Honorable Members of PUPID,

Well, it is already the first week of December and 2011 is almost over, three more weeks until Christmas.

Just like last newsletter, we still need a Director-Elect, and a symposia coordinator. The Director-Elect will train with me in 2012 and take over as Director for the 2013/2014 biennium. If you can only do it for a single year, then we can look at single terms. In return for the work, you’ll get your ISA Spring and Fall Conference expenses paid by the division.

I encourage you all to listen to some of the fourteen hours of audio from the ISA Automation Week 2011 conference. You can get the links on page 3 & 4 of this newsletter.

Next year, the ISA Automation Week 2012 will be at the Convention Center in Orlando, Florida. If you’ve thought about getting involved with a technical conference and/or writing a paper, this is for you. You can bring the family to play at Disney World while you see all of the latest instrumentation and controls at the Fall conference.

Our division membership is stabilized at 436 members with 24 new division members since September. The membership has stayed nearly constant since last January. Welcome to all of you new members!

I am also pleased to be able to include Read Rick Van Fleet’s paper and see his presentation for “Modern Bleach Plant Advanced Process Control utilizing Inline Sensors and Model Predictive Control” from the TAPPI International Bleaching Conference.

I hope it is an encouragement to you to become more involved with the Division and to enroll more members from the great international pulp & paper community.

Please do not hesitate to contact me at either (251) 454-1200 or brad.carlberg@bsc-engineering.com to discuss how you can help PUPID.

Do feel free to forward the Newsletter to your friends and colleagues who may have an interest in it.
TUNING TIP:

ABSTRACT

This Tuning Tip was excerpted from "" by from.
ISA Members can download this paper FOR FREE from the ISA website.

Calendar of Events

Get a quick overview of the ISA PUPID events for 2011 by going to the Calendar at:
http://www.isa.org/~pupid/2011_PUPID_Calendar.htm

ABTCP 2012-45th Pulp & Paper International Congress & Exh
10/9/2012 to 10/11/2012
Transamerica Expo Center
Sao Paulo, Brasil
http://www.abtcp2011.org.br/ingles/

Industry Application Society
58th Annual Pulp and Paper Industry Conference
The Nines Hotel
Portland, OR
June 17 – 21, 2012
http://pulppaper.org/

2012 TAPPI PLACE Conference
5/7/2012 to 5/9/2012
Grand Hyatt Seattle Seattle, WA USA
http://www.tappi.org/content/events/12place

66th Appita Conference & Exhibition
4/15/2012 to 4/18/2012
Melbourne Park Melbourne, Australia
http://www.appita.com/

2012 ISA FALL LEADERS MEETING
SATURDAY, SEPT 22 2012 AND SUNDAY, SEPT 23 2012

ISA AUTOMATION WEEK 2011
MONDAY, SEPT 24 2012 THROUGH THURSDAY, SEPT 27 2012
ORANGE COUNTY CONVENTION CENTER ORLANDO, FL
Come meet your leaders & get involved!
### LISTEN TO THE TECHNICAL SESSIONS FROM ISA AUTOMATION WEEK 2011

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<tr>
<th>Wireless Track</th>
<th>Wireless Measurement and Control Opportunities Tutorial</th>
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<td>Tuesday Session 1 (10:00 am-11:30 am)</td>
<td><strong>Session Moderator:</strong> Tom Fillers; Filltronic Services; Mobile, AL</td>
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<td><strong>AUDIO POWERPOINT PAPER</strong> Greg McMillan</td>
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<th>Wireless Track</th>
<th>Wireless, CyberSecurity, &amp; Control Systems</th>
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<td><strong>Session Moderator:</strong> Kenneth R. Williams; Instrument Control Specialist Sr. Alabama Power Company Barry Generating Plant; Bucks, AL</td>
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<td><strong>POWERPOINT PAPER</strong> Wireless In-Core Detector Instrumentation (WIDI) - Jorge Carvajal Westinghouse Nuclear</td>
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<td><strong>POWERPOINT PAPER</strong> The opportunities and threats of the wireless technology market in process control - Mitra Moghaddam (Presenter) &amp; Peyman Shahsavari</td>
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<td><strong>POWERPOINT</strong> Wireless, CyberSecurity, Control Systems - Designing a Resilient SCADA System - Peter Fuhr Oak Ridge National Laboratory</td>
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<th>Large Scale Sensor Networks Tutorial</th>
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<td>Tuesday Session 3 (3:30 pm-5:00 pm)</td>
<td><strong>Session Moderator:</strong> Will Kiser, E&amp;I Resource Leader; Hargrove Engineers &amp; Constructors; Mobile, AL</td>
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<td><strong>AUDIO POWERPOINT PAPER</strong> Large Scale Sensor Networks - Mark Nixon - Emerson</td>
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<th>Installation, Operations, and Maintenance Track</th>
<th>Trends in Instrumentation and Control in the Pulp &amp; Paper Industry Panel</th>
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<td><strong>Session Moderator:</strong> Richard E. Britton – (Retired) International Paper; Mobile, AL</td>
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<td><strong>PAPER</strong> Panelists: David W. Peters – Sigma Associates; Fairhope, AL</td>
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<td><strong>PAPER</strong> Bob Barber – (Retired) International Paper; Cantonment, FL</td>
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<td><strong>PAPER</strong> Ben Blanchette – Honeywell Process Solutions; Atlanta, GA</td>
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<td><strong>PAPER</strong> Davis McAlpine – Hargrove Engineers &amp; Constructor; Mobile, AL</td>
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<td><strong>PAPER</strong> Larry E. Wells – CCSA LLC; Atlanta, GA</td>
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<tr>
<th>Wireless Track</th>
<th>Utilize All Of The Data From Wireless And Smart Instrumentation</th>
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<td>Wednesday Session 1 (10:00 am - 11:30 am)</td>
<td><strong>Session Moderator:</strong> Michael Jarreau; The JAC Group; Mobile, AL</td>
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<td><strong>POWERPOINT PAPER</strong> Being Smart with Smart Instruments - Ian Verhappen</td>
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<td><strong>POWERPOINT PAPER</strong> Low power long range wireless opens up exciting new possibilities in remote automation - Richard May</td>
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<td><strong>POWERPOINT PAPER</strong> Secure and Easy Access to Data from a Remote Device - Gary Marrs</td>
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<th>Wireless Track</th>
<th>Industrial Wireless Applications</th>
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<tr>
<td>Wednesday Session 2 (1:30 pm - 3:00 pm)</td>
<td><strong>Session Moderator:</strong> Brad S. Carlberg, P.E.; Invensys; Lake Forest, CA</td>
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<td><strong>PAPER</strong> Applying Wireless to Ethernet Pipeline Automation Systems - Jim Ralston</td>
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<td><strong>PAPER</strong> Wireless Technology in Industry - Obaidullah Syed</td>
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<td><strong>PAPER</strong> “Lick and Stick” Wireless Industrial Sensors - Jay Werb &amp; Robert Gooch</td>
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### Wireless Track

#### Wednesday Session 3
(3:30 pm - 5:00 pm)

**New Technologies for Wireless Applications**

*Session Moderator: James (Lyn) Givens; Fluid Flow; Mobile, AL*

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<td>Energy Budgets of Thermal Harvesting for Powering Wireless Sensors</td>
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<td>- Burkhard Habbe</td>
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<td>The Reliability of Wireless Mesh Networks in Industrial Environments</td>
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<td>- Brian Cunningham</td>
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<td>Ethernet I/O</td>
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<td>- Jim McConahay</td>
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#### Wireless Track

#### Thursday Session 1
(10:00 am-11:30 am)

**Wireless Applications in Robotics, NC Machines, and Predictive Maintenance**

*Session Moderator: Vincent LoPresti; Director - Process & Energy; PM Services, LLC; Mobile, AL*

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<tr>
<td>Application of the next-generation emergency stop system utilizing</td>
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<td>functional safety wireless technology to outdoor life-supporting</td>
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<td>robots - Kazuya Okada</td>
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<td>Wireless enables predictive maintenance for rotating assets</td>
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<td>- Jim Haza</td>
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<td>Why Lord Kelvin Would Love MTConnect</td>
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<td>- Dave Edstrom</td>
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#### Wireless Track

#### Thursday Session 2
(1:30 pm-3:00 pm)

**"Ask The Wireless Experts" Panel**

*Session Moderator: Brad S. Carlberg, P.E.; Invensys; Lake Forest, CA*

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<td>Panelists:</td>
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<td>Dr. Penny Chen Yokogawa; Palo Alto, CA</td>
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<td>Brad Lazenby -- N-Tron Inc; Mobile, AL</td>
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<td>Wayne Manges – Oak Ridge National Laboratory</td>
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<td>Jim McConahay – Moore Industries; North Hills, CA</td>
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<td>David McKay – Wingtip LLC; Kennewick, WA</td>
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<td>Eric Rotvold – Emerson Process Management; Twin Cities, MN</td>
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<td>Steven Toteda – VP &amp; GM - Wireless at Cooper Industries Ltd.; San</td>
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<td>Francisco Bay Area , CA</td>
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<td>Ian Verhappen – Director at Industrial Automation Networks Inc.:</td>
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<td>Edmonton, AB</td>
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#### Wireless Track

#### Thursday Session 3
(3:30 pm-5:00 pm)

**Learn How The Oil & Gas Companies In Saudi Arabia And Northern Alberta Are Using Wireless**

*Session Moderator: Ric McNaughton; Maverick Technologies; Mobile, AL*

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<td>Aramco’s environmental monitoring data center - Paul Richards</td>
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<td>Server Virtualization Services for Oil &amp; Gas Applications: a User</td>
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<td>Prospective - Hassan Al Yousef</td>
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<td>Wireless Application in Oil Sands Projects - James Wang</td>
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WELCOME TO THE 24 NEW ISA PULP & PAPER INDUSTRY DIVISION MEMBERS SINCE MAY 2011

Ms. Gisela Costa
Aroldo Elias Da Silva
Claudio Da Silva Ferreira
Willie Lee Dorman, P.E.
Gabriel Epichin Pena
Eric Duane Fleming
Monte Hansford
Mark Knapp
Kurt Trampler
Adil Benrezzoug
Sergio Furuta
Todd Larry Gionet
Ms. Joanna Ioannides
Mario Luis Terres
Daljit Singh
Dennis Gwin
Chris Howell
Charles W. Lee
S Pushparaj
Austin David Carley
Scott A. Langendoerfer
Diego Giovanni Cruz Cañenguez
Carlos Stanley Luna Rodriguez
Francisco Miguel Martinez Albanez

HERE’S A REMINDER TO THE 40 ISA PULP & PAPER INDUSTRY DIVISION MEMBERS WHO NEED TO RENEW THEIR MEMBERSHIP

Dr. Puya Afshar
Shahzad Ahmed
Charles Arrera
Jerry N. Bransom
William E. Brown, Jr.
George L. Bryant, Jr.
Gert Burkhardt
Daniel C. Capra
Horace K. Carter
David Chief
Jon Clifford
Ms. Fabio Carneiro Da Cunha
Emerson de Oliveira Lanna
Huibertus H. De Rijk
Peter L. Den Hollander
Johannes Jacobus Engelbrecht
Alberto Franguelli
Menachem Gelbgiser
Ted Hansen
Joey Joseph T. Herrin
David W. Johnson
David Ray Leger
Jose Luis Mancia
Ernie Marshall
Helmer Muñoz Valderrama
Andre Leme De Oliveira
Thomas H. Owen
Jose Jorge Pedreiro
Moises Schmoeller Prado
David Quirion
Thomas Raiche
Jeffrey Lyle Ramberg
Ronaldo Ribeiro
Alex Andrade Ribeiro
Stetson Ridley
David Strobhar
Lyle Swanson
Pankaj M. Vaid
Joe Veroski
Phillip J. Warren

DON’T FORGET TO RENEW!
Sappi Limited Announces Major Investment In North American Operations

Sappi Fine Paper North America to Convert Cloquet Kraft Pulp Mill to Chemical Cellulose and to Upgrade Coated Paper Capability at Somerset Boston, MA and Johannesburg /PRNewswire/ -- Sappi Limited announced today the approval of a US$170 million capital project to convert the Kraft pulp mill in Cloquet, Minnesota to chemical cellulose used in textile and consumer goods markets. The planned conversion is slated to come online in 2013 and once complete will allow the production of 330,000 metric tons of chemical cellulose per year. Approved capital plans also call for a US$13 million project to upgrade coated paper manufacturing at the Sappi Somerset Mill in Skowhegan, Maine. These investments reflect Sappi Limited's confidence that the North American region can play a significant role in the global chemical cellulose market, complementing already strong market positions in release and fine papers. "The chemical cellulose conversion project at the Cloquet Mill is consistent with our announced strategy to diversify further into this fast growing segment," said Ralph Boettger, Chief Executive Officer Sappi Limited. "The globally low cost position of Sappi's Cloquet pulp mill will provide an attractive platform for growth with our current chemical cellulose customers as well as open up new markets to us." Sappi is currently the world's largest manufacturer of chemical cellulose out of its Saiccor Mill in KwaZulu-Natal, South Africa. The Cloquet project, together with the earlier announced expansion at the Sappi Ngodwana Mill in South Africa will bring Sappi's total chemical cellulose capacity to over 1.3 million metric tons per year. "We are excited about the new growth opportunities this investment in chemical cellulose brings to Sappi Fine Paper North America, all of our employees and the Cloquet community," said Mark Gardner, President and Chief Executive Officer Sappi Fine Paper North America. "Our planned conversion will allow the continued production of Kraft pulp for maximum flexibility to react to changes in global pulp markets. This project, together with the coated paper investment at Somerset Mill, ensures that we can grow profitably in both cellulose and fine paper markets for years to come." The Cloquet conversion project will not affect the company's coated paper business at that site. Dry fiber handling systems and improvements to paper machine capabilities approved as part of this project ensure that product quality across all grades will be unaffected. Currently, the Cloquet pulp mill produces hardwood kraft (NBHK) pulp for market sales. Sappi will work closely with its pulp customers to ensure an orderly transition, including, where appropriate, making supplies available from its Somerset Mill in Skowhegan, Maine. The US$13 million capital project at the Somerset Mill includes upgrades to the existing gap former on PM3, improving its cost structure and allowing the production of a broader range of products on the machine. The PM3 rebuild project is slated for completion in fall 2012.

Fortress Paper Commences Start-Up Phase At Fortress Specialty Cellulose Mill

Vancouver, British Columbia (Marketwire) - Fortress Paper Ltd. ("Fortress Paper" or the "Company") (TSX:FTP) announced today that it has initiated the final stages of the conversion project at its Fortress Specialty Cellulose Mill. The mill has commenced its start-up phase with final process testing, which will include cold and hot water trials, together with the testing of safety systems scheduled to occur over the coming days. Production of dissolving pulp beginning with wood chips cooking is expected to commence shortly thereafter. The minor delay in the scheduled completion of the conversion project has resulted from: (1) the previously announced unexpected walkout in October of construction employees of contractors engaged by the Company; (2) the extra time subsequently required upon the return of the workers to fully ramp-up construction activities at the site; (3) completion of identified improvements to infrastructure relating to buildings, supports and the chip tower inter-connection; and (4) implementation of enhancements to the mill's safety and control systems. Chad Wasilenkoff, Chairman and Chief Executive Officer of Fortress Paper, commented: "We look forward to the imminent production of dissolving pulp, which will signify an important milestone in the history of Fortress Paper. We believe that the implementation of supplemental process control testing will provide for a more efficient ramp-up to commercial production." The completion of the conversion project is currently materially on budget, with the exception of costs resulting from the unexpected walkout of construction workers which remain to be quantified. The cogeneration project at the Fortress Specialty Cellulose Mill is proceeding substantially on schedule, and is expected to be completed in the third quarter of 2012.

Boise Inc. Completes Hexacomb Acquisition

Boise, Idaho - Boise Inc. recently announced that it had completed the acquisition of the Hexacomb protective packaging business of Pregis Corporation. Hexacomb is a leader in kraft-paper-based honeycomb protective packaging and operates twelve manufacturing facilities across six countries. "We are pleased to complete this acquisition and welcome Hexacomb employees to Boise," said Alexander Toeldte, president and chief executive officer of Boise Inc. "Hexacomb expands our position in the
protective packaging market, provides a platform for further growth, steps up our vertical integration within our containerboard business, and delivers synergies with limited execution risk." In 2010, Hexacomb had revenues of $102M and converted approximately 60,000 tons of containerboard. The $125M transaction was financed through cash on hand.

**Vaahto Started Up Kama PM7 Succesfully – The First Reels Of Coated Paper Are Manufactured In Russia**

Vaahto paper-making machine PM No 7 up is and running at Kama mill in Krasnokamsk city (Perm region) in Russia. The first coated paper was manufactured on November 3, 2011. Vaahto Paper Technology start-up crew together with Kama professionals confirm that characteristics of paper produced with unique innovative technology meet world standards. The manufacture of the first in Russia coated paper is the key point of large LWC-Kama investment project, says Oleg Arminen, JVC “Investlesprom” general director. Investlesprom managed to give the second life to the oldest Russian ”Kama” Pulp-and-Paper Mill through setting up on its base a modern unique facility of hardwood processing and production of coated paper. Now there are two enterprises producing unique paper grades in Russia within Investlesprom group: Segezha PPM produces high quality microcrepe sack paper and Kama PPM produces low weight coated (LWC) paper. Today the first stage of 6 billion rubles investment project is actually accomplished, continues Vasily Preminin, executive director of JVC ”Investlesprom”’s Pulp and Paper Division. In 2008-2011 the following production facilities were built: new woodyard, BCTMP department, coating kitchen, paper-making machine No 7 with the winder and automatic packaging line. The Kama Mill utilizes Manufacturing execution systems (MES). Estimated LWC production volume is some 86 thousand tons per year. The wire width of the machine is 3700 mm and design speed 1050 m/min. In light-weighted coated paper manufacture unique technology of making paper out of birch BCTMP is used for the first time in the world. The technology is developed and patented by Investlesprom experts; pilot samples of paper manufactured using this technology, were tested in May 2010 in Moscow at Polygraphic complex "Pushkin square" and highly appreciated by specialists. Light-weighted coated paper production project is very important for Russia, it is oriented towards meeting domestic customers' demands and partial replacement of imported paper from Europe and Asia. Equipment were manufactured in Vaahto’s workshops in Hollola and Tampere in Finland, and Vaahto’s deliveries included also important equipment and services from other remarkable sub-suppliers like Honeywell, TM-Systems, UMV Coating Systems and Gapco Vaahto Paper Technology is part of Vaahto Group, which is a globally operating high technology company serving process industry in the fields of pulp and paper machinery and process machinery.

**Metso To Supply Tissue Line To CMPC Tissue, Chile**

Helsinki, Finland--(Marketwire) - Metso Corporation's press release on October 31, 2011 at 10:00 a.m. local time Metso will supply a complete tissue production line to CMPC Tissue S.A. of Santiago, Chile. The tissue line will be installed at CMPC's Talagante mill in Chile. The line will be started up during 2013. The value of the order will not be disclosed. This kind of production line is typically valued at EUR 20-30 million, depending on the scope of the delivery and the production output. Metso's delivery will comprise a complete tissue production line with stock preparation equipment and a tissue machine including a headbox, a Yankee cylinder, a hood, a dust management system and a reel. The production line will be optimized to enhance final product quality and save energy. The delivery will also contain an extensive automation package including a process automation system for machine, process and drive controls as well as a quality control system. The new production line will produce high-quality facial, toilet and towel grades. The raw material for the new line will be virgin and DIP pulp. The main part of the order is included in Paper and Fiber Technology's third quarter 2011 orders received and the automation package in Energy and Environmental Technology's third quarter 2011 orders received. CMPC Tissue S.A. is part of the larger pulp and paper group Empresas CMPC, and is a leading tissue products supplier in Latin America with industrial operations in 8 countries of that region. Metso is a global supplier of sustainable technology and services for mining, construction, power generation, automation, recycling and the pulp and paper industries. We have about 29,000 employees in more than 50 countries. www.metso.com This announcement is distributed by Thomson Reuters on behalf of Thomson Reuters clients. The owner of this announcement warrants that: (i) the releases contained herein are protected by copyright and other applicable laws; and (ii) they are solely responsible for the content, accuracy and originality of the information contained therein.

**ANDRITZ To Rebuild Paper Machine For SFT Group, Russia**
WHO’S DOIN’ ANYTHING?: (CONTINUED)

International technology Group ANDRITZ has received an order by SFT Group, a rapidly growing packaging producer in Russia, to rebuild and modernize a mothballed kraft paper machine after dismantling it at UPM's Kymi mill in Finland and relocating it to SFT's Kamenskaya mill in the Tver region, Russia. The modernized board machine for the production of fluting and testliner will have a capacity of 215,000 t/a (design speed 1,050 m/min, trim width 4,600 mm). Start-up is scheduled for October 2012. ANDRITZ PULP & PAPER will deliver a recycled fiberline, a paper machine approach system, and a broke handling line. The recycled fiberline will process 800 t/d of 20% mixed waste paper and 80% OCC (Old Corrugated Container) from Russia. The approach system will include a three-stage headbox screening system, a save-all disc filter, and under-machine pulpers. The scope of supply comprises also various machine components such as a PrimePress X press section and drying cylinders, the modification of wire and reel sections, process pumps and agitators for the stock preparation, as well as the complete automation systems (process control and quality control).

Clearwater Paper Completes Sale Of Lewiston Sawmill

SPOKANE, WASH.--(BUSINESS WIRE)-- Clearwater Paper Corporation (NYSE:CLW) announced today that it has completed the sale of Clearwater Paper's sawmill, planer mill, dry kilns, and related assets along with log and finished goods inventories and timber under contract, in the aggregate amount of approximately $30 million. As part of the transaction, the two companies have entered into a long-term residual fiber supply agreement with the goal of delivering consistent supplies of chips and sawdust to Clearwater Paper's Lewiston pulp mill from Idaho Forest Group mills. ABOUT CLEARWATER PAPER Clearwater Paper manufactures quality consumer tissue, away-from-home tissue, hard roll tissue, machine glazed tissue, bleached paperboard and pulp at 15 manufacturing locations in the U.S. and Canada. The company is a premier supplier of private label tissue to major retailers and wholesale distributors. This includes grocery, drug, mass merchants and discount stores. The company also produces bleached paperboard used by quality-conscious printers and packaging converters. Clearwater Paper's employees build shareholder value by developing strong customer partnerships through quality and service. FORWARD-LOOKING STATEMENTS This press release contains certain forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995 as amended, including statements regarding the aggregate amount of the transaction and the supply of wood fiber to Clearwater Paper. These forward-looking statements are based on current expectations, estimates, assumptions and projections that are subject to change, and actual results may differ materially from the forward-looking statements. Factors that could cause actual results to differ materially include, but are not limited to, difficulties with the realization of the benefits expected from the proposed transaction; general economic conditions in the regions and industries in which Clearwater Paper and Idaho Forest Group operate; changes in the cost and availability of wood fiber used in the production of Clearwater Paper's products; changes in the United States and international economies; cyclical industry conditions; changes in freight costs and disruptions in transportation services; unanticipated manufacturing disruptions; changes in general and industry-specific laws and regulations; unforeseen environmental liabilities or expenditures; labor disruptions; and other risks and uncertainties described from time to time in the company's public filings with the Securities and Exchange Commission. The forward-looking statements are made as of the date of this press release and the company does not undertake to update any forward-looking statements.

AMEC Awarded South African Contract By Pulp And Paper Giant Sappi

London, United Kingdom - AMEC, the international engineering and project management company, has been appointed by paper producer Sappi to undertake the engineering, procurement, construction management (EPCM) of its GoCell Project in South Africa. The contract value has not been announced. The AMEC team has started mobilisation and set-up, with the EPCM to follow. Completion is scheduled for 2013. The GoCell Project is located at Sappi's Ngodwana mill, near Nelspruit in Mpumalanga. The project will reconfigure one of the mill's existing production lines to produce chemical cellulose (CC). CC is a feedstock for the viscose staple fibre industry, which manufactures textile and non-woven fibres. "This is a major win for AMEC," said Colin Kubank, Managing Director of AMEC's operations in South Africa. "Sappi is a blue-chip client with prospects for a considerable amount of future work within the pulp and paper industry. The combination of local knowledge and our global expertise across markets has led directly to this project award, and provides a solid platform to grow and diversify our service offering in South Africa." The project will be delivered by the combined expertise of AMEC's Johannesburg and Vancouver offices, with the Vancouver office providing project management and engineering design services, and the local
office providing engineering design support, project services and construction management and site support.

**ABB Wins $15M Pulp And Paper Order In India**

Reliable, efficient automation and power solutions for JK Paper production expansion ABB, the leading power and automation technology group, has won an order worth more than $15M to supply integrated automation and power equipment and related engineering and commissioning services to JK Paper Ltd for its expansion project. The Company is a major player in the Indian Paper industry and is the largest producer of Branded Copier papers in India. The order is for capacity enhancement for one of its units, JK Paper Mills. Located in Rayagada in the state of Orissa, southeast India, this mill annually produces 125,000 tons of branded printing, writing and copier paper. The mill expansion and modernization project will more than double its production capacity. It will add a new paper machine with a capacity of 165,000 tons per year, a pulp mill that will produce 215,000 tons of wood pulp per year, and a 55 MW power plant. This expansion project is one of the largest in the Indian Paper industry involving close to USD $400 million. ABB’s delivery for the mill will help to improve its overall production efficiency and capacity. While maximizing energy efficiency and ensuring a reliable source of power, it will provide further impetus to the Company’s resource conservation efforts in energy and water. "Our ability to deliver a complete mill solution, with leading edge automation and power technology and industry standard equipment, and related pulp and paper industry expertise will help this project to be implemented and operated successfully from design to start-up," said Veli-Matti Reinikkala, head of ABB's Process Automation division. ABB will deliver energy efficient drive systems for the new paper machine, standalone drives and motors, and intelligent motor control centers (MCCs). The scope of supply also includes electrical infrastructure equipment such as transformers, transmission lines, other power equipment, and power management system for the pulp mill & paper machine. ABB's flagship automation System 800xA will control the new pulp mill and provide a common control and visualization platform for all mill systems to optimize energy efficiency, the use of production resources and overall mill maintenance. ABB will also provide design, engineering, commissioning and related on-site services. Project commissioning is scheduled for the early fourth quarter of 2012. ABB's Process Automation division delivers industry specific solutions and services for industrial automation and plant electrification. These solutions help customers meet their critical business needs in the areas of energy efficiency, operational profitability, capital productivity, risk management and global responsibility. Available industry specific solutions include process control, instrumentation, analytics, safety, plant optimization, telecommunications, energy management and power distribution.
MODERN BLEACH PLANT ADVANCED PROCESS CONTROL UTILIZING INLINE SENSORS AND MODEL PREDICTIVE CONTROL

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PRESENTED AT THE TAPPI INTERNATIONAL PULP BLEACHING CONFERENCE OCTOBER 5-7, 2011 AT THE OREGON CONVENTION CENTER IN PORTLAND, OR
Modern Bleach Plant Advanced Process Control utilizing Inline Sensors and Model Predictive Control

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ABSTRACT
During the past two decades there have been significant changes to operating conditions of fiber lines and bleach plants in particular. In addition to major mechanical modifications, environmentally driven changes in particular have resulted in the elimination of chlorine for most Kraft bleached grades. However, many of the norms or control philosophies have not changed and are in fact rooted in the theories related to the characteristics of chlorine bleaching. Very small amounts of lignin remain in lower Kappa Number pulp entering the brightening stage. The traditional location of sensors needs to be changed as the reaction rates of chlorine dioxide are much different than chlorine. Brightness control becomes more appropriate than the traditional kappa factor control and evidence will be presented that shows DEK levels less than 2 have a high degree of testing error and variability when compared to brightness measurement.

Introduction
Early control of bleaching was based on applying chemical prior to the first stage such that a residual level of chemical remained after the tower as measured by an oxidation reduction potential (ORP) sensor. This approach was based on the assumption that if an excess of chemical remained in the vat, then enough had been applied to complete the reaction. This often resulted in unsafe operating conditions on the operating floor and more commonly a loss of pulp strength and a wasting of chemicals. Strategies have evolved to the point where it is most common to see implemented a combination of residual (Polarographic based) and brightness (optical reflectance).

North American Bleach Plants began replacing chlorine with chlorine dioxide as a delignification agent (oxidant) in the first bleaching stage beginning in the 1990’s. Several researchers, such as Berry, Fleming, Voss, Luthe and Wrist of Paprican (1) showed that certain conditions related to the use of chlorine as a bleaching agent produced dioxins as a by-product in the bleach effluents. Mills responded to the studies and converted their bleaching strategy to Elemental Chlorine Free (ECF) bleaching which included the increased use of oxygen and peroxide. By 2000, all US mills were required to employ ECF or TCF (Total Chlorine Free) bleaching. The first stage of the bleach plant was usually controlled through the use of an inferential control strategy commonly referred to as Compensated Brightness which required the use of a combination of pH, temperature, conductivity, brightness and residual inline sensors. An accurate consistency meter and flow meter were critical to calculate tonnage through the bleach plant in order dose the proper amount of chemical needed to reach a desired Kappa target at the end of the first extraction stage. The sensor readings were used as a combined weighting signal placed into a linear model that would calculate the amount of chlorine and/or chlorine dioxide, to inject into the incoming brown stock pulp in order to estimate a desired property after the retention time of the first two stages.
Figure 1 Typical Configuration of sensors for chlorine bleaching

Figure 1 depicts a configuration where the brightness meter, BI, was installed before chemical addition and the residual, RI sensor was installed between 18 to 30 seconds after chemical addition. The placement of the residual transmitter was dependent on the theory that the chemical reaction and brightness development was at least two thirds complete. Arbitrary rules such as this were one of the main shortcomings of this approach. It was also important to measure the amount of chlorine remaining before the stock entered the first tower. Poor washing conditions resulting in heavy black liquor carry over into the bleach plant would consume the entire chemical charge and a low residual value would be observed. Any increase in process temperature would also change the reaction dynamics and would require compensation. Some mills would place the brightness and residual sensors after chemical addition using a feedback strategy. Although this was billed as an automated control strategy, it also required the attention of the operator to provide the necessary feedback or correction to the feed forward only control. Normally, based on a test of either the pulp brightness or more commonly the K number at the extraction washer, referred to as the Caustic Extracted K number or today as the DEK, the operator would have to make some form of judgment call on which variable to change. This included reacting to a change in the unbleached K number or a change in the production rate, which would completely change the dynamics of the bleaching process. In addition to these disturbances, the reliance on manual sampling and testing of the pulp also introduced variability.

The use of automated kappa analyzers became popular when the ECF conversion took place. This also was the start of a basic control strategy called Kappa factor.

\[
\text{Kappa Factor} = \frac{\% \text{ Applied TEC}}{\text{unbleached Kappa}}
\]

Kappa factor control ratios the amount of total equivalent chlorine (TEC) to the incoming unbleached kappa of the pulp. In the case where chemicals other than chlorine are used, the corresponding conversion to TEC is applied. In the most common instance, the conversion factor to chlorine dioxide is 2.63 based on the oxidizing
equivalence. Early designs had many problems with the sampling system but one of the main advantages was that the analysis was always performed the same way (2) However, the placement of the other inline sensors needed for control often remained in locations that were originally designed for chlorine only bleaching even though it was recognized early on that the reaction kinetics of chlorine dioxide bleaching are much different than chlorine only bleaching. Perala and Kirby pointed out that 100% chlorine dioxide substitution would not only require pH control but as a result of the formation of sodium chlorate, problems with the traditional polarographic measurement of residual would result. (3) Many attempts at combinations of brightness and residual sensors have been tried over the years. Some workers have also employed fuzzy logic and neural networks for soft sensors. Tessier et al provided an excellent review of control practices up to and including work done in early 2000 (4) and concluded that the compensated brightness approach was not adequate to deal with disturbances such as incoming kappa numbers and this often resulted in an increase in bleaching chemicals or even off grade pulp and introduced the concept of model based control for the first two stages of the bleach plant. This resulted in reduced variability as measured by the traditional DEK number.

Achieving environmental compliance is no longer only a desire to be a better corporate citizen. This has now become a legislated requirement and the primary focus has been placed on those chemicals that are either directly used by the pulping industry for the cooking (delignification) and bleaching (whitening) processes, as well as certain by-product chemicals. Therefore, in addition to raw material, yield and energy costs, the control and elimination of excess and harmful chemicals must be considered as part of the operating control strategy. Quite often the bleaching reaction kinetics are not properly accounted for and even with adherence to the proper tuning rules, oscillations in the controllers output are common. The major consequence of this strategy is that the operator is forced to over-apply chemical in order to ensure that off-quality pulp is not produced. Lookup tables and static factors do not capture the true dynamics of the bleaching process required from improved control.

By providing a reliable continuous measurement of these parameters, the pulp mill can avoid over-processing the pulp, thus reducing the amount of chemicals used per ton of pulp produced, as well as increasing the yield of the process. Providing a more reliable “measurement” with greater accuracy and faster, real-time information can realize the following benefits: (i) reduced variability, (ii) reduced chemical and energy usage, (iii) minimized environmental impact, (iv) increased operator confidence, (v) increased productivity, and (vi) improved operability through rate and grade transitions.

A new approach to bleach plant control utilizes a combination of proper placement of inline sensors and the use of multivariable model predictive control (MPC). Transfer function are typically determined by exciting the process, commonly known as bump tests, at nominal conditions that are experience during normal operations of the bleach plant. These transfer functions assume that the bleaching process is linear or nearly linear in the expected operating range. The bleaching process is inherently interactive meaning that there is no 1:1 correspondence to any one single parameter. This is shown below in Figure 2.
Modern Bleach Plant Advanced Process Control utilizing Inline Sensors and Model Predictive Control

The modern bleach plant, in order to stay competitive must be operated with advanced control to achieve both quality objectives and at an economic minimum. By taking advantage of advances in technology, not only can the implementation time be reduced but greater benefits can be achieved. The bleaching process as shown above is a highly interactive process and in control terms, can be desired as a multi-input, multi-output (MIMO) process. The real value to this control approach is that you can then consider the bleaching process, typically made up of 3 to 5 stages, as one single entity rather than a collection of independent and isolated control loops. MPC controllers provide both control and economic optimization of processes that have significant interaction between variables. The controller incorporates a model of the bleach plant process and determines how to adjust the individual controller’s output in order to bring all process variables to the desired set points while operating within process constraints. Then, if there are any degrees of freedom remaining, the controller adjusts the process to optimize the overall operation. For example, reducing overall chemical costs while maintaining quality targets.

The design of a bleach plant controller utilizing an MPC strategy would have the following considerations:

**Delignification (D0)** – The primary control objective for the first stage of the bleach plant is delignification through oxidation of lignin in the pulp. This stage works in close association with the alkaline extraction stage, where the chlorinated organic compounds produced in the first stage are dissolved, made soluble, and removed in the extraction stage washer. The control strategy for this stage uses both feedforward and feedback control. The inlet kappa number is used as the primary feedforward variable, and the brightness reading after the extraction stage is used as the primary feedback variable. The controlled variable (set point) may be either degree of delignification or an actual brightness target. Based on the operator-entered target, the control program will adjust the total equivalent chlorine (TEC) set point to maintain a constant degree of delignification.

**Extraction (Eop)** – The primary control objective for this stage is to solubilize lignin made susceptible to alkali by the delignification stage. In addition, oxygen and peroxide may be added to provide further delignification.
Modern Bleach Plant Advanced Process Control utilizing Inline Sensors and Model Predictive Control

and to provide some additional brightening of the pulp. Stock Tracking is used to provide accurate feedforward application of sodium hydroxide based upon applied total equivalent chlorine. However, the key control variable for this stage should actually be the terminal pH in the extraction tower. This is often a difficult measurement due to the use of countercurrent dilution water, so a pre-tube pH sensor is often used in conjunction with the coordinated amount of TEC applied in the first stage. This is known as the Caustic to TEC ratio and can provide a good indication of the required caustic dosage. Feedback from the pre-tube pH is used as a trim.

**Brightening (D1)** – The most successful method of controlling final brightness is to place an optical sensor after the E stage washer and prior to any chlorine dioxide injection. This sensor is used to determine the real-time brightness value. Chlorine dioxide addition is based on the developed relationship between this measured brightness and the desired final brightness set point. Brightness is a preferred variable due to the low levels of remaining lignin at this point in the process. Changes to both cooking and oxygen delignification process have made the traditional DEK value to be often less than 1. In the lab, this results in less than one drop of potassium permanganate and can be highly inaccurate. This relationship varies from mill to mill and can be tuned from the engineering schematic on line. This stage is extremely important in the bleaching of shives. Tight pH control of the stock is also maintained due to its strong impact on the efficiency of chlorine dioxide bleaching. From a bleaching efficiency standpoint, sequential Kappa factor over the entire process is also controlled. This is a totaling of all the oxidants used, converted to their equivalent chlorine values divided by the incoming Kappa. This strategy also lends itself to economic optimization since the cost of chemicals can also be a controlled variable.

The design of the controller then follows the functions of the bleaching process. A MPC model for a typical bleach plant is shown in Figure 4

**Figure 4 Profit Controller Development Environment**

**DO Stage**

**DV1 UNBLEACHED KAPPA**

This measurement is known as a disturbance variable (DV). The purpose of this sensor is to measure the total bleaching load to the bleach plant. The location of the sensor should be after the first press but before any chemical addition. It is assumed that the discharge consistency off the press will be 12%. The preferred location
as shown in Figure 4 is after the standpipe. This will only be applicable if there is room to locate the sensor before chemical addition. The requirements for sensor location are that the line is completely full of stock and a representative sample can be taken in close proximity to the sensor. Sufficient clearance (3-4 feet) should also be available in order to extract the sensor probe for maintenance and checking. The issue with a periodic laboratory kappa test, or even one from an analyzer, is that a typical calibration does not address any carry over with pulp and the fact that the response to chemical addition is non-linear and is different if the kappa is high or low and is also species dependent. One alternative is to bias the kappa measurement by some amount. The chart below, Figure 3, shows a linear calibrated kappa with a potential plant derived kappa data and a best fitted curve. The extended kappa curve has the following setting, min., max., knee, and shoulder and slope adjustment. This versatility allows one to adjust the bias in any shape or form. It is also felt that improved performance can be obtained through the use of an inline measurement rather than a sampling analyzer. Van Fleet first introduced the procedure of a continuous optical measurement of kappa in 2001 (6) BTG has further refined the concept of a Bleach Load Transmitter by introducing the BLT-5400 which uses a UV light source to measure both the dry fiber lignin and the “wet” lignin, or the lignin contained in the mat squeezing. This is not a washed sample and therefore gives a total bleach load or demand for the pulp.
The purpose of the pH sensor is to be used as feedback to the sulfuric acid control loop. It is our experience that the reaction time of the acid is very fast so the location of the sensor should be downstream of the acid and chlorine dioxide injection point but before the actual D0 tower. It is important to note that the objective is to control the pH conditions in which the chlorine dioxide will be reacting in order to optimize the delignification process (5). The process dynamic for pH control at this point are so fast that a well design and tuned controller at the DCS level will be satisfactory for feedback control.

**CV1 PRE TOWER RESIDUAL**

The purpose of this residual sensor is to ensure that a minimum amount of chemical (chlorine dioxide) exists before the stock enters the D0 tower, as well as making sure that a maximum (for safety reasons) has not been exceeded. This value is known as a controlled variable (CV). In conjunction with the intermediate feedforward kappa factor and sequence kappa factor control strategies, this signal is incorporated into a range control.
algorithm such that a specific residual target is not the control objective. This is important to location since conventional strategies attempt to define sensor location as a function of the “color development” of the stock and therefore introduce a time from chemical addition dependency. This complicates the control strategy in that a compensation term must be applied which corrects for the time/distance from chemical addition, concentration and production rate. By using the range control approach, the residual signals allowed to float between the maximum and minimum values without trying to control to a specific target. This also takes into account any impact that upstream temperature or washing efficiencies may have. The location should be convenient from a maintenance point of view and located after the chemical addition and before the entrance to the tower.

![Sensor locations diagram]

**CV2 Eop tower pH**

The purpose of the pH sensor is to be used as feedback to the caustic control loop. It is our experience that a feed forward from chemical (chlorine dioxide) is required to maintain the stoichiometry and also to get the pH in the proper range. A pH feedback loop is applied at this point after any oxidizing chemical addition to maintain the pH within some control limit. A typical control range in a bleach plant is around 11.0 to 10.9, with a feed forward from chlorine dioxide dosage the pH target range can be reduce from the reduce from the typical to 10.8, 10.7 range. Other condition will affect the target range, for example the amount of water dilution added and the corresponding pH of that water. Each plant is different in that sense. The caustic addition by itself produce a reduction in DEK or an increase in brightness after the stage, therefore maintaining the pH constant will help in keeping the overall (D0 & Eop) brightness gain constant.

**CV3 Eop tower brightness**

The purpose of the brightness sensor is to be used as feedback on peroxide in the Eop tower in a short term and to the extended Kappa factor in the D0 stage on the long term, the scheme would then bring back the peroxide
dosage to a desired value while compensating with the Extended Kappa factor to maintain the Eop brightness within a control range. Of course this scheme is all coordinated taking into account process dead time and dynamic into consideration. The main issue with this control scheme is the calibration of the on-line sensor, any drift or offset from time to time is very detrimental to the desire outcome. Any of the events above would create the operation to start a hunting target range to maintain their brightness test at their specification, also it will prevent any shift in target downward in an attempt to reduce chemicals usage. The brightness is a much more precise test then the DEK test has show below, the correlation is very low if non existent in this case.

Figure 7 Comparison of CEK vs Eop Brightness
CONCLUSION

The use of MPC combined with inline sensors can provide improved control of the bleaching process. This approach allows for a lower installed cost when compared to using samplers and analyzers and also allows for a reduced implementation and maintenance cost. Gone are the need for look up tables and the requirement for arbitrary operator feedback. This innovative application addresses the increasing business complexity and profitability pressures by effectively managing all aspects of control and optimization of the bleaching process. From improving regulatory loop control to optimizing the entire bleaching process, this method improves pulp quality, reduces chemical usage and maximizes production while integrating the entire bleaching process to drive mill-wide optimization. With improvements in the reliability of sensors and the ease of implementing MPC, benefits of this approach have yielded savings of 5-8% as measured by lower bleaching costs.

References

5. Hart, P and Connell “Improving Chlorine Dioxide Bleaching Efficiency by Selecting the Optimal pH Targets” proceedings from the 2005 Engineering, Pulping and Environmental Conference
An Age Old Challenge

“The need for dependable and accurate meters and instruments for application to the many phases of pulp and paper making is well recognized by everyone connected with the industry”

TAPPI - Technical Association Papers - Twelfth Series, May 1929
Modern Bleach Plant Advanced Process Control using Inline Sensors and Model Predictive Control

Rick Van Fleet, Honeywell
Michel Dion, Honeywell
Sandy Beder-Miller, BTG Americas
Tom Biazzo, BTG Americas

International Pulp Bleaching Conference October 6, 2011
Bleaching Has Changed!

- Bleaching control concepts are rooted in chlorine/chlorine dioxide configurations of the pre-1990’s
  - Kappa numbers into the bleach plant were higher, pre EMCC, O2 Delig
  - up to 30 Kappa, now around 18 or lower
  - DE Kappa were 5 to 6, now are well below 2

- Not much lignin to measure!
D0 Kappa Factor Control

- NaOH
- Steam
- Cl
- ClO₂
- H₂SO₄
- H₂O₂
- O₂

Compensated Brightness, Mode 1

Kappa Factor, Mode 2

Compensated Brightness, Mode 1

ClO₂ % Substitution

Mode 0
% Applied, SP
Manual

0 – 100%
SP, x

Auto
Mode 1

Auto
Mode 2

KF
SP

Compensated Brightness, Mode 1

Tracked Tonnage to subsequent stages, TON

NaOH Steam Cl₂ ClO₂

H₂SO₄ H₂O₂ O₂

FFIC

FFIC

AI

FFIC

FFIC

RT BT XT

ph

Compensated Brightness, Mode 1

Kappa Factor, Mode 2
Typical 2011 Bleach Plant Configuration

- Kappa Analyzer & Washed Brightness
  - Measuring from the digester, pre and post O2 Delig, Bleach Plant through the Eop stage
  - Washed sample, no carryover measured
  - Need faster update time for Kappa Factor control, can adjust polling
  - Regular maintenance crucial for high uptime.
Kappa Factor Limitations

- Response to chemical addition is non-linear
  - different if the kappa is high or low
  - species dependant
  - Operator “bias” often a requirement
  - Based on “bound lignin” only
  - Black liquor solids from washer carryover- “dissolved lignin”- also consumes delignification chemicals in 1st stage.
Introduction to Bleach Load

The Optical Bleach Plant:

- Joint development project between Honeywell and BTG
- Based on UV measurement
- Provide separate inputs for lignin and black liquor solids.
- “Bound lignin”- optical
- “Dissolved Lignin”- optical
- Sum is known as “Bleach Load”
Bleach Load

- Uses an optical in line sensor that measures both dry fiber lignin and wet lignin (lignin in the washer mat squeezing)

- Measurement must be taken before chemical addition
Bleach Load Calibration

Example of Bleach Load Transmitter Results

- Sensor Output vs. Lab Fiber + Wet Kappa
Adjustments to KF Control

- Chart below shows a linear calibrated Kappa.
- This versatility allows adjustment of the bias in any shape or form.
Eop Control

- NaOH
- Steam
- Cl₂
- ClO₂
- H₂SO₄
- H₂O₂
- O₂
D1 Control

- **Common configuration:**
  - Kappa Factor
  - Compensated brightness

- **Alternative:**
  - Use real time brightness
  - $\text{ClO}_2$ addition based on real time relationship of incoming and final set point brightness
  - Place sensor after Eop Washer and before chemical addition
D₁ Stage Control

- Compensated Brightness, Mode 1
- Bright-DEK Factor, Mode 2
- FTIC
- Split Range
- KF
- SP
- Tracked Tonnage From BP Feed
- FFIC
- AI
- RT
- pH
- XT
- BT
- S
- K

Reactants:
- NaOH
- Steam
- Cl₂
- ClO₂
- H₂SO₄
- H₂O₂
- O₂

Final Brightness Monitoring To Pulp Dryer

To HD
Feed to Eop Brightness

Calibration results

Adj\(r^2\)=0.869
Std Error=1.47
What is Different From Compensated Brightness???

- CB is a weighted linear function
- Require Brightness Indication BEFORE Chemical addition
- Residual used as a constraint variable if available but not used in the calculations
CEK vs. Brightness

\[ y = -0.5424x + 81.563 \]

\[ R^2 = 0.0027 \]
Bleaching or Delignification?

KAPPA after COOKING

KAPPA REDUCTION
60 %
KAPPA FEED FORWARD AND
FEEDBACK CORRECTION

KAPPA REDUCTION
50 %
KAPPA FEED FORWARD AND
BRIGHTNESS FEEDBACK
CORRECTION

BRIGHTNESS FEED FORWARD
AND/OR FEEDBACK
CORRECTION

Final
Brightness

Bleached Pulp
Kappa

O2-DELIGN. 1-STAGE 2-STAGE 3-STAGE 4-STAGE
Process Dynamics – Bleaching

- Stock Flow
- Chlorine Dioxide Flow
- Incoming Kappa
- Residual
- Brightness
- Reaction Rates
Bleach Plant /MPC Design - DELIGNIFICATION

- 
  - Chlorine Dioxide
  - NaOH
  - MV02
  - MV03
  - MV04
  - DV01
  - MV01
  - CV01
  - CV02
  - CV03
  - MV02
  - O2
  - H2O2
Step Response Trials
### MPC CONTROL MIMO - D0/E1

<table>
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<th>MV / DV</th>
<th>CV</th>
<th>MV01 D0 ClO2</th>
<th>MV02 E1 NaOH</th>
<th>MV03 E1Oxygen</th>
<th>MV04 E1 Peroxide</th>
<th>DV01 Incoming Kappa</th>
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The table above shows the control variables and manipulated variables for the MPC control system in the D0/E1 process. Each row represents a different control variable (CV), and each column represents a manipulated variable (MV). The lines represent the dynamic behavior of each control loop over time.
Eop Bright vs %D1 ClO$_2$ - BASELINE

$R^2 = 0.2032$
Eop Bright vs D1 % ClO₂

R² = 0.8321

% D1 ClO₂

Eop Bright

Series1 Linear (Series1)
Output of D1 Brightness Control
Regulatory Control Only!

\[ R^2 = 0.4973 \]

Remaining mill issues:
(1) Very poor chemical mixing
(2) Poor pH control at this stage
(3) ClO2 Generator Issues
RESULTS

TOTAL CHLORINE DIOXIDE REDUCED BY 5.25%

$400,000/yr   $1.45/adt
**Mill Example of Sequence Kappa Factor**

### Before Control:
- Chlorine Dioxide: 0.217 kf
- Oxygen: 0.122
- Hydrogen Peroxide: 0.086
- Sequence Kappa Factor: 0.425
- Total Cost: $21.95/adt

### After Control:
- Chlorine Dioxide: 0.174
- Oxygen: 0.147
- Hydrogen Peroxide: 0.104
- Sequence Kappa Factor: 0.425
- Total Cost: $19.14/adt

**DELTA**

- Total Cost: $2.75
CONCLUSIONS

- Inline sensors can provide a lower cost alternative to analyzers
- The Bleach Load Sensor is an effective measure of chemical demand
- Post Eop brightness is an effective control variable
- MPC can be used to lower bleaching costs
Questions?
LETTERS TO THE EDITOR

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http://www.isa.org/~pupid/

**ISA Pulp & Paper Technical Discussion Forum**  
http://www.isa.org/scripts/lyris.pl?enter=pupid&text_mode=&lang=english

**ISA Technical Conference Session Schedule**  
http://www.isa.org/Template.cfm?Section=Conferences_and_Exhibitions&template=taggedpage/conferencesbydate.cfm&icid=61

**Pulp & Paper Research Institute of Canada**  
http://www.paprican.ca/

**TAPPI**  
http://www.tappi.org/

**PIMA**  
http://www.pimaweb.com/

**American Forest and Paper Association**  
http://www.afandpa.org/

**National Society of Professional Engineers**  
http://www.nspe.org/

**Swedish Royal Institute of Technology**  
http://www.pmt.kth.se  
http://www.hit.fi/English/

**Helsinki University of Technology**  
http://www.hit.fi/English/

**Technical Association of the Australian and New Zealand Pulp & Paper Industry (APPITA)**  

**Australian Pulp & Paper Institute**  

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Get a quick overview of ISA PUPID events for 2002 by going to the Calendar at:  
http://www.isa.org/~pupid/2002_PUPID_Calendar.htm
**WORLD CORNERS**

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<td>Nothing from anyone there this time!</td>
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<tr>
<td><strong>Central &amp; South American Corner</strong></td>
<td>Nothing from anyone there this time!</td>
</tr>
<tr>
<td><strong>Far East Corner</strong></td>
<td>Nothing from anyone there this time!</td>
</tr>
<tr>
<td><strong>From The Land Of The Midnight Sun</strong></td>
<td>Nothing from anyone there this time!</td>
</tr>
<tr>
<td><strong>European Corner</strong></td>
<td>Nothing from anyone there this time!</td>
</tr>
</tbody>
</table>
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