work by van Lierop et al, *Journal of Pulp & Paper Science*, May 1986

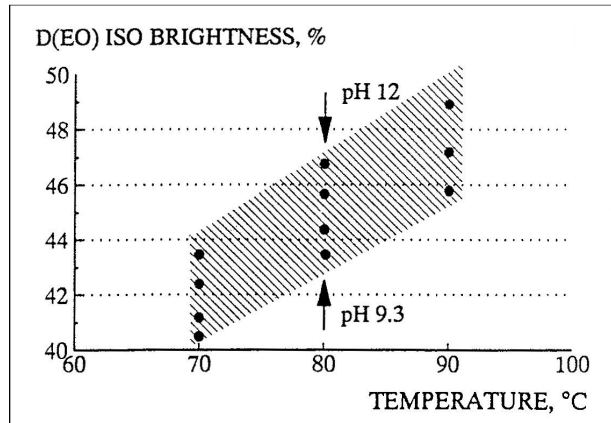
## EFFECT OF pH AND TEMPERATURE IN EO STAGE



Note: All pH values are measured on a cooled sample at 25 C

ECF Southern Pine Kraft, Kappa # 24  
 Reference: Basta, et al., "New and Improved Possibilities in D100 Bleaching,"  
 Proceedings of 1992 TAPPI Pulping Conference

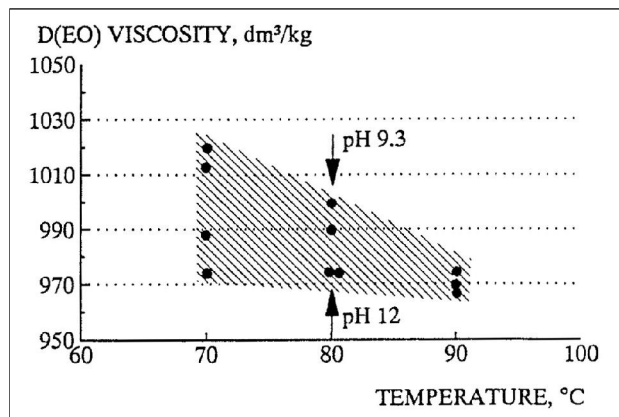
## EFFECT OF pH AND TEMPERATURE IN EO STAGE



Note: All pH values are measured on a cooled sample at 25 C

ECF Southern Pine Kraft, Kappa # 24  
 Reference: Basta, et al., "New and Improved Possibilities in D100 Bleaching,"  
 Proceedings of 1992 TAPPI Pulping Conference

## EFFECT OF pH AND TEMPERATURE IN EO STAGE



Note: All pH values are measured on a cooled sample at 25 C

ECF Southern Pine Kraft, Kappa # 24  
 Reference: Basta, et al., "New and Improved Possibilities in D100 Bleaching,"  
 Proceedings of 1992 TAPPI Pulping Conference

## CONDITIONS FOR OXYGEN REINFORCEMENT

- Typical O<sub>2</sub> charge = 5 kg/ADMT
- Minimum pressure of 140 kPa (20 psig) for 3 minutes
  - Upflow pre-retention tube (hydrostatic pressure only) is adequate
  - Pressurized tube can give better results (but must have proper safeguards – it's now a pressure vessel!)
- Hi-shear mixer
- Similar time, temperature, and consistency as for E stage

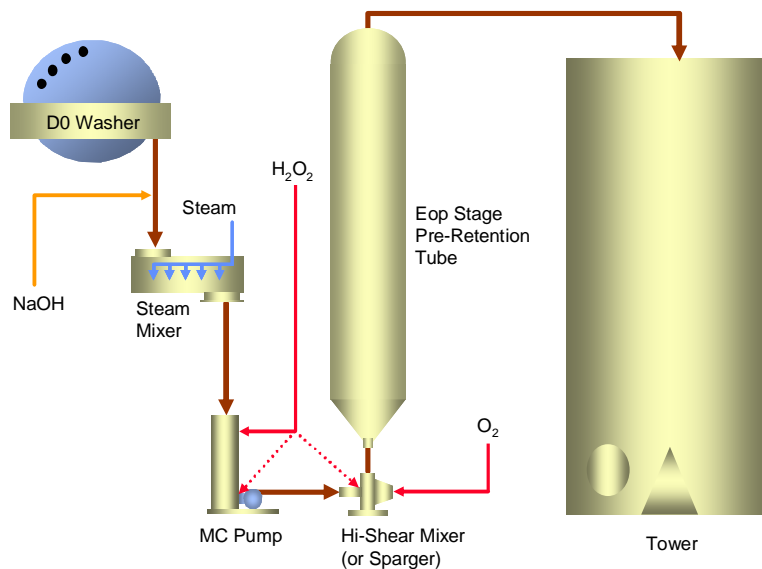
## OUTLINE

- Extraction Stage Basics
- E Stage
- EO Stage
- EOP Stage

## REASONS FOR PEROXIDE REINFORCEMENT

- Fairly easy and low capital upgrade
  - Cost savings
  - Environmental (AOX, effluent color, OX in pulp)
  - Compensate for limited  $\text{ClO}_2$  capacity
- Rule of thumb: 1 kg  $\text{H}_2\text{O}_2$  in Eop saves 1 – 1.5 kg  $\text{ClO}_2$ 
  - Better results with SW compared to HW
  - BUT: diminishing returns with higher charges
  - BUT: Highly oxidized pulps are less responsive to  $\text{H}_2\text{O}_2$
  - “Leave something for the peroxide to work on”
- Delignifies and brightens
- Most mills use peroxide reinforcement (with oxygen)

## CHEMICAL ADDITION IN EOP CONFIGURATION



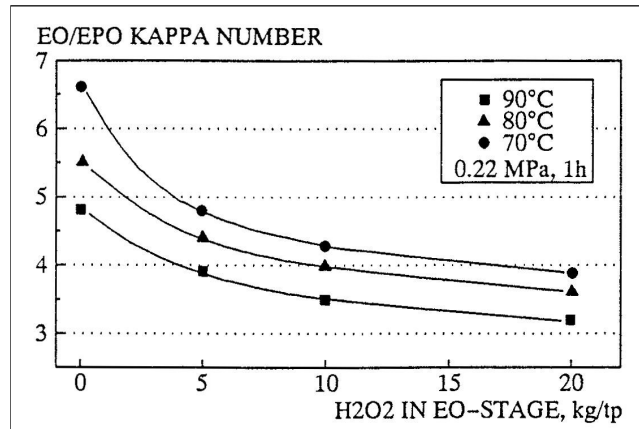
## CHEMISTRY OF H<sub>2</sub>O<sub>2</sub> BLEACHING

- H<sub>2</sub>O<sub>2</sub> generally forms three intermediate reacting species:
  - Hydroxonium ion (HO<sup>+</sup>) under acidic conditions
  - Perohydroxyl anion (HO<sub>2</sub><sup>-</sup>) under alkaline conditions
  - Hydroxyl radical (HO•) in presence of transition metals

## EOP STAGE IMPORTANT PARAMETERS

- H<sub>2</sub>O<sub>2</sub> charge
- Terminal pH
- Residence time
- Temperature
- Pulp consistency
- Chemical mixing efficiency
- Pulp metal profile
- COD carryover from previous stage

## EFFECT OF TEMPERATURE AND H<sub>2</sub>O<sub>2</sub> CHARGE ON EOP STAGE



ECF Southern Pine Kraft Pulp, Kappa # 24, KF = 0.17  
Reference: Basta, *et al.*, "New and Improved Possibilities in D100 Bleaching,"  
Proceedings of 1992 TAPPI Pulping Conference

## EOP STAGE OPERATING CONDITIONS pH

- Optimum terminal pH generally 10.5 – 11.0 in EOP
- Positive effect in range of pH 10-12 on most pulp properties
- pH 12-14 results in H<sub>2</sub>O<sub>2</sub> decomposition and negative effect on pulp properties

Note: All pH values are measured on a cooled sample at 25 C

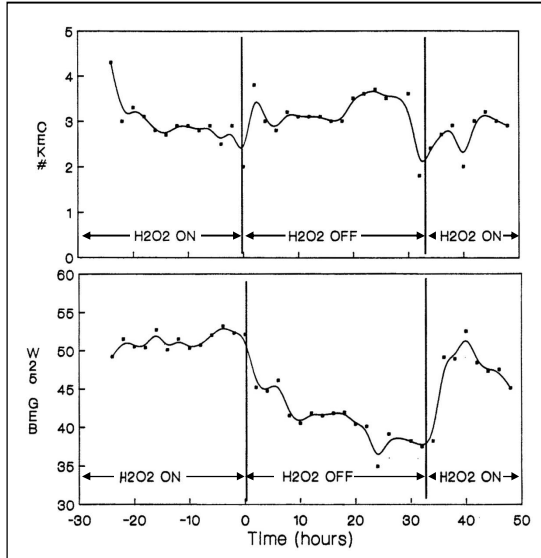
## **EOP STAGE OPERATING CONDITIONS TIME**

- Most EOP stages are approximately 60-90 minutes
- 90% H<sub>2</sub>O<sub>2</sub> consumed within 10 minutes under mild conditions (60° C, 0.2% H<sub>2</sub>O<sub>2</sub>)
- Usually no residual at end of EOP stage

## **METAL MANAGEMENT**

- High content of alkaline metals (Mg, Ca) low concentration of transition metals (Mn, Fe, Cu) is desirable
- Low pH in the D0 stage will partially remove metals
- Chelants can be added to improve metal profile
- Normally in kraft process metal management is not a concern

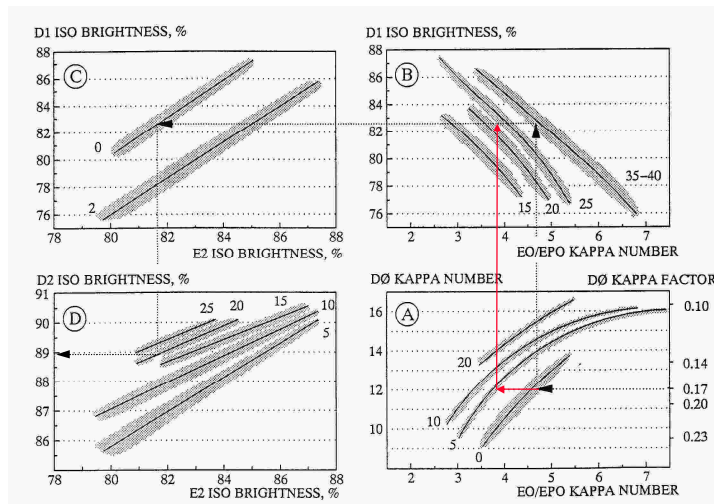
## HOW TO MONITOR EOP PERFORMANCE?



- Kappa or K# is probably the best absolute measure of Eop performance, especially if an accurate Kappa analyzer is available
- For routine monitoring (not optimization or trials) using hand tests, brightness may be a more sensitive indicator at some mills

Mill data, Softwood Kraft pulp - K# and GE Brightness measured after Eop  
Reference: Reid, "Peroxide Bleaching - Mill Experience," 1991 CPPA Kraft Pulp Bleaching Course Notes

## SUBSTITUTION OF PEROXIDE IN A FIVE-STAGE ECF SEQUENCE



Chemical charge in kg/tp ( $\text{ClO}_2$  as aCl), ECF Southern Pine Kraft, Kappa number 24  
Reference: Basta, *et al.*, "New and Improved Possibilities in D100 Bleaching,"  
Proceedings of 1992 TAPPI Pulping Conference

## EOP STAGE OPERATING CONDITIONS SUMMARY

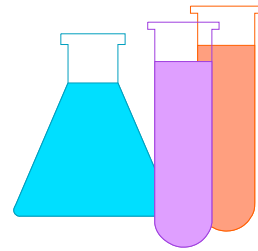
- Typical  $\text{H}_2\text{O}_2$  charge = 3 - 7 kg/t
- Replacement ratio 1.0 - 1.5 kg  $\text{ClO}_2$  per kg  $\text{H}_2\text{O}_2$
- Typical pH = 10.5 - 11.0
- Typical temperature range = 75 - 90° C
  - Hotter is generally better
- Typical  $\text{O}_2$  charge = 5 - 7 kg/t
- Separate NaOH and  $\text{H}_2\text{O}_2$  and ensure thorough mixing
  - 5 - 10 wt %  $\text{H}_2\text{O}_2$  can give better mixing
- Establish and monitor E-stage kappa or brightness target

Note: All pH values are measured  
on a cooled sample at 25 C

Questions ??

# Chlorine Dioxide Generation Chemistry

Dennis Froats  
ERCO Worldwide Technical Service

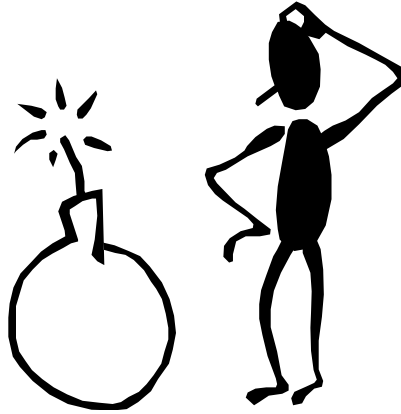


## What is Chlorine Dioxide?

- $\text{ClO}_2$  is a valuable bleaching agent for pulp.
- It can bleach pulp to a high brightness while maintaining pulp strength & viscosity.

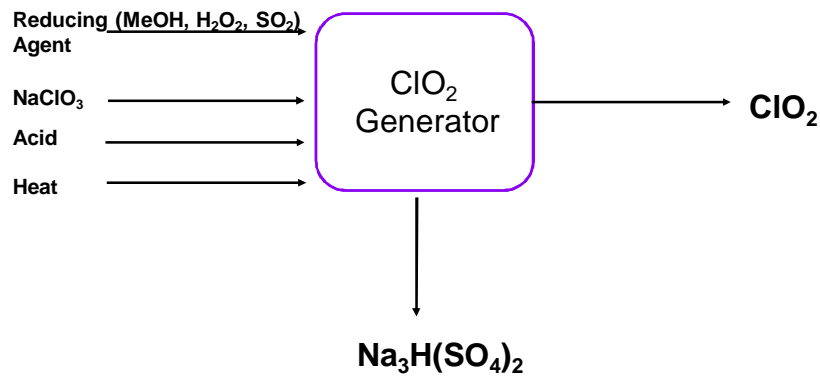
## What is Chlorine Dioxide?

- $\text{ClO}_2$  gas will decompose violently under certain conditions.
- It must be produced at the mill near the point of application.
- It must be treated with respect.



3

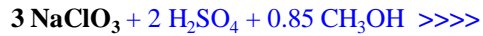
## Process Flow Diagram



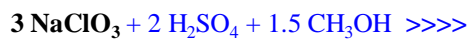
# Chemical Reactions



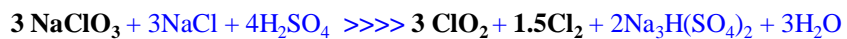
## Reaction 1 (Most Desirable)



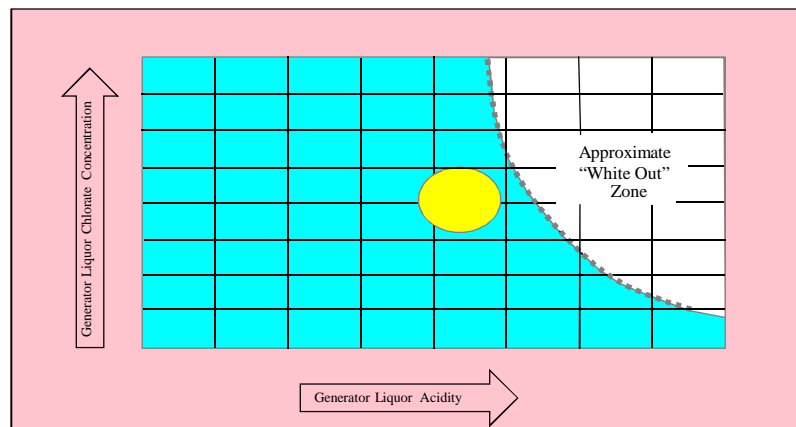
## Reaction 2 (Less Desirable)



## Reaction 3 (Unavoidable)



# Generator Liquor Conditions





## What is a “White-Out”?



A white-out is the cessation of chlorine dioxide production due to the depletion of chloride in the generator, which typically occurs at high generator liquor acidity.

Production of chlorine dioxide will stop even though there is a flow of all the feed chemicals into the generator. (Reducing Agent, Chlorate, & Acid)

## How to recognize a “white-out”



- $\text{ClO}_2$  analyzer reading drops quickly to zero (0) gpl.
- The generator liquor is a milky “greyish” color. The  $\text{ClO}_2$ , which imparts the yellow/green color, is absent.
- The generator liquor temperature generally higher than normal due to higher acidity.
- Chlorine is formed, consuming all the chloride present in the generator.
- Typically there is a high generator pressure when MeOH is flowing or restarted (ejectors are overloaded with chlorine) and the liquor remains milky grey even after the methanol has been flowing for some time.

## How to recover from a “white-out”

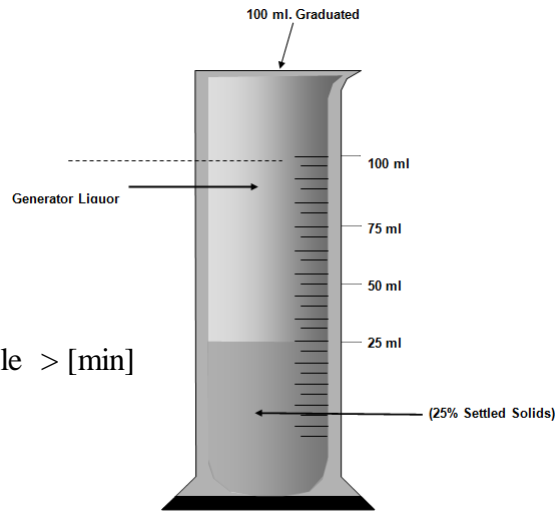
- Test generator liquor. Is white-out due to high acid, chlorate, or both?
- If generator has not tripped - shut off acid feed.
  - Stop chlorate feed only if necessary.
- Dilute generator liquor with water.
  - Add water until the liquor temperature is approximately 1°C lower than the normal operating temperature.
- Adjust flow of chilled water to absorption tower and start ClO<sub>2</sub> production by restarting methanol (MeOH) flow.
- Test liquor concentrations again and restart acid feed at correct flow.

## Low Acidity White-Out

*A White-Out can also occur when starting up the generator with a fresh chemical batch.*

Liquor Acidity Test

[max] > acidity sample > [min]

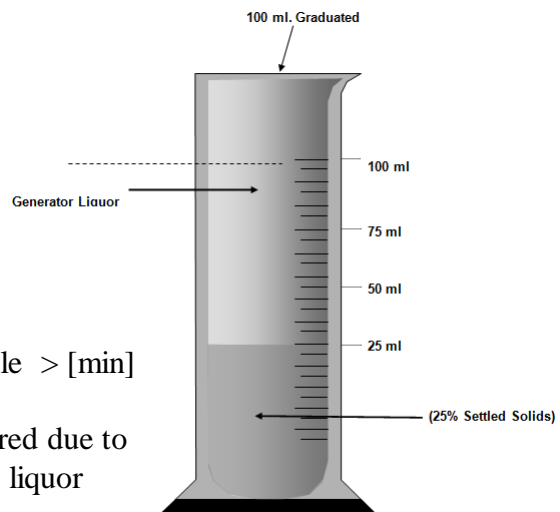


Liquor Acidity Test

[max] > acidity sample > [min]

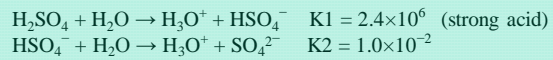
> 70% acidity measured due to dissolved bisulfate in liquor

$\text{Na}_3\text{H}(\text{SO}_4)_2$  solid



## Low Acidity White-Out

*In this case, a measure known as the Free Acidity is important.*



*Free acidity is the measure of the concentration of the first proton from the sulphuric acid, which is available for the reaction to produce  $\text{ClO}_2$ .*

*Free acidity does not include bisulfate ( $\text{HSO}_4^-$ ) acidity*

*Total acidity = acid test = free acidity + bisulfate acidity*

## How to Avoid a Low Acidity White-Out

**Keep the Free Acidity constant at the appropriate value until the saltcake saturation point has been reached (solids appear in liquor).**

**Follow the recipe in the operators manual.**

## ClO<sub>2</sub> Chemistry - Summary

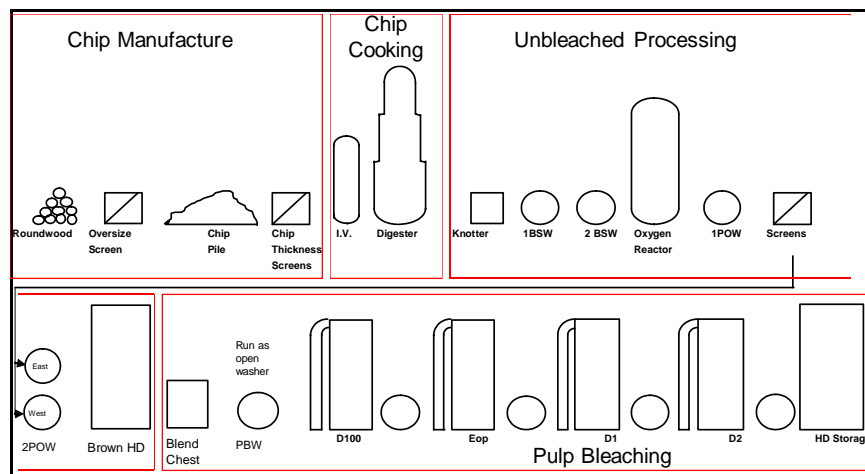
- There always needs to be traces of chloride in the generator to sustain the reaction (amount is a function of the reducing agent).
- Reaction 1 is the most efficient reaction.
- Acid is the greatest contributor to reaction efficiency.
- Too much acid (or chlorate) can cause “white-outs”.
- Follow operator’s manual recipe for fresh chemical batch startups.

# BSW Improvements for ClO2 Reduction

PAPTAC Bleaching Committee Meeting  
Fall 2014  
Kimberely, BC, Canada

Brian La Brash / Barry Voss Verso Paper - Quinnesec

## Quinnesec Fiberline



## Opportunity / Issues

- Washer audits in 2013/2014 identified potential opportunities for low cost improvements
  - Automating level control on washers
  - Minimizing by-pass flows between filtrate tanks by improving washer drainage
  - Evaluating post Oxygen Delignification pH target as this pH correlated to pre-bleach washer conductivity and Do acid use
  - Improving shower performance by adjusting showers and keeping clean/unplugged
  - Challenging solids limit from the Evaporators, i.e. send lower solids
- Solids/T to O2D and Bleach Plant were very high

## Challenges

- Production shad increased since 1985 from 750 to 1400+ ADTPD and runnability/reliability in Fiberline was high
- Bleaching costs not excessively high, but above benchmark goal
- Previous experience with existing vat level control was poor – washers sealed

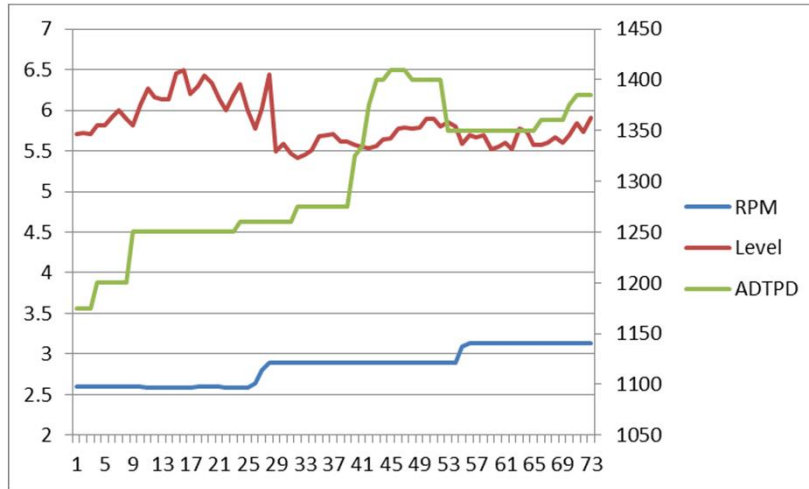
## Issues Addressed

- Level control for BSW and POW's
- Trials lowering pH target for O2D
- Lowered solids target 0.5 points

## Overview of Changes - BSW

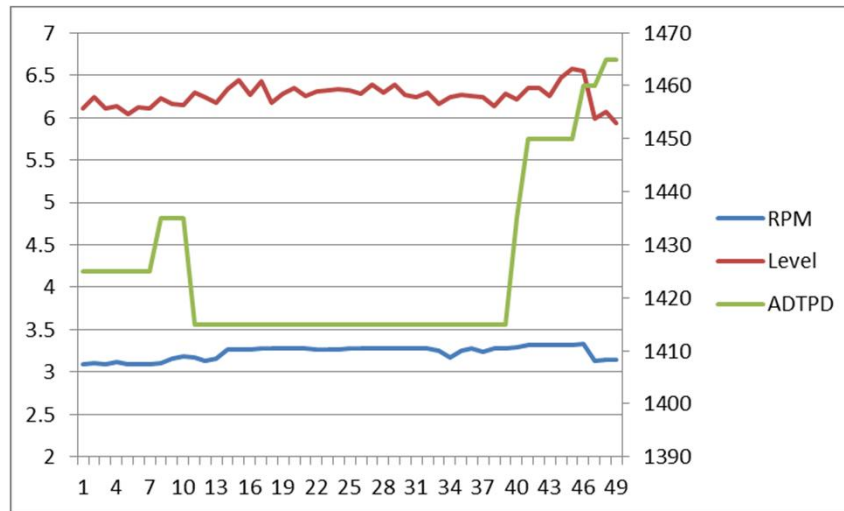
- Washer Controls (Concept from Buckman)
  - Drums in speed control with vat dilution varying in a defined range depending upon level. Clamps on both.
  - Minimizing by-passing of filtrate between tanks as washer drainage improved due to maximizing vat dilution flow (lower vat consistency)
- Taking advantage of improved drainage to run additional showers to new solids target

## Prior to Washer Controls



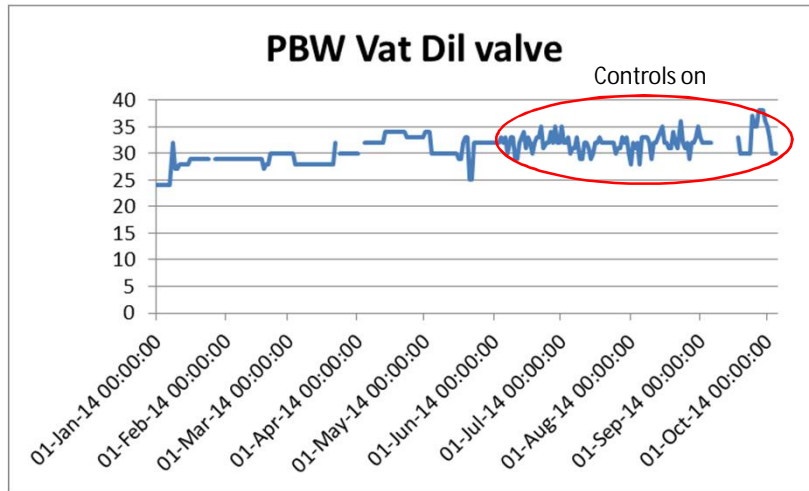
Vat dilution valve seldom changed. Sometimes drum speed, sometimes not.

## After Washer Controls

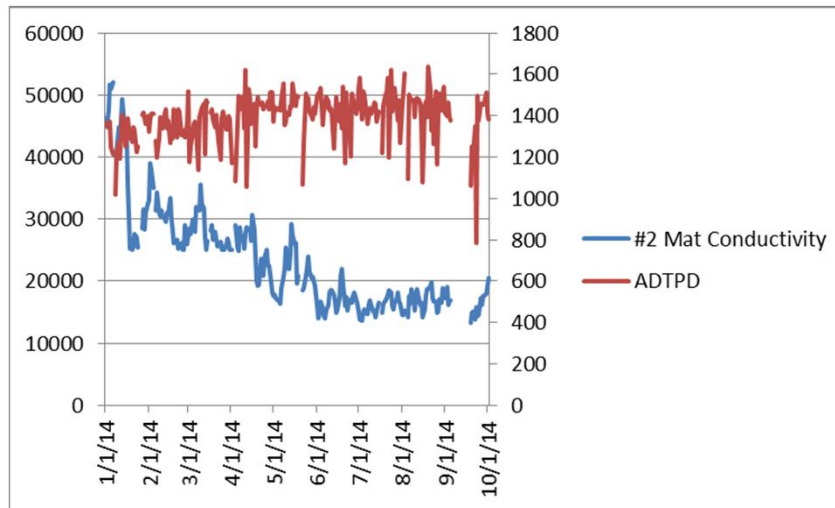


Vat dilution and drum speed manipulated to maintain level

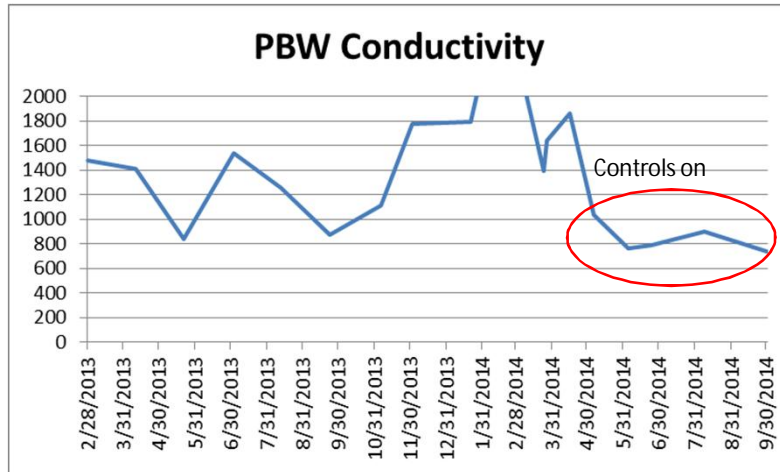
## Pre-Bleach Washer Vat Dilution



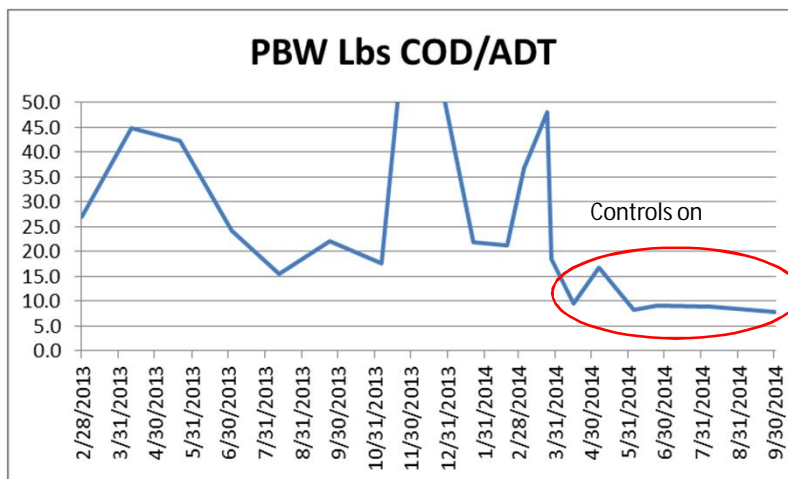
## Impact on Pre-O2D Carryover



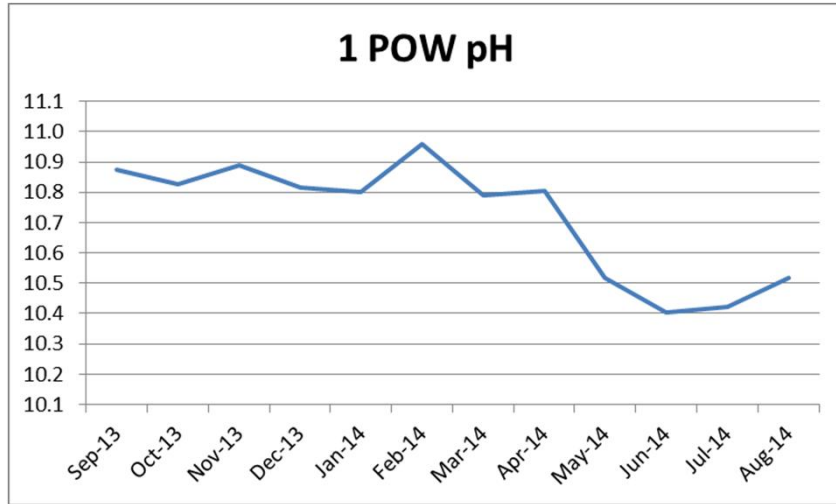
## Pre-Bleach Washer Conductivity



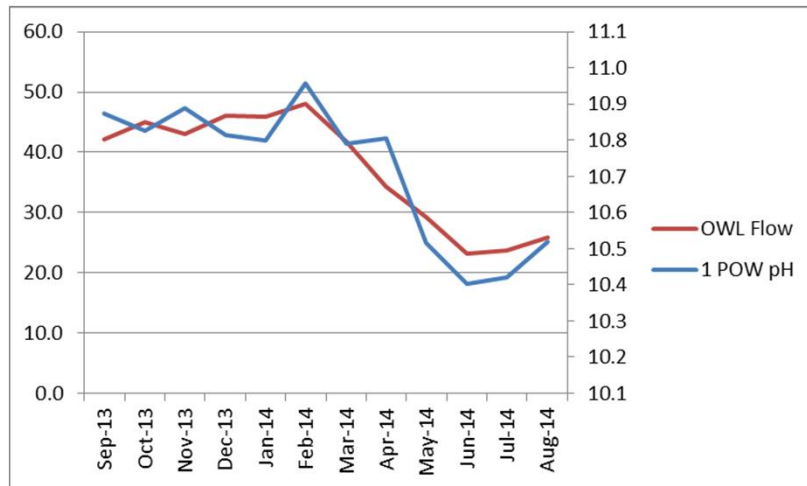
## Impact on Pre-Bleach Carryover



## Reduction in Post O2D pH

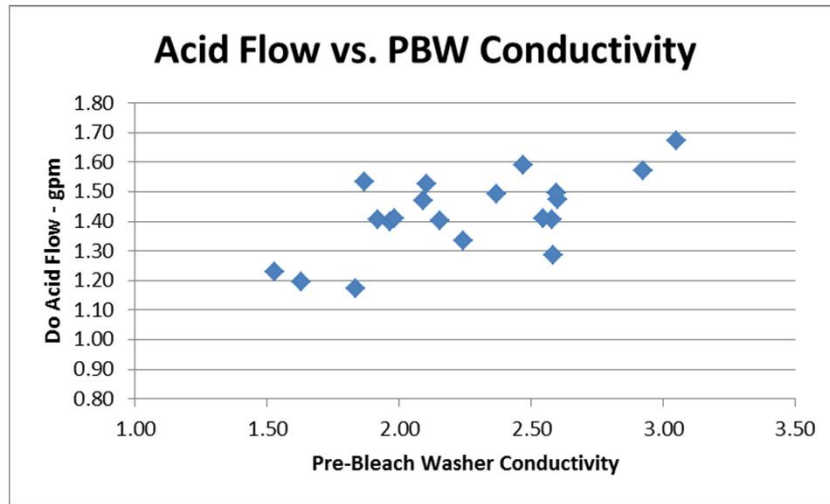


## Reduction in OWL Flow

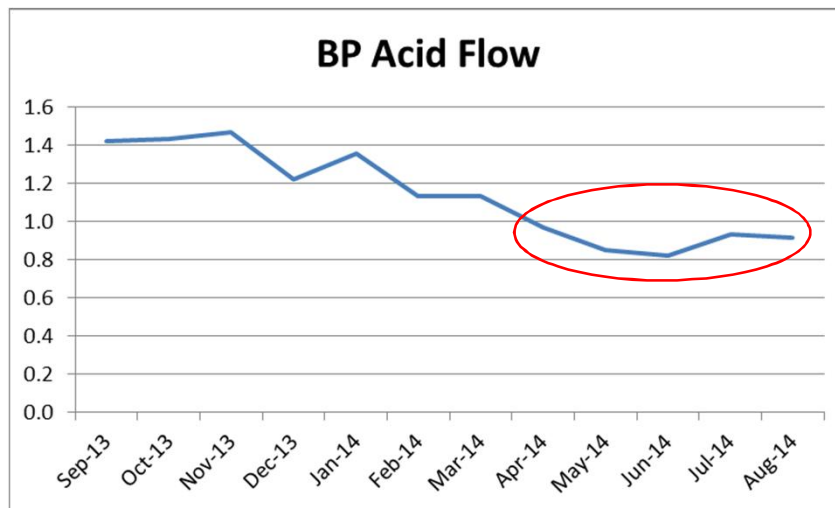


Note: using 1 gpm caustic to help maintain 0 sulfidity from WL Oxidizer. The flow reduction is a combination of the 1 gpm of caustic and the pH target reduction.

## Impact of PBW Conductivity on Do Acid Use

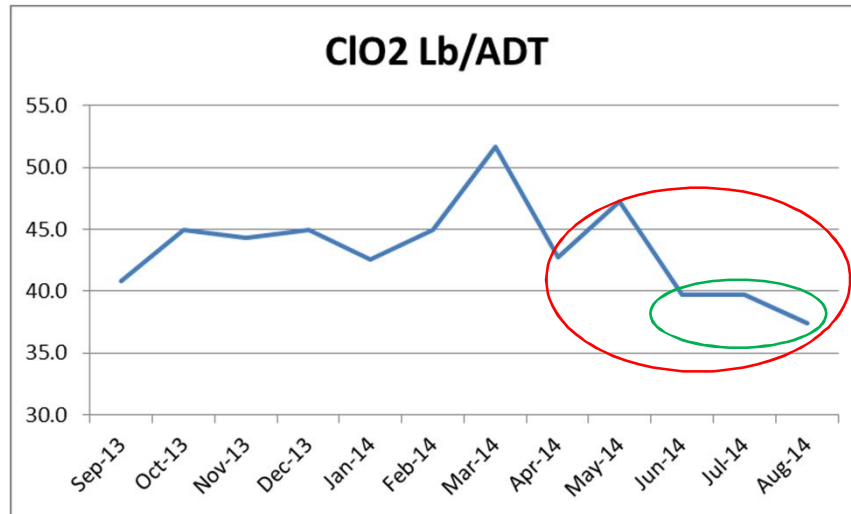


## Impact on Do Acid Consumption



Acid use is down even though Do CLO2 use has also decreased

## Impact on ClO2 Use



ClO2 use to the same final brightness has been reduced at record production rates

## Summary

- The level controls installed are working well and the concept will be transferred to the bleach washers
- Solids control work is next
- ClO2 usage has been significantly reduced as a result of less carryover to the Bleach Plant.
- Being challenged to try things again and not to accept the status quo were the keys to the success for this improvement. We had been successful at making tons, but not efficient tons with the equipment we already had.

## Acknowledgements

- Wally McDonald – Verso
- Doug Weber – Verso Quinnesec
- Ed Zychowski – Verso Quinnesec
- Mark Schroen – Buckman
- Jim Gelhoff – Buckman
- Joe Marcy – Buckman
- Central Lab – Verso Quinnesec

## Verso Jay, ME Mill Washer Projects – Softwood Line

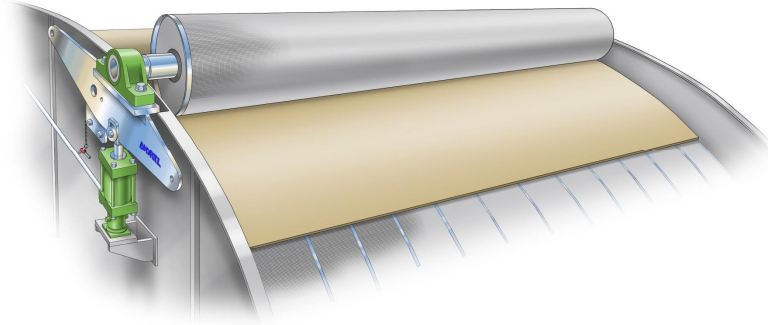
October 2014

PAPTAC Bleaching Committee Meeting  
Fall 2014  
Kimberely, BC. Canada

Wally McDonald - Verso Paper

### Vacuum Washer Technology

Andritz Maxton™ Roll



### Decker Maxton Roll



Maxton Roll Video.mov

## Decker Maxton Roll

- Two parallel deckers -900 tpd softwood (450 tpd each) - 11.5'x20' pipe washer
- Maxton roll installed on one decker
- Equipment cost / Installed cost - \$70k / \$100k
- Actual savings +1.5-2% mat consistency improvement and 30-40% COD reduction - estimate \$150k savings ClO<sub>2</sub>/NaOH
- Project highlighted the importance of dilution washing from to running optimum vat consistency - B&Ts
  - To fully optimize Maxton roll needed to reduce vat consistency by increasing max speed on washer drum

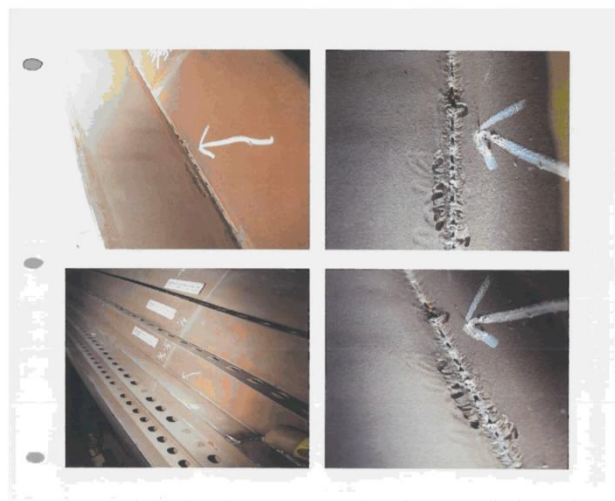
## Decker Maxton Roll

Washer	Comment	Vat Cons (%)	Mat Cons (%)	COD lb/ton pulp	Est Cost Impact \$
#1 Decker	Baseline Oct 2013	1.58	10.7	10.22	
#1 Decker	Maxton roll up	1.18	12.06	8.93	
#1 Decker	Maxton roll down (20 psi)	1.18	12.95	6.56	
#1 Decker	Maxton roll down (5 psi)	0.91	13.84	6.08	
	Overall improvement from project baseline		29.3%	-40.5%	\$150,000/yr
	Roll up / down improvement		14.8%	-31.9%	\$100,000/yr

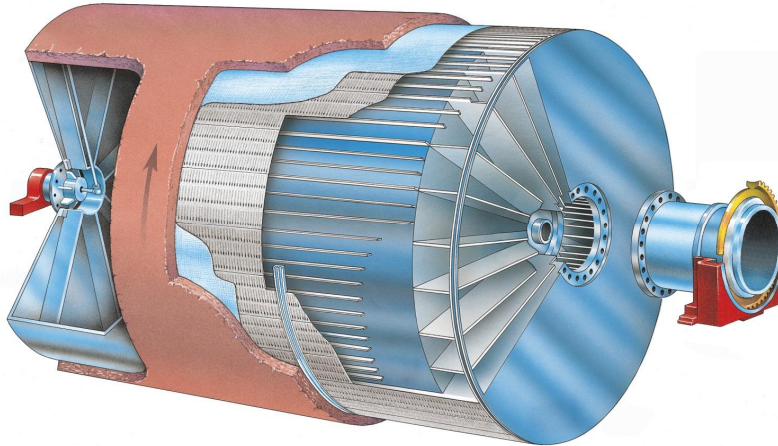
## Bleach Plant D1 Drum

- Original drum – 11.5'x20'GL&V corrudeck III
- Replaced due to corrosion / drum failure
  - Original installed 1995 254 smo / hastelloy c276 welds
  - Severe corrosion of welds
- New drum – Andritz Bmax
  - 6% molybdenum
- Gas free valve
- Equipment cost / Installed cost - \$750k / \$900k
- Actual consistency improvement of 2-3%
  - Baseline mat consistency 9-10% (<5" Hg vac)
  - After project mat 12.5-13.5% (~10" Hg vac)

## Bleach Plant D1 Drum



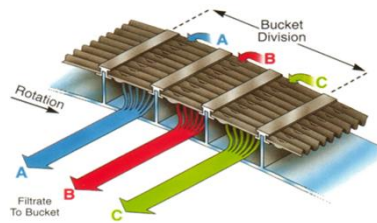
### Vacuum Washer Technology Andritz BMax



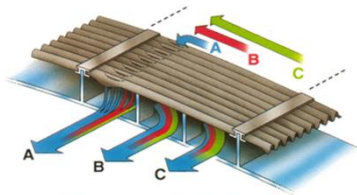
27

### Vacuum Washer Technology Decks

**New washer  
Maxton Deck**



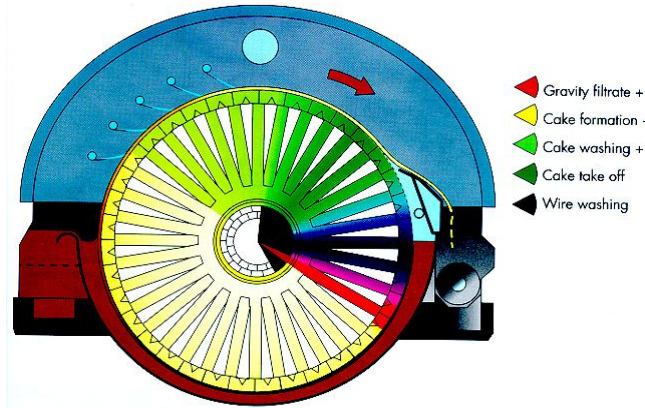
**Original  
Corrugated Deck**



28

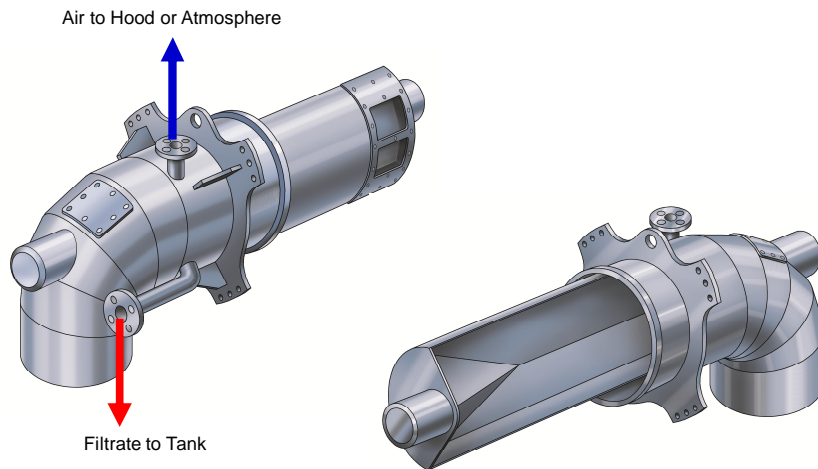
### Vacuum Washer Technology

Andritz GasFree™ Valve



### Vacuum Washer Technology

GasFree™ Valve



## Possible future projects based on these results

- Maximize dilution washing in all washers – we call B&Ts
  - Run optimum vat consistency
  - Ensure washers are in auto level control
  - Display calculated consistency on DCS
  - Evaluate any drum speed limitations
- Consider “laydown” rolls on pre-bleach deckers and washers prior to O2 delignification
- Evaluate drum and valve technologies to improve performance

## D0 Retention Time and Eop Caustic Usage

Bleaching Committee Meeting Oct 2014

## Two of our Mills have very low Caustic Usage

• Sent out email question on extended D0 stage (greater than 1.5 hours) and got a response from Norm Liebergott:

- *Initial phase in D0 is rapid (~80% completed in first 5 mins)*
- *Remaining delignification proceeds slowly over next 45-60 minutes*
- *If pulp has another hour or more to sit in the bleaching liquor, even though the ClO<sub>2</sub> is spent, other ionic species (chlorate (useless), chlorite, chlorous and hypochlorous acids (HClO<sub>2</sub> and HClO) exist*
- *Unbleached softwood kraft pulps contain up to 7% HexA which are not removed in O<sub>2</sub> Delig and as lignin is removed in O<sub>2</sub> Delig, that percentage may go up to 15%v of the total residual value.*
- *The chemical acids affect the solution containing the ions and the extended retention time DO has a leaching effect, reducing the acidity of the pulp after washing, thereby reducing the charge of caustic in Extraction"*

Bleaching Committee Meeting Oct  
2014

## Two of our Mills have very low Caustic Usage

•Other Responses:

- "I have one client mill with an NaOH-to-CIO2 ratio of 0.75; they also have O2 delignification, an open pre-bleach washer, low kappa to the bleach plant, and an MC Do stage (although not with 2 hours retention time). Their average Eop washer vat pH averages 9.8 to 10.1. I would suggest wood species as a possible explanation as well - Paul Earl*
- I would think the 2 hour retention time and the open washers must be the key - James Goldman*
- One suggestion would be to test the caustic demand on the DO filtrate as well as the caustic demand of the pulp off of the washer. If the last shower on the DO washer is hot water due to the three stages you may just have a very clean pulp with a low caustic demand to get to the pH target" - Dale Shewchuck*

Bleaching Committee Meeting Oct  
2014

## Two of our Mills have very low Caustic Usage

•Other Responses:

- "2 Hypotheses: The first one is if peroxide gets decomposed quickly, peroxide being acid, then caustic takes the floor. The second one is how much alkaline water is returned to DO showers, if there is alkalinity in those showers. But I think the first hypothesis is more likely" - Raymond Paquet*

Bleaching Committee Meeting Oct  
2014

## Two of our Mills have very low Caustic Usage

•Other Responses:

•*"The long Do stage definitely has an impact and is probably main cause of good performance. I would also ask the following questions: What DF is being used on the Do washer? What is being used on the Do showers? How are the different mills controlling their caustic addition? It is possible it is used in excess at other mills. Are all the mills same sequence? If so is the low caustic use being made up by higher usage in following stages or lower final bright than the other mills?" - Gerry Pageau*

Bleaching Committee Meeting Oct  
2014

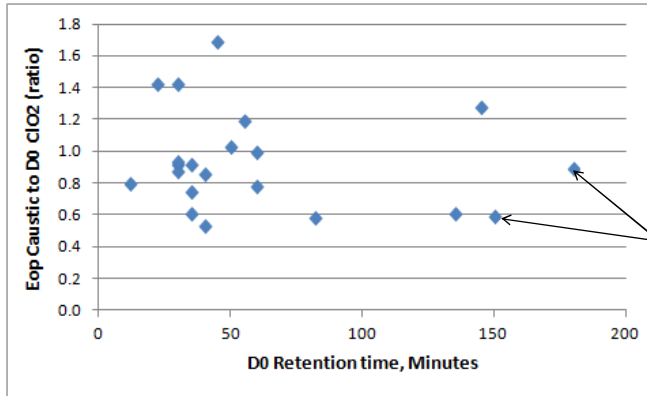
## Two of our Mills have very low Caustic Usage

•Other Responses:

•*"On the Do washer we have 6 shower bars, the bottom 2 bars have D1 filtrate and the top 4 bars have E1 filtrate. By doing this, we have reduced caustic demand at E1 because we are increasing the stock pH as it leaves the Do washer. We also add E1 filtrate to the Do repulper. We have also found that cleaning and calibrating the E1 tower pH probes is key; we do it once per week." - Andrew Anacker*

Bleaching Committee Meeting Oct  
2014

## SURVEYED MILLS – ALL O2 DELIG SWD



These are our mills. Both have very low caustic usage (~20 lb/ton, or 10 kg/tonne). But realize that in looking at the ratio of caustic:ClO<sub>2</sub>, the ratio can be high if the mill has very low D0 dosage, maybe ratio is not what we need to look at.

Thanks to Paul for the Paptac Survey results and I added our mills that did not partake in survey

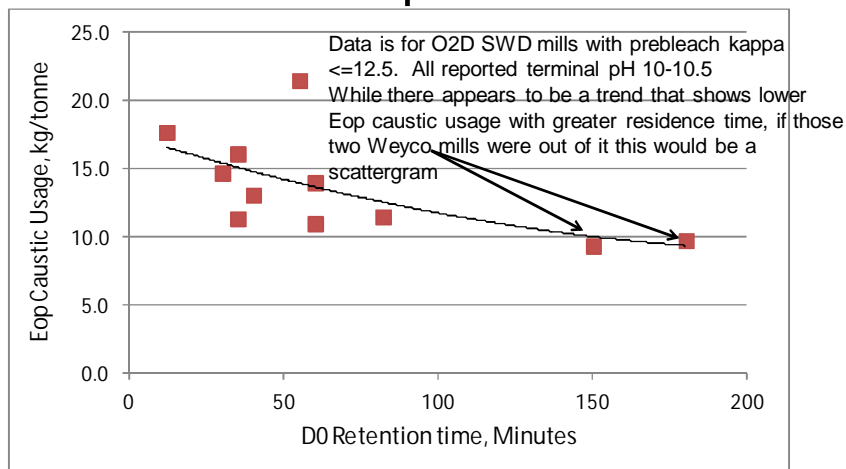
Bleaching Committee Meeting Oct  
2014

## SURVEYED MILLS – ALL O2 DELIG SWD

- Does not appear that we can conclude anything regarding extended D0 retention time and low Eop ratio to ClO<sub>2</sub>.

Bleaching Committee Meeting Oct  
2014

## BECAUSE IF PLOTTED WITH ACTUAL Eop USAGE...



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2014

## SURVEYED MILLS – ALL O2 DELIG SWD

- Still does not appear that we can conclude much regarding why some mills have very low (0.95-1%) caustic charge in Eop and still have terminal pH in the 10's.
- Time to do some bleach studies on pulp using different D0 retention times to see if retention time has any affect on the next stage caustic addition.

Bleaching Committee Meeting Oct  
2014

# **PAPTAC Bleaching Committee**

**Fall 2014 Meeting**

**Hosted by Skookumchuck Pulp, Kimberley, BC – Oct. 6-8, 2014**

## ***“Projects” Sub-Committee Presentations***

**2013 PAPTAC Bleaching Survey (SWD & O2-SWD Mills) – Paul Earl (Paul Earl Consulting)**

**Washer Vat Replacement – Meredith Illman (Canfor Intercon)**

**Defoamer and Pitch Dispersant Safety – Mike Kjerulf (Solenis)**

**Bleach Plant pH Control – Laurier Morissette (TEXO)**

**Pre-Bleaching Enzyme Use – Art Meusel (Chemstone)**

**New Findings on E1 Washer Carryover – Paul Earl (Paul Earl Consulting)**



**DEFOAMER & PITCH DISPERSANT  
SAFETY & HANDLING  
SKOOKUMCHUCK 2014  
MICHAEL KJERULF**



### Outline

- Defoamers
- Pitch Dispersants
- Product Safety
- PPE

### Chemical Defoamer Types

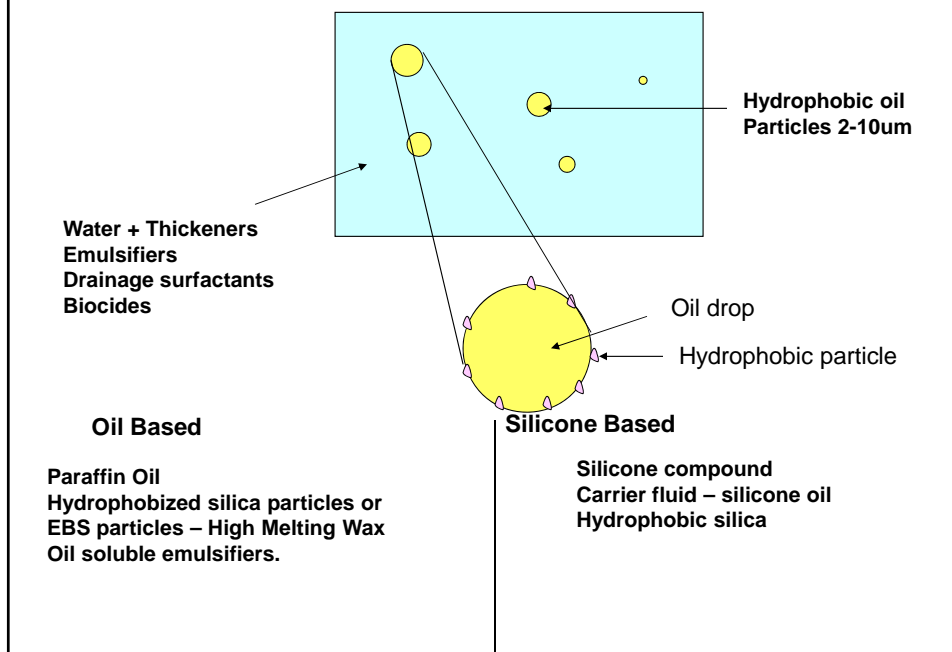
**Oil Based** - hydrocarbon oil carrier with EBS (amide) or silica particulate. Older technology. Newer products may be water extended. Older generation prone to deposits

**Silicone Emulsion** - stabilized silica particulate in silicone oil carrier, emulsified in water. May contain various silicone compounds for drainage. Common modern type of defoamer.

**Water Based**- fatty alcohol C12-C14 in a water carrier. Effective at lower temperares

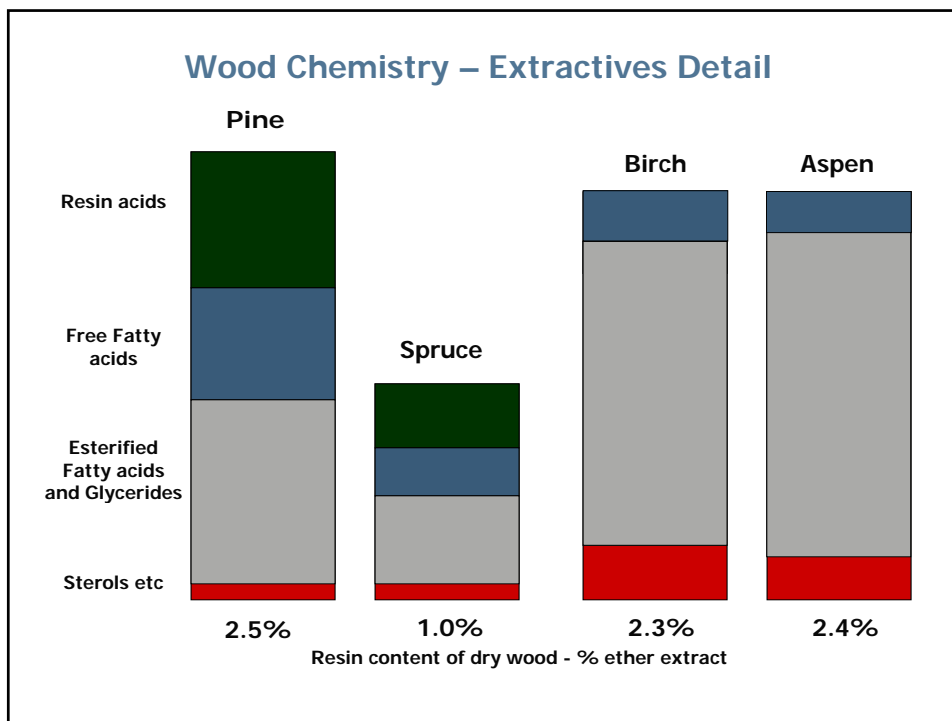
**Surfactant**- Concentrates

### ANATOMY OF AN EMULSION DEFOAMER



### What is Pitch?

- “Pitch” - is the collective term used to describe the **hydrophobic wood resin** materials found in the wood which “appear” in the Pulp process
- Resin - is a natural organic component of all trees
  - it functions as an energy storage source (fats) and a defense mechanism against disease and insects
  - it typically occurs in “free flowing” resin canals (most softwoods and some tropical hardwoods) and as a storage inclusion in parenchyma cells (predominant resin source in most hardwoods)
  - it makes up (typically) 1 to 6% of the wood volume (DCM extract), with higher concentrations in the bark and the heartwood (esp. in older trees)



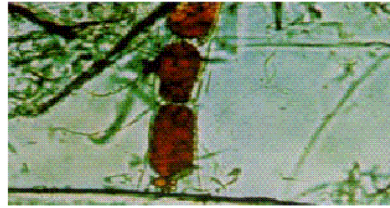


Figure 2.3.1: Encapsulated Pitch Within Fiber

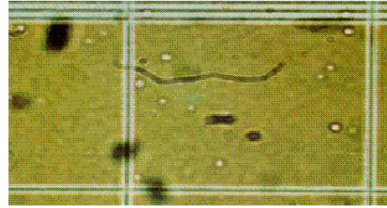


Figure 2.3.2: Free Colloidal Pitch

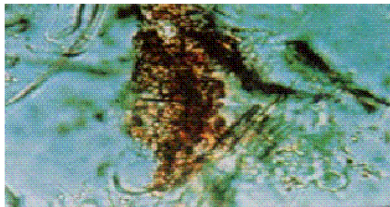


Figure 2.3.3: Aggregated Pitch in Water Phase

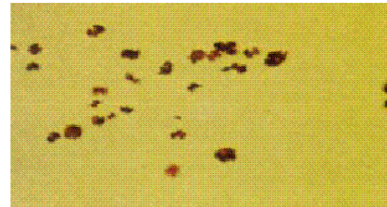


Figure 2.3.4: Precipitated (or Crystalized) Sudan IV Fat Stain

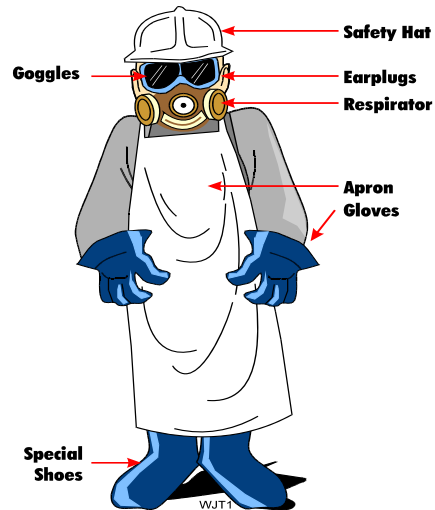
### Pitch Dispersant

#### 2 Main Chemical Types

**Surfactant** Products are combinations of non-ionic surfactants and anionic dispersants  
Used to make the hydrophobic 'Pitch" more Hydrophilic  
Ethoxylated Alcohol / Castor Oils

**Solvent** Products that remove or have a Creep effect or Stripping function  
Orange Terpenes / Biosolvents  
Batch Felt wash systems

## SAFETY ASPECTS & PERSONAL PROTECTIVE EQUIPMENT



## Defoamer Safety

Defoamer Product XXXX **IS NOT** a dangerous chemical

However:

Use gloves & safety glasses when handling.

Avoid contact with eyes and skin.

Locate nearest eyewash fountains.

Wash PPE thoroughly after handling.

Spills are slippery! Be cautious around feed stations and near addition points

- Have spill kit near by

Refer to MSDS.



## Surfactant Safety

XXXXXXXX **IS NOT** a dangerous chemical. However:

Use gloves & safety glasses when handling.

Avoid contact with eyes and skin.

Locate nearest eyewash fountains.

Wash PPE thoroughly after handling.

Spills are slippery! Be cautious around feed stations and near addition points

Refer to MSDS.

### MSDS / SDS HAZARD CLASSIFICATIONS

#### Typical Silicone Emulsion Defoamer

	HMIS	NFPA
Health	1	1
Flammability	1	1
Physical hazards	0	
Instability		0

#### Typical Surfactant Pitch Dispersant

	HMIS	NFPA
Health	2	2
Flammability	1	1
Physical hazards	0	
Instability		0

### SAFETY AND HANDLING TIPS

Know where MSDS's are located  
Keep MSDS's current



Always wash hands with soap before drinking, eating, smoking, etc. and at quitting time

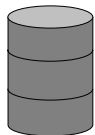
Refer to MSDS for potential health effects, first aid, PPE, or spill instructions

Keep adequate ventilation where chemicals are stored or used



### SAFETY AND HANDLING TIPS

Know where chemicals are in your workplace



Keep containers closed when not in use

Report any unlabelled chemicals



Never mix chemicals unless instructed to



Clean up or report spills immediately, post signs

## **SAFETY AND HANDLING TIPS**

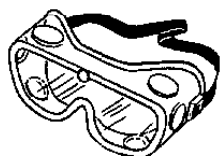
**Before handling any chemical locate the emergency showers and eyewash station. It should be no more than 10 seconds from the chemical hazard with an unobstructed approach.**

**Be sure they have been checked for proper operation.**

## **EYE PROTECTION**



**Safety Glasses** are the basic form of eye protection. They protect the eye from impact of flying particles.



**Splash-proof Safety Goggles** should be worn whenever there is a possibility of liquid chemical splashing.

**SAFETY GLASSES DO NOT  
COMPLETELY PROTECT YOUR  
EYES FROM CHEMICAL  
SPLASHING!!**

**USE SAFETY GOGGLES**

## **HAND PROTECTION**



**Gloves** are the most common protection for the hands. Glove material should be compatible with the hazard. Neoprene or butyl gloves are used for many chemicals.



Thank You

# An Alternative to Tile Lining of a D100 Washer Vat



October 7, 2014  
PAPTAC Bleaching Committee Meeting  
Kimberley, BC

CANFOR PULP LTD

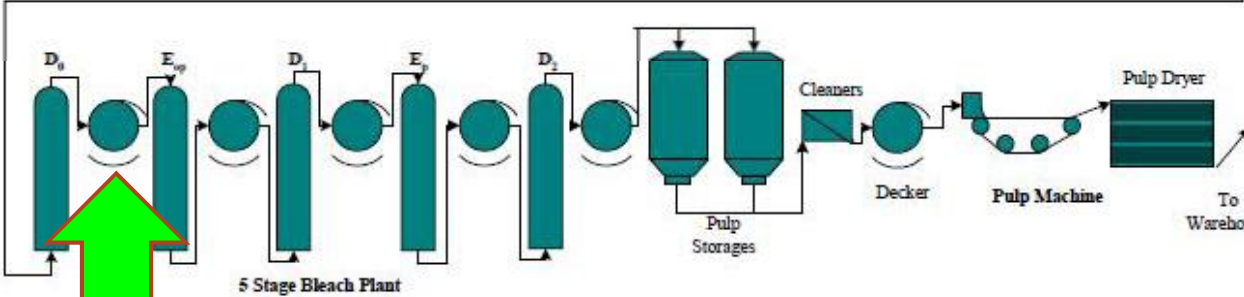
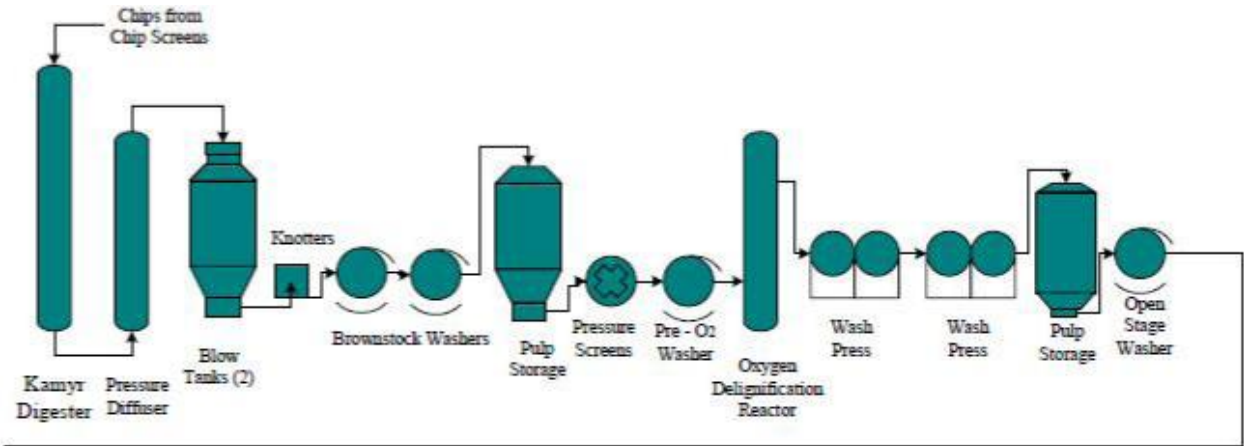
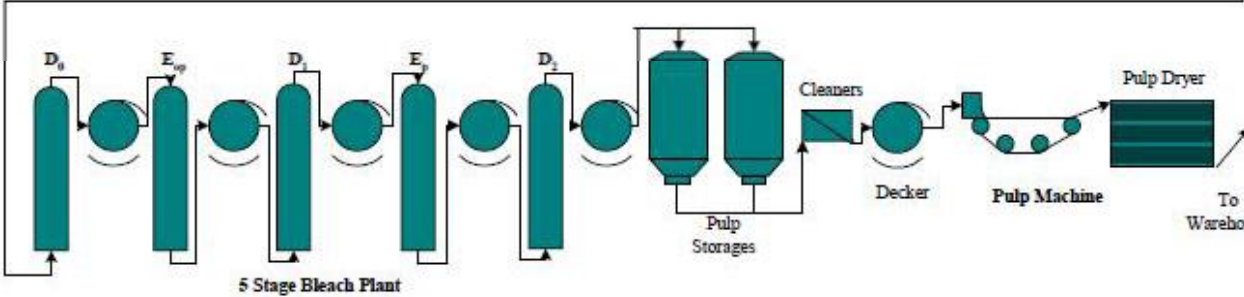
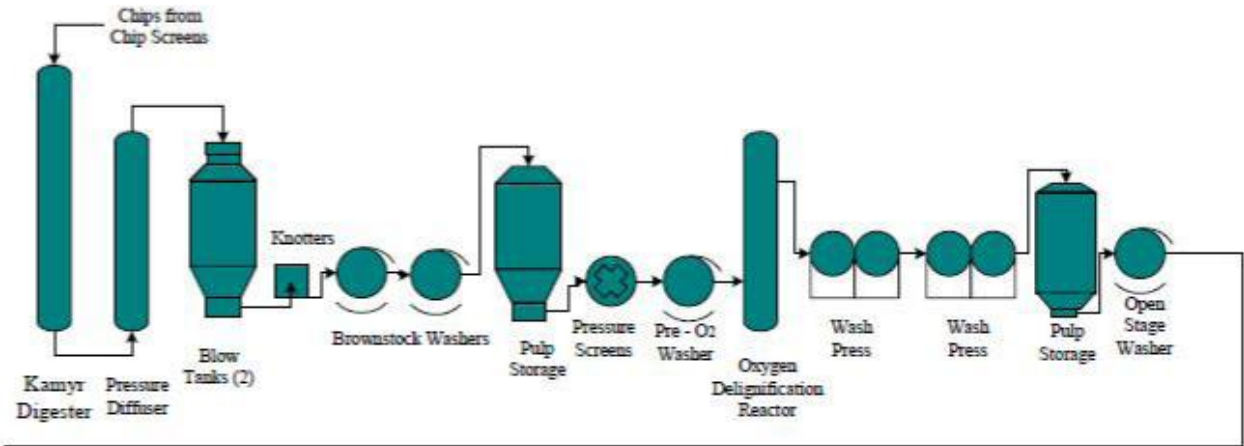
## Intercon Pulpmill



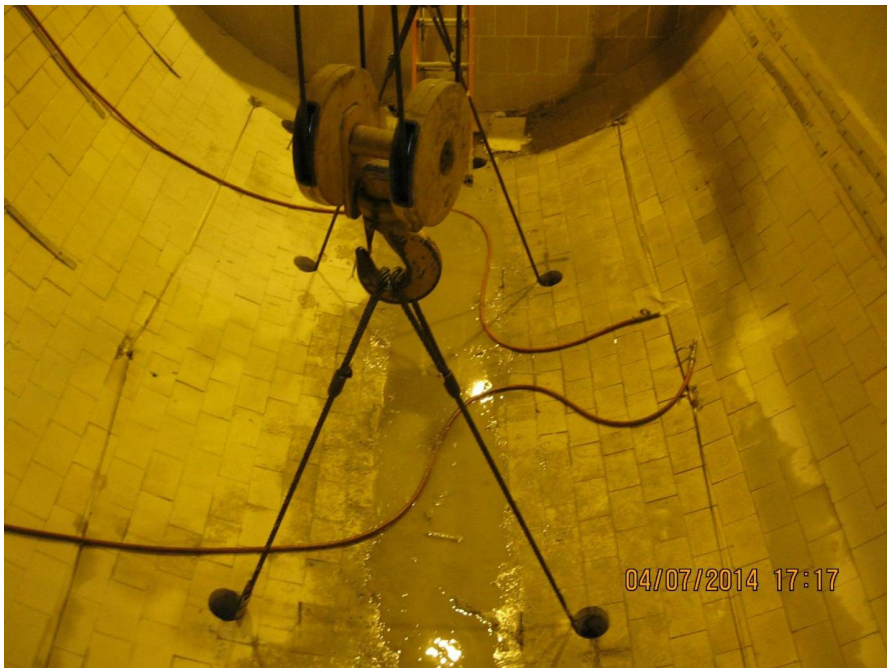
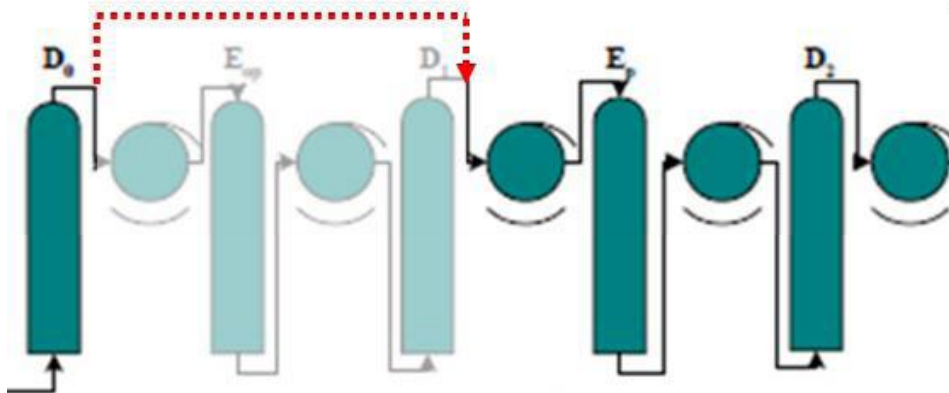
### Intercon:

- Located in Prince George, BC
- 1968 – Mill operation started
- Original design – 540 ADt/d
- Current production rate – 900 ADt/d NBSK
- 5-stage bleach plant sequence is DEopDEpD
- Bleach inter-stage washing – GL&V drum washers





- D100 washer vat identified for repair in concrete restoration program
- Work scheduled for April 2014 prior to major turn-around
- Two bleaching stages bypassed to allow work during regular production







- Vat removal
- Found work
  - Damaged brick of vat, repulper and end walls
- Major turn-around approaching
  - Resources committed to TA work

**An alternative required to complete project & found work without negatively impacting upcoming major turn-around**

- Grind & point inlet vat & repulper
- In place of brick & tile, coat vat with TL-220
- TL-220 – Flake glass vinyl ester membrane liner
- Formulation suited for chlorine dioxide bleaching
- TL-220 was successfully used for a repair to the #1 washer in the past
- Titanium washers embedded in high erosion areas of vat to help identify wear
- Washer vat scheduled for inspection during 2016 TA to assess membrane liner



# pH Control of E<sub>OP</sub> Stage

Laurier Morissette, M.Sc.A., ing.



• Bleaching Committee – Fall 2014: Skookumchuck, BC

•1

## E<sub>OP</sub> stage pH control: why do it?

- Significant savings in NaOH if end pH can be lowered without affecting brightness
  - Target reduction from 10.8 to 10.3 results in ~2.0-2.5kg/ton NaOH saving
  - At ~0.50\$/kg NaOH, this represents ~330,000-410,000\$/yr for a 1000 bdmt/d.

• Bleaching Committee – Fall 2014 : Skookumchuck, BC

•2

# $E_{OP}$ stage pH control: other incentives?

- Temperature affects how pH of  $E_{OP}$  filtrate behave
  - This is not temperature correction for the pH probe electronics
  - This is temperature compensation of solution
- Safety issue
  - Insertion/retraction of pH probe
  - Hot process media
  - High pH

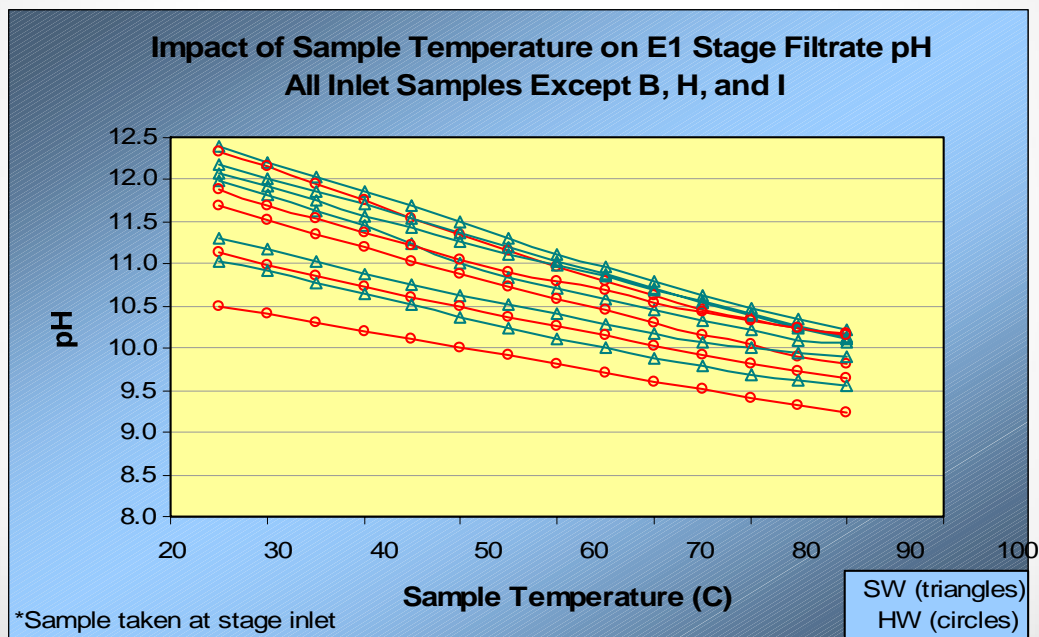
# $E_{OP}$ stage pH control: other incentives?

- Simplify and speed up preventive maintenance
  - Typically a long process for calibration
  - Insertion pH probe tends to have short life span (due to high temp, high pH, scaling)
  - Become insensitive with time (due to high temp, high pH, scaling)
  - Calibration accuracy
    - Measure in medium consistency pulp, calibrate in liquid

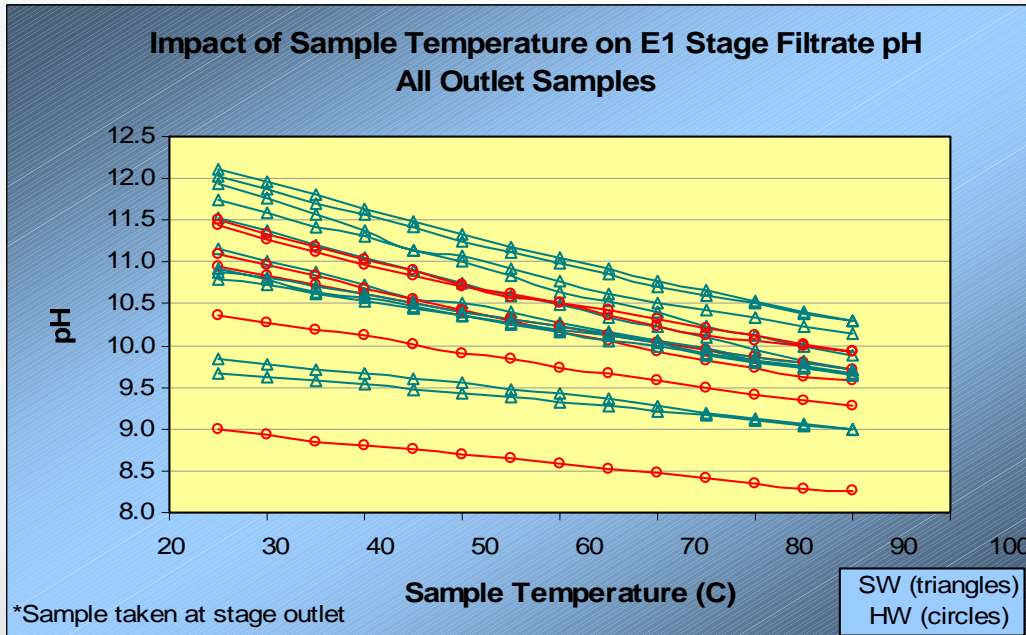
# $E_{OP}$ stage pH control: correction at 25°C

- Standardization at 25°C:
  - Report pH meter at 25°C at operator level
  - Report lab test at 25°C to the operator
  - Recommended 25°C because this is how pH are reported in technical papers by research facilities such as FPIinnovations
  - Allow comparisons from mill to mill
    - However, any fixed temperature standardization would work...
- Works for  $O_2$  stage &  $E_{OP}$  stage of hardwood and softwood

# $E_{OP}$ stage pH control: correction at 25°C



# E<sub>OP</sub> stage pH control: correction at 25°C



# E<sub>OP</sub> stage pH control:

Correction Table for E1 Stage Inlet pH

correction at 25°C

Sample Temperature (C)										pH Corrected to 25 C
90	80	70	60	55	50	45	40	35	30	
6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
9.02	9.05	9.07	9.09	9.10	9.10	9.10	9.10	9.10	9.10	9.10
9.09	9.13	9.16	9.18	9.19	9.19	9.19	9.20	9.20	9.20	9.20
9.15	9.20	9.24	9.27	9.28	9.29	9.29	9.30	9.30	9.30	9.30
9.20	9.26	9.32	9.36	9.37	9.38	9.39	9.39	9.40	9.40	9.40
9.25	9.32	9.38	9.44	9.45	9.47	9.48	9.49	9.49	9.50	9.50
9.28	9.36	9.44	9.51	9.51	9.55	9.57	9.58	9.59	9.60	9.60
9.31	9.40	9.49	9.57	9.57	9.63	9.66	9.67	9.69	9.69	9.70
9.33	9.43	9.54	9.63	9.63	9.70	9.74	9.76	9.78	9.79	9.80
9.35	9.45	9.57	9.68	9.68	9.77	9.81	9.84	9.87	9.89	9.90
9.37	9.48	9.60	9.72	9.72	9.83	9.88	9.92	9.95	9.98	10.00
9.38	9.49	9.63	9.76	9.76	9.88	9.94	9.99	10.03	10.07	10.10
9.39	9.51	9.65	9.79	9.79	9.92	9.99	10.05	10.11	10.16	10.20
9.40	9.52	9.67	9.82	9.82	9.96	10.04	10.11	10.18	10.24	10.30
9.41	9.54	9.68	9.84	9.84	10.00	10.09	10.17	10.25	10.33	10.40
9.42	9.55	9.70	9.87	9.87	10.04	10.13	10.22	10.32	10.41	10.50
9.43	9.56	9.72	9.89	9.89	10.08	10.18	10.28	10.39	10.49	10.60
9.44	9.57	9.74	9.92	9.92	10.09	10.19	10.29	10.40	10.50	10.70
9.46	9.59	9.76	9.95	9.95	10.14	10.24	10.41	10.54	10.67	10.80
9.47	9.60	9.78	9.98	9.98	10.16	10.26	10.43	10.57	10.70	10.90
9.48	9.61	9.79	10.00	10.00	10.18	10.28	10.45	10.60	10.74	11.00
9.49	9.62	9.80	10.01	10.01	10.20	10.30	10.48	10.63	10.76	11.10
9.51	9.66	9.85	10.08	10.20	10.33	10.43	10.61	10.76	10.90	11.10
9.53	9.69	9.90	10.14	10.26	10.41	10.57	10.72	10.88	11.04	11.20
9.56	9.73	9.95	10.20	10.34	10.49	10.65	10.81	10.98	11.14	11.30
9.60	9.77	10.01	10.28	10.42	10.57	10.74	10.91	11.08	11.24	11.40
9.64	9.83	10.07	10.36	10.50	10.66	10.84	11.00	11.17	11.34	11.50
9.69	9.89	10.15	10.44	10.59	10.76	10.93	11.10	11.27	11.44	11.60
9.75	9.96	10.23	10.53	10.69	10.85	11.03	11.20	11.37	11.54	11.70
9.82	10.04	10.32	10.63	10.78	10.95	11.13	11.30	11.47	11.64	11.80
9.90	10.12	10.41	10.72	10.88	11.05	11.23	11.40	11.57	11.74	11.90
9.98	10.21	10.50	10.82	10.98	11.14	11.33	11.50	11.67	11.84	12.00
10.07	10.30	10.60	10.92	11.08	11.24	11.43	11.60	11.77	11.94	12.10
10.16	10.40	10.70	11.02	11.17	11.34	11.52	11.70	11.87	12.04	12.20
10.26	10.50	10.80	11.12	11.27	11.44	11.62	11.80	11.97	12.14	12.30
10.35	10.59	10.90	11.22	11.37	11.54	11.72	11.90	12.07	12.24	12.40
10.45	10.69	11.00	11.32	11.47	11.64	11.82	12.00	12.17	12.34	12.50
10.55	10.79	11.09	11.42	11.57	11.74	11.92	12.10	12.27	12.44	12.60
10.65	10.89	11.19	11.52	11.67	11.84	12.02	12.20	12.37	12.54	12.70
10.75	10.99	11.29	11.62	11.77	11.94	12.12	12.30	12.47	12.64	12.80
10.85	11.09	11.39	11.72	11.87	12.04	12.22	12.40	12.57	12.74	12.90
10.95	11.19	11.49	11.82	11.97	12.14	12.32	12.50	12.67	12.84	13.00

# E<sub>OP</sub> stage pH control: How to do it?

- Safety issue
  - Recommend the use of filtrate extractor
    - Static type with filter screen
    - Piston type with squeeze mat
- Simplify and speed up preventive maintenance
  - Scarce E&I resources
  - Calibration liquid-liquid

# E<sub>OP</sub> stage pH control: How to do it?

- Filtrate extractor
  - Allow the use of cheaper pH probe
  - Safe handling of hot filtrate media
  - Faster calibration check
  - Use temperature measurement at pH probe location
    - Beware of built-in temperature measurement, here is it located on the probe
    - Use RTD on filtrate pot
  - Minimize deadtime with location close to pump/mixer
    - Also minimize piping diameter and pipe length to pH pot
  - Look for minimum 200-250ml/min filtrate flow
  - Flush back with combination of steam/hot water/air to avoid scaling deposit of filter screen and temperature shock of pH probe

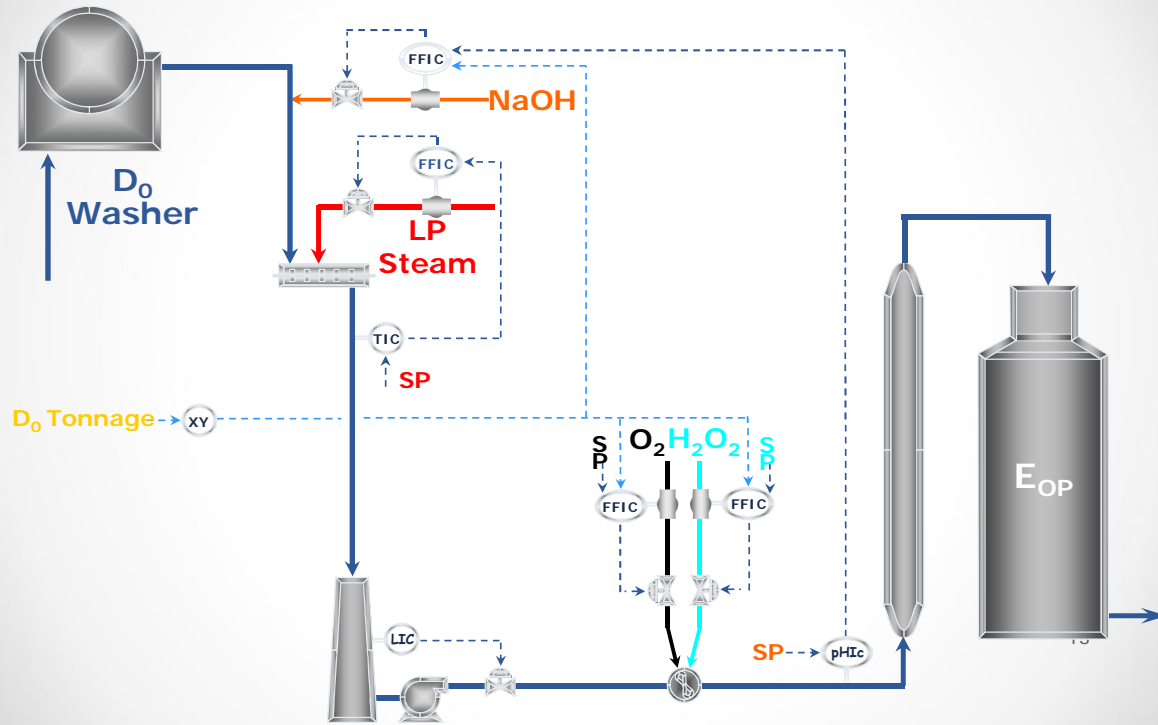
# $E_{OP}$ stage pH control: How to do it?

- pH probe preventive maintenance
  - Weekly
  - Use pH buffer 7 and 10, higher if available
  - Replace probe at fixed date
    - Have a historical tracking of pH probe
    - You may lose your accumulated savings by trying to extend probe life to failure.
  - When replacing a pH probe, always double check the next day. Somehow it needs to “cure in process media”

# $E_{OP}$ stage pH control: control

- NaOH dosage is added as kg/ton, lb/ton or % applied
- Monitor NaOH/ $ClO_2$  ratio – back up control
  - Indication of potential issues
- PID controller to be Lambda tune
  - with possible gain schedule on tonnage
- Multiple cascades loop possible
  - End pH is what we're after
    - Achieved by better control of pH early on
  - pH at top of upflow pipe or tube
    - before pressure control valve if present
  - End pH
    - at the bottom of downflow tower some 5 ft above dilution ring
    - In the vat

# $E_{OP}$ stage pH control:



• Bleaching Committee – Fall 2014 : Skookumchuck, BC

# $E_{OP}$ stage pH control: control

- Multiple cascades loop possible
  - Permissive: time delay for PID on top of upflow tube
  - Permissive: time delay for PID at end of tower
  - Lambda tuned with gain schedule based upon tonnage
- Troubleshooting: when pH loop starts cycling, this is a strong indication pH probe has become insensitive
  - Don't retune the loop!!!
  - Change pH probe.

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**CHEMSTONE, INC.**

“Chemistry that works for Industry”

## X stage—where are they going next?

Art Meusel

Paptac Bleaching Committee

October 2014

### Overview- Supply

- No major basic enzyme manufacturer is selling direct to the P&P Industry
- Many basic manufacturers sell to several Industry suppliers, a few P&P suppliers have exclusivity
- One P&P supplier has 20+ years of experience in fiber modification in P&P. They are the new Industry leader.
- Some P&P suppliers are simple direct resellers
- But at least one is making down concentrates, blending different combinations, creating new products

# So now picking an enzyme supplier is more difficult...what to ask

- Experience in Product AND Application?
- Mill references?
- Lab capabilities
  - Bleaching
  - Matching applications and performance
  - Prove their concepts
- Automated equipment
- Support systems
  - Data analysis
  - Onsite and Lab testing

3

## Expectation for Product offerings from a quality P&P supplier

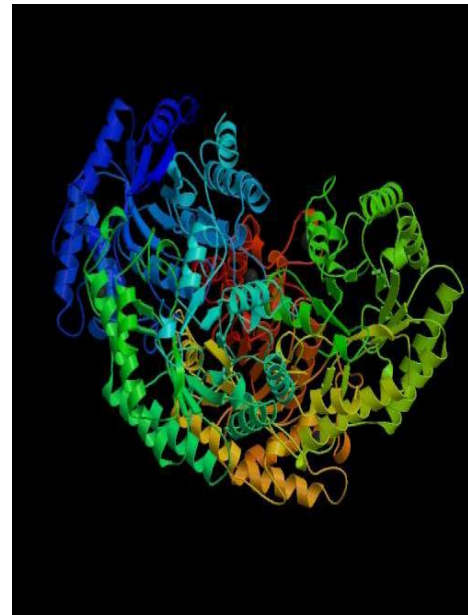
Enzyme Type	pH and Temperature
<b>Endoglucanase with lignin tolerance</b>	4.5 – 7.5 / 30 – 65 °C
Cellulase (Multi)	4.5 – 7.5 / 30 – 65 °C
Cellulase (EG)	4.5 – 8.5 / 30 – 65 °C
<b>Monocomponent Xylanase with varying pH &amp; temperature thresholds</b>	5.0 – 8.0 / 40 – 85 °C
<b>Combination Hemicellulase with variable pH &amp; temperature optimums</b>	4.5– 8.0 / 48 – 74 °C

4

# Fundamentals

## What are Enzymes?

- Protein molecules made up of hundreds of amino acids
- Biocatalysts (substances that accelerate certain reactions without being consumed themselves)
- Occur throughout nature, very specific and generally safe
- Functional chemistry given the right conditions



## Enzyme creation process

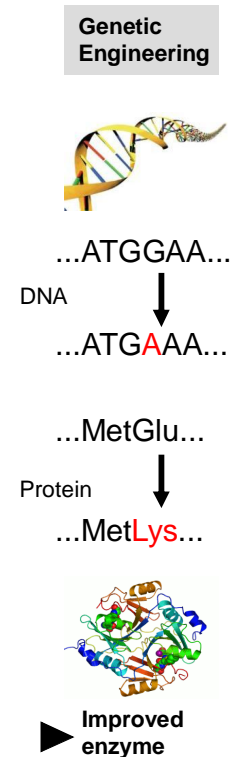
Some P&P suppliers have created alliances with basic manufacturers engaging multiple R&D resources to resolve problems



# Enzyme Creation Process

## Key Properties: Sequencing and Folding

- The sequence of nucleotides in the DNA determines the sequence of amino acids in protein
- The sequence of amino acids determines enzyme properties
- Resultant protein is folded in a specific way which determines that enzyme function
- So do the combination of different enzymes generate different results?



## Is there value to combined enzymes?

- Different wood baskets have varying susceptibilities
- Ability to create new applications/grades/markets
  - Chemical cost, strength, brightness, whiteness, less reversion, improved specialty functionality
- Specificity of Application (no side reactions)

# Can new value be created with combined enzymes?

Species	$\alpha$ -Cellulose	$\alpha$ -Cellulosea	Lignin	Acetyl	Ash	Uronic Anhydride	Galactan	Glucan	Mannan	Araban	Xylan
<b>Hardwoods</b>											
Trembling aspen ( <i>Populus tremuloides</i> )	56.5	53.3	16.3	3.4	0.2	3.3	0.8	57.3	2.3	0.4	16.0
White birch ( <i>Betula papyrifera</i> )	44.5	41.0	18.9	4.4	0.2	4.6	0.6	44.7	1.5	0.5	24.6
Red maple ( <i>Acer rubrum</i> )	44.8	44.1	24.0	3.8	0.2	3.5	0.6	46.6	3.5	0.5	17.3
<b>Softwoods</b>											
Balsam fir ( <i>Abies balsamea</i> )	47.7	44.8	29.4	1.5	0.2	3.4	1.0	46.8	12.4	0.5	4.8
Eastern white cedar ( <i>Thuja occidentalis</i> )	48.9	45.4	30.7	1.1	0.2	4.2	1.5	45.2	8.3	1.3	7.5
Jack pine ( <i>Pinus banksiana</i> )	45.0	41.6	28.6	1.2	0.2	3.9	1.4	45.6	10.6	1.4	7.1
White spruce ( <i>Picea glauca</i> )	48.5	44.8	27.1	1.3	0.3	3.6	1.2	46.5	11.6	1.6	6.8

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## PRE-BLEACH



### Features

Latest generations of thermo-stable hemicellulase combinations

### Advantages

The opportunity to match species and wood basket to improve susceptibility match for highly effective catalyzing the cleavage hemicellulose polymers. Degrades portion of the hemi present on the fiber surface.

### Benefits

Enables bleaching chemicals to more effectively attack lignin in the fiber & removes certain portions where hemi attachment dissolution releases lignin

10

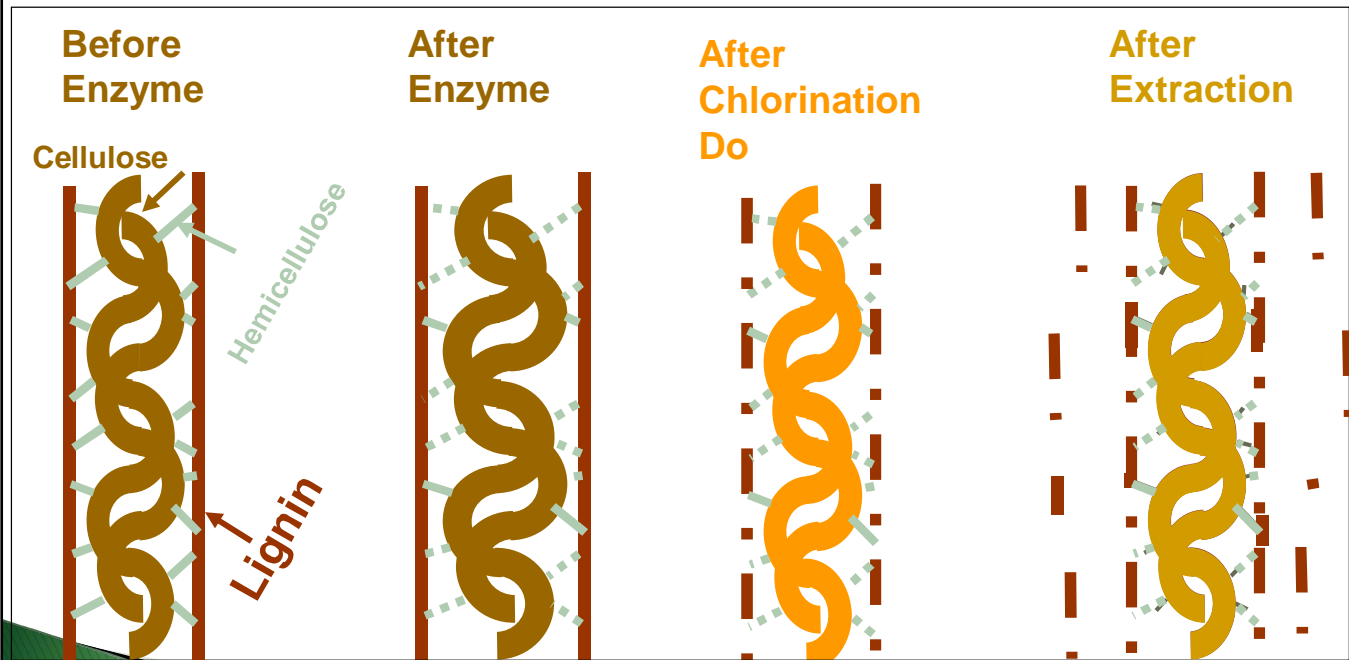
# POTENTIAL BENEFITS

## Enzyme Pre-Bleaching

- Increased Brightness
- Increased production where generator limited
- Lower bleaching chemicals/costs

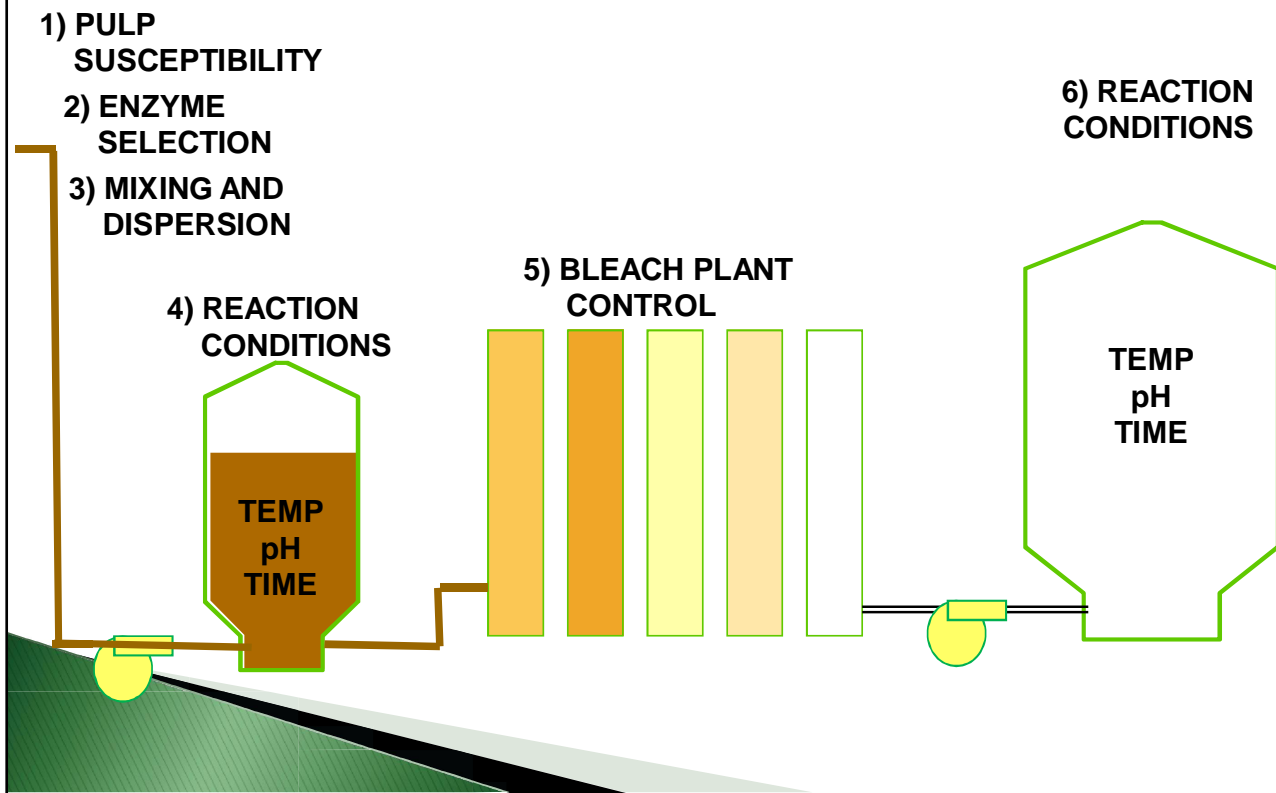
11

## How pre-bleaching enzymes work



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# APPLICATIONS – BLEACHING



Regardless of where...You must have fit!

## Critical process fit has not changed

- Multiple thermo-stable hemicellulases with broad pH range of 6-9 (Optimal 6.5-7.5)
- Temperature range 40-77°C (optimal 45-65°C)
- Minimum contact time 20 minutes
- Low dose range requires near perfect mixing
- No cellulase activity- a taboo no longer?

## Post Bleach Enzyme

Enzyme treatment of bleached pulp to enhance brightness and whiteness and reduce reversion prior to the paper machine or pulp dryer

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## Potential Post Bleach Benefits

- ▶ **Easy fit to most Operations**
  - pH/Temp/retention rarely a concern
  - Typically largest storage is Bleached HD's
- ▶ **Higher Pulp Brightness**
- ▶ **Bleach Plant Chemical savings**
- ▶ **b\* reduction**
- ▶ **Less Brightness Reversion**
- ▶ **Operational flexibility**

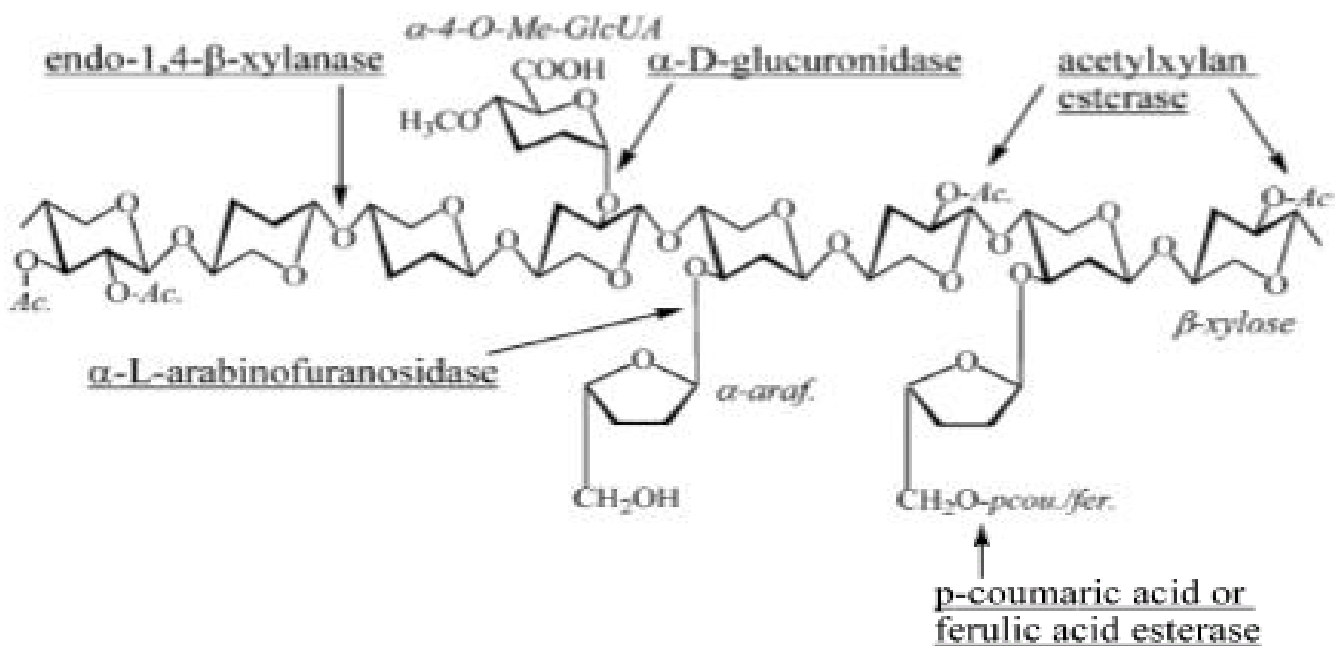
16

# How Does Post Bleach Work?

- ▶ Residual chromophoric materials remaining in bleached pulp
  - Lignin
  - Degraded carbohydrates
  - Extractives
  - Metals and various oxidizable compounds
- ▶ Conventional bleaching chemicals are not effective
- ▶ Removing enzymatically
  - Boosts brightness
  - Reduces  $b^*$  (yellowness)

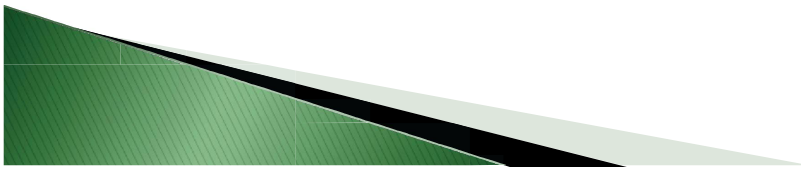
17

## Potential for removal of Chromophores Attached/Linked to Hemi-Cellulose



# That's all folks!

- ▶ **Future may be in combinations:**
  - **Multiple mono components?**
  - **Multi component?**
- ▶ **Industry needs to share their needs & demands**
- ▶ **Remove the conventional barriers to solution**

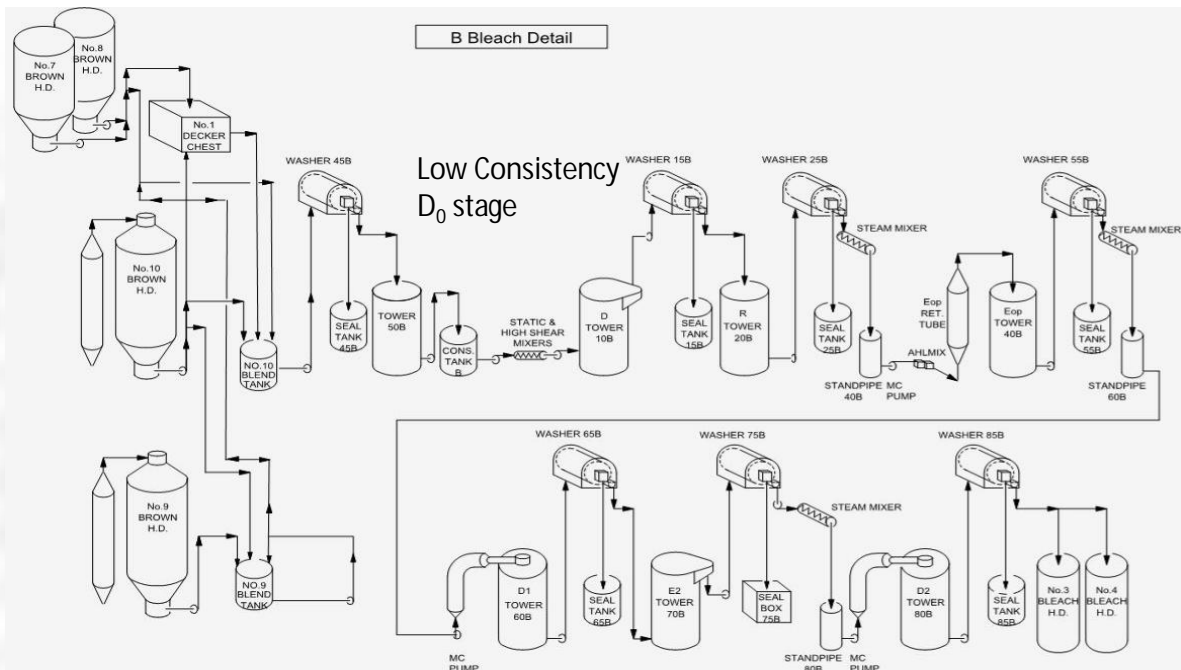


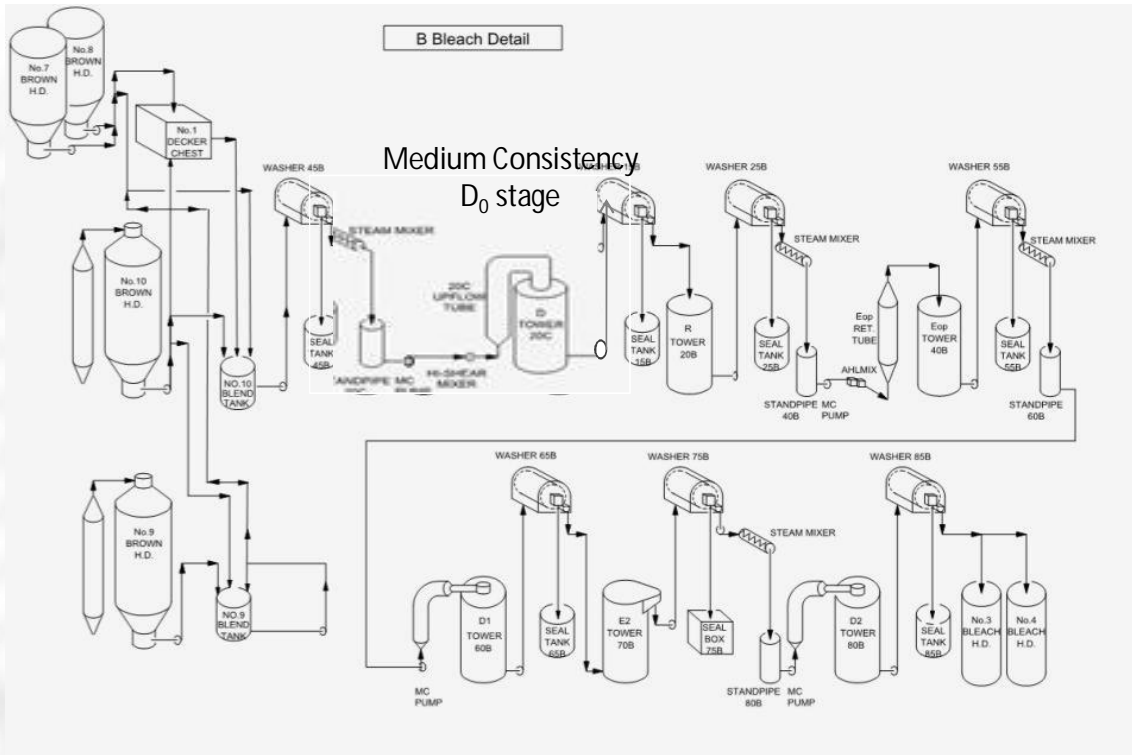
# D<sub>0</sub> Conversion



PAPTAC Bleaching Committee  
October 2014

## B Bleach



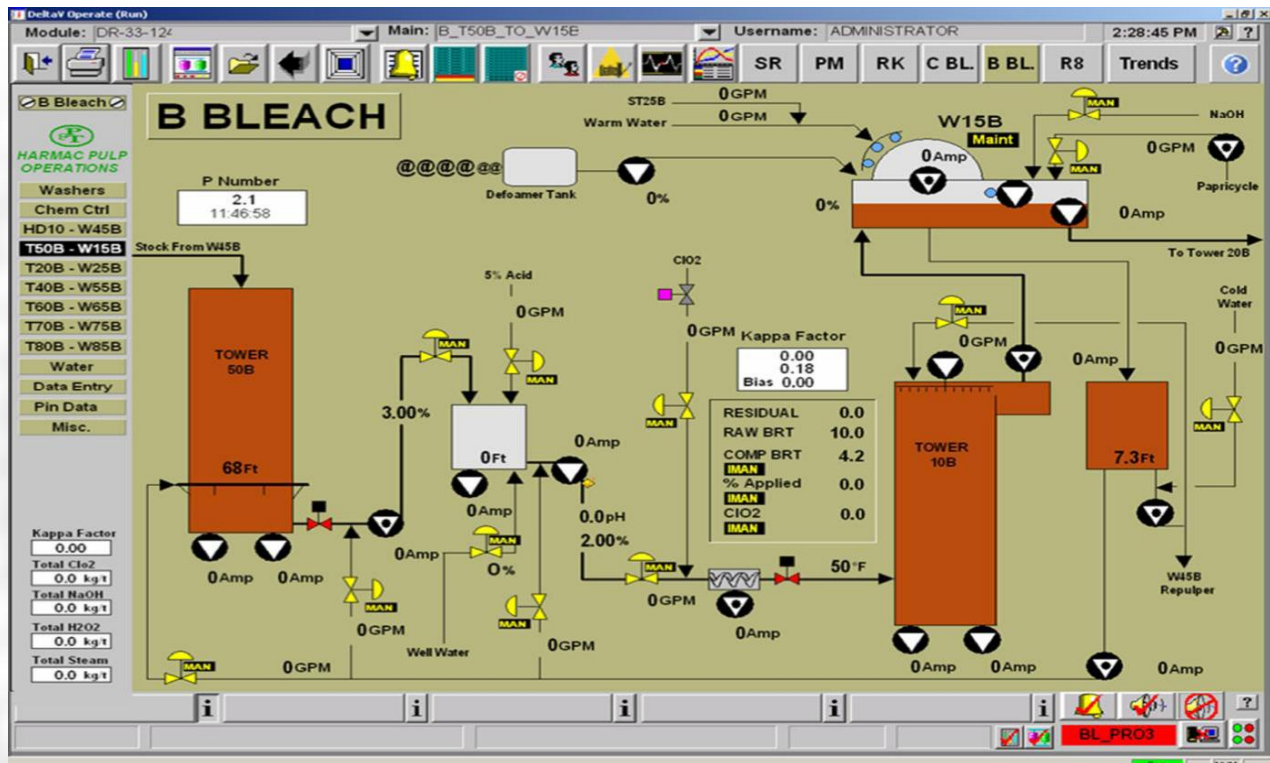


## Objectives

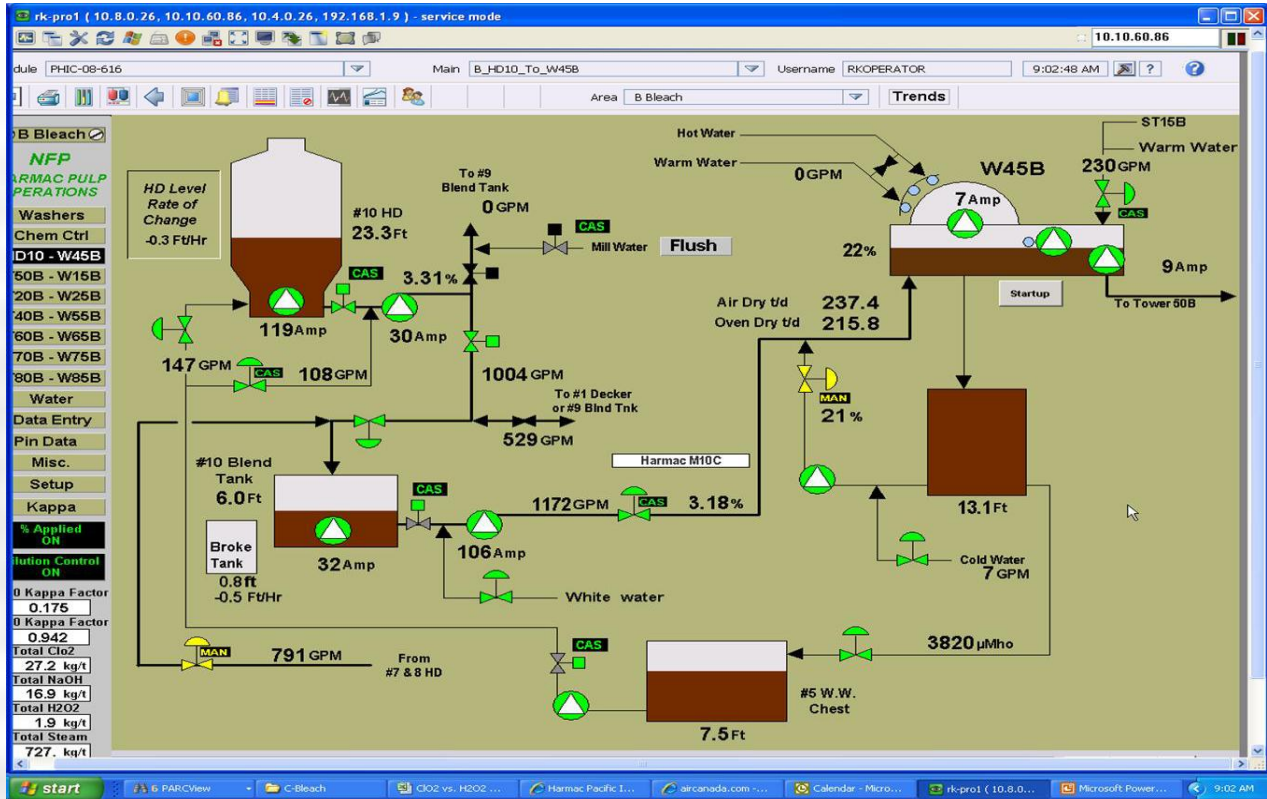
- Increase stock consistency and retention time at D<sub>0</sub>
- Reduce filtrate volume, reduce bleach plant COD
- Reducing ClO<sub>2</sub> consumption in the overall bleaching process
- Increase storage capacity in B bleach
- Reduce installed horsepower in process
- Improve process temperature with reducing water dilution dependence and adding a steam mixer to medium consistency stock

- Remove steam mixer from T40A and recondition. Install steam mixer below washer 45B
- Install drop chute to basement MC chute. Install MC chute and pump
- Install SS piping on discharge of MC Pump to ClO<sub>2</sub> mixer

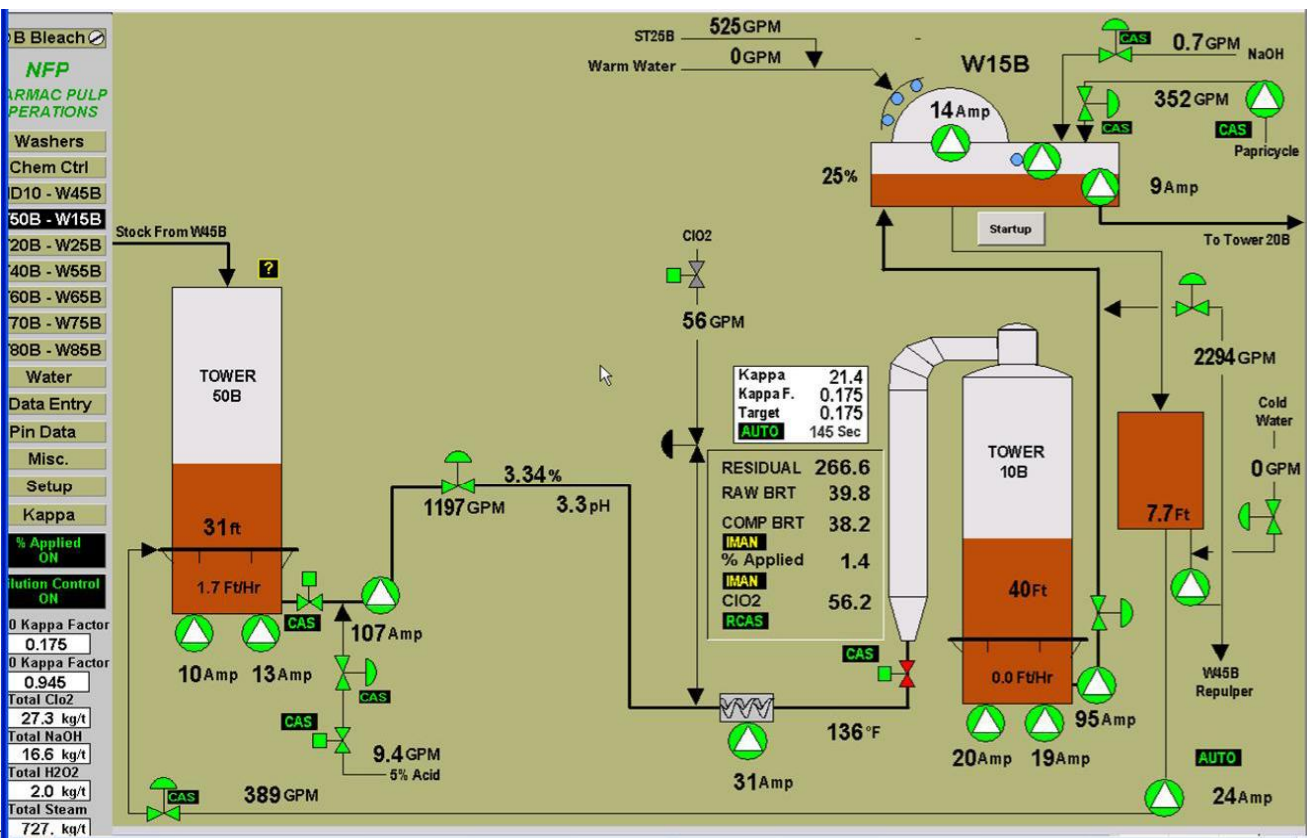
## Old LC D<sub>0</sub>



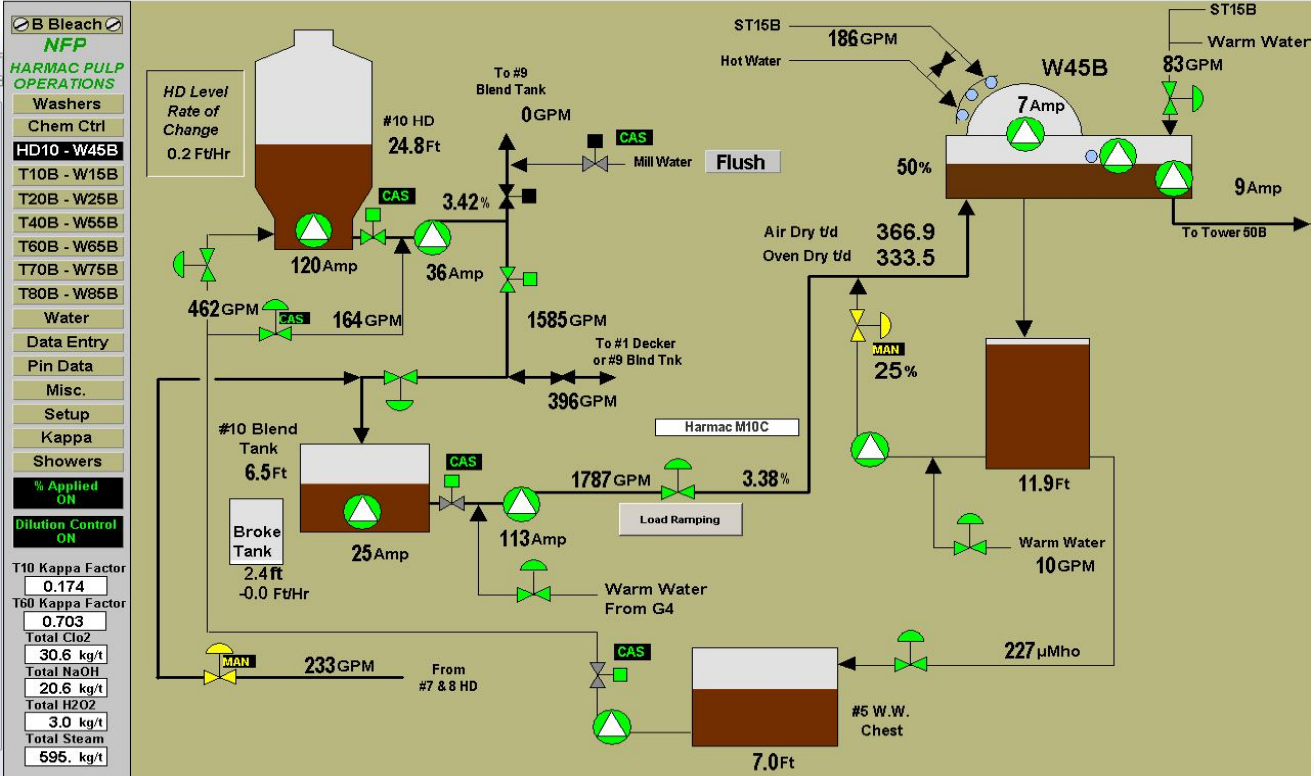
# Interim LC D<sub>0</sub>



# Interim LC D<sub>0</sub>



# Final MC D<sub>0</sub> Stage



B Bleach

**NFP**

**HARMAC PULP OPERATIONS**

Washers

Chem Ctrl

**HD10 - W45B**

T10B - W15B

T20B - W25B

T40B - W55B

T60B - W65B

T70B - W75B

T80B - W85B

Water

Data Entry

Pin Data

Misc.

Setup

Kappa

Showers

% Applied **ON**

**Dilution Control ON**

T10 Kappa Factor 0.174

T60 Kappa Factor 0.703

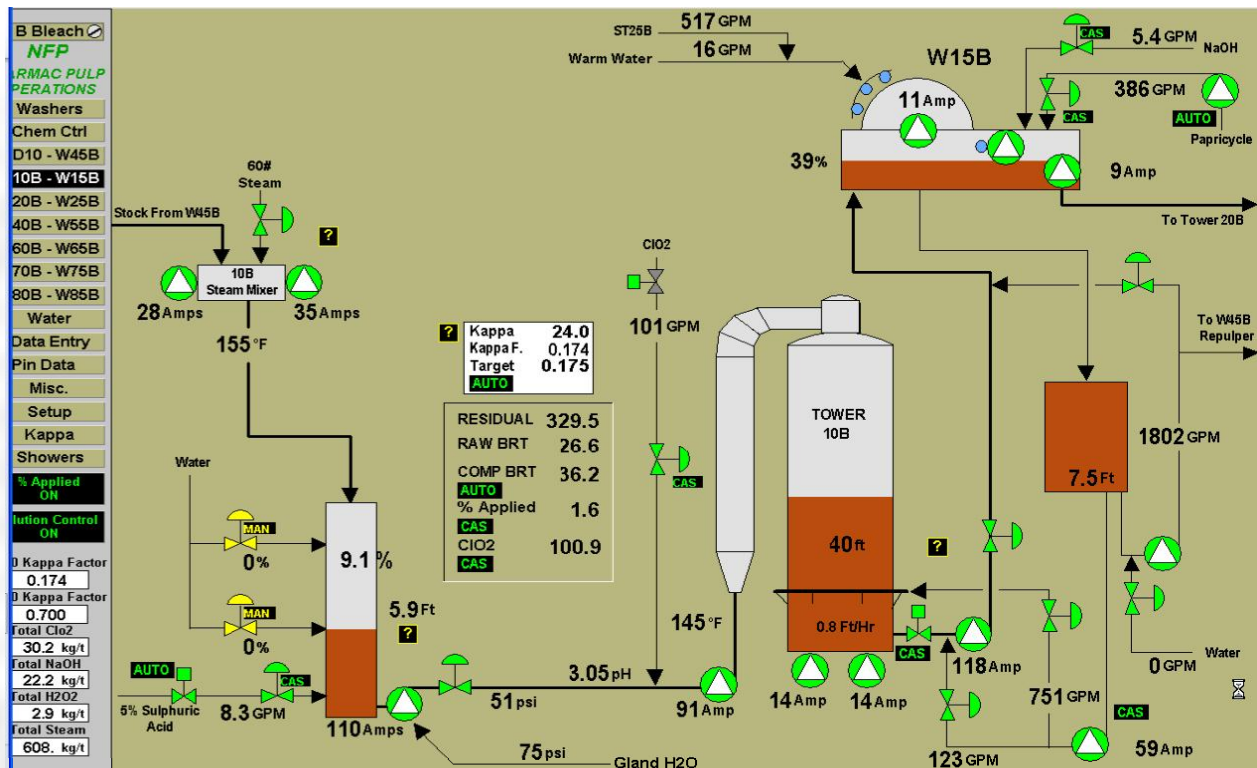
Total ClO<sub>2</sub> 30.6 kg/t

Total NaOH 20.6 kg/t

Total H<sub>2</sub>O<sub>2</sub> 3.0 kg/t

Total Steam 595. kg/t

# Final MC D<sub>0</sub> Stage



B Bleach

**NFP**

**HARMAC PULP OPERATIONS**

Washers

Chem Ctrl

**D10 - W45B**

**10B - W15B**

20B - W25B

40B - W55B

60B - W65B

70B - W75B

80B - W85B

Water

Data Entry

Pin Data

Misc.

Setup

Kappa

Showers

% Applied **ON**

**Dilution Control ON**

D Kappa Factor 0.174

D Kappa Factor 0.700

Total ClO<sub>2</sub> 30.2 kg/t

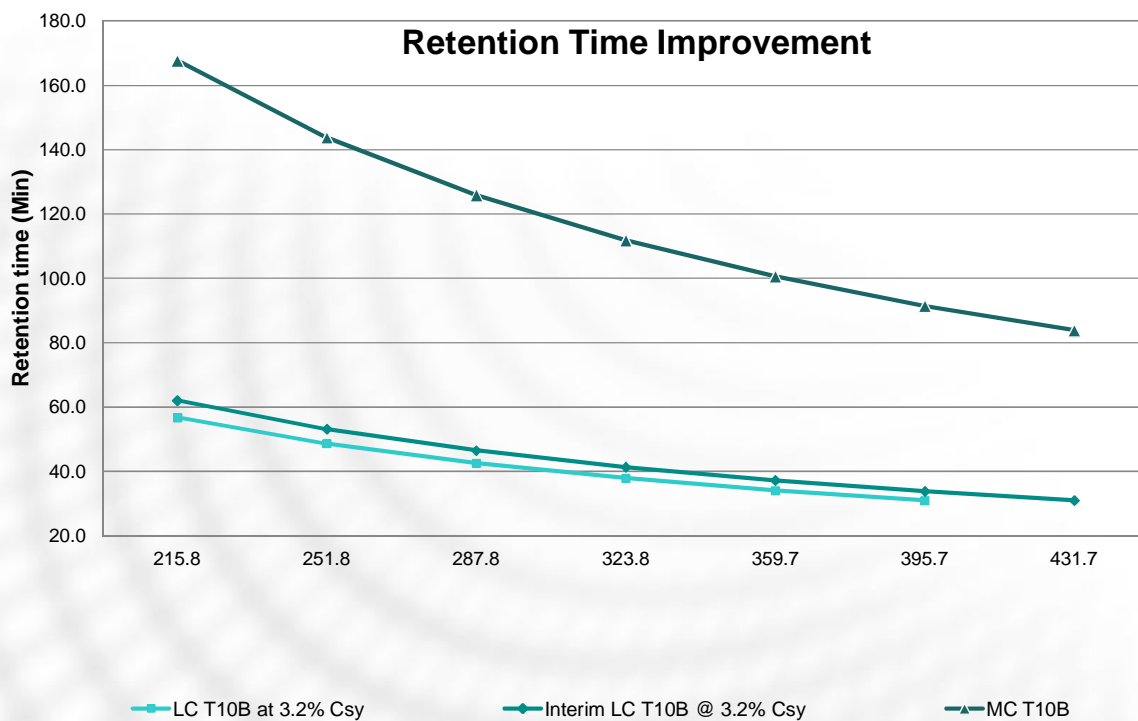
Total NaOH 22.2 kg/t

Total H<sub>2</sub>O<sub>2</sub> 2.9 kg/t

Total Steam 608. kg/t

**Process Parameters:**

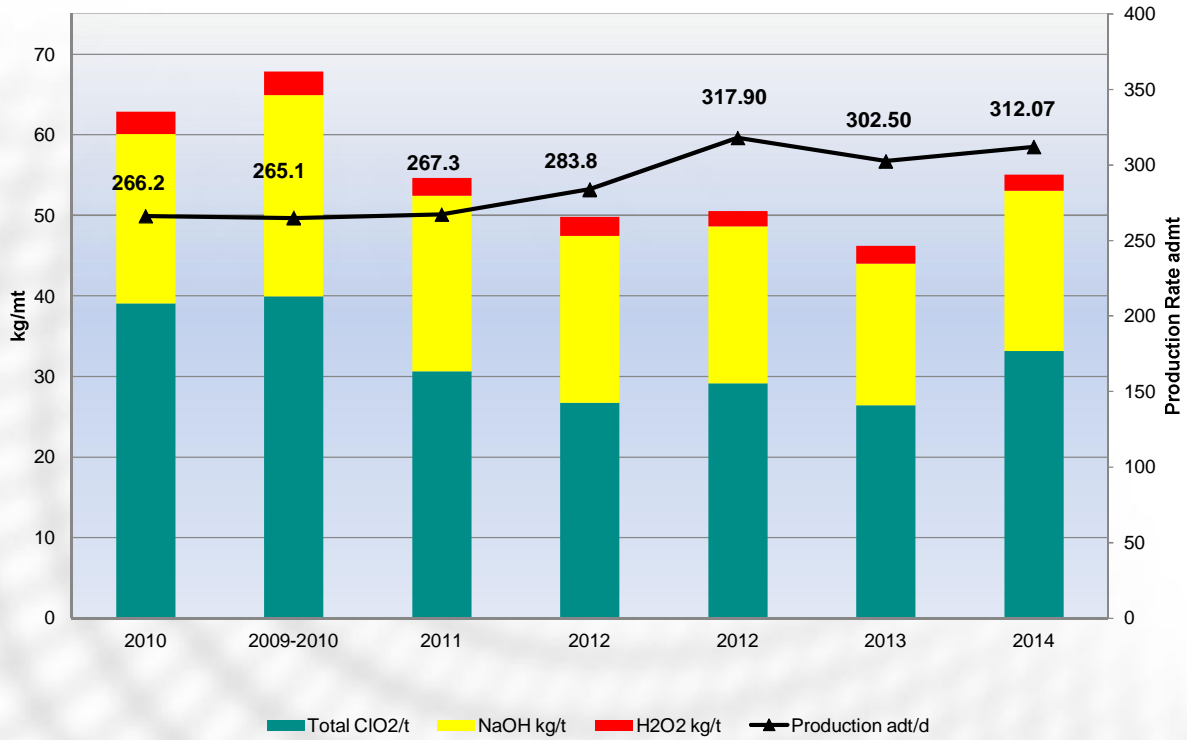
- Kappa: 24.0
- Kappa F: 0.174
- Target: 0.175
- % Applied: 1.6
- ClO<sub>2</sub>: 100.9
- RESIDUAL: 329.5
- RAW BRT: 26.6
- COMP BRT: 36.2
- 5% Sulphuric Acid: 8.3 GPM



## Condition and results @ Avg. 255admt/d

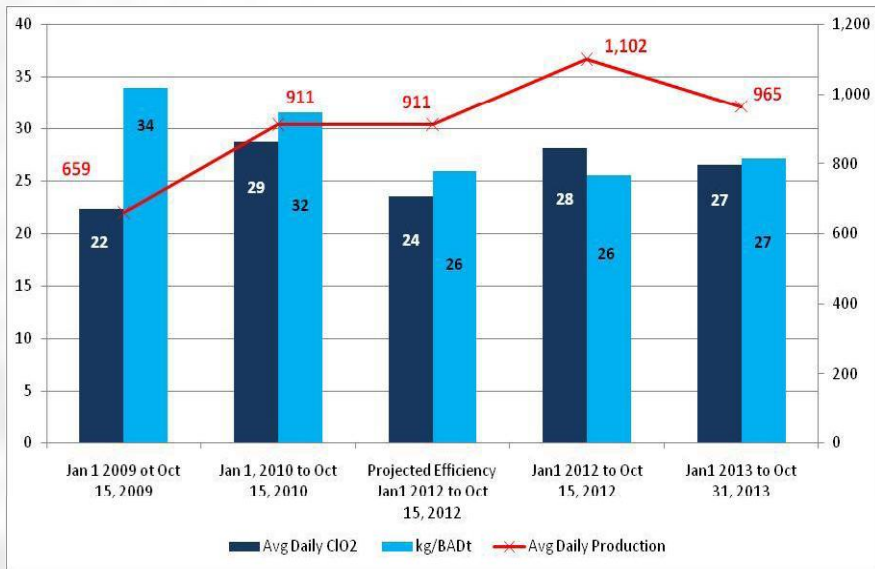
	Consist (%)	Retention Time (min)	Temp. (° C)	D <sub>0</sub> Kappa Factor	Brightness D <sub>0</sub> (EOP)	D1 Kappa Factor
LC D <sub>0</sub>	3.2	48.7	43.3	0.17	46.6	0.95
Interim LC D <sub>0</sub>	3.4	56.5	53.3	0.17	49.1	0.83
MC D <sub>0</sub>	10.0	143.8	58.9	0.17	54.5	0.77

# B Bleach Chemical Usage Results



## Energy Savings

NaClO <sub>3</sub> to ClO <sub>2</sub> Conversion Factor	1.67
NaClO <sub>3</sub> Conversion to ClO <sub>2</sub> efficiency	93.70%
Total NaClO <sub>3</sub> Savings	2,030 Tonnes
NaClO <sub>3</sub> Electrical Energy Input	5,175 Kw-hr/tonne
Total Electrical Energy Savings	10,503,278 Kw-hr
Total Electrical Energy Savings	37,812 GJ



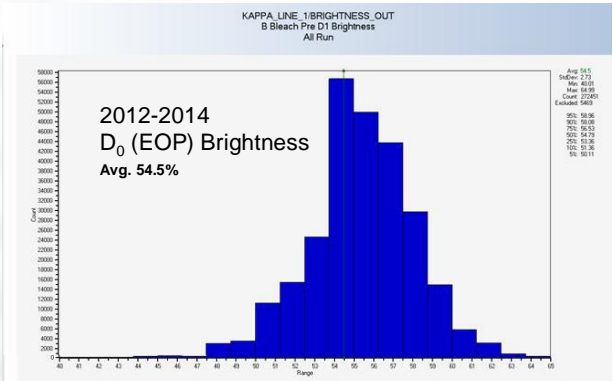
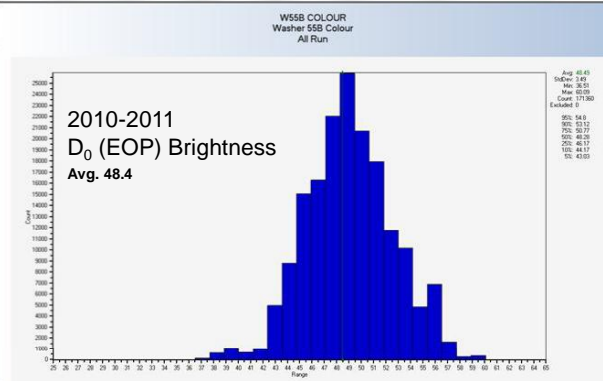
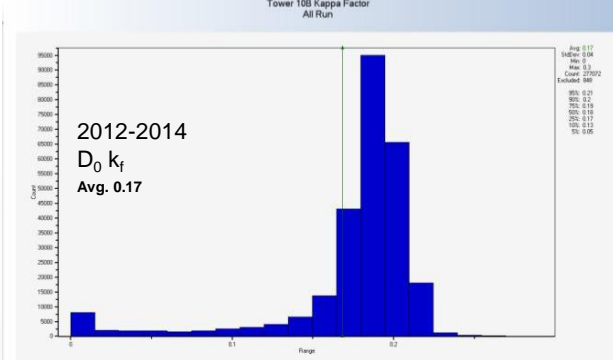
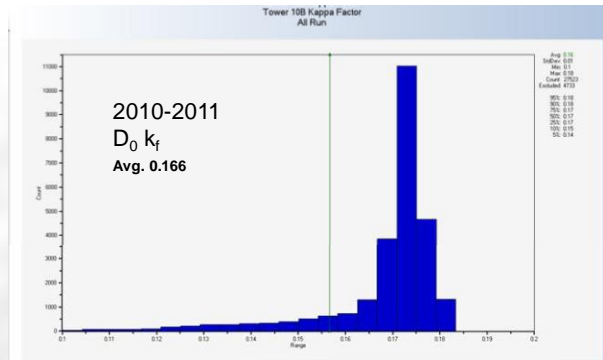
<b>CIO2 Efficiency</b>						
	CIO2 Generation (tonnes)	Avg Daily ClO2	Production (ADMT)	Avg Daily Production	Tonnes Pulp/Tonne ClO2	kg/BADt
Jan 1 2009 to Oct 15, 2009	6,420	22	189,062	659	29	34.0
Jan 1, 2010 to Oct 15, 2010	8,261	29	261,527	911	32	31.6
Jan1 2013 to Oct 31, 2013	7,939	26.6	292,272	965	36	27.2
<b>Projected Efficiency and ClO2 Savings- 2012:</b>						
Projected Efficiency Jan1 2012 to Oct 15, 2012	6,800	24	261,527	911	39	<b>26.0</b>
Projected Annual Savings - Tonnes of ClO2 (340,000 TPY)	2,735					
Factor by 0.4	<b>1,094</b>				32.5	
<b>Achieved Efficiency and ClO2 Savings- 2012:</b>						
Jan1 2012 to Oct 15, 2012	8,121	28	317,456	1,102	39	<b>25.6</b>
Annual Savings - Tonnes of ClO2 (340,000 TPY)	2,847					
Factor by 0.4	<b>1,139</b>				32.7	

## Achieved Benefits

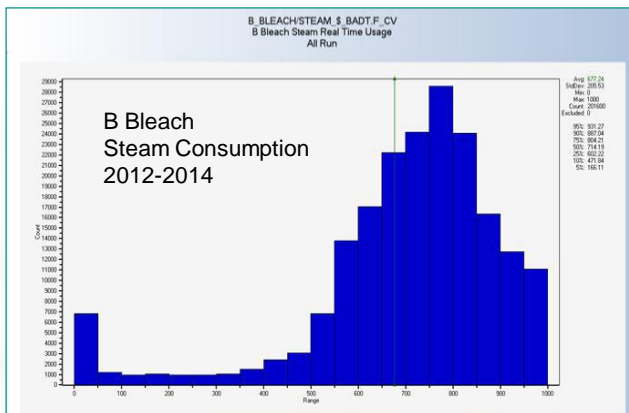
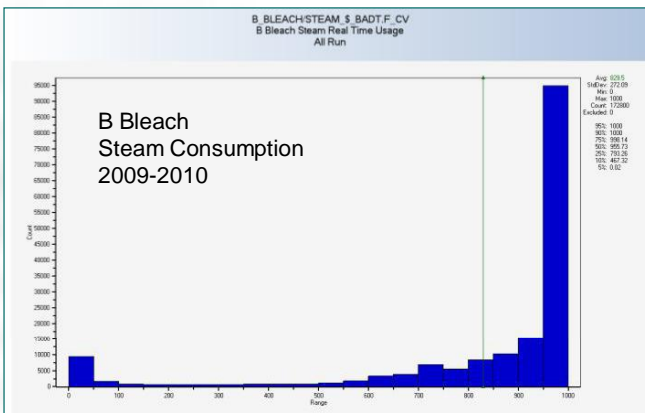
- Overall ClO2 usage improvement in B bleach
- B Bleach D<sub>0</sub> maintenance cost reduction
- 200hp power usage reduction
- Storage capacity increase in B bleach
- 10% total chemical cost reduction

# Thank You

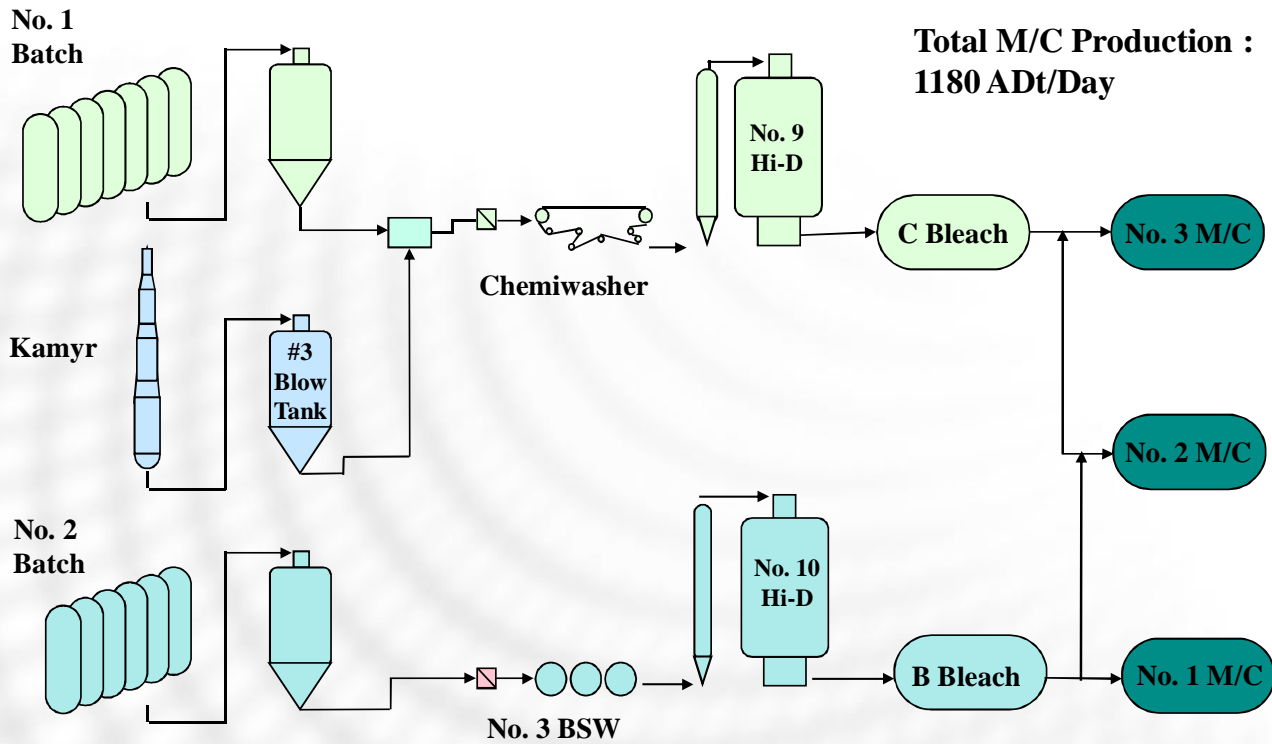




## B Bleach Steam







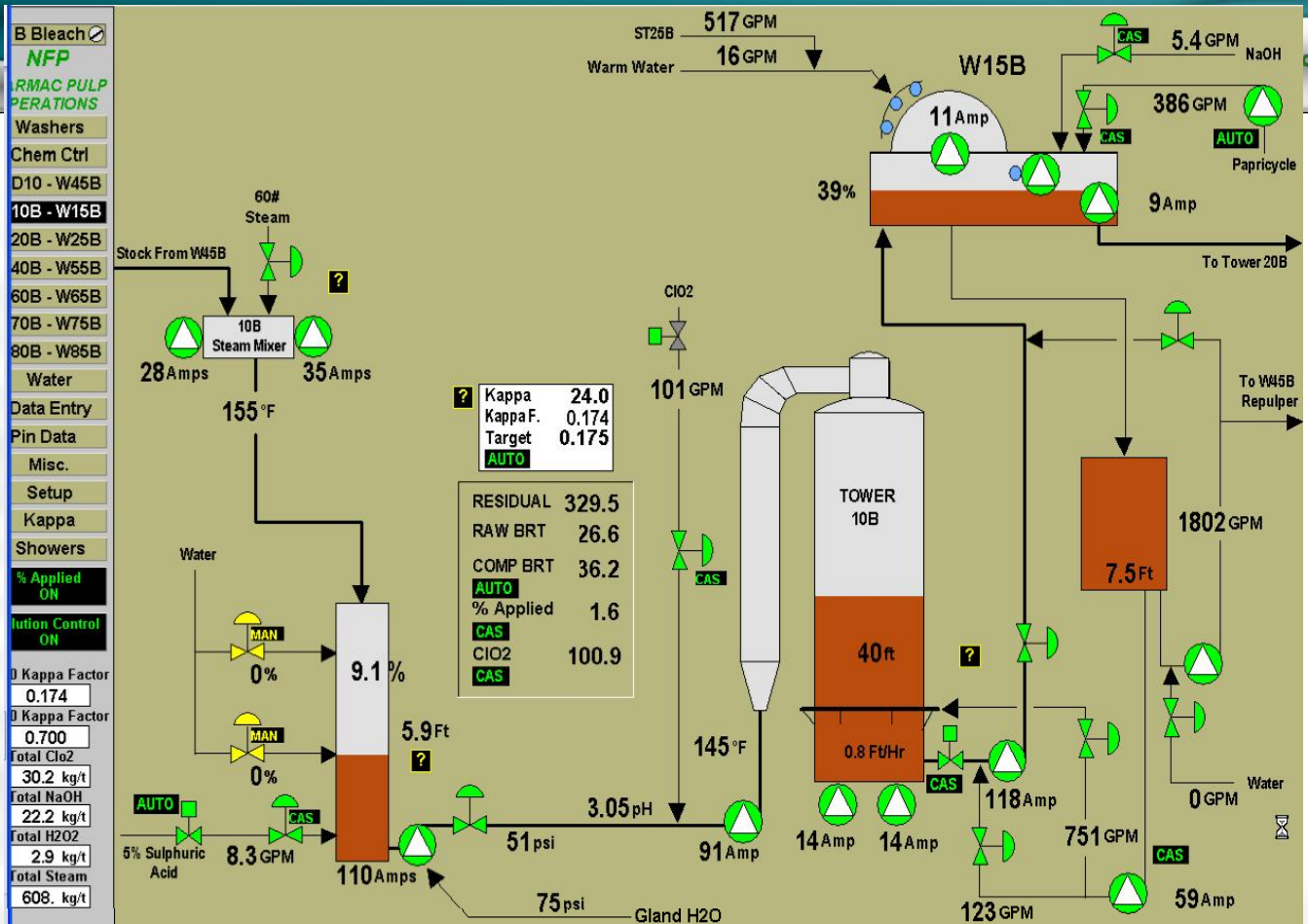
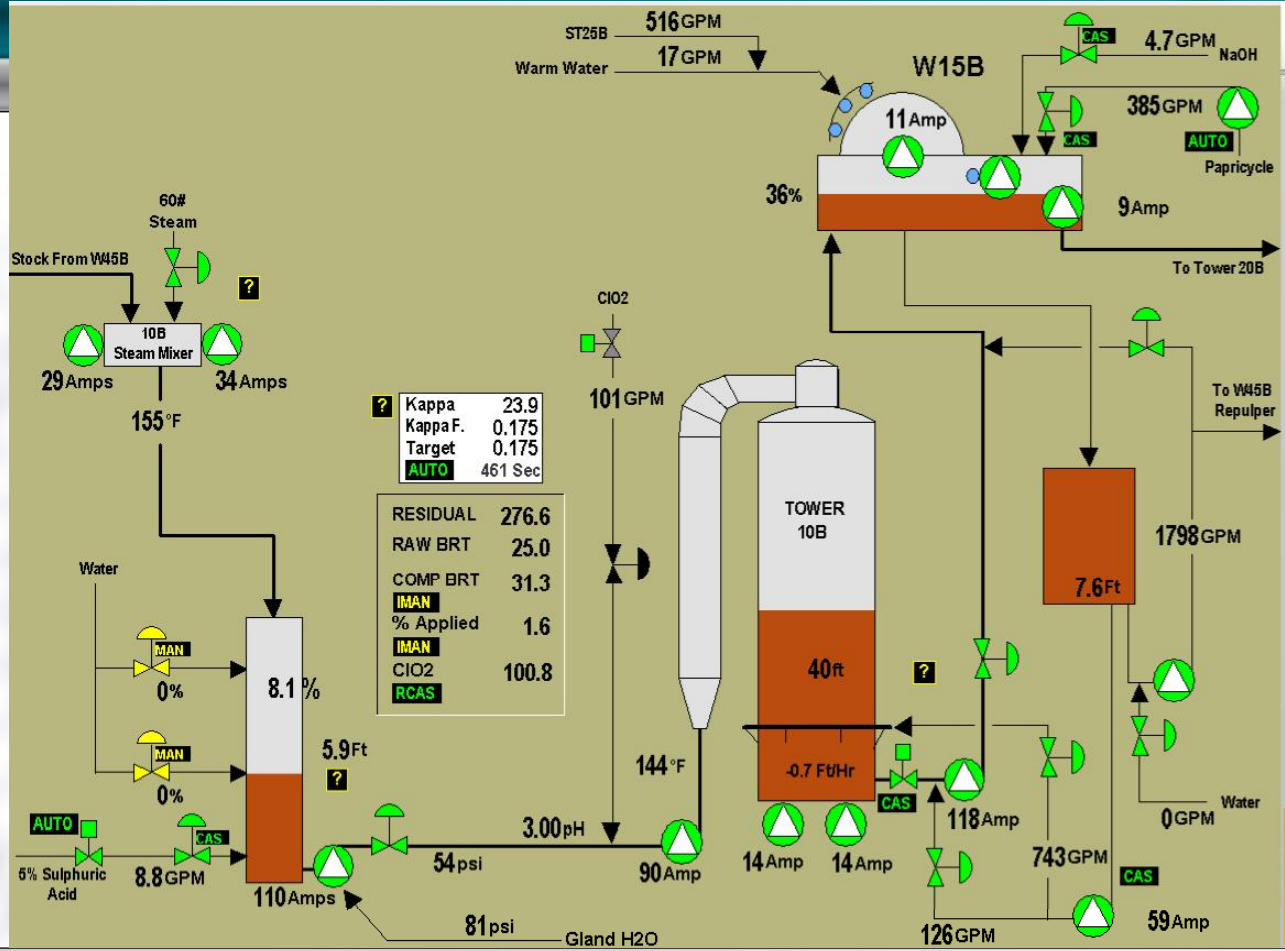
## Scope

Remove steam mixer from T40A and recondition. Install steam mixer below washer 45B.

Install drop chute to basement MC chute. Install MC chute and pump.

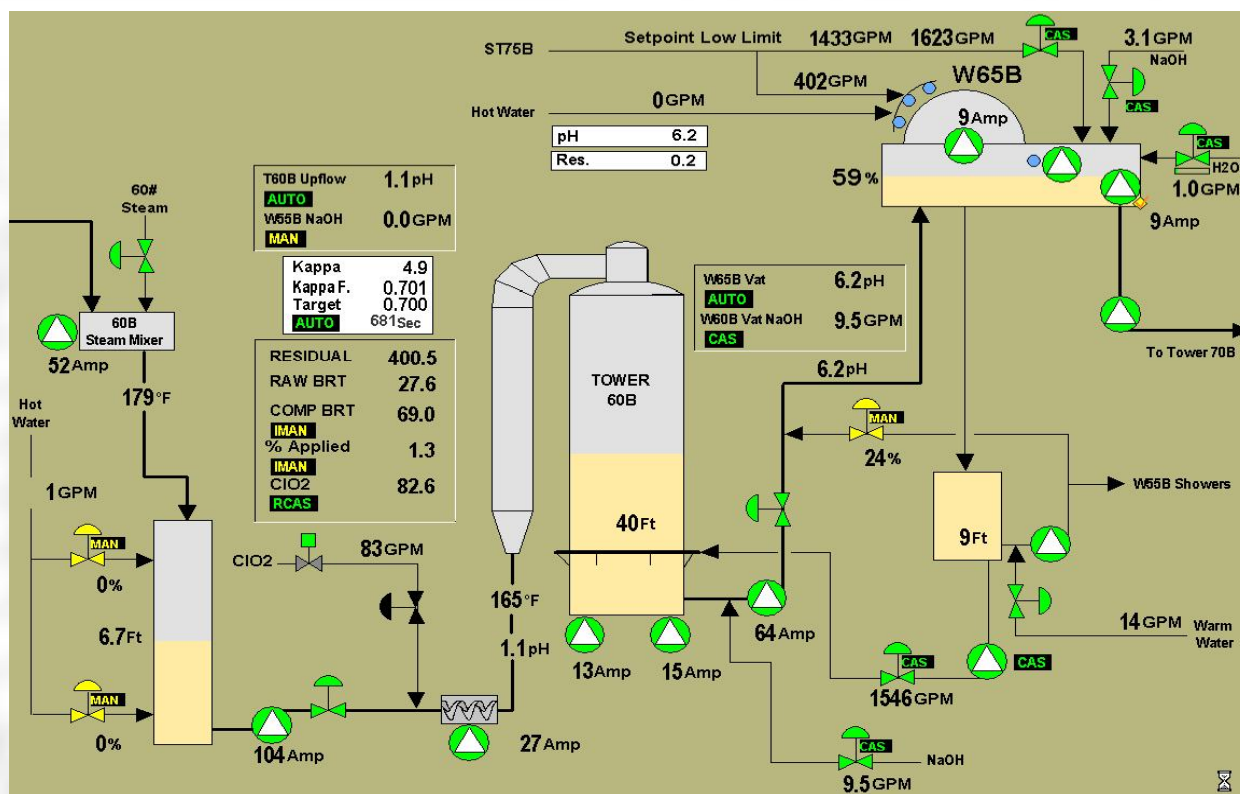
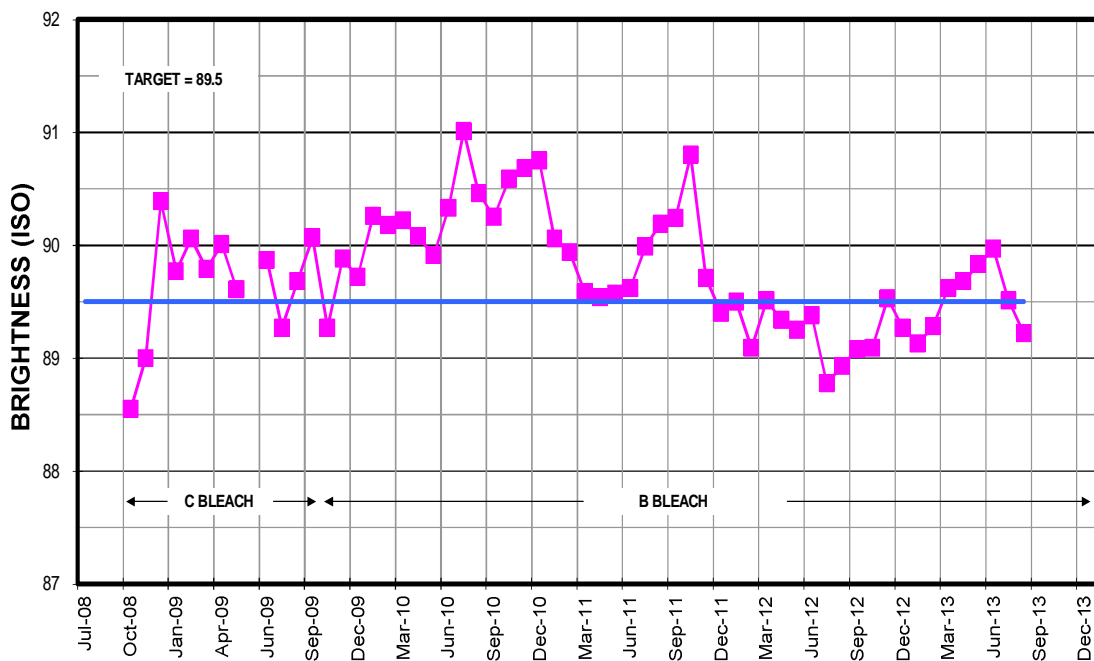
Install SS piping on discharge of MC Pump to ClO<sub>2</sub> mixer.

MC pump is controlled so that all stock falling into the drop leg is pumped further at the higher possible consistency. Pulp level in the drop leg will be measured. The flow rate through the pump can be adjusted by a control valve (it could be considered to combine the control valve strategy by changing the speed of the pump).



## NO. 1 MACHINE BRIGHTNESS

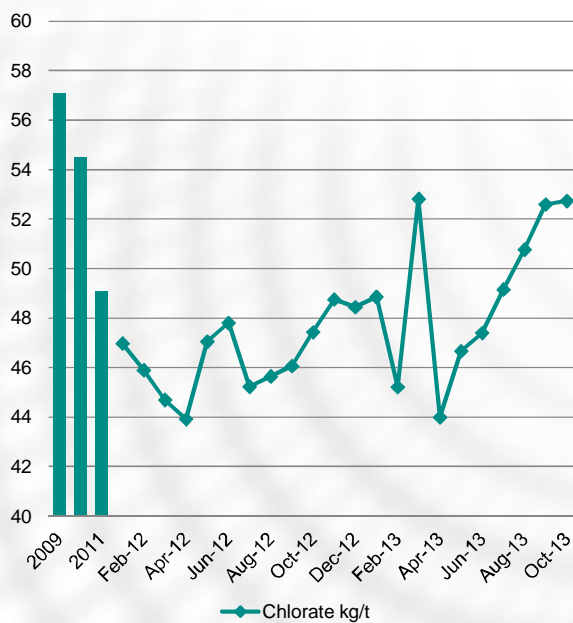
ALL FB GRADES (B LINE SINCE SEP 2009)



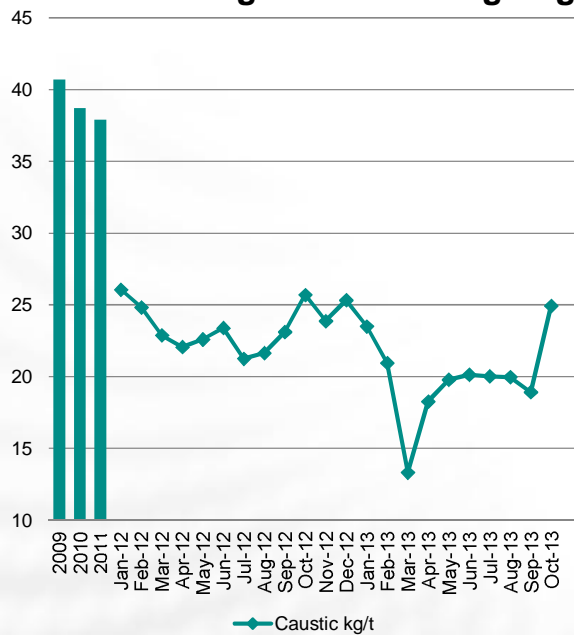
Overview	Kappa	Brightness	Consistency	Models						
<b>2&amp;3 BSW Channel A</b>										
Status: Adjusting consistency to 0.2%										
Kappa: 32.05      Kappa (Avg. of last 5 samples): 32.09										
Last Sample: 12:50										
<input checked="" type="radio"/> Cedar Grades <input checked="" type="radio"/> Channel Enable <input checked="" type="radio"/> Sampler ON <input type="radio"/> Hem/Fir Grades										
<table border="1"> <thead> <tr> <th>Parameter Reference</th> <th>Value</th> <th>Timestamp</th> </tr> </thead> <tbody> <tr> <td>KAPPA_CH_A/KAPPA_VAL/FL_OUT.CV</td> <td>32.05</td> <td>03/10/2014 1:12:55 PM</td> </tr> </tbody> </table>					Parameter Reference	Value	Timestamp	KAPPA_CH_A/KAPPA_VAL/FL_OUT.CV	32.05	03/10/2014 1:12:55 PM
Parameter Reference	Value	Timestamp								
KAPPA_CH_A/KAPPA_VAL/FL_OUT.CV	32.05	03/10/2014 1:12:55 PM								
<b>T10B Channel B</b>										
Status: Standby (Waiting)										
Kappa: 23.96      Kappa (Avg. of last 5 samples): 23.57										
Kappa Tolerance: HI 35.0    LO 11.0										
Last Sample: 13:4										
<input checked="" type="radio"/> Cedar Grades <input checked="" type="radio"/> Channel Enable <input checked="" type="radio"/> Sampler ON <input type="radio"/> Hem/Fir Grades										
<table border="1"> <thead> <tr> <th>Parameter Reference</th> <th>Value</th> <th>Timestamp</th> </tr> </thead> <tbody> <tr> <td>KAPPA_CH_B/KAPPA_VAL/FL_OUT.CV</td> <td>23.96</td> <td>03/10/2014 1:12:59 PM</td> </tr> </tbody> </table>					Parameter Reference	Value	Timestamp	KAPPA_CH_B/KAPPA_VAL/FL_OUT.CV	23.96	03/10/2014 1:12:59 PM
Parameter Reference	Value	Timestamp								
KAPPA_CH_B/KAPPA_VAL/FL_OUT.CV	23.96	03/10/2014 1:12:59 PM								
<b>T60B Pre D1 [KappaQ Line 1]</b>										
Status: Waiting...										
Kappa: 4.69										
Kappa Tolerance: HI 7.2    LO 3.5										
Last Sample: 12:52										
<input checked="" type="radio"/> Line Enable <input checked="" type="radio"/> Sampler ON										
<table border="1"> <thead> <tr> <th>Parameter Reference</th> <th>Value</th> <th>Timestamp</th> </tr> </thead> <tbody> <tr> <td>KAPPA_LINE_1/KAPPA_OUT.CV</td> <td>4.69</td> <td>03/10/2014 1:12:59 PM</td> </tr> </tbody> </table>					Parameter Reference	Value	Timestamp	KAPPA_LINE_1/KAPPA_OUT.CV	4.69	03/10/2014 1:12:59 PM
Parameter Reference	Value	Timestamp								
KAPPA_LINE_1/KAPPA_OUT.CV	4.69	03/10/2014 1:12:59 PM								

# Chlorate & Caustic: Bleach Plant

### Average Chlorate Usage Kg/t



### Average Caustic Usage Kg/t



## Skookumchuck Pulpmill

### (Skookumchuck Pulp Inc)

#### 780 ADMT/D Bleached Softwood Market Kraft

#### Chips

- About 60% sawmill residual chips, truck hauled, 40% whole log chips from Canfor segregated operation
- 50% Pine, 30% Spruce, remainder Douglas Fir, Larch, some Balsam. Two “grades” are produced, with Fir/Larch, or without.
- Single, 127 tonne Rader dumper, up to 125 trucks/day
- Primary chip screens are Rader Dynagage bar screens , replacing blade screens about 3 years ago. Followed by Liwell screens with 10 mm top screen and 6 mm lower screen. Single Rader slicer.

#### Digester

- Original, 1968 vintage digester was converted to two-vessel vapor phase in 1985. 15’6” diameter, original design was 380 tpd, now running at 950 ADMTD—could be the world’s most heavily loaded.
- Atmospheric presteaming chip bin is Kone, with screw feed discharger, and nearly plug-free.
- Running 15.5% EAW, 280 DegF on bottom circulation, 320 DegF cook temperature. At this point there is no sophisticated control system on the digester, no licensed cooking strategy. Kappa target is 24, variability (std dev/Kappa) normally about 8%.
- Rely heavily on two rows of wash screens, radial wash, very large cold blow coolers, cold blow temperature down to 70 DegF to maintain blow temperature low enough for the double atmospheric diffuser.

#### Brownstock

- Washing is comprised of: 2-stage atmospheric diffuser on the digester blowline (above 300 tonne unscreened hi-d storage), Corudek II decker after screening and before O2 delig, two compaction baffle washers post-O2.
- Two Hi-Q primary knotters, Sunds secondary knotter, with knots blown to the chip bin. Screens: Four I-R primary (212) screens, 212 secondary, 210 tertiary, and 210 quaternary, with quat rejects to a Sunds con-flow rejects refiner, refined tailings returned to the quat. Pair of grit cleaners on the tertiary screen feed.
- Single stage O2-delig, running oxidized white liquor, fed by Praxair owned and operated O2 plant. Achieving ~48% delig. Kappa feed forward control only, no feedback, no pH control.

#### Bleach Plant

- Very conventional, 5-stage bleach plant, built in 1978 for 580 tpd, now up to 900 bleached ADMTD. Running DoEopD1EpD2, incoming Kappa 12, final brightness usually 90% ISO, though the target is 88.
- 13’6” Impco washers on first two stages, 11’6” washers on last 3, all Impco style. Impco steam mixers, Warren thick stock pumps still chugging.

- BTG KNA 5200 kappa analyzer provides all ClO<sub>2</sub> control on Do and D1. Does 5 measurements (blow, pre-O<sub>2</sub>, post-O<sub>2</sub>, into Do, CE exit kappa), plus a dissolved lignin measurement, which is used to bias ClO<sub>2</sub> addition on Do. In-line BTG brightness measurement out of D1 and E2, but neither are tied into control.
- Note that the towers are all equipped with sampling screens above the dilution zone, so pH and residuals are measured truly at the end of the stage, not in the washer vat. Tower retentions are : 30 min Do; 1.5 hours E1 and E2, 2.5 hours D1 and D2. Do is upflow low consistency, all others downflow.
- Chemical usage spots us low overall in surveys, largely due to low kappa, but middle pack on usage/kappa. Caustic usage is down to about 18 Kg/ADMT, with ClO<sub>2</sub> 17-18 Kg/ADMT, peroxide 2 Kg/ADMT.
- Turbotak scrubber is run with white liquor, regulated to 39 ppmv ClO<sub>2</sub> discharge, using an Optek ClO<sub>2</sub> analyzer on the stack to control white liquor addition.
- ClO<sub>2</sub> generator is an atmospheric (Mathieson) built by Omni, converted to run on peroxide, ie the HPA process, generally expected to run 91-93% efficiency, at up to 21 tpd ClO<sub>2</sub> production.

### Machine

- Pulp machine is mostly the original 1968 vintage but with improvements, 140" width, maximum production has been 925 ADMT/D. Mitsubishi-Beloit open headbox, first and third presses have been double felted, added dryer decks to total 27. Lambs cutter layboy, single bale line, single 1000 ton press. No strapping, no gluing.
- Cleaners are four stage Celleco with final fiber recovery, to an Impco slusher.

### Power and Recovery

- Evaporators, recovery boiler and recausticizing were new in 1993. Evaporators are 5 effect Ahlstrom, producing 75% solids. Recovery boiler is ABB single drum, producing 480,000 lb/hr of steam at 600 psi, at 150 KLb/hr solids fired.
- Hog boiler is the original recovery boiler, converted in 2000, and producing 250,000 lb/hr of steam.
- All 600 lb steam is run through a 45.5 MW Siemens condensing turbogenerator, with extraction of MP and LP steam for process. Target production is 44 MW, with the mill using 25 MW, the remainder for cogeneration sale.
- Collection of CNG from the Digester and Evaps is handled through a MODO Chemetics designed system, and all incineration is done in a dedicated incinerator.
- Reconst, also new in 1993, is standard design, with a 70 ft green liquor clarifier, 4 causticizers, weak wash and white liquor pressure filters, and a problematic kiln. Fitnir, on 6 streams, has recently been added, and is using Texo's Caust-X control.

### Environment

- Effluent is settled in a settling pond (dredged, solids to an upscale, lined landfill), thence to an ASB, and then to a colour clarifier. This clarifier is expensively operated during the months of the year that the Kootenay river has insufficient flow to sustain the mandated restriction of <15 color unit increase below the mill outfall. Effluent color reduction is a high priority, strict spill containment is practiced, and Eop recycle has been practiced to some extent.

- Water is supplied from the Skookumchuck creek, water usage is about 45 m<sup>3</sup>/ADMT. Recently four wells were drilled adjacent to the creek, pumps and lines are in the process of being installed. The intention is to provide most or all of the 5,500 USGPM mill water demand—more reliably, and with cleaner water.

**PAPTAC Bleaching Committee**  
**Section 7 – Mill Updates and Problems Roundtable**  
**Kimberley, BC – October 5-7, 2014**

**Chemstone**

Question: How are mills reacting to HW fiber supply issues? Is anyone increasing their timberland resources?

- IP saw this coming a few years ago and made changes to mitigate

**Paper Excellence - Skookumchuck**

- Started-up FTNIR with Texo control in recaust area
- Looking to significantly expand production in mill with capital projects being available
- Recently hired 8 engineers in all disciplines. Paper Excellence has hired 40 new engineers company-wide.
- Drilled 4 new mill water wells due to river water being unreliable

Question: Trying to reduce bleaching costs. Has anyone put dollars to converting the Do stage to MC or the value of BSW improvements?

- Carryover to Do should be <15 lbs Na<sub>2</sub>SO<sub>4</sub>/T squeezed. May see a 0.02 drop in KF.
- 1 lb/t Na<sub>2</sub>SO<sub>4</sub> consumes 1 lb/t eq. Cl<sub>2</sub> (Gopal)
- New pre-bleach washer or press is usually also needed, confounds the issue (IP)
- MC Do concentration of ClO<sub>2</sub> is higher so reaction rate is 3X higher as well
- Open washer at Verso Quinnesec showed 4-5 lbs/T ClO<sub>2</sub> savings
- Expect a 10% reduction in ClO<sub>2</sub> (Harmac)
- MC D0 decreases D0 ClO<sub>2</sub> use by about 10% (IP/Paul Earl)
- HSPP – also looking at MC D0. Also consider caustic savings in E1.
- Focus on pre-O2D washing
- May want to look at differences in washing between using caustic and OWL on O<sub>2</sub> stage

**Tom Mullen (asked by Laurier Morissette)**

Question: How many mills are using OWL for O2D?

- Laurier captured the number responding

Question: Do people see better delignification from caustic or OWL?

- Verso Quinnesec – No difference at zero sulfidity OWL, with Sulfidity >7 see a negative impact
- Skookumchuck – OWL is better

Question: Do mills use OWL, NaOH, or both in O2D and how do they control it?

- Irving – Based on WL availability
- Canfor Intercon – One or the other based on WL inventory
- Weyerhaeuser – All mills can run either or in combination. Use more caustic if WL inventory is low.

**Domtar Espanola**

- New Diamond Back chip bin and Turbo Chip Meter were installed in May 2014
- New larger ICC for R10 also installed in May 2014
- Running SW campaigns on the HW line and having some issues

Question: Are seeing poor runnability of CB Filters on softwood. Has anyone else seen this?

- DMI Peace River has CB washers

### **Paper Excellence - Howe Sound**

- O2D / BSW upgrade – have broken ground
- Evaporator 2<sup>nd</sup> line project under way
- CRP (chloride removal process) starting up soon
- Lots of efforts in getting Howe Sound to 500,000 TPY

Question: Have seen decrease in bleachability. Noted that washing has gotten worse and kappa from digester and O2D has decreased from 28 to 24 and 16 to 14 during this period of time. Thoughts?

- Issue is low kappa from digester. You're removing easy lignin in digester, leaving the harder to bleach lignin going to the bleach plant.
- Check residual WL after digester – could be getting re-precipitation. Also check O2D pH.
- Try caustic wash of digester pulp to check for lignin re-precipitation
- Likely a washing issue since the digester kappa is lower and there is more dissolved material

Question: Has anyone switched from Eop Kappa analyzer to brightness meter for control?

- Crofton is phasing out Eop Kappa and going to brightness. Production rate can make brightness a little flaky at times.
- Canfor Intercon – measure both brightness and kappa into D1. Decent relationship unless they change H<sub>2</sub>O<sub>2</sub> application a lot.
- Clearwater Lewiston – Eop kappa and brightness, compensated brightness control

### **West Fraser – Hinton**

- Completed first shutdown in 3 years
- Upgraded D2 stage washer
- Completed DCS upgrade project from ABB to Delta V in brownstock and bleach plant areas

Question: Looking at installing online dirt and brightness analyzers for finished pulp. Who has these?

- Canfor – Have a Metso DCD for dirt and brightness. Samples every 10 minutes
- Skookumchuck has a Metso DCD
- Verso Quinnesec has online brightness scanner
- Clearwater Paper Lewiston – has online dirt analyzer

Question: What basket size(s) are people running in brown stock? They are thinking of going to 0.006" from 0.008"

- Skookumchuck – 0.008" slots on softwood
- Northern Pulp – switching from 0.006" to 0.008"
- Valmet – Need to consider rotor design
- Irving – 0.008"
- Bancroft Western – Most screen baskets they sell are 0.008"
- Clearwater Paper – Lewiston – 0.006" on softwood

Question: Having a scale problem with caustic line – 10% nominal is actually 17%. What strength do people run?

- Canfor Intercon – 8% and clean line every 2 months
- Skookumchuck – 7% no scale
- Irving – 8%
- Lewiston – 12%
- Varies from 5 – 16% between mills
- You can clean out caustic lines with EDTA at 200-300 ppm without shutting down (Nalco - Jack Thomas) Domtar Espanola tried this – worked over 8 hours.

### Clearwater Paper – Lewiston

- Installing sawdust line brightness and residual probes for Compensated KF control
- Installing KappaQ on sawdust line for final brightness
- Moving peroxide unloading area
- Installing brown stock heat exchanger on sawdust line

Question: Anyone running higher sulfidity (approx. 35%)?

- Verso Quinnesec pushing up to 35% on AA basis no issues seen. Lower WL flow for EA charge.
- Irving – saw higher TRS
- Cariboo – 32-35
- Castlegar runs high (no number given)

Question: Does temperature of the oxygen into the O<sub>2</sub> reactor matter? What do people control to?

- No responses

### West Fraser - Cariboo

- Replaced SO<sub>2</sub> with Formic Acid for bleach scrubber cleaning
- Skipped annual digester acid cleaning due to improved anti-scale treatment program
- Have hired a number of Process and Maintenance Engineers

Question: Is anyone using chip washers for dust control instead of cyclones?

- No responses

Question: What are people running for Do pH? They raised theirs from 2.5 to 2.8 recently

- Harmac – running up to 3.2
- Irving running 3.0
- Paul Earl – check out bleaching survey results
- Many folks running this range or higher, up to 3.5

Question: Who is using a residual EA analyzer for digester control?

- Weyerhaeuser is using a Kajaani in two of their mills

### DMI- Peace River

- Suffered a 3 day blackout due to a wind storm. Examining ways to be better prepared if it happens during winter.
- Installed a new (additional) white liquor pressure filter
- Installed new dust cyclone
- Ongoing project to improve digester pressure/level control to improve digester stability
- Looking at machine drainage, throughput issues

Question: Anyone measuring production off a Mud Filter?

- Texo – many measure before, no of no one measuring after. Flow meter and density meter.
- Several responded they measure before
- Can calculate using discharge moisture

### Irving Pulp

- Upgraded brown stock washing press post screening
- Upgraded DCS to Delta V in brownstock
- Installing a Metso continuous digester in 2015
- Commenced engineering for a new pulp dryer
- Upgrading demineralizing plant
- New centrifugal air compressors

Question: What kind of life are folks getting on Canron type washers for the vacuum seal?

- Skookumchuck – Corrudek II felt seal 1/year

- Domtar Espanola – 4 Canron washers 1 seal every 4 months

Question: Generator liquor started to get cloudy. Saltcake looked ok. Filtrate sample if left to sit settled out. Saw filter performance degradation. Still cloudy after running through filter paper.

- Espanola – Saw cloudy liquor in R10 mode vs R8
- Problems with filter can result in fines in system, making liquor look cloudy

Question: What kind of filter are people using for saltcake removal from their generators? They have a Bird filter.

- All ERCO plants use the ERCO saltcake filters
- Canfor Intercon has a filter similar to the Bird

Question: Does anyone have an iron spec for Mag Sulfate?

- No responses

Question: Anyone have issues with green liquor dregs settling?

- Verso Quinnesec: had black liquor getting in through contaminated condensate.
- Solenis - Look at organic carry-over and RB Reduction Efficiency
- Howe Sound - FTNIR saw char from boiler
- Metso – Mud seeding could help

Question: Anyone doing fiber fractionation?

- No responses

### **Harmac Pacific**

- Lots of reliability issues
- New turbine is running and they are selling electricity
- Resolved digester runnability issues
- Adding showers to chips
- Focusing on projects < \$6000
- Found errors in Baume tests vs. solids tests
- Going back to 12 month outages from 18

Question: Where is the best location for a new washer (pre or post O2D)?

- Valmet - 120 Kg COD/T typical pre-O2D, 80 or less is very good
- Poor pre-O<sub>2</sub> washing can consume alkali in O2D
- Poor washing can cause many issues
- It's a cascading effect
- Clearwater Lewiston - Moved a POW to pre-O2D and saw improvements
- Castlegar – added a pressure diffuser for better pre-O2D washing

Question: If someone has a paper on the difference in O2D performance between OWL and caustic please send it to Honey.

Question: What is the recommended pressure for the first reactor in a 2-stage O2D system?

- First stage should have higher pressure and lower temperature than second reactor
- Irving - High temperature in first reactor will result in a different Kappa to viscosity ratio (lower viscosity for a kappa)

### **Verso Paper – Wally Mc Donald**

Question: Do people track yield change over time periods shorter than a month?

- Measure BLS/ADT
- Mass balance

Question: What are folks using for material of construction for Chlorate piping?

- FRP common – (Irving/Canfor/McKenzie)
- Skookumchuck – Teflon lined pipe

Question: Is anyone running carbonate control on kilns?

- Spartan Controls – Knows of folks that have controls
- Irving – has advanced controls
- Solenis – watch availability and inerts
- Metso – has mills on control. They control carbonate and production
- Target carbonates between 2-3

#### **Verso Paper – Androscoggin**

- Installed an Andritz Maxton Roll on decker – may install one on second decker and BSW
- Trialing an Andritz Gas Free Valve on a BSW
- Converted their chipper to an Andritz HQ Plus Cassette Knife system

Question: Anyone running chip silos that has a strategy to keep them from freezing?

- Irving has 4 silos and during the winter they run them empty, it not they plug

Question: Is anyone running a smaller chip pile to be able to turn-over more frequently for improved yield?

- Clearwater Paper rotates their pile
- Quinnesec does, pins and fines segregate within pile
- Running short on inventory can result in slugs of different species
- Consider impact of dirt and rocks
- Irving – does a pile turn every year. Causes issues with blending.

Question: For WWTP Limitation issue, what about use of paper machine white water to brown stock?

- Paul Earl – If carbonate recycles back to around to Do it could cause scale on Eop stage.
- David Trzil – Got white water back into brown stock years ago and it caused significant scale. Would not recommend.

#### **Verso Paper Quinnesec**

- Completed an 11 day outage
- Announced closure of Bucksport Maine mill, now a 2 mill company

Question: Is anyone recovering water from press felts?

- Skookumchuck looked at what comes out in the press felt water and decided not to recover it – resin, felt hairs, etc.

Question: How many people are changing the tower dilution flow with production rate?

- 3-4 mills said they do, most don't. Not a focus by many folks

Question: Life of Neutral Saltcake Filter side seals?

- No responses

Question: Where are people adding caustic for Eop? We have seen build-up of scale in repulper and chute to steam mixer.

- Irving – have moved it to after the repulper

#### **Catalyst - Crofton**

- Ramping up production, pulp dryer upgrades and reliability improvements
- Sharpened focus on Kraft business, assessing debottlenecking opportunities

Question: The ClO<sub>2</sub> Generator is a bottleneck. Has anyone upgraded their generator for more capacity? It is running 40 TPD and was designed for 27.

- Canfor Northwood – upgraded 32 to 65 TPD, required capital
- Paul Earl - A limiting factor at some point will be the mass flux (adequate surface area of generator)

Question: Anyone doing "Poor Man's O2D"? Injecting O<sub>2</sub> into the stock line ahead of the Brown HD

- Harmac – 20 minutes, 55 psi at top, 1% O<sub>2</sub> & 1% NaOH
- Consider putting peroxide in a Hi-D instead of O<sub>2</sub>
- You need alkali for O<sub>2</sub>
- If you just add caustic you can get alkali leaching
- Verso Androscoggin Mill does a version of "Poor Man's" O2D

Question: Has anyone seen channeling in a D1 tower and what did you do about it?

- Some people have an inverted cone in the pre-tube
- Paul Earl – Can get diffuser / distributor, but will not help with low consistency

#### **International Paper**

- CEO retiring after 42 years with company. New CEO is a mechanical engineer.

#### **Nalco**

- Looking into AQ replacement chemistry

#### **Bancroft Western**

- Representatives for GL&V and BTG

#### **Spartan Controls**

- APC controls
- Energy management controls at Hinton and Canfor

#### **Canfor Intercon**

- Had to replace caustic effluent line. Underground, so ended up combining acid and alkaline effluent in single line.
- New recovery boiler attemperator
- New weak black liquor fiber filter
- New Forte system on Pulp Dryer
- New residual and brightness probes for Do and D1
- D1 tower lined with duplex stainless steel
- Replaced D1 washer vat, ran 3-stage bleaching for a while
- Looking to justify raw water treatment in the future for spring runoff
- New lime kiln dust scrubber
- Going to 2-stage O2D next year
- Installing a moisture analyzer

Question: Are seeing CaCO<sub>3</sub> and MgSiO<sub>2</sub> scale on E2 washer. Are others seeing this issue?

- Gopal Goyal – Could be talc
- Mike Kjerulf – Has talc quality changed?
- Paul Earl – Would expect to see this kind of deposit in Eop. Mag silicate is a talc issue – may be co-depositing and contributing to carbonate scaling

Question: Who monitors chlorate carryover in generator saltcake? Do you correct for chlorate concentration in generator? Measure other than using a titration?

- Paul Earl – should do every 2 weeks. Bulk of Cl in saltcake is from chlorate. No one adjusts for chlorate concentration
- Irving – Every 2 weeks.
- Kent Robarge – Manual test to know what goes to the Recovery cycle

### Paper Excellence - Northern Pulp

- New Recovery Boiler Precipitator, new nozzles in RB scrubber
- Converted Kiln and power boiler to natural gas
- Installed pH probe in D1
- ERCO SMARTS to be installed in the future
- Still looking at O2D

**Question: Is anyone running a ClO<sub>2</sub> heat exchanger?**

- Verso – The Verso Androscoggin Mill is running a lamella style HX
- Paul Earl – Some mills are running Do filtrate to reduce scaling tendency
- Irving – Running one seasonally
- Most mills have stopped using them due to scaling
- Verso Quinnesec is running as a pre-chiller
- Cariboo is running a HX

**Question: What type of defoamer are people using? They use oil based.**

- Silicone
- Some water based
- Silicone carryover to paper machine is bad
- Verso targets < 10 ppm silicone and no silicone based after O<sub>2</sub> delig
- Hinton no longer uses silicone for customer requirements

### Paper Excellence - Mackenzie

- Re-started in 2010
- Increasing liquor to wood ratio on digester and working on moisture analyzer
- Anti-scale trial in digester
- Working on bleach Plant automation
- Using Eo stage for mini-O<sub>2</sub> delig; promising but too unstable for 3-stage DED bleaching.
- Installed ABB DCS
- Upgrading evaporators
- Bleaching costs are high in the 5-stage bleach plant
- High kappa no. variation – looking at kappa analyzer.
- Peroxide trial

**Question: In a 5 stage BP, what should the Do ClO<sub>2</sub> charge be on softwood?**

- Doug Reid – 55-60% of total charge. D1 should have 75% of the remaining charge.
- Meredith Kaknevicus – 60% to Do / 30% to D1 / 10% to D2
- Gopal Goyal – Do KF 0.20-0.25, D1 .75%, D2 0.3-0.35%

**Question: Who has an online chip moisture analyzer?**

- Texo – Celgar has one running
- Irving – had one without much luck
- Metso has a lab unit that measure in ~ 2 minutes vs 12 hours.
- Catalyst Elk Falls – Had an Acrowood moisture analyzer on sawdust line. Used in control.
- Verso Quinnesec – Senfit unit

**Question: In a 5 stage BP running to 87 brightness, what should the D1 target be?**

- Paul Earl – 78-80 brightness, , with peroxide in E2

**Question: Have a low dilution factor on BSW but low evaporator solids. What can be done? How do you calculate DF for entire line?**

- Check for tramp water entering system
- Look for manual valves that are open into tanks
- Check flow meters

- Yes, DF can be done on entire line or individual washers

### **Weyerhaeuser**

- Flint River has new Do and Eop stage wash presses, partial DCS upgrade to Delta V, and significant recovery boiler upgrade
- Moving headquarter to Seattle in a couple of years
- New Bern got a new headbox
- Longview going to Downflow Cooking, upgrade to #3 Machine

**Question: Anything to watch out for when storing brown stock during an extended S/D (20 days)?**

- Mona Henderson – Have seen sludge type material develop from prolonged storage
- Irving – Irving: stored it in Hi-D for a couple weeks. Run agitator every 3-4 hours – it gets too hot in the bottom if run continuously.
- Consider putting in biocide & agitating periodically
- Make sure to have H<sub>2</sub>S monitor if you start sewerage or running pulp

### **Canfor Northwood**

- Pulp machines are new focus as bottleneck moves away from recovery boiler
- New focus on energy / management projects. Re-purposing heat exchangers to save steam
- Glulam beam repairs going on in mill
- Looking to install a new R8 chiller in 2015
- Developing training videos to address high turnover rates and information loss

**Question: Any reason for seasonal bleaching costs? Low in February, high in August**

- Irving – Different species and chip size impacts ClO<sub>2</sub> and yield
- Solenis – Do you have to add more alkali? Yes. Check if the digester residuals are higher in the winter?
- Kent Robarge – Will need more alkali in winter because moisture higher, so concentration in fibre will be lower.
- Change in ClO<sub>2</sub> strength
- Look at water quality / turbidity differences

**Question: Have an obsolete LiBr Absorption Chiller. What are people installing?**

- Harmac – Trane liquid chiller. No steam. No problems. Electric. Centrifugal. Did not add recirc system. Have trouble during shoulder seasons because recirc not there.
- DMI – more of a need to purge LiBr over the years but due to lack of PMs. Brought in a rental chiller this year. Will forward along recommendations from when they started looking at replacing it.
- Verso Quinnesec- just replaced LiBr with screw chiller and centrifugal chillers. May need a mixture of two different types depending on whether you need to ramp up and down, for example. Centrifugal – total water use will go up.

### **Canfor Prince George (PG Pulp)**

- The Pulp Eye testing system installed 2 years ago is struggling with performance guarantee
- Compensating for pH with temperature
- Running a digester trial with Chemstone

**Question: How are people controlling defoamer use?**

- Irving and Verso Quinnesec add on production rate
- Northern Pulp adds on vat level
- Harmac – production and species

- HSPP paper re: defoamer usage where defoamer increases if washer starts speeding up past target
  - Operator has a bias with a timer that brings it back to original setpoint when the timer expires
- Question: Currently putting 80% of ClO<sub>2</sub> in 3-stage plant to the Do stage (final brightness = 83). Is this a good practice?
- Consensus is that there should be more in 2<sup>nd</sup> D stage

#### **Evonik**

Question: Why is the metals content (in wood) so different between costal and interior woods?

- Soil pH, species differences, rainfall, sea spray, geology?
- No one has the answer

#### **AkzoNobel**

- Selling paper chemicals division to Kemira. Bleaching chemicals stay with AkzoNobel.

#### **Peroxychem**

- FMC divested peroxide, persulfate, and peracetic acid business (7 facilities, 650 people), now called Peroxychem. Owned by equity firm.
- PacWest 2015 will be in Whistler June 10-13

#### **Texo**

- Updated generator controls
- Many recaust projects going on
- Releasing new wood chip analyzer

#### **Solenis**

- New company that was the spin-off from Ashland Chemicals water technologies and Hercules pulp and paper chemicals
- Owned by private investors