PAPTAC BLEACHING COMMITTEE
SPRING 2015 MEETING MINUTES

Pointe Claire, QC
May 4-6, 2015

PAPTAC Bleaching Committee

Section 2 - ATTENDANCE LIST

Pointe Claire, QC – May 4-6, 2015

	Name	Mill / Company	Job Title
	Doug Reid	AkzoNobel	Sr. Process Engineer
	Andre Gaudet	FPInnovations	Principal Technician
	Norman Liebergott	Liebergott & Associates	President
	Ross Anderson	Arkema	Appl'n Services Mgr.
5	RAYMOND PAQUET	KEMIRA	APPLICATION SPECIALIST
	Brian LaBrash	Verso-Quinnesec	Process Engineer
	Troy Adams	Verso- Wis Rapids	PAL
	SCOTT CHARBAN	CHEMSTONE	APPLICATIONS MGR.
	DAVID LABRECQUE	RESOLUTE ST-FÉLICIEN	TECHNICAL ASST
10	JAMES GOLDMAN	VALMET	PRODUCT MANAGER
	Theo Radiotis	FPInnovations	ASSOCIATE RESEARCH LEADER.
	Chung-Li Lee	FPInnovations	Researcher
	Jack Thomas	NALCO	Industry Tech Consultant.
	Shree Prakash Mishra	FPInnovations	Scientist
15	LAURIER MORISSETTE	TEXO	PROCESS CTRL ENG.
	LUCIANA SAVULESCU	FPInnovations	Research Scientist
	David Tizil	Clearwater Paper	Sr Process Engineer
	Sabrina Burkhardt	Econotech	Supervisor - Pulping & Bleaching
	RANJIT KARI	AV Terrace Bay	Process Engineer
20	MICHEL EPINEY	AIR LIQUIDE	MARKET SPECIALIST
	JIM COLLINS	AV TERRACE BAY	Process Engineer
	JOHN ADIWINATA	ADCHEM Pulp & Paper Chemicals	TECH. SALES
	Brian Collins	Resolute FP-Thunder Bay	Process Engineer
	André-Olivier Piché	Resolute FP- St-Félicien	Sr. PROCESS ENGINEER
25	Paul Earl	Paul Earl Consulting	consultant

PAPTAC Bleaching Committee

Section 2 - ATTENDANCE LIST

Pointe Claire, QC – May 4-6, 2015

	Name	Mill / Company	Job Title
26	DOUGLAS PRYKE	CONSULTANT / AET	EXECUTIVE DIRECTOR.
	DAVE WILLIS	PEROXYCHEM	TECHNICAL ACCOUNT MGR
	Steve Ladd	Verso Corp/Androscoggin	Process Control Eng.
	Phil Sekerak	Verso Corp	Pulp Technology.
30	STEPHANE MESSIER	CANEXUS CORP	TECHNICAL SERVICE MANAGER
	John Gillespie	Irving Pulp & Paper	Process Engineer
	SHAUN MORRISON	BORDEN CHEMICAL	SALES MANAGER.
	Mona Henderson	Valmet	Business Manager
	John Shao	Skookumchuck Pulp	Process Engineer
35	Mark Cameron	Skookumchuck Pulp	Process Specialist.
	DANIEL BROUILLETTE	GL&V	Global Business Manager
	Honey Nampak	Harmac Pacific	Process Engineer
	Jessica Paul	Sappi-Somerset	Shift Operations Supervisor
	BENEDICT CRACOLICI	SAPPI-SOMERSET	Area Operations Supervisor
40	Doug Weber	Verso Corp - Wickliffe	R-Gap Coordinator
	AUDREY BERNARD	FORTRESS SPECIALITY CELLULOSE.	Process Engineer
	Rick Van Fleet	BTG Americas, Inc	Manager Fiberline Bus Dev.
	Luciane Daniels	FPInnovations	Research Scientist
	Aline Nolin	FPInnovations	Technologue.
45	CRISTINA MURCIANO	PAPTAC	DEVELOPMENT LEAD
50			

PAPTAC Bleaching Committee
Section 3 – BUSINESS MEETING MINUTES
Pointe Claire, QC; May 4-6, 2015

1) NEWS FROM PAPTAC
- Christina Murciano from PAPTAC is attending this meeting as a guest

2) MEMBERSHIP REVIEW
- New members
  - Doug Pryke (AET)
  - Rick Van Fleet (BTG)
  - Harold Petke (Solenis)
  - John Shao (Skookumchuck)
  - Brian Ellick (Nackawic)
  - Katherine Parkinson (Domtar Espanola)
  - Jessie Chan and Songbo Lei (Howe Sound)
- Resignations
  - Mike Kjerulf (Solenis)
  - Ted Tam will retire Aug. 14 (Cariboo)
- Seven guests at this meeting (1 from suppliers, 5 from mills, 1 from PAPTAC)

3) SUB-COMMITTEE REPORTS
- Meetings & Conferences Subcommittee organized 3 sessions at PaperWeek 2015 in Montreal. Most presenters were committee members.

4) FUTURE MEETINGS
- Fall 2015 – Harmac
  Technical session = "Bleaching Stages: O2D / DO / Eop / D1, D2, P"
- Spring 2016 – TBD
  Technical session = "Cooking and Impacts Downstream"

5) FINANCIAL – Doug Reid
- Balance in supplier fund is $4211 before this meeting's dinner

6) NEW BUSINESS
- Looking for Jr. Vice Chair due to Mike Kjerulf's resignation

7) CUNNINGTON AWARD
- Mark Cameron of Skookumchuck won the Cunnington award for the meeting attendee who most added to the value of the meeting with their participation and contributions.

Shree Prakash Mishra (FPInnovations) presents Mark Cameron (Skookumchuck) with the Cunnington Award.

PAPTAC Bleaching Committee – Spring 2015 Meeting
Section 4 – SUB-COMMITTEE MEETINGS & REPORTS

Pointe-Claire, QC – May 4-6, 2015

4-1. **Technical** – Paul Earl for Alison Rowat

The Fall 2015 technical theme will be *"Bleaching Stages: O2D / D0 / Eop / D1+D2 / P"*. This was selected at the Fall 2014 meeting.

The Spring 2016 technical theme (selected at this meeting) will be *"Cooking and Impacts Downstream"*.

4-2. **Meetings and Conferences** – Doug Reid for Dan Davies

2014 International Pulp Bleaching Conference

- Grenoble, France; October 29-31
- 150 attendees
- More academic than typical PAPTAC or TAPPI conferences, but overall quality of presentations and papers was higher.
- Themes included dissolving pulp, chromophores removal and re-formation, and bleaching and the bio-refinery.
- Next IPBC will be held in June 2017 in Brazil, in conjunction with the ISWPC.

PAPTAC Annual Meeting (PaperWeek Canada 2015)

- Attendance steady this year
  - At 1023, compared with 1117 last year
- Excellent blend of business & technical
- Well distributed by session and room
- Same excellent system for submitting & evaluating presentations
- 30 Mills represented
  - Mill personnel were 20% of attendees
- Presentation rooms well positioned & accessible
  - Well sized for number of attendees
- FP Innovations had usual strong presence
- Biotechnology important, but somewhat muted
- Sessions in separate tracks:
  - Maintenance, Packaging, Tissue, Technical, Business
- Keynote & Business Lunch presentations were excellent
  - Refutation of last year's "…Tabula Rasa…" presentation
- Bleaching Presentations:
  - 3 Sessions
  - 11 presentations (1 cancellation)

    - Mostly by Committee members

2015 PacWest Conference

- Whistler, BC; June 10-13
- Three short courses: Project Management, Continuous Cooking, and TMP
- http://pacwestcon.net

4-3. **Projects** – James Goldman

- Raymond Paquet compiled a searchable list of all presentations to the Bleaching Committee since 1997. It also contains a link to each presentation.

- “Standing Categories” have been created, to help with the generation of new ideas for “Projects” presentations. This list was last reviewed at the Fall 2014 meeting.

- Safety: A chemical safety presentation is always part of the agenda, along with a safety roundtable discussion.

- Presentations from this meeting can be found in Section 6.

4-4. **Internet** – Paul Earl

- New Members’ Website; microsite within main PAPTAC website:
    - www.paptac.ca
    - Then select *Technical Communities* / *Bleaching* / *Members Corner*
    - Access with your PAPTAC login username and password
    - All minutes and documents from old site have been transferred over to new site.

- Please remember that presentations & information from these meetings and on the website are not “public domain”
    - Please use only within your own mill or company
    - Please contact the author if you wish to use any of the information

- Group e-mail system – use “bleach@paptac.ca” to send message to all members
    - E-mail system for Bleaching Committee members only
    - Your current e-mail address must match the one on the server!
    - Administered by PAPTAC; only currently active PAPTAC members can be added to the mailing list
- Please summarize the responses that you receive and send them back to the whole committee in a timely manner (□2 weeks)

PAPTAC Bleaching Committee

Spring 2015 Meeting

Hosted by FPInnovations – Pointe Claire, QC – May 4-6, 2015

Technical Program:

Washing Efficiency, Filtrate Recycle Management and Water Use

Bleach Plant Effluent Fibre Filters - Daniel Brouillette (GL&V)

Shocking D0 and D1 Costs from Poor Washing - Mark Cameron (Skookumchuck Pulp Inc.)

Eop Diffusion Washer Replaced with Evolution Press and Mill Results - Mona Henderson (Valmet)

Washing at the Bottom of a Vapour Phase Digester - Laurier Morissette (TEXO)

Optimization of a Brown Stock Double Stage Atmospheric Diffuser - Laurier Morissette (TEXO)

Recycling D Filtrate to the Sawdust Bleach Feed Repulper – David Trzil (Clearwater Lewiston)

Sensor Based Dilution Factor Control – Rick Van Fleet (BTG)

Bleach Plant Effluent Fibre Filters

by Daniel BROUILLETTE
GL&V

Reduce your operating cost with GL&V's cost saving solutions...

AGENDA

1. The Hardware
2. Process Matters
3. Solving Common Issues

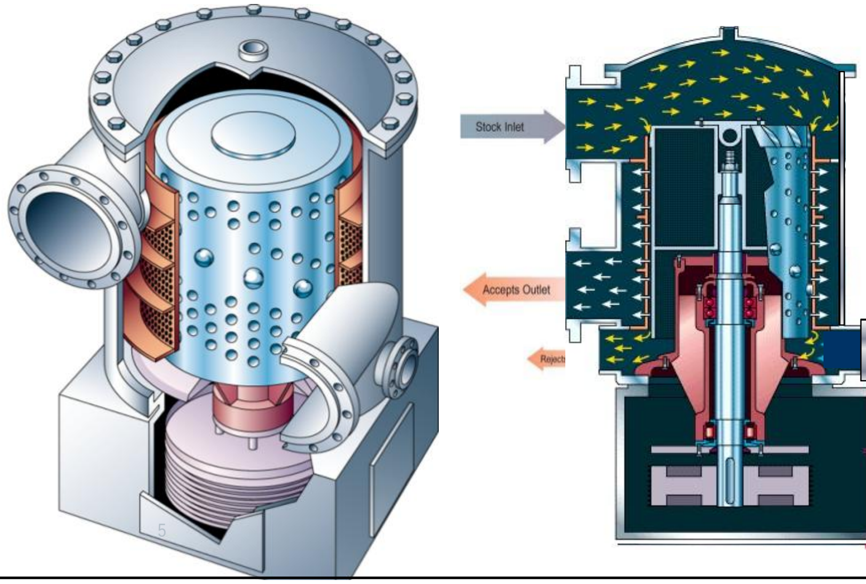
2

NOT THAT KIND OF LIQUOR FILTERS

SECTION 1 – THE HARDWARE

4

Fibre Filters: How do they work?



SMALL FIBRE FILTER

6

**INTERMEDIATE SIZE
FIBRE FILTER**

HI-Q® FIBRESAVER™ FILTER

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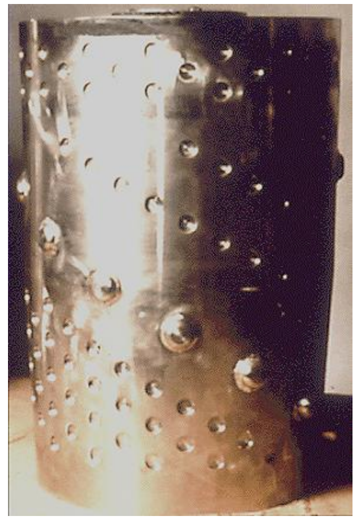
**BLEACH PLANT ALKALINE AND
ACID FILTERS BEING INSTALLED**

Typical Fibre Filter Rotor

- Uses both bumps and depressions to maximize the efficiency



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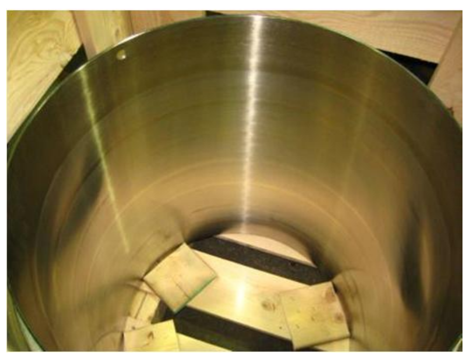
Fibre Filters use Electron Beam Drilled Screen Cylinders



PERFORATION SIZE

Previously: 0,30mm, 0,25mm, 0.20mm diameter

Today: **0.15 or 0.10 mm** diameter

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What is Electron Beam Drilling (EBD)?

- EBD is a thermal drilling process
- EBD is performed inside of a vacuum chamber
- A focused beam of electrons is accelerated up to 2/3 the speed of light.

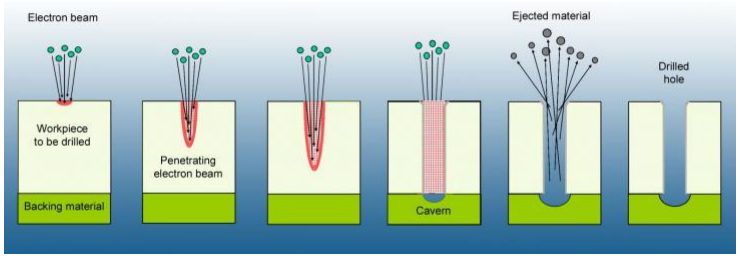

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Image source: http://www.steigerwald-eb.de/en/application-areas/drilling.html

What is Electron Beam Drilling (EBD)?

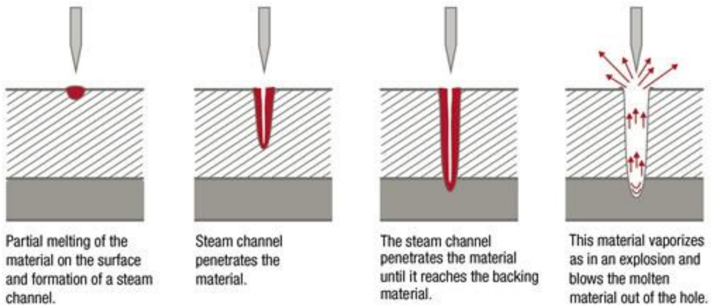

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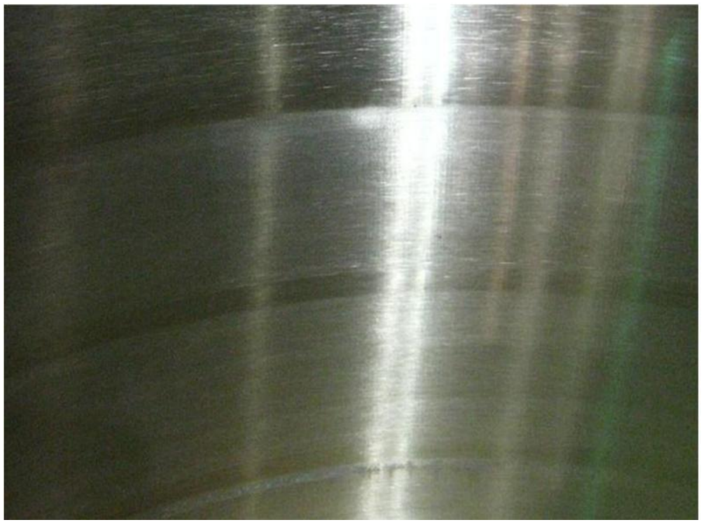
Image source: http://www.micromanufacturing.com/sites/default/files/stories/import/1308-Micromachining-web-resources/image/EB-Perforation%20engl_ha_opt.jpeg

EB Drilled cylinder



Although the screen surface appears to be blind, this screen cylinder has just under 4.5 million holes.

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EB Drilled cylinder

Same picture angle as on previous slide, this time with flashlight on opposite side of screen surface

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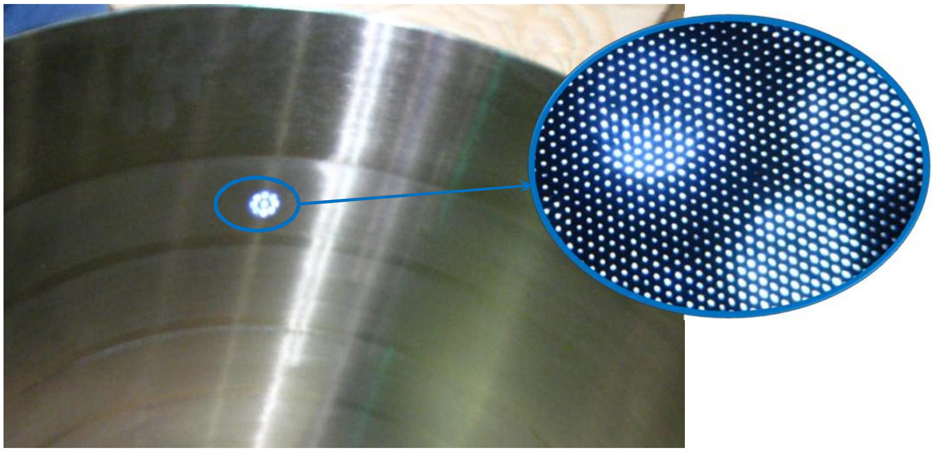
EB Drilled cylinder



Electron Beam Drilled Screen Cylinder
Close-up on illuminated area

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EXAMPLE FOR FIBRE FILTER EBD CYLINDER		
Cylinder Surface	1.25	sq. m
Cylinder Surface	13.5	sq.ft
Open Area	10%	
Effective Area	1.35	sq.ft
Hole Diameter	0.006	inch (0.15mm)
Surface/hole	0.00002827	sq. in.
Number of holes	**6 875 494**	

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HI-Q FIBRESAVER FILTER
Being prepared for shipment

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SECTION 2 – PROCESS MATTERS

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Example of Capacities

Installed Power	Approximate Maximum Accept Capacity	
HP / kW	USgpm	m³/h
30 / 22	550	125
60 / 45	1,500	340
100 / 75	2,400	550
150 / 110	3,500	800
250 / 200	5,500	1,250

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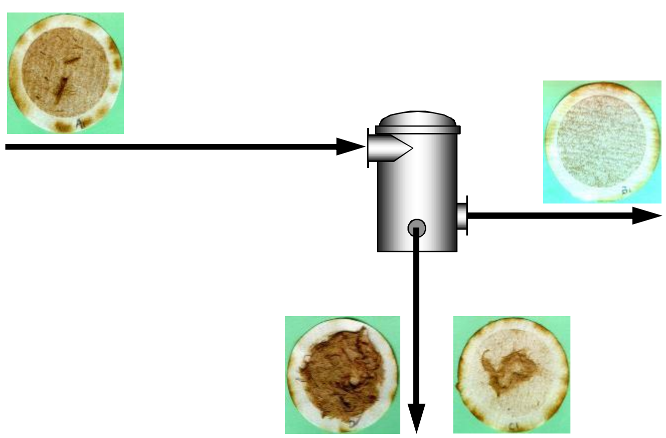
Fibre Filter Results



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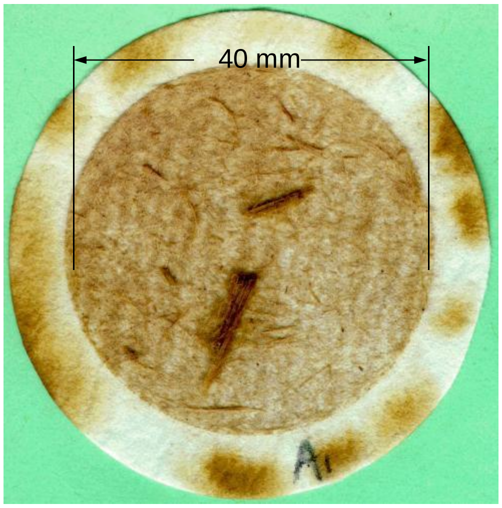
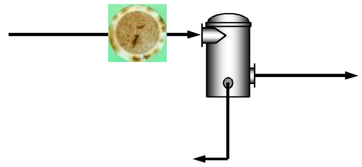
Filter Inlet





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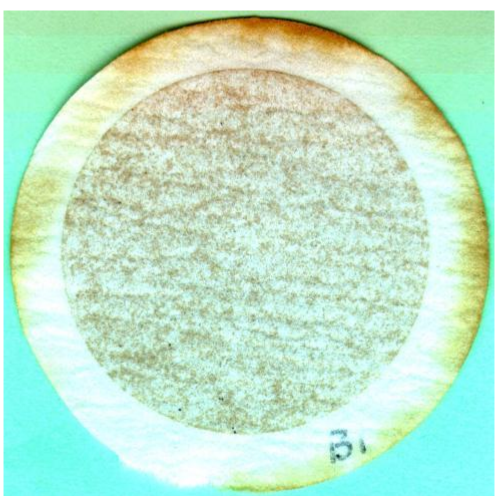
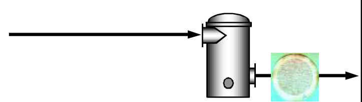
Filtered Stream (Accepts)





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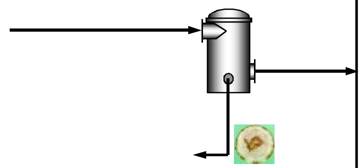
Recovered Fibres ("Rejects")



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Fibre Filters Cylinder Hole Size Selection

PERFORATION SIZE

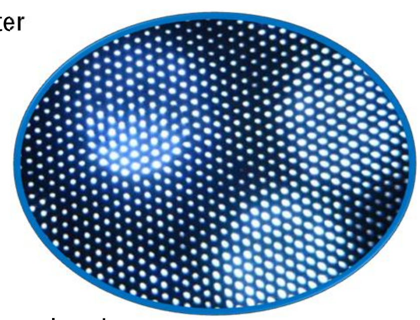
- Previously: 0,30mm, 0,25mm, 0.20mm diameter
- Today: **0.15 or 0.10 mm** diameter

CAPACITY

- Is a function of Open Area
- (EB Drilling Limitations)

EFFICIENCY vs OPERABILITY

- Unlike pulp screens,
  smaller holes does not mean more plugging



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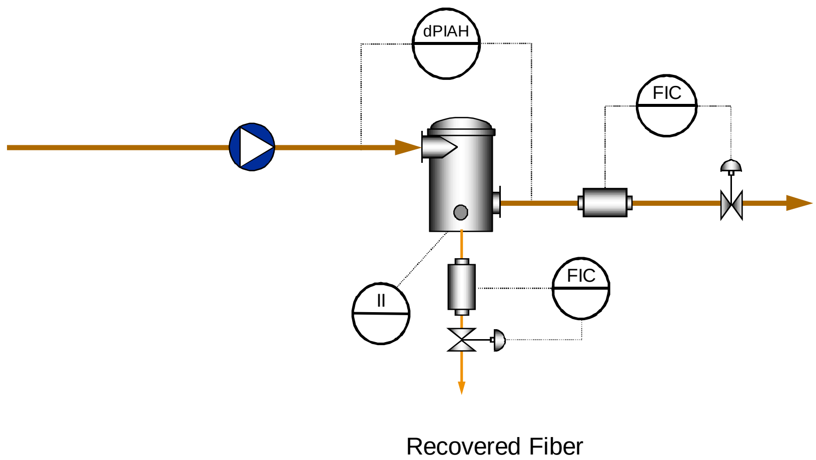
Fibre Filter - Typical Instrumentation



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Fibre Filter Installation

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SECTION 3 – SOLVING COMMON ISSUES

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Safety Reminder

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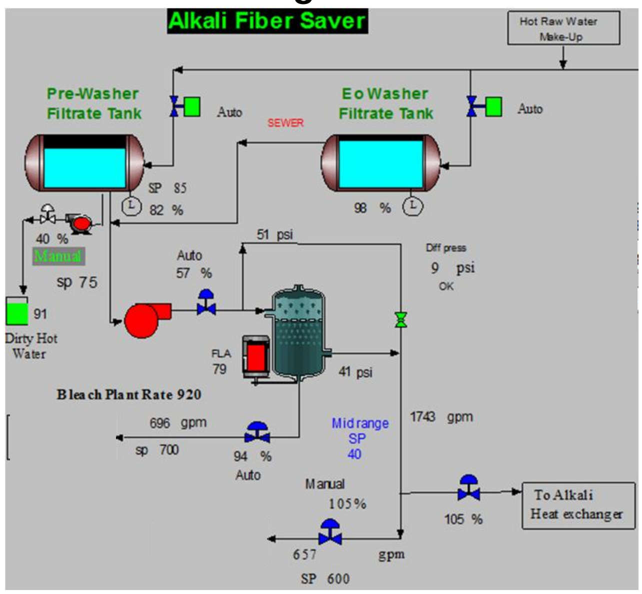
Fibre Filter Troubleshooting 1



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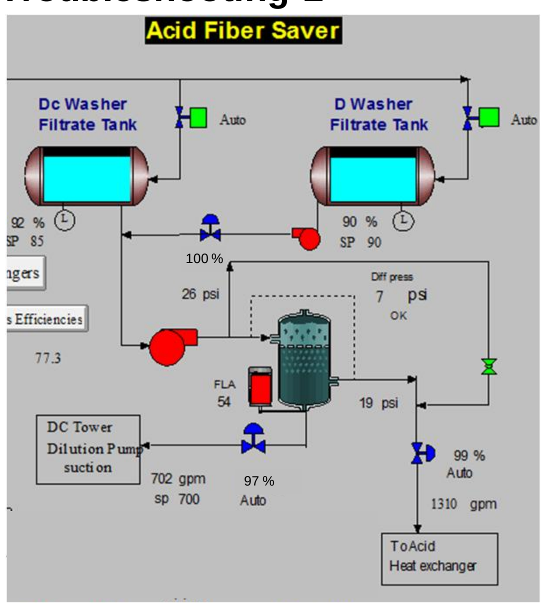
Fibre Filter Troubleshooting 2



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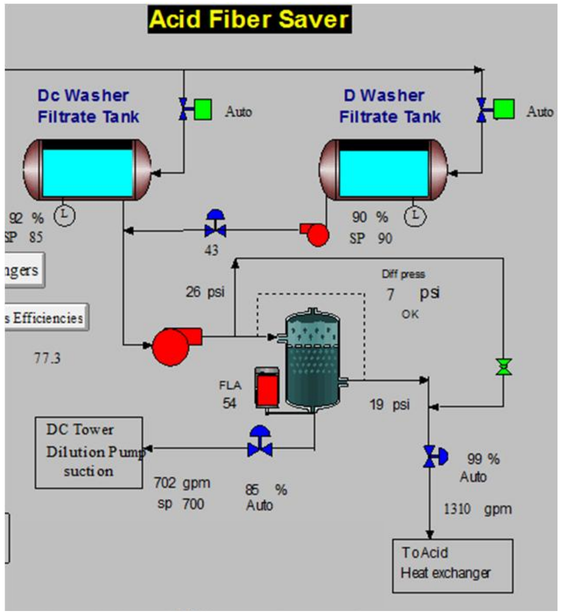
Fibre Filter Troubleshooting 3



A word on scaling

SCALING ON FIBRE FILTER CYLINDERS

DAMN !

1. Have a sample of the deposit analysed to understand what your dealing with
2. Find proper solvent for the subject scale
3. **High pressure washing by itself is ineffective**
4. High pressure wash to expose surface
5. Then soak cylinder in solvent or apply as a paste
6. Repeat 4 and 5 as needed so that solvent can access the deposits inside the holes
7. Rinse

QUESTIONS and DISCUSSION

Reduce your operating cost with GL&V's cost saving solutions...

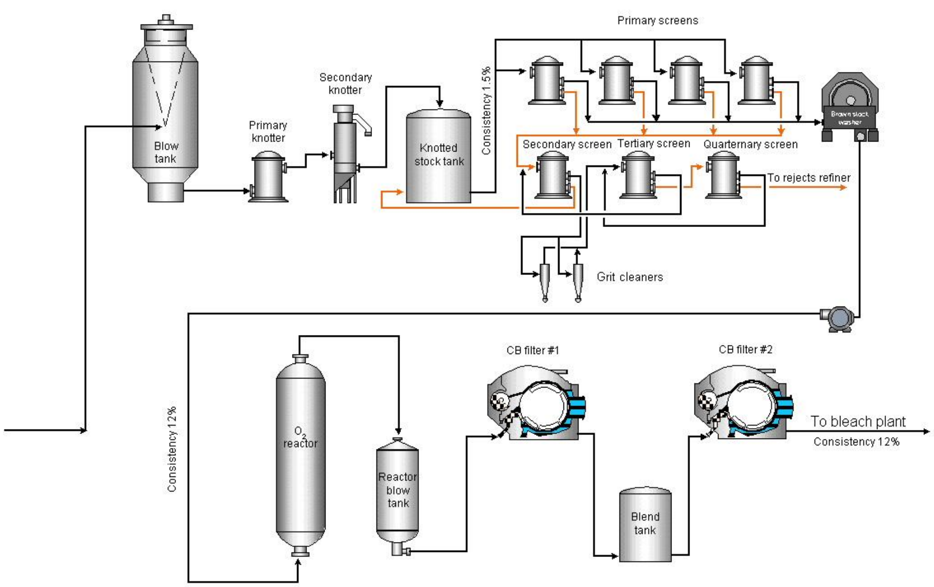
SKOOKUMCHUCK
PULP INC.
A PAPER EXCELLENCE COMPANY

Shocking Do and D1 Costs from Poor Washing

(A Dirty Story)

Mark Cameron

Screening Washing Oxygen Delignification



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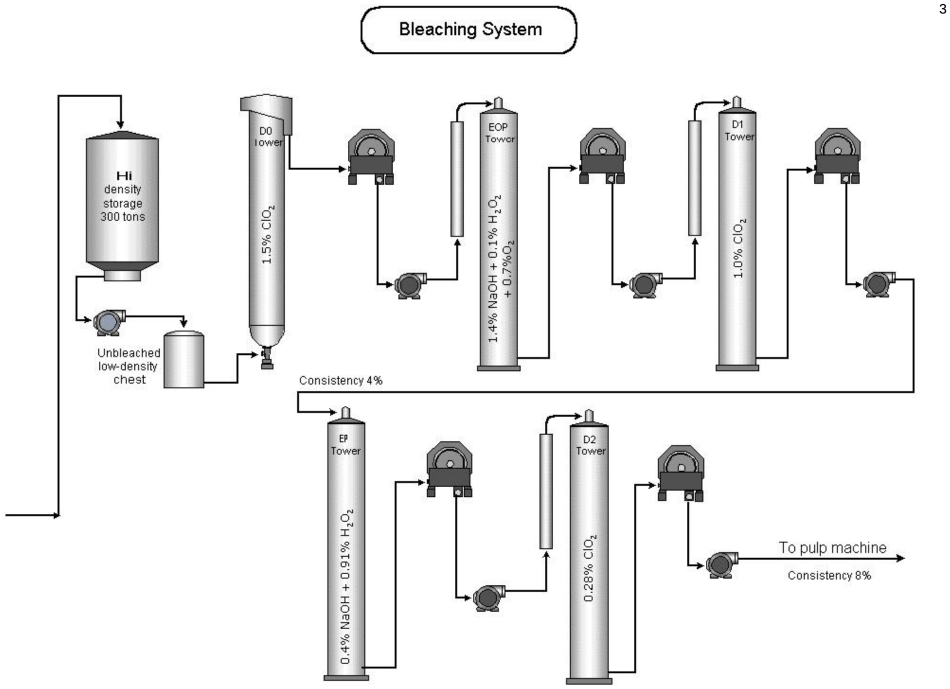

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Some Good Things

- Do Kappa Factor 0.22 (good control)
- Eop Caustic 11 Kg/ADMT
- Eop Caustic/Do ratio ~1.0
- Peroxide 2.8 Kg/ADMT
- Total ClO2 <20 Kg/ADMT
- Total Bleaching Cost about $43-44/ADMT

Some Not So Good Things

- Kappa into Bleach Plant only 12.3 (O2 delig 45% efficiency).
- Post-Eop Kappa is higher than it should be.
- ClO2/Kappa is only "average".

- How Come??

Procedure for Washer Filtrate Kappa Measurement

1) **Collect representative sample of washed stock from doctor board side, with wooden paddle, being <u>very</u> careful not to contact the repulper, or catch the paddle on the rotating drum.**
2) **Remove a plug of pulp from the sample representing both top and bottom of the sheet equally, and squeeze filtrate from the sample into a sample bottle. Good practice is to collect several samples across the sheet, and combine the filtrate into on sample, or best practice is to test the sheet at several points and look for variability in washing.**
3) **Perform a standard "K number" test using 40 mls of permanganate, and 80 mls of the squeezed filtrate instead of pulp, as a starting point. Volume of filtrate used can be adjusted for a second test, to consume approximately half of the permanganate.**
4) **Calculate filtrate Kappa as: (for 80 ml sample)**

(Blank (or 40.0) – titration)/10.96 = filtrate Kappa equivalent to 1.0 g pulp

Explanation: assume 12% washer discharge, so the filtrate associated with 1.0 g of pulp (standard Kappa) = (1-consist/100)/(cons/100), which is 7.3 g at 12% consistency. 80 g filtrate/7.3 g filtrate per g pulp = 10.96

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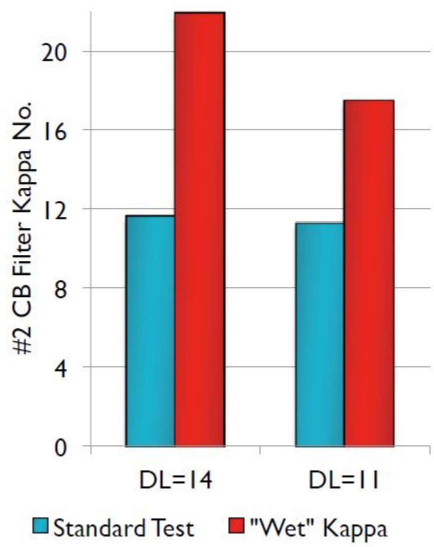
Pre-Bleach Washing



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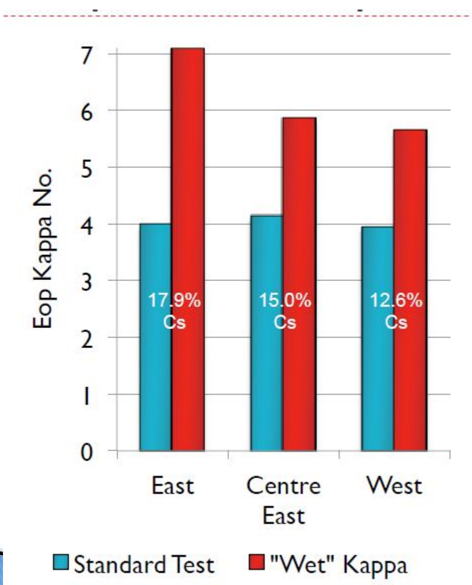
Pre-Bleaching Washing Costs

- COD tests 14-18 kg/ADMT from post-O2
- Reduction to <10 kg/ADMT COD would:
  - Save ~2kg/ADMT ClO2 in Do and D1 stages
  - Savings estimate ~$1MM per year

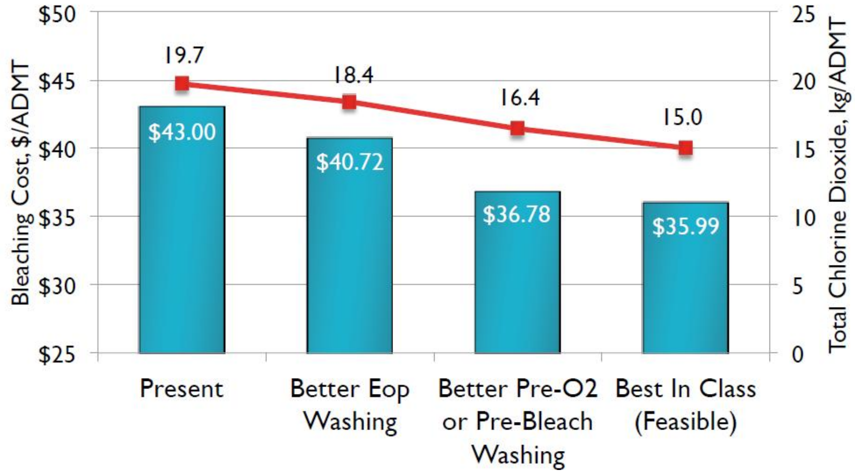
Impact of Eop Washing on D1 ClO2



Pre-D1 Washing Costs

- 30% or more of D1 ClO2 consumed by washer carryover!!!
- Improved pre-D1 washing would save 1. 5kg/ADMT ClO2 year.
- Cost saving of $0.75 MM per year………
  - ………. Just by keeping the shower clean

Potential Cost Reduction



Lessons?

- Most cost reductions take some capital, but……
- Some are right under our noses.

  - Know thine enemy.

  - Be not slothful.

Thank you

- Questions??

  - (or catcalls?)

INTERNAL

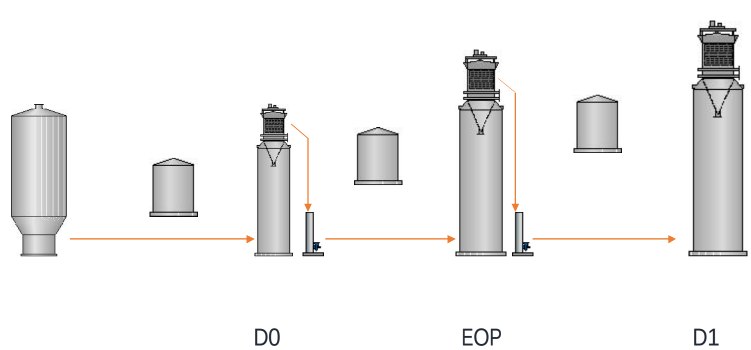
EOP Diffusion Washer Replaced with Evolution Press - Mill Results

Mona Henderson - Valmet

Valmet

INTERNAL

Original Bleach Plant
3-stage diffusion washer



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INTERNAL

Project Goals

- Lower bleaching chemicals consumption (ClO_2)
- Reduce the hot water usage
- Avoided maintenance costs and reduced maintenance time (diffuser)

INTERNAL

Back To Basics

The Importance of Good Washing

Removes dissolved solids: organic and inorganic carryover .... "gunk" that negatively impacts the bleaching process

The Benefits of High Discharge Consistency Washing in the Bleach Plant

Removes most of the free water which makes it easier to change pH and temperature

Makes it easier to control consistency to the next bleaching stage

Creates a "water lock"

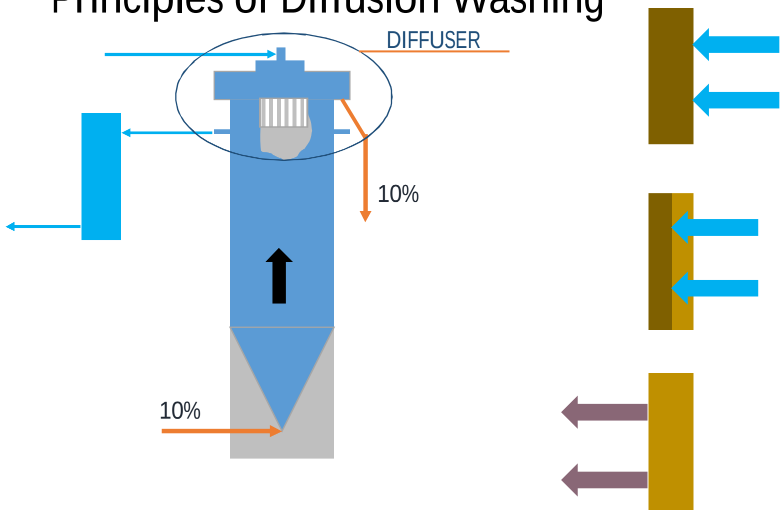
Allows savings in steam and water consumption

Guide-lines for how COD carryover impacts chemical consumptions

From....	To....	Impact (estimate)
O2	D0	0.6 kg act Cl / kg COD
EO	D1	0.3 kg act Cl / kg COD

INTERNAL

Principles of Diffusion Washing



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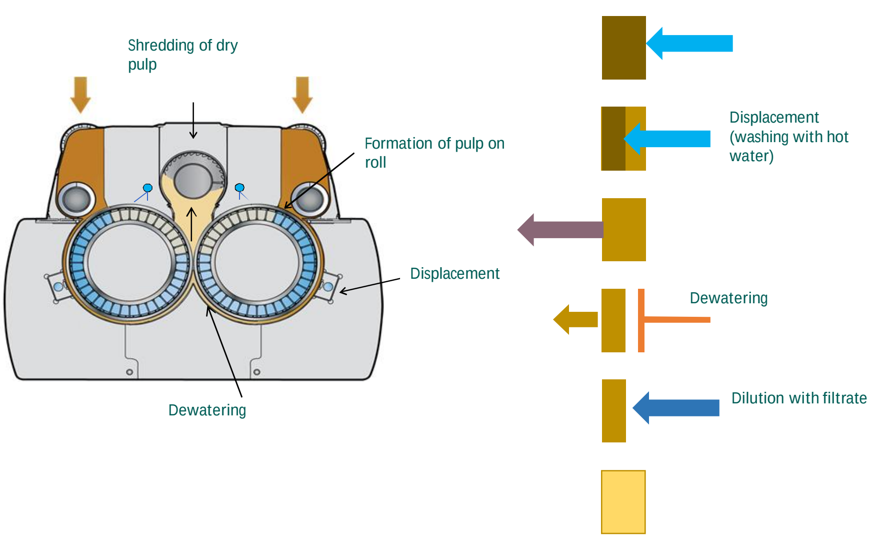
INTERNAL

Principles of Displacement Press Washing



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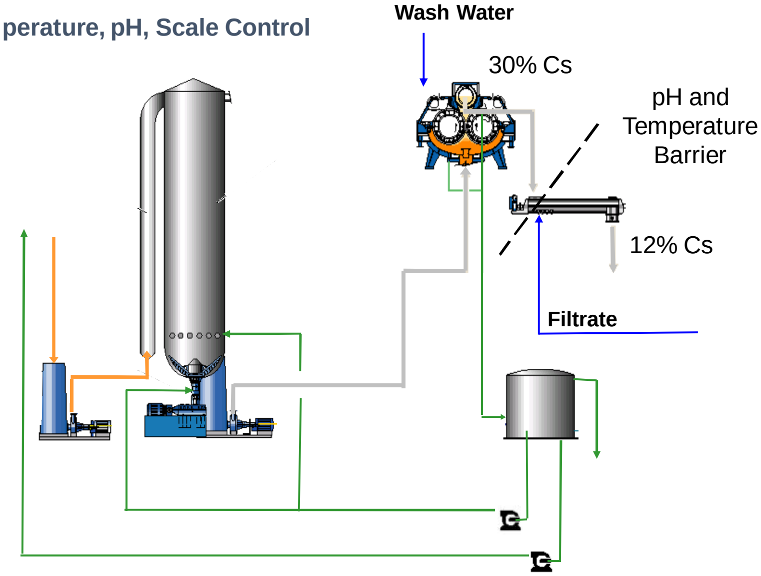
INTERNAL

The First Washing Principle

INTERNAL

Temperature, pH, Scale Control



INTERNAL

Case Study:
Implementation and Results

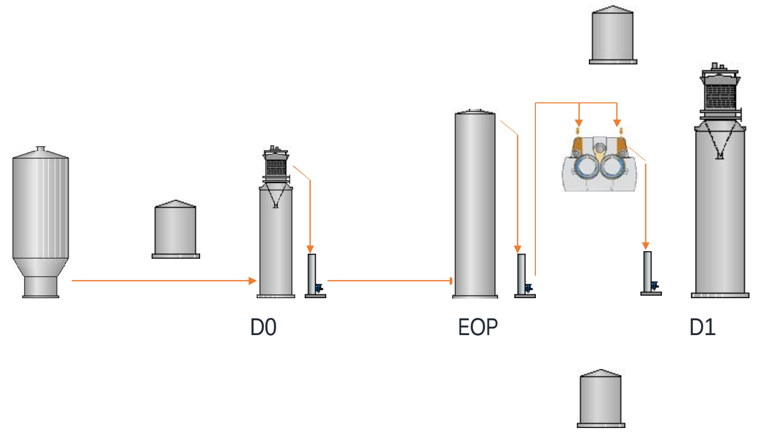
INTERNAL

System Modifications

Before	After	Result 1	Result 2	Result 3
Diffuser	Press	Better washing	Higher discharge consistency	T and pH "Barrier" between EOP and D1
Hot water to D1 tank	No hot water to D1 tank	Lower hot water consumption		

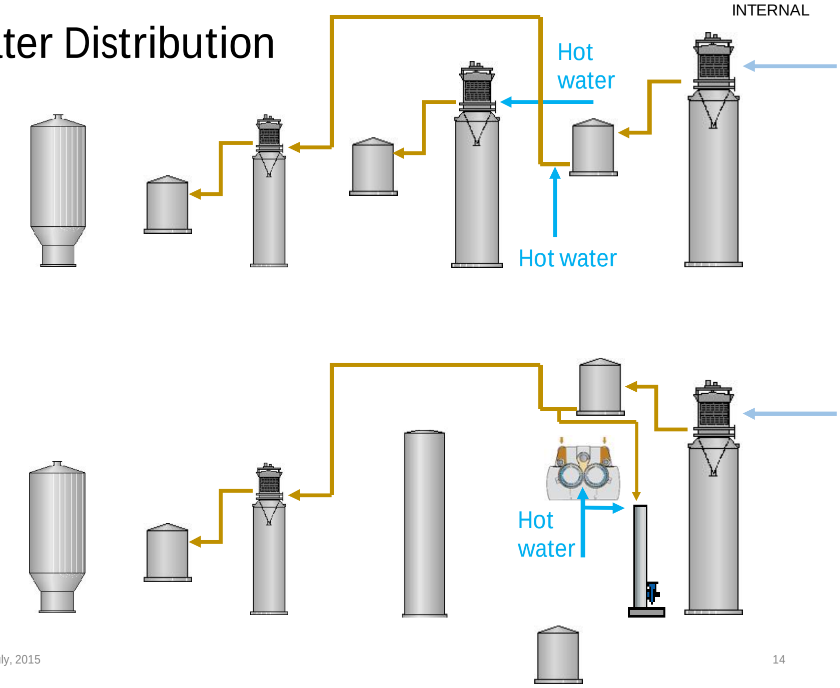
INTERNAL

Modernized Bleach Plant
EOP diffuser replaced with press



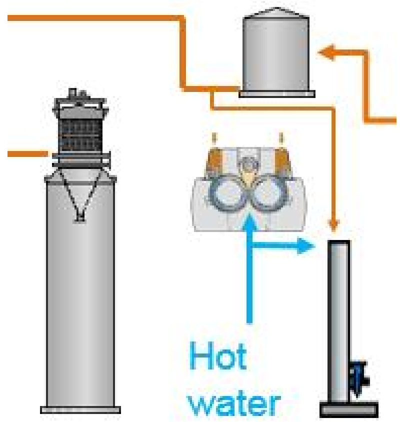
INTERNAL

Water Distribution



INTERNAL

Close – up of water distribution



No hot water added to suction side of D0 tower wash water

➡Hot water savings

Recover D1 filtrate as dilution

➡Dilute with right pH (H_2SO_4 savings)

➡Dilute with right temperature for D1 stage

31 July, 2015 15

INTERNAL

Results
(first year after TwinRoll Press installation)

Lower bleaching chemicals consumption (ClO_2 and sulfuric acid)

>>> almost 20% ClO_2 reduction

>>> ~55% H_2SO_4 reduction

Reduced hot water usage

>>> 340 m^3/h

Avoided maintenance costs and reduced maintenance time

TARGETED SAVINGS MET OR EXCEEDED

31 July, 2015 16

INTERNAL

THANK YOU!

31 July, 2015 17

Asset Optimization of Kamyr Digester

COOK-X – WASH
Washing at the bottom of a vapor phase continuous digester

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

Outline

- Mill Overview
- Drivers
- Issues
- Deliverables
- Results

Mill Overview

- Skookumchuck Pulp Inc.
  - Located in the East Kootenays, north of Cranbrook BC
- 900 admtpd Softwood fully bleached
  - SPF wood mix, "pine beetle left over"
  - Trucks and on-site chipper
- Hydraulic impregnation vessel followed by vapor phase continuous digester designed for 375admtpd;
- Produces green power for export to the grid;
- Mill is well balanced and almost maxed out at recovery boiler and pulp machine

Drivers for optimization

- Several senior operators are to retire within years;
- Standardization of operation around the digester;
- Optimize digester wash zone
  - best brown stock washer;
  - digester is massively hydraulically overloaded;
- Reduction of Kappa # standard deviation;
  - Kappa# at the digester drives pulp machine runnability.

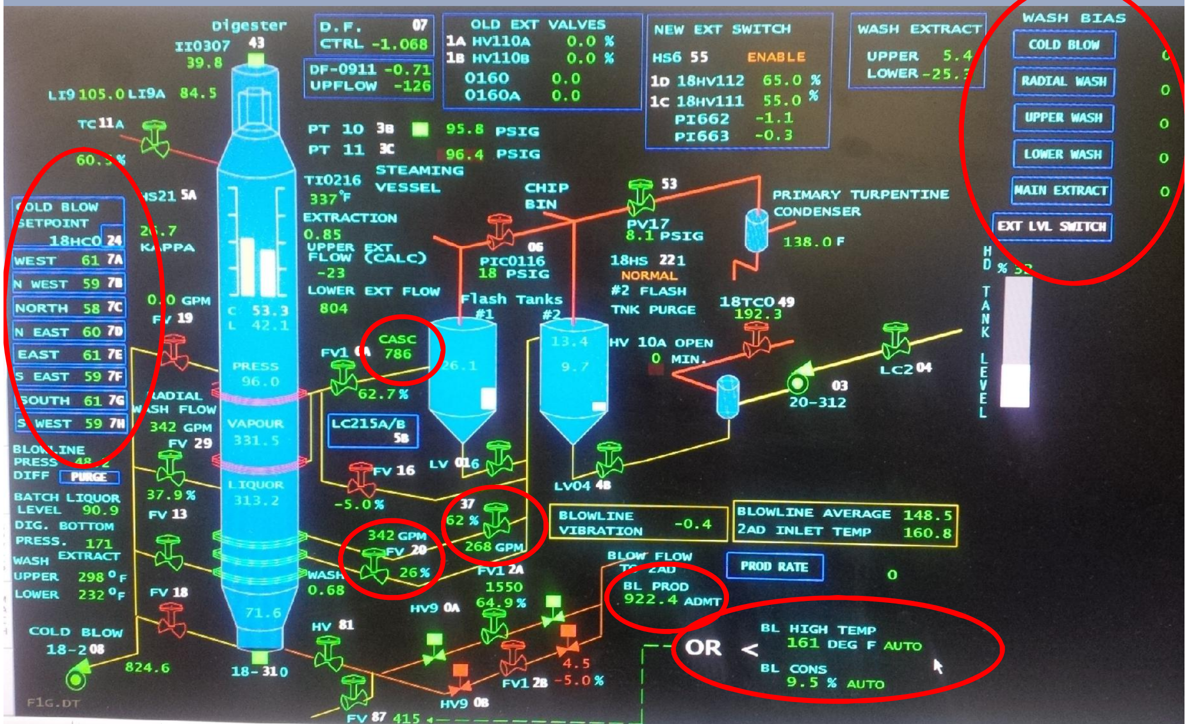
Issues

- Digester is massively hydraulically overloaded; rank #1!
- High blow line temperature causes diversion around double stage atmospheric diffuser (2AD);
- Kappa# at the digester drives pulp machine runnability;
- Issue with "weekend wood"
- Never had AUTO mode on digester liquid level;
- Small blow line 6"… at 900 admtpd;
  - vibration is an issue
  - blow line pluggage

Deliverables

- Blow line consistency control;
  - Consistency soft-sensor;
    - Blow ton production;
- Blow line temperature control;
  - Cold blow cooler control;
- Automation of cold blow, wash, radial and extraction flows;
- Digester liquid level;
- Operator biases;
- Production rate change and temperature control;
- Adjustment of pressure / temperature control;
  - Mill air instead of compressor;

Digester



Results

- Simple operator interface;
- Sustainable increase in production of 50 admtpd;
  - from 900admtpd to 950admtpd;
  - Unlock blow line flow from 1600 to 1800usgpm
- No more (almost) bypass around double atmospheric diffuser due to high temperature;
- Get the heat out of digester wash zone;
- Stable blow line consistency;
- Reduction of Kappa # variability by ~50%;
  - from 10-12%COV to 5-6%COV;
- Digester stability;
- On time, on budget!

Acknowledgement

Skookumchuck Pulp Inc, Skookumchuck BC

- Mark Cameron, Process Specialist
- Ian Dougall / Don Deynon, Pulp Mill Superintendent
- Chris Brown, Senior Digester Operator

TEXO Consulting & Controls Inc., Gatineau QC

- Mario Leclerc, VP APC Development & Deployment

Asset Optimization of Brown Stock Washing

WASH –X DIFFUSER
Optimization of a double stage atmospheric diffuser (2AD)

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

Outline

Mill Overview
Drivers
Issues
Deliverables
Results

Mill Overview

Skookumchuck Pulp Inc.

- Located in the East Kootenays north of Cranbrook BC
- 900 admtpd Softwood fully bleached
  - SPF wood mix
  - Trucks and on-site chipper
- Hydraulic impregnation vessel followed by vapor phase continuous digester designed for 375atmtpd;
- Produces green power for export to the grid;
- Mill is well balanced and almost maxed out at recovery boiler and pulp machine

Drivers for optimization

- Several senior operators are to retire within years;
- Standardization of operation around the diffuser;
- Optimize double stage atmospheric diffuser;
  - Next to digester, best brown stock washer;
- Limitation in subsequent brown stock washing;
- Reduction of carry-over;
- Maintain strong weak black solids;

Issues

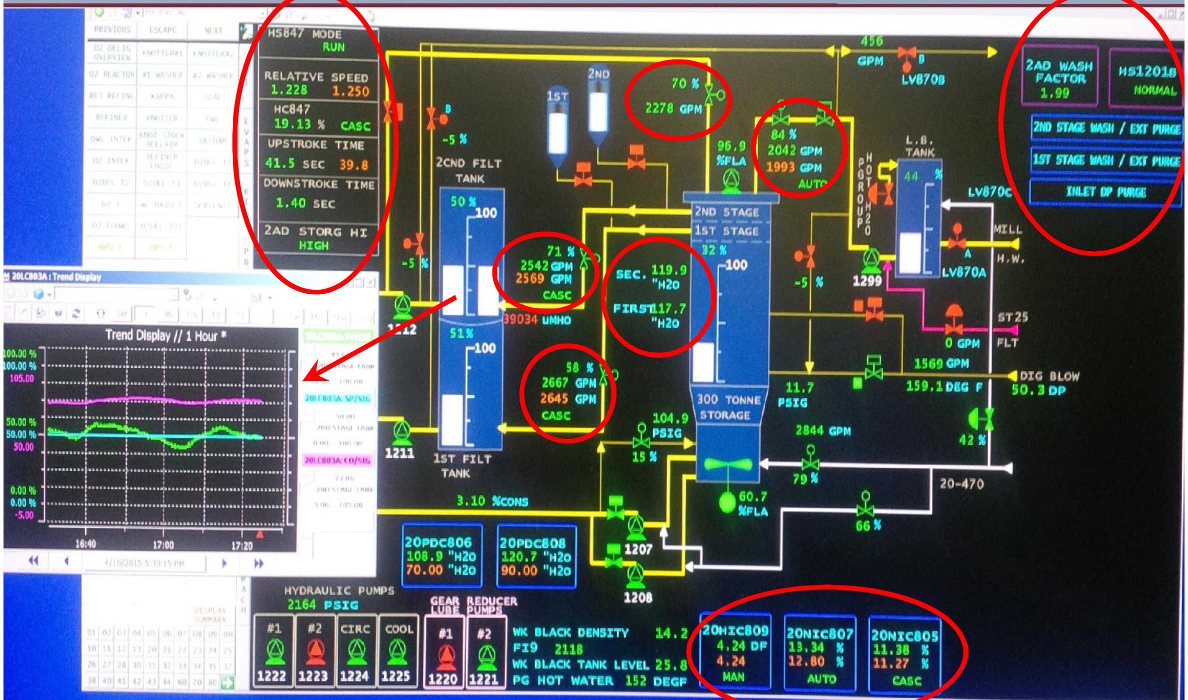
- Small blow line…at 900 admtpd;
- Limitations in wash and extraction flows;
- Only level control of second stage filtrate tank;
- Diffuser speed in manual running fast!;
- Have no idea of discharge consistency;
- Better brown stock washing equipment in the mill, but no optimization;
- All flows measured with orifice plate
  - Full balance doesn't quite add up…
- Peaks in DP at second stage.
  - Affects blow line flow control.

Deliverables

- Consistency control;
  - First Stage discharge;
  - Second stage discharge;
- Dilution factor control;
- Relative speed control of diffuser;

- Flow control of first/second stage extraction;
- Loop tuning;
  - Level control of second stage filtrate tank.
  - Second stage wash, and 1st/2nd extraction flows

Double stage atmospheric diffuser



Results

- Simple operator interface;
  - Forecast of instantaneous wash/extraction flows;
- Reduces filtrate conductivity to rest of brown stock;
- Slow down diffuser speed by up to 20% as a function of blow line production;
- Even out DP raises between 1st and 2nd stages;
- Currently operating at
  - 2.9% discharge consistency (Cs) higher than blow line
  - 4.2 dilution factor (DF)
- Raise blow line consistency by 0.1%;
- Allow a rise of up to 3.5% Cs from blow line Cs;
- Stabilize weak black concentration ~14.5%;
- On time and on budget!

Acknowledgement

Skookumchuck Pulp Inc., Skookumchuck BC

- Mark Cameron, Process Specialist
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- Chris Brown, Senior Digester Operator

TEXO Consulting & Controls Inc., Gatineau QC

- Mario Leclerc, VP APC Development & Deployment

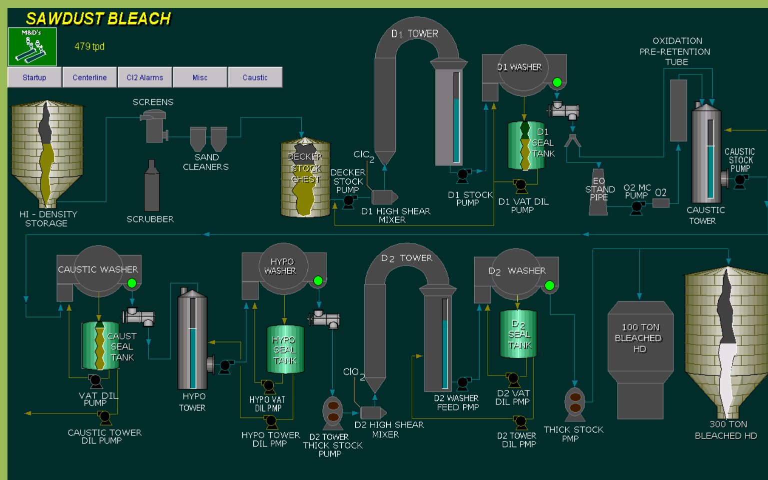
TEXO
www.texo-cc.com

Recycling D Filtrate to the Sawdust Bleach Feed Repulper

David Trzil
Clearwater Paper

Social Responsibilty Goals

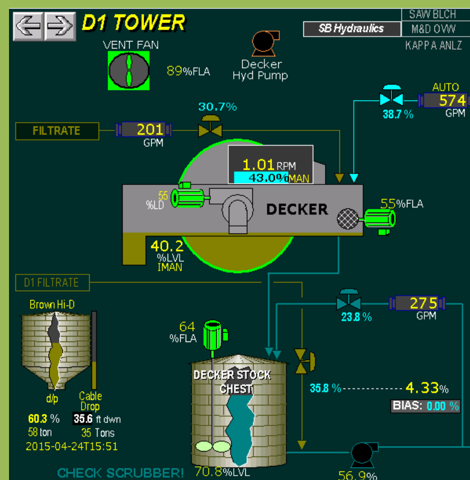
Sawdust Bleach DEpoWpD



Note: Hypo is just the equipment name. No sodium hypochlorite is used to bleach.

Decker (but really a Washer!)

Decker Repulper



Benefits and Challenges

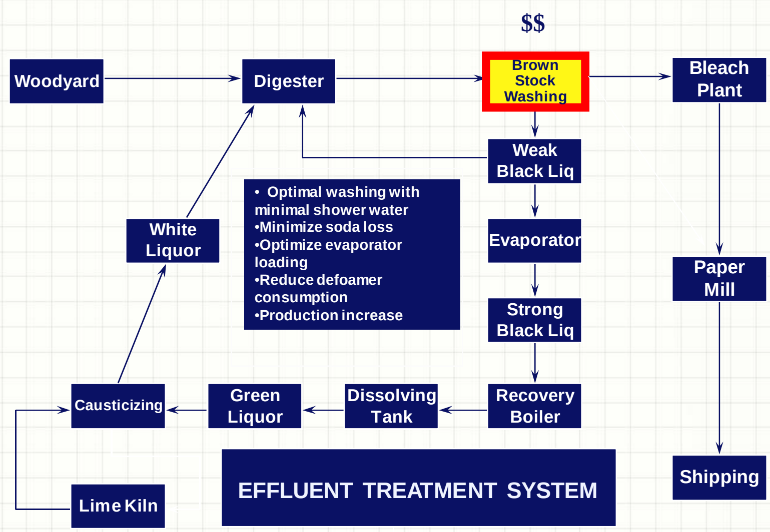
- Hot Water Reduction (Sustainability)
- Energy Savings (Sustainability)
- Acidic Filtrate Neutralizes Carryover
- Some Odor Noticeable from Decker Chest at Higher Replacement – Over Bleaching Signal!

A New Sensor Based approach to Brownstock washer Optimization

Rick Van Fleet

BTG
RAISING YOUR PRODUCTIVITY

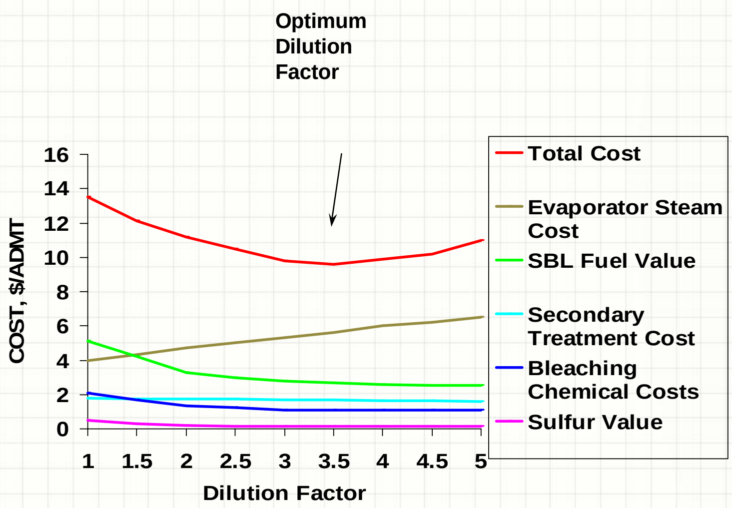
Why Improve Control of Brown Stock Washing?



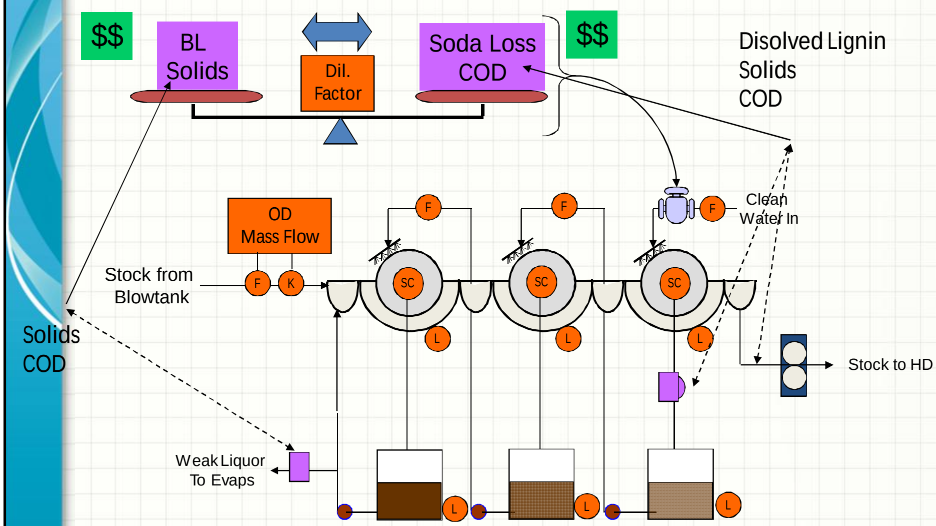
Washing Objectives

- The overall objective of the Brownstock washing operation is to remove the maximum amount of dissolved black liquor solids, with a minimum amount of water used.
- Minimizing the water input will maximize the black liquor solids to the evaporators, which will result in steam savings.
- Minimizing losses to the bleach plant will benefit the bleaching operation.
- Overall objective is to find the optimized dilution factor which benefits the cost of make-up chemicals, lowest bleaching cost, and maximize the effeciency of the recovery process.

Washing Control Objectives



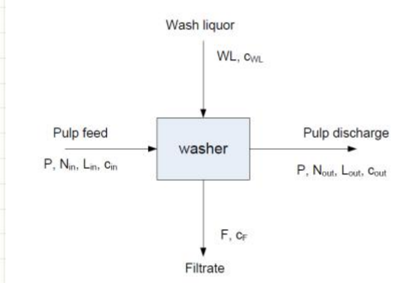
Balancing Between COD and BL Solids



Key Operational Variables

- Production Rate
  - Flow X Consistency is involved in all calculations
  - Mat profile impacted for both rotary and press type washers
- Shower Water Control
  - To control DF, must be a manipulated variable
- Black Liquor Solids to Evaps
  - Constraint variable for optimization

Washer Efficiency Calculations



Dilution Factor - DF = (WS-WLout)/P

Wash Yield - Y= 1-(Lout * Cout)/(Lin * Cin) = (F * Cf) / (Lin* Cin)

Displacement Ratio - DR = (Cin - Cout)/Cin - Cwl)

Nordic Efficiency Factor - E = (log ((Lin/Lout)*(Cin-Cf)/(Cout-Cwl)) / (log (WL/Lout))

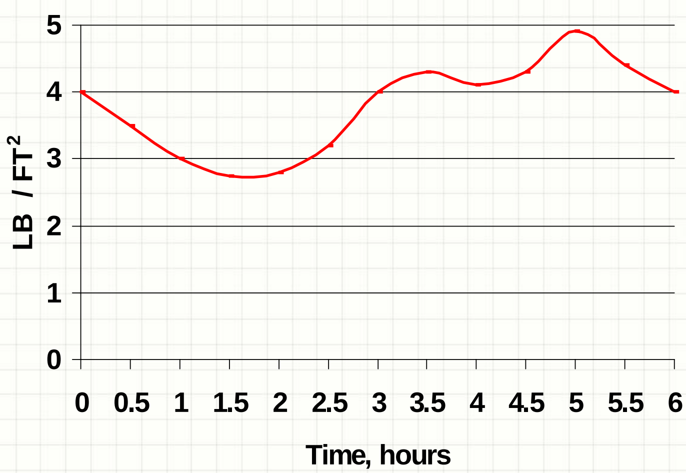
E in standard 10% consistence - E10 (log ((Lib/Lout)*(Cin-Cf)/Cout-Cwl))/ (log (1+DF/9))

% COV= 1 sigma S.D / mean

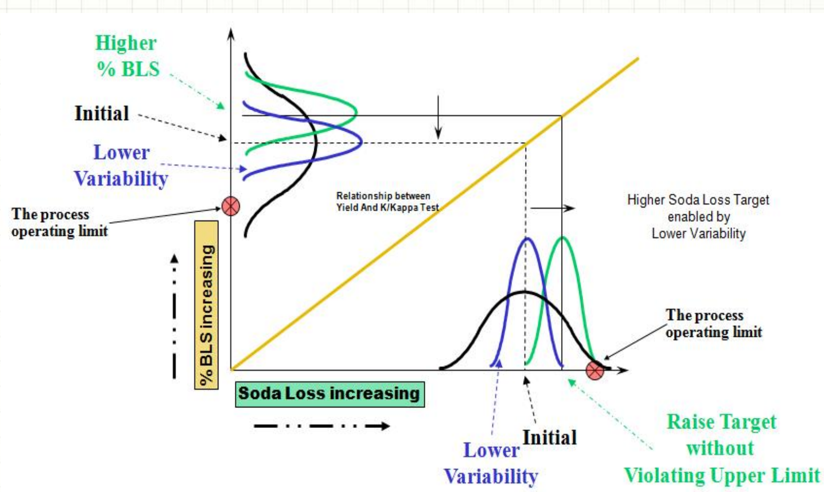
In Systems Where Dilution Factor is Uncontrolled.....

- Analysis of variance: Dilution factor has the largest effect on the solids leaving the washers (soda loss and organics).
- Largest contributor of water into the weak liquor system is from the dilution factor.
- Dilution factor is normally the largest contributor to the variability of the evaporator feed liquor solids

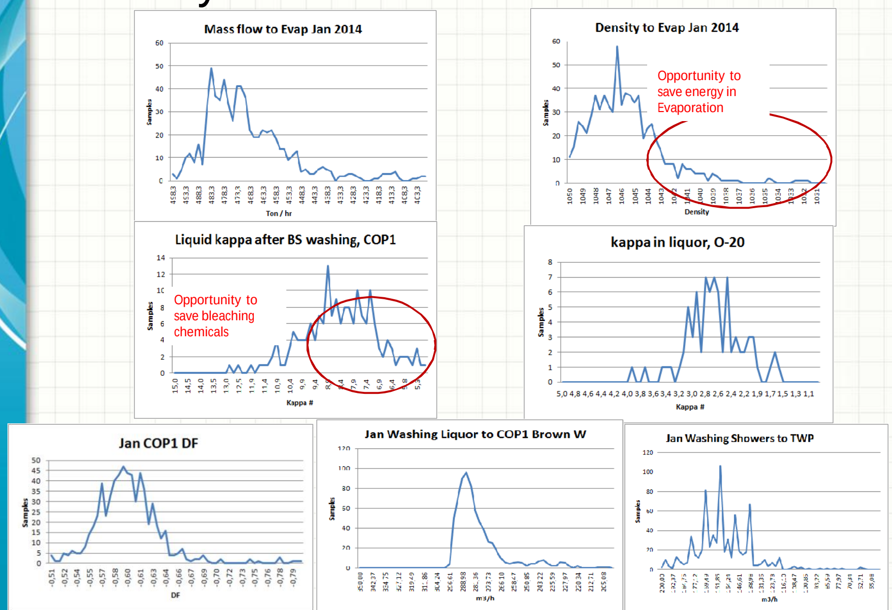
Typical Pulp Mass Variations on Last Stage Washer



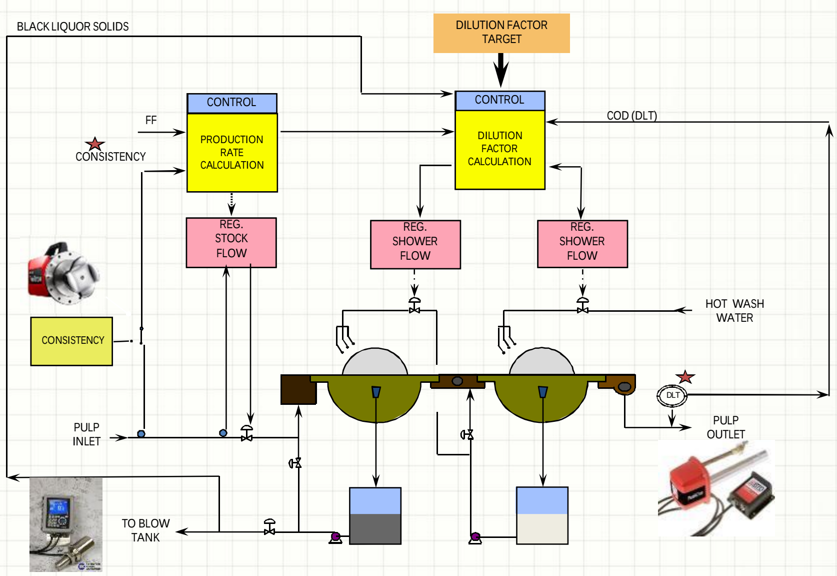
Soda Loss Shift Example



January Observations



New Sensor Based Approach to Washer Control



DLT- Dissolved Lignin Transmitter

- Measures UV absorption in filtrate portion of pulp suspension
- Correlate absorption to filtrate kappa, COD
- Correlation is excellent
- Applications:
  - Do Feed
  - Brown Stock washing
  - Board machine head box
  - Sulfite & Continuous digester recirculation
  - Pre O2 Delig
  - Waste water

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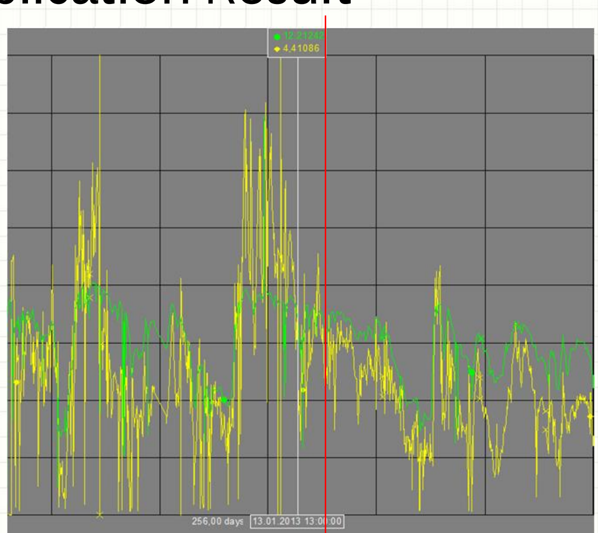
Application Result



MANUAL CONTROL

DF WITH DLT CONTROL

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Benefits of Improved Control

- Minimize chemical losses to sewer
- Reduce chemical carryover to bleach plant and paper machine
- Control COD
- Optimize evaporator loading
- Lower use of defoamers
- Increase production
- Reduce operations demand

Savings in the range of $2.00/ADT

QUESTIONS?

PAPTAC Bleaching Committee

Spring 2015 Meeting

Hosted by FPInnovations – Pointe Claire, QC – May 4-6, 2015

"Projects" Sub-Committee Presentations

Enzymatic Bleaching – Sabrina Burkhardt (Econotech)

Update on PAPTAC Bleaching Survey – Paul Earl (Paul Earl Consulting)

New Findings – E1 Washing and D1 Filtrate – Paul Earl (Paul Earl Consulting), Jim Collins (AV Terrace Bay)

Improved pH measurement and Caustic Optimization on E1/E2 Stages – Jessica Paul (Skowhegan)

Lock-out Tag-out Review – Jessica Paul (Skowhegan), John Gillespie (Irving), Brian LaBrash (Verso Quinnesec)

Bleaching Committee Presentation Index – Raymond Paquet (Kemira)

Respirator Safety – Doug Reid (AkzoNobel)

Scale Rate Monitoring – Jack Thomas (Nalco)

E Stage pH Control – Rick Van Fleet (BTG)

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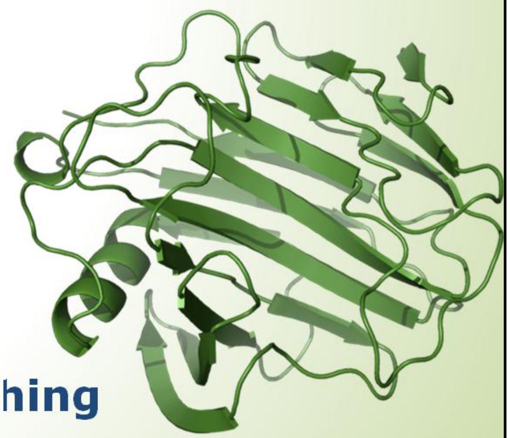

Enzymatic Bleaching

Sabrina Burkhardt
Pulping, Bleaching & Dissolving Supervisor
Econotech Services Ltd.

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Agenda

- Enzyme basics
- Chemistry
- Brief history
- Enzyme types
- Going commercial
- Optimistic outlook

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3

Enzymes – what are they?

- Proteins released from a variety of microorganisms – fungi, bacteria
- Biological catalysts to complete a specific task
- Have evolved in a wide range of environments – acidic/basic, hot/cold

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4

Enzymes – what do they do?

- Everything from breaking down food to woody biomass
- Highly selective action
- Classifications we care about:
  - Oxidoreductases
  - Hydrolases

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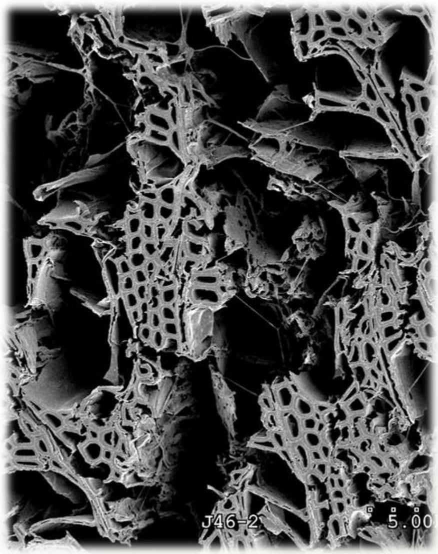
Enzymes for wood degradation



Extracted from wood-rot fungi, and other bacteria:

- Hydrolases:
  - Cellulases
  - Hemicellulases (xylanases, mannanases)
- Oxidoreductases:
  - Laccases
  - Peroxidaises

Photo Source: Robert A. Blanchette / Joel A. Jurgens, University of Minnesota, ecology.com

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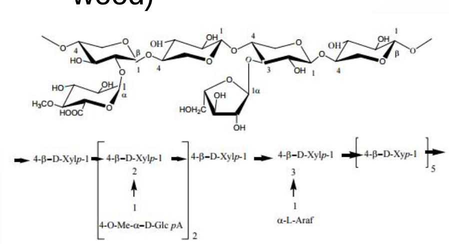
Wood Chemistry

Hardwoods

- Lignin: 16-25%
- Hemicellulose: ~30%
- Primary hemicellulose: glucuronoxylans (15-30% wood)



Softwoods

- Lignin: 23-33%
- Hemicellulose: ~27%
- Primary hemicellulose: galactoglucomannnan (10-15% wood)
- Secondary hemicellulose: arabinoglucuronoxylan (5-10%)

Photo Source: ipst.gatech.edu

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After kraft pulping

High alkalinity and temperature leads to:

- Dissolution of much lignin, extractives, and majority of mannan hemicelluloses
- Xylan hemicelluloses often reprecipitate on fibers during cook (up to 15% of initial)
- Glucuronic acids for hexeneuronic acids and can bind to lignin

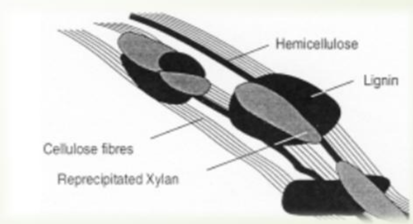

Photo Source: University of Auckland, School of Biological Sciences, Forestry – Dr. David Saul

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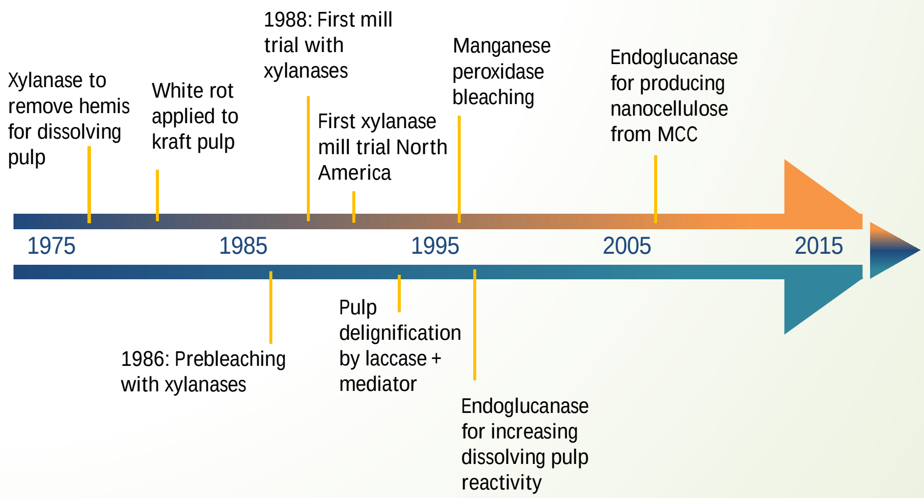
History of enzyme use in Pulp Bleaching



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Cellulases

- Endoglucanase
- Cellobiohydrolase

- Little use in pulp bleaching
- Have been used at mill-scale
- Causes reduction in viscosity/DP cellulose
- Good for fiber modification + deinking

Picture source: "1NLRribbon" by Nicholas Sawyer.

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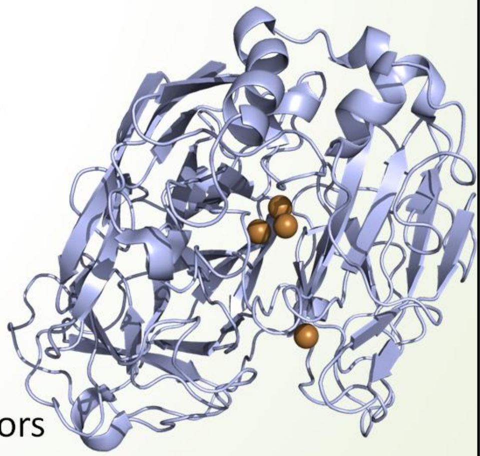
Lignin-oxidizing enzymes



- Laccase
- Manganese-peroxidase
- Lignin-peroxidase
- Derived from white rot fungi
- No trials at mill-scale
- Early attempts to use these enzymes failed
- Need mediators/ chelators to attack

Picture source: Armstrong research group, Oxford University

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Lignin-oxidising enzymes

Advantages

- Attack lignin directly (no carbohydrate degradation)
- Can remove more lignin than an O_2 delig stage
- Shorter reaction time than white rot fungi (≤ 24h)

Limitations

- Requires mediators – which are expensive, toxic, and variable in performance
- Still needs relatively long contact time
- Much more research is needed to understand this system

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Hemicellulases

- Xylanase
- Mannanase
- Biggest success story
- Unexpected pulp brightening properties
- Xylanases more effective than mannanses on both HW & SW species
- Synergism reported when using both hemicellulases in some studies

Picture source: portalice.ca

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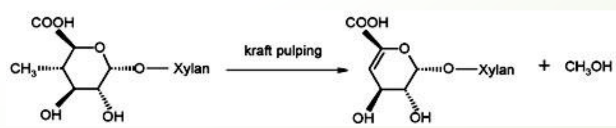
Xylanase delignification – proposed mechanisms

- Hydrolyses reprecipitated xylan on the surface of fibers, allowing more lignin to diffuse
- When the xylan is cleaved, any monomers that are linked to lignin (LCC bonds), may also be liberated
- Xylanase also helps to release Hex-A, which has been shown to bond to lignin after pulping



(Formation of Hex-A during pulping) Source: Petit-Breuith et al 2004, J. Chilean Chem Soc.

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Hemicellulases: advantages and limitations

Advantages

- Decrease in chlorine-chemical usage: ~20% for HW, 15% for SW
- Chemical cost savings
- Decrease in AOX in effluent
- Increased brightness ceilings
- Easy application to most bleaching processes

Limitations

- Strict temperature and pH control needed
- Corrosion issues reported at mill scale due to H_2SO_4 application to acidify brownstock pH

Challenges with commercial enzyme treatments

- pH
- Temperature
- Source of enzyme
- Wood species
- Quantity applied
- Contact time
- Cooking and bleaching chemistries/ conditions
- Lab-scale trials to fine tune all of the above

Accessibility to reaction sites is key!

Picture source: Vancouver Sun

Enzymes – an optimistic outlook

- Opportunity for mills to save on chemicals costs, simultaneously reducing environmental impact.
- Xylanases are available and have been running in mills for nearly 30 years
- Room for growth of enzyme use as pre-bleaching aid
- Expect more developments in these fields:
  - Laccases: potential to reduce kappa by 50-70%, but currently need an expensive/toxic mediator
  - Endoglucanase and xylanases: increased interest as a post-bleaching treatment

Questions?

PAPTAC Bleaching Committee

2012-2013 Bleaching Survey
SWD & O2-SWD
Updated Results & Analysis

(still a work in progress…)

Spring 2015 Meeting
Pointe-Claire, QC
May 4-6, 2015

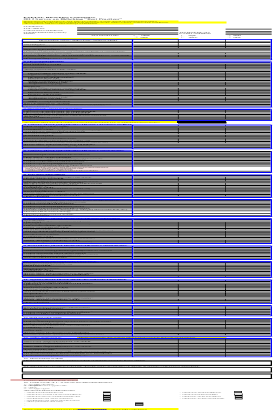
Outline

- Background
  - Survey response & methodology
- Results
  - SWD & O2-SWD
    - Comparison with 2003 results
    - Brownstock & Oxygen Delignification
    - Bleaching stages
    - Overall chemical use and bleaching cost
- Analysis
  - Differences between "Low" and "High" relative chemical consumption bleach plants
  - Trends since 2003
  - Identification of Bleaching "Best Practices"

Background

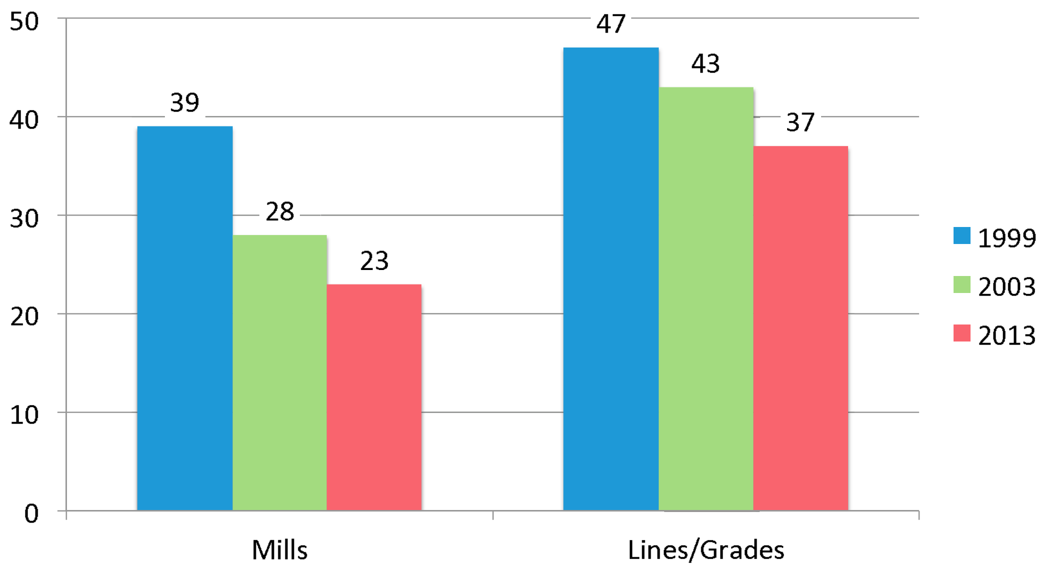
- Bleach Plant Surveys carried out in early 1990's, 1998-99, 2003-04
- Survey of Operational Parameters
  - Chemical use
  - Bleaching stage variables (time, temperature, pH)
  - Washers and showers
  - Energy use
  - Process control
- Last survey sent out January 2003, presented Spring 2004
  - 28 mills responded (~80% response)
  - 43 bleach lines or grades (72% response)

2012/13 Bleaching Survey

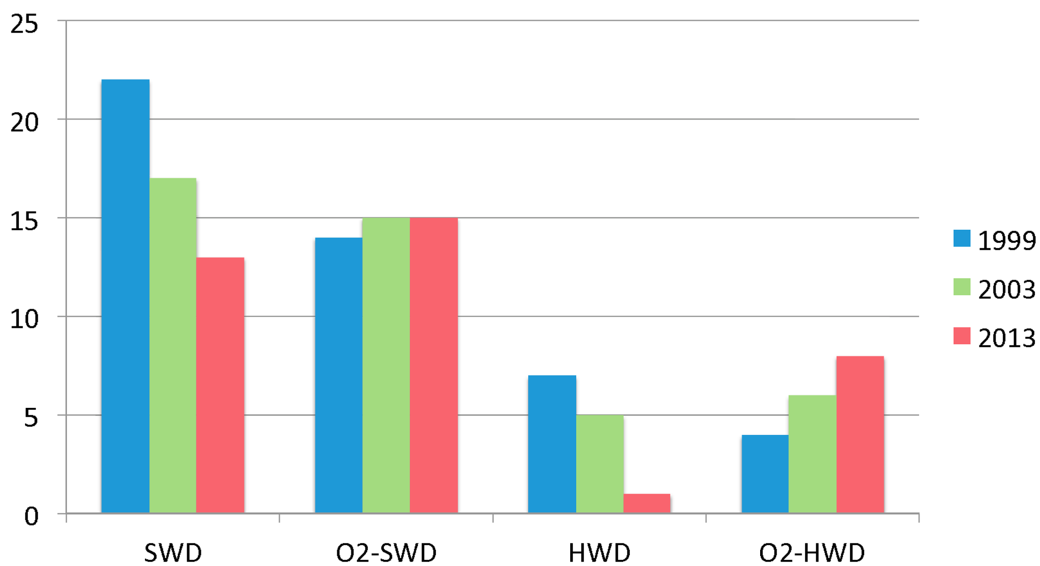


- ✓ Using previous survey as template (with modifications / additions)
  - spreadsheet, 300+ rows
- ✓ All dated is coded; no mill names
- Changes:
  - Includes Oxygen Delignification now
  - More details on steam & water use
  - Updated process control questions
- Project Team
  - Paul Earl, Dan Davies, Brian La Brash, Honey Nampak, Doug Reid, Murray Walters
- Survey initially sent out Sept. 7, 2012
  - First response Sept. 25, 2012
- 23 responses, representing 37 lines or grades

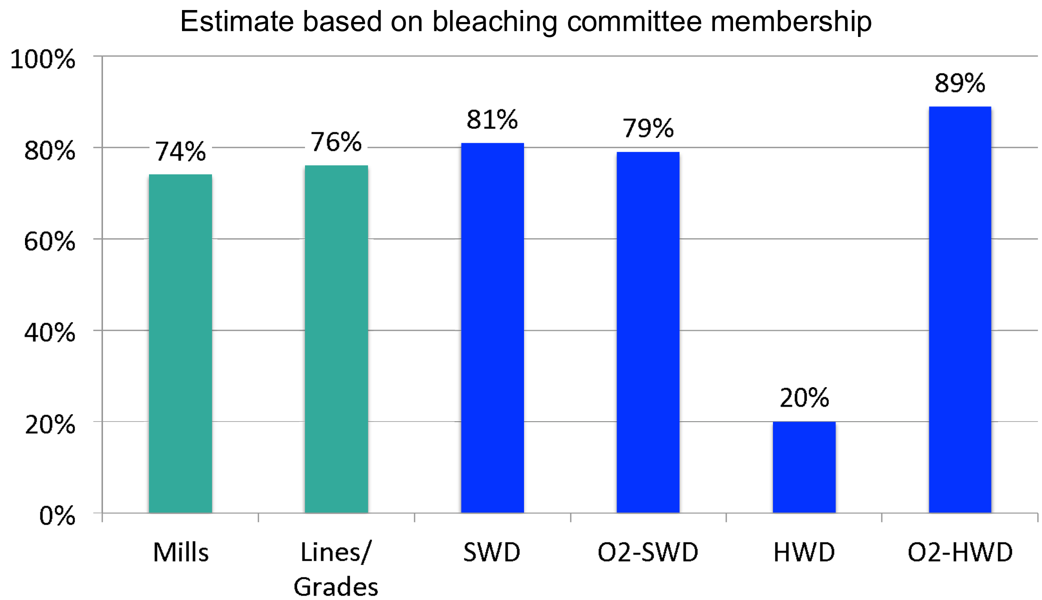
Survey Response



Response By Grade



Response Rate



Methodology

- Responses were coded
  - Wood furnish and ClO_2 generator removed
- Data converted to "standard" units:
  - *e.g.* chemicals as kg/ADMT, temperature in °C
- SWD & O2-SWD analysis = Fall 2014 / Spring 2015
- O2-HWD analysis = Fall 2015 ?
- Process Control and Water & Energy Use to be analyzed separately
- Results (coded spreadsheets & slides) posted after presentation on new members' website

Definitions

- "Kappa Factor" = <u>% Chemical on Bleached ADMT pulp (as eq. Cl_2)</u>
  Kappa No. into bleach plant
- Total ClO_2 Kappa Factor includes all ClO_2 used in bleach plant
- Sequence Kappa Factor includes all oxidizing chemicals in bleach plant (ClO_2 & H_2O_2 only)
  - Oxygen in Eop-stage is *not* included
- In each of the pulp grade categories, mills were sorted by Sequence Kappa Factor
  - Divided into two groups and averaged:
  - "Low Relative Chemical Consumption" are the mills below the median (*i.e.* the lower 50%)
  - "High Relative Chemical Consumption" are the mills above the median (*i.e.* the upper 50%)

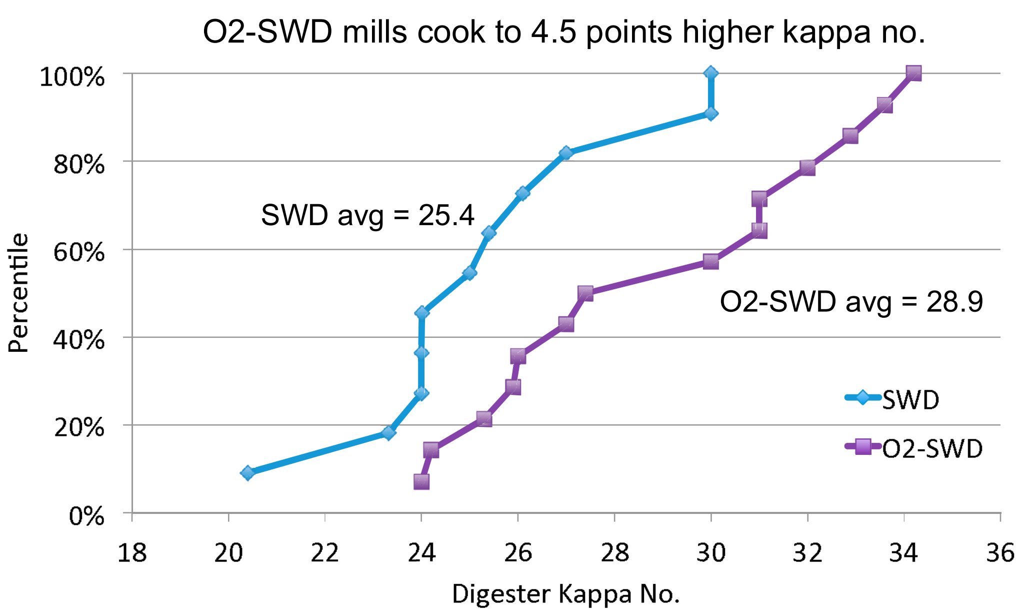
Assumptions

- If ranges were provided instead of single data points, then the average was taken
  - *e.g.* "8-10 kg/t" = 9 kg/t
- Conversion of K# to Kappa No.
  - K# >14, Hatton SWD Eq'n
  - K# ≤14, Hatton HWD Eq'n
  - Eop K# x 1.35
- "*Bleaching Cost*" graphs assume all mills have same chemical costs:
  ClO_2 = $1.30/kg H_2O_2 = $0.65/kg
  O_2 = $0.05/kg   NaOH = $0.60/kg
- Bleaching Cost does not include acid, $MgSO_4$, bleach plant steam, or the costs associated with oxygen delignification
- "Normalized Bleaching Cost" pro-rates the cost linearly to a constant bleach feed Kappa No.

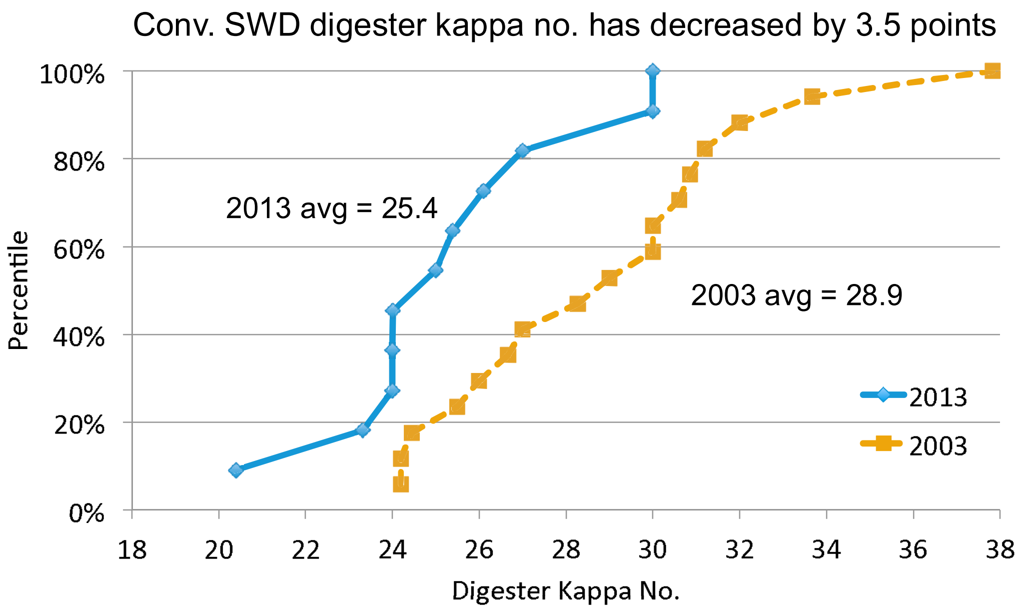
Outline

- Background
  - Survey response & methodology
- Results
  - SWD & O2-SWD
    - Comparison with 2003 results
    - Brownstock & Oxygen Delignification
    - Bleaching stages
    - Overall chemical use and bleaching cost
- Analysis
  - Differences between "Low" and "High" relative chemical consumption bleach plants
  - Trends since 2003
  - Identification of bleaching "Best Practices"?

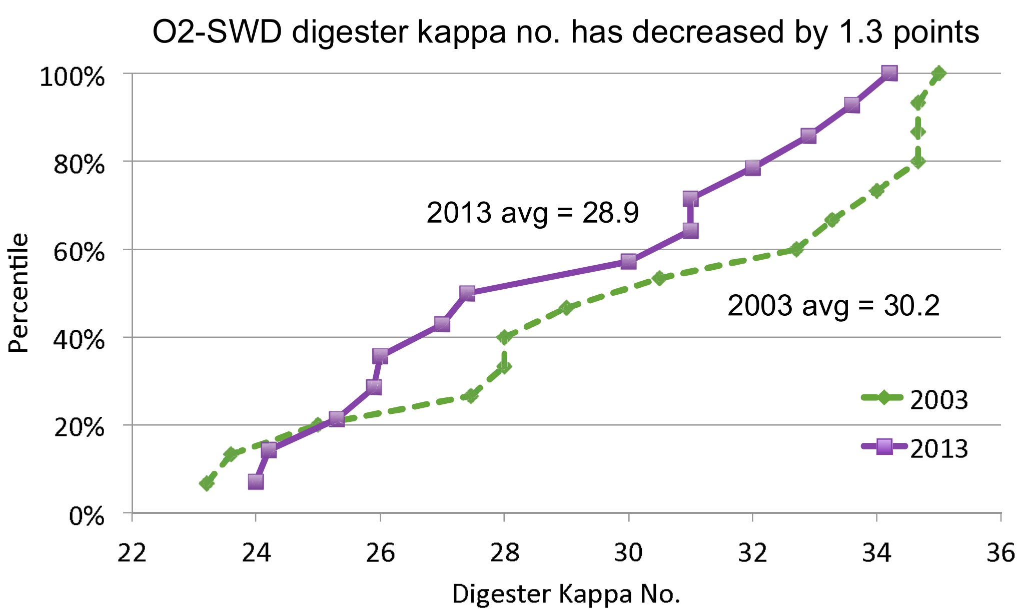
Digester Kappa No.



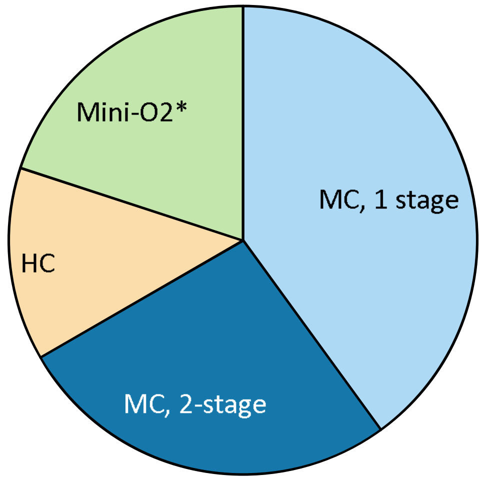
SWD Digester Kappa No.



O2-SWD Digester Kappa No.

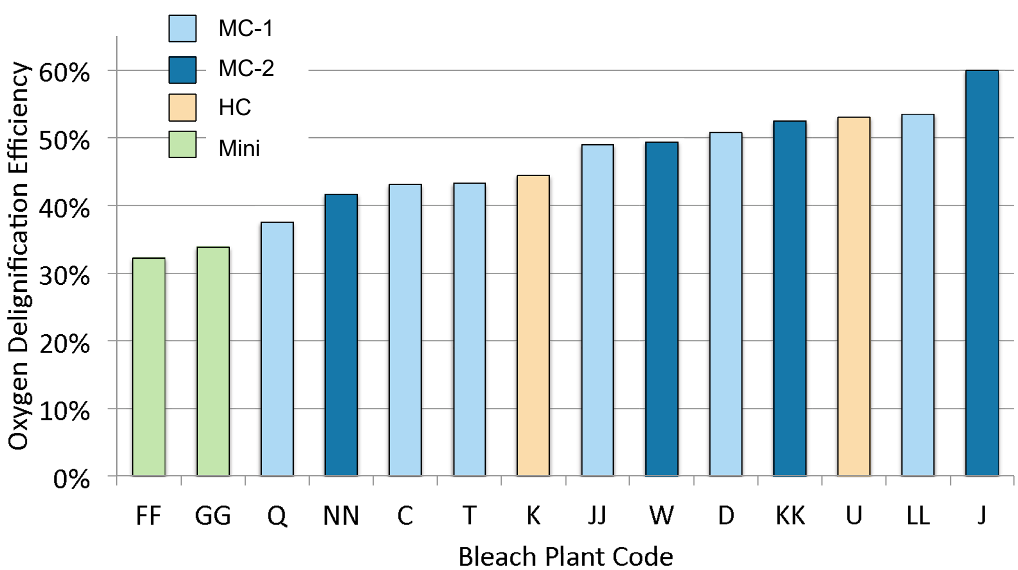


O2 Delignification Systems

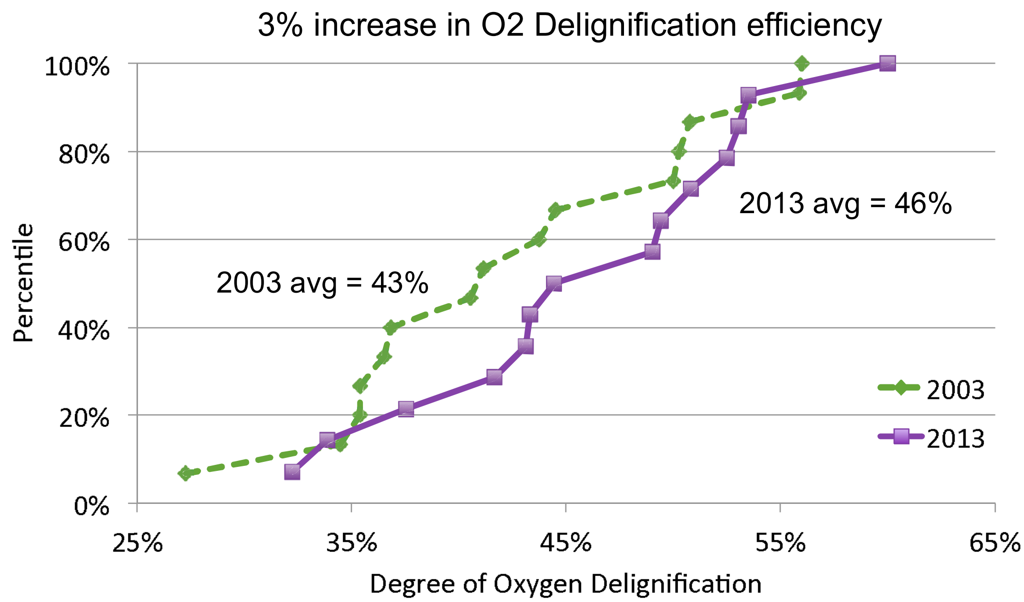


* One mini-O2 bleach plant removed from analysis due to very low delignification efficiency

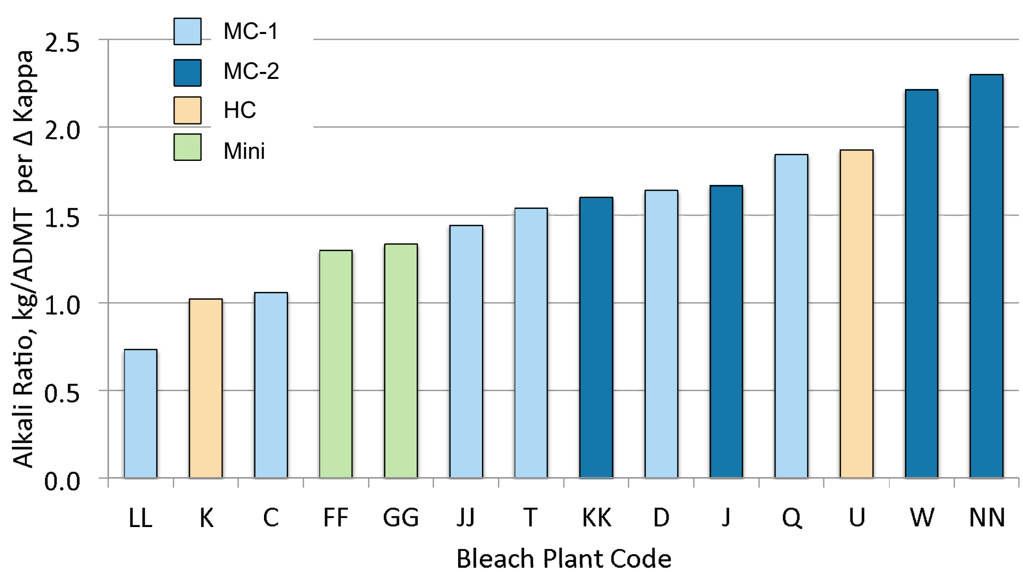
Oxygen Delignification



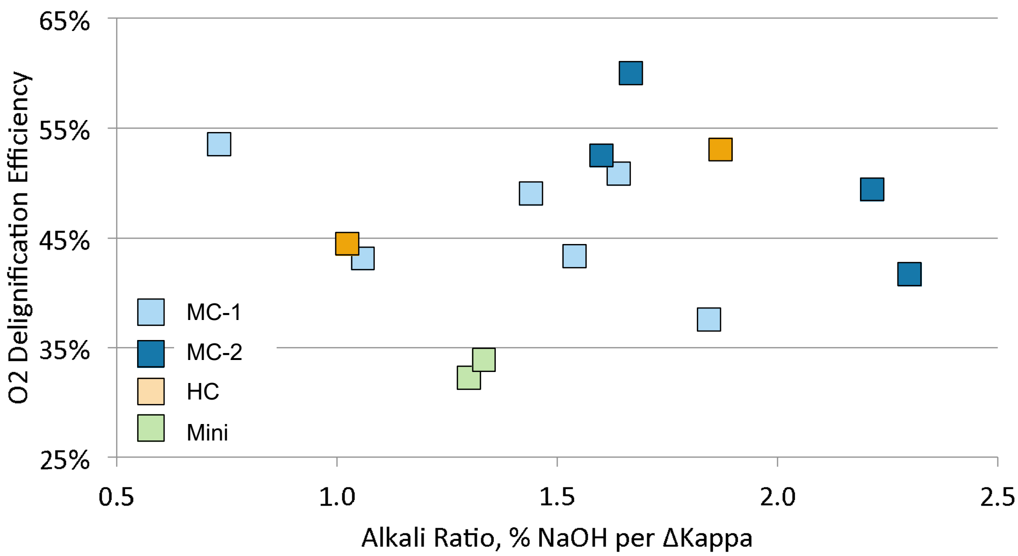
Oxygen Delignification



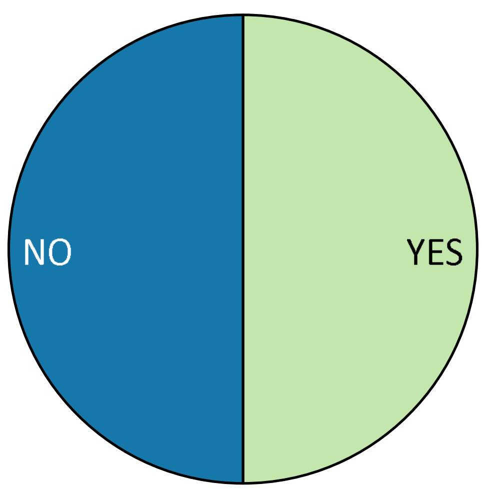
O2D Alkali Ratio



O2D Alkali Ratio

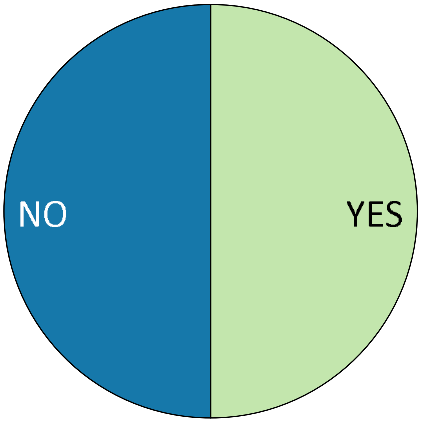


O2-SWD: Magnesium Sulfate?

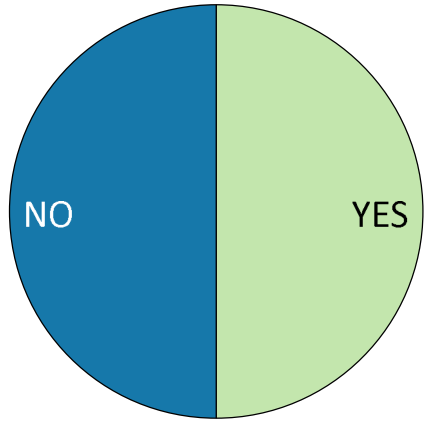


Open Washer Ahead of Bleach Plant?

Half of all bleach plants have open pre-bleach washers



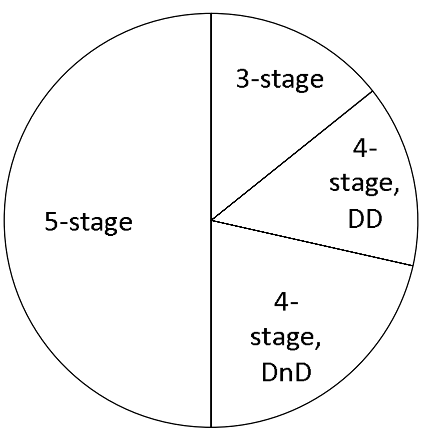
O2-SWD



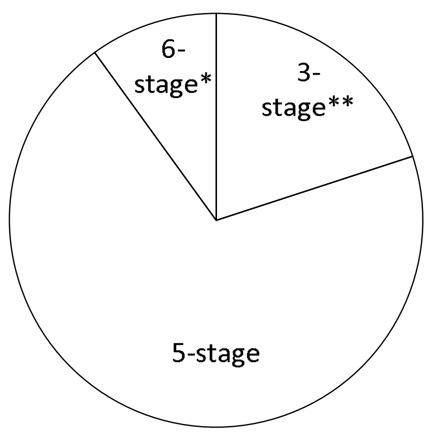
SWD

SWD Bleach Plants

O2-SWD

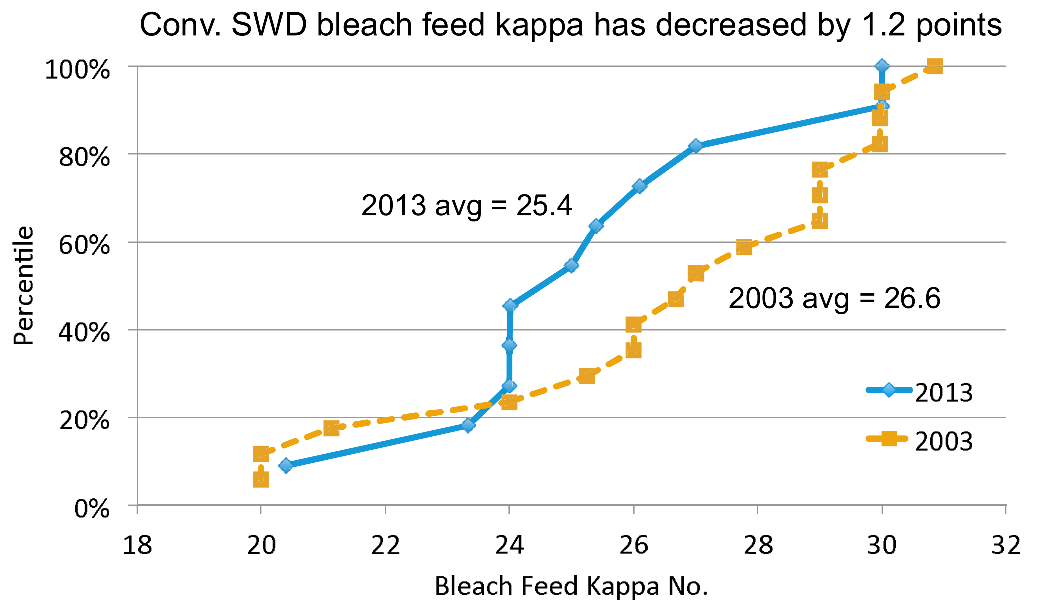


SWD

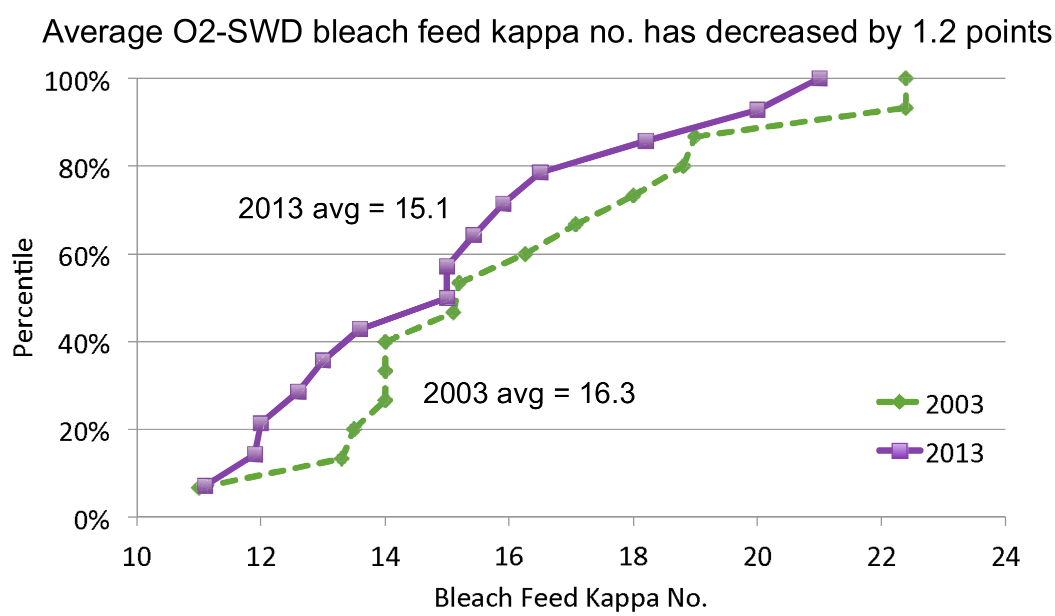


* 6 stages includes Papricycle
** Both using DEopWpD sequences

SWD Bleach Feed Kappa No.

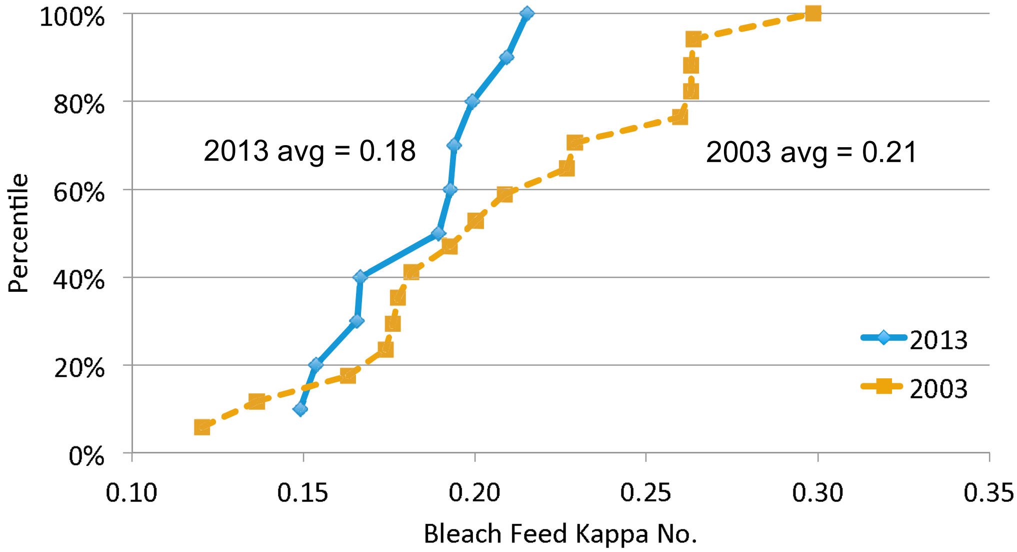


O2-SWD Bleach Feed Kappa No.



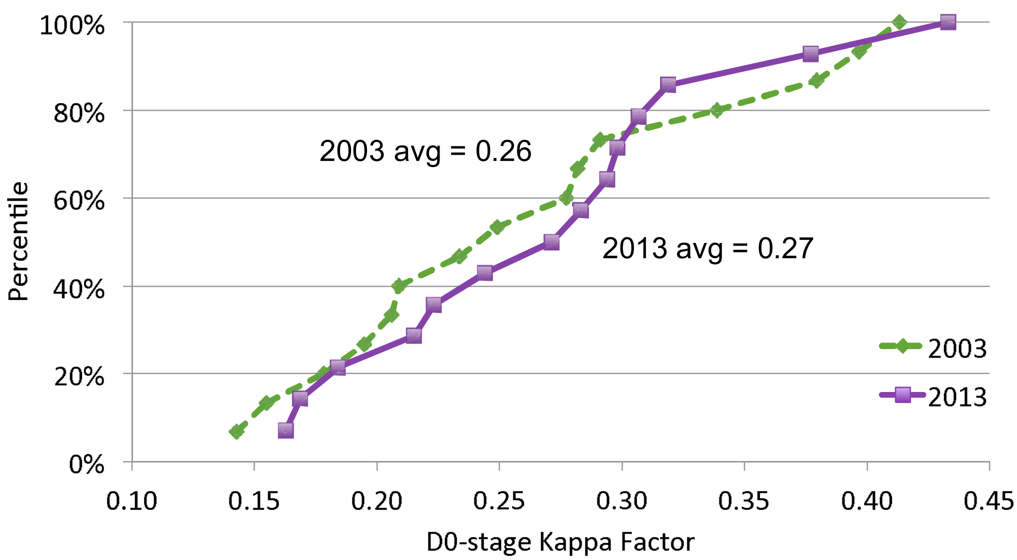
SWD D_0 Kappa Factor

12% decrease in conv. SWD Kappa Factor, and tighter distribution



O2-SWD D_0 Kappa Factor

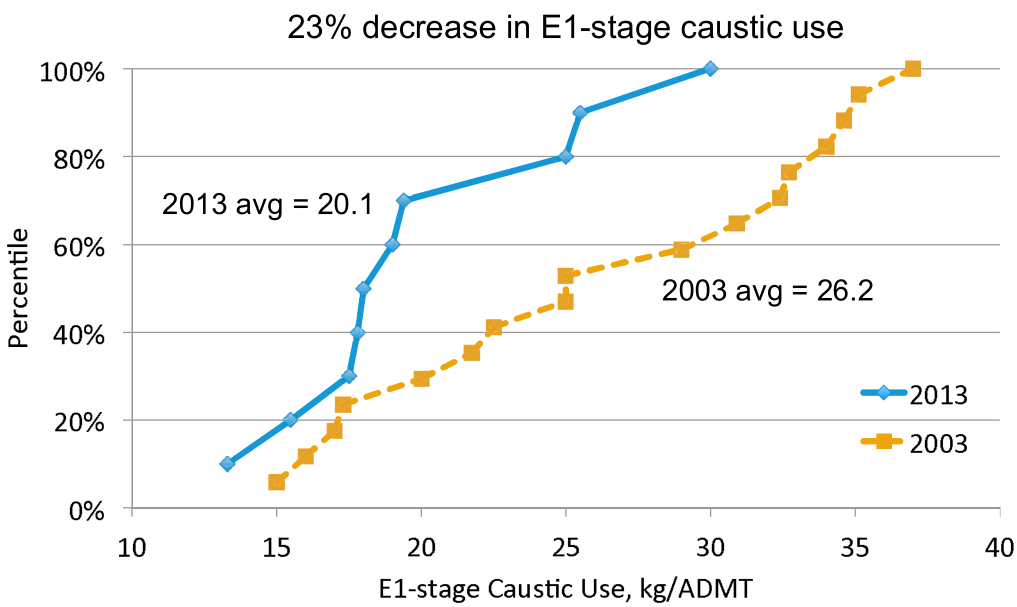
No significant change in O2-SWD Kappa Factor



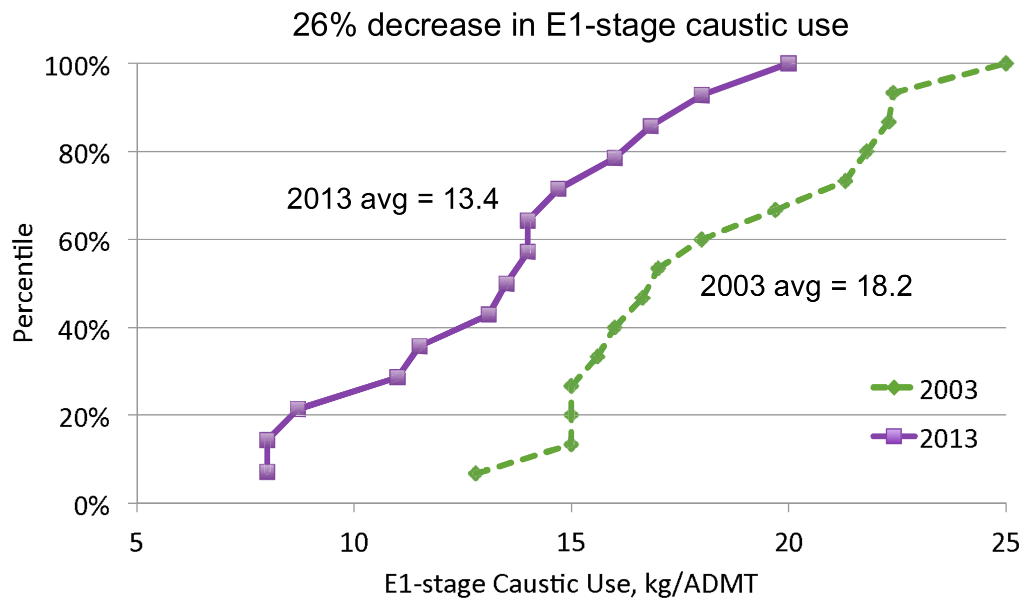
D0-stage Operating Conditions

	Softwood	O2-SWD
Bleach Feed Kappa No.	**24.9** (20 – 30)	**15.1** (11 – 21)
Chlorine Dioxide, kg/ADMT	**17.2** (15 – 19)	**15.1** (10 – 26)
D0 Kappa Factor	**0.183** (0.15 – 0.22)	**0.270** (0.17 – 0.43)
Retention Time	**33 min** (25 – 75)	**56 min** (22 – 145)
Temperature	50 – 60 °C	50 – 64 °C
Terminal pH	1.5 – 3.0; many do not test	1.8 – 3.0
Terminal Residual	Zero; many do not test. One report of 0.33 g/L	0 – 0.02 g/L
Terminal Brightness	33 – 65% many do not test	45 – 50% most do not test

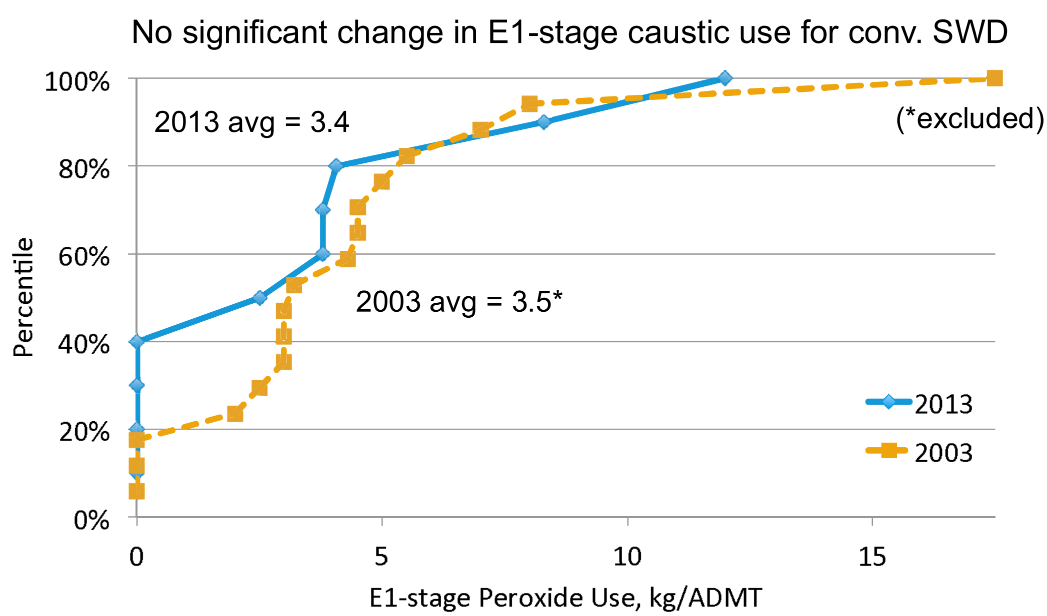
SWD E1-stage Caustic Use



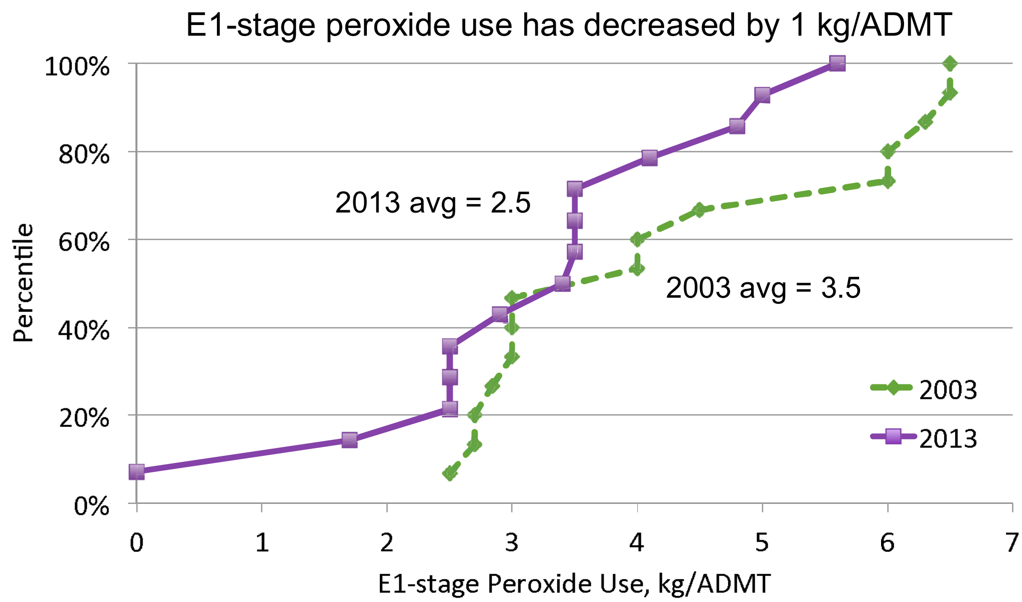
O2-SWD E1-stage Caustic Use



SWD E1-stage Peroxide Use



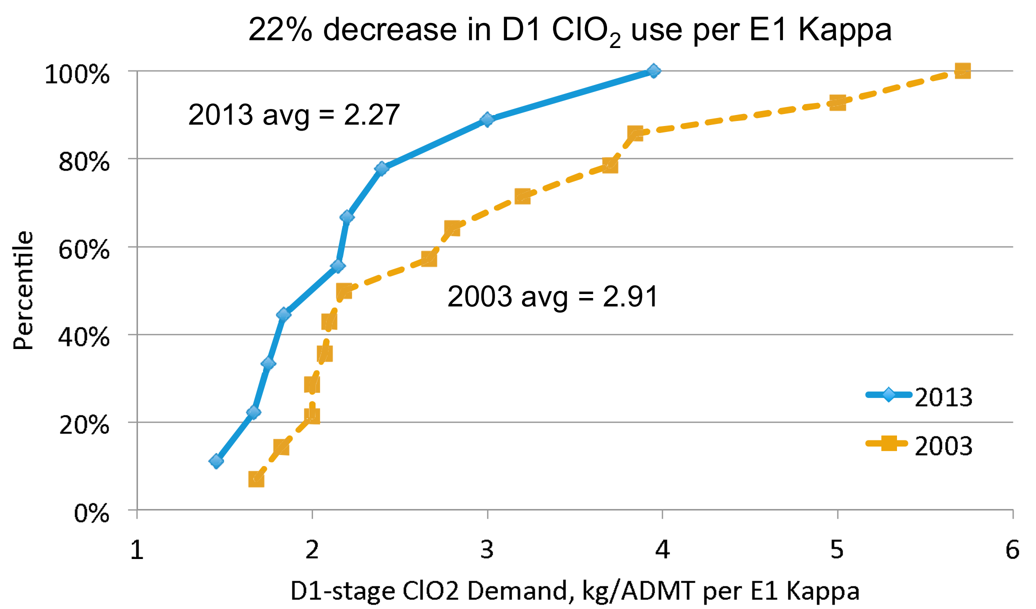
O2-SWD E1-stage Peroxide Use



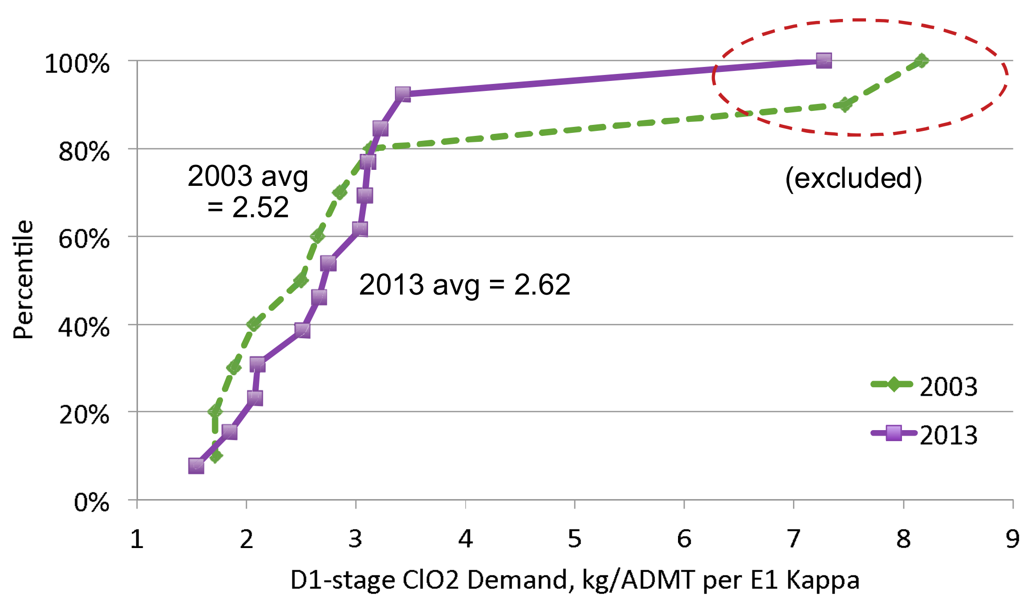
Eop-stage Operating Conditions

	Softwood	O2-SWD
NaOH, kg/ADMT	**20.1** (16 – 30)	**13.4** (8 – 20)
Peroxide, kg/ADMT	**3.4** (0 -12)	**2.5** (0 – 5.6)
Oxygen, kg/ADMT	**7.0** (5 – 12)	**3.7** (0 – 6.0)
Temperature	75 – 95 °C	70 – 89 °C
Total Retention Time	**80 minutes** (37 – 110)	**65 minutes** (20 – 90)
Pressure	40% pressurized; Up to 50 psig at top	Up to 40 psig at top
Time under pressure	**32 minutes** (10 – 60)	**15 minutes** (0 – 25)
Terminal pH	9.3 – 10.6	9.7 – 10.8
Post-Eop Kappa No.	**5.3** (4.2 – 6.5)	**3.2** (1.0 – 4.6)
Post-Eop Brightness	48 – 68%; most do not test	52 – 83%; half do not test

SWD D1-stage ClO_2 Demand



O2-SWD D1-stage ClO_2 Demand

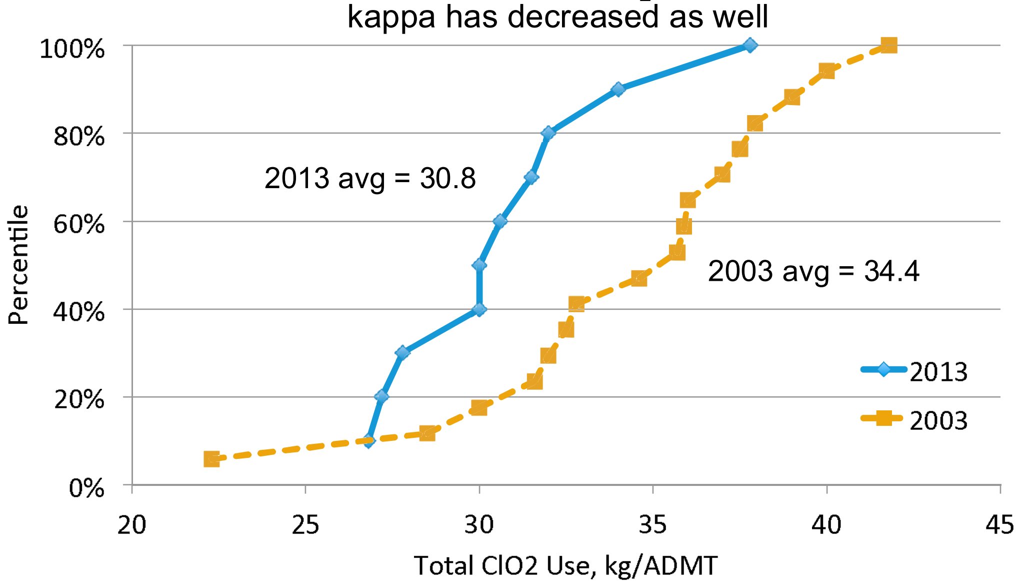


D1-stage Operating Conditions

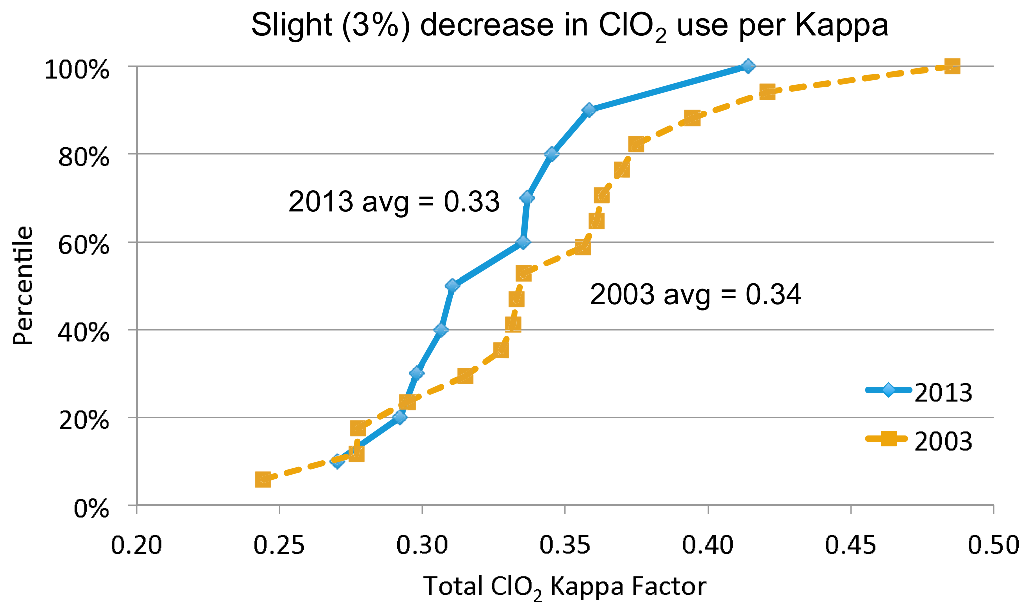
	Softwood	O2-SWD
Post-Eop Kappa No.	**5.3** (4.2 – 6.5)	**3.2** (1.0 – 4.6)
Chlorine Dioxide, kg/ADMT	**11.6** (8.0 – 16.7)	**8.9** (2.8 – 14.5)
Retention Time	**151 minutes** (108 – 240)	**158 minutes** (80 – 300)
Temperature	60 – 84 °C	68 – 87 °C
Upflow/inlet pH	**3.9** (3.7 – 4.0); most do not measure	**4.4** (2.5 – 6.3)
Terminal pH	2.5 – 4.0	2.3 – 4.9
Terminal Residual	**0.030 g/L**; many do not measure	0 – 0.040 g/L
Terminal Brightness	**81.4%** (73 – 89)	**84.4%** (79 – 90)

SWD Total ClO_2 Use

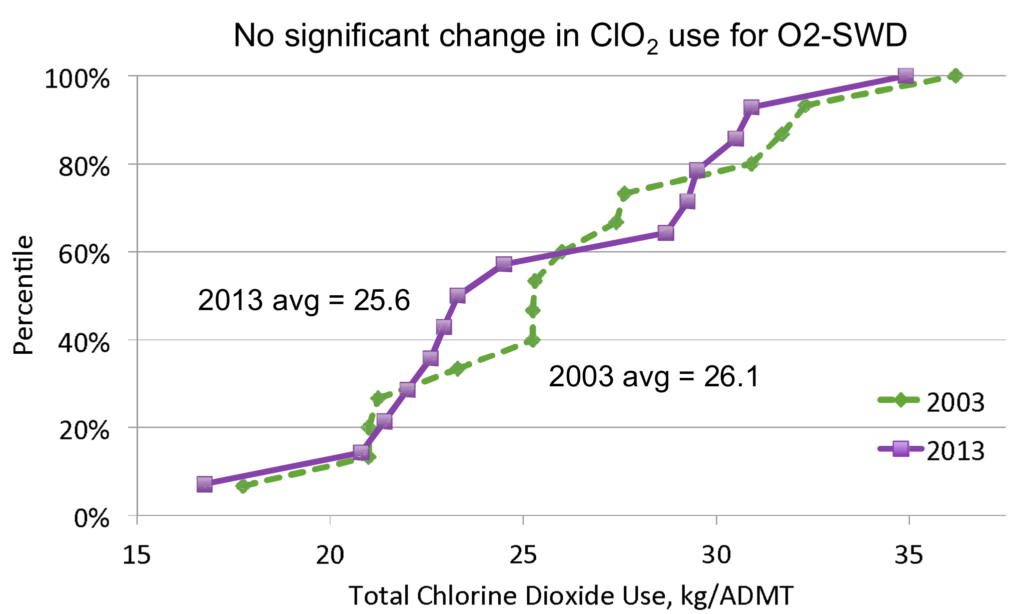
3.6 kg/ADMT decrease in total ClO_2 use – but bleach feed kappa has decreased as well



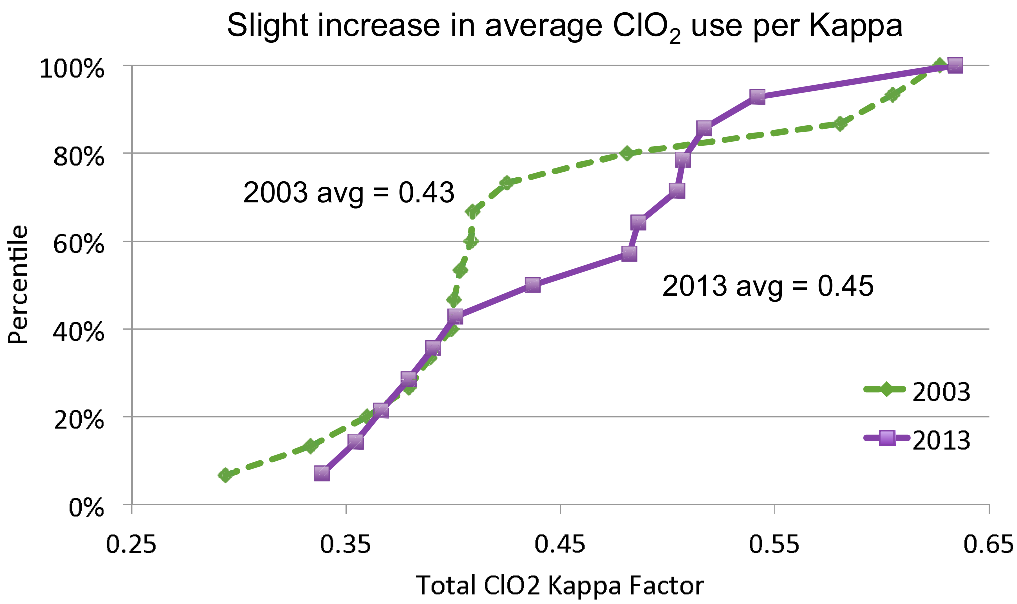
SWD Total ClO_2 Kappa Factor



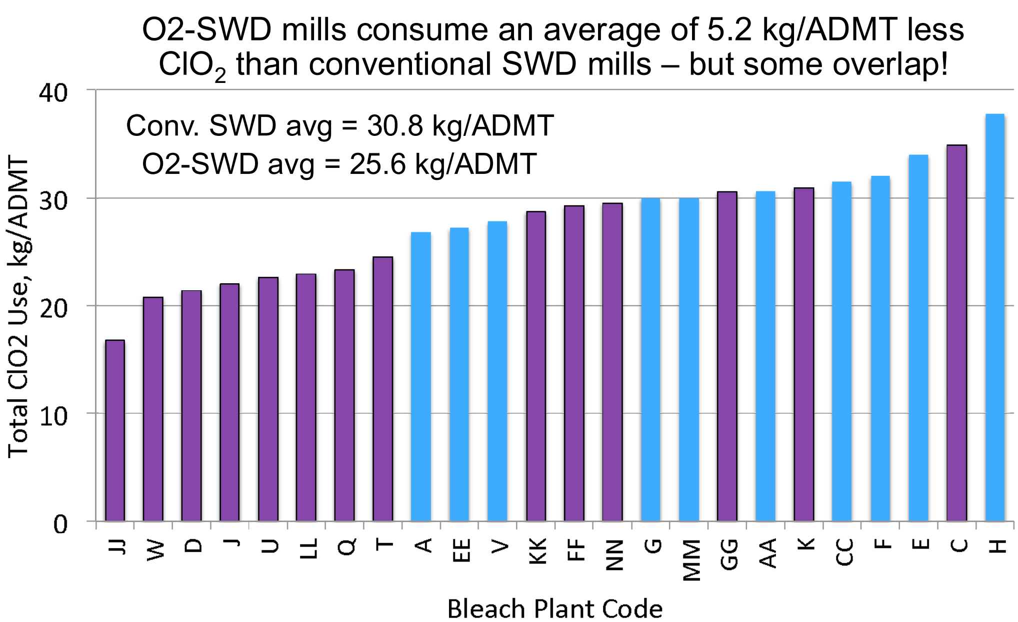
O2-SWD Total ClO_2 Use



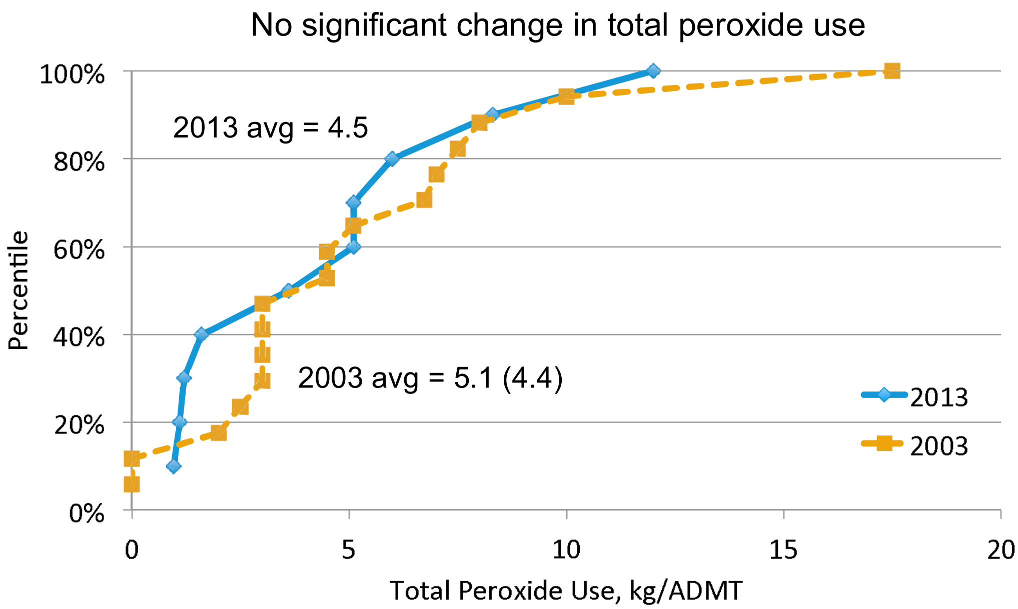
O2-SWD Total ClO_2 Kappa Factor



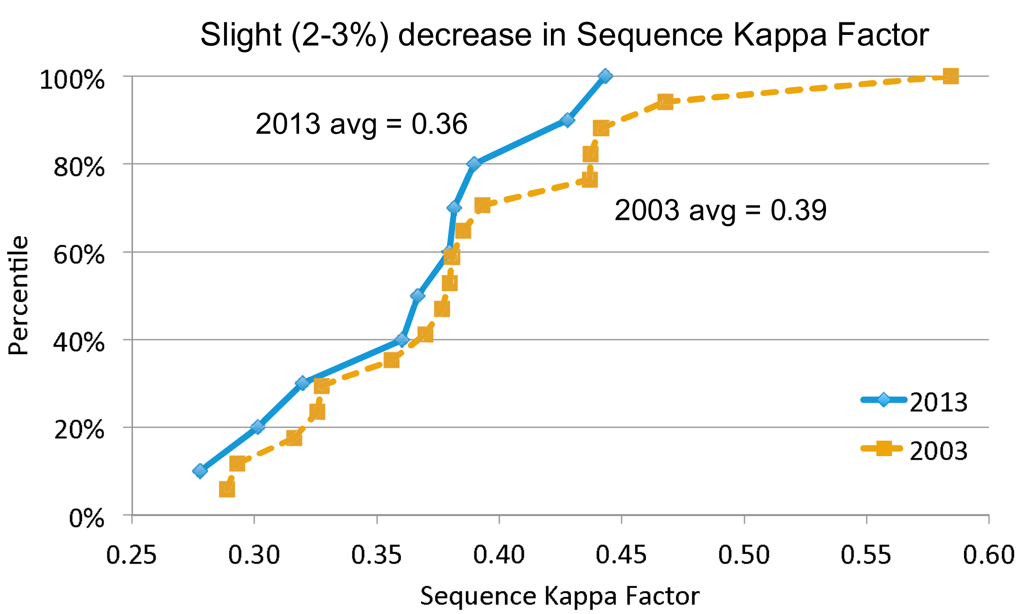
Total Chlorine Dioxide Use



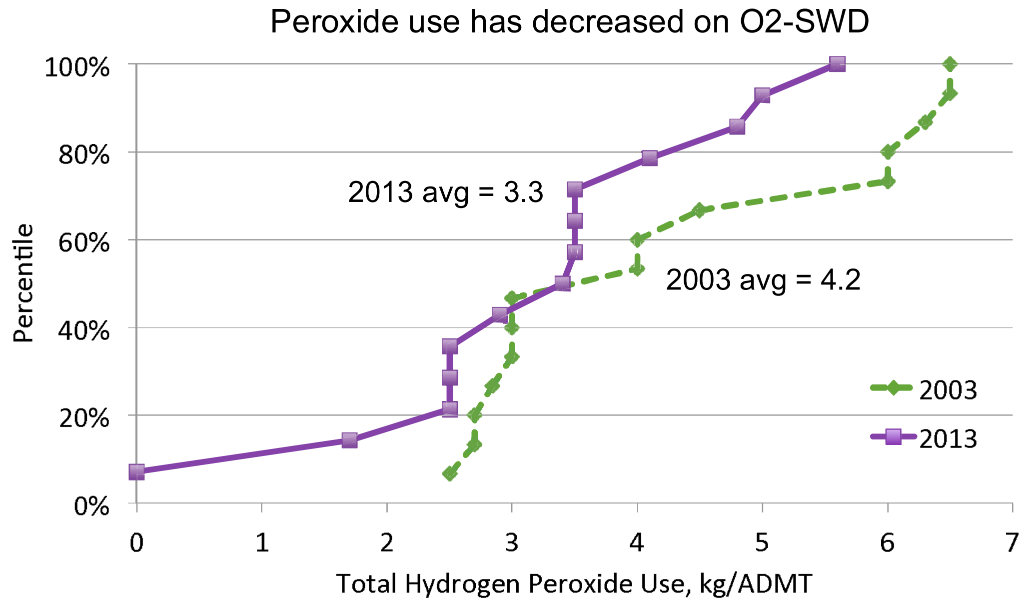
SWD Total H_2O_2 Use



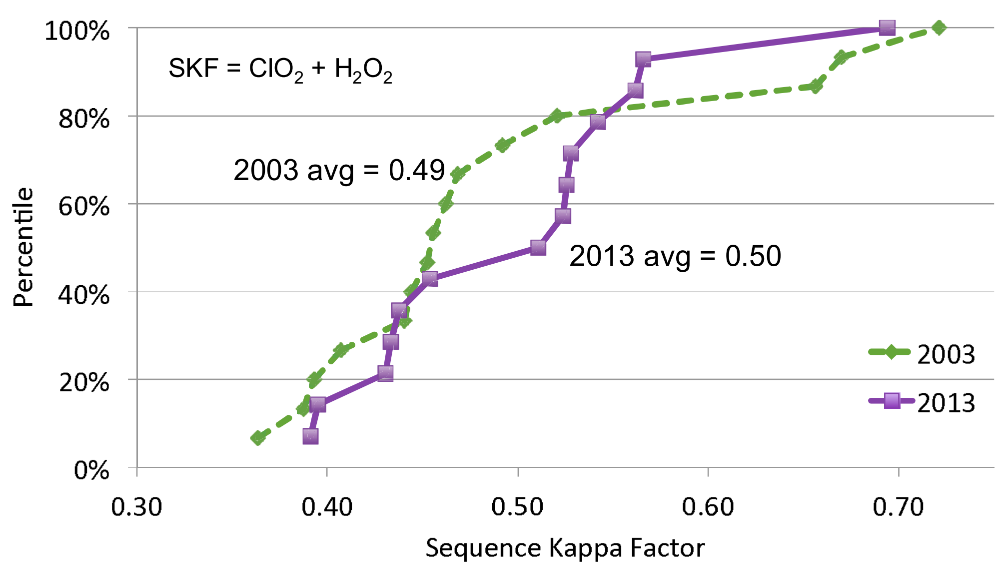
SWD Sequence Kappa Factor



O2-SWD Total H_2O_2 Use

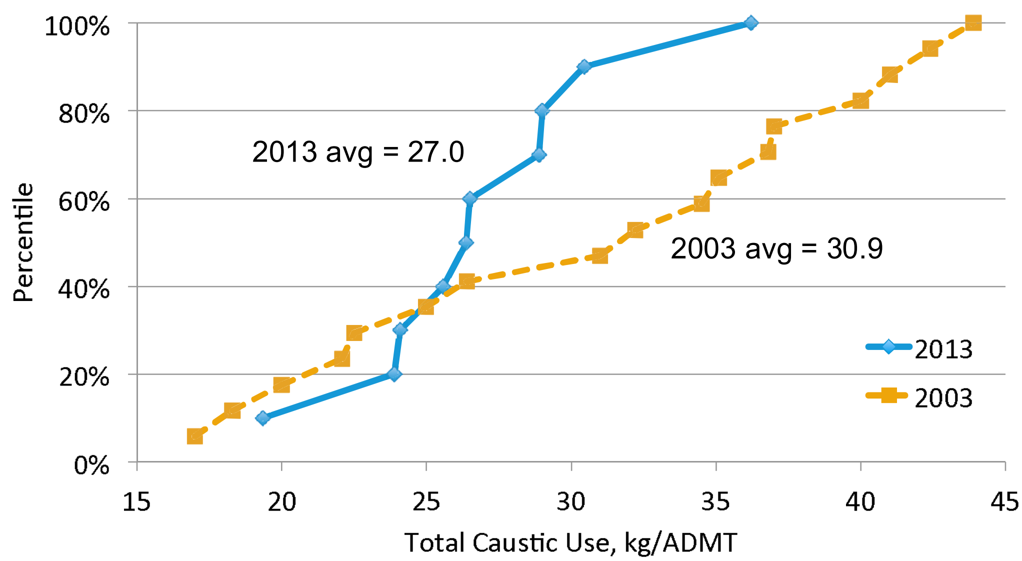


O2-SWD Sequence Kappa Factor



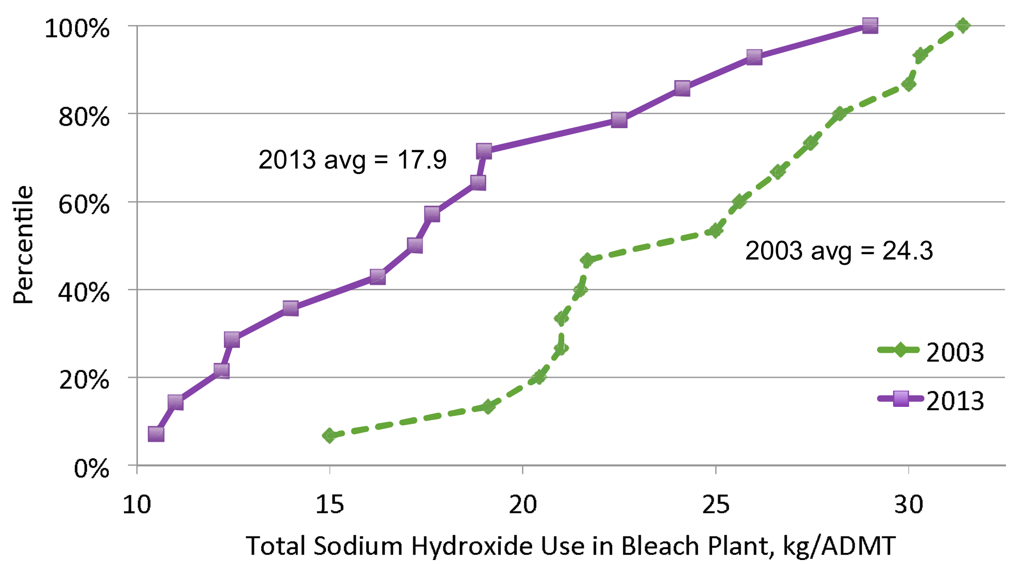
SWD Total Caustic Use

13% decrease in bleach plant caustic use for conv. SWD mills



O2-SWD Total Caustic Use

26% decrease in bleach plant caustic use for O2-SWD mills



Summary: Conventional Softwood

Since the last survey in 2003, the following changes have been observed for "conventional" (non-O2D) softwood kraft pulp:

- Pulp production rate?;
- Bleach feed kappa no. has decreased by an average of 1.2 kappa units;
- Final bleach plant brightness has increased by an average of 0.3% ISO;
- Sodium hydroxide use in the bleach plant has decreased by an average of 3.9 kg/ADMT or 13%;
- Chlorine dioxide use has decreased by an average of 3.6 kg/ADMT;
- Hydrogen peroxide use is unchanged.

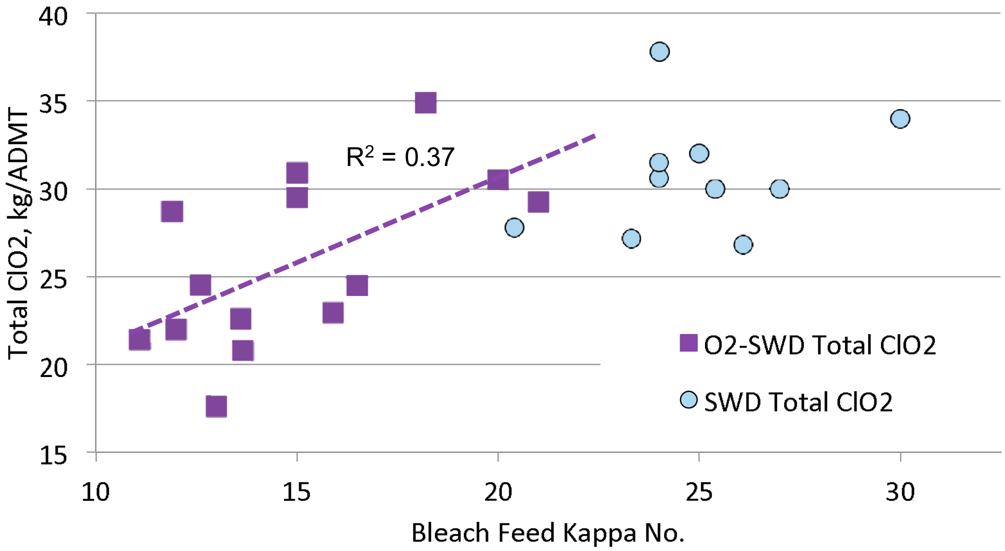
Summary: O2-Delignified Softwood

Since the last survey in 2003, the following changes have been observed for oxygen-delignified softwood kraft pulp:

- Pulp production has increased by an average of 6.5%;
- Final bleach plant brightness has increased by an average of 0.5% ISO;
- Digester kappa no. has decreased by an average of 1.3 kappa units, and bleach feed kappa no. has decreased by an average of 1.2 kappa units;
- Sodium hydroxide use in the bleach plant has decreased by an average of 6.4 kg/ADMT or 26%;
- Chlorine dioxide use has decreased by an average of 0.5 kg/ADMT;
- Hydrogen peroxide use has decreased by an average of 0.9 kg/ADMT.

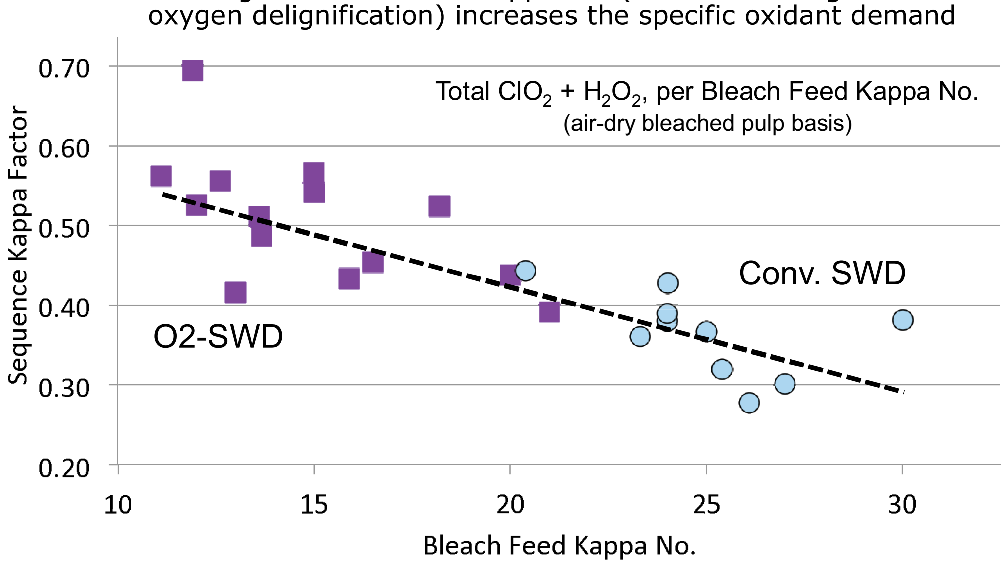
ClO_2 Use vs. Kappa No.

Some correlation for O2-SWD mills; none for conventional SWD



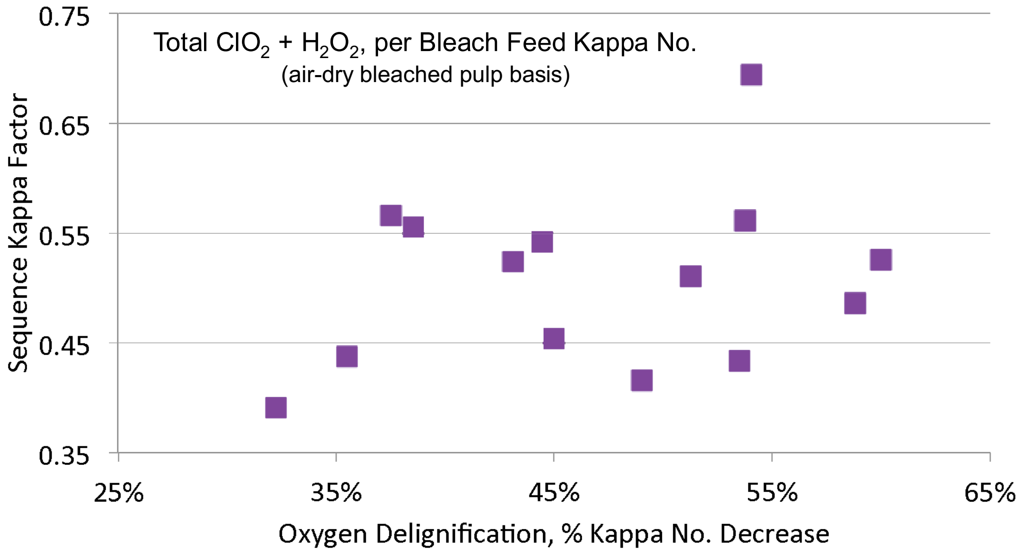
Sequence KF vs. Kappa No.

Decreasing the bleach feed Kappa No. (either in the digester or via oxygen delignification) increases the specific oxidant demand



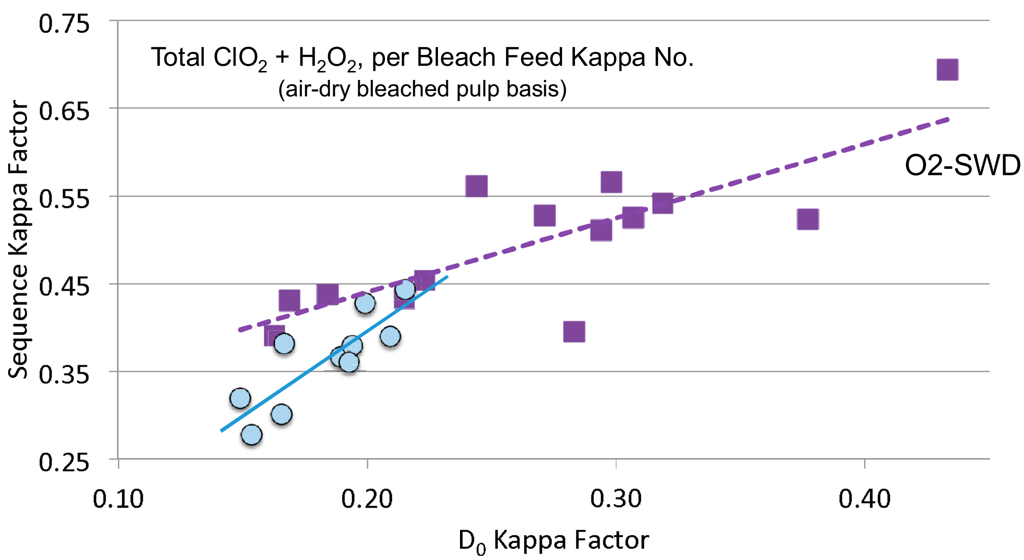
O2 Delignification & Chemical Use

No relationship between *degree* of O2 Delignification and Bleachability; Bleach Feed Kappa No. (*i.e.* free phenolic content) is more significant



SKF vs. D_0 Kappa Factor

A low D_0-stage Kappa Factor correlates will with low overall chemical use



Chemical Use & Kappa No.

- Total specific oxidizing chemical use (Sequence Kappa Factor, ClO_2 + H_2O_2) correlates well with bleach feed kappa no.
  - In general, pulps appear to become more difficult to bleach as the kappa no. is decreased
  - But ClO_2 use (kg/ADMT) has only a weak correlation with kappa no. for O2-SWD pulps, and no correlation for conventional SWD pulps
- There is a strong positive relationship between a low D_0-stage Kappa Factor and a low Sequence Kappa Factor (total oxidizing chemical use per kappa)
- There appears to be no relationship between the *extent* of oxygen delignification (% kappa n0. decrease) and relative oxidizing chemical use
  - Speculation: the degree of oxygen delignification does not impact the reactivity with chlorine dioxide significantly; instead it is the extent of delignification ahead of the bleach plant (digester plus oxygen delignification) which is the determining factor

Outline

- Background
  - Survey response & methodology
- Results
  - SWD & O2-SWD
    - Comparison with 2003 results
    - Brownstock & Oxygen Delignification
    - Bleaching stages
    - Overall chemical use and bleaching cost
- Analysis
  - Differences between “Low” and “High” relative chemical consumption bleach plants
  - Trends since 2003
  - Identification of bleaching “Best Practices”?

Relative Chemical Consumption: O2-SWD

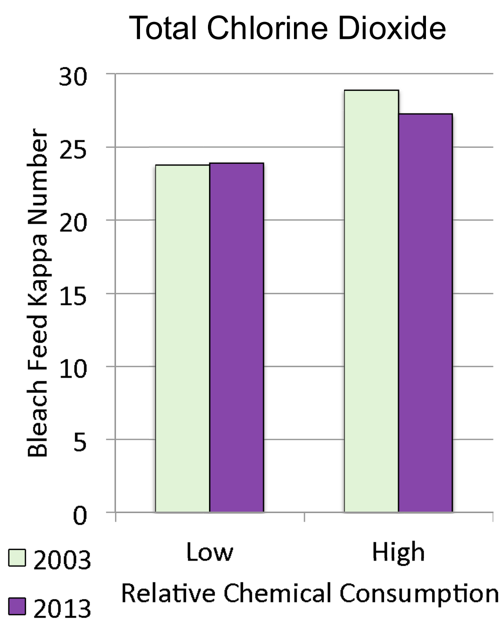
O2-SWD mills sorted by Sequence Kappa Factor & averaged into two groups

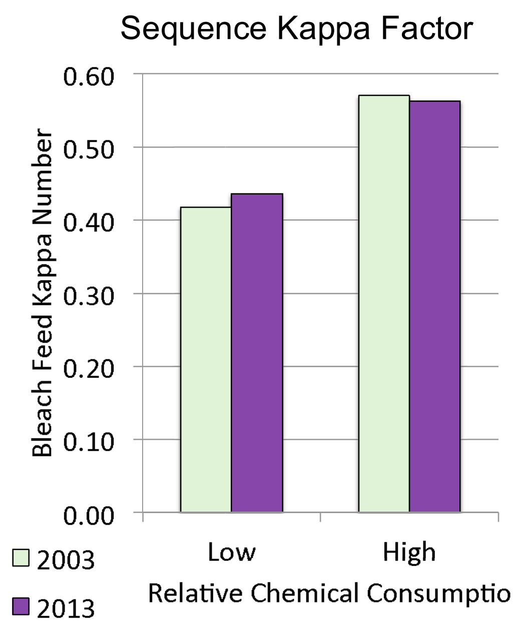
Parameter	Low Relative Chemical Consumption Average	High Relative Chemical Consumption Average
Pre-O_2 Kappa No.	30.4	26.2
Bleach Feed Kappa No.	16.5	13.7
O_2 Delignification	45%	47%
D_0-stage Kappa Factor	0.22	0.32
Eop-stage NaOH, kg/ADMT	13.2	13.6
Eop-stage H_2O_2, kg/ADMT	3.5	1.5
Post-Eop Kappa No.	3.4	3.0
D1-stage ClO_2, kg/ADMT	9.2	8.6
D2-stage ClO_2, kg/ADMT	2.0	1.8
Final Brightness, % ISO	89.2%	88.7%
Total ClO_2, kg/ADMT	23.9	27.2
Total H_2O_2, kg/ADMT	4.1	2.4
Total NaOH, kg/ADMT	17.2	18.6
Sequence Kappa Factor	0.44	0.56

"Low Relative Consumption" O2-SWD mills:

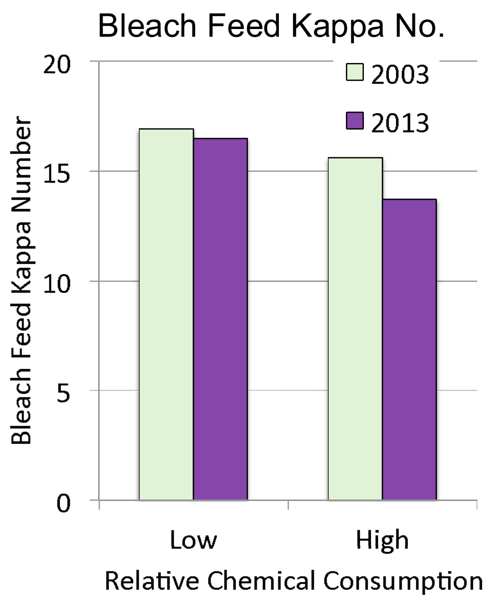
- Have a higher bleach feed kappa no. (by 2.8 points)
- Use 3.3 kg/ADMT less total ClO_2
- Use 1.7 kg/ADMT more peroxide
- Make a higher brightness pulp

O2-SWD: Oxidizing Chemicals





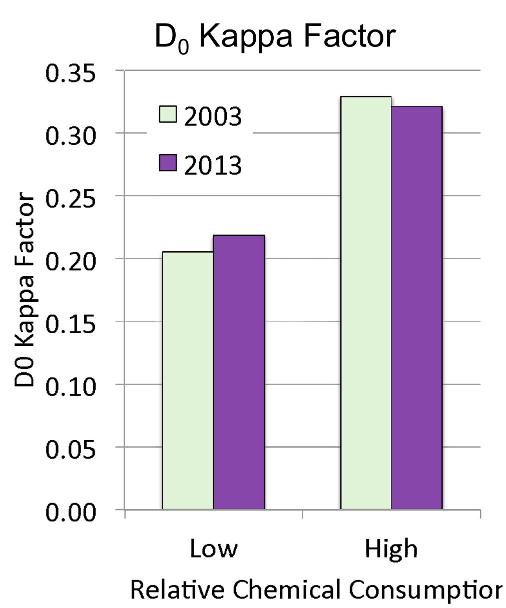
O2-SWD: Kappa No.



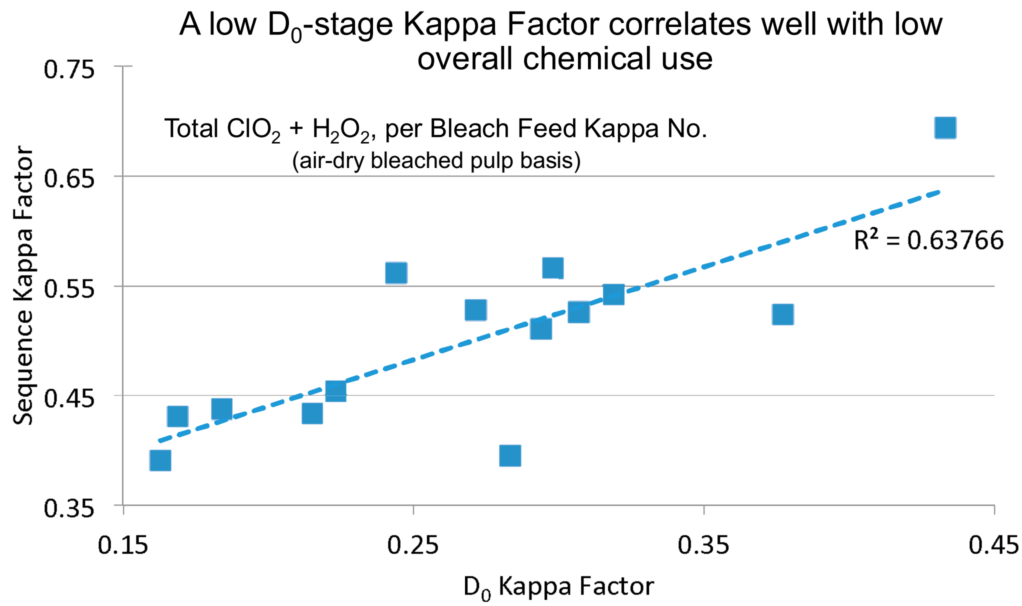
- Low relative chemical consumption mills have a higher bleach feed kappa no.
  - Produce a pulp with 0.5% ISO higher final brightness
- Wood species is not a significant differentiator
- Is higher-kappa pulp easier to bleach?

O2-SWD: D_0 Kappa Factor

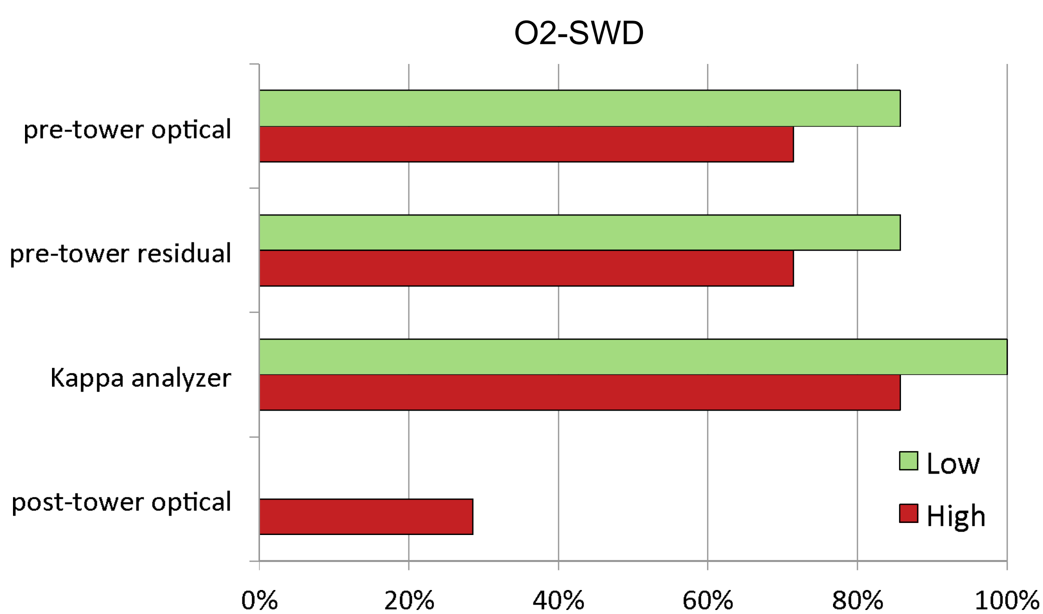
- Low relative chemical consumption bleach plants operate with a significantly lower Kappa Factor in the D_0 stage
  - No difference in carryover
  - Number of bleaching stages was not a factor



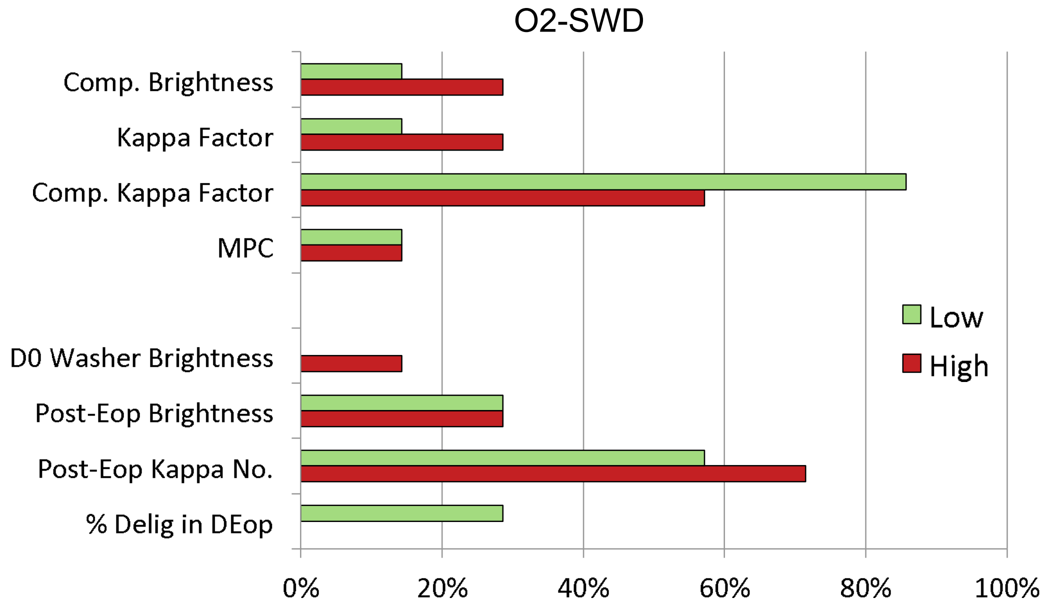
D_0 Kappa Factor & Chemical Use



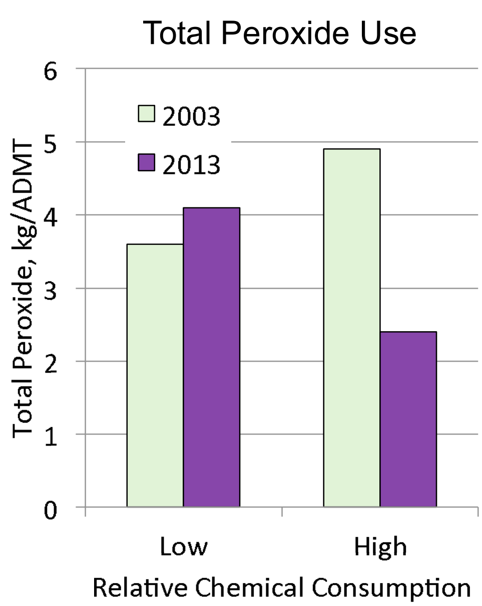
O2-SWD: D0 Sensors & Analyzers



O2-SWD: D0 Process Control



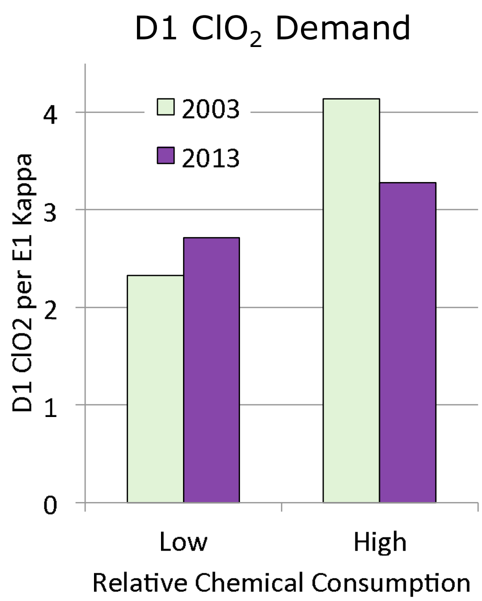
O2-SWD: Peroxide



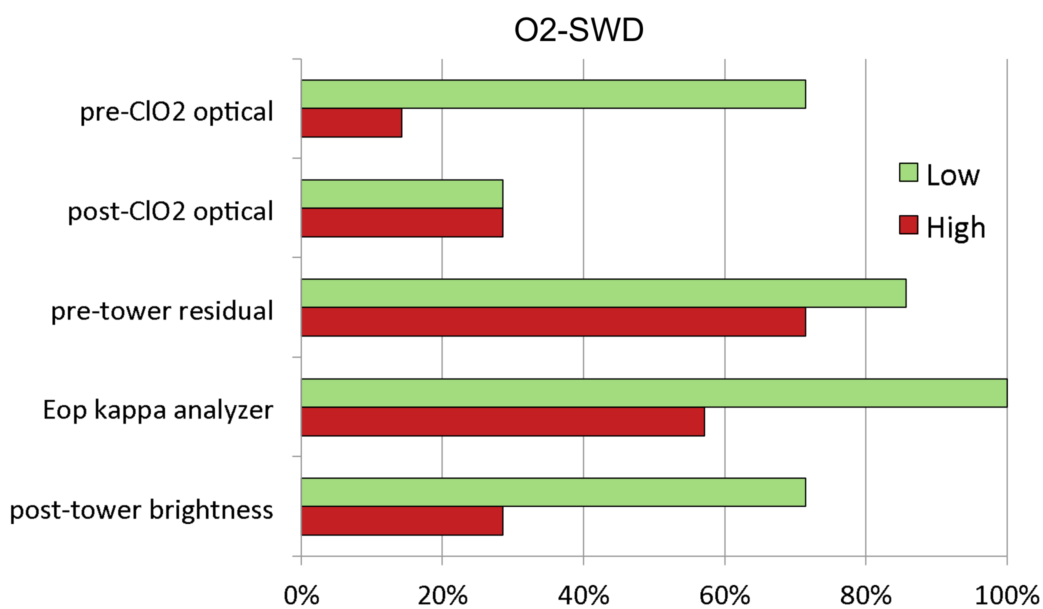
- High relative chemical consumption bleach plants use less peroxide
  - Reversal from 2003
- High D_0 Kappa Factors may leave insufficient lignin in the pulp to react with peroxide?

O2-SWD: D1-stage ClO_2 Demand

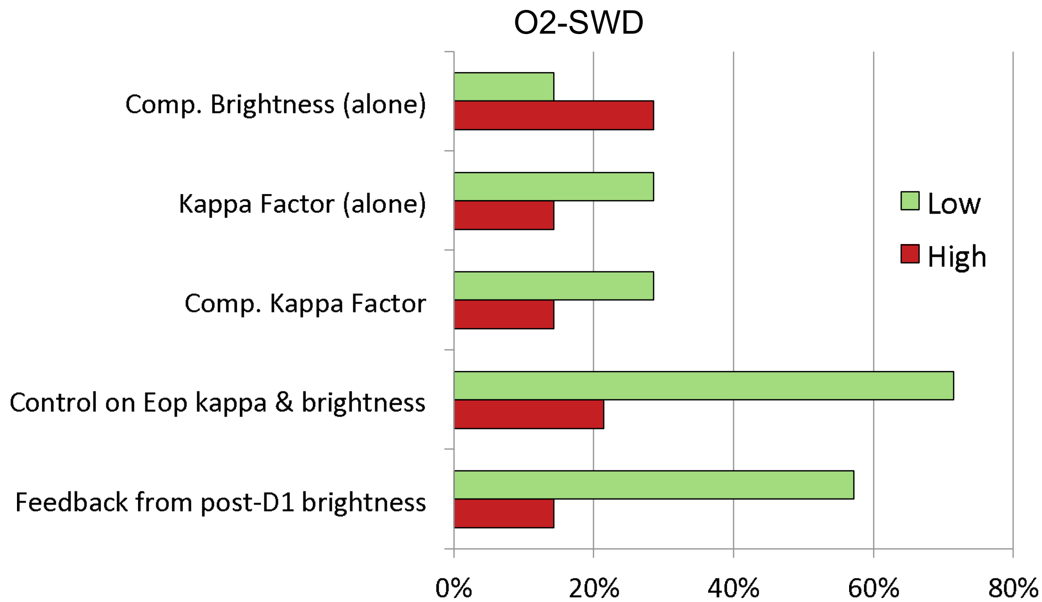
- Low relative chemical consumption bleach plants operate with a lower ratio of D1-stage chlorine dioxide to the Eop kappa number
  - Similar brightness
  - Similar terminal pH
- A high D1 ClO_2/Kappa ratio often indicates poor Eop-stage washing
  - Eop-stage carryover will increase ClO_2 demand



O2-SWD: D1 Sensors & Analyzers



O2-SWD: D1 Process Control



O2-SWD “Best Practices”

Comparison of mills with low and high relative chemical consumption indicates that “low chemical consuming” oxygen-delignified softwood bleach plants:

- Feed the bleach with a pulp having a kappa no. 2.8 units higher than the “high relative consumption” bleach plants;
- Produce pulp with 0.5 points higher final brightness;
- Use 3.3 kg/ADMT less chlorine dioxide, but 1.7 kg/ADMT more hydrogen peroxide;
- ***Operate with a significantly lower D0-stage Kappa Factor***;
- Are more likely to control the D0 stage using an online kappa analyzer in combination with optical and residual sensors;
- Are more likely to control the D1 stage using a combination of post-Eop kappa no. and post-Eop brightness, with feedback from the post-D1 brightness;
- Have a lower ratio of D1-stage chlorine dioxide to the Eop kappa number;
- Operate with a higher pH in the D2 stage

Relative Chemical Consumption: Conventional SWD

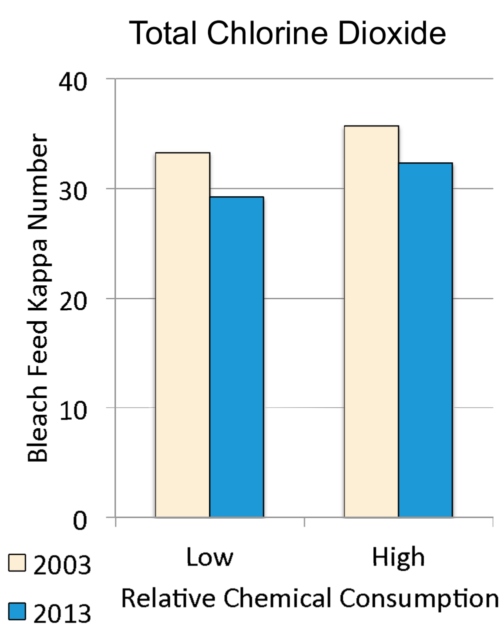
SWD mills sorted by Sequence Kappa Factor & averaged into two groups

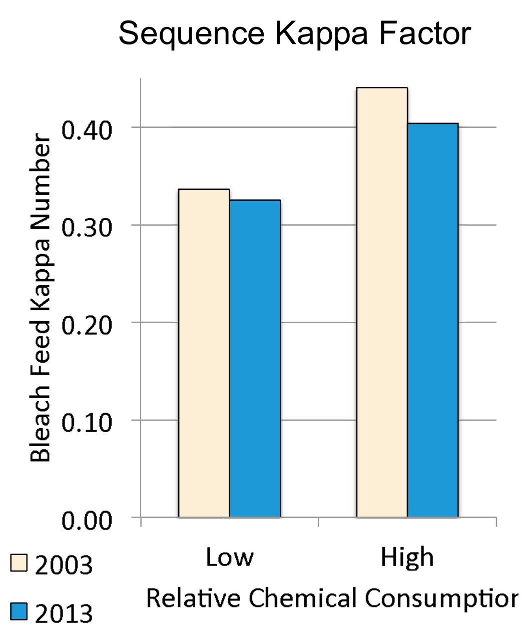
Parameter	Low Relative Chemical Consumption Average	High Relative Chemical Consumption Average
Bleach Feed Kappa No.	25.4	24.5
D_0-stage Kappa Factor	0.17	0.20
Eop-stage NaOH, kg/ADMT	20.6	19.6
Eop-stage H_2O_2, kg/ADMT	1.3	5.6
Post-Eop Kappa No.	5.5	5.1
D1-stage ClO_2, kg/ADMT	10.7	12.6
E2-stage H_2O_2, kg/ADMT	1.3	1.4
D2-stage ClO_2, kg/ADMT	2.1	2.7
Final Brightness, % ISO	88.8%	89.3%
Total ClO_2, kg/ADMT	29.2	32.3
Total H_2O_2, kg/ADMT	2.6	6.4
Total NaOH, kg/ADMT	27.3	26.8
Sequence Kappa Factor	0.33	0.40

"Low Relative Consumption" SWD mills:

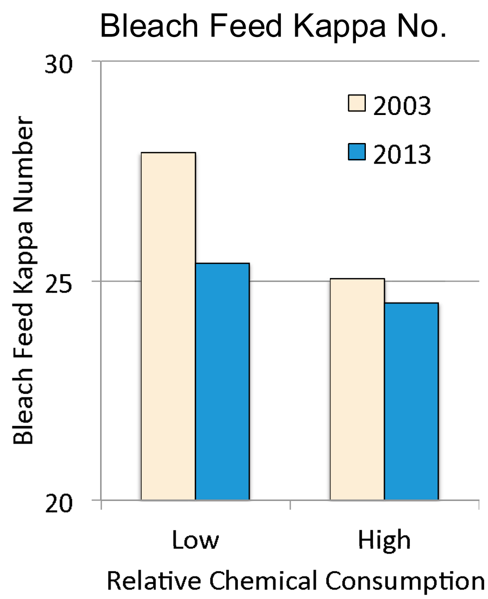
- Use 3.1 kg/ADMT less total ClO_2
- Use 3.8 kg/ADMT less peroxide
- Produce a pulp with 0.5% lower brightness

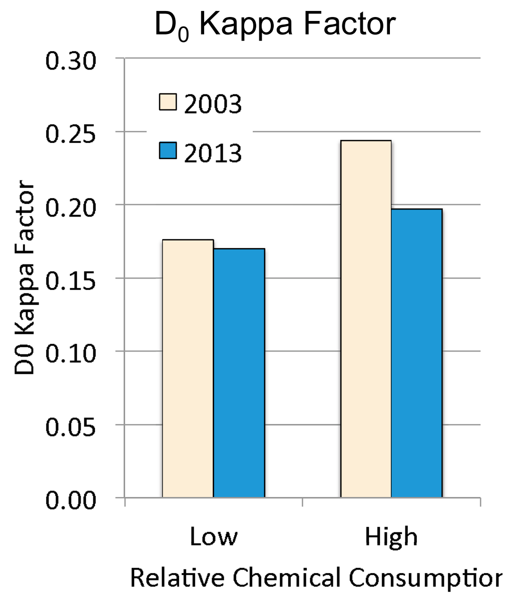
Conv. SWD: Oxidizing Chemicals



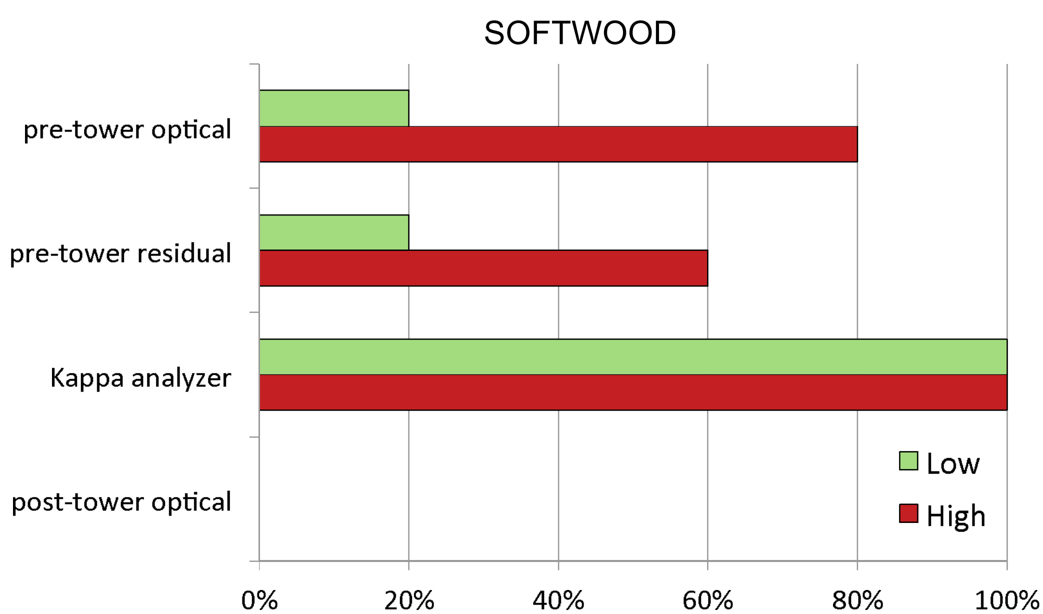


Conv. SWD: 2013 vs. 2003

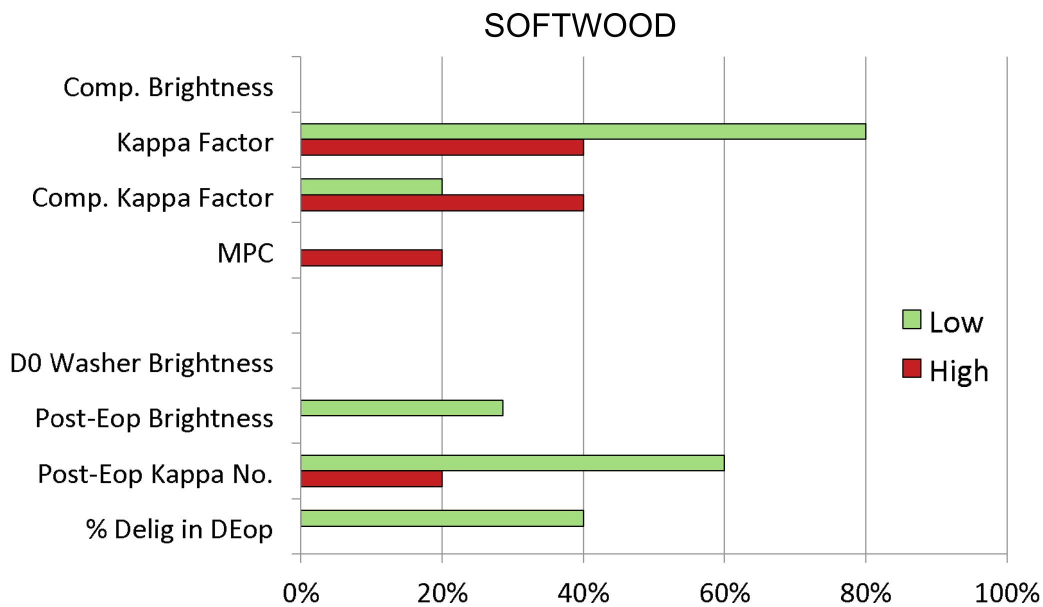




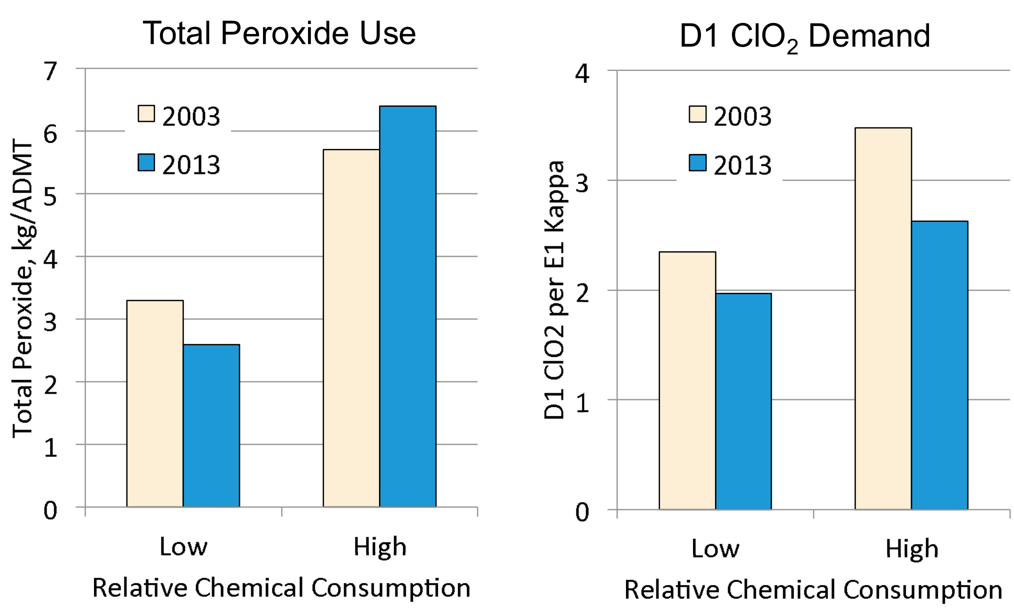
SWD: D0 Sensors & Analyzers



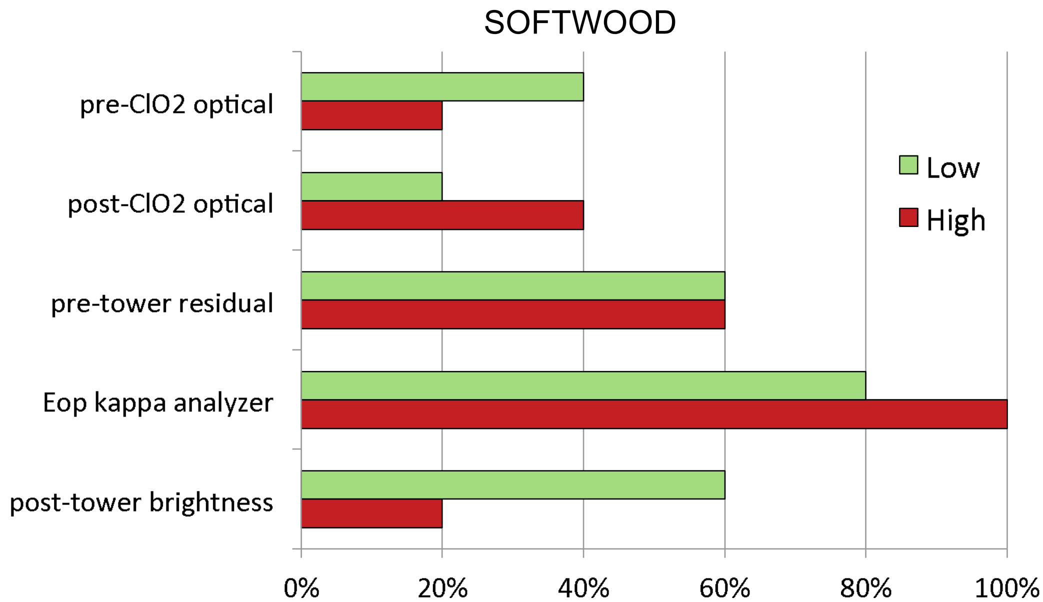
SWD: D0 Process Control



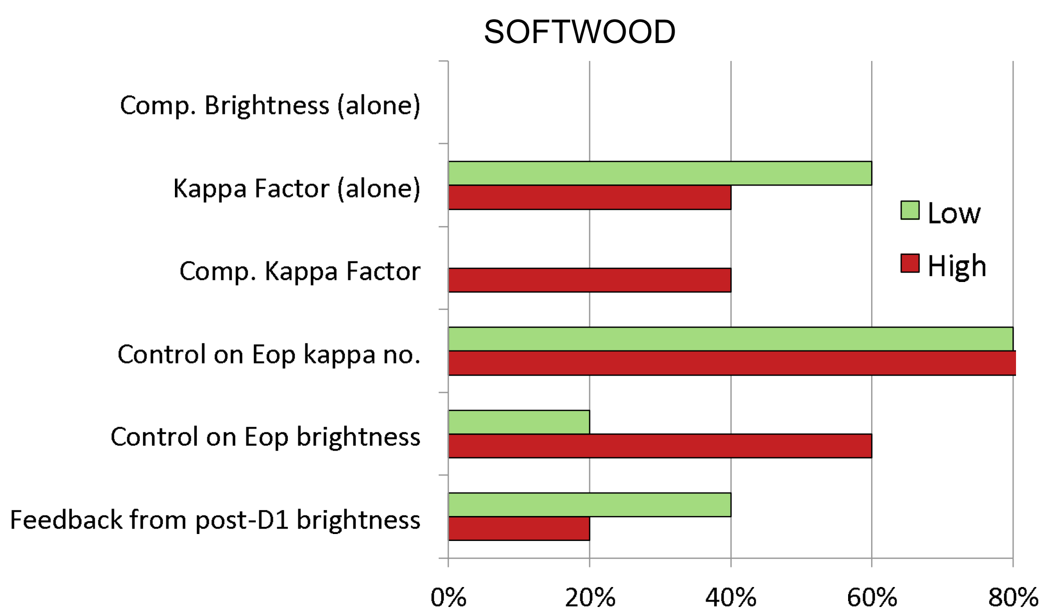
Conv. SWD: 2013 vs. 2003



SWD: D1 Sensors & Analyzers



SWD: D1 Process Control



SWD "Best Practices"

Difference (spread) between "low" and "high" relative chemical consumption softwood bleach plants has decreased since 2003

- Improvement in high chemical consumers? Or mill shut-downs?

Comparison of mills with low and high relative chemical consumption indicates that "low chemical consuming" softwood bleach plants:

- Produce pulp with 0.5 points ***lower*** final brightness;
- Use 3.1 kg/ADMT less chlorine dioxide and 3.8 kg/ADMT less hydrogen peroxide;
- ***Operate with a lower D0-stage Kappa Factor***;
- Are more likely to control the D0 stage using Kappa Factor control (alone);
- Are more likely to operate a high-temperature/high-pressue "EO" stage; 40% of the "low chemical consuming" mills use "oxygen bleaching", *i.e.* DODEpD
- Have a lower ratio of D1-stage chlorine dioxide to the Eop kappa number.

And that's all for now…

These slides and coded spreadsheets will be posted on the new Bleaching Committee website

- Updates will be posted as available

Next steps:

- O2-SWD results to be presented (again) at 2015 TAPPI PEERS
  - Same presentation as at 2014 IPBC and 2015 PaperWeek
- O2-HWD results and analysis to be presented at Fall 2015 Bleaching Committee meeting

New Findings:
E1 Washing & D1 Filtrate

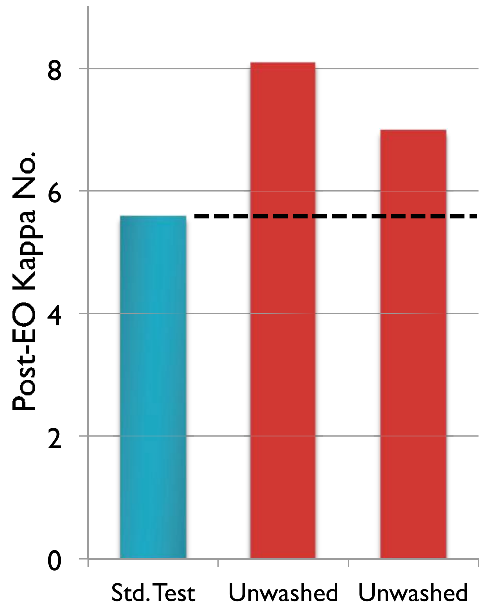
Paul Earl & Jim Collins

PAPTAC Bleaching Committee
Fall 2014 Meeting

E1 Washer Carryover

It is well-known the E1 washer carryover consumes ClO_2 in the D1 stage

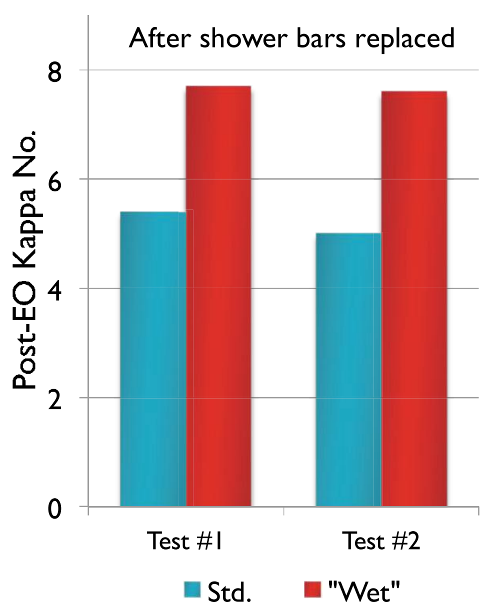
"Wet" Kappa No. Testing



- "Wet" or "unwashed" kappa no. test includes the filtrate surrounding the pulp sample
  - Measures contribution of carryover
- Example on left (Mill A) indicates that on average, 25% of the ClO_2 added to the D1 stage is being consumed by EO carryover

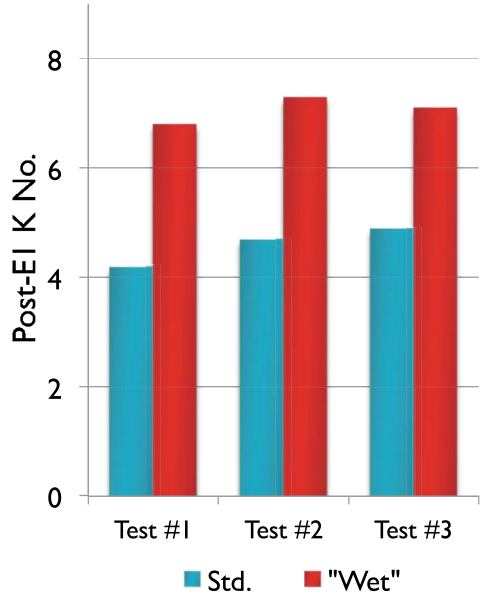
Mill A: Changes to EO Washing

- Mill replaced EO washer shower bars
  - Pulp was visually cleaner
  - Mat pH profile indicated good washing
- ***But kappa no. testing indicated no improvement!***
- D1 ClO_2 use had decreased, but mill had also implemented D1 Kappa Factor control at the same time



Mill B: E1 Washer Testing

- Mill B – E1 pulp visually very clean
- ***But repeat K# testing indicated significant carryover***



E1 Washing with D1 Filtrate

- Both Mill A and Mill B operate with a very low D_0-stage Kappa Factor
- Both mills run to a relatively high E1 kappa no.
- Both mills use D1-stage filtrate for E1-stage washing
- Both mills operate the D1 stage at low pH
- Both mills run to low D1-stage residual
  - Mill A = 6 ppm ClO_2 average vat residual
  - Mill B = zero residual
- Both mills run to low D1 brightness

Testing of D1 Filtrate

Mill A:

- D1 filtrate Kappa No. = 2.0 to 4.0
  (corrected to 1 g pulp)

Mill B:

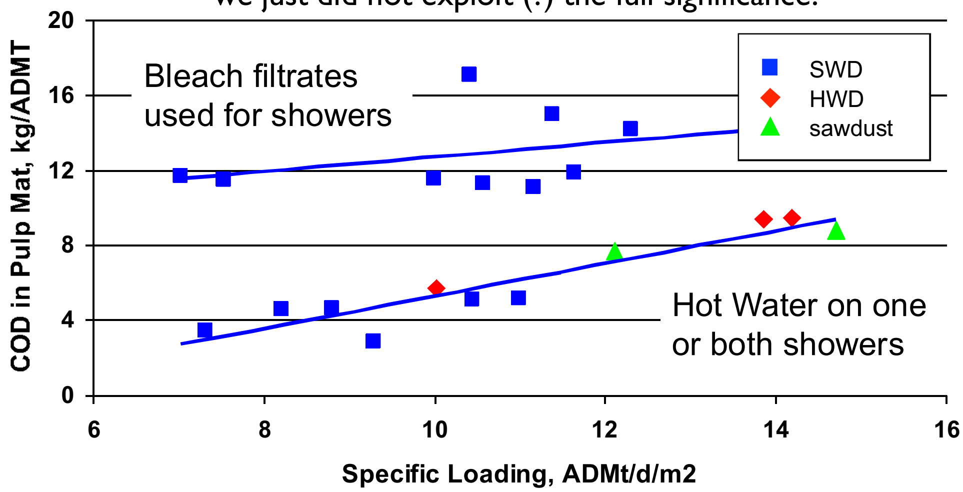
- D1 Filtrate K# = 2.6
  (corrected to 1 g pulp)
- ClO_2 demand of D1 filtrate = 0.186 g/L

Hypothesis:

- Both mills run the D_0E_1 stages in such a way that a significant amount of lignin enters the D1 stage, and the D1 stage applies only enough ClO_2 to partially oxidize the remaining lignin.
- So in some circumstances, D1-stage filtrate can still have a significant ClO_2 demand!

E1 Washing / D1 Filtrate

We saw this before – 2006 Bleaching Committee project – we just did not exploit (?) the full significance!



(Earl & Schofield, 2007)

Proposed Project

- Have mills measure Kappa No. (and ClO_2 demand?) of D1- & E2-stage filtrates
- Report test results with bleaching conditions at time of sampling:
  - Bleach feed kappa no.
  - D_0 Kappa Factor
  - E1 kappa no.
  - E1 shower sources
  - D1 ClO_2 charge
  - D1 terminal pH & terminal residual
  - D1 brightness

Subject 1	Subject 2	Subject 3	Title	Link to presentation	Author(s)	Affiliation	Mill	Time	Year	
Bleaching	Chemistry		General bleaching Chemistry	Bleaching Chemistry - Shree Prakash Mishra (FPInnovations)	Shree Prakash Mishra	FP Innovations		Fall	2014	Skookumchuck BC
Extraction	Optimization		E1 Stage Optimization	E1 Stage Optimization - Doug Reid (Akzo Nobel)	Doug Reid	Akso Nobel		Fall	2014	Skookumchuck BC
Chlorine Dioxide	Generation	Chemistry	ClO2 Generation Chemistry	ClO2 Generation Chemistry - Dennis Froats (ERCO Worldwide)	Dennis Froats	ERCO Worldwide		Fall	2014	Skookumchuck BC
Brown Stock	Washing	Bleaching	Improved Bleaching from Simple Vacuum Drum BSW Improvements	Improved Bleaching from Simple Vacuum Drum BSW Improvements - Brian La Brash (Verso Quinnesec)	Brian La Brash	Verso	Quinnesec	Fall	2014	Skookumchuck BC
D0 Stage Retention	Retention	Eop Caustic	Extended D0 Stage & Eop Chemical Use	Extended D0 Stage & Eop Chemical Use - Alison Rowat (Weyerhaeuser)	Alison Rowat	Weyerhaeuser		Fall	2014	Skookumchuck BC
Defoamers	Pitch Dispersants	Safety	Defoamers & Pitch Dispersants	Defoamers & Pitch Dispersants - Mike Kjerulf (Solenis)	Mike Kjerulf	Solenis		Fall	2014	Skookumchuck BC
Bleaching	Survey 2013	O2 SWD & HWD	2013 PAPTAC Bleaching Survey: O2-SWD & SWD Results	2013 PAPTAC Bleaching Survey: O2-SWD & SWD Results - Paul Earl (Paul Earl Consulting)	Paul Earl	Paul Earl Consulting		Fall	2014	Skookumchuck BC
Washer	Vat	Replacement	Washer Vat Replacement	Washer Vat Replacement - Meredith Kaknevicius (Canfor Intercon)	Meredith Kaknevicius	Canfor	Intercon	Fall	2014	Skookumchuck BC
pH	Control	Bleaching	Bleach Plant pH Control	Bleach Plant pH Control - Laurier Morissette (TEXO)	Laurier Morissette	TEXO		Fall	2014	Skookumchuck BC
Enzyme	Pre-Bleaching		Pre-Bleaching Enzyme Use	Pre-Bleaching Enzyme Use - Art Meusel (Chemstone)	Art Meusel	ChemStone		Fall	2014	Skookumchuck BC
D0 Stage	Conversion		D0 Stage Conversion	D0 Stage Conversion - Honey Nampak (Harmac)	Honey Nampak	Harmac		Fall	2014	Skookumchuck BC
E1 Stage	Carryover		New Findings on E1 Washer Carryover	New Findings on E1 Washer Carryover - Paul Earl (Paul Earl Consulting)	Paul Earl	Paul Earl Consulting		Fall	2014	Skookumchuck BC
Skookumchuck	Mill		Overview of Skookumchuck Pulp Mill	Overview of Skookumchuck Pulp Mill - Mark Cameron (Skookumchuck)	Mark Cameron	Paper Excellence	Skookumchuck	Fall	2014	Skookumchuck BC
Scale	Chemistry	Control	The Chemistry of Scale Control	The Chemistry of Scale Control – Harold Petke (Ashland	Harold Petke	Ashland		Spring	2014	Columbus MS
Scale	Columbus MS		Scale at Weyerhaeuser Columbus	Scale at Weyerhaeuser Columbus – Kent Robarge (Weyerhaeuser)	Kent Robarge	Weyerhaeuser	Columbus	Spring	2014	Columbus MS
Calcium Oxalate	Scale	Tacoma WA	Factors Contributing to Calcium Oxalate Scale at Simpson Tacoma	Factors Contributing to Calcium Oxalate Scale at Simpson Tacoma – Doug Reid (AkzoNobel)	Doug Reid	Simpson	Tacoma WA	Spring	2014	Columbus MS
Extractives	Understanding		Understanding Extractives in Pulp Manufacturing	Understanding Extractives in Pulp Manufacturing – Raymond Paquet (Kemira)	Raymond Paquet	Kemira		Spring	2014	Columbus MS
Screening			Inside the Black Box: Three Screening Mysteries Revealed	Inside the Black Box: Three Screening Mysteries Revealed – Daniel Brouillette (GL&V)	Daniel Brouillette	GL&V		Spring	2014	Columbus MS
Bleach Plant	Control	Inline Measurements	Bleach Plant Control Optimization Using Inline Brightness and Residual Measurements /	Bleach Plant Control Optimization Using Inline Brightness and Residual Measurements Along With On-Line Kappa Me	James Goldman	Metso		Spring	2014	Columbus MS
Oxygen	Safety		Chemical Safety: Oxygen	Chemical Safety: Oxygen – Chris Ho (Praxair)	Chris Ho	Praxair		Spring	2014	Columbus MS
ClO2	Generator	Hatch Explosion	ClO2 Generator Explosion Hatch Survey	ClO2 Generator Explosion Hatch Survey – Brian La Brash (Verso)	Brian La Brash	Verso	Quinnesec	Spring	2014	Columbus MS
Extraction Stage	Operation	Efficiency	Extraction Stage Operation and Efficiency	Extraction Stage Operation and Efficiency – Raymond Paquet (Kemira)	Raymond Paquet	Kemira		Spring	2014	Columbus MS
Brightness	Whiteness	Optical Brighteners	The Contribution of Pulp Brightness and Optical Brightening Agents to Paper Whiteness	The Contribution of Pulp Brightness and Optical Brightening Agents to Paper Whiteness – Daniel Connell (AkzoNobel)	Daniel Connell	Akso Nobel		Spring	2014	Columbus MS
Extraction Stage	Washing		The Importance of Washing in the Alkali Extraction Stage	The Importance of Washing in the Alkali Extraction Stage – Rick Van Fleet (BTG)	Rick Van Fleet	BTG		Spring	2014	Columbus MS
Monitoring	Control	Fibreline	Proper Use of Lab, In-line, and On-line Measurements for Fiberline Monitoring and Con	Proper Use of Lab, In-line, and On-line Measurements for Fiberline Monitoring and Control – James Goldman (Metso	James Goldman	Metso		Spring	2014	Columbus MS
Bleaching	Survey 2013		2012/13 Bleaching Survey Update	2012/13 Bleaching Survey Update – Doug Reid for Paul Earl	Paul Earl	Paul Earl Consulting		Spring	2014	Columbus MS
Monitor	Track	Report	MTR - Monitor, Track, Report	MTR - Monitor, Track, Report (Murray Walters - Allnorth)	Murray Walter	Allnorth		Fall	2013	Quesnel BC
D1 stage	pH		The Importance of D1 pH	The Importance of D1 pH (James Goldman - Metso)	James Goldman	Metso		Fall	2013	Quesnel BC
Sodium Hydroxide	Safety		Safety: Sodium Hydroxide	Safety: Sodium Hydroxide - Mark Logan (Canexus)	Mark Logan	Canexus		Fall	2013	Quesnel BC
Wood Chip	Analyzer	Digester Control	Continuous Digester Control with Wood Chip Analyzer	Continuous Digester Control with Wood Chip Analyzer - Laurier Morissette (TEXO)	Laurier Morissette	TEXO		Fall	2013	Quesnel BC
Lignin	Transmitter		Dissolved Lignin Transmitter	Disssolved Lignin Transmitter - Sandy Beder-Miller (BTG)	Sandy Beder-Miller	BTG		Fall	2013	Quesnel BC
Dust	Abatement		Dust Abatement	Dust Abatement - Meredith Illman (Canfor)	Meredith Illman	Canfor		Fall	2013	Quesnel BC
Screening			Balancing the Screenroom	Balancing the Screenroom (Daniel Brouillette - GL&V)	Daniel Brouillette	GL&V		Spring	2013	New Bern NC
Chips	Moisture	Analyzers	Analyzing Moisture Content Using Magnetic Resonance	Analyzing Moisture Content Using Magnetic Resonance (James Goldman - Metso)	James Goldman	Metso		Spring	2013	New Bern NC
Extraction Stage	Oxygen		Oxygen in Eop	Oxygen in Eop (Tim Monk - Weyerhaeuser)	Tim Monk	Weyerhaeuser		Spring	2013	New Bern NC
Extraction Stage	pH		Implementing Standardized Extraction pH	Implementing Standardized Extraction pH (David Trzil - Clearwater Paper)	David Trzil	Clearwater Paper	Lewiston	Spring	2013	New Bern NC
Bleach Plant	Bottleneck	Issues	Bleach Plant Bottleneck Issues	Bleach Plant Bottleneck Issues (Brian La Brash)	Brian La Brash	Verso	Quinnesec	Spring	2013	New Bern NC
Sodium Chlorate	Safety		Safety: Sodium Chlorate	Safety: Sodium Chlorate (Bill Adams - ERCO Worldwide)	Bill Adams	ERCO Worldwide		Spring	2013	New Bern NC
D0 Stage	Brightness		Post-Do Brightness: Useful or Not	Post-Do Brightness: Useful or Not? (James Goldman - Metso)	James Goldman	Metso		Spring	2013	New Bern NC
Brightness	Meter	Bleached Pulp	Brightness Meter to Bleached Hi-D	Brightness Meter to Bleached Hi-D (Brian La Brash - Verso Paper)	Brian La Brash	Verso	Quinnesec	Spring	2013	New Bern NC
OnGuard	Control		OnGuard: Web Based Monitoring of Chemical Control Systems	OnGuard: Web Based Monitoring of Chemical Control Systems (Harold Petke)	Harold Petke	Ashland		Fall	2012	Prince George BC
Recovery	Boiler	Online Analyzers	Recovery Boiler Optimization Using Online Recovery Analyzer Measurements	Recovery Boiler Optimization Using Online Recovery Analyzer Measurements (Jeff Butler)	Jeff Butler	Metso		Fall	2012	Prince George BC
Technologies	New Technologies	Lewiston ID	New Technologies at Clearwater Paper	New Technologies at Clearwater Paper (David Trzil)	David Trzil	Clearwater Paper	Lewiston	Fall	2012	Prince George BC
Technologies	New Technologies	Canfor	New Technologies at Canfor Pulp	New Technologies at Canfor Pulp (Francesca Apruzzese)	Francesca Apruzzese	Canfor		Fall	2012	Prince George BC
PulpEye	New Technologies	Canfor	New Technologies at Canfor: PulpEye	New Technologies at Canfor: PulpEye (Jennifer Rusnell)	Jennifer Rusnell	Canfor		Fall	2012	Prince George BC
Dissolving Pulp			Dissolving Pulp: A Renewed Technology	Dissolving Pulp: A Renewed Technology (David Flater)	David Flater			Fall	2012	Prince George BC
Peroxide	Safety	Hydrogen Peroxide	Safety: Hydrogen Peroxide	Safety: Hydrogen Peroxide (Dan Davies)	Dan Davies	Evonik		Fall	2012	Prince George BC
Extraction Stage	Oxidants		E-Stage Oxidants	E-Stage Oxidants (Dan Davies)	Dan Davies	Evonik		Fall	2012	Prince George BC
Recausticizing	Benchmark Study		Recausticizing Benchmark Study	Recausticizing Benchmark Study (Alison Rowat)	Alison Rowat	Weyerhaeuser		Fall	2012	Prince George BC
Green Liquor	Clarification	Survey	Green Liquor Clarifier Survey Results	Green Liquor Clarifier Survey Results (Kevin Taylor)	Kevin Taylor			Fall	2012	Prince George BC
Talc	Brightness		Effect of Talc Impurities on Pulp Brightness	Effect of Talc Impurities on Pulp Brightness (Kevin Taylor)	Kevin Taylor			Fall	2012	Prince George BC
Canfor Intercon			Overview of Canfor Intercon Pulp Mill	Overview of Canfor Intercon Pulp Mill (Francesca Apruzzese)	Francesca Apruzzese	Canfor	Intercon	Fall	2012	Prince George BC
Screening			Screening Do's and Don'ts	Screening Do's and Don'ts (Daniel Brouillette)	Daniel Brouillette	GL&V		Spring	2012	Dryden ON
Chip	Chip Pile	Rotation	Chip Pile Rotation - Impact on Fiberline	Chip Pile Rotation - Impact on Fiberline (Brian La Brash)	Brian La Brash	Verso	Quinnesec	Spring	2012	Dryden ON
Kappa Number	Variability	Digester	Decreasing Kappa No. Variability in the Digester	Decreasing Kappa No. Variability in the Digester (James Goldman)	James Goldman	Metso		Spring	2012	Dryden ON
Corrosion	Material of Construction		Fiberline Corrosion & Materials of Construction	Fiberline Corrosion & Materials of Construction (Margaret Gorog)	Margaret Gorog	Weyerhaeuser		Spring	2012	Dryden ON
FRP			FRP Technology & NDE Evaluation	FRP Technology & NDE Evaluation (Todd Bishop)	Todd Bishop	BRER Technical Inc		Spring	2012	Dryden ON
Sulphuric Acid	Safety		Safety: Sulphuric Acid	Safety: Sulphuric Acid (Shaun Morrison)	Shaun Morrison	Border Chemical Co		Spring	2012	Dryden ON
Scrubber	Additive		Bleach Plant Scrubber Additive	Bleach Plant Scrubber Additive (David Campbell)	David Campbell	ChemStone		Spring	2012	Dryden ON
Bleach Plant	Control		Bleach Plant Control Methods	Bleach Plant Control Methods (James Goldman)	James Goldman	Metso		Fall	2011	Athabasca AB
ClO2	Generator	MPC	ClO2 Generator Optimization using MPC	ClO2 Generator Optimization using MPC (Rick Van Fleet)	Rick Van Fleet	BTG		Fall	2011	Athabasca AB
Chlorine	Bleaching		Beyond Chlorine Bleaching	Beyond Chlorine Bleaching (Sandy Beder-Miller)	Sandy Beder-Miller	BTG		Fall	2011	Athabasca AB
Brownstock	Washing	Control	Brownstock Washer Control	Brownstock Washer Control (Gary Samek)	Gary Samek	Peace River Pulp		Fall	2011	Athabasca AB
Recausticizing	Control		Recaust Control	Recaust Control (Laurier Morissette)	Laurier Morissette	TEXO		Fall	2011	Athabasca AB
Chips	Digester	Control	Chip Monitoring for Digester Control	Chip Monitoriing for Digester Control (Laurier Morissette)	Laurier Morissette	TEXO		Fall	2011	Athabasca AB
Chlorine Dioxide	Safety		Safety: Chlorine Dioxide	Safety: Chlorine Dioxide (Dennis Froats)	Dennis Froats	ERCO Worldwide		Fall	2011	Athabasca AB
Chlorine Dioxide	Generator	Cariboo R8	Cariboo Turbine and R8	Cariboo Turbine and R8 (Ted Tam)	Ted Tam	Cariboo		Fall	2011	Athabasca AB
Peroxide	Residual	Testing	Peroxide Residual Testing	Peroxide Residual Testing (Brian La Brash)	Brian La Brash	Verso	Quinnesec	Fall	2011	Athabasca AB
ClO2	Residual	Measurement	Measuring Residual ClO2	Measuring Residual ClO2 (Sandy Beder-Miller)	Sandy Beder-Miller	BTG		Fall	2011	Athabasca AB
Methanol		Alpac	Methanol Purification at Alpac	Methanol Purification at Alpac (Jamie Percy)	Jamie Percy	Alpac		Fall	2011	Athabasca AB
CO2	pH	Control	pH Control with CO2	pH Control with CO2 (Brian La Brash)	Brian La Brash	Verso	Quinnesec MI	Fall	2011	Athabasca AB
Filtrate	Washing	Management	D Filtrate for Dilution, Washing & DF Control	D Filtrate for Dilution, Washing & DF Control (Phil Sekerak)	Phil Sekerak	Verso	Jay ME	Spring	2011	Espanola ON
Process Information			Advanced Uses for PI	Advanced Uses for PI (Tiffany Reid)	Tiffany Reid	Domtar	Espanola ON	Spring	2011	Espanola ON
Filtrate	Management	Espanola	Espanola Bleaching Filtrate Schemes	Espanola Bleaching Filtrate Schemes (Steve Neufeld)	Steve Neufeld	Domtar	Espanola ON	Spring	2011	Espanola ON
Filtrate	Management	New Glasgow NS	NPNS Bleach Plant Filtrate Management	NPNS Bleach Plant Filtrate Management (Jim Collins	Jim Collins	Northern Pulp	New Glasgow NS	Spring	2011	Espanola ON
Filtrate	Management	Marathon	Marathon Bleach Plant Filtrate Management	Marathon Bleach Plant Filtrate Management (2008 - Jim Collins)	Jim Collins	Tembec	Marathon ON	Spring	2011	Espanola ON
Defoamers			Advances in Pulp Mill Defoamer Technology	Advances in Pulp Mill Defoamer Technology (Bill Miskimins)	Bill Miskimins	Kemira		Spring	2011	Espanola ON
Sodium Chlorate	Safety	Rail Cars	Safety: Sodium Chlorate Rail Cars	Safety: Sodium Chlorate Rail Cars (J.C. Smith)	J.C. Smith	EKA		Spring	2011	Espanola ON
Filtrate	Eop Stage	Recycle	Eop Filtrate Recycle	Eop Filtrate Recycle (Tom Mullen)	Tom Mullen	Process Innovations		Spring	2011	Espanola ON
P stage	Survey		Final P Stage Survey	Final P Stage Survey (Dan Davies)	Dan Davies	Evonik		Spring	2011	Espanola ON
Condensates	Energy	Management	Use of Condensates	Use of Condensates (Mike Schofields)	Mike Schofields	Solenis		Spring	2011	Espanola ON
Kappa Analyzers	Brightness Analyzers	Survey	Kappa/Brightness Analyzer Calibration Survey	Kappa/Brightness Analyzer Calibration Survey (Brian La Brash)	Brian La Brash	Verso	Quinnesec MI	Spring	2011	Espanola ON
Cooking	Washing		Downflow Cooking and Pre-Bleach Washing	Downflow Cooking and Pre-Bleach Washing (Kevin McCanty)	Kevin McCanty	Metso		Fall	2010	Crofton BC
Hydrocyclone	Energy		Hydrocyclone Energy Improvements	Hydrocyclone Energy Improvements (Daniel Brouillette)	Daniel Brouillette	GL&V		Fall	2010	Crofton BC
Black Liquor	Fatty Acid		Fatty Acid Addition to Black Liquor	Fatty Acid Addition to Black Liquor (Ted Tam)	Ted Tam	Cariboo		Fall	2010	Crofton BC
Cogen	Project	Cariboo	Cariboo Pulp Cogen	Cariboo Pulp Cogen (Ted Tam)	Ted Tam	Cariboo		Fall	2010	Crofton BC
Filtrate	Recycle	Cariboo	Cariboo Bleach Filtrate Recycle	Cariboo Bleach Filtrate Recycle (Ted Tam)	Ted Tam	Cariboo		Fall	2010	Crofton BC
Green Transformation	Project	Grand Prairie		Weyerhaeuser Grande Prairie (Grant Bourree)	Grant Bourree	Weyerhaeuser	Grande Prairie BC	Fall	2010	Crofton BC
Green Transformation	Project	Canfor	Canfor Pulp	Canfor Pulp (Jennifer Fewster)	Jennifer Fewster	Canfor		Fall	2010	Crofton BC
Green Transformation	Project	Celgar		Zellstoff Celgar (Haitham Hosny)	Haitham Hosny	Zellstoff	Celgar BC	Fall	2010	Crofton BC

Green Transformation	Project	Harmac		Harmac Pacific (Honey Nampack)	Honey Nampak	Harmac Pacific		Fall	2010	Crofton BC
Green Transformation	Project	New Glasgow NS		Northern Pulp (Jim Collins)	Jim Collins	Northern Pulp	New Glasgow NS	Fall	2010	Crofton BC
Green Transformation	Project	Irving		Irving Pulp & Paper (Chris Halcrow)	Chris Halcrow	Irving P&P	Saint-John NB	Fall	2010	Crofton BC
Metallurgy	Stainless Steel		Stainless Steel	Update on New Stainless Steels (Doug Singbeil)	Doug Singbeil			Fall	2010	Crofton BC
ClO2	Storage	Safety	Safety: ClO2 Storage	Safety: ClO2 Storage (Gerry Ferweda)	Gerry Ferweda	Catalyst	Crofton BC	Fall	2010	Crofton BC
Knots	Bioconversion		Research: Bioconversion of Knots	Research: Bioconversion of Knots (Hua Jiang)	Hua Jiang	FPInnovations		Fall	2010	Crofton BC
Scale	Control		Scale control	Scale Control (Marcius De Oliverira & Mike Scholfield)	Mike Schofields	Solenis		Fall	2010	Crofton BC
BOD			BOD and Salmon Recovery	BOD and Salmon Recovery (David Trzil)	David Trzil	Clearwater Paper	Lewiston ID	Fall	2010	Crofton BC
Magnesium Hydroxide	D1 Stage		Magnesium Hydroxide in the D1 Stage	Magnesium Hydroxide in the D1 Stage (Brian La Brash)	Brian La Brash	Verso	Quinnesec MI	Fall	2010	Crofton BC
Bottleneck	Survey		Bottleneck survey	Bottleneck Survey (Dan Davies)	Dan Davies	Evonik		Fall	2010	Crofton BC
Eop stage	Variables		Temperature, pH & Caustic in the Eop Stage	Temperature, pH & Caustic in the Eop Stage (Paul Earl)	Paul Earl	Paul Earl Consulting		Fall	2010	Crofton BC
Bleaching Committee History			Bleaching Committee History	Bleaching Committee History: Prediciton for 2010 from 1989				Fall	2010	Crofton BC
Brownstock	Defoamer	Applications	Brownstock Defoamer Applications	Brownstock Defoamer Applications (Mike Schofield)	Mike Schofields	Solenis		Spring	2010	Saint John NB
Washing	Control		Washer control	Washer Control (Laurier Morissette)	Laurier Morissette	TEXO		Spring	2010	Saint John NB
Brownstock	Washers		BSW Anti-Rewet Deck Retrofit	BSW Anti-Rewet Deck Retrofit (Brian La Brash)	Brian La Brash	Verso	Quinnesec MI	Spring	2010	Saint John NB
Brightness	Variability		Minimizing Final Brightness Variability	Minimizing Final Brightness Variability (Alison Rowat & Jessica Paul)	Jessica Paul Alison Rowa	NewPage	Rumford ME	Spring	2010	Saint John NB
Methanol	Safety		Safety: Methanol	Safety: Methanol (Marc Germain - Brenntag)	Marc Germain	Brenntag		Spring	2010	Saint John NB
Bleaching	Near Neutral		Near Neutral Bleaching	Near Neutral Bleaching (Hua Jiang)	Hua Jiang	FPInnovations		Spring	2010	Saint John NB
ClO2	Heat Exchange		ClO2 Heat Exchanges	ClO2 Heat Exchanges (Paul Earl)	Paul Earl	Paul Earl Consulting		Spring	2010	Saint John NB
ClO2	Generator	Carryover	ClO2 Generator Carryover	ClO2 Generator Carryover (Don McCabe)	Don McCabe			Spring	2010	Saint John NB
Dryer	Clothing	Survey	Pulp Dryer Clothing Survey	Pulp Dryer Clothing Survey (Brian La Brash)	Brian La Brash	Verso	Quinnesec MI	Spring	2010	Saint John NB
Communication	Operator	Survey	Operator Communication Survey	Operator Communication Survey (Laurier Morissette)	Laurier Morissette	TEXO		Spring	2010	Saint John NB
Pulping			Kraft Pulping: A Bright Future	Kraft Pulping: A Bright Future (Jim Brewster)	Jim Brewster	Irving P&P	Saint-John NB	Spring	2010	Saint John NB
O2 Delignification	Survey		Oxygen Delignification: Overview (includes O2D survey results)	Survey slides only	Paul Earl	Paul Earl Consulting		Fall	2009	Lewiston ID
O2 Delignification	Survey		Oxygen Delignification: Overview (includes O2D survey results)	Survey spreadsheet	Paul Earl	Paul Earl Consulting		Fall	2009	Lewiston ID
O2 Delignification	High Consistency		High Consistency O2 Delignification	High Consistency O2 Delignification (Tom Harms)	Tom Harms			Fall	2009	Lewiston ID
O2 stage	Deresination		De-Resination in the O2 Stage	De-Resination in the O2 Stage (Mike Schofield)	Mike Schofields	Solenis		Fall	2009	Lewiston ID
White Liquor	Oxidation		White Liquor Oxidation	White Liquor Oxidation (Michel Epiney)	Michel Epinay	Air Liquide		Fall	2009	Lewiston ID
O2 Bleaching	Crofton		O2 Bleaching at Crofton	O2 Bleaching at Crofton (David Flater)	David Flater	Catalyst	Crofton BC	Fall	2009	Lewiston ID
Oxygen	Safety		Safety: Oxygen Handling	Safety: Oxygen Handling (Michel Epiney)	Michel Epinay	Air Liquide		Fall	2009	Lewiston ID
HexA	Survey		HexA Survey	HexA Survey (Brian La Brash)	Brian La Brash	Verso	Quinnesec MI	Fall	2009	Lewiston ID
Pulp	Properties	Bleaching	Impact of Bleaching on Pulp Properties	Impact of Bleaching on Pulp Properties (David Trzil & Alison Rowat)	David Trzil & Alison Rowat			Fall	2009	Lewiston ID
CO2			Use of CO2 in Fibrelines	Use of CO2 in Fibrelines (Murray Walters)	Murray Walter	AllNorth Consultants Ltd		Fall	2009	Lewiston ID
Chemical	Unloading	Survey	Chemical Unloading Survey - Update	Chemical Unloading Survey - Update (Brian La Brash & Doug Reid)	Brian La Brash Doug Reid			Fall	2009	Lewiston ID
ClO2	Generator	ERCO Smarts	Mill Experience with ERCO Smarts	Mill Experience with ERCO Smarts (Gerry Pageau)	Gerry Pageau	Howe Sound		Fall	2009	Lewiston ID
Process	Control		Process Control Examples	Process Control Examples (Gerry Pageau)	Gerry Pageau	Howe Sound		Fall	2009	Lewiston ID
Storage	Pulp	Channelling	Top Entry Spreader	Top Entry Spreader (Gerry Pageau)	Gerry Pageau	Howe Sound		Fall	2009	Lewiston ID
ClO2	Generator	Sesquisulfate	GAP Technology	GAP Technology (Jon Foan)	Jon Foan	Weyerhaeuser		Fall	2009	Lewiston ID
Carbon Monoxide	Bleaching	Safety		Safety: Carbon Monoxide & Bleaching (Paul Earl & Francesca Apruzzese)				Spring	2009	Iron Mountain MI
Chemical	Unloading	Survey	Chemical Unloading Survey	slides	Doug Reid Brian La Brash			Spring	2009	Iron Mountain MI
Chemical	Unloading	Survey	Chemical Unloading Survey	spreadsheet	Doug Reid Brian La Brash			Spring	2009	Iron Mountain MI
Caustic	Optimization		Optimizing Bleach Plant Caustic Use	Optimizing Bleach Plant Caustic Use (Paul Earl, Jim Collins & Nancy Van Allen)	Paul Earl Jim Collins Nancy Van Allen			Spring	2009	Iron Mountain MI
Carryover	Bleach Plant		Measurement of Carryover in the Bleach Plant	Measurement of Carryover in the Bleach Plant (Paul Earl & Gerry Pageau)	Paul Earl Gerry Pageau			Spring	2009	Iron Mountain MI
Mg(OH)2	NaOH	Replacement	Mg(OH)2 Use for Partial NaOH Replacement	Mg(OH)2 Use for Partial NaOH Replacement (Brian La Brash)	Brian LaBrash	Verso	Quinnesec MI	Spring	2009	Iron Mountain MI
Alarms	Interlocks		Alarms & Interlocks in the Bleach Plant	Alarms & Interlocks in the Bleach Plant (Ed Zychowski)	Ed Zychowski	Verso	Quinnesec MI	Spring	2009	Iron Mountain MI
Viscosity	Pulp	Measurement	Pulp Viscosity Measurement	Pulp Viscosity Measurement (Luc Lapierre)	Luc Lapierre	FPInnovations		Spring	2009	Iron Mountain MI
Saltcake			What To Do With Your Acid Saltcake	What To Do With Your Acid Saltcake (Paul Earl & Doug Reid)	Paul Earl Doug Reid			Spring	2009	Iron Mountain MI
ClO2	Generator	Debottlenecking	ClO2 Generator Debottlenecking	ClO2 Generator Debottlenecking (Jim Hopmans)	Jim Hopmans	ERCO Worldwide		Spring	2009	Iron Mountain MI
Unloading	Elevated Work	Safety	Unloading Procedures / Elevated Work Procedures	Unloading Procedures / Elevated Work Procedures (Gary Brooks)	Gary Brooks	Canexus		Spring	2009	Iron Mountain MI
Soda Ash	Handling	Safety	Soda Ash Handling	Soda Ash Handling (Jonathan Kuhn)	Jonathan Kuhn	FMC		Spring	2009	Iron Mountain MI
Chemical	Unloading		Chemical Unloading	Chemical Unloading (David Trzil)	David Trzil	Clearwater Paper	Lewiston ID	Spring	2009	Iron Mountain MI
Sodium Hydroxide	Handling	Safety	Sodium Hydroxide - Safety & Handling	Sodium Hydroxide - Safety & Handling (Nancy Van Allen)	Nancy Van Allen	Canexus		Fall	2008	Castlegar BC
Celgar			Blue Goose Upgrade at Celgar	"Blue Goose" Upgrade at Celgar (Shawn Russell & Ralph Lunn)	Shawn Russell Ralph Lun	Zellstoff	Celgar BC	Fall	2008	Castlegar BC
Screens	Cleaners		Replacing Pulp Mill Cleaners with Slotted Screens	Brian La BrashÂÂ ---ÂÂ Murray Walters	Brian LaBrash Murray Walters			Fall	2008	Castlegar BC
Screening			Slotted Screen Rotor Upgrade for Energy Savings	Slotted Screen Rotor Upgrade for Energy Savings (Brian La Brash)	Brian LaBrash	Verso	Quinnesec MI	Fall	2008	Castlegar BC
Carryover	Measurement		Measurement of Bleach Plant Carryover	slides	Paul Earl Gerry Pageau			Fall	2008	Castlegar BC
Carryover	Measurement		Measurement of Bleach Plant Carryover	"ClO2 Demand" test method	Paul Earl Gerry Pageau			Fall	2008	Castlegar BC
Brownstock	Washing	Water	Impact of Tramp Water in BSW Systems	Impact of Tramp Water in BSW Systems (Doug Reid)	Doug Reid	EKA		Fall	2008	Castlegar BC
Hexenuronic Acid			Hexenuronic Acid Groups in Pulping and Bleaching	Hexenuronic Acid Groups in Pulping and Bleaching (Zhi-Hua Jiang)	Zhi-Hua Jiang	FPInnovations		Fall	2008	Castlegar BC
Washing Overview	Brownstock		Pulp Washing Overview	Pulp Washing Overview (Jason Smith)	Jason Smith			Fall	2008	Castlegar BC
Washer	Survey		Bleach Plant Washer Survey Results	slides	Paul Earl	Paul Earl consulting		Fall	2008	Castlegar BC
Washer	Survey		Bleach Plant Washer Survey Results	spreadsheet	Paul Earl	Paul Earl consulting		Fall	2008	Castlegar BC
Washing	Washers		There's More To Washing Than The Washer	There's More To Washing Than The Washer (Murray Walters)	Murray Walter	AllNorth Consultants Ltd		Fall	2008	Castlegar BC
Washing	Pre-Bleaching	Open Washer	Impact of an Open Pre-Bleach Washer	Impact of an Open Pre-Bleach Washer (Brian La Brash)	Brian LaBrash	Verso	Quinnesec MI	Fall	2008	Castlegar BC
Washer	Drum washer	Control	A Proven Control Scheme for Vacuum Drum Washers	A Proven Control Scheme for Vacuum Drum Washers (Gerry Pageau)	Gerry Pageau	Howe Sound		Fall	2008	Castlegar BC
Washing			Pulp Washing	Pulp Washing (Laurier Morissette)	Laurier Morissette	TEXO		Fall	2008	Castlegar BC
Colour	Source	Bleach Plant	Source and Fate of Colour Through the Bleach Plant	Source and Fate of Colour Through the Bleach Plant (Grant Bourree)	Grant Bourree	Weyerhaeuser	Grande Prairie BC	Fall	2007	Gibsons BS
Brightness	Measurement	Round-Robin	Round-Robin Brightness Measurements: Final Result	Round-Robin Brightness Measurements: Final Results (Jean Bouchard)	Jean Bouchard	FPInnovations		Fall	2007	Gibsons BS
HWD/SWD Swing Operations			HWD/SWD Swing Operations	HWD/SWD Swing Operations (Peter Webber)	Peter Webber	Irving P&P	Saint-John NB	Fall	2007	Gibsons BS
Cost Saving	Ideas		Mill Cost-Saving Ideas	Update: Mill Cost-Saving Ideas (Laurier Morissette)	Laurier Morissette	TEXO		Fall	2007	Gibsons BS
Do Stage	Peroxide		Using Peroxide Ahead of Do Stage	Using Peroxide Ahead of Do Stage (Gerry Pageau)	Gerry Pageau	Howe Sound	Howe Sound BC	Fall	2007	Gibsons BS
ClO2	Generator	Reboiler	O-Ring Change on the Reboiler	O-Ring Change on the Reboiler (Jim Collins)	Jim Collins	Marathon Pulp	Marathon ON	Fall	2007	Gibsons BS
Nanotechnologies			Nanotechnologies for the P+P Industry	Nanotechnologies for the P+P Industry (Jean Bouchard)	Jean Bouchard	FPInnovations		Fall	2007	Gibsons BS
Do Stage	Fort Frances		Fort Frances Do Stage Incident	Fort Frances Do Stage Incident (Mike Kjerulf)	Mike Kjerulf	Resolute FP	Fort Frances ON	Fall	2007	Gibsons BS
Safety	Occupational Hygiene		Occupational Hygiene	Occupational Hygiene (Barry Greenfield, HSPP)	Barry Greenfield	Howe Sound	Howe Sound BC	Fall	2007	Gibsons BS
Spectroscopy	Vibrational Spectroscopy		Advanced Vibrational Spectroscopy	Advanced Vibrational Spectroscopy (Thanh Trung)	Thanh Trung	FPInnovations		Fall	2007	Gibsons BS
Spectroscopy	Infra Red	Northwood	Spectroscopic Applications at Northwood	Spectroscopic Applications at Northwood (Jim Menard)	Jim Menard	Canfor	Northwood	Fall	2007	Gibsons BS
NIR Technology	Marathon		NIR Technology at Marathon	NIR Technology at Marathon (Jim Collins)	Jim Collins	Marathon Pulp	Marathon ON	Fall	2007	Gibsons BS
Consistency	Control		Consistency Control	Consistency Control (Brian La Brash & Tom Biazzo)	Brian La Brash Tom Biazzo			Fall	2007	Gibsons BS
Lignin	Dissolved Lignin	Measurement	Dissolved Lignin Measurement	Dissolved Lignin Measurement (Tom Biazzo)	Tom Biazzo	BTG		Fall	2007	Gibsons BS
Controls	Measurement Tools & (	Measurement	Measurement Tools & Controls	Measurement Tools & Controls (Alison Rowat)	Alison Rowat	Metso		Fall	2007	Gibsons BS
Brightness	Measurements	Round-Robin	Round-Robin Brightness Measurements: Preliminary Results	Round-Robin Brightness Measurements: Preliminary Results (Luc Lapierre)	Luc Lapierre	FPInnovations		Spring	2007	Fort Frances ON
Filtrate	Filtrate Extraction	Sampling	The Harmac Needle: Filtrate Sampling on a Budget	The Harmac Needle: Filtrate Sampling on a Budget (Murray Walters)	Murray Walter	Harmac	Nanaimo BC	Spring	2007	Fort Frances ON
Brightness	Very High Brightness		Very High Brightness Pulp	Very High Brightness Pulp (Francesca Apruzzese)	Francesca Apruzzese	Tembec	Skookumchuck BC	Spring	2007	Fort Frances ON
Yield	Bleach Plant		Yield in the Bleach Plant	Yield in the Bleach Plant (Hua Jiang)	Hua Jiang	FPInnovations		Spring	2007	Fort Frances ON
Environment	Fort Frances		Environmental Challenges at Abitibi-Consolidated, Fort Frances	Environmental Challenges at Abitibi-Consolidated, Fort Frances (Gary Rogozinski)	Gary Rogozinski	Abitibi-Consolidate	Fort Frances ON	Spring	2007	Fort Frances ON
Peroxide	Safety	Hydrogen Peroxide	Hydrogen Peroxide Safety	Hydrogen Peroxide Safety (Ross Anderson)	Ross Anderson	Kemira		Spring	2007	Fort Frances ON
Safety	Investigation Reporting	Reporting	Safety Incidents: Investigation & Reporting	Safety Incidents: Investigation & Reporting (Tim Anderson)	Tim Anderson	Marsulex		Spring	2007	Fort Frances ON
D1 Stage	Fundamentals		D1 Stage Fundamentals	D1 Stage Fundamentals (Paul Earl)	Paul Earl	Paul Earl Consulting		Spring	2007	Fort Frances ON
Brightness	Stability		Brightness Stability	Brightness Stability (Dan Davies)	Dan Davies	Evonik		Spring	2007	Fort Frances ON
D1 Stage	Skookumchuck	Control	D1 Stage Control at Skookumchuck	D1 Stage Control at Skookumchuck (Francesca Apruzzese)	Francesca Apruzzese	Tembec	Skookumchuck BC	Spring	2007	Fort Frances ON

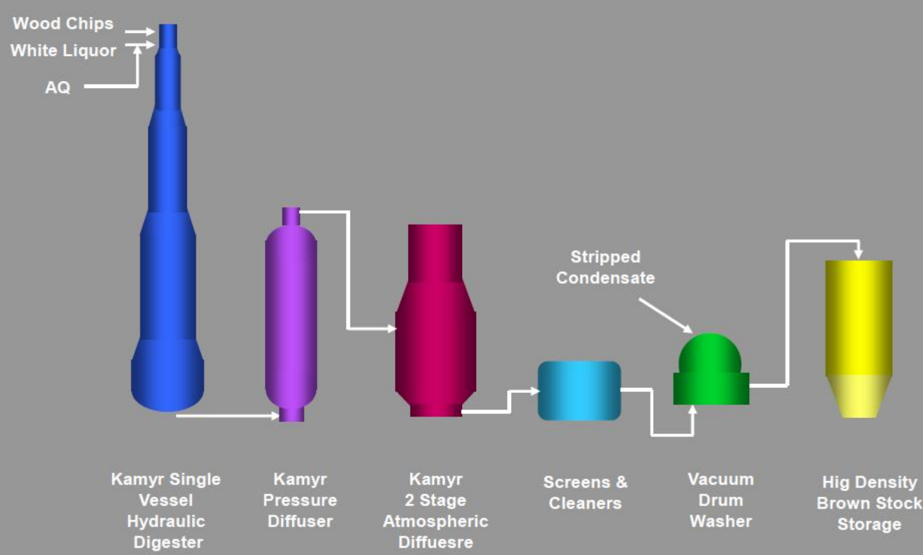
D1 Stage	Irving	Control	D1 Stage Control at Irving	D1 Stage Control at Irving (Peter Webber)	Peter Webber	Irving P&P	Saint-John NB	Spring	2007	Fort Frances ON
Xylanase	D1 and D2 stage	Brightening	The Benefits of Xylanase on D1 and D2 Brightening	The Benefits of Xylanase on D1 and D2 Brightening (Harold Petke)	Harold Petke	Iogen		Spring	2007	Fort Frances ON
Peroxide	Last stage		Hydrogen Peroxide in the Last Stage of Bleaching	Hydrogen Peroxide in the Last Stage of Bleaching (Bimal Khandelwal)	Bimal Khandelwal	FMC		Spring	2007	Fort Frances ON
Peroxide	HD Storage		Hydrogen Peroxide in HD Storage	Hydrogen Peroxide in HD Stoarage (Mike Kjerulf)	Mike Kjerulf	Abitibi-Consolidate	Fort Frances ON	Spring	2007	Fort Frances ON
Safety	Peroxide Explosion	Canfor Intercon	Peroxide Explosion Incident at Canfor Intercon	Peroxide Explosion Incident at Canfor Intercon (Paul Robilliard)	Paul Robilliard	Canfor	Intercon	Spring	2007	Fort Frances ON
Bleaching	Glossary		Bleaching Glossary Distribution	Bleaching Glossary Distribution (Luc Thibault)	Luc Thibeault			Fall	2006	Peace River AB
Materials	Construction	Survey	Materials of Construction Survey	slides	Jeff Bennett			Fall	2006	Peace River AB
Materials	Construction	Survey	Materials of Construction Survey	tables	Jeff Bennett			Fall	2006	Peace River AB
Brightness		Measurement	Brightness Measurement Variation	Brightness Measurement Variation (Jean Bouchard)	Jean Bouchard	FPInnovations		Fall	2006	Peace River AB
Cleaning	Wire	Showers	Wire Cleaning Showers	Wire Cleaning Showers (Murray Walters)	Murray Walter	Harmac	Nanaimo BC	Fall	2006	Peace River AB
ClO2 Generator	Troubleshooting		ClO2 Generator Troubleshooting	ClO2 Generator Troubleshooting (Gerry Pageau)	Gerry Pageau	Howe Sound	Howe Sound BC	Fall	2006	Peace River AB
Safety	Sulphuric Acid Handling		Sulphuric Acid Safe Handling	Sulphuric Acid Safe Handling (Shaun Morrison)	Shaun Morrison	Border Chemical Co		Fall	2006	Peace River AB
Bio-Solids	Land application		Bio-Solids Land Application	Bio-Solids Land Application (Tom Tarpey, DMI)	Tom Tarpey	Daishowa Marubini	Peace River AB	Fall	2006	Peace River AB
Eop Washer	Survey		Eop Washer Survey	Eop Washer Survey (Paul Earl)	Paul Earl	Paul Earl Consulting		Fall	2006	Peace River AB
Extraction Stage	Fundamentals		Extraction Stage Fundamentals	Extraction Stage Fundamentals (Doug Reid)	Doug Reid	EKA		Fall	2006	Peace River AB
E1 Stage	Kappa		Kappa Drop in the E1 Stage	Kappa Drop in the E1 Stage (Luc Thibault)	Luc Thibeault	Marathon Pulp	Marathon ON	Fall	2006	Peace River AB
E Stage	pH Temperature	Temperature	Review: Impact of Temperature on E-Stage pH	Review: Impact of Temperature on E-Stage pH (Doug Reid)	Doug Reid	EKA		Fall	2006	Peace River AB
Alkali	Residual	Measurement	Measurement of Residual Alkali	Measurement of Residual Alkali (Hua Jiang)	Hua Jiang	FPInnovations		Fall	2006	Peace River AB
Oxygen	Bleaching	Crofton	Oxygen Bleaching at Crofton	Oxygen Bleaching at Crofton (Jana Dagsvik)	Jana Dagsvik	Catalyst	Crofton BC	Fall	2006	Peace River AB
Eo Stage	Marathon Pulp		Eo-Stage Optimization at Marathon Pulp	Eo-Stage Optimization at Marathon Pulp (Jim Collins)	Jim Collins	Marathon Pulp	Marathon ON	Fall	2006	Peace River AB
Do Stage	Control	Eop feedback	Do-Stage Control with Feedback from Eop	Do-Stage Control with Feedback from Eop (Alison Rowat)	Alison Rowat	Metso		Fall	2006	Peace River AB
Do Stage	Fundamentals		Do Stage Fundamentals	Do Stage Fundamentals (Paul Earl)	Paul Earl	Paul Earl Consulting		Spring	2006	Chicoutimi QC
Do Stage	Marathon		New Developments at Marathon for Do Stage Operation	New Developments at Marathon for Do Stage Operation (Jim Collins)	Jim Collins	Marathon Pulp	Marathon ON	Spring	2006	Chicoutimi QC
Do Stage	Irving		Do Sliding Kappa Factor Control at Irving Pulp & Paper	Do Sliding Kappa Factor Control at Irving Pulp & Paper (Jason Smith)	Jason Smith	Irving P&P	Saint-John NB	Spring	2006	Chicoutimi QC
Do Stage	Fjordcell		Do Stage Control at Cascades Fjordcel	Do Stage Control at Cascades Fjordcell (Laurier Morissette)	Laurier Morissette	TEXO		Spring	2006	Chicoutimi QC
Do Stage	Eop Stage	Limitations	Practical Limitations of DoEop Bleaching	Practical Limitations of DoEop Bleaching (Dave Thireault)	Dave Thireault	Pope & Talbot	Halsey	Spring	2006	Chicoutimi QC
South America	Bleaching		South American Bleaching Update	South American Bleaching Update (Mike Schofield)	Mike Schofields	Solenis		Spring	2006	Chicoutimi QC
Safety	Chlorine Dioxide		Chlorine Dioxide Safety	Chlorine Dioxide Safety (Jim Hopmans)	Jim Hopmans			Fall	2005	Squamish BC
Safety	Process Safety	Management	Overview of Process Safety Management	Overview of Process Safety Management (Tina Cameron)	Tina Cameron	Weyerhaeuser	Grande Prairie BC	Fall	2005	Squamish BC
Regulations US	Environment		US Environmental Regulations	US Environmental Regulations (Lisa Scott)	Lisa Scott	Pope & Talbot		Fall	2005	Squamish BC
Bleach Plant	Electricity	Survey	Bleach Plant Electricity Use Survey	Bleach Plant Electricity Use Survey (Doug Reid)	Doug Reid	EKA		Fall	2005	Squamish BC
Bleaching	Washing		Impact of Washing Strategy in the Bleach Plant:	Overview of the Grande Prairie Mill (Tina Cameron)	Tina Cameron	Weyerhaeuser	Grande Prairie BC	Fall	2005	Squamish BC
Bleaching	Washing		Impact of Washing Strategy in the Bleach Plant:	Impact of Washing Strategy in the Bleach Plant (Doug Reid)	Doug Reid	EKA		Fall	2005	Squamish BC
Eop Stage	Washing	Survey	Update on the Eop Washer Survey Project	Update on the Eop Washer Survey Project (Mike Schofield)	Mike Schofields	Solenis		Fall	2005	Squamish BC
Washing	Bleach Plant	Survey 2003	Bleach Plant Washing; Results from the 2003 Survey	Bleach Plant Washing; Results from the 2003 Survey (Shane Svendsen)		Shane Svendsen		Fall	2005	Squamish BC
Washer	Shower	Crofton	Shower Modifications at Crofton	Shower Modifications at Crofton (Gerry Ferweda)	Gerry Ferweda	Catalyst	Crofton BC	Fall	2005	Squamish BC
Eop stage	Washer	Elk Falls	Eop Washer Upgrades at Elk Falls	Eop Washer Upgrades at Elk Falls (Dave Flater)	Dave Flater	Catalyst	Elk Falls BC	Fall	2005	Squamish BC
Washing	Bleach Plant	Celgar	Bleach Plant Washing at Celgar	Bleach Plant Washing at Celgar (Alex Edwards)	Alex Edouards	Zellstoff	Celgar BC	Fall	2005	Squamish BC
Washing	Bleach Plant	Marathon	Bleach Plant Washing at Marathon	Bleach Plant Washing at Marathon (Jim Collins)	Jim Collins	Marathon Pulp	Marathon ON	Fall	2005	Squamish BC
Washing	Strategies	Survey	Member Mill Washing Strategies	Member Mill Washing Strategies (various)				Fall	2005	Squamish BC
Sodium Hydroxide	Storage	Handling	Sodium Hydroxide Storage & Handling	Sodium Hydroxide Storage & Handling (Nancy Van Allen)	Nancy Van Allen			Spring	2005	New Glasgow NS
Energy	Usage	PG pulp	Energy Usage and Conservation at PG Pulp	Energy Usage and Conservation at PG Pulp (Jeff Bennett)	Jeff Bennett	Canfor	Prince George BC	Spring	2005	New Glasgow NS
Energy	Usage	New Glasgow Neenah F	Neenah Paper's Energy Story	Neenah Paper's Energy Story (Dave Lundin)	Dave Lundin	Neenah Paper	New Glasgow NS	Spring	2005	New Glasgow NS
Extraction Stage	pH		Taking Cues from pH in an Extraction Stage	Taking Cues from pH in an Extraction Stage (Barbara van Lierop)	Barbara van Lierop	FPInnovations		Spring	2005	New Glasgow NS
Brightness	TAPPI Brightness	Staples	Staples (Business Depot) and TAPPI Brightness	Staples (Business Depot) and TAPPI Brightness (Paprican)		FPInnovations		Fall	2004	Nanaimo BC
Defoamers	Bleach Plant		Bleach Plant Defoamers	Bleach Plant Defoamers (Dave Semple, Kemira)	Dave Semple	Kemira		Fall	2004	Nanaimo BC
Peroxide	Storage Handling	Peroxide Storage Handl	Peroxide Storage & Handling	Peroxide Storage & Handling (Dan Davies)	Dan Davies	Evonik		Fall	2004	Nanaimo BC
Wood Chips	Management		The Future of Wood Chips Management	The Future of Wood Chips Management				Fall	2004	Nanaimo BC
Bleaching Demand	Carry Over	Inter-stage	Inter-Stage Carry Over & Bleaching Chemical Demand	Inter-Stage Carry Over & Bleaching Chemical Demand (Luc Thibault)	Luc Thibeault	Marathon Pulp	Marathon ON	Fall	2004	Nanaimo BC
Chlorine Dioxide	Generator	Control	Chlorine Dioxide Generator Control	Chlorine Dioxide Generator Control (Bruce Allison)	Bruce Allison	FPInnovations		Fall	2004	Nanaimo BC
Bleaching	Survey	Control	Bleaching Survey Results Analysis & Bleaching Controls	Bleaching Survey Results Analysis & Bleaching Controls (Gerry Pageau)	Gerry Pageau	Howe Sound	Howe Sound BC	Fall	2004	Nanaimo BC
Bleach Plant	Control	Peace River	Bleaching Plant Advanced Control at DMI Peace Controls	Bleaching Plant Advanced Control at DMI Peace Controls (Guy Normandeau & Alison Rowat)	Guy Normandeau & Alisc	Daishowa Marubini	Peace River AB	Fall	2004	Nanaimo BC
Mixing	Bleach Plant	Control	Mixing & Modeling: Improving Bleach Plant Control & Pulp Quality	Mixing & Modeling: Improving Bleach Plant Control & Pulp Quality (Chad Bennington)	Chad Bennington	FPInnovations		Fall	2004	Nanaimo BC
Dirt	Pulp Sheet	Analysis	Pulp Sheet Dirt Analysis, Incident Analysis and Response Strategies	Pulp Sheet Dirt Analysis, Incident Analysis and Response Strategies (Mike Schofield)	Mike Schofields	Solenis		Fall	2004	Nanaimo BC
White Liquor	Safety		White Liquor - Safe Practice	White Liquor - Safe Practice (Marilyn Cramer)	Marilyn Cramer			Spring	2004	Fredericton NB
Sodium Bisulfite	AntiChlor		Sodium Bisulfite as an AntiChlor	Sodium Bisculfite as an AntiChlor (Ross Stacey)	Ross Stacey	Marsulex		Spring	2004	Fredericton NB
Bleach Plant	Energy	Survey	Bleach Plant Energy Survery	Bleach Plant Energy Survery (Dave Thireault)	Dave Thireault	Pope & Talbot	Halsey	Spring	2004	Fredericton NB
FPInnovations	Pilot Plant	Paprican	Paprican Pilot Plant	Paprican Pilot Plant (Hua Jiang)	Hua Jiang	FPInnovations		Spring	2004	Fredericton NB
Chlorate & ClO2	Storage Tank	Inspection	Chlorate & ClO2 Storage Tank Inspection	Chlorate & ClO2 Storage Tank Inspection (Tom Rollbuhler)	Tom Rollbuhler	EKA		Spring	2004	Fredericton NB
Bleaching	Survey 2003	Best Practices	2003 Bleaching "Best Practices" Survey Results	Introductions	Paul Earl	Paul Earl consulting		Spring	2004	Fredericton NB
Bleaching	Survey 2004	Best Practices	2003 Bleaching "Best Practices" Survey Results	Softwood	Paul Earl	Paul Earl consulting		Spring	2004	Fredericton NB
Bleaching	Survey 2005	Best Practices	2003 Bleaching "Best Practices" Survey Results	Hardwood	Paul Earl	Paul Earl consulting		Spring	2004	Fredericton NB
Bleaching	Survey 2006	Best Practices	2003 Bleaching "Best Practices" Survey Results Spreadsheets	Complete Results	Paul Earl	Paul Earl consulting		Spring	2004	Fredericton NB
Bleaching	Survey 2007	Best Practices	2003 Bleaching "Best Practices" Survey Results Spreadsheets	Softwood	Paul Earl	Paul Earl consulting		Spring	2004	Fredericton NB
Bleaching	Survey 2008	Best Practices	2003 Bleaching "Best Practices" Survey Results Spreadsheets	Hardwood	Paul Earl	Paul Earl consulting		Spring	2004	Fredericton NB
Mg(OH)2	Western Pulp	Squamish	Mg(OH)2 Trial at Western Pulp (Jim Oei)	paper	Jim Oei	Western Pulp	Squamish BC	Spring	2004	Fredericton NB
Mg(OH)3	Western Pulp	Squamish	Mg(OH)2 Trial at Western Pulp (Jim Oei)	slides	Jim Oei	Western Pulp	Squamish BC	Spring	2004	Fredericton NB
Extraction Stage	Variables	Modelling	Modelling the Variables in an Extraction Stage	Modelling the Variables in an Extraction Stage (Hua Jiang)	Hua Jiang	FPInnovations		Spring	2004	Fredericton NB
Kappa No	Measurement		Kappa No. Measurement	Procedure	Alison Rowat	Metso		Spring	2004	Fredericton NB
Kappa No	Measurement		Kappa No. Measurement	Spreadsheet	Alison Rowat	Metso		Spring	2004	Fredericton NB
K No	Measurement		K No. Measurement	Procedure	Alison Rowat	Metso		Spring	2004	Fredericton NB
K No	Measurement		K No. Measurement	Spreadsheet	Alison Rowat	Metso		Spring	2004	Fredericton NB
Oxygen	Safety		Oxygen Safety	Oxygen Safety (Chris Ho)	Chris Ho	Praxair		Fall	2003	Quesnel BC
Sulfuric Acid	Storage Tank	Inspection	Acid Storage Tank Inspection	Acid Storage Tank Inspection (Ross Stacey)	Ross Stacey	Marsulex		Fall	2003	Quesnel BC
E Stage	pH	Temperature	Effect of Temperature on E-Stage pH	Update: Effect of Temperature on E-Stage pH (Doug Reid)	Doug Reid Laurier Morris	EKA		Fall	2003	Quesnel BC
D1 stage	Survey		Beyond the D1-Stage: Metso Survey Results	Beyond the D1-Stage: Metso Survey Results (Alison Rowat)	Alison Rowat	Metso		Fall	2003	Quesnel BC
E2 Stage	D2 Stage		The E2 & D2 Stages	The E2 & D2 Stages (Paul Earl)	Paul Earl	Paul Earl Consulting		Fall	2003	Quesnel BC
(DEp)D	Conversion	Cariboo Pulp	(DEp)D Conversion at Cariboo Pulp	(DEp)D Conversion at Cariboo Pulp (Rob Kovacs)	Rob Kovacs	Cariboo	Prince George BC	Fall	2003	Quesnel BC
(DE)DP	Halsey		(DE)DP at Pope & Talbot Halsey	(DE)DP at Pope & Talbot Halsey (Dave Thireault)	Dave Thireault	Pope & Talbot	Halsey OR	Fall	2003	Quesnel BC
DED	Variations		Variations on DED	Variations on DED (Norm Liebergott)	Norm Liebergott			Fall	2003	Quesnel BC
Brightness	Reversion	Loss	Brightness Loss & Reversion	Brightness Loss & Reversion (Jean Bouchard & Mike Schofield)	Jean Bouchard	FPInnovations		Fall	2003	Quesnel BC
Chemical Unloading	Best Practice	Safety	Chemical Unloading Best Practices	Chemical Unloading Best Practices (Ross Stacey)	Ross Stacey	Marsulex		Spring	2003	Saint-Félicien QC
E-Stage	pH	Temperature	Effect of Temperature on E-Stage pH	Effect of Temperature on E-Stage pH (Doug Reid)	Doug Reid Laurier Morris	EKA		Spring	2003	Saint-Félicien QC
Energy	Reduction	Canfor PG Pulp	Energy Reduction Projects at PG Pulp	Energy Reduction Projects at PG Pulp (Jeff Bennett)	Jeff Bennett	Canfor	Prince George BC	Spring	2003	Saint-Félicien QC
Sesquisulfate	pH Control		Sesquisulfate for Bleach Plant pH Control	Sesquisulfate for Bleach Plant pH Control (Jim Collins)	Jim Collins	Marathon Pulp	Marathon ON	Spring	2003	Saint-Félicien QC
Energy	Saving Projects	Harmac	Energy Savings Projects at Harmac	Energy Savings Projects at Harmac (Murray Walters)	Murray Walter	Pope & Talbot	Harmac	Spring	2003	Saint-Félicien QC
Costs	Reduction	Skookumchuck	Cost Reduction at Tembec Skookumchuck	Cost Reduction at Tembec Skookumchuck (Gavin Baxter)	Gavin Baxter	Tembec	Skookumchuck BC	Spring	2003	Saint-Félicien QC
Materials	Corrosion	Bleach Plant	Bleach Plant Materials & Corrosion	Bleach Plant Materials & Corrosion (Andy Garner, Paprican)	Andy Garner	FPInnovations		Spring	2003	Saint-Félicien QC
ClO2	Storage	Crofton	ClO2 Storage "Best Practices" at Crofton	ClO2 Storage "Best Practices" at Crofton (Gerry Ferweda)	Gerry Ferweda	Catalyst	Crofton BC	Spring	2003	Saint-Félicien QC
Enzymes	Marathon		Enzymes at Marathon Pulp Ltd.	Enzymes at Marathon Pulp Ltd. (Luc Thibault)	Luc Thibeault	Marathon Pulp	Marathon ON	Fall	2002	Skookumchuck BC
Oxygen Delignification	Delignification	Harmac	Mini-Oxygen Delignification at Harmac	Mini-Oxygen Delignification at Harmac (Murray Walters)	Murray Walter	Pope & Talbot	Harmac	Fall	2002	Skookumchuck BC

Ozone	Espanola		Ozone at Domtar Espanola	Ozone at Domtar Espanola (Brian Gartley)	Brian Gartley	Domtar	Espanola ON	Fall	2002	Skookumchuck BC
Do Stage	Formaldehyde		Formaldehyde in the Do-Stage	Formaldehyde in the Do-Stage (Hua Jiang)	Hua Jiang	FPInnovations		Fall	2002	Skookumchuck BC
O2 Delignification	Delignification		O2 Delignification Optimization	O2 Delignification Optimization (Hua Jiang)	Hua Jiang	FPInnovations		Fall	2002	Skookumchuck BC
AOX	British Columbia	Survey	BC AOX Report - A Summary	BC AOX Report - A Summary (Dave Willis)	Dave Willis			Fall	2002	Skookumchuck BC
ClO2	Handling	Safety	ClO2 Safe Handling Seminar	ClO2 Safe Handling Seminar (Mark Minday)	Mark Minday	EKA		Fall	2002	Skookumchuck BC
ClO2	Scrubber	Skookumchuck	ClO2 Scrubber Upgrade at Tembec Skookumchuck	ClO2 Scrubber Upgrade at Tembec Skookumchuck (Kari Rae)	Kari Rae	Tembec	Skookumchuck BC	Fall	2002	Skookumchuck BC
ClO3	Scrubber	Peace River	Fibre Line Scrubber Upgrade at DMI Peace River	Fibre Line Scrubber Upgrade at DMI Peace River (Guy Normandeau)	Guy Normandeau	Daishowa Marubini	Peace River AB	Fall	2002	Skookumchuck BC
White Liquor	Oxidized WL		Oxidized White Liquor in the Bleach Plant	Oxidized White Liquor in the Bleach Plant (Tom Mullen)	Tom Mullen	Air Products		Spring	2002	Dryden ON
SO2	Handling	Safety	SO2 Safe Handling Seminar	SO2 Safe Handling Seminar (Ross Stacey)	Ross Stacey	Marsulex		Spring	2002	Dryden ON
Irving	25 years Retrospective		A 25 Year Retrospective at Irving	A 25 Year Retrospective at Irving (Don McCabe)	Don McCabe	Irving P&P	Saint-John NB	Spring	2002	Dryden ON
Effluent	Colour	25 years Retrospective	Looking at Effluent Colour Reduction 25 Years Ago	Looking at Effluent Colour Reduction 25 Years Ago (Rae Cunnington)	Rae Cunnington	Catalyst	Port Alberni BC	Spring	2002	Dryden ON
ClO2	Generator	25 years Retrospective	Chlorine Dioxide Generation Over the Last 25 Years	Chlorine Dioxide Generation Over the Last 25 Years (Dennis Owen)	Dennis Owen			Spring	2002	Dryden ON
D1 Stage	Practices	Survey	Overview of D1 Stage Practices from Last Bleaching Survey	Overview of D1 Stage Practices from Last Bleaching Survey (Paul Earl)	Paul Earl	Paul Earl Consulting		Spring	2002	Dryden ON
D1 Stage	Carryover	Celgar	Effect of Carryover to the D1 Stage at Celgar	Effect of Carryover to the D1 Stage at Celgar (Ralph Lunn)	Ralph Lunn	Zellstoff	Celgar BC	Spring	2002	Dryden ON
D1 Stage	Irving		The D1 Stage at Irving	The D1 Stage at Irving (Don McCabe)	Don McCabe	Irving P&P	Saint-John NB	Spring	2002	Dryden ON
D1 Stage	Control		A Control Overview	A Control Overview (Laurier Morissette)	Laurier Morissette	TEXO		Spring	2002	Dryden ON
D1 Stage	Control	Schemes	Advanced Control Schemes	Advanced Control Schemes (Rob Laurendeau)	Rob Laurendeau	Canfor	Intercon	Spring	2002	Dryden ON
D1 Stage	Survey		Review of Mill Responses to the D1 Questionnaire	Review of Mill Responses to the D1 Questionnaire (Dave Willis & Rae Cunnington)	Dave Willis Rae Cunnington			Spring	2002	Dryden ON
Bleaching Chemicals	Subcommittee		Bleaching Chemicals Subcommittee	Bleaching Chemicals Subcommittee (Chris Kanters)	Chris Kanters			Fall	2001	Halsey OR
Chlorate	Handling	Safety	Chlorate Safe Handling Seminar	Chlorate Safe Handling Seminar (Jim Hopmans)	Jim Hopmans	Sterling		Fall	2001	Halsey OR
Kappa	Analyzers	Online	Online Kappa Analysers	Online Kappa Analysers (Peter Lau)	Peter Lau	Weyerhaeuser	Kamloops BC	Fall	2001	Halsey OR
Heat	Exchange	Survey	Heat Exchange Survey	Heat Exchange Survey (Dennis Owen)	Dennis Owen			Fall	2001	Halsey OR
ClO2	Analyzers	Survey	ClO2 Analyser Survey	ClO2 Analyser Survey (Dennis Owen)	Dennis Owen			Fall	2001	Halsey OR
FPInnovations	Bleach Sequencer		Bleach Sequencer at Paprican	Bleach Sequencer at Paprican (Jean Bouchard)	Jean Bouchard	FPInnovations		Fall	2001	Halsey OR
Filtrate	Recycle	Peace River	DMI Peace River Pulp Filtrate Recycle Review	DMI Peace River Pulp Filtrate Recycle Review	Guy Normandeau	Daishowa Marubini	Peace River AB	Fall	2001	Halsey OR
Eop	Filtrate Recycle	Skookumchuck	Eop Filtrate Recycle & Closure Plans at Skookumchuck	Eop Filtrate Recycle & Closure Plans at Skookumchuck (Gavin Baxter)	Gavin Baxter	Tembec	Skookumchuck BC	Fall	2001	Halsey OR
D0 Stage	Consistency	Low vs MC	Low vs. MC Do	Low vs. MC Do (Murray Walters)	Murray Walter	Pope & Talbot	Harmac	Fall	2001	Halsey OR
Filtrate	Recycle		BFR Update	BFR Update (Paul Earl)	Paul Earl	Paul Earl Consulting		Fall	2001	Halsey OR
Eop Stage	Filtrate	Ultrafiltration	Ultrafiltration of Eop Filtrate	Ultrafiltration of Eop Filtrate (Doug Reid)	Doug Reid	EKA		Fall	2001	Halsey OR
Filtrate	Recycle		Bleach Plant Filtrate Recycle	Bleach Plant Filtrate Recycle (Jean Bouchard)	Jean Bouchard	FPInnovations		Fall	2001	Halsey OR
Eop Stage	Peroxide	Celgar	Split Peroxide Addition in Eop at Celgar Pulp	Split Peroxide Addition in Eop at Celgar Pulp		Zellstoff	Celgar BC	Spring	2001	Marathon ON
Eop Stage	Squamish		Pressurized Eop at Western Pulp, Squamish	Pressurized Eop at Western Pulp, Squamish	Jim Oei	Western Pulp	Squamish BC	Spring	2001	Marathon ON
Eop Stage	Powell River		Conductivity Control on Eop Stage at Powell River	Conductivity Control on Eop Stage at Powell River		Catalyst	Powell River BC	Spring	2001	Marathon ON
Peracetic Acid	Peroxide Catalyzed		Developments with Peracetic Acid and Catalysed Peroxide	Developments with Peracetic Acid and Catalysed Peroxide	Ross Anderson	Kemira		Spring	2001	Marathon ON
Oxygen Stage	Crofton		Double Oxygen Stage at Second Bleaching Stage at Crofton	Double Oxygen Stage at Second Bleaching Stage at Crofton		Catalyst	Crofton BC	Spring	2001	Marathon ON
MeOH	Safety		MeOH Safety Presentation	MeOH Safety Presentation	Steve Schaffer	Vopak		Spring	2001	Marathon ON
Ozone Stage			Ozone in the Last Bleaching Stages	Ozone in the Last Bleaching Stages	Gord Homer	Air Liquide		Spring	2001	Marathon ON
Calcium Carbonate	Scaling		Calcium Carbonate Scaling	Calcium Carbonate Scaling (Chris Ho)	Chris Ho	Praxair		Spring	2001	Marathon ON
MgSO4	O2 Delignification	Eop Stage	MgSO4 in O2 Delig, Eo & Eop Stages	MgSO4 in O2 Delig, Eo & Eop Stages (Chris Ho)	Chris Ho	Praxair		Spring	2001	Marathon ON
MgSO4	Survey		MgSO4 Application Survey Results	webpage				Spring	2001	Marathon ON
MgSO5	Survey		MgSO4 Application Survey Results	spreadsheet				Spring	2001	Marathon ON
MgSO4	Eop Stage		MgSO4 in Eop	MgSO4 in Eop (M. Gavriliu, National Silicates)	M. Gavriliu	National Silicates		Spring	2001	Marathon ON
Kappa Factor	Compensation	Canfor	Compensated KF Control at Canfor	paper	Doug Prkye Rob Laurend	Canfor	Prince George BC	Fall	2000	Prince George BC
Kappa Factor	Compensation	Canfor	Compensated KF Control at Canfor	slides	Doug Prkye Rob Laurendeau		Prince George BC	Fall	2000	Prince George BC
pH	Control		pH Control	pH Control	Laurier Morissette	Texo		Fall	2000	Prince George BC
CO2	Use	Canfor	CO2 Use at Canfor	paper	Jeff Bennett	Canfor	Prince George BC	Fall	2000	Prince George BC
CO2	Use	Canfor	CO2 Use at Canfor	slides	Jeff Bennett	Canfor	Prince George BC	Fall	2000	Prince George BC
Costs	Monitoring	Canfor	BP Cost Monitoring at Canfor	BP Cost Monitoring at Canfor	Jeff Bennett	Canfor		Fall	2000	Prince George BC
Bleaching	Strategies	Irving	Bleaching Strategies at Irving	Bleaching Strategies at Irving	Don McCabe	Irving P&P	Saint-John NB	Fall	2000	Prince George BC
OX	Control	Europe	Controlling OX in Europe	Controlling OX in Europe	Dan Davies	Evonik		Fall	2000	Prince George BC
Organochlorine	Peroxide		Organochlorine in Pulp - Role of H2O2	Organochlorine in Pulp - Role of H2O2	Dave Willis			Fall	2000	Prince George BC
Organochlorine	Peroxide		Effect of Using Peroxide in Bleaching on Organochlorine Content in Pulp	Effect of Using Peroxide in Bleaching on Organochlorine Content in Pulp	Jeff Tolan			Fall	2000	Prince George BC
Organochlorine	Bleached Kraft Pulp		Organochlorine in Bleached Kraft Pulp	Organochlorine in Bleached Kraft Pulp	Ross Anderson	Kemira		Fall	2000	Prince George BC
Scaling	Bleach Plant	Introduction	Introduction to Bleach Plant Scaling	Introduction to Bleach Plant Scaling	Irene Yaraskavitch	Dow		Fall	2000	Prince George BC
Calcium Oxalate	Scaling		Calcium Oxalate Scaling	Calcium Oxalate Scaling	Stan Heimburger	ATO Fina		Fall	2000	Prince George BC
Scaling	Survey		Scaling Survey	Scaling Survey	Jim Oei	Western Pulp	Squamish BC	Fall	2000	Prince George BC
Scaling	Celgar		Celgar's Scaling Experiences	Celgar's Scaling Experiences	Ralph Lunn	Zellstoff	Celgar BC	Fall	2000	Prince George BC
Scaling	Grand Prairie		Scaling Issues at Weyerhaeuser, Grand Prairie	Scaling Issues at Weyerhaeuser, Grand Prairie	Tina Larson	Weyerhaeuser	Grande Prairie BC	Fall	2000	Prince George BC
H2O2	Safety		H2O2 Safety Seminar	H2O2 Safety Seminar	Stan Heimburger	ATO Fina		Fall	2000	Prince George BC
MgSO4	Survey		MgSO4 Survey	MgSO4 Survey	Chris Ho	Praxair		Fall	2000	Prince George BC
MgSO5	Survey		Comments on MgSO4 Survey	Comments on MgSO4 Survey	Chris Ho	Praxair		Fall	2000	Prince George BC
Consistency	Measurement		Consistency Measurement	Consistency Measurement	Ralph Lunn	Zellstoff	Celgar BC	Fall	2000	Prince George BC
Consistency	Measurement	Devices	Consistency Measurement Devices	Consistency Measurement Devices	Don McCabe	Irving P&P	Saint-John NB	Fall	2000	Prince George BC
Bleaching	Costs		Bleaching Sequences Cost Estimates	Bleaching Sequences Cost Estimates				Spring	2000	Halifax NS
Yield	Model		Yield Model Presentation	Yield Model Presentation	Gord Homer	Air Liquide		Spring	2000	Halifax NS
MgSO4	Survey		MgSO4 Survey - Interim Report	MgSO4 Survey - Interim Report	Chris Ho	Praxair		Spring	2000	Halifax NS
BaSO4	Scale		Controlling BaSO4 Scale	Controlling BaSO4 Scale	Doug Reid	EKA		Spring	2000	Halifax NS
Grand Prairie	Mill		Weyerhaeuser, Grand Prairie	Weyerhaeuser, Grand Prairie	Tina Larson	Weyerhaeuser	Grande Prairie BC	Fall	1999	Espanola ON
Irving	Mill		Irving Pulp & Paper	Irving Pulp & Paper	Don McCabe	Irving P&P	Saint-John NB	Fall	1999	Espanola ON
Powell River	Mill		Pacifica Papers	Pacifica Papers	Paul Herar			Fall	1999	Espanola ON
Environment	Improvements	Espanola	Domtar Inc., Espanola	Environmental Improvements at Eddy	Sekar Chandrasekara	Domtar	Espanola ON	Fall	1999	Espanola ON
TOX	Maple Grade	Espanola	Domtar Inc., Espanola	TOX - Maple Grade	Sekar Chandrasekara	Domtar	Espanola ON	Fall	1999	Espanola ON
Extractives		Espanola	Domtar Inc., Espanola	Pulp DCM Extractives	Sekar Chandrasekara	Domtar	Espanola ON	Fall	1999	Espanola ON
Chloroform	Phenolics	Espanola	Domtar Inc., Espanola	Phenolics/Choroform	Sekar Chandrasekara	Domtar	Espanola ON	Fall	1999	Espanola ON
AOX Data		Espanola	Domtar Inc., Espanola	AOX Data	Sekar Chandrasekara	Domtar	Espanola ON	Fall	1999	Espanola ON
O2	Safety		O2 Safety Seminar - Air Products	O2 Safety Seminar - Air Products		Air Products		Fall	1999	Espanola ON
Scrubber	Survey		Bleach Plant Scrubber Survey Result	Bleach Plant Scrubber Survey Result	Dennis Owen			Fall	1999	Espanola ON
ECF Survey HWD	Survey	HWD	ECF Survey - HWD raw data	ECF Survey - HWD raw data				Spring	1999	Grande Prairie AB
ECF Survey SWD	Survey	SWD	ECF Survey - SWD raw data	ECF Survey - SWD raw data				Spring	1999	Grande Prairie AB
ECF Survey HWD	Survey	HWD	ECF Survey - HWD report	ECF Survey - HWD report				Spring	1999	Grande Prairie AB
ECF Survey SWD	Survey	SWD	ECF Survey - SWD report	ECF Survey - SWD report				Spring	1999	Grande Prairie AB
ECF Survey HWD	Survey	HWD	ECF Survey - Table Comparing HWD O2 and Conventional Bleach Plants	ECF Survey - Table Comparing HWD O2 and Conventional Bleach Plants				Spring	1999	Grande Prairie AB
ECF Survey SWD	Survey	SWD	ECF Survey - SWD Best Practices Table	ECF Survey - SWD Best Practices Table				Spring	1999	Grande Prairie AB
ECF Survey HWD	Survey	HWD	ECF Survey - HWD Presentation	ECF Survey - HWD Presentation				Spring	1999	Grande Prairie AB
ECF Survey SWD	Survey	SWD	ECF Survey - SWD Presentation	ECF Survey - SWD Presentation				Spring	1999	Grande Prairie AB
Brown Stock	Filtrate	Characterization	Brown Stock Filtrate Characterization	Brown Stock Filtrate Characterization		Pope & Talbot	Halsey OR	Spring	1999	Grande Prairie AB
Brown Stock	Filtrate	Characterization	Graphs for Brown Stock Filtrate Characterization	Graphs for Brown Stock Filtrate Characterization				Spring	1999	Grande Prairie AB
Washer	Survey		CPPA Washer Survey	CPPA Washer Survey	Doug Reid	EKA		Spring	1999	Grande Prairie AB
Extraction Stage	High Temperature		High Temperature Extraction Presentation	High Temperature Extraction Presentation	Barbara van Lierop	FPInnovations		Fall	1998	Pointe-Claire QC
ClO2	Generation	Standards of Operation	SOP for ClO2	SOP for ClO2				Fall	1998	Pointe-Claire QC
ClO2	High Temperature	Safety	High Temperature ClO2 Safety Considerations	High Temperature ClO2 Safety Considerations				Fall	1998	Pointe-Claire QC

ClO2	Generator	Survey Report	ClO2 Generator Survey Report	ClO2 Generator Survey Report				Fall	1998	Pointe-Claire QC
ClO2	Generator	Survey Data	ClO2 Generator Survey Report	ClO2 Generator Survey Data				Fall	1998	Pointe-Claire QC
ClO2	Generator	Survey Blank Form	ClO2 Generator Survey Report	ClO2 Generator Survey - Blank Form				Fall	1998	Pointe-Claire QC
O2	Handling	Safety		Bulk O2 Safe Handling				Fall	1998	Pointe-Claire QC
ClO2	Handling	Safety		ClO2 Safe Handling				Fall	1998	Pointe-Claire QC
Pulp	Strength	Bleaching	Bleaching & Pulp Strength		Reid & Libergott			Spring	1998	Kamloops BC
O2 Delignification	Pulp Strength	Harmac	Impact of Mini O2 Delignification System on Pulp Quality at Harmac		Murray Walter	Pope & Talbot	Harmac	Fall	1997	Saint John NB
Pulp	Strength	Cooking/Bleaching	What Pulp Strength Is and How Cooking/Bleaching/Mill Closure		Norm Liebergott			Fall	1997	Saint John NB
Pulp	Quality	Process Changes	Impact of Recent Process Changes on Pulp Quality		D. Embley			Fall	1997	Saint John NB
Pulp	Quality	Cooking/Bleaching	Impact of Pulping/Bleaching Technologies on Pulp Quality					Fall	1997	Saint John NB
Corrosion								Spring	1997	Boyle AB
Kappa Factor	Bleaching							Spring	1997	Boyle AB
Methanol Handling	Handling							Spring	1997	Boyle AB
								Fall	1997	Asheville NC

E1 Caustic Optimization
Somerset R&D
(rip off and duplicate)

Current Brown Stock Configuration



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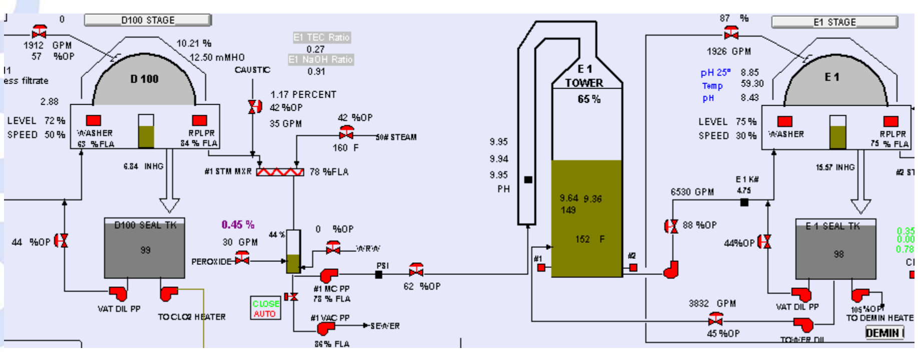

- Somerset runs a 5-stage bleach plant: D Ep D Ep D
- Approximately 1700 TPD Kraft CoPulp bleached to 88.7% ISO
- Total Bleach Plant residence time is approximately 5 hours at normal rate
- Shower water for the E1 washer is 100% D1 filtrate, D100 shower water is a combination of warm raw water sources, pulp machine white water, & a few hundred gallons of D2 excess filtrate

4 | PAPTAC Spring 2015 sappi

What are the chances?

- Required to perform a Lean Six Sigma project in my area
- Bleaching costs were rising and were under extreme scrutiny
- I was full of knowledge from attending the PAPTAC Bleaching committee meeting in New Bern

- Why not pick a project that I know can be completed successfully and on time…

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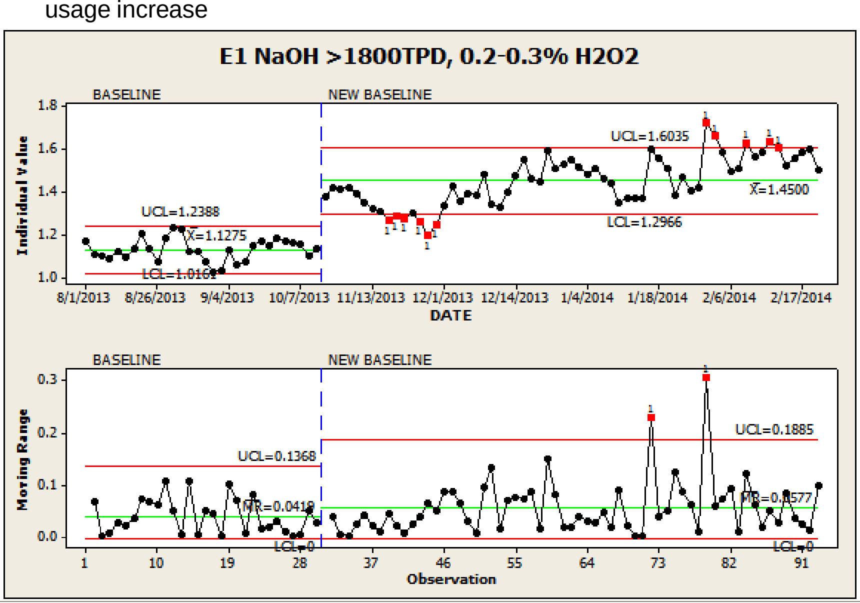
- Effect of washing efficiency and carryover shown in signification chemical usage increase



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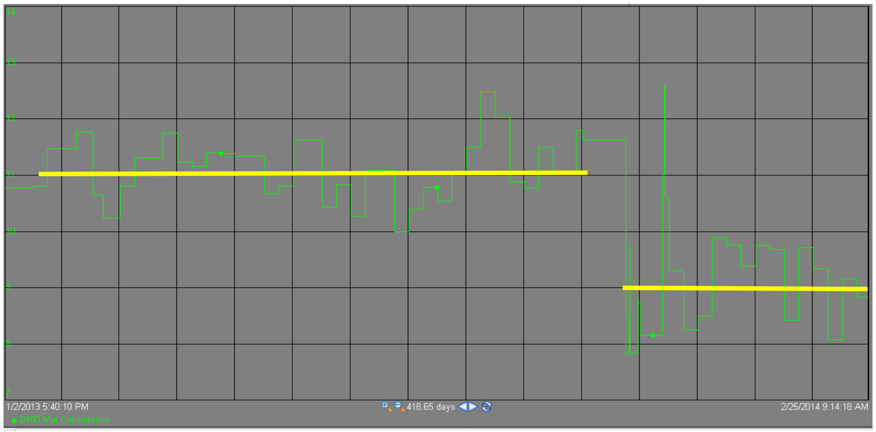

- It is shown clearly the drop in D100 washer discharge consistency from 11% down to 9%
- Operationally it was difficult to run the drum without sealing over
- Operators had to compensate by running extremely low drum speeds which resulted in thick wet mats
- With all the extra D100 filtrate, and the control scheme we were using for E1 caustic, usage skyrocketed

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- Since some baseline data had already been collected for the Lean Six Sigma project to “Optimize E1 NaOH usage” we were able to lower our caustic usage and start running to a lab sample of “Tower pH”
- This immediately dropped the stage pH by 0.5 as we targeted 10pH in the tower, where we had been targeting 10pH in the vat
- There was no increase in ClO2 usage in any stage
- We continued to run to the 10pH in the tower until taking a department shut down to have maintenance evaluate the washer.
- The center valve was found to be the issue and was replaced.

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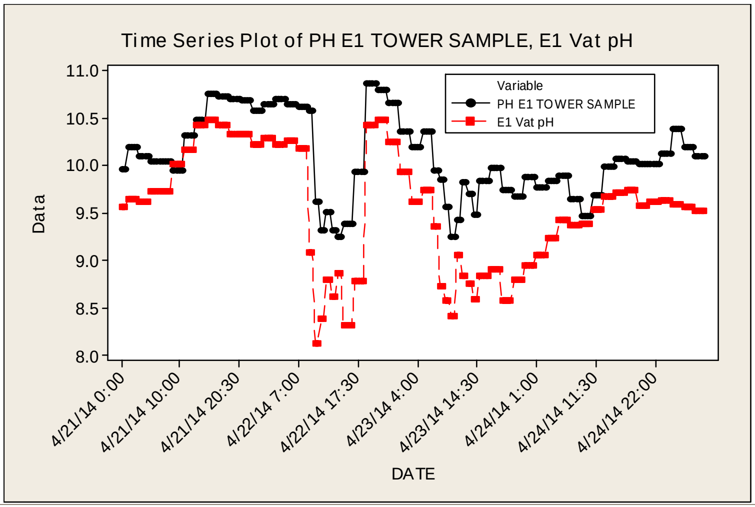
Not only were we dealing with the temperature issue, but a sampling location issue complicated by countercurrent washing. A vat sample is STANDARD sample location for vacuum drum washers, direct countercurrent washing is not. This study shows the difference in measurement locations.



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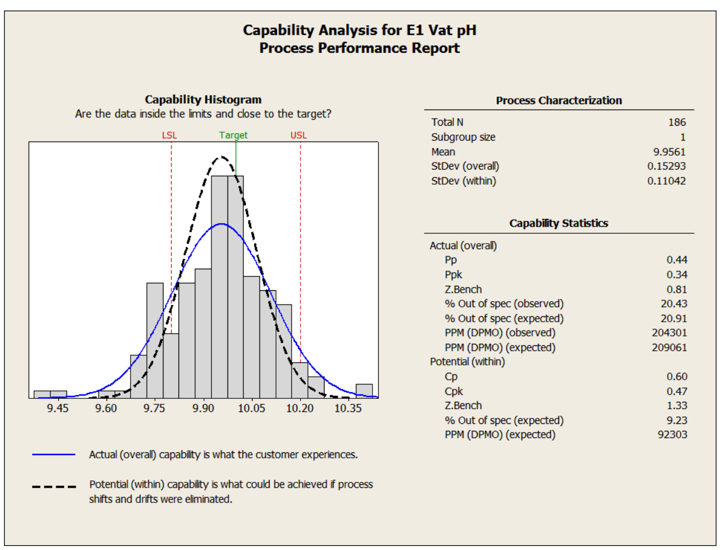
Process Normality



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Doesn't a pH meter already have a temperature compensation?
Yes – and…

Research shows that alkaline samples are severely affected by the temperature at which they are measured

Old news to PAPTAC…new news to our E&I folks and Operations folks at the Mill

DISSOCIATION CONSTANT

Note that pH is defined as the negative logarithm of the hydrogen ion concentration. The hydrogen ion concentration also obeys the following equilibrium relationship for pure water:

$$Kw = [OH^-][H^+] \quad (2)$$

Where:

- Kw = Dissociation constant of water;
- $[OH^-]$ = Hydroxide ion concentration (mol/L); and
- $[H^+]$ = Hydrogen ion concentration (mol/L)

An important fact is that the dissociation constant, Kw, is not really a constant. It varies with temperature so the hydroxide ion concentration, hydrogen ion concentration, and pH also vary with temperature. The effect on pH is large for alkaline solutions because the hydrogen ion concentration is low to start with, and negligible for acidic solutions because the hydrogen ion concentration is high to start with, Table I. Kw increases by a factor of 37 between 25°C and 90°C.

We emphasize that this behaviour has nothing to do with the pH meter. Water molecules are actually breaking apart to form OH^- and H^+ as the temperature increases so the actual pH of the solution is changing. Since this is an equilibrium reaction, the water molecules will re-form as the temperature decreases.

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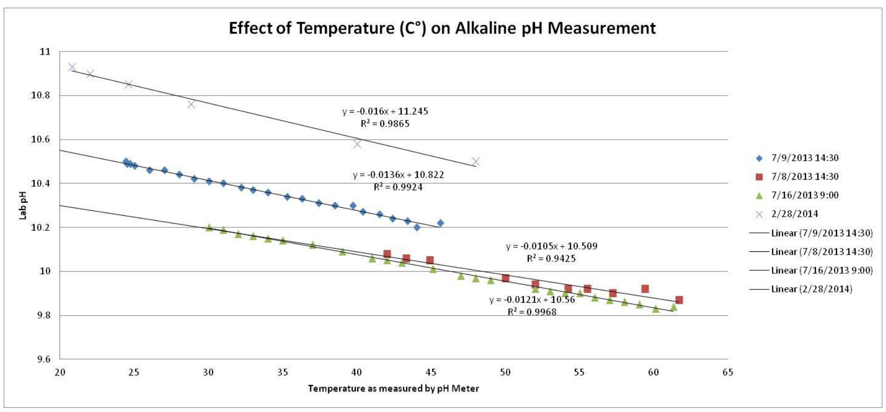

- The effect of cooling on Alkaline pH measurement has been documented (ref. Reid and Morissette) and proven at Somerset
- A study here shows that an average slope of ~ 0.012 can be used to calculate a 25C° corrected pH
- With a dual output probe, this can be automatically compensated

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The difference between 10.5 and 10.0 in the tower has been estimated to save 0.2% Applied of NaOH with no detrimental effect to D1 ClO2 usage.

Due to the upsets during several of the trial phases we should repeat the 9.8 target for a longer period of time to fully understand the effect on D1 ClO2 usage.

Example:

D100 conditions constant, E1 ...), and Production rate constant:

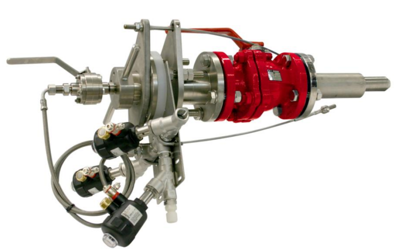
- Target 9.5 at the E1 tower
- Target 10.0 at the E1 towe
- Return to 9.5 for 2 days
- Return to 10.0 for 2 days.

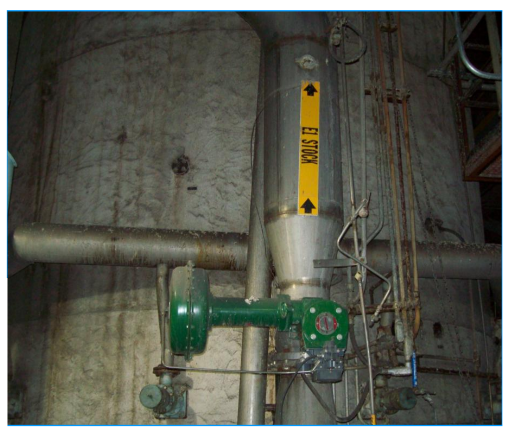
If 9.5 appears to be a viable ... week to evaluate normal incoming K# variability.

Even though we measured a trace ... of 'low' pH we still need to evaluate a sustained period of time at a lower E1 stage pH. We did not see any evidence of 'falling off the cliff" where we reached such a low alkalinity that the oxidized lignin was insoluble.

Install a filtrate extractor:

- BTG FXS1300 Filtrate Extractor to be installed at E1 and E2 above the Tower Dilution header
- Provides a 'true' end of stage pH that does not have countercurrent dilution influence





- To be installed in October 2014
- Will provide pH and temperature results

•Filtrate extractor installed 5 feet above the tower dilution nozzles

•VCU, pH probe pot, and sample point located at the base of the tower with the filtrate piped into the nearby sewer

•Endress Hauser dual-output pH and temperature probe

•Extractors installed into E1 and E2 tower *October* 2014

•E&I support available to set them up and complete associated piping work in *February* 2015

•Data available and on Honeywell graphics *March* 2015

•Trial work ongoing *April* 2015

Summary:

•No issues with installation or runnability.

•Extractor has not plugged since going on-line.

•Longer life out of pH probes as they are in a much gentler environment

•Trial work continuing

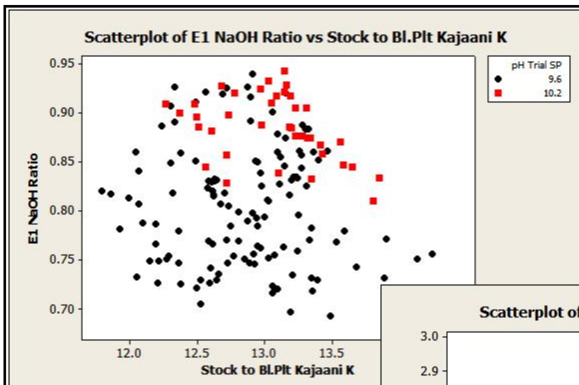
The slow march - How low can you go?

Start
- 10.0 Vat pH target (~10.5 tower)
- Lab Testing every 2hrs

- 10.0 Tower pH target
- Lab Testing every 2hrs

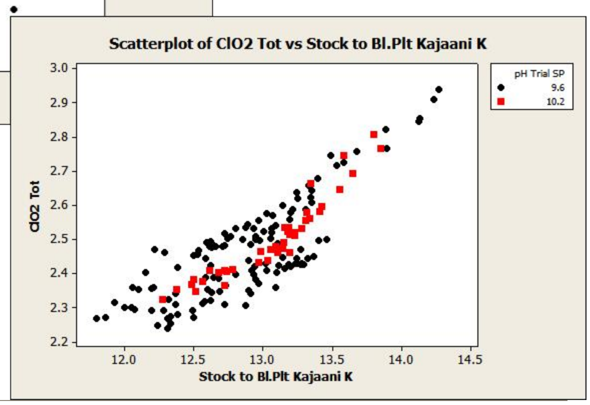
End?
- 9.6 'hot' Tower (10pH @ 25C)
- Filtrate extractor

sappi



•Encouraging that the E1 caustic ratio drops from 0.9 to 0.8 while total ClO2 to K# relationship is unchanged

- We have not yet found the 'the cliff' where back end bleaching takes a hit



sappi

What Next?

- Complete the trial work – including a determination of how low we can go with the E1 and E2 tower pH before we see detrimental effects

- Determine which control method provides the most stable operation

- Compare the longevity of the pH probes in the sample pot to those in the upflow tubes? Are there other application points where we could use filtrate extractors?

IRVING PULP & PAPER
LOCKOUT INFORMATION
PAPTAC BLEACHING COMMITTEE
SPRING MEETING 2015 MONTREAL, CANADA
JOHN GILLESPIE

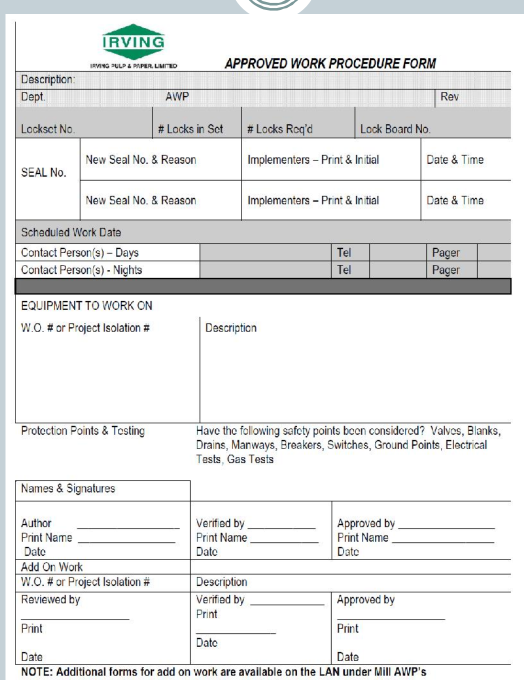
Overview of LOTO Policy

- SAF-1 governs how lockouts are to be completed
  - Personal lockout
  - Approved Work Procedures
  - Special Lockout Procedures
- 4 Levels of training within SAF-1
- Personal locks are issued through security

Lockout System

- Two qualified field operators are responsible for developing the lockouts (Approved Work Procedures -AWP) an author and a verifier.
- Supervisors or Superintendents are the final check off to allow the AWP to be implemented.
- Two qualified field operators implement the lockout.
- Locks are removed by at least one qualified field operator.

AWP Form – Page 1


IRVING
IRVING PULP & PAPER, LIMITED

APPROVED WORK PROCEDURE FORM

Description:

Dept. | AWP | Rev

Lockset No. | # Locks in Set | # Locks Req'd | Lock Board No.

SEAL No. | New Seal No. & Reason | Implementers – Print & Initial | Date & Time
 | New Seal No. & Reason | Implementers – Print & Initial | Date & Time

Scheduled Work Date

Contact Person(s) – Days | | Tel | | Pager
Contact Person(s) - Nights | | Tel | | Pager

EQUIPMENT TO WORK ON

W.O. # or Project Isolation # | Description

Protection Points & Testing | Have the following safety points been considered? Valves, Blanks, Drains, Manways, Breakers, Switches, Ground Points, Electrical Tests, Gas Tests

Names & Signatures

Author ____________ Print Name ____________ Date | Verified by ____________ Print Name ____________ Date | Approved by ____________ Print Name ____________ Date

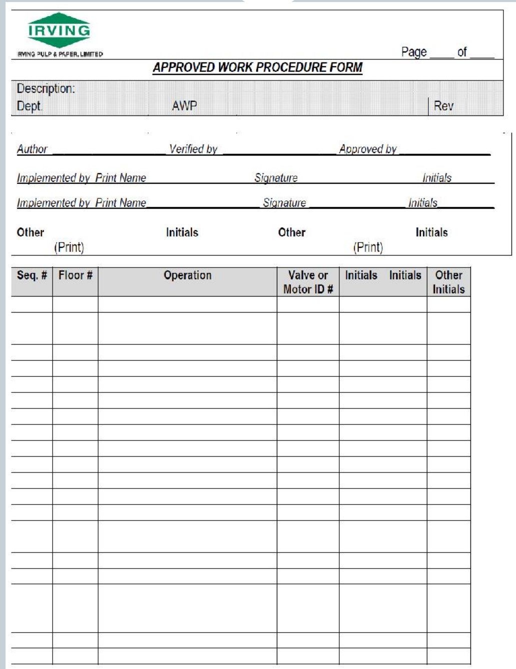
Add On Work

W.O. # or Project Isolation # | Description

Reviewed by ____________ Print Date | Verified by ____________ Print ____________ Date | Approved by ____________ Print Date

NOTE: Additional forms for add on work are available on the LAN under Mill AWP's

AWP Form – Page 2



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Page ____ of ____

APPROVED WORK PROCEDURE FORM

Description:

Dept AWP Rev

Author ____ Verified by ____ Approved by ____

Implemented by Print Name ____ Signature ____ Initials ____

Implemented by Print Name ____ Signature ____ Initials ____

Other (Print) Initials Other (Print) Initials

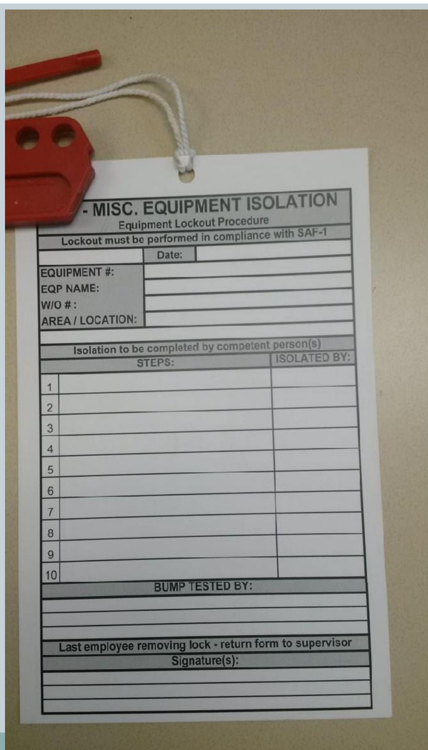
Seq. #	Floor #	Operation	Valve or Motor ID #	Initials	Initials	Other Initials

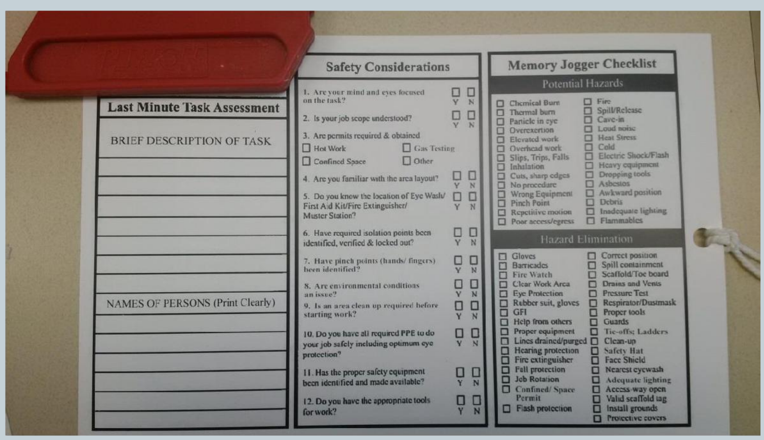
Lockout Boards

Personal Locks

- Personal lock system requires a tag to be filled out including the work being done and the locks to be applied in consultation with an operator for simpler systems. The operator does the non motor isolations, an electrician assists with the motor isolations and whoever is doing the work places their locks appropriately.

Personal Lock Tags





Safegaurds/Checks and balances

- Author and verifier are to independently develop the AWP and then they come together to discuss any differences.
- Supervisor does a final paperwork check.
- Two implementers to verify that each step is complete. Space for sign off of other personal as required (i.e.: Electrician)
- Protocol for motor bumps. Field bump motor by entity. Take power off. Field bump again. Verify no movement.
- AWPs are only valid for 45 days

Bleach Plant Practices

- How to handle wire changes
  - Handled through the normal AWP process
- How to handle access to repulper
  - Any time that someone's face "breaks the plane" then it must be treated as a Confined Space otherwise it is done under personal locks or an AWP.
- Other specifics?
  - AWPs and Personal Locks cannot be combined
    - Cannot use an AWP then add a lock to do another job.

Summary of Best Practices

- Use Personal lockout whenever possible
  - Tradesman and operator can see/verify what's been locked out
- Two competent employees develop/implement AWP's
- Each lock set has a unique key that only the employee has excess to
  - Procedure in place to deal with locks left on
- Lockouts to be maintained by department locks at shift end

Summary of Opportunity

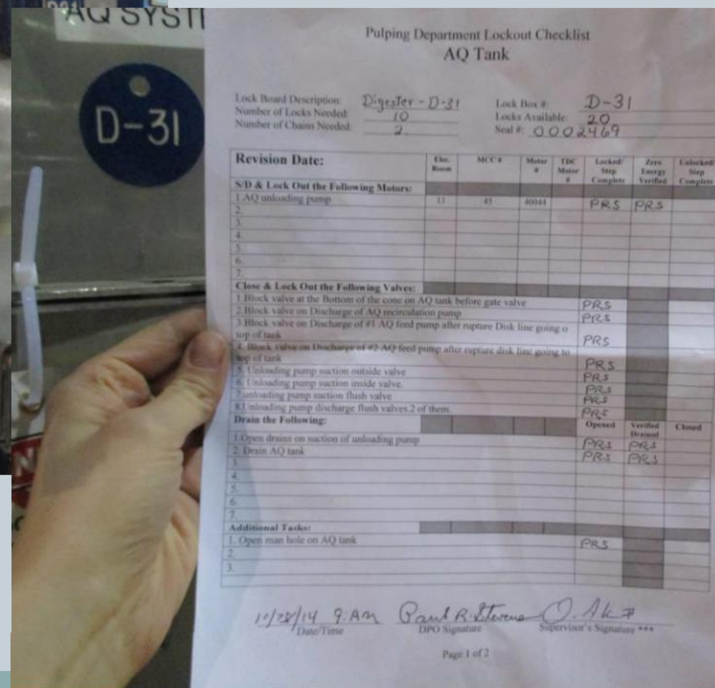
SAPPI FINE PAPER NORTH AMERICA
LOCKOUT INFORMATION FOR PULP MILL
PAPTAC BLEACHING COMMITTEE
SPRING MEETING 2015 MONTREAL, CANADA
JESSICA PAUL

Sappi Somerset Mill Overview

- Somerset is a USW facility, the lead Pulp Operator typically performs the day to day lockouts (during a shutdown, all qualified Operators perform area lockouts)
  - Perform lockout procedure based on lockout sheet
- Management's role is to validate that the lockbox is in order
  - Paperwork is complete
  - Key in the box
  - Seal and Operators' lock on the box
  - Sign the lockout to show it is ready for Maintenance

Sappi Somerset Program Features

- Lockout checklists are maintained in our ISO system
  - Any changes, errors, corrections must be updated and kept as the sole electronic copy for Operators to download and use
- Supervisor must sign-off on any checklist with 3 locks or more
  - Helps to find errors in paperwork, a line item not signed, Operator forgetting to put the key in the lockbox, etc.
- Lockbox Addendum sheets are bright orange and signal a review of anybody locking on that box
  - Allows for explanation of an addition or deletion, or special instruction on that box, all must read and sign before putting their personal lock on the box



Sappi Somerset Best Practices / Opportunities

- Uncoupling the repulper for wire changes, lip seal installations, doctor blade setting
- Security guards (under our Safety department) perform Lockboard audits during major shutdowns to ensure policy is being followed
- Have contractors speak directly to Operators to determine which lockout to use
  - We do not post a list of WO# and corresponding lockboxes, this was done in past practice and can lead to locking out on the wrong box.
- The plastic seal maintains integrity of the lockbox, shift to shift, etc.

Opportunity

- There is no double-check that the correct valves/motors/pumps were locked out
- New installations/connections *should* get caught in the MOC system if they effect the lockout of an existing system
- Using descriptions versus unique identifying tags
- Tradespeople on the wrong lockbox during an outage

VERSO CORPORATION – QUINNESEC MILL
LOCKOUT INFORMATION FOR PULP MILL
PAPTAC BLEACHING COMMITTEE
SPRING MEETING 2015 MONTREAL, CANADA
BRIAN LA BRASH

Lockout System in Pulp Mill

- Broken down into major areas in Fiberline and sub areas (Ex. Bleach Plant, Do stage, Stage equip, drive)
- Each sub area has a full lockout pre-defined. Frequent smaller lockouts in these areas are also pre-defined and referred to as subsets. (washer entry)
- Non-typical lockouts can be custom generated, but most commonly are built off an existing lockout and modified to fit the job(s).

Lockout System in Pulp Mill

- Two **certified** operators review and modify lockout sheets prior to use.
- A **certified** operator places locks in the field and documents lock number on the lockout sheets.
- Operators lockout 480V breakers, E&I's handle the higher voltage as well as any breakers with known issues. (Operators still place the lock though)
- A **certified** operator removes locks in the field and documents this on the lockout sheets

Lockout Sheets

- General information to be filled in: lockout start date, names of 2 operators preparing lockout sheet, name of Operator(s) locking out the equipment
- All jobs are listed on front page of lockout sheet
- Jobs are identified as IES, if not they are ZES
- Hazardous energy source section (pre-populated) with place for special hazards to be written in
- Special instruction/procedures section
- Lockout sections include lockout initialed, lock#, bump test status, unlock initialed
  - Electrical lockout section
  - Mechanical lockout section
- Editing history section at end

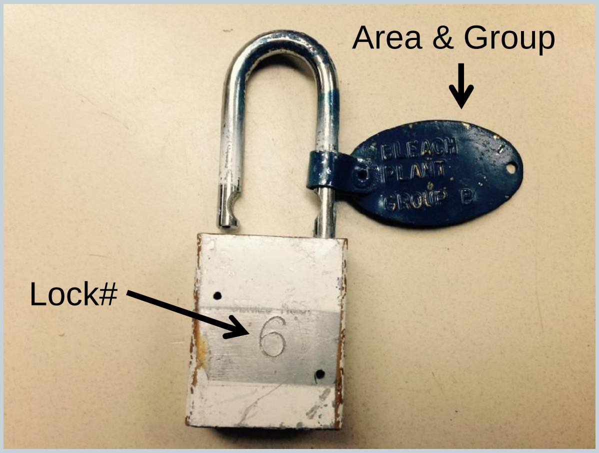
Lock Storage Boards

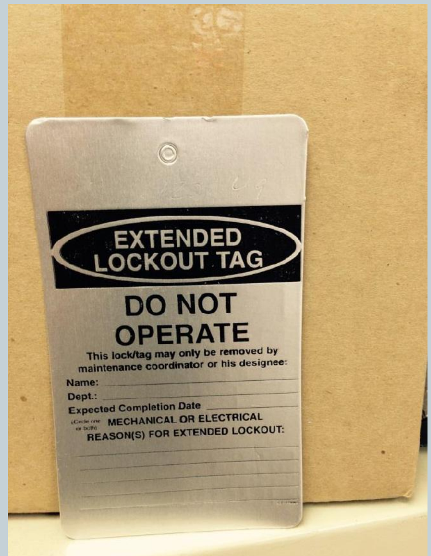
- Section for each major area in Fiberline
- Major areas broken down as needed
- Locks are colored, tagged by group, and numbered
- Opened by a single key for the appropriate lock box for the area/sub-area
- Located adjacent to Lockout Room

Locks

Used for breakers and valves

Used temporarily until an extended lock can be installed



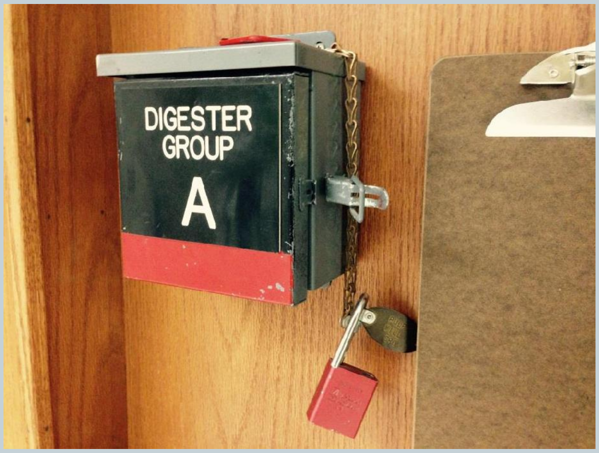


Lockout Boxes - Fiberline

Area Lock Boxes

Box & Lockout Sheets for Box

Lockout Boxes - Fiberline

Individual Box	NOTES
	• Each area has its own box(s). Washer drives in an area have their own box. • Separate extended lock box. Key controlled by Maintenance Coordinator • Dedicated lock and key for each box

Explain features of your program

- Safeguards
  - Area lockout sheets have been built and verified
  - Two certified Operators review lockout sheets with jobs to be done to identify the scope of the lockout
  - Certified Operators conduct the lockout / lock-in
  - Lock numbers recorded on lockout sheets identifying location of lock in relation to valves/breakers
- Checks and balances
  - Random audits of lockouts by supervisors
  - Lockout Coordinators for major outages – days & nights
  - Contractors/Maintenance check in with Operators/Lockout Coordinator on where to lockout

Bleach Plant Practices

- How to handle wire changes
  - Only lockout item that changes from normal washer lockout is that the drive lockout changes to allow for local jogging via a switch at the washer run by dead man switch.
  - Confined space entry
- How to handle access to repulper
  - E&I's verify that the disconnect on the breaker is in the open position by opening cabinet, otherwise a normal full lockout for the washer mechanically and electrically
- Other Bleach Plant specifics
  - Hot water system has to be unlocked to shrink wires if hot water system is not already unlocked. Requires coordination of jobs.
  - Bump tests of new equip, etc. requires coordination to temporarily remove locks

Summary of Best Practices

- Random lockout audits performed by Managers/Supervisors
- Use of Lockout Coordinators
  - All jobs planned prior to outage have been reviewed by Lockout Coordinator and lockout sheets have been printed and verified.
  - All jobs are run through the area Lockout Coordinator. Any changes have to get Lockout Coordinator approval.
- Breaker locations in MCC's shown on DCS for each motor. Example FL 207 MCC 70-R3C

Summary of Opportunity

- Bump starts are not field verified, just on DCS
- Valves not numbered / labeled in field

Respirator Types & Selection

Spring 2015 PAPTAC Bleaching Committee Meeting

Presented by:
Doug Reid, Sr. Process Engineer
May 5, 2015

AkzoNobel

Introduction

- This presentation deals with protection from gases and mists associated with bleaching chemicals
  - Does not deal with oxygen-deficient atmospheres, confined spaces, protection from dust, particulates, asbestos, etc.
- Many types of respirators available
- Many agencies involved in:
  - Recommending (i.e. NIOSH)
  - Regulating (WCB / WorkSafe BC, OSHA)
- Always comply with all applicable local rules and regulations

APF Ratings

- Respirators are rated by their Assigned Protection Factor (APF)
  - Higher APF indicates better protection
  - Range from 5 to 10,000
  - APF rankings are generally similar across different regions

Types of Respirators

Cartridge Respirator (APF = 5-10)

- Normally used for escape purposes
- Purifies air using cartridges that are made to filter specific contaminants
- Be sure that the cartridge installed is made to remove the expected contaminants
- Effective for short exposures
- Cartridges should be replaced after use (i.e. exposure to the contaminant).

Types of Respirators

Full Facepiece Cartridge Respirator (APF = 50)

- Similar to cartridge respirators on previous slide but provides better respiratory protection.
- Also protects the eyes from irritating gases

Types of Respirators

Full Facepiece Canister Gas Mask (APF = 50)

- Essentially the same as a full face piece cartridge respirator
- Only difference is that the canister may be bigger than the cartridge therefore allowing for longer exposure before the filter medium is exhausted.

Types of Respirators

Powered Air Purifying Respirator (APF = 50)

- Seldom, if ever, used in pulp mills
- Use a motor to draw air past the filter media.
- Easier to breathe through than canister respirators
- BUT - more complicated, require batteries, and require more maintenance
- Be sure that the cartridge installed is made to remove the expected contaminants

7

Types of Respirators

Full Facepiece Type C Supplied Air Respirator (SAR) (APF = 1,000 in pressure-demand or continuous flow mode)

- Also called an “airline” respirator
- Seldom, if ever, used in pulp mills
- Compressed air is supplied through a long hose to a mask worn by the worker
- Not suitable for emergencies, entry into unknown atmospheres, concentrations above IDLH (immediately dangerous to life or health), or firefighting
- APF falls to 50 if it is used in demand (negative pressure) mode because contaminants will leak into the mask

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Types of Respirators

Full Facepiece Type C Supplied Air Respirator with Auxiliary SCBA
(APF = 10,000 in pressure-demand or continuous flow modes)

- Seldom, if ever, used in pulp mills
- Combines a Type C SAR with a small air tank (SCBA) for escape
- Suitable for emergencies, entry into unknown atmospheres, and concentrations above IDLH (in pressure demand and continuous mode)
  - Not suitable for firefighting.

9

Types of Respirators

Self Contained Breathing Apparatus (SCBA)
(APF = 10,000 in pressure-demand or continuous flow modes)

- Commonly used in pulp mills when personnel respond to gas leaks
- Provide compressed air from a tank carried by the wearer
- Suitable for all situations including emergencies, entry into unknown atmospheres, concentrations above IDLH, and firefighting (in pressure-demand or continuous flow modes).

10

Table of APF's

Respiratory Type	Protection Factor
Air-purifying Respirators	
Non-powered air-purifying	
Half-facepiece—filtering facepiece style (NIOSH TC-21C-XXX type)	5
Half-facepiece—filtering facepiece style (NIOSH TC-84A-XXX type)	10
Half-facepiece—elastomeric facepiece style	10
Full-facepiece	50
Powered air-purifying	
Loose-fitting facepiece PAPR	25
Half-facepiece PAPR	50
Full-facepiece PAPR equipped with "100" (HEPA) filters for exposure to asbestos	100
Full-facepiece PAPR or helmet/hood PAPR for exposure to contaminants other than asbestos	1,000
Air-supplying Respirators	
Airline-demand (negative-pressure)	
Half-facepiece	10
Full-facepiece	50
Airline-continuous flow	
Loose-fitting facepiece	25
Half-facepiece	50
Full-facepiece	1,000
Helmet / hood	1,000
Airline-pressure demand (positive-pressure)	
Half-facepiece	50
Full-facepiece	1,000
Full-facepiece with egress (escape) bottle	10,000
Self-contained breathing apparatus (SCBA)	
Demand (negative-pressure)	50
Pressure-demand (positive-pressure)	10,000

Note: Protection factors do not apply to escape respirators.

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Four Situations That Require a Respirator

1. Emergency escape from a hazardous atmosphere
2. Firefighting in a hazardous atmosphere
3. Entering/working in a hazardous atmosphere:
   a) in an emergency OR
   b) when there are unknown concentrations of hazardous substances OR
   c) concentrations above IDLH (Immediately Dangerous to Life and Health)
4. Entering/working in a hazardous atmosphere when the concentration is known and below the IDLH

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Emergency Escape

- Guidance leaves room for interpretation
- A typical statement comes from the Workers Compensation Board of British Columbia:

1. If the nature or quantity of an air contaminant and the nature of the work area could prevent a worker escaping from a contaminated area without assistance, the worker must carry an emergency escape respirator

2. The emergency escape respirator must be
   a) carried on the worker's person or be within arm's reach at all times, and
   b) sufficient to permit the worker to leave the contaminated area without assistance

- Most pulp mills have decided on a bite-block or half facepiece cartridge respirator.
  - Advantages: small size, ease of use, readily available cartridges, and low cost.
  - Full facepiece canister respirators offer eye protection and longer protection time, however, their size may make them impractical to carry at all times.

Firefighting in a Hazardous Atmosphere

- SCBA operated in positive pressure mode such as pressure-demand is required

Emergencies, Unknown Concentrations, or Concentrations Above IDLH

- SCBA or combination SAR/auxiliary SCBA is required
- Respirator must be operated in a positive pressure mode such as pressure-demand to keep hazardous material from entering the mask.
- In my experience, all pulp mills use SCBAs in these situations.

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Hazardous Atmosphere With Known Concentrations Below IDLH

- Remember, this assumes there is sufficient oxygen in the atmosphere
  - If in doubt, check the oxygen level
  - In situations where the oxygen level is suspect, very near to, or below 19.5%, use a SCBA or combined SAR/escape SCBA
- Determine the Minimum Protection Factor (MPF) or Hazard Ratio.
- MPF = (airborne concentration of contaminant) / (8-hour TWA [time-weighted average] limit)
  - Example: Suppose the airborne ClO_2 concentration is 2 ppm
    - 8-hour TWA limit for ClO_2 is 0.1 ppm
    - Minimum Protection Factor is $2 \div 0.1 = 20$.
    - Therefore, a respirator with an Assigned Protection Factor (APF) of 20 or higher will provide adequate protection for up to 8 hours.
  - Other TWA limits such as the 15 minute STEL (if available) may be used to calculate the MPF for different exposure times.

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Additional Resources

- "Breathe Safer – How to Use Respirators Safely and Start a Respirator Program," Worker's Compensation Board of BC, 2005 http://www.worksafebc.com/publications/health_and_safety/by_topic/assets/pdf/breathe_safer.pdf
- "NIOSH Respirator Selection Logic," NIOSH, 2004 http://www.cdc.gov/niosh/docs/2005-100/default.html
- The Bleaching of Pulp, 5th edition, edited by Hart & Rudie, Chapter 20.10, TAPPI Press, 2012 http://www.tappi.org/0101R331

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Thank you for your attention

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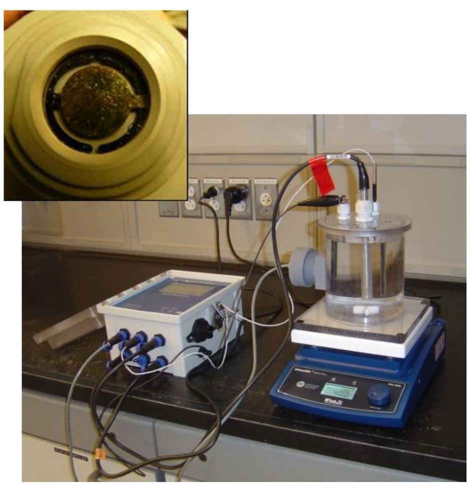
PAPTAC Bleaching Committee
Spring Meeting 2015
Point Claire, Quebec

Nalco Scale Rate Monitor

by Jack Thomas
Industry Technical Consultant for Pulping, Bleaching and Recovery
Nalco and Ecolab Company

Scale Rate Monitor (SRM)



Benchtop SRM-3 instrument, patented technology

Quartz Crystal Microbalance (QCM) technology:

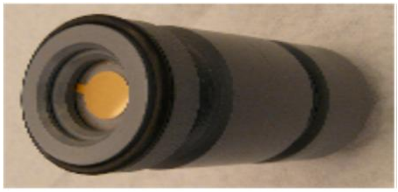
- Quartz crystal sandwiched between two metal surfaces vibrates when electrical potential is applied (piezoelectric effect)
- Vibration frequency is proportional to the mass of a deposit on the QCM sensor and can detect accumulating mass in micrograms
- Local pH shift upward of 2 to 2.5 units near the QCM surface causes deposition on the vibrating crystal for calcium oxalate and calcium carbonate scale.
- Compares the relative activities of scale control chemistries for product development and for effective control treatment

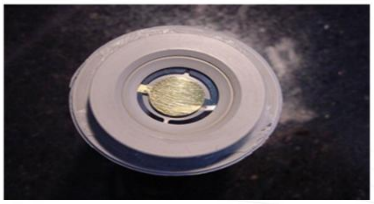
2

3

Scale Rate Monitor (SRM)

- SRM Crystals





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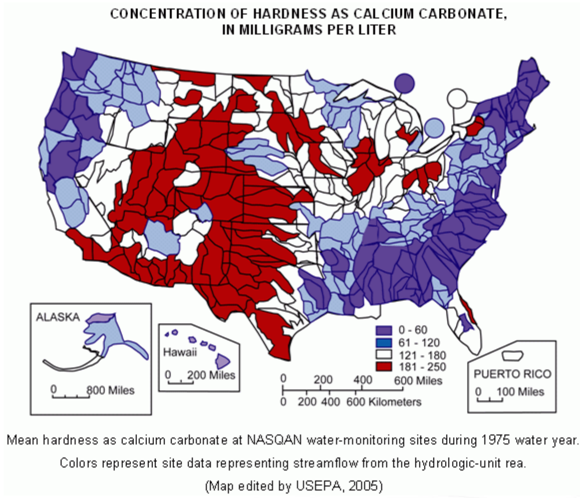
How does the SRM work?

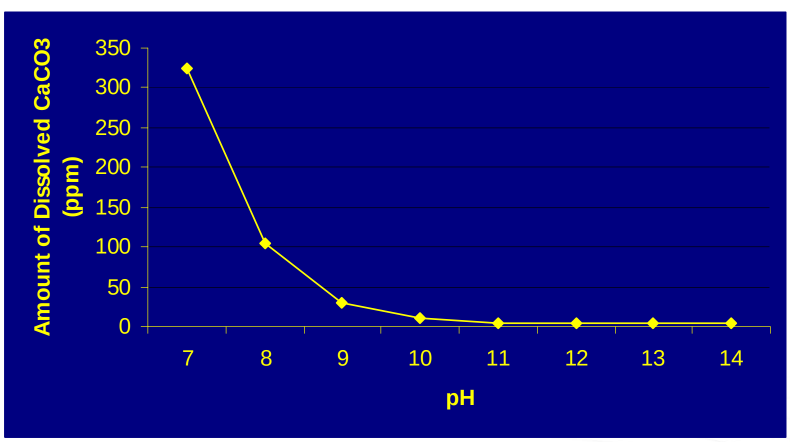
1.0 Deposit Rate Monitor SRM3 – General Information

The SRM3 is a proprietary Nalco instrument used in the field to test the propensity for scale formation in aqueous solutions, including colloidal solutions, and slurries to form deposits.
The measuring unit for the SRM is a metal-plated piezoelectric quartz crystal (quartz crystal microbalance, QCM) that vibrates at a particular resonant frequency dependent on the mass of the crystal newly formed. As the deposits accumulate, the crystal mass increases and causes the vibration frequency to decrease. The instrument registers the change, thus allowing both the mass and the rate of scale accumulation to be simultaneously monitored. The mass-frequency dependence is linear.

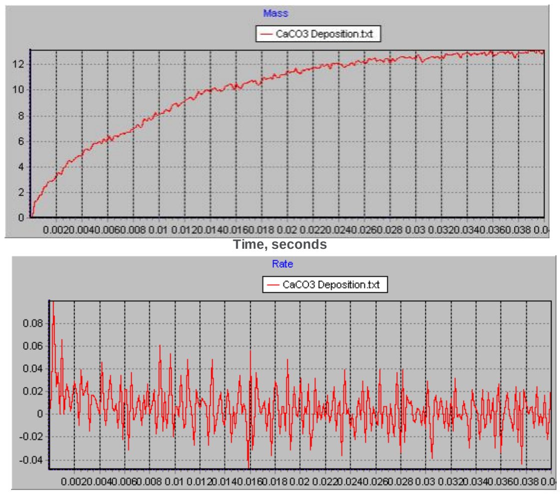
Hardness in Ground Water



$CaCO_3$ Solubility vs. pH



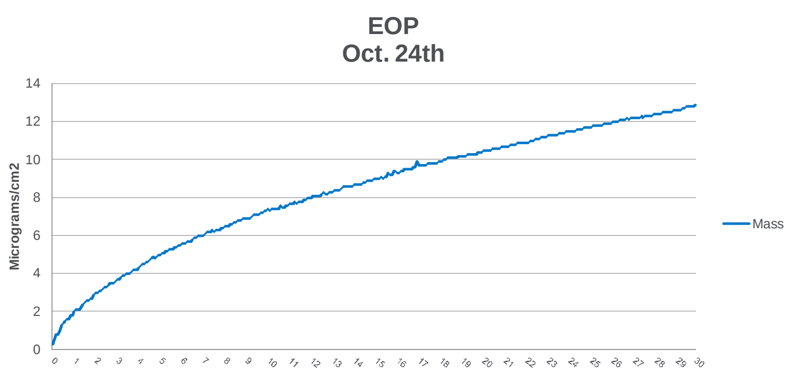
Typical SRM Test Results for $CaCO_3$ Scale



7

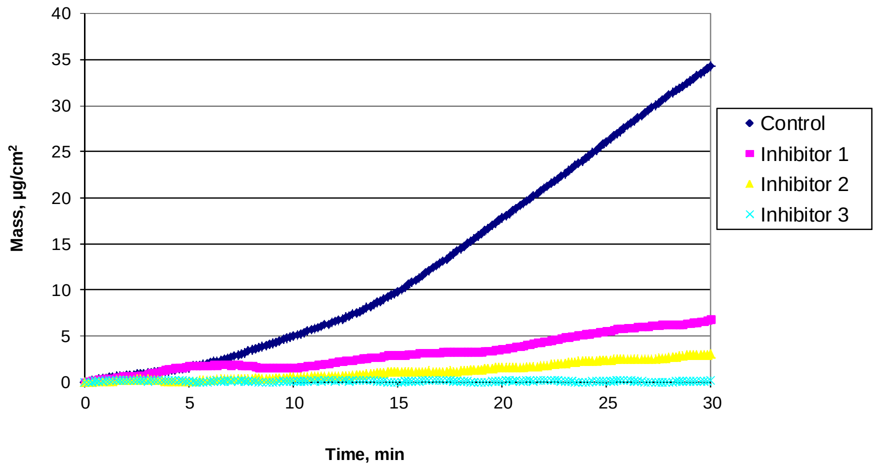
Time, seconds

EOP Washer Calcium Carbonate

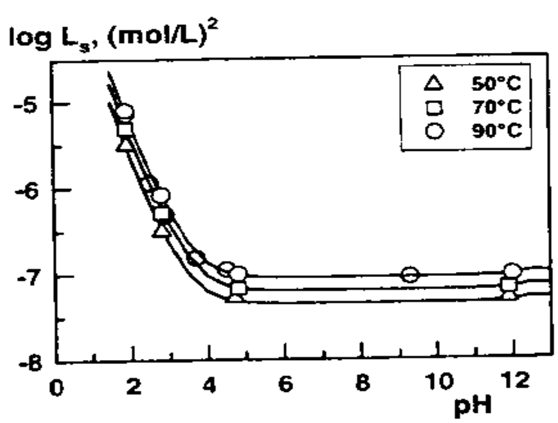


Mass Accumulated 12.9μg/cm2

Scale Inhibition



Oxalate Solubility Vs pH



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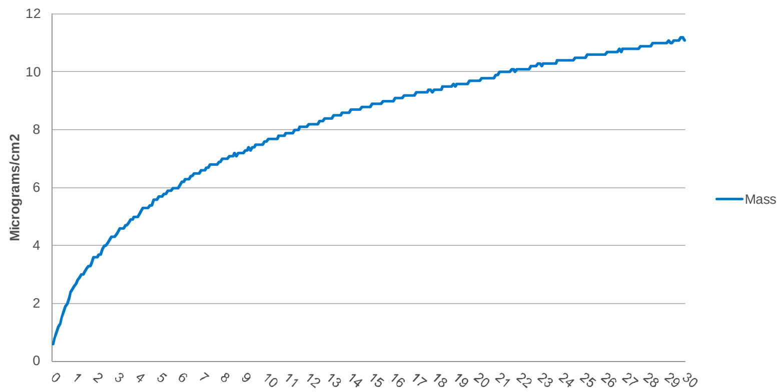
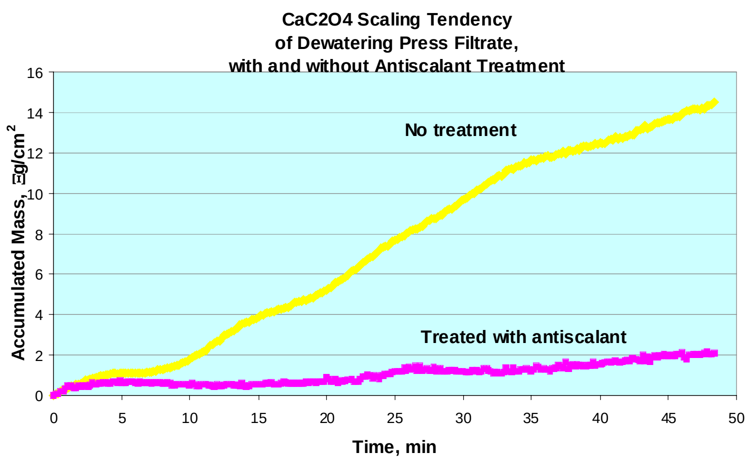
D100 Washer Calcium Oxalate



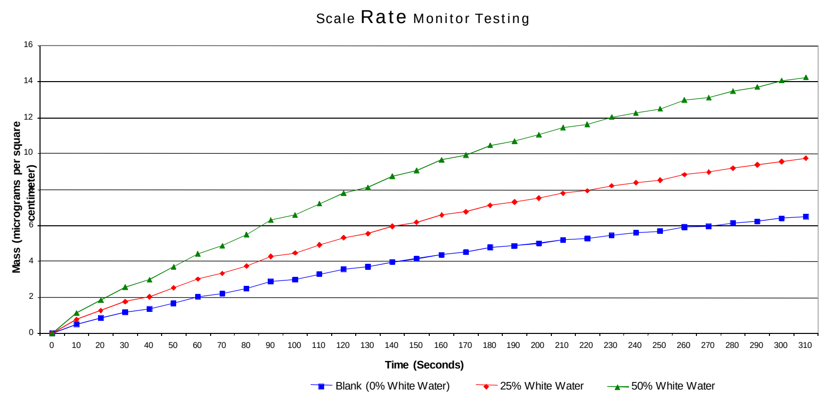
Mass Accumulation 11.2µg/cm2

SRM: Inorganic Scale, Electrochemical Mode



Calcium Oxalate, Bleach Plant, D100

Deposite Control: Example Case



SRM testing was performed on site to determine the impact of excess paper machine white water on scaling potential in the bleach plant

Summary

- Diagnostic field tool for determining the severity of scaling rates for calcium carbonate and oxalate scales in the BP
- Used for pH induced calcium scale
- Work from the solubility vs. pH curves for both calcium scales
- Used in R&D for scale control chemistry product development
- Used in the field to screen anti scale chemistries
- Used in the field to estimate dosage to manage the scale
- Program/system assurance program for the customer

- Questions?

Control of the Extraction Stage Using the True Terminal pH

Presented by:
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Fiber Line Business Manager
BTG Americas, Inc.

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BTG Americas, Inc.

www.paperweekcanada.ca
Hosted by / organisé par :

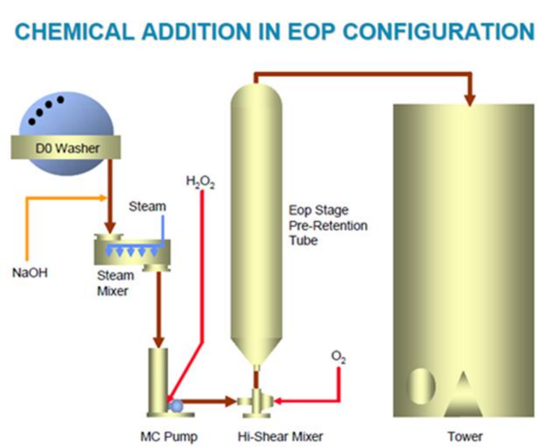
Agenda

- Introduction
- Measuring pH
  - Manual
  - On-line
- Control Options
- Benefits

Objective

- The purpose of the extraction stage washer is two fold:
  1. solubilize and remove the organic material that was oxidized in the previous bleach stage and
  2. reactivation of the remaining lignin for further oxidation in the subsequent bleach stage
- Both functions directly impact the economics and efficiency of the subsequent bleaching stage.

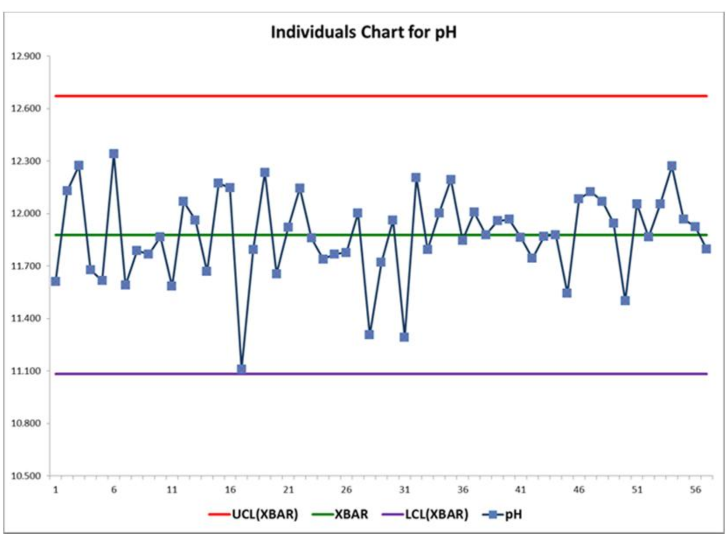
Extraction Stage Layout



Measuring pH

- Where are you taking the sample?
- How do you prepare the sample?
- How are you processing the sample?
- Frequency of calibration of your pH probe
- Temperature Influences

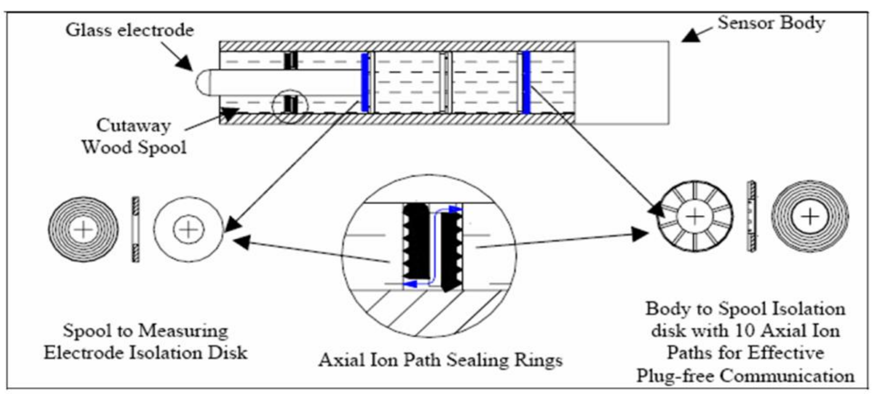
Calibration and Validation



Measuring pH

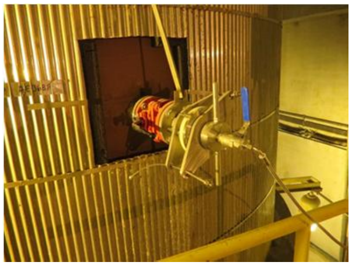
- Manual Methods
  - Highly Variable due to sample collection
  - Frequency too low for control
- In-Line Methods
  - In-line pH probes
- Semi-Automatic Methods
  - In-line filtrate extractor feeding a sample pot with pH probe

pH Probes



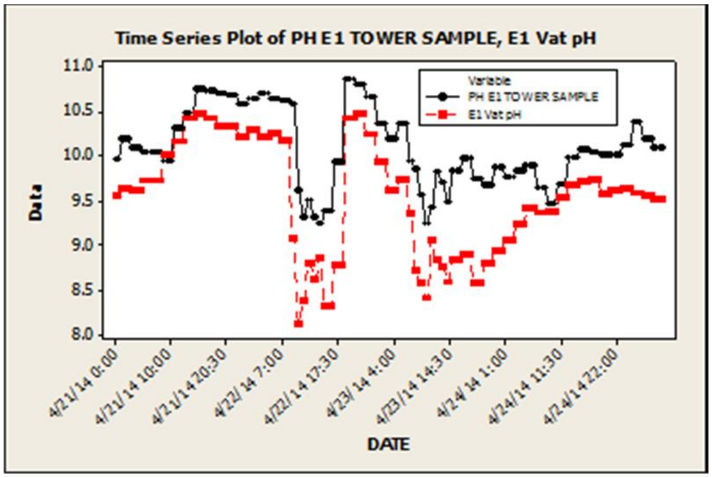
Examples of Field pH Measurement

Manual sample point


Filtrate Extractor in Extraction Tower

pH sample pot

Where Should We Sample Terminal Extraction pH?



How Should We Control the Extraction Stage?

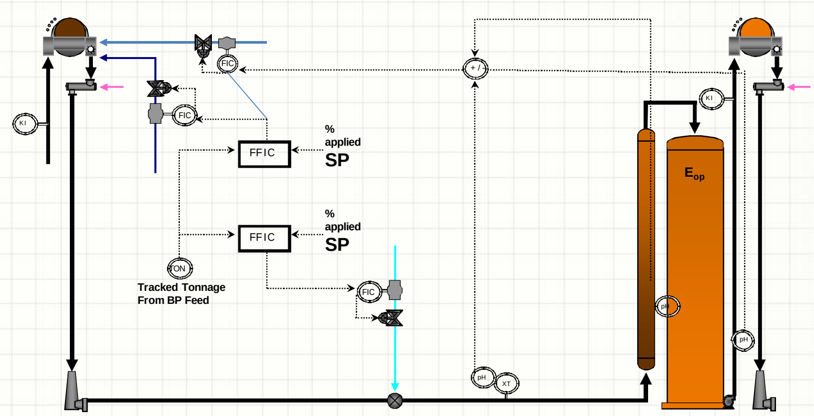
- What are the components?
  - Tonnage
  - Incoming pH
  - Caustic Dosage
  - Caustic to Eq. ClO2 Ratio

PAPER WEEK CANADA 2015

SHAPING THE FUTURE: PEOPLE, PROCESS & INNOVATION

BÂTIR L'AVENIR : TALENT, PROCÉDÉS & INNOVATION

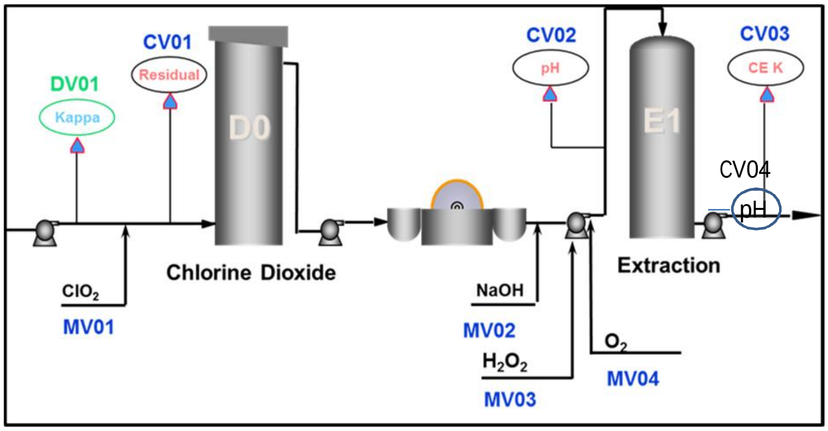
Eop Control



NaOH Steam Cl_2 ClO_2
H_2SO_4 H_2O_2 O_2

TAPPI

Elements of Advanced Control



Preliminary Mill Trial

- Manual samples were taken in tower and vat prior to installation of filtrate extractor
- Control strategy was modified to use a feed forward Caustic to TEC ratio that was trimmed using terminal pH value
- D1 charge and brightness was recorded for comparison

Results

	Before	After	
Incoming Kappa	9.90	9.95	
D0 % ClO2 Charge	0.947	0.950	
Incoming Eo pH	10.75	10.77	
Eo Caustic Charge	1.196	1.055	11% ↓
% D1 ClO2 Charge	0.86	0.82	5% ↓
D1 Brightness	86.58	87.60	

Conclusions

- The extraction stage remains an important part of the bleaching process
- pH can be an effective "surrogate" measure of the efficiency of the stage
- Sample location and collection techniques are critical
- True terminal pH control has been shown to be effective
- Further mill studies to follow.

Acknowledgements

- Sandy Beder-Miller, BTG Americas, Inc.
- Jessica Paul SAPPI Somerset, ME

Thank you!
Merci beaucoup!

PAPTAC Bleaching Committee
Mill Updates and Problems Roundtable
Pointe Claire, QC – May 4-6, 2015

Chemstone

- Will be sending out a Digester Survey to the Committee to gather data on digester operations

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Paper Excellence - Skookumchuck

- Paper Excellence continuing to invest heavily in Mill. Projects proposed or in planning stage
    - 3-stage O2D
    - Conversion of Do to MC
    - ClO2 HX
    - FTNIR for Digester and R-8
- Production target 800,000 ADMTPY
- Have installed 4 wells to supply water to the Mill. Ready to commission in 1-2 weeks
- Focusing on reliability

Question: Does anyone have data showing the ClO2 demand in shower waters?

- Brian Collins – depends upon stripper
- Paul Earl – COD not a good measurement for condensate. Methanol can have a high COD, but no ClO2 demand. D1 filtrate can have a high ClO2 demand when the kappa# to D1 is high
- PAPRICAN studies – Dirty condensate can be used further back in BSW
- Castlegar may have data - Laurier suggests contacting them. They have seen ClO2 increase.
- Norm Liebergott – pulp contains UV and Klason lignin, UV lignin can consume much more lignin

Question: Does anyone have a good design for a Chip Silo?

- SAPPI Sommerset - Hwd has a screw which feeds better than the softwood silo which has a stoker. Screw provides a more uniform flow.
- Irving struggles with their silos bridging during the winter
- Verso – Androscoggin – 80 ft silos with a cone at the bottom. Run silos to lower levels in winter, must cycle the feed rate to keep from bridging, trialing a sonic level detector
- Fortress Specialty Cellulose runs a lower level in the winter and uses air cannons
- Resolute – St. Felicien – No problem with their chip silos during winter operation
- Texo – Keep the silos cold or warm, in between is where they freeze up
- Jim Collins – Excessive steaming can result in fires in chip silos

Question: Are seeing pitch on shower bars using E2 filtrate. Any Ideas on what is causing this?

- Irving – Take end caps off and flush showers bars
- GL&V – Put end caps on bars to allow for flushing

Clearwater Paper – Lewiston

- Engineering and permitting a 1400 TPD Valmet continuous digester
- Purchased a FTNIR in 2015 for Kiln
- New 1000 ADT bleached HD in 2016
- Evaluating pressurizing Eop and evaluating a Precipitator Dust Purification™(PDP) for chloride removal
- Question: Who is running a WL Sock Pressure Filter and have you seen any changes in sock design?
- 4 mills are running sock type filters.
- Terrance Bay – Need to buy OEM socks, had similar issues with non-OEM socks

Question: Does anyone add emulsified sulfur?
- Jim Collins- Marathon tried it but abandoned due to corrosion concerns

Question: Does anyone run reverse cleaners in their bleach plant?
- Quinnesec tried them and they are a pain to operate

Irving Pulp
- New Valmet digester to start-up in 2016
- Working on upgrade project for replacing 3 old pulp machines with 1

Question: Is anyone doing NDT on Kynar lined pipe and FRP? Having failures on acid piping.
- Quinnesec inspects lined acid pipe yearly and replaces a section with several bends
- Laurier – Be careful of over-tightening flanges and cutting the rolled over liner

Question: What are people doing to calibrate/check their Kappa Analyzers?
- Resolute – St. Felicien – Weekly checks by Central Lab and charted
- Harmac-Pacific – Check every 6 months by testing samples
- Laurier – Discussed using kappa standard samples to check. Check unit grounding. Clean sample lines to remove biological growth.
- Metso – Discussed how they calibrate
- Several folks mentioned making sure testers are using a solid procedure
- Paul Earl – Calibrate on Kappa, not K#. K# is not linear, but Kappa is
- Jim Collins – Use a autotitrator for Kappa tests

Question: can high K# contribute to Barium Sulfate scale on Do?
- Paul Earl and Doug Pryke – high K# will not cause $BaSO_4$
- Paul Earl – Let terminal Do pH come up to 3.5 to minimize acid use and therefore sulfate addition

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Harmac Pacific

Question: Had scale on the D100 washer – Initial testing is 80-96% Organic – don't know exact identification yet. It dissolved in caustic and EDTA. What could it be?
- Norm Liebergott – Could be phenolic oxalate, it's soluble in caustic. Has wood supply changed?
- Use defoamer to help carry material out of seal tank
- Shree-Prakash – Could be a pitch co-deposit
- Brian – Verso – Is an oil base defoamer being used?
- Scott Charban – Chemstone – Has wood supply changed to interior BC? Could be calcium loading.

Question: Using both pre-bleach kappa measurement as well as residual and brightness measurements for Do. The brightness and residual instruments are old and expensive to maintain. Has anyone gone to just KF control?
- David Trzil – Clearwater – Keep both brightness and residual. If you can have only 1 keep residual.
- James Goldman – Valmet – Residual measurement is key, keep it.
- Laurier – Texo – Relationship of brightness and kappa changes with species. Addition of peroxide will also change this relationship.
- Skookumchuck – Now use feed forward KF only

Verso Paper – Phil Sekerak
- Integration of 6 new facilities into Verso
- By-Passing Peroxide stage at Luke, Maryland Mill and E2 stage at Escanaba, Michigan Mill

Question: Are people still using FRP for ClO_2 piping and how do you inspect it?
- Terrace Bay uses core sampling
- Skookumchuck – Mark Cameron – Fiber optic and robotic inspections on FRP
- Most mills still using FRP

Verso Paper – Androscoggin
- Installed a FTNIR on ClO_2 Generator
- Switched to natural gas on lime kiln
- Using model based control for D1 pH
- Installed a kappa analyzer for softwood

Question: Anyone using a Mettler-Toledo pH probe in Bleach Plants?
- Jim Collins – Terrace Bay – Evaluating TBI and ABB

Verso Paper Quinnesec
- Installed a new Turbo chip meter. Installed to reduce variability
- New kiln burner in Fall 2014

Question: Is anyone recovering water from press felts?
- No

Question: Is anyone recovering fiber from bleach plant filtrates?
- Skookumchuck recovers fiber from CB washer filtrate
- Ranjit – Terrace Bay – An Indian Mill he knows of recovers fiber from Do and Eop

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Nalco
- Have had success with AQ replacement in South America. Product is not as good as AQ, but still is justified. Information to be out soon.

AkzoNobel
- Paper chemicals division sold to Kemira. Retaining bleaching chemicals and chlorate business

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Kemira
- Gained 6 new production sites with AkzoNobel purchase and 350 employees
- Now can supply chemicals from wood to paper machines

Texo
- Lots of work on digesters/causticizing/Generators
- Completing integration of Tune-X with Process ID, Lambda tuning, and PID tune

Question: How many mills send pin chips to the power boiler?
- Verso WI. Rapids, Resolute - St. Felicien, and Resolute-Thunder Bay all send pins to the boiler
- Skookumchuck accepts all pins that stay on a 6mm (square) screen
- Many responded it depends upon digester runnability. Some screen out and meter a portion back in to the digester feed

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Verso - Wisconsin Rapids
- Eliminating hi-consistency ozone
- Converting 2 digesters to Downflow Cooking

Question: Does anyone have a good way to seal the ends of bleach plant oscillating showers to prevent ClO_2 escape and do mills run air doctor blowers on bleach washers?
- Clearwater Paper – Have a good fan draw to the washers and have no issues

- SAPPI – run air doctors with no issues
- Verso-Quinnesec – replaced air doctors with hydrodoctors and shut down oscillating showers to reduce ClO_2 emissions from washers

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Resolute -St. Felicien

- Added a 9MW generator in 2011
- Converted kiln to natural gas in 2013

Question: For those that converted from fuel oil to natural gas in their lime kilns did production decrease for the same carbonate level?

- Quinnesec – Yes, about 10%
- Verso – Phil Sekerak – Co
- Common to lose capacity on natural gas. Should increase carbonate level to minimize production loss

Question: Is anyone recovering fiber from sewers?

- Clearwater Paper – Have fiber screens for sumps on brown stock
- Irving – Brown and bleach sumps recover filtrate and recycle back to unbleached HD
- Many comments on potential for plastic contamination
- GL&V – New Richmond mill used to do this

Valmet Automation

- Metso is out of Pulp and Paper

Fortress Specialty Cellulose

- Producing energy to the grid at up to 24 MW in 2015
- Program to shut down old power boiler due to environmental regulations, studying option to burn CNCG's in recovery boiler
- Energy focus to optimize new biomass boiler and shut down the old one mentioned above
- No plan to produce NBHK in 2015

Question: Having very short life on white liquor pressure filter socks – replaced 5X in 3 months, usually 2X/year. Believed to be dregs related. Any thoughts on the cause?

- Clearwater Paper – Polymer addition helps with dregs removal, talk to your vendors.
- Texo – Some clients acid wash every 3-4 days. Re-burn lime several times before putting across filter after heavy fresh lime use. Quality of fresh lime for many mills has decreased in recent years. Drop CE to reduce lime requirement.
- Resolute – Thunder Bay – Kevin Taylor from Vancouver would be a resource he helped Thunder Bay a few years ago. Thunder Bay not currently running their filter. www.**industrialresearch**.ca

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AV Terrace Bay

- Installed new efficient Ultra-Flow Shower bars on our 3 BS Washers and Brown Thickener
- Just started up a new Plate Heat Exchanger for recovery of Blow Heat Energy – working well
- We recently completely revamped our dirt count procedure and now using the Tappi Dirt Count Method – previously we were over estimating the dirt level in our pulp
- Commissioned a new Weak Black Liquor Filter to reduce fiber to the Evaporators
- During the past year we diverted our neutral sodium sesquisulphate from the weak black settling tank to the #2 Recovery Retention to reduce water and deadload to our evaporator system

- Have started a optimization program to improve our bleach cleaner system operation – overhaul and put Radiscreen back in service, replace defective cleaner valves
- Past year we installed new Gorator and high capacity circulation pump for 75% solids to #2 Recovery to reduce plugging
- Investigating the installation of automatic Dirt Scanner on our pulp machine
- Upgrading our obsolete ClO2 strength analyser to new Optek dual sensor unit
- We are on a 4 phase approach for installation of new Delta V DCS system. The new Lime Mud Disk Filter, R8, #2 Recovery and #2 Evaporators are now complete. The #2 Recovery and #2 Evaporator previously had no DCS system
- Currently working on installation of PI system

Question: Is anyone measuring consistency of the stock from bleach towers to washers to control filtrate dilution?

- A paper was presented by Gerry Pageau (Howe Sound) 12-15 years ago on this topic.
- Texo – blade consistency meters work well in this application

Question: My recent ClO2 analyzer survey showed 10 of 13 mills responding are using dual sensor ClO2 analyzers to measure ClO2 strength out of the Absorption Tower and out of storage to the Bleach Plant?

- Most mills are using an Optek analyzer.

Question: Is anyone using an automatic dirt analyzer on their pulp machine?

- Cameras are mostly used on paperboard machines.
- Canfor Prince George has one on all the pulp dryers – Metso product. The Intercon Mill has a scanner travelling across the sheet at the dry end.

Question: How many folks are using pitch dispersant and talc?

- 3 Mills using pitch dispersant
- 5 mills using talc
- No mills reported a combination of the two

Question: Is there a chemical that can replace the seasoning of chips?

- Clearwater Paper - A fungal pre-treatment was tried years ago

Question: What is the level of pin chips in purchased chips?

- Clearwater Paper – About 6%

Question: Having CO alarms around the Eop reactors and on the ground floor by the general sewers?

- Paul Earl – CO comes from the delignification reaction (oxidation)

Question: Does anyone have a quick procedure to clean pitch from cleaner cones?

- No responses

AD Chemical

- Represent defoamers and enzymes

Resolute- Thunder Bay

- Replacing Cold Blow Cooler with one 4X as large

Question: Has anyone replaced steam ejectors for evaporators with vacuum pumps?

- No responses

Question: Does anyone have experience with the plugging the E1 filtrate line after an Eo filtrate HX?

- Could put in taps to allow for hydroblasting
- Terrace Bay – In past would circulate caustic and dispersant in HX
- SAPPI – Somerset Run talc on Eop stage repulper

GL&V

- Renewed focus on R&D, paper machines, low energy rotors resulting in new products being brought to market
- New trash screen with only 7.5 to 20 HP required

SAPPI - Somerset

- Ran natural gas pipeline to mill
- Had first cold mill outage in 14 years in Fall 2014
- Have installed BTG filtrate extractors
- Installed fiber length and shive modules to new Metso KappaQ analyzer
- Running softwood campaigns 1/month

Question: Does anyone know of a training simulator for digesters?

- BTG – Honeywell and Andritz both offer simulators
- Wisconsin Rapids – They have the Andritz simulator and it works well
- Irving – Valmet has a simulator that is being used to train their operators

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Valmet

Question: Does adding CO_2 for pulp washing cause H_2S?

- Clearwater Paper – Did not see this when running CO_2 to washer in late 90's
- Air Liquide – Cannot add enough CO_2 to get the pH low enough to generate H_2S. Air Liquide did testing.
- Skookumchuck – Should not be able to get the pH low enough

Question: Can oil leaking into the process cause foaming?

- Clearwater Paper – maybe if the oil is leaking in from the bearing it is possible that air is also leaking into the process causing foaming?

Peroxychem

Question: A customer that has a 2-stage O2D in the Eo position wants to add peroxide. Where would be the best place(s) to add it?

- Paul Earl – Try the 2nd reactor, but it may not provide any benefit
- Terrace Bay – Tried it once and it was not effective in a conventional O2D

Verso - Wickliffe

- Installing Downflow cooking on digester
- Installing a new Turbo chip meter
- Adding filtrate extractors to bleach plant
- Adding pre-bleach and DEK analyzers
- Adding production measurement to bleach plant
- Upgrading DCS in recovery boiler area
- Adding white liquor and recaust on-line titrators

Question: How are folks maintaining their Kappa Analyzers?

- SAPPI – good uptime on liquor and kappa analyzers, daily checks and maintenance looks at weekly
- Clearwater Paper – Weekly pm's. Service agreement
- Harmac Pacific – 1-2 days per week maintenance needed
- Terrace Bay – All E&I techs trained on unit
- BTG and Valmet – Someone has to "Own" the units and check them regularly

FP Innovations

Question: Who is using acidic bleach filtrates as a heat source?

- Paul Earl – A few mills are using Do filtrate for ClO_2 HX's since they have to be built from titanium anyway