

**REVISED 8/29/06**

**2006 Engineering, Pulping & Environmental Conference**

**11/5/2006 - 11/8/2006**

**Marriott Marquis**

**Atlanta, GA**

11/5/06

**Session: 1**      **8:00 a.m. – 12:30 p.m.**  
**Eucalyptus Workshop**  
**(supplemental fee to attend)**

**Session 2:**      **8:00 a.m. – 4:00 p.m.**  
**Bleach Plant Workshop**  
**(supplemental fee to attend)**

**Session 3:**      **1:00 p.m. – 5:00 p.m.**  
**Process Simulation/Engineering Valves Design Tutorial**

**Session 4:**      **2:00 p.m. – 5:00 p.m.**  
**Recycling Workshop**  
**(supplemental fee to attend)**

11/6/2006  
**Session: 5**      **8:30:a.m. - 10:00:a.m.**  
**Opening Session-Awards/Keynote**

**Session: 6**      **10:30:a.m. - 12:30:p.m.**  
**Nonwood Pulping**

**Session Chair**

Jairo Lora, GreenValue SA

- 6 - 1      10:30 am      **Chemical and Pulp Characteristics of Corn Stalk Fractions**  
Medwick V. Byrd, Jr., North Carolina State University, Speaker  
Sean M. Warby, North Carolina State University  
Whole corn stalk (stover) was separated into three fractions: stalk, leaves, and husks. Each fraction was milled and tested for ash content, cold water solubles, hot water solubles, NaOH solubles, solvent extractables, and klason lignin content. With respect to lignin content, the test values showed that stalks > leaves > husks. Ash content values were similar for all three fractions. The leaf fraction had higher levels of all solubles, compared to the other fractions. The stalk fraction had the highest level of solvent extractables. Each fraction was pulped, using a soda-AQ process. The yield and fiber properties of each resulting pulp sample were compared
- 6-2      11:00 am      **The Spanish "Biovid" Project. An Ecological Way for Producing Pulp From Residual Vine Shoots**  
Alberto Ganzalo, University of Zaragoza, Speaker  
The "Biovid" project started on 2003, focused on providing a clean alternative for vegetal remainders produced as a residue from the wine production. The project has included the implementation of a plant that transforms vine shoot into pulp viable for papermaking, with a production of 5000 tons pulp/year. A prototype digester was built for the project, using caustic soda and low pressure steam (for indirect heating), and operates at low temperature and atmospheric pressure, which contributes to simplicity and safety at work. The digester was placed in an industrial premise, close to the vineyards. Previous bench scale tests, Table I, and first results obtained in the plant, show that the resulting paper, obtained after cleaning and refining the pulp, has enough quality for being introduced in the normal channels of distribution and commercialisation. It is necessary to notice that this pulp requires a longer time and more concentrated caustic soda concentrations than other non-wood pulp productions.
- 6 - 3      11:30 am      **Two-step Rice Straw Processing - A New Concept of Silica Problem Solution**  
Jan X. Pekarovic, Western Michigan University, Speaker  
Alexandra Pekarovicova, Western Michigan University  
Two-step rice straw processing, as a new concept of agricultural by-product utilization, is presented. The first step includes wet removal of ash/silica, second step conventional non-sulfur high-yield pulping. The mechanical properties are shown and compared with the properties of conventional rice straw pulp (fluting). Removal of solubilized silica from black impregnation liquor and reuse of this biosilica-enriched filler in final product is an important supporting step. Overall material balance is a part of study.
- 6 - 4      12:00 pm      **Hardwood CMP Pulp Improvement By Wheat Straw Chemical Pulps**  
Hossein Resalati, University of Gorgan, Speaker  
Agri-pulp production from agricultural residues, such as wheat straw, and their utilization in blends with wood based fibers, appears to be the most practical means to supplement the fiber needs of the paper industry. In this respects, the effects of up to 30% wheat straw soda and soda-oxygen semi bleached pulps in blend with local mill made mixed hardwood CMP pulp, on the optical and strength properties of newsprint, have been investigated at laboratory scale. In addition, the effects of agri-pulp on the possible reduction of imported softwood chemical pulp will be presented.

11/6/2006 10:30:a.m. - 12:00:p.m.  
Session: 7 The State of the North American Pulp and Paper Industry

**Session Chair**

Tom McDonough, Professor Emeritus, IPST

- 7 - 1 10:30 am **State of the North American Pulp and Paper Industry "The Innovation Imperative"**  
Jim McNutt, CPBIS at Georgia Tech  
The North American Pulp and Paper Industry is not the low-cost producer on most grades, and high-volume grades have significant substitution threats. In addition, a large share of N. A. assets are aging and approaching the end of their economic lifetime. Participants must learn to thrive under these negative conditions. The overall industry will probably not fare well, but the individual companies can thrive if they use the next short-term upturn to embrace and leverage innovation. Innovation is imperative to create value. Typical North American pulp and paper companies have shutdown their innovative capacity (if it ever existed). As a result, in part, industry performance has been dismal. Investment is spiraling downward and competitiveness is eroding. However, individual suppliers and paper companies can leverage innovation to outperform the industry and create value. To restart the innovation machine, we need to open the culture to allow practices that drive innovation, become more comfortable with different risk/return ratios by adopting an investors' mentality of portfolio management, and become more intellectual through leverage of market-driven inventing and valuation/portfolio management tools.

11/6/2006 10:30:a.m. - 12:30:p.m.  
Session: 8 Recycling - Stickies

**Session Chair**

Mahendra Doshi, Progress in Paper Recycling

- 8 - 1 10:30 am **Establishing the Techniques to Relate Paper Machine Runnability Issues to Colloidal Microstickies**  
Daniel R. Haynes, EKA Chemicals Inc, Speaker  
A new technology that measures colloidal organic solids has been developed by the IPST at Georgia Tech. This paper will review how the accumulated colloids from pulping can be related to paper machine runnability. The colloidal organic material manifests itself in several visible ways such as stickies, deposition onto wires, foils, and felts, sheet holes, and build-up on scanners. The objective of this paper is to show how protocols can be established for monitoring this dynamic process of colloidal organic material and relating these measurements to paper machine runnability.
- 8 - 2 11:00 am **Addressing the Nature of Stickies in Deinked Pulp**  
Tiina Sarja, Kemira Chemicals Oy, Speaker  
The state of stickies in deinked pulp is discussed. New information about micro and secondary stickies, their size and distribution, and chemical control in deinked pulp is presented. This knowledge is important for focusing stickies control methods on the right pulp fraction. A new analytical procedure for determining stickies in deinked pulp or deposit was used in the study. The method consists of extraction with tetrahydrofuran followed by HPLC-SEC and ELS detector.
- 8 - 3 11:30 am **How Printing Affects Adhesive Removal During Paper Recycling**  
Carl J. Houtman, USDA Forest Products Lab, Speaker  
Jihui Guo and Steven J. Severtson, University of Minnesota  
Printing processes involve exposure of paper webs to pressure and heat. If the web is a pressure sensitive adhesive (PSA) laminate, the exposure to the printing process can change the performance of the adhesive. The movement of PSAs in laminates exposed to pressure and temperature have been studied. We have found that both viscoelastic properties and wetting behavior can be used to explain our observations. Implication for removing adhesive during paper recycling will be discussed.
- 8 - 4 12:00 pm **Determination of Macro and Microstickies in the Same Stock and Water Samples**  
Robert de Jong, 2 Fiber Consulting, Speaker  
By determining the microstickies content of the first 5 gallons of screenate from the standard TAPPI macrostickies test, it is possible to pinpoint causes for stickies problems due to agglomerated microstickies. The test can be used to determine the formation tendency for microstickies in recycled paper samples (eg labels, waxed OCC) during different repulping conditions. It can also be used to determine the efficiency of the different unit operations in a recycling process to remove or create microstickies (eg screens, cleaners, flotation and/or dissolved air flotation cells). Since the macrostickies and the agglomerated microstickies are retained on the same screen with 0.006 inch slots using the same original sample, it is possible to compare the values obtained for each sample. Preliminary results from an accelerated agglomeration test for microstickies will also be presented.

11/6/2006 10:30:a.m. - 12:00:p.m.  
Session: 9 Bill Babbington Maintenance Roundtable

### **Session Chair**

Jerry Kahn, JK Consulting

Wade Parks, SEPA Automation, Speaker

Jerry Kahn, JK Consulting, Speaker

The Bill Babbington Maintenance Roundtable is an open forum for discussing maintenance and reliability issues in our industry. The focus of this roundtable is on lubrication systems. The Asset Management Committee has developed a TAPPI Lubrication Engineer's Manual, a collection of best practices which offer guidance for achieving world class lubrication practices. An overview of the manual, which is available through TAPPI Press, will be presented at the start of the roundtable.

**11/6/2006**  
**Session: 10**

**10:30:a.m. - 12:00:p.m.**

### **Alkaline Pulping**

### **Session Chair**

Bruce Archibald, International Paper

10 - 1 10:30 am

#### **On the Control of Forming and Cleavage of HexA During Kraft Pulping**

Koki, Kisara, Oji Paper, Speaker

In this study, the activation energies (Ea) for hexenuronic acid (HexA) formation and degradation were determined during kraft pulping of hardwood in constant composition cooks. The results show that Ea of delignification is similar to that of HexA formation, but it is lower than that of HexA degradation. The common suggestion of minimising HexA by an increase in cooking temperature has very small effects on the actual HexA content in xylan.

10 - 2 11:00 am

#### **Effect of Alkali Charge on Eucalyptus Pulping**

Francides Gomes Silva, University of Sao Paulo, Speaker

The objective of this study was to evaluate the limits of the effect of the alkali charge on kraft pulping of industrial chips of Eucalyptus spp. The alkali charge applied varied between 10 and 20 %, with intervals of 1%. The analyzed parameters were: total yield, screened yield, Kappa number, pH, viscosity, lignin content in the pulp and hexenuronic acid content. For all these parameters variation in the results were noticed as the applied alkaline charge changed. The wood density of the wood (average of 5 repetitions) was 0.483 g/cm<sup>3</sup>. For total yield the values varied between 65.4 and 50.6%. For screened yield the values varied between 9.2 and 54.5%. The high total yield and the very low screened yield can be explained by the high content of rejects in some of the pulping conditions, indicating a total consumption of some alkali during the pulping process. The reject content was high for the lowest alkaline charges, but by the 13% of alkaline charge it reached values around zero. For kappa number, the values varied from 82.4 to 13.4. The Kappa number had also high values for the lower alkaline charges. For viscosity the results changed from 807 up to 1225 cm<sup>3</sup>/g and for lignin content in the pulp from 12.7 up to 3.02%. The values of pH varied between 10.3 and 13.7. The hexenuronic acid formed with 10% of alkali was low, and increased as the dosage of alkali charge increased, until about 16%.

10 - 3 11:30 am

#### **How Fiber Dimensions Influence Refining Response and Paper Properties Using Acacia and Eucalyptus as Examples**

Ulla-Britt Mohlin, STFI-Packforsk, Speaker

Three market hardwood pulps; one acacia of Indonesian origin (Acacia mangium) and two eucalyptuses of Iberian and Brazilian origin were refined in an industrial conical refiner. Fibre properties were evaluated using image analysis and microscopy and the drainage characteristics and handsheet properties were related to the differences in fibre properties. The main difference between the acacia and the eucalyptus was that the acacia had thinner fibre walls but about the same surface area per fibre. This resulted in a lower coarseness and a higher degree of fiber collapse. The acacia fibres also had fewer defects. The refining response was slower for the acacia than for the eucalypt and the difference was of the same magnitude as the difference in coarseness. There were no systematic differences in fibre shortening and fines generation between the pulps. Some fibre straightening occurred during refining but differences between pulps remained after refining. WRV was shown to be related to the fibre bonding in the sheet as it correlated with the Z-strength measured as Scott Bond strength and with the calculated material density (derived from the theoretical relationship between bending stiffness, tensile stiffness and density). WRV together with some measurement of fibre defects explained the differences in tensile strength and tensile stiffness observed. The results indicated that the degree of fibre collapse together with the level of bonding developed by refining was responsible for the differences in structural sheet properties, apparent density, surface roughness and air permeability. The differences in fibre collapse between the pulps were however not reflected in the fibre bonding as the WRV could be used as the measure of bonding. This is in contrast to the common belief that fibre collapse makes a positive contribution to sheet strength. The different action of industrial refining compared with laboratory refining may have contributed to the interpretation of the results. The light scattering ability was shown to be influenced by the inverse of wall thickness. Together with WRV as the measure of bonding all the differences observed in light scattering coefficient could be explained with a simple linear regression model. This relationship was further strengthened by some additional pulps that were tested at other occasions. It is also easier to identify the effect of wall

thickness on light scattering when the fibre walls become thinner; for thicker walls the fibre bonding component in the regression may dominate. The number of fibres and the amount of fines are the explanations usually offered for the improved light scattering of acacia (1, 3). All the results indicate that pulps containing fibres with thin fibre walls like the acacia pulp are interesting fibre sources for high-quality printing papers. The relationships between fibre properties and sheet properties revealed in this study may lay the ground for a further development of new fibre sources.

**1:30:p.m. - 3:00:p.m.**

**Session: 11      Understanding Materials Performance – How to Save Your Mill Millions of Dollars Panel**

**Session Chair**

Chris Thompson, PAPRICAN

The Corrosion and Materials Engineering (C&ME) Committee has produced much useful engineering information over the years, in a determined effort to help mill engineers manage their corrosion and materials issues. Some of this information may not be as well known as it deserves to be. In this panel discussion, the sub-committees of the C&ME will review their key technical contributions and consider future challenges. The main objective of the panel is to show people the wealth of material available to help them control corrosion in the pulp and paper industry.

**11/6/2006**

**1:30:p.m. - 3:00:p.m.**

**Session: 12      Nonwood in Papermaking**

**Session Chair**

Bob Hurter, HurterConsult Inc.

12-1      1:30 pm

**Pulp and Paper Production from EFB Using a Semichemical Process**

Alberto Gonzalo, University of Zaragoza, Speaker

Nowadays, Malaysia and other countries from Southeast Asia, represent the main nucleus of palm oil production in the world. This country, more specifically, produces 11.6 MM tons palm oil/year which generates more than 44 MM tons/year of a residue known as EFB (Empty Fruit Bunches). At this moment, only a small percentage of those EFB are used, mainly as fuel, being the remainder stored in dumps, where many times spontaneous combustion is produced due to fermentation. A different way for its valorization, apart from the energetic one, has been studied in this work, which consists in the pulp production. The pulp from EFB has been produced, using a semichemical process with sodium hydroxide in a bench scale plant. Different papers were made by mixing this pulp with a commercial fluting one, in percentages of 100% EFB, 75% EFB, 50% EFB and 25% EFB pulp, achieving results quite similar to those of paper made of 100% recycled paper. On the other hand, a part of the paper made by 100 % EFB pulp has been repulped after four weeks, for a new production in paper machine. Physical tests do not show a significant change of the paper properties after repulping.

12 - 2      2:00 pm

**Refining Response of Wheat Straw Pulp and Woodpulp Blends**

Wade Chute, Alberta Research Council, Speaker

The response of commercial wheat straw soda-AQ pulps to both laboratory beating and commercial refining was observed versus three hardwood (acacia, aspen, eucalyptus) and two softwood (spruce, radiata pine) market kraft pulps. Tested parameters include Canadian Standard Freeness, PQM fibre length distribution, shive content, handsheet strength (tear, tensile, stretch, burst, TEA), Bendtsen roughness and air permeability. Blend systems containing wheat, hardwood and softwood pulps at constant refiner specific energy were also prepared and tested in order to observe the impact of wheat pulp substitution on the physical characteristics of the blend. For the wheat-aspen-spruce system, blends were also prepared when the refiner specific energy for each furnish was different, providing additional insight into the commercial application of blends containing wheat pulp. Due to the lower bleached brightness of the sourced wheat straw pulp versus the wood pulps, comparison of optical properties was not possible.

12 - 3      2:30 pm

**Observations on Commercial Papermachine Runs with Atmospherically Produce Wheat Straw Pulp**

Mark Lewis, University of Washington, Speaker

Two successful commercial trials were completed with wheat straw pulp produce under atmospheric pulping conditions. The grades of paper produced were both unbleached paperboard grades. The first trial was run with 25% substitution for secondary fiber and the second trial was with a 35% substitution. Both trials showed strength increases and a cleaner brighter appearance to the board.

**11/6/2006**

**1:30:p.m. - 3:00:p.m.**

**Session: 13      Trends in Global Paper Demand & Industry Innovation**

**Session Chair**

Colleen Walker, CPBIS at Georgia Tech

13 - 1 1:30 pm **Shifts in Regional Demands for Pulp and Paper: Implications for the North American Industry**  
Patrick McCarthy, School of Economics, Georgia Tech, Speaker  
This analysis focuses on pulp and paper demands among four major consuming and producing regions of the world: Asia, Europe, North America Free Trade Area (NAFTA), and South America. Based upon data that span a forty-two year period, 1961 ... 2002, the paper documents the growth of paper demands and the relative shifts in market shares across product categories. The paper also reports the results of statistical demand models that estimate the role that per capita income and product prices have on per capita pulp and paper demands. Among the preliminary results, the analysis finds that the effect of per capita income depends upon product category and geographical region. Further, in total and for all product categories, increases in per capita income have a much larger impact on consumption in Asian (largely driven by China) relative to NAFTA (largely driven by the US) countries, suggesting that existing trends will continue into the foreseeable future.

13 - 2 2:15 pm **The Role and Value of Innovation in the Pulp and Paper Industry**  
Vivek Ghosal, School of Economics, Georgia Tech, Speaker  
In an era of rapidly changing international markets and global overcapacity, it is vitally important for the U.S. pulp and paper industry to understand how innovation impacts their long-term profitability and competitiveness. The primary goals of this project are to analyze innovations and adoption of new technologies in the pulp and paper industry. By focusing on innovation, we seek to gain insights into the key channel via which companies seek to enhance their cost-efficiency and competitiveness. We also identify some economic drivers of innovations in the pulp and paper industry and evaluate costs and benefits. The secondary aim of this project is to compare the twin strategies of innovation and mergers and acquisitions (M&As), quantify their relative impacts and shed light on which strategy may provide a bigger bang for the buck in improving the competitive position of firms. We have developed a database containing information about firm-level innovations and technology adoption and M&As in the industry, and are analyzing how innovations impact the productivity and competitiveness of firms in the industry after controlling for the impact of mergers and acquisitions. The project will aim to develop a set of recommendations to enhance firm productivity and profitability.

11/6/2006  
Session: 14 1:30:p.m. - 3:00:p.m.  
**Optimizing Chip and Fiber Quality**

Session Chair  
Bill Fuller, FRM Consulting

14 - 1 1:30 pm **Advancing The Fibre Value Chain - An Overview of Paprican's Fibre Supply and Quality Research Program (REMOVED FROM PROGRAM 8/11 – BILL IS CHECKING TO SEE IF HE CAN PRESENT THIS PAPER, DUE TO IT BEING IMPORTANT TO THE SESSION)**

Paul A. Watson, PAPRICAN, Speaker

The current model for business success in the forest products industry, cost minimization and superior customer service, may not be enough to ensure survival in the longer term. A holistic approach is needed which considers the forest products value chain as a whole and focuses on margin, rather than cost reduction by individual unit operations. Such an approach brings together leading edge developments including value chain optimization modeling, on-line wood and fibre quality analysis tools, and information on the sources of variability of fundamental wood and fibre properties. Armed with this suite of technologies and information, it is possible to both optimize processes and to develop new products based upon wood and fibre segregation. Paprican and it's collaborators are at the forefront of these developments. We have shown that it is possible to map wood and fibre properties variability as a function of variations in site quality. We have implemented and are continuing developments of the next generation of low-cost on-line wood and fibre properties analysers. And we have developed a value chain model for the pulp and paper industry which clearly shows the financial benefits of chip segregation based on fibre properties quality under a variety of market conditions. To further these goals, and building upon our expertise in wood and fibre, we have, in collaboration with the Canada Foundation for Innovation and the British Columbia Knowledge Development Fund, recently developed EvaluTree. This unique suite of state-of-the-art technologies will increase the accuracy and throughput of wood and fibre analyses.

14-2 2:00 pm **Utilization of Optical Wood Chip Analyzer in Pulping and Chipping Processes**  
Ari Havu, Metso Paper, Speaker  
Wood chip analyses have traditionally utilized the TAPPI and SCAN mechanical test methods. Although hand-sorting chips is the most accurate method of measuring chip size distribution, it is labor intensive and time consuming. Consequently, the test results are not used in on-line process control. Mechanical devices that simulate hand-sorting chips are typically used to improve productivity and practicality. However, these devices introduce result variability and are expensive to maintain due to component wear life and calibration problems. Measuring devices based on machine vision can be used to measure all three dimensions of the wood chip simultaneously. The result is width, length and thickness distributions from a test sample of wood chips that can present results in various forms. The results can be sorted to emulate a TAPPI or SCAN report or they can be configured to provide customized reports to assist in studying specific issues. A chip quality analyser can be equipped with an automated sampler to provide continuous analysis of chip flow to assist in monitoring the chipping process, purchased chip supply, or controlling digester parameters. Further, when the device is equipped with a special conveyor, several

separate samples can be loaded on to the conveyor for automated analysis. This is a useful way to measure samples from various locations or to analyze the quality of purchased chips. Modern optical chip analysers provide extremely accurate measurement of all the chips in the sample, quickly, with very low maintenance, and very little manpower. This paper presents an overview of an optical chip quality analyser and highlights two modern Finnish installations successfully utilizing this technology.

- 14 - 3    2:30 pm    **Chip Quality - Moving Forward, But Still in Need of Improvement**  
Alastair A. Twaddle, International Paper, Speaker  
Many US companies have made significant progress in their chip quality programs over the last few years. Much of this has been associated with improvements in sampling methodology that have allowed more confidence application of chip quality measurement results. Mechanical chip classifiers have been static in their development over the last decade and continue to present a limitation in data quality. Thickness measurement systems dominate as companies attempt to better link chip size distribution to pulp yield and quality although suspicion remains that models often are more directionally correct than predictive. Most gains in chip quality have been through attention to the relationship between supplier and customer.

11/6/2006    1:30:p.m. – 2:30:p.m.  
Session: 15    **Process Simulation/Engineering I**

**Session Chair:**  
Luc Laperriere, UQTR

- 15 - 1    1:30 pm    **Strategies for Optimizing Pump Efficiency and LCC Performance: "Process Pumps Are the Largest Consumers of Energy in a Typical Pulp and Papermill -Boosting Their Efficiency is a New Avenue to Reduced Plant Operating Costs"**  
Mike Pemberton, ITT Goulds Pumps / PumpSmart Control Solutions, Speaker  
In today's global economy, plants are under constant pressure to reduce operating costs. Recent studies have shown that average pumping efficiency in industrial plant is less than 40%. Pump over-sizing and throttled valves are identified as the two major contributors to this sizeable efficiency loss. Process pumps, depending on type, have mechanical designs that allow high efficiency operation. Although, initial system design and process conditions often result in pump operation far away from its best efficiency point. The application of variable frequency drives, with embedded pump intelligence, allow for smoother transitions such as start-ups and production changes, tighter control during process operation, and faster diagnostics of potential system problems before product quality or process operation is negatively affected. Case studies have shown that the application of an intelligent pumping system can achieve 30% to 70% reductions in energy and maintenance cost, while improving both pump and process reliability.
- 15 - 2    2:00 pm    **An Outline of Sensor-based Condition Monitoring Techniques for Hydraulic and Lubricating Systems in Pulp & Paper Applications.**  
John K. Duchowski, HYDAC Technology Corp., Speaker  
Shea A. Ceriello, ISOPur Fluid Technologies  
The increasingly complex nature of machinery in present day industrial environments demands new and sophisticated maintenance practices that evolve with application requirements. Capital expenditures on equipment and fluids have put pressure on OEMs and plant operators to increase the longevity of hardware components and extend fluid service life. This paper describes a sensor array for monitoring properties of interest on a pulper lubricating system at a major industrial facility in Quebec, Canada. The distributed system is built on a Web platform that allows for real-time trending of equipment environment and can be accessed remotely with the aim of arriving at the optimal predictive maintenance practices.

11/6/2006    1:30:p.m. - 3:00:p.m.  
Session: 16    **What to Do With the Sludge (joint Environmental/Pulping)**

**Session Chair:**  
Terry Bliss, Hercules Inc.

- 16 - 1    1:30 pm    **Improved Sludge Dewatering with Cyclodextrins**  
Sujit Banerjee, IPST at Georgia Tech, Speaker  
Bradley H. Hartong, IPST at Georgia Tech  
Cyclodextrins are relatively inexpensive structures that are constructed from sugar molecules. They have a hydrophobic cavity and a hydrophilic surface and have been used commercially for odor capture, drug delivery and other applications. We have found that these chemicals increase both the rate of dewatering and the final solids of primary and secondary sludge. Laboratory work and a full-scale mill trial showed that cake solids increased by up to three percentage points.

- 16- 2 2:00 pm **Evaluation of treatment methods for deinking mill sludge**  
Akpojotor Shemi, Georgia Inst. of Technology, Speaker  
Jeffery S. Hsieh, Georgia Inst. of Technology  
Evaluation of treatment methods for deinking mill sludge Abstract We reviewed current methods of treatments for deinking mill sludge. We considered reduction of sludge volume prior to landfilling or incineration. Reduction of sludge volume involves the recovery of reusable fiber and the thickening of the sludge. Thus, both the land demand for landfilling and the energy requirement for burning low consistency sludge are reduced. Optimization of the process of separating fiber from the sludge would determine if the recovered fiber could be reused. We used ash content and brightness of treated sludge to characterize the separation treatment. We treated the sludge by a combination of screening, washing and flotation treatments in different order.
- 16 - 3 2:30 pm **Integration of Oxycair Technology for Pulp and Paper Secondary Sludge Management in Cascades Wastewater Treatment Plant, Kingsey Falls, QC, Canada**  
Annie Veilleux, Cascades, Speaker  
Daniel Gagnon, PhD, Whaddon Water Management  
Oxycair provides a solution to secondary sludge management problems. Using no chemicals, the technology is based on concurrent physical mechanisms. It is an economical alternative to other sludge management methods. The final product is a nearly sterile solution, rich in dissolved oxygen, and containing all nutrients originally in the bacterial cells. It is returned to the bioreactor as a nutrient supplement without causing overloading. An Oxycair technology integration study in industrial WWTP will be presented.

11/6/2006 3:30:p.m. - 5:30:p.m.  
Session: 17 Recycling - Deinking

**Session Chair**

Danny Haynes, EKA Chemicals Inc.

- 17 - 1 3:30 pm **A New Flotation System for High Efficiency at Low Energy Input**  
Marco Pescantini, Comer SpA, Speaker  
In the last two years a number of resources were invested in the development of a new flotation system that would further innovate and perfect the de-inking process. This system would not only eliminate the ink in recovered paper but also diverse contaminants. With regard to the development of a new system we were able to achieve promising results by the removal of a majority of macro and microstickies, PSA, and dirt while controlling the residual ashes on the foams. An important parameter is the recuperation of energy consumption (50% less than various cells present in the market today). The flotation system can be single or multi-level and more flotation devices can be inserted into the de-inking system using diverse configurations. The paper is the presentation of results that were obtained in the pilot project of industrial applications. These results will be shown in comparison to ZERO K the CYBERCEL and other commercial cells. The flotation device ZERO K can be applied to existing cells with simple modifications that can lead to a possible reconstruction and implementation of the existing de-inking systems with low investment and with a drastic reduction in energy consumption. The ZERO K concept can also be applied to reduce contamination of the water system on the DIP line. Data and applications will be presented. \*patent pending
- 17 - 2 4:00 pm **Visualization of Toner Ink Adsorption at Bubble Surfaces**  
Steve R. Duke, Auburn University, Speaker  
Gopal A. Krishnagopalan, Zachery I. Emerson, Auburn University  
Toner ink interactions with bubble surfaces are investigated in laboratory-scale flotation deinking processes using high magnification and high temporal resolution imaging. Stable adsorption of large toner particles and of toner particle complexes were observed at surfaces of stationary and suspended bubbles for several system chemistries. Direct measurements of bubble surface coverage and mass of ink per bubble as functions of residence time and particle size allow evaluation of effects of process conditions on deinking efficiency.
- 17 - 3 4:30 pm **Global Application of Sulphite Based Neutral Deinking Technology**  
Daniel R. Haynes, EKA Chemicals Ltd., Speaker  
Jim S. Merza, Akzo Nobel  
Neutral Deinking has become a reality in the Newsprint Recycle Industry. A unique chemical system that successfully detaches and removes ink from fiber under neutral pH (6.5 – 7.5) has been jointly development between Eka, Paprican and Bowater, Thunder Bay. The technology has been applied on an industry scale at several operations and evaluated globally. The objective of this paper is to review the benefits of the neutral deinking technology, compare the performance of batch vs drum pulpers under neutral conditions and outline the results at the several mill scale evaluations. The review of sulphite based neutral deinking will examine the effects of removing caustic and peroxide from the pulper chemistry on pH, ink fragmentation, ink detachment, residual ink after flotation, and brightness using data collected during implementation of the technology in mill scale evaluations in North American and Asia.



- 17 - 4 5:00 pm **On-line Measurement of Air Content in Pulp and Papermaking Systems. Part I. Application to Ink Flotation.**  
Gilles Dorris, PAPRICAN, Speaker  
An on-line air content probe was installed in a number of recycling mills to obtain insights into the role of aeration on the flotation kinetics of ink particles. A survey of air contents in various commercial flotation cells revealed considerable variations from one type of cell to another. Though injector designs affected air content, furnish type, flotation chemistry and pulp consistency were also found to be very important. Based on mill trials and mill distributed control system data, we have established that changes in bubble size in a given flotation machine were affected principally by the pulp consistency and by the waste paper furnish. Certain papers, such as old magazines, release surface active agents and filler particles during repulping, which minimizes bubble coalescence in a flotation cell. Smaller bubbles were shown to be often, but not always, beneficial for ink removal. Indeed, a switch from one blend of fatty acid soaps to another increased flotation rate despite forming larger bubbles. This observation indicated that not only bubble size, but also collection efficiency, was a very significant parameter of ink flotation rate. The on-line monitoring of air content in commercial cells allows for a better understanding of the role of aeration in flotation, and can be used to optimize flotation operation.

**11/6/2006**  
**Session: 18**      **3:30:p.m. - 5:00:p.m.**  
**Bleach Plant Operations**

Session Chair

Wayne Bucher, WB Consulting, Inc.

- 18 - 1 3:30 pm **Final Chloride Dioxide Bleaching in Multi-Stage Bleaching as an Option for the Production of Very High Brightness and Optically Balanced Pulps - A Comparison of DD Versus DP Bleaching Sequences in the Bleaching of Kraft Pulps**  
V R. Parthasarathy, Canexus Ltd, Speaker  
Gary Brooks, Canexus Ltd  
To produce very high brightness (>92 %ISO) and high whiteness (>90) paper products with low HunterLab "a" and "b" numbers (color index), it is imperative to bring to the papermachines, pulps that are not only very high in brightness but also optically balanced as to their whiteness (L\*) and a\* and b\* values. In addition, the pulps should have a\* and b\* values of 0.3 and 0.3, respectively, when plotted in the CIE chromatic diagram at wavelength coordinates of 450 nm, 550 nm and 610 nm. The use of chlorine dioxide in the final bleach stage of a multi-stage bleaching is discussed with respect to its ability to produce optically balanced pulps that will enable the paper makers to produce very high brightness and whiteness paper products with the use of as little use of Optical Brightening Agents (OBA) as possible. Since bleaching is oxidative chemistry related, when pulps are bleached to very high brightness, the pulp has the tendency to revert and therefore the choice of the chemical used in the final bleach stages to reach the brightness target is very critical. In this paper, the chemistry of two predominant chemicals used in the final bleaching stages, chlorine dioxide and hydrogen peroxide is reviewed and two distinct final bleaching stages, DD and DP are compared with respect to their ability to produce not only very bright and optically balanced pulps but also pulps with low brightness reversion.
- 18 - 2 4:00 pm **Progress Towards Best in Class - A Summary of Bleaching Chemical Consumption Reduction and Optimization**  
Douglas C. Pryke, Speaker  
The paper would cover the following. 1. Problem identification and confirmation 2. Optimize D1 stages with new mixers 3. Eliminate peroxide in Eo stage 4. Vacuum assist idea and trial 5. Install vacuum assist and evaluation 6. Optimized kappa factor control 7. Best in Class Summary
- 18 - 3 4:30 pm **Use of Hydrochloric Acid and a Mixture of Hydrochloric and Sulfuric Acids in the Pre-Acidification of Pulps Prior to Chlorine Dioxide Delignification and Multi-Stage Bleaching**  
V R. Parthasarathy, Canexus Ltd, Speaker  
Gary Brooks, Canexus Ltd  
Recent concerns about hexauronic acids (HexAs) and their influence on ozone and chlorine dioxide bleaching has raised the awareness of acid pretreatment prior to bleaching of hardwood pulps with oxidants such as ozone and chlorine dioxide. Hexauronic acid and Lignin-Carbohydrate Complexes (LCC) that the hexauronic acid associate with are prominent in hardwood pulping. Compared to high Kappa number pulp, the low Kappa number pulps have almost twice HexAs and therefore, extended cooked low Kappa number pulps require rigorous acid treatment prior to chlorine dioxide application. If oxygen delignification is practiced prior to multi-stage bleaching of hardwood pulps, then the pre-treatment conditions would have to be even more rigorous to have an effective bleaching to reach target pulp properties. The acid pretreatment conditions employed while conducive to the removal of HexAs, also initiate acid hydrolysis of cellulose, resulting in yield and viscosity losses in pulp. Acid hydrolysis of cellulose or for that matter the hydrolysis of glycosidic bonds is a pH-dependent reaction and the nature of hydrolysis depends on the type of acid used; strong protic acids like sulfuric acid and hydrochloric acid react differently than aprotic acids like acetic acids. If acid is used just for the adjustment of pH of pulp prior to bleaching, it is not important as to whether a protic or aprotic acid is used. On the other hand if the purpose of pre-acidification is to activate the lignocellulosic structures and to enhance the delignification

of pulp, then the type of acid used is critical since it should not have an adverse impact on the hydrolysis of cellulose. In this paper, the use of hydrochloric acid alone and a mixture of hydrochloric acid and sulfuric acid in pre-acidification of hardwood pulps prior to chlorine dioxide delignification are discussed and the implications on multi-stage bleaching and pulp conditions are outlined. There are two issues to evaluate the effect of the acid used. One is the whether the use of the type of acid will warrant any special metallurgy for transportation and for the reactor and secondly whether the acid will change the characteristics of the pulp adversely. These two aspects will determine the choice of the acid for treatment with pulp. The corrosiveness of sulfuric acid increases as it is diluted and the corrosiveness of hydrochloric acid is a function of salt formation and its association with water (gaseous HCl is for all practical purposes is noncorrosive whereas acid HCl is very corrosive)and does not change when diluted.

11/6/2006  
Session: 19

3:30:p.m. - 5:00:p.m.  
**Nonwood Processing and the Biorefinery**

**Session Chair**

Mark Lewis, University of Washington

19 - 1 3:30 pm

**BioRegional MiniMill Technology- Report on UK Demonstration Mill**

Sue Riddlestone, BioRegional Minimills, Speaker

Agricultural residues are bulky and so best pulped locally on a smaller scale. However there has been no small-scale clean technology to recover energy and pulping chemicals from the black liquor effluent produced when pulping. This effluent has been the cause of much industrial waste water pollution in India and China. The BioRegional MiniMill has been developed as a response to this problem and in order to facilitate manufacture of paper pulp from agricultural residues around the world, reducing pressure on the world's forests. Since 1997 a development programme, in a partnership between environmental organisations and paper companies, has developed new technology and tested it on a large pilot scale in the UK and the Netherlands.

19 - 2 4:00 pm

**A Novel Biorefinery - Production of Pulp, Bioenergy and Green Chemicals from Nonwood Materials**

Pasi P. Rousu, Chempolis Oy, Speaker

A biorefinery concept is introduced as one attractive solution to current challenges in paper industry. The lack of wood in main growing markets and its limitations, poor profitability, and effluents to the water and air are the issues which a novel biorefinery concept can overcome. Many nonwood raw materials are voluminously available in current highly growing paper markets, while they are inexpensive as by-product from agriculture requiring much less transportation than wood. Also fibre plantations based on nonwood plants are cost efficient and even more productive than eucalyptus plantations. As raw material of paper nonwood fibres offer much wider possibilities due to their wider dimensional opportunities than wood. This article focuses on pulping of high quality chemical pulp from typical and some uncommon nonwood materials. Energy is one of the key inputs in pulping. Due to the limitations of fossil fuels and energy inefficient pulp manufacturing processes, pulping has to be based more and more on the use of energy self-sufficient chemical pulping processes to avoid formation of additional CO<sub>2</sub> emissions. Article focuses on energy efficient sulphur-free processing of nonwood materials and production of high caloric value biofuel for energy self-sufficient manufacture of pulp and green chemicals. Pulping, especially nonwood pulping, typically consumes high amount of water, while the great part of it is disposed without efficient recycling and energy recovery. Also the green chemicals dissolved and derived from lignocellulosic materials are lost with these filtrates. In the worst cases pulp mill's filtrates may enter to waterways having very high COD, BOD and AOX loads. Article will focus on the refining and generation of acetic acid, formic acid, furfural, sulphur-free lignin and compound fertilizer, from nonwood materials with the minimum use of water and energy approaching an effluent-free operation. According to recent studies chemical pulping of wood, which is based on wood plantations is very capital intensive and far away from paper markets. This article will enlighten also how a biorefinery, which is integrated directly to paper markets and raw material sources, has high profitability, small capital and operation costs in comparison to state-of-the-art wood Kraft mills.

19 - 3 4:30 pm

**Chemical Recovery in a Nonwood Pulping Process Based on Formic Acid**

Juha Anttila, Chempolis Oy, Speaker

The potential of wood to meet the growing demand for paper is limited in many regions of the world, even with the help of new plantations. Nonwood materials like straw and bagasse are excellent raw materials for paper, as they are available in huge volumes all over the world and they are typically cheaper than wood. The main drawbacks in nonwood papermaking to date have been the environmental problems related to conventional alkaline pulping technology and only fair quality of nonwood pulps. Completely novel processes, such as a process based on formic acid, can provide solutions to the typical problems of conventional nonwood processes. The present article describes the principles of chemical recovery in such a process. The presented results have been applied in the design of a commercial scale nonwood pulp mill. The volatility of formic acid is the core in the chemical recovery of the pulping process based on formic acid. The chemical recovery consists of two major sections: 1) evaporation of spent cooking liquor and 2) concentration of aqueous formic acid by multistage distillation. When the spent liquor is

evaporated, formic acid vaporizes together with water and the evaporation condensates can directly be returned to the process. In distillation, washing filtrates and evaporation condensates are separated mainly into formic acid and water that are returned to cooking and washing, respectively. Approximately 99% of the applied formic acid can be recovered by evaporation and distillation. In addition, acetic acid and furfural are recovered from distillation as valuable by-products. Based on experimental data, the present paper illustrates the favorable features of the evaporation in the nonwood pulping processes based on formic acid. Firstly, the spent liquor does not contain silicates, because silicates do not dissolve into formic acid.

This feature makes it possible to evaporate spent liquor into a high concentration without viscosity limitations and scaling caused by silicates and inorganic cooking chemicals. Secondly, the heat of vaporization of formic acid is only a fraction of that of water. Therefore, evaporation consumes minor amounts of energy. Thirdly, the absence of inorganic cooking chemicals makes it possible to concentrate the spent liquor into extremely high concentrations (>90%). Fourthly, the concentrated spent liquor is an excellent fuel (heat value 22 MJ/kg) and it can be combusted efficiently and independently of the chemical recovery. The combustion produces sufficiently energy to cover the needs of the entire process. The present paper illustrates the performance of distillation by experimental and simulated profiles in the core column. The present article also illustrates how the load of distillation (and consequently the cost of distillation) depends on the other parts of the process. Firstly, the decrease in acid concentration in cooking decreases the demand for concentrated formic acid and, in consequence, the load of distillation. Secondly, liquor-to-solid ratio in cooking has a negligible impact on distillation. Thirdly, the decrease in the quantity of washing water directly decreases the load of distillation.

**11/6/2006**  
**Session: 20**      **3:30:p.m. - 5:00:p.m.**  
**Engineering/Pulping/Environmental NTS**

**11/6/2006**  
**Session: 21**      **3:30:p.m. – 4:30:p.m.**  
**Process Simulation/Engineering II**

**Session Chair:**  
Luc Laperriere, UQTR

21 - 1    3:30 pm    **Replacing Existing Press Section Controls with Open Control Solution**  
Bruce P. Marling, Emerson Process Management, Speaker  
Press Section controls for Paper Machines have historically been dedicated black box solutions provided by the Press Manufacturer. Emerson Process Management has partnered with a press manufacturer to implement the Press Controls on two paper machines in the DeltaV distributed control system. DeltaV is also used as the overall control platform for both paper machines. The graphic interface provides a complete window into the press section operations for the first time. The end results have been better paper quality, decreased variability, increased control system reliability, and ease of operation and maintenance.

21 - 2    4:00 pm    **Effects of Process Variability on Ring Formation in Lime Kilns**  
Teresa M. D'Souza, University of Toronto, Speaker  
Honghi Tran, Joe Repka, University of Toronto  
While flame temperature fluctuations are believed to be the main factor that leads to ring formation in lime kilns, the effect has not been verified due to the infeasibility of obtaining accurate temperature measurements inside an operating kiln where rings form. An indirect approach is needed. Operating data from three lime kilns over several ringing periods were examined using SIMCA-P, a multivariate analysis program, to identify parameters that cause temperature fluctuations, and to examine possible correlations between the process variability and the severity of ringing problems. The results suggest that temperature-related parameters are not the only potential contributors to ringing. The variability in certain temperature-related parameters may also play a role.

---

**11/7/2006**  
**Session: 22**      **7:00:a.m. - 8:00:a.m.**  
**Hot Topics Breakfast**

**11/7/2006**  
**Session: 23**      **8:30:a.m. - 10:00:a.m.**  
**Water Quality**  
**Session Chair:**  
Bill Jernigan, Georgia Pacific

23 - 1    8:30 am    **Simulation of Hydrodynamics and Mixing in the Near-Port Zone of Initial Dilution using a CFD Model**  
Sreenivasa C. Chopakatla, Battelle Seattle Research Center, PNNL, Speaker  
Tarang Khangaonkar, Foster Wheeler Environmental  
Thor E. Sorenson, Georgia-Pacific Corporation  
A high-resolution, 3-D Computational Fluid Dynamics model was developed to simulate dilution, velocity

distribution and temperature isopleths within the effluent mixing zone associated with the Fort James – Wauna Mill's discharge. The model setup and calibration was based on the port velocities measured within the zone of initial dilution. Potential for entrainment of migrating fish and exposure to lethal temperatures was evaluated by simulating neutrally buoyant particles as surrogate fish. The results showed that the discharge was in compliance with the water quality standards and did not pose a threat to migrating fish.

- 23 - 2 9:00 am **Findings from Long-term Studies in Four US Rivers Receiving Pulp and Paper Mill Effluent**  
Camille Flinders, NCASI, Speaker  
Timothy J. Hall, NCASI  
NCASI's ongoing long-term receiving waters study (LTRWS) examines the potential impact of pulp and paper mill effluent on water quality; and fish, macroinvertebrate, and periphyton communities in four US rivers. Study rivers represent distinct ecoregions, river types, mill process and effluent treatment type, and effluent concentrations. Data are collected using standard methods, and spatial (upstream-downstream of effluent input) and temporal (seasonal and annual) water quality and community patterns are examined using univariate and multivariate statistical procedures. In this presentation, based upon seven years of in-stream and effluent data, general patterns of water quality and aquatic communities are described and implications for continued research are addressed. The significance of the findings to the North American pulp and paper industry are discussed.

- 23-3 9:30 am **Determining Labile and Recalcitrant Organic Nitrogen for TMDL Projections**  
Stephanie Kilgore, Tim Jones, Kim Grantham, Georgia-Pacific, Monticello, Mississippi  
Robert Sackellares, Bill Jernigan, Georgia-Pacific, Atlanta, Georgia  
John Michael Corn, E.I.T., AquAeTer, Brentwood, Tennessee  
As part of a Total Maximum Daily Load Analysis (TMDL) of the Pearl River downstream from the Georgia-Pacific Monticello, Mississippi Mill, time-series biochemical oxygen demand (BOD) tests were run for 120-days. Following the completion of the tests, the results were analyzed using the Georgia EPD program LTBO<sub>D</sub> for the breakdown of CBOD<sub>u</sub> and NBOD. During the course of the 120-day test, samples were collected for the analysis of TKN, ammonia-nitrogen, and nitrite+nitrate at days 0, 20, 45, 60, 75, 90, and 120. The organic nitrogen was determined by subtracting the ammonia-nitrogen from the TKN. The organic-nitrogen remaining in the sample following the completion of the 120-day test was considered recalcitrant. On average, the samples had approximately 50% of the original organic nitrogen remaining. The recalcitrant organic nitrogen is not available for ammonification to ammonia, which in turn is not available for the deoxygenation of the river during the nitrification process. These results were used to reduce the impacts of organic nitrogen being converted to ammonia and subsequently asserting a DO demand in the Pearl River wasteload allocation model. The paper will discuss analytical and laboratory methods for determining recalcitrant nitrogen and give examples of the measurements from the Pearl River TMDL analyses for determining recalcitrant nitrogen.

**11/7/2006**  
**Session: 24** **8:30:a.m. - 10:00:a.m.**  
**Project Management Fundamentals Tutorial Part 1**

**Session Chair**

Steve Dowe, Jacobs Engineering Group Inc.

The industry has undergone dramatic change resulting in consolidation, pressure to provide a better return on investments and compliance with more stringent standards for publicly owned corporations. Many mills have had drastic reductions in their engineering staff forcing broadened responsibilities for those left running the show. Project management has taken the place of design engineering functions for mill engineers. This seminar will provide an overview of the fundamentals required to manage mill projects less than approximately \$5 million in total installed cost. We will look at the key tools required for project management and various types of contracting strategies used. The seminar will cover schedules, phases of a project, work and information flow, and typical engineering deliverables and budgets. These will be described in the context of a hypothetical project. We will provide commentary on the implication of new Sarbanes Oxley requirements in the way projects must be managed. This seminar will be of use to those executing these projects and those affected by such projects.

**11/7/2006**  
**Session: 25** **8:30:a.m. - 10:00:a.m.**  
**Recycling Tutorial: Using Optical Properties to Measure Fiber**

**Session Chair**

Carl Houtman, USDA Forest Products Laboratory

- 25 - 1 8:30 am **Online Measurement of Dirt**  
Kenneth W. Corscadden,, OPTest Equipment Inc, Speaker  
This paper presents new online technology that measures dirt to Tappi standard T563 on machines running up to 400m/min. The technology has been tested in an operational environment and analyzes 1m<sup>2</sup> of pulp surface every 40 seconds. The results are presented as physical count, dirt per m<sup>2</sup> and PPM (mm<sup>2</sup>/m<sup>2</sup>) and TAPPI count and PPM. The online technology has been shown to correlate to laboratory instrumentation

25 - 2 9:15 am **Using Optical Properties to Measure the Quality of Recycled Fiber**  
Carl J. Houtman, USDA Forest Products Lab, Speaker  
Brightness, particle counts, and effective residual ink concentration (ERIC) are all optical measurements that are typically used to determine the quality of recycled fibers. This tutorial will begin with basic theories of light interaction with fiber mats. From this foundation, we will look at the specific applications. We will discuss issues associated with sample preparation, instrumentation, and calibration.

**11/7/2006**  
**Session: 26** **8:30:a.m. - 10:00:a.m.**  
**Cracking Issues in Kraft Pulp Mills**  
**Session Chair**  
Sandy Sharp, MeadWestvaco

26 - 1 8:30 am **Mechanism of Stress Assisted Corrosion Crack Initiation on Carbon Steels**  
Dong Yang, IPST at Georgia Tech, Speaker  
Industrial boilers experience stress assisted corrosion cracks in their carbon steel tubes. The performance of carbon steel in industrial boilers strongly depends upon the formation and stability of the magnetite film on the surface of boiler tubes. Initial tests were conducted to develop the magnetite film on carbon steel tube samples. Slow strain rate tests were carried out to investigate the role of temperature and water chemistry on crack initiation. The mechanism of stress assisted corrosion was proposed here, and an interrupted slow strain rate test was designed and carried out to validate the proposed mechanism.

26-2 9:00 am **Stress Corrosion Cracking of Different Duplex Stainless Steel Grades in Pulping Liquor**  
Ananya Bhattacharya, Georgia Inst. of Technology, Speaker  
Jamshad Mahmood and Preet M. Singh, IPST at Georgia Tech  
Stress Corrosion Cracking (SCC) of various Duplex Stainless Steel (DSS) grades has been experienced in several pulp mill equipments. The susceptibility of DSS to stress corrosion cracking is due to certain fabrication processes that may change the microstructure (ferrite/austenite ratio, precipitation) of the steel, making it prone to cracking in aggressive environments and high temperature. This paper aims at studying the various conditions under which DSS alloys may be susceptible to SCC in pulping liquors.

26-3 9:30 am **Digester Outlet Device Scraper Arm Cracking**  
Margaret E. Gorog, Weyerhaeuser Company, Speaker  
Continuous digester bottom scraper arms have mainly been fabricated out of carbon steel and 304L stainless steel. They are subject to unpredictable wear and cracking that makes it difficult to plan maintenance and can lead to frequent rebuilds and replacement. To alleviate this situation, scraper arms have recently been built out of 2205 duplex stainless steel. Experience has revealed however that for this application it is also susceptible to cracking. This paper covers cases that involve all of these materials. In addition to 2205 it also describes an option using Inconel 625 weld overlay that has offered good performance compared to the use of 304L liners.

**11/7/2006**  
**Session: 27** **8:30:a.m. – 9:00:a.m.**  
**Process Simulation of Kraft Pulping** (joint with Alkaline Pulping & Bleaching)  
**Session Chair**  
Cal Clark, BE&K

27 - 1 8:30 am **Long Feedback Compensated Kappa Factor Control: Part II of Process Optimization at Rock-Tenn Company, Demopolis Alabama Mill**  
Sean M. Smith, Rock Tenn Company, Speaker  
Keith Shuttlesworth and Marty Wells, Rock Tenn Company  
Alison C. Rowat, Metso Automation USA Inc.  
Rock-Tenn Mill Company, LLC in Demopolis Alabama has two fiberlines: one dedicated to HWD pulping & bleaching and the other dedicated to SWD pulping & bleaching. The mill installed an online Kajaani Kappa Analyzer and implemented Compensated Kappa Factor Control for the D0 and D1 stages for both fiberlines. On the Hardwood fiberline, because its production rate is more than three times the Softwood production, the mill installed filtrate pistons for pH control in every bleach stage and an inline brightness sensor (a Cormec-i after the D1 stage to the Hardwood HD Bleached Storage). Also on the Hardwood fiberline, the soon-to-be obsolete inline Brightness and Residual sensors were upgraded to i-series sensors feeding the D0 and D1 stages. The mill plans to make the same modifications to the Softwood fiberline. After bleach plant process optimization and implementation of Kajaani long feedback control strategies (CEKappa feedback control to D0 ClO<sub>2</sub> dosage for both fiberlines and D1 final brightness feedback control to D1 dosage for HWD bleaching), the mill realized 11.6% ClO<sub>2</sub> and 24% Caustic savings from baseline while bleaching HWD pulp and 16.8% ClO<sub>2</sub> and 24% Caustic savings from baseline while bleaching SWD pulp. This paper describes the evolution in bleaching measurements and controls at Demopolis that have resulted in placing Demopolis among the lowest cost bleach plants for both HWD and SWD manufacturing in North American benchmarking.

11/7/2006  
Session: 28

8:30:a.m. - 10:00:a.m.  
Recovery Boiler Emissions

**Session Chair**

Alarick Tavares, Diamond Power

28 - 1 8:30 am

**Effects of SO<sub>2</sub> on Superheater Fouling in Recovery Boilers**

Honghi Tran, University of Toronto, Speaker

Christian A. Brown and Andrew K. Jones, University of Toronto

A study was carried out in an Entrained Flow Reactor to examine the effect of SO<sub>2</sub> concentration in the flue gas on the deposition rate, composition and adhesion strength of carryover deposits produced by burning dried black liquor. The results imply that SO<sub>2</sub> is not the main cause of fouling in the superheater region of recovery boilers. High SO<sub>2</sub> may even be beneficial, since as it helps produce deposits that are easier to be removed by sootblowers. In recovery boilers where high SO<sub>2</sub> and excessive carryover fouling are observed at the same time, it is likely that they are a result of other boiler operating factors.

28 - 2 9:00 am

**Black Liquor Enrichment with Petroleum Coke**

Christopher T. Dietel, DTE Energy Services, Speaker

Howard L. Empie, Jr., IPST at GeorgiaTech

Kraft paper mill energy costs may be significantly reduced by co-firing petroleum coke with black liquor, provided that the mill's recovery boiler has excess firing capacity and steam generation capability. Petroleum coke, a byproduct of petroleum refining with a relatively low cost per unit of energy, is a good fit with a kraft mill because it is about 90% carbon with its major other element being sulfur. A number of technical issues were identified that have been addressed in a recently completed laboratory study. Included are: good mixture uniformity and acceptable viscosity to enable conventional liquor spraying methods; minimal change in liquor swelling properties and combustion characteristics to maintain the proper balance between in-flight combustion and char bed reaction phenomena; acceptable disposition of sulfur; and purge of non-process elements via the green liquor dregs. Answers to these questions have been obtained in a recent laboratory study at IPST @ Georgia Tech using its Single Particle Reactor. Results have facilitated commercialization of the technology with a mill trial at a Southeastern kraft mill. Results of that trial will be summarized

28 - 3 9:30 am

**Investigation and Analysis of the Causes of Recovery Boiler Economizer Failures**

John L. Clement, , Speaker

Thomas M. Grace, T. M. Grace Company Inc.

An investigation of economizer failures in chemical recovery boilers was carried out aimed at understanding the causes of failures and to identify means for preventing their occurrence. Data from questionnaires sent to recovery superintendents, BLRBAC records, operating sources and recovery boiler suppliers was combined for 346 economizers in Canada and the USA. Analysis of data provides the basis for specification and construction guidelines and a reference for operating and maintenance practices

11/6/2006  
Session: 29

10:30:a.m. - 12:00:p.m.  
Combustion Process: An Environmental Perspective Tutorial

**Session Chair**

Ashok Jain, NCASI

**Instructors:**

Regulatory Overview - Tammy Wyles, Georgia Pacific

Permitting Issues – Daryl Whitt, RMT

Emission Controls – Arun Someshwar, NCASI

11/7/2006  
Session: 30

10:30:a.m. - 12:00:p.m.  
Project Management Fundamentals Tutorial Part II

**Session Chair**

Steve Dowe, Jacobs Engineering Group Inc.

This is a continuation "Project Management Fundamentals - Part 1" This seminar will provide an overview of the fundamentals required to manage mill projects less than approximately \$5 million in total installed cost. We will look at the key tools required for project management and various types of contracting strategies used. The seminar will cover schedules, phases of a project, work and information flow, and typical engineering deliverables and budgets. These will be described in the context of a hypothetical project. We will provide commentary on the implication of new Sarbanes Oxley requirements in the way projects must be managed. This seminar will be of use to those executing these projects and those affected by such projects.

11/7/2006  
Session: 31

10:30:a.m. - 12:00:p.m.  
TMDL Panel

**Session Chair**

Bob Stein, Aware Environmental Inc.

**Panelists:**

Robert Sackellares, Georgia Pacific  
Wilson Gautreaux, MeadWestvaco  
Martin Lebo, Weyerhaeuser

This session will focus on the TMDL/Nutrient issues which have affected the industry and the approach mills have taken to address these issues. The panel will consist of industry personnel who have experience in addressing these issues.

11/7/2006  
Session: 32

10:30:a.m. - 12:00:p.m.  
Low Temperature Black Liquor Gasification

**Session Chair**

Reyhaneh Shenassa, Kvaerner Power Inc.

32 - 1 10:30 am **Performance of a Small-scale Fluidized Bed Black Liquor Steam Reformer**

Kevin Whitty, University of Utah, Speaker

Mauricio Naranjo and Delance Warner, University of Utah

The University of Utah operates a small-scale (0.25 ton/day BLS) fluidized bed black liquor steam reformer which converts liquor in the same manner as the MTCI/ThermoChem process. This system has been used to investigate the influence of operating parameters, including temperature, pressure, and co-injection of air, on liquor conversion efficiency, product gas composition, and overall gasification performance. This paper presents details and results of these studies.

32 - 2 11:00 am **Measurement of Tars From Low-Temperature Black Liquor Gasification**

Kristiina lisa, IPST at Georgia Tech, Speaker

The amount of tar produced by gasification of black liquor in the Big island , and The total amount of tar was determined gravimetrically, and the tar species were identified by GC-MS analysis. A semi-quantitative classification by analyte class according to the number of aromatic rings. The results were compared to laboratory experiments in which black liquor was gasified or pyrolyzed at temperatures of 450-650°C. at The results suggest an evolution from biomass to primary tars that consist primarily of phenols and other substituted single ring compounds. These primary tar species evolve to secondary tar species and eventually to multi-ring, polyaromatic hydrocarbons. The polyaromatic hydrocarbons are eventually degraded to benzene and naphthalene.

32-3 11:30 pm **AF&PA Update**

Tom Grant, AF&PA

11/7/2006  
Session: 33

10:30:a.m. - 12:00:p.m.  
Bleaching: Minimizing Scaling and Improving Fiber Properties

**Session Chair**

Peter W. Hart, MeadWestvaco Corporation

33 - 1 10:30 am **Modeling and Minimization of Barium Sulfate Scale**

Alan W. Rudie, USDA Forest Products Lab, Speaker

Peter W. Hart, MeadWestvaco Corporation

Most barium exits the digester as barium carbonate. This dissolves when the pH drops below 7 and if concentrations are too high, begins to precipitate as barium sulfate in the bleach plant. The difficulty in controlling barium is that a mill cannot avoid this carbonate to sulfate transition using common bleaching technology. The advantage in controlling barium is that the sulfate once formed will not re-dissolve and this reduces the probability for barite scales in other locations in the bleach plant. From an operating standpoint, the only tools the mill has to control barium sulfate are to insure very good debarking to minimize barium coming into the mill and minimize the sulfate content of the first stage. This is accomplished with good brown stock washing and by using sulfuric acid for pH control instead of ClO<sub>2</sub> generator spent acid. Sulfate can also be reduced by operating the initial ClO<sub>2</sub> stage at higher pH but this will only work in mills where calcium scales are not a concern.

33 - 2 11:00 am **Investiagtion of Fiber Modification by Peroxide Bleaching on ECF Softwood Pulp**

Zheng Dang, IPST at Georgia Tech, Speaker

Arthur J. Ragauskas, IPST at Georgia Tech

Thomas J. Elder, USDA-Forest Service

This presentation summarizes our studies directed at peroxide 'bleaching' of fully bleached softwood ECF kraft pulps and evaluating the changes in fiber charge and paper physical strength properties. The surface of peroxide treated pulp fibers were characterized by AFM and surface acid groups. Pulp refining and wet-end studies demonstrated the beneficial effects of peroxide-enhanced fiber charge in terms of refinability, wet-end, and physical properties of paper sheets.

33 - 3 11:30 am **The Effect of Sequential Bleaching on Total Fiber Charge of SW Kraft Pulp Fibers**

Dongcheng Zhang, IPST at Georgia Tech, Speaker

Charles E. Courchene, Arthur J. Ragauskas, and Xinshen Chai, IPST at Georgia Tech

The total fiber charge of fully bleached SW kraft pulps with a brightness of 88% was comparably examined in this study. The results demonstrated that total pulp fiber charge decreased from an initial 95.9  $\mu\text{mol/g}$  to a final 32.0-43.0  $\mu\text{mol/g}$  as the different sequential bleaching. The effect of a second alkaline extraction stage in the bleaching sequence and the use of hydrogen peroxide on fiber charge was also evaluated.

11/7/2006  
Session: 34

10:30:a.m. - 12:00:p.m.  
Recycling - Fiber Processing

**Session Chair**

Terry Bliss, Hercules Inc.

34 - 1 10:30 am **Defibering of OCC in Hgh Dry Content**

Pirjo Yli-Viitala, University of Oulu, Speaker

Jouko Niinimaki, Ari J. Ammala, and Esa Anttila, University of Oulu

The aim is to introduce possibilities to defiber OCC in high dry content. Dry defibering of OCC is interesting because of the potential feasibility to process also screening and cleaning in high dry content. In that case, water usage could be decreased significantly. Defibering was studied using hammermill. Various operating parameters and conditions were tested. Pulp properties were compared with wet disintegrated reference samples evaluating the strength properties of paper, fibre morphology and microscopy.

34 - 2 11:00 am **Pressure Screen Capacity - Current Findings on the Role of Wire Width and Height**

Hanna Jokinen, University of Oulu, Speaker

Jukka Virtanen, Metso Paper

Ari J. Ammala and Jouko Niinimaki, University of Oulu

The objective of this study was to determine the effects of wire geometry parameters on screen plate performance. Contrary to the common belief, the open area of the screen plate did not directly indicate its capacity. Capacity gain is not necessarily achieved if the open area is increased by reducing the wire width. In practise the results mean that the advantage of wider wires lies not only in their strength but also in capacity, despite their smaller open area compared to narrow wire screen baskets.

34 - 3 11:30 pm **Pressurized Tail Screen - Improved Fiber Recovery Using Intermediate Dilution**

Johan Carlsson, Metso Paper Sundsvall AB, Speaker

Fredrik Broman, Korsnas AB

The tail screen function of fine reject is a vastly discussed matter. The large holes recovers good fibers, but it also lets sand separated in the screen room back to the process. Another drawback is the risk of air-entrainment since it is un-pressurized. A pressurized tail screen with the possibility to use slotted screen baskets is a most sought-after equipment. This paper describes the development of a new concept for a pressurized tail screen and the evaluation in mill scale. The concept involves utilizing the Metso invention of intermediate dilution in the screen basket that was developed to eliminate the reduction of capacity and screening efficiency that is caused by the pulp thickening across the screening surface. In co-operation with Korsnäs AB pulp mill, Metso was allowed to rebuild the tertiary screen of line 3. During the trial period of four months the mass flow rate of reject from the tertiary screen was decreased from 390 kg/h to 250 kg/h. With an increased shive content from 35% to 67%, the amount of good fibers rejected decreased from 260 kg/h to 80 kg/h. This gives a total increase in yield by 140 kg/h. The shive content in the accept pulp from the primary screen did not increase during the trial period.

11/7/2006  
Session: 35

1:30:p.m. - 3:00:p.m.  
Recycled Paper Fundamentals

**Session Chair**

Garnet Bremner, Madison Paper Co.

35 - 1 1:30 pm **Comparison of Drying Characteristics of Fractionated Fiber Using TGA Technique and Drying Equipment**

Hussam E. Alkhasawneh, Western Michigan University, Speaker

John H. Cameron, Western Michigan University

Said Abubakr, Western Michigan University

In an earlier work [1], drying behavior of fractionated recycled fibers was studied. We reported that for when the fiber length decreased, the amount of surface water decreased and the bound water increased.



In addition, the energy required to dry each fraction was increased. The sheet drying rate and the heat transfer characteristics during drying was also affected by fractionation. This paper presents a study on the effect of fiber fractionation on the properties and drying behavior of paper made from virgin or recycled fiber. Fibers were separated using a Clerk Classifier. These fibers were used to produce single layer sheets of different fiber coarseness. Initial water content of (5g/g) and (2.5g/g) (water/dry fiber) water were studied. Thermogravimetric analyzer system (Q500 TGA) manufactured by TA, Inc. and "Drying set-up" [2] that simulate 2 m commercial drying cylinder were used to study the drying behavior of those sheets. The TGA tests show the same specific characteristics of drying trends of both virgin and recycled fiber. Recycled and virgin fibers show the opposite drying trends when using the "Drying set-up".

- 35 - 2 2:00 pm **A New Measurement of Bonding Potential and Active Surface Area of Fibers**  
Frances Jacobson, IPST at Georgia Tech, Speaker  
Sujit Banerjee, IPST at Georgia Tech  
A method has been developed to determine the bonding potential of fibers through measuring the activated surface of fibers in solution. This method differs from traditional methods such as freeness and solute exclusion with the ability to distinguish small variations in fiber samples. This ability potentially provides insight into grade fluctuation and runnability issues. This method is applicable to pulping, refining and recycling.
- 35 - 3 2:30 pm **Chemical reduction and energy savings of flotation deinking aided with electric field**  
Akpojotor Shemi, Georgia Inst. of Technology, Speaker  
Jeffery S. Hsieh, Georgia Inst. of Technology  
Flotation deinking was performed on recycled stock. We note that with electric field technology chemical consumption is lower than with traditional deinking chemistry. Though there is energy consumption with electric field technology, savings may be realized due to reduced chemical consumption of deinking liquor. While higher dosage of deinking agent can improved deinking, it may also result in higher yield loss. With electric field technology the ink particles are selectively removed by electric field force, which results in lower yield loss.

**11/7/2006** 1:30:p.m. - 3:00:p.m.  
**Session: 36** **Implications of Contracting Strategy on Project Management Workshop**

**Session Chair**

H. Charles Anderson, QBM Management Inc.

H. Charles Anderson, QBM Management Inc., Speaker  
Mike Lemke, QBM Management, Inc.

Selecting the right Contract Strategy is a key component in having a successful project. The Project Team needs to understand the appropriate application of a contract type and the implications on the project organization. Many times, improper contract types lead to disputes. This takes the focus away from a successful project execution. This paper summarizes for both owners and contractors various types of contracts, when each is best used, and discusses the organization necessary to successfully chose, negotiate and implement the proper type of contract for the project.

**11/7/2006** 1:30:p.m. - 3:00:p.m.  
**Session: 37** **Evaporators**

**Session Chair**

David Clay, International Paper

- 37 - 1 1:30 pm **Evaporator Boil Out Guidelines**  
Christopher L. Verrill, IPST at Georgia Tech, Speaker  
Nikolai A. DeMartini, IPST at Georgia Tech  
It is common industry practice to periodically introduce weak black liquor or condensate to black liquor evaporators for dissolving deposits and regaining heat transfer capacity. Key variables are the minimum solids attained, temperature, and duration of the wash or boil out procedure. Our recent work has shown that the procedures used to return to target product solids and reclaim the boil out liquor must also be managed to prevent rapid recurrence of soluble scale fouling. This paper provides guidelines for conducting more effective evaporator boil outs. Mill cases are discussed to illustrate how these guidelines can be implemented to minimize scaling and plugging of evaporators and concentrators.
- 37 - 2 2:00 pm **Stability of Sodium Sulfate Dicarboxylate at Conditions Corresponding to Industrial Black Liquor Concentrators**  
Cosmas Bayuadri, IPST at Georgia Tech, Speaker  
Christopher L. Verrill IPST at Georgia Tech  
Ronald W. Rousseau, ChBE at Georgia Inst. of Technology  
Crystallization of sodium sulfate dicarboxylate ( $\sim 2\text{Na}_2\text{CO}_3 \cdot \text{Na}_2\text{SO}_4$ ) is known to contribute to fouling of

heat-transfer surfaces in black liquor concentrators. The present work demonstrated that the sodium sulfate dicarbonate crystal phase was formed in laboratory-scale evaporative crystallization experiments at close to industrial process conditions. The crystal phase was identified by a characteristic powder x-ray diffraction pattern that was distinguishable from burkeite and other sodium salts, which confirmed the industrial evidence of sodium sulfate dicarbonate existence in black liquor evaporators. X-ray diffraction, calorimetry, and microscopic observations were used to investigate the stability of the salts to in-process aging, isolation and storage, and exposure to high temperature. The results showed that sodium sulfate dicarbonate can exist as a unique phase in black liquor and that it remains stable at industrial process conditions. Parallel experiments showed that samples of sodium sulfate dicarbonate that had been isolated from process liquors degraded when held in contact with moisture and ambient air for extended periods of time.

37 - 3 2:30 pm **EVAPS Solutions - Energy Efficiency and the Environment**

Randy Stern, Kvaerner, Speaker

Evaporator technology has developed to improve the energy efficiency and environmental performance of the mill. To optimize evaporator plants, it is important to evaluate the "life cycle cost" (LCC). A low LCC includes optimized energy solutions, high availability and positive impacts on the environment, especially air and water. Energy optimization requires that fuel price, electricity price and fuel self sufficiency be evaluated. Older evaporator plants were primarily six effect, recent plants have typically been six or seven effects. Mill experience with a nine effect system installed in a European mill will be reviewed. Other mill experiences relating to improved energy efficiency by firing higher dry solids and minimizing solids variations are also discussed. Recent North American mill experience has shown that MACT compliance has improved the Methanol removal in most mills. Liquor and vapor flow configuration to improve condensate segregation, efficiently integrated condensate treatment systems, and reprocessing intermediate condensate inside of falling film evaporators are all lessons which can be applied to further improve mill operations. Primary Contact – Randy Stern Randy.Stern@akerkvaerner.com

11/7/2006 1:30:p.m. - 3:00:p.m.

Session: 38

**Energy**

**Session Chair**

Tom Hartz, Jacobs Engineering Group Inc.

38 - 1 1:30 pm **Conservation Through Energy Supply Optimization**

Theodora Retsina, American Process Inc., Speaker

Steve Rutherford, American Process Inc.

Charles R. Davis, Jr., Georgia-Pacific Corporation

Paper mill energy demands are dynamic, requiring frequent changes in steam and electricity supply. Compounding complexities of varying electricity / fuel costs, equipment / fuel availability, and different turbine steam path efficiencies make it impossible to manually determine the most efficient operation in time to avoid higher than necessary energy use and costs. This paper presents a real-time energy supply optimization approach that continues to realize energy use and cost reductions in Georgia Pacific, Crossett mill

38- 2 2:00 pm **Purchased Power Optimization in an Energy Management System**

Jonathan Ben Rodin, Orion CEM Inc., Speaker

Powerhouse operations frequently allow savings opportunities. Online Purchased Power Optimization (PPO), which is a continuous comparison of varying utility and in-plant generation costs, can be used to advise operators and change setpoints to boilers and turbines. This presentation gives a tutorial on determining whether economic opportunities exist in powerhouse operation. An example is also given for PPO-related results of an implemented system at a Southeastern US paper mill. Savings of up to \$1500/hr are seen.

38 - 3 2:30 pm **Pulp and Paper Industry Energy Bandwidth Study**

David White, IPST at Georgia Tech

Robert Kinstrey, Jacobs

A pulp and paper industry energy bandwidth study has been conducted with support from the AIChE and DOE-OIT. Overall objective is to use results of this study to identify the R&D areas that have the greatest potential for energy savings. To accomplish this result, the following estimates were made: • Industry average energy (steam, electricity, fossil fuel) consumption, both overall and for specific unit operations, as balanced against the DOE MECS total domestic energy consumption • Energy consumption by mill areas / technologies if "best available" practices were applied, i.e. current state-of-the-art • Theoretical Minimum given processes similar to current processes (e.g. chemical pulping and wet forming) The difference between today's state-of-the-art and theoretical minima provide opportunities to identify "reasonable future technologies" as an area of opportunity for future research/development resulting in reduction in energy consumption.

11/7/2006 1:30:p.m. - 3:00:p.m.

Session: 39

**Assessing Kraft Pulp Bleachability**

**Session Chair:**

- 39 - 1 1:30 pm **An Attempt at Quantifying Bleachability of Hardwood Chemical Pulps**  
Raymond C. Francis, Empire State Paper Res. Inst., Speaker  
Nourredine Abdoulmoumine and Samar K. Bose, State University of New York  
Nataliya Lavrykova, Syracuse University  
The kappa number reduction caused by O<sub>2</sub> delignification varies quite significantly amongst hardwood kraft pulps for reasons that are not yet clear. However, it does not appear that variation in transition metal contents of the pulps entering the O stage is a major contributor. A straight line correlation was obtained between O<sub>2</sub> kappa number and final light absorption coefficient (LAC) value after standardized OD<sub>0</sub>EpD<sub>1</sub> bleaching for a wide range of hardwood kraft pulps. The bleachability of pulps from three different soda processes catalyzed by anthraquinones were compared to kraft pulps. The evaluation was based on kappa number reduction due to O<sub>2</sub> and final LAC value as compared to that calculated from the linear regression equation for kraft pulps. Keywords: Poplars, Alkaline Pulping, Bleaching, Oxygen, Chlorine dioxide
- 39 - 2 2:00 pm **Relationship Between the Pulp Yield, Bleachability and Cooking Conditions of Loblolly Pine**  
Daniel Connell, EKA Chemicals Inc., Speaker  
Magnus Bjorklund and AnnBritt Forsstrom, EKA Chemicals AB  
Selecting the optimal target kappa for bleached pulp production requires balancing yield in cooking and bleaching with recovery boiler solids load, bleaching costs, wood costs and the desired final papermaking qualities of the pulp. We designed a series of over 30 laboratory pulping and bleaching experiments to evaluate the pulping of Loblolly pine based on these criteria. The cooking conditions varied were EA applied and temperature. The kappa numbers achieved varied between 23 and 50. As cooking conditions changed leading to higher kappa, the total yield increased. The rate of increase in screened yield with increasing kappa number levels off at about kappa number 40. We also measured bleach yield across the range of kappa numbers. At a given kappa target, cooking with a higher EA charge (and therefore lower temperature) has a positive effect on shive content and pulp brightness. At the same kappa target, the potential to effect pulp yield or carbohydrates seems to be rather limited. The effect of these parameters on bleachability and viscosity is also examined.
- 39 - 3 2:30 pm **Extension and Application of a Simple Mathematical Model of D(EO)DED Bleaching: Effects of Hardwood Kraft Pulp History on Bleachability**  
Thomas J. McDonough, IPST at Georgia Tech, Speaker  
Charles E. Courchene, IPST at Georgia Tech  
Shunichiro Uno, Nippon Paper Industries Co Ltd  
Alan W. Rudie, USDA Forest Products Lab  
In an earlier study, it was shown that when a hardwood kraft pulp is bleached in the D<sub>0</sub>(EO)D<sub>1</sub>E<sub>2</sub>D<sub>2</sub> sequence with a D<sub>0</sub> stage kappa factor of 0.20, the brightness of the pulp emerging from the D<sub>2</sub> stage can be modeled by an exponential relationship, the parameters of which can be predicted from the brightness of the pulp emerging from the preceding extraction stage, which is practically the same as the brightness of the pulp emerging from the D<sub>1</sub> stage. The latter brightness can be accurately modeled by another exponential relationship, according to which the D<sub>1</sub> brightness is a function of the ratio of the D<sub>1</sub> ClO<sub>2</sub> charge to the (EO) stage kappa number. The present study was undertaken to assess and account for the effect of changing the D<sub>0</sub> kappa factor on the predictions of this model. In addition, the model was used to quantify the effects of conditions prevailing during the production of the unbleached pulp, such as digester alkali charge.

11/7/2006  
Session: 40

1:30:p.m. –2:00 p.m.  
Sustainability/Climate Change

**Session Chair**

Pat Fleischauer, ENSR International

- 40 - 1 1:30 pm **The Greenhouse Gas and Carbon Profile of the Forest Products Industry**  
Reid A. Miner, NCASI, Speaker  
The potential implications of the climate change issue to the forest products industry are more complex than for any other industry. The forests that supply the industry's raw material remove carbon dioxide from the atmosphere and store the carbon - not only in trees, but also below ground in soils and root systems, and ultimately in forest products. These forests and their carbon sequestration potential are affected by management practices, climate and by the rise in atmospheric CO<sub>2</sub>. Most of the industry's manufacturing facilities require fossil fuels and these fuels generate greenhouse gases when burned. The industry obtains much of its energy, however, from biomass fuels that, unlike fossil fuels, add no new carbon to the atmosphere and are therefore considered "carbon neutral." The forest products industry is one of the leaders in using co-generation, also known as combined heat and power (CHP). CHP systems produce electricity while using fuels far more efficiently than conventional electricity generation systems, meaning that smaller amounts of fuel are required and fewer greenhouse gases emitted. The industry's products compete against products with different greenhouse gas and carbon attributes. As a result, market forces that cause product substitutions can have important greenhouse gas and carbon implications. The end-of-life management options for forest products, ranging from recycling to landfilling and burning for

energy, have important but complex greenhouse gas and carbon implications. The significance of the various elements of the forest products industry's greenhouse gas and carbon profile will be explored in this paper.

**11/7/2006**  
**Session: 41**      **3:30:p.m. - 5:30:p.m.**  
**In Mill Pollution Reduction**

**Session Chair**

John Sparapany, Nalco Company

41 - 1      3:30 pm      **Environmental Technology Development of Kraft Pulping**

Helena Wessman, KCL, Speaker

Environmental technology development of kraft pulping / Helena Wessman, KCL The study was done as KCL research project in 2005 and it describes technology development in kraft pulping technology in Finnish kraft pulp mills. Both kraft production technology and process energy balance are included. Data was collected directly from the mills and the results will be presented as an average of this data. The changes of environmental parameters and their interaction with technology development in different steps in the pulping process will be presented. Trend in mill energy balance will be presented accordingly. Based on the results the role of forest industry's core technology and supporting technology and their environmental significance will be discussed.

41 - 2      4:00 pm      **Refiner Bleaching of Mechanical Pulp with Magnesium Hydroxide and Hydrogen Peroxide – A Mill Experience**

Aileen R. Gibson, Martin Marietta Magnesia Spec., Speaker

Ray E. Harrison, Anthony Parrish, and Gregg McCarthy, North Pacific Paper Corp

Mark Wajer, Martin Marietta Magnesia Spec.

Conventional bleaching of mechanical pulp with magnesium hydroxide and hydrogen peroxide has shown significant economic benefits for pulp mills over bleaching with caustic soda and sodium silicate. Magnesium hydroxide bleaching generates lower effluent BOD/COD, higher pulp yield, lower anionic trash in the papermachines, reduced oxalate scaling and in some cases, higher bulk. NORPAC has taken this bleaching process one step further through their patented refiner bleaching technology, which provides an enhanced and more efficient peroxide bleaching process. By adding magnesium hydroxide into the refining system, refiner energy demand is reduced by 100-200 KW-hr/odmt and pulp strength is improved by 5-10%. This paper describes NORPAC's development of refiner bleaching with magnesium hydroxide and hydrogen peroxide, and the additional benefits this technology provides to the mill.

41 - 3      4:30 pm      **Resource Recovery and pollution Prevention at Source**

Talat Mahmood, PAPRICAN, Speaker

Coated paper and board manufacturers use large quantities of coating colour. Despite good housekeeping and efficient process control, up to 15% of the coating colour produced at some commercial facilities has been reported to go down the drain, contributing BOD, suspended solids and possibly colour to the mill effluent. A large fraction of the suspended solids originating from the coating colour is non biodegradable, and it has to be either managed as waste sludge or as TSS in the treated effluent. BOD associated with waste coating, on the other hand, casts additional aeration demand. We suggest that coating recovery with or without using processing equipment is techno-economically feasible. There are two options to affect recovery. One option is to use re-concentration equipment (ultrafiltration) to recover coating from dilute waste streams. The other option is to recover waste coating at source, by selectively capturing highly concentrated waste streams or portions of them. This approach, evaluated at a Quebec mill, does not require processing equipment, and involves only minor expenditures. Coating recovered without using concentration equipment was blended at up to 5% with the original coating, and the combined coating was tested for viscosity, water drainage, and contamination by large particles or clumps. No significant differences were observed in the combined and original coating samples tested. It is believed that large mills can save millions of dollars a year by recovering waste coating colour while offloading the effluent treatment plant.

41 - 4      5:00 pm      **Application of Methane Fermentation Technology to Kraft Pulp Mill Evaporate Condensate**

Isao Onodera, Nippon Paper Industries Co Ltd, Speaker

Reiko Oshima, Yuko Iijima, Hitoshi Nagao, and Hideaki Fujita, Nippon Paper Industries Co Ltd

Recent development of methane fermentation technology has made wastewater treatment highly effective. It was decided to introduce this technology to treat kraft pulp mill evaporate condensate and this is the second case in the world. A mix of hardwood and softwood kraft pulp mill evaporate condensate was treated continuously in a pilot plant and COD was removed stably even at a high loading rate. Based on these results we started to run the operation plant.

**11/7/2006**  
**Session: 42**      **3:30:p.m. - 5:00:p.m.**  
**Current Topics in Asset Management**

**Session Chair**

- 42 - 1 3:30 pm **Achieving World Class Lubrication at SAPPI Fine Paper**  
David S. Kolstad, Porous Media, Speakers  
Michael R Lofald, SAPPI Fine Paper  
A 26% increase in plant output without significant increases in maintenance and operational costs! Process improvements of this magnitude are what every manufacturer is searching for, and SAPPI Fine Paper in Cloquet, Minnesota has done it. Equipment reliability is of critical importance to the ongoing profitability and productivity of paper manufacturing operations. At SAPPI, reliability has been dramatically increased through the implementation of effective process improvements and strategic fluid conditioning upgrades. Paper Machine 12 went on-line in 1988. Process and equipment enhancements since 2000 have made impressive and sustainable improvements to the overall fluid condition, reducing moisture and particulate contamination by more than 90%. Looking forward, these improvements will lead toward improved equipment reliability and reduced rates of wear. Ultimately, resulting in increased throughput, sales and substantial operational savings. Prior to the upgrades, the output of PM12 was 117,000 tons/year. The mill output for 2005 is projected to reach 148,000 tons, 86% of maximum capacity. To achieve this substantial increase in throughput, it was necessary to replace a press section of the machine to eliminate a chronic bottleneck. Since the upgraded machine would be operating at significantly higher rates, it was considered crucial to ensure that significant fluid quality and reliability improvements were achieved at the same time. Comparing the average results shown on SAPPI's Mobil Oil analysis reports from 1998/99 with those from 2004/05 for the main lubricating fluid indicated the following improvements: ISO Cleanliness Level Down >90% Moisture Content Down 93% As indicated in the data, ISO cleanliness and moisture content of the lubricating fluid have both experienced a contamination reduction of 90% or better. As stated earlier, this has been done without significant increases to maintenance or operating costs. In this paper, we will identify some of the key process improvements and fluid conditioning upgrades that have enabled this plant to attain world-class performance in a challenging lubrication environment.
- 42 - 2 4:00 pm **Chip Quality Optimization and Chipper Condition Monitoring Concept**  
Seppo Silenius, Andritz, Speaker  
Specific targets for competitive chipper operation are to produce uniform and high chip quality with high operational reliability and equipment availability. A new chipper concept has been developed to make these specific targets possible to reach. This has been done by continuous and on-line integration of scanning systems for detection of final chip quality and machine condition monitoring to a modern chipper knife application.
- 11/7/2006 **3:30:p.m. - 5:00:p.m.**  
Session: 43 **Bleaching Panel**
- 11/7/2006 **3:30:p.m. - 5:30:p.m.**  
Session: 44 **Recovery Cycle**
- Session Chair**  
Jim Dickinson, Babcock & Wilcox Company
- 44 - 1 3:30 pm **Determination of Sulfate Ions in Kraft Mill Liquors by a Turbidity Method**  
Xin-Sheng Chai, IPST at Georgia Tech., Speaker  
Christopher L. Verrill, IPST at Georgia Tech  
This study demonstrates a method for determination of sulfate ions in pulp and paper mill liquors based on spectral turbidometry using barium chloride (BaCl<sub>2</sub>) as a precipitant. By sample acidification pretreatment, the interference species such as alkaline dissolved lignin in black liquor will precipitate and can be easily removed by filtration while the sulfate remains dissolved in the filtrate. After addition of the BaCl<sub>2</sub>, several inorganic species such as sulfite and oxalate co-existing in the mill liquors also form barium salt precipitates, which consequently affect sulfate determination. By controlling the acidity in the BaCl<sub>2</sub> medium, the formation of these interfering barium salts can be avoided. In this work, we established a medium containing 5 wt.% barium chloride and 0.5 mol/L of hydrogen chloride acid, in which the sulfate ion can be quantitatively precipitated while the concentrations of the interference anions remain below their barium salt solubility. The turbidity of the resulting solution caused by barium sulfate precipitate is determined by UV/vis spectroscopy at a wavelength of ~500 nm using a 10 mm optical path-length cell. Key words: Sulfate, UV-Vis spectroscopy, Turbidity, Black liquor, Barium, Acidification.
- 44 - 2 4:00 pm **NO<sub>x</sub> Control using Quaternary Air – Mill Experience**  
John Kulig, Babcock & Wilcox, Speaker  
Testing was performed at the B&W single drum recovery boiler (PR213) at International Paper in Courtland, AL to measure the influence on NO<sub>x</sub> of changing air distribution between the units tertiary and quaternary air ports. On one day of testing, the quaternary air flow was "maximized" and showed a very distinguishable reduction in NO<sub>x</sub> from the other test conditions collected, including compared to equal

amounts of tertiary/quaternary and also maximum tertiary/minimum quaternary. Besides reporting the test results, the paper also describes the relationship between the test values versus B&W predicted curves for one-stage and two-stage combustion at varying amounts of fuel bound nitrogen based on experimental nitrogen conversion standards.

44- 3 4:30 pm **Extend Recovery Boiler Runtime Using Smart Sootblowers**

Sandeep Shah, Clyde Bergemann, Speaker  
Danny Tandra, Clyde Bergemann

A Smart Sootblower has been developed to help recovery boiler to extend boiler runtime and reduce steam consumption. The accumulation of fireside deposits in a recovery boiler often causes boiler plugging and unscheduled shutdown, leading to severe financial cost. In order to extend the uninterrupted boiler operation time, it is vital to clean the heat transfer surfaces, particularly the generating bank, effectively to prevent excessive fouling. Fouling condition may be significantly different from pendant to pendant across the boiler. Conventional retractable sootblowers clean the entire tube surface with even intensity, resulting in over cleaning of some areas and under cleaning in others. Modern Fouling Measurement system is able to locate the exact spot where the slag is accumulated. With the help of these detection systems, the Smart Sootblower, a multi-mode operating sootblower, is able to target and adjust cleaning intensity based on fouling condition, thus maximizing sootblowing effectiveness and minimizing steam consumption. The Smart Sootblower has two motors that independently control translation and rotation motions. This allows the sootblower to change helix for different cleaning intensity in different sections of the boiler. Operators can select zones require aggressive cleaning and zones need less or no cleaning. The addition of Smart Sootblowers in critical locations such as generating bank is able to significantly extend boiler runtime.

44 - 4 5:00 pm **State of the Art Evaporation System**

John Rauscher, Andritz, Speaker  
Jarmo Kaila and Heikki Jaakkola, Andritz

Energy efficiency, high availability and low emissions are the main requirements for a modern recovery island. An evaporation system is a key part of a complete recovery island. This paper describes Andritz concept for a state-of-the art evaporation system:

- Reliable process design for uninterrupted liquor flow to the recovery boiler
- High dry solids concentration with crystallization technology
- Liquor Heat Treatment to decrease liquor viscosity
- Secondary condensate fractionating and handling to get clean process water for the mill
- Maximized steam economy for minimized operating costs
- Handling or treatment of mill by-product process streams (CNCG, DNCG and foul condensate)

One way to improve energy efficiency is to increase the firing liquor dry solids concentration. Increasing the firing liquor dry solids content from 75% to 80% in the recovery boiler provides numerous benefits:

- Steam flow is increased over 2%
- Dry solids throughput is increased
- SO<sub>2</sub> emissions are practically eliminated

11/7/2006  
Session: 45

3:30:p.m. - 5:30:p.m.  
**Determining the Benefits of the Biorefinery – Panel Discussion**

**Session Chair**

Kristiina lisa, IPST at Georgia Tech

45 - 1 3:30 pm **Industrial Symbiosis as a Model for BioRefineries**

Jim Fredrick, Jr., ChBE and IPST at Georgia Tech, Speaker  
Kristiina lisa, IPST at Georgia Tech

Traditional forest products manufacturing plants produce a single product or a very limited number of them, and a great deal of waste that is utilized as a low-grade fuel. Integrated biorefineries, composed of individual plants that utilize each other's waste materials or energy as well as external resources, can produce materials, chemicals, and fuels more efficiently. An excellent example of the application of this concept is the Kalundborg Eco-Industrial Park in Denmark. This concept of industrial symbiosis applies well to biorefineries. For example, consider three stand-alone plants producing (a) ethanol from biomass, (b) pulp fibers from wood, and (c) liquid transportation fuel from biomass via syngas. Each produces biomass wastes that may be used for fuel within the facility. Two have a demand for low availability energy (as process steam) and require additional biomass as fuel to generate it. The third produces a large excess of low-level energy. Separation costs for ethanol-water are very high in stand-alone distillation columns. In contrast, an integrated biorefinery utilizes waste biomass from ethanol plants to generate syngas for production of liquid fuel. Ethanol-water distillation is integrated with the black liquor evaporation plant, decreasing the energy cost for distillation by 2/3. Low availability energy from the liquid fuels plant is used for distillation, evaporation, and drying. Requirements for biomass as a fuel are decreased or eliminated. Electrical power, potentially a product of the stand-alone plants, can be produced more

efficiently and with full utilization of low availability energy discharged as process steam.

- 45 - 2 4:00 pm **Biomass and Spent Liquor Gasification; the Foundation of the Integrated Mill Biorefinery**  
Eric J. Connor, Thermochem Recovery Intl., Speaker  
Daniel A. Burciaga and Dave G. Newport, ThermoChem Rec. Int'l Inc.  
The presentation will give a short review of low temperature biomass and spent liquor gasification and an update on two commercial projects. The presentation will then discuss the thermochemical biorefinery at a pulp or paper mill, the technical and process options that are available and the value propositions for each. It will describe the total impact of a mature integrated biorefinery on the host mill, the community, the environment, associated industries, and the nation. Note; this presentation will be written to be a part of the biorefinery session of the conference.
- 45 - 3 4:30 pm **Cost-Benefit Analysis of Gasification-Based Biorefining at U.S. Kraft Pulp Mills**  
Eric R. Larson, Princeton University, Speaker  
Ryan Katofsky, Navigant Consulting Inc.  
Stefano Consonni, Politecnico di Milano  
Kristiina Lisa and Jim Frederick, IPST at Georgia Tech  
Detailed energy balances and projected commercial costs are presented for full-scale biorefinery configurations at a typical Southeast U.S. pulpmill, circa 2010. The biorefinery includes gasification of black liquor and biomass residues to make synthesis gas that is converted into liquid fuels, with some byproduct electricity production. The production of Fischer-Tropsch liquids, dimethyl ether, and an ethanol-rich mixed-alcohols product have all been examined in this work, which builds in part on an early study by the same authors that examined energy balances, economics, and regional and national market impacts of black-liquor gasification combined cycle (BLGCC) technology for heat and power generation at pulp and paper mills.
- 11/7/2006**  
**Session: 46** **3:30:p.m. - 5:30:p.m.**  
**Equipment Inspection and Repair Strategies**
- Session Chair**  
David Crowe, Corrosion Probe
- 46 - 1 3:30 pm **Inspection and Repair of Kraft Steaming Vessels**  
Angela Wensley, P.E., Angela Wensley Eng. Inc., Speaker  
Kraft steaming vessels in continuous digester systems can experience a wide range of corrosion, erosion, and cracking problems. Depending on the materials of construction, these problems may include external stress corrosion cracking beneath wet thermal insulation, internal stress corrosion cracking in contaminated steam service, erosion wear of so-called wear liners, and fatigue cracking of the screw shafts. Examples of problems are presented together with recommendations for repair and prevention.
- 46 - 2 4:00 pm **Appropriate Use of Tank and Pressure Vessel "In Service" Codes when Assessing Localized Corrosion and Cracking Damage**  
Jeremy M. Orr, Applied Technical Services Inc., Speaker  
Douglas A. Sherman, Corrosion Probe Inc.  
Tanks and pressure vessels exhibiting localized corrosion and/or cracking can be evaluated for their fitness-for-continued service by application of post-construction (in-service) codes. Proper use of these codes can help avoid over-conservative, superficial decisions for unnecessary repair and replacement of serviceable equipment. This paper discusses appropriate application of the most widely used in-service codes for regular tanks and pressure vessels in pulp and paper mills, including liquor tanks, digesters, paper machine dryer cans and boiler tubes.
- 46 - 3 4:30 pm **Brick & Tile Linings - Protecting Equipment and the Bottom Line**  
David C. Bennett, Corrosion Probe Inc., Speaker  
Randy Nixon, Corrosion Probe Inc.  
Inspection and repair strategies and procedures deliberately based on how brick and tile linings are constructed and how they degrade and fail in different mill environments are described. Inspection methods, condition assessment guidelines and repair guidelines and damage mitigation measures recommended in the paper enable mill personnel to consistently direct lining maintenance work to simultaneously improve lining performance and minimize lining maintenance costs.
- 46 - 4 5:00 pm **Life Extension Strategies, Condition or Risk Based Assessment; a Pulp & Paper Industry Material Engineer's Point of View**  
Ronald W. Lansing, Mechanical & Materials Eng., Speaker  
Max D. Moskal and Nancy Hoffman, Mechanical & Materials Eng  
"Life Extension" gets thrown about liberally with promises of reduced operating costs as old equipment continues in service long after its "design life" period. Materials engineers in the pulp and paper industry have worked for decades with plant maintenance engineers to slow down the ravages of "process" time on

critical equipment. Mostly this focus has been on individual critical equipment like digesters using what is called "condition assessment". With recent cross-fertilization of thought from the petroleum industry the use of a wider ranging, statistically based method called "risk-based assessment" is being discussed. This paper compares and contrasts these two strategies for use in the paper industry and will hopefully lay the groundwork for a discussion in the conference session.

\*\*\*\*\*

11/8/2006 7:00:a.m. - 8:00:a.m.  
Session: 47 Hot Topics Breakfast

11/8/2006 8:30:a.m. - 10:00:a.m.  
Session: 48 Improving Pulping with Additives

**Session Chair:**

Joe Wilson, Star Technologies

48 - 1 8:30 am **The Effects of Initial Alkali Profiling on Polysulfide Pulping Yield and Properties**

Mathias Lindstrom, North Carolina State University, Speaker

Ved P. Naithani, Hasan Jameel, and Adrianna G. Kirkman. North Carolina State University

The potential implementation of black liquor gasification into pulp mill chemical recovery operations will open up new possibilities in the area of modified continuous cooking. The recovered entities of sodium and sulfur can be split into two separate fractions with varying degrees of separation dependent on the operating conditions and the technology used. This will allow for more efficient application of sodium and sulfur during pulping operations. The benefits from polysulfide (PS) addition to the kraft process have been described in the literature and are commonly accepted. In addition, published literature has described different approaches to the utilization of alkali in PS cooking. The effect of initial alkali concentration in PS pulping operations has been shown to have a significant impact on PS efficiency relative pulp yield. Different pulping methods have shown the potential yield benefits from using both very low and very high levels of initial alkali. The possibility to vary initial alkali concentrations and to generate pulping liquors with very high PS concentrations only exists in conjunction with black liquor gasification (BLG). The work here described explores a multi-stage laboratory cooking protocol simulating modified continuous cooking (MCC) combined with initial alkali profiling and the addition of high PS concentrations, as enabled by BLG. The effects on pulp yield, viscosity and physical properties are described.

48 - 2 9:00 am **New Process of Producing Highly Concentrated Polysulfide Liquor by Electrolysis of White Liquor(IV) -Utilization of Anode Cell Liquor-**

Shinichi Onogi, Nippon Paper Industries Co. Ltd., Speaker

Keigo Watanabe and Yasunori Nanri, Nippon Paper Industries Co. Ltd.

Tatsuya Ando, Kawasaki Kasei Chemicals Ltd.

Yoshitsugu Shinomiya, Chlorine Engineers Corp., Ltd.

Electrolytic polysulfide(PS) generation can produce highly concentrated PS liquor without any undesirable by products.

This highly concentrated PS liquor can increase not only pulp yield, but the virtually pure NaOH generated in the PS

liquor production can be added to an oxygen delignification stage and/or multiple bleaching stages to improve efficiency.

Furthermore, since the cathode cell liquor includes a small amount of KOH, this KOH can be discharged along with waste water from the bleaching stage to reduce troubles in the recovery boiler.

48 - 3 9:30 am **Seasonal Impacts on the Performance of AQ/Penetrants**

John C. Ransdell MeadWestvaco Corporation, Speaker

Peter W. Hart, , MeadWestvaco Corporation

A series of laboratory experiments were performed to determine the impact anthraquinone and anthraquinone/penetrant blends on pulp yield. Attempts to explain differences between laboratory and mill trial data have led to the understanding that the performance of AQ and AQ/penetrant varies depending upon the time of year in which the mill trials are employed. Mill trial data have been employed to help explain the impact of seasonal variations on the effectiveness of AQ and AQ/penetrants.

11/8/2006 8:30:a.m. - 10:00:a.m.  
Session: 49 O2 Delignification & Enzymes

**Session Chair**

Richard Berry, PAPRICAN

49 - 1 8:30 am **Enzyme Prebleaching of Kraft Pulp – A Success Story in Indian Paper Industry**

Rakesh K. Jain, Central Pulp & Paper Research Inst., Speaker

Central Pulp and Paper Research Institute has carried out extensive studies in the recent past and evaluated several xylanase enzymes on wood and non wood based paper mills. Having studied the



requirements of the Indian paper industry, the mill scale trial was conducted in a paper mill employing eucalyptus and bagasse as a raw material. The present paper covers a success story of implementation of enzyme prebleaching process in Indian paper industry.

49 - 2 9:00 am **Oxygen Delignification of Southern Softwood Kraft Pulps With High Lignin Content**

Joseph M. Genco, University of Maine, Speaker

Li Tao,

Barbara J.W. Cole, University of Maine

The kinetics and selectivity of the oxygen delignification process was investigated for Kraft pulps over the kappa number range from 25 to 90. The process variables investigated were the initial kappa number, the temperature, alkali application rate, oxygen pressure and the reaction time. The experimental data were fit to mathematical models that describe the decrease in the kappa number of the lignin, the molecular weight of the cellulose and the selectivity of the process. A comparison was made between the selectivity of Kraft pulping and the oxygen delignification process.

49 - 3 9:30 am **A New White Liquor Oxidation Process : Experience From Recent Start Up at Metsa Botnia Kaskinen**

Michel Muguet, Air Liquide, Speaker

Kari Kaila, Metsa Botnia

Since the early 70's, oxidized white liquor has been the preferred source of alkali for the O<sub>2</sub> delignification processes ; cheaper than caustic soda, the white liquor stream requires however that the sodium sulphide is pre-oxidized into sodium thiosulfate prior its introduction in the pulp. Commonly air has been used as oxidant but progressively, more sophisticated processes based on oxygen have emerged. Higher efficiency, smaller footprint less sulphur emissions and specially lower investment & maintenance costs explain this gradual change. Today more than 40 oxygen-based systems are operating worldwide. In large pulp mills where high amount of O<sub>2</sub> is needed, a convenient way of supplying gas is with an On Site VSA production plant ; the lower purity (around 93% O<sub>2</sub>) is no longer a problem for most applications like bleaching, however the presence of inert gases represents a operational issue when it comes to O<sub>2</sub> based white liquor oxidation units and lower efficiencies were noticed. Recognizing this problem could slow down the O<sub>2</sub> use in the Pulp & Paper industry, Air Liquide started investigations which conducted to develop a complete technology now in operation in three pulp mills in Europe. This paper will cover in the first part the main conclusions of the laboratory study : - kinetics of oxidation from sodium sulphide to sodium thiosulfate ("partial oxidation ") is an extremely fast reaction even at 110 °C - conversion to "fully oxidized " white liquor is possible at relatively low temperature, preventing metallurgical problem - the overall reaction is governed by gas to liquid transfer meaning an efficient gas to liquid transfer system is required - the system can operate at 10 bars overall pressure A multi referenced existing gas transfer technology (self suction turbine) was then adapted to white liquor oxidation and tested at pilot scale with success with high purity O<sub>2</sub> (LOX) ; additional studies helped to develop a special purge system making possible the use of lower purity O<sub>2</sub> (down to 80 %) with excellent O<sub>2</sub> records. The second part of the paper will describe in details mill implementation. Metsa Botnia, in Kaskinen within the course of a global mill modification aiming at replacing an air based system, awarded the white liquor oxidation project to Air Liquide. This system in operation since mid 2005, encompasses several interesting features, among them : - the production of 25 m<sup>3</sup>/h of "partial oxidized" white liquor for standard use (O<sub>2</sub> delignification) - the test with "fully oxidized white" liquor in oxygen delignification to evaluate the global process enhancement - the replacement of "fully oxidized" white liquor in the peroxide bleaching stage to reduce caustic requirement - the use of recompressed Offgas from the O<sub>3</sub> bleaching stage as the source of O<sub>2</sub> meaning a purity of 80 to 85% Experience and results after several month of operation will be described.

11/8/2006  
Session: 50

8:30:a.m. - 10:00:a.m.

**Workshop on Nitrogen Chemistry in Recovery Cycle (Joint Environmental/Engineering)**

**Session Chair**

Andrew Jones, International Paper

50-1 8:30 a.m. **Nitrogen Oxide Emissions From the Kraft Recovery Cycle - Do We Know Enough?**

Mikko Hupa and Mikael Forssen, Åbo Akademi University, Speakers

The paper gives an overview of our present understanding of the nitrogen oxide emissions from the chemicals recovery cycle of kraft pulp mills. The various sources for NO<sub>x</sub> emissions and the whole nitrogen chemistry in the chemical recovery cycle has shown to be much more complex than previously expected. During the last years laboratory tests and mill measurements have, however, brought a lot of new information and made the overall picture significantly clearer. The paper reviews the fate of the organic nitrogen in the wood raw material from the digester to the black liquor treatment and to the recovery boiler. It discusses the complex conversion of the black liquor nitrogen in the recovery furnace. The nitrogen is partly oxidized to NO<sub>x</sub>, but part of the nitrogen is captured by the smelt in the form of sodium cyanate. Further, the paper reviews the fate of the smelt cyanate in the white liquor preparation process and in the digester. The paper is concluded by a discussion of the remaining open questions concerning the recovery cycle NO<sub>x</sub> emissions.

50 - 2 9:00 am **Cyanate and Ammonia in the Kraft Recovery Process**

Nikolai DeMartini, Speaker

Cyanate is a product of black liquor combustion. It is an inorganic ion that exits the recovery boiler with the smelt, dissolving in the smelt dissolving tank. It reacts slowly in alkaline solutions, forming ammonia, which is partially released from the green and white liquor storage tanks as well as the slaker and causticizers. This paper will discuss the analysis of cyanate in green liquor and smelt as well as the reaction chemistry for ammonia formation from cyanate.

50 - 3 9:30 am **Nitrogen Balances in Recovery Boilers**

Kari Saviharju, Andritz Oy, Speaker

Nitrogen balances can vary a lot between different mills and recovery boilers. On the mill level, mass of the NO<sub>x</sub> emission / Adt pulp, depend strongly on wood species, on pulping yield, and on the conversion factor from black liquor N into N in NO<sub>x</sub>. The conversion factor depends on liquor, on boiler design and on boiler operation. The traditional split of the incoming N has been reported to be 25- 35 % into NO<sub>x</sub> , 10- 35 % in smelt out of the boiler, and rest 35 – 65 %, into nitrogen gas in flue gases. Nitrogen in smelt goes into green liquor, and further into weak odorous gases and into white liquor. As weak and strong odorous gases are burnt, and SO<sub>2</sub> emissions are in practice close to zero in new boilers, focus in emissions is in NO<sub>x</sub>. Andritz has delivered many recovery boilers with the Vertical air system since 1999 to meet this demand, and has carried out a large amount of testing to recognize the critical issues for low NO<sub>x</sub> emissions, and to find out the possible consequences for other issues, as SO<sub>2</sub> , capability to generate greenhouse gas free electricity, possibility to increase in the future liquor firing capacity etc. The presentation deals nitrogen balances for several boilers. They show that the split can be with low-NO<sub>x</sub> design for instance 15 % into NO<sub>x</sub>, 10 % into smelt and 75 % into N<sub>2</sub> in flue gases. Low NO<sub>x</sub> emission does not correlate with high concentration of N in out flowing smelt. On the other hand, N concentration in smelt can represent over 40 % of the incoming N in black liquor. The emission figures correlate with the same upper furnace parameters as in power boilers, i.e. excess air, temperature, staging, low carry-over. These parameters can be met with the Vertical air system. In modern non low-NO<sub>x</sub> boilers the N conversion factor from black liquor N into N in NO<sub>x</sub> is typically in the range of 20 – 30 %. With the low NO<sub>x</sub> design the range is 15-20 %. The balance figures vary with the firing system, with the loadings, with liquor firing properties including dry solids, with the operation parameters etc. The missing data for reliable numerical modeling, without experience related parameters, are in pyrolysis and lower furnace oxidation processes, including deep temperature, concentrations and velocity gradients. The effect of weak and strong odorous gases into NO<sub>x</sub> emission, depend on system design. With right design, the N input via NH<sub>3</sub> in the odorous gases does not effect the NO<sub>x</sub> emissions of recovery boilers. The important, practical issue is that NO<sub>x</sub> emission and other emissions have cross effects, data for BAT has to be from the same recovery boiler in this respect. Lower NO<sub>x</sub> emission may generate SO<sub>2</sub> emission, and the operation mode, which results into low NO<sub>x</sub> emission may affect on the melting behavior of carry-over. Lower melting temperature can induce fouling and corrosion in the superheater; more sootblowing steam is needed and the generation capability of greenhouse gas free power is reduced. Naturally the corrosion issue can be compensated with more expensive materials. The other important practical issue is that generally boiler loading has effect on NO<sub>x</sub> emission via temperatures. If the permit is for the today's firing capacity, the capacity increase will result into higher NO<sub>x</sub> concentration in flue gases, and into higher figures per Adt pulp.

11/8/2006  
Session: 51

8:30:a.m. - 10:00:a.m.  
**Gulf Coast Hurricanes - Preparation and Response in the Pulp and Paper Industry**

**Session Chair**

Mike Foster, Env. Bus. Specialists, L.L.C.

11/8/2006  
Session: 52

10:30:a.m. - 12:00:p.m.  
**Controlling Pulp Yield and Composition**

**Session Chair**

John Ransdell, MeadWestvaco

52 - 1 10:30 am **Seasonal Variation in Wood: Perceived and Real Impacts on Pulp Yield**

Peter W. Hart, MeadWestvaco Corporation, Speaker

Wood constitutes up to 60% of the cost of bleached pulp. Unfortunately, the industry does not understand the impact of seasonal changes on wood processing and pulp yield. Perceived and actual changes in pulp yield are examined as a function of repeatable, long-term seasonal changes in wood. Several years of mill data are examined to determine the level of seasonal impact on pulp yield and accounting systems.

52 - 2 11:00 am **A kinetic study of softwood kraft cooking -carbohydrate composition as a function of the cooking conditions**

Dan Johansson, Karlstad University, Speaker

Ulf H. Germgard, Karlstad University

A softwood kraft pulp has three mayor carbohydrate components i.e. cellulose, glucomannan and xylan, which give rise to different pulp properties. These are partly degraded and dissolved during kraft cooking. However, these carbohydrates react differently to the cooking conditions and makes it possible

to vary the carbohydrate composition in the pulp. A model, based on a large kinetic study, has therefore been developed to be able to control the carbohydrate composition in the pulp.

52 - 3 11:30 am **Influence of Fiber Scale Heterogeneity on Softwood Kraft Pulp Uniformity**

Ming Qiao, University of Washington, Speaker  
Richard Gustafson, University of Washington

Pulp uniformity is an important characteristic of kraft pulp. Non-uniform pulp results in higher bleaching chemical cost and can result in an inferior paper product. New digester configurations have evolved, in part, to produce more uniform pulp. Pulp non-uniformity can result from heterogeneities at different scales. These include concentration and temperature gradients at the digester scale and chip scale, and heterogeneities at the fiber scale. In this paper, the influence of fiber scale heterogeneity on softwood kraft pulp uniformity is investigated. Softwood mini-chips are produced by cutting earlywood and latewood sections from Douglas fir wood. The mini-chips are then pulped in well mixed reactors under conditions that eliminate concentration gradients within the chips themselves. The kappa distributions of the pulps are then analyzed in the single fiber kappa analyzer to assess their uniformity. It was found that all the pulps had kappa distributions with COVs of 16% and that the distributions were Gaussian in shape. This is in contrast to softwood kraft pulps from conventional chips pulped under conventional conditions that always have a high kappa tail and COVs of greater than 22%. When earlywood and latewood minichips are pulped together under the uniform pulping conditions, the resulting pulp as a kappa distribution COV of 20%. The kappa distribution of this pulp is identical to the weighted average distribution of the corresponding earlywood pulp and latewood pulp kappa distributions. The fiber scale heterogeneity quantified in this study can now be incorporated into kraft pulping models that account for chip scale and fiber scale heterogeneity, to get more accurate predictions of softwood kraft pulp uniformity

11/8/2006  
Session: 53

10:30:a.m. - 12:00:p.m.  
**High Temperature Black Liquor Gasification**

**Session Chair**

Kevin Whitty, University of Utah

53 - 1 10:30 am **On Pressurized High-Temperature Black Liquor Gasification Kinetics**

Chris Young, IPST at Georgia Tech, Speaker  
Kristiina Iisa, IPST at Georgia Tech  
Jim Fredrick, Jr., ChBE and IPST at Georgia Tech

Black liquor gasification is a cornerstone technology for the forest products thermochemical biorefinery. It has long been known that the operating cost of a biorefinery can be greatly reduced by pressurizing the gasifier, but little information exists regarding pressure effects on BLG kinetics. Using the IPST@GT's pressurized entrained flow reactor, the author has investigated the effect of pressure (at 5, 10, and 15 bars) on carbon conversion of gasification and pyrolysis chars at 900°C and residence times between approximately ½ and 4 seconds. Two groups of gasification experiments were conducted, with one group at a constant mole fraction and another at constant partial pressure of CO<sub>2</sub> and H<sub>2</sub>O.

53 - 2 11:00 am **Studies and Selection of Containment Materials for High-Temperature Black Liquor Gasification**

James R. Keiser, Oak Ridge National Laboratory, Speaker  
James Hemrick and Roberta Meisner, Oak Ridge National Laboratory  
J. Peter Gorog, Weyerhaeuser Company

Selection of suitable containment materials is a major obstacle in the successful implementation of black liquor gasification. Through examination of exposed components, conduction of laboratory corrosion tests and cooperative efforts with refractory manufacturers the materials issues in high-temperature black liquor gasification have been addressed.

53 - 3 11:30 am **Status of the Swedish National Black Liquor Gasification (BLG) Development Program**

Mats Lindblom, Chemrec AB, Speaker  
Ingvar Landalv, Chemrec

A focused effort to bring high temperature black liquor gasification technology to market was started in 2004 when the Swedish government and industry joined forces to fund a national 3-year BLG Development Program. This paper will report on the status of both parts of the program, experience from the first year of operation in the pressurized oxygen blown 20 tds/day Chemrec high temperature black liquor gasification development plant DP-1 in Pitea, Sweden and a summary of the focused BLG research program aimed at closing identified knowledge gaps before scale-up and commercialisation. An outlook of the planned continuation of DP-1 operations and R&D activities during the three year period 2007-2009 will be made and plans shared for scale-up of the technology to commercial demonstration of the BLGMF technology for production of renewable motor fuels at Swedish pulp mills.

11/8/2006  
Session: 54

10:30:a.m. - 12:00:p.m.  
**Lime Kilns (joint Environmental/Engineering)**

### **Session Chair**

Venki Venkatesh, International Paper

- 54 - 1 10:30 am **Flame Patterns in Lime Kilns Burning NCG**  
Arafat Mahmoud Alokaily, University of Toronto, Speaker  
David C. S. Kuhn, University of Toronto  
Pierre E. Sullivan and Honghi Tran, University of Toronto  
The efficiency of a lime kiln in converting lime mud into lime depends greatly on how effectively the heat from the burner flame can be transferred to the lime mud particles. Since burners are the only source of heat in the kiln, the flame patterns they produce are critical to the kiln operation and performance. This is particularly true for kilns that burn non-condensable gases (NCG) in a separate burner. A study has been performed to determine the key parameters that affect flame patterns in lime kilns using an acid-alkali flow visualization method. The results suggest that combined Craya-Curtet number (Ct) and excess O<sub>2</sub> are the two most dominant parameters affecting the flame length, while the angle of the NCG burner has little effect. An empirical equation involving combined Ct has been developed for calculating the flame length; it may be used to evaluate the effects of NCG burning on flame patterns and kiln operation.
- 54 - 2 11:00 am **Successful Experience of Firing of Petroleum Coke (Petcoke) in Lime Recovery Kilns**  
Richard P. Manning, Kiln Flame Systems Ltd., Speaker  
Cliff J. Rennie, Kiln Flame Systems Ltd  
Recent trends in traditional fuel prices have been escalating, particularly in North America. Pulp mill operations have been forced to look at alternative lower fuel cost options such as petroleum coke (petcoke), tall oil and recycled oils. Since Dec-03, the number of mills firing petcoke in the US has already increased from 3 to 11. This paper describes the successful practical experience of conversion of gas/oil fired kilns to petcoke firing.
- 54 - 3 11:30 am **Air Permitting Considerations for Firing Petroleum Coke in a Lime Kiln**  
Michelle Kolozsvary, DTE Energy Services, Speaker  
In response to increased energy costs, a growing number of paper mills are switching to petroleum coke (pet coke) firing in their lime kilns. Firing pet coke in a lime kiln is an ideal application of the fuel because of the inherent scrubbing properties of the kiln. Switching to pet coke requires that a mill undergo an evaluation of potential changes in air emissions from the kiln. Updated information on air permitting and results of test burns will be presented.

**11/8/2006** 10:30:a.m. - 12:00:p.m.  
**Session: 55** **Environmental Management System Panel**

### **Session Chair**

Dale Phenicie, Environmental Affairs Consulting Peachtree City

### **Panelists**

Saul J. Furstein, Georgia-Pacific Corporation

William Jernigan, Georgia-Pacific Corporation

Environmental management activities at pulp and paper mills include many different tasks and events. This panel will examine a number of these and provide perspectives on how to ensure environmental program success, track continuous environmental performance improvements, gain enhanced environmental profiles, and reduce costs. Topics covered include:

- Environmental auditing experiences
- Successful environmental compliance inspections
- Beyond compliance programs
- Defining environmental and business sustainability

**11/8/2006** 1:30:p.m. - 3:00:p.m.  
**Session: 56** **Sootblowing**

### **Session Chair**

Danny Tandra, Clyde Bergemann Inc.

- 56 - 1 1:30 pm **Low Pressure Sootblowing System**  
Simon Youssef, Diamond Power Int'l, Speaker  
Alarick Tavares, Diamond Power Int'l  
Energy efficiency has become a core strategy for pulp and paper mills to reduce production costs and maintain competitiveness in a global marketplace. Energy costs represent 25-30 percent of the total manufacturing costs for pulp and paper mills. Recovery boiler cleaning requirements have a large effect on

the overall energy cost for a mill due the relatively high costs associated with using high pressure steam for sootblowing. The concept of utilizing lower pressure steam for sootblower cleaning would increase the availability of high pressure steam for power generation. The additional power provides an opportunity for pulp and paper mills to lower their operating costs. Typically, traditional sootblowing systems require a steam source with a minimum pressure of 400-450 psig. This high pressure source is required due to pressure losses in the sootblowing system. This, in conjunction with the high cleaning demands of a recovery boiler, prevents the use of a lower pressure steam source with standard sootblowing systems. The technology to implement a low pressure sootblowing system is a combination of low pressure loss sootblower hardware, upgraded sootblower piping components, and a variable flow control system. This new low pressure sootblowing technology can effectively use lower pressure steam sources, such as turbine extraction steam, to deliver the required cleaning energy and maintain boiler run time. This paper cites a case study at a recovery boiler in the U.S., where six sootblowers in the superheater region were equipped with this technology. The project goal was to prove that effective sootblower cleaning can be accomplished with a low pressure steam source. This paper will discuss the technology, testing, and results of this study, confirming that this low pressure sootblowing technology works.

56 - 2    2:00 pm    **Replacing Sootblower Control System with Open Control Solutions**  
 Bruce P. Marling, Orion CEM Inc., Speaker  
 Historically, sootblowing controls in North American Paper Mills have been done in a dedicated black box provided by the Sootblower Manufacturer. Emerson Process Management has implemented the SmartProcess® Soot Solution in two boilers. In the first boiler, an oil fired power boiler, emissions are monitored and controlled by regulating the sootblowing. In the second boiler, a recovery boiler, sootblowing controls the overall steam smoothing, optimizing the power house operations.

56 - 3    2:30 pm    **Intelligent Recovery Boiler Cleaning Management - A Tiered Approach to Saving Steam while Improving Boiler Cleanliness**  
 Alarick J. Tavares, Diamond Power, Speaker  
 Jason Moore, Diamond Power  
 Energy costs represent as much as thirty percent of the total manufacturing costs for a pulp and paper mill. Recovery boiler cleaning has a large effect on the amount of steam used for sootblowing, the thermal efficiency of the heat transfer sections, and the duration between outages. Each of these three parameters contributes to the mill's overall energy costs. Properly balancing the cost of sootblowing steam with the benefit of boiler cleanliness can often be difficult. Until recently, almost all mills ran their sootblowers continuously using a predetermined ordering to maintain boiler cleanliness. Under this scenario, the only real options for saving sootblowing steam were cleaning hardware upgrades or adjustments. Presently, a tiered approach has been developed to increase recovery boiler cleanliness while concurrently decreasing sootblower steam consumption. This approach includes the following five tiers: intelligent clean/dirty determination, adaptive cleaning management, flexible controls, high performance hardware, and continuous assessment. Each tier reduces steam consumption and increases boiler cleanliness in a different manner. When the tiers are built on top of each other, starting with intelligent clean/dirty determination and ending with continuous assessment, the result is a powerful system for intelligently managing recovery boiler cleaning. Under the tiered approach, sootblowers only run when and where a heat transfer section is fouled and, they only use the appropriate amount of steam during each portion of their travel path to do so. Additionally, continuous adaptation to changing boiler conditions is used in conjunction with state-of-the-art hardware to provide unparalleled cleaning. This paper discusses the features and the benefits of a tiered cleaning approach over the traditional approach to recovery boiler cleaning.

11/8/2006    1:30:p.m. – 4:00:p.m.  
 Session: 57    **Implementing the Biorefinery**

**Session Chair**  
 Tom Amidon, State University of New York

57 - 1    1:30 pm    **Co-Production of Ethanol and Cellulose Fiber from Southern Pine: A Technical and Economic Assessment**  
 Jim Fredrick, Jr., Speaker  
 Steve Lien, Charles Courchene, Art Ragauskas and Kristiina Iisa, IPST at Georgia Tech  
 Woody biomass contains 20-30 wt-% of hemicelluloses which can be extracted relatively easily and with minimal damage to the remaining cellulose. The hemicelluloses can be bioconverted to pentose sugars and fermented to produce ethanol. In the present study, a technical and economic assessment was made for a biorefinery that utilizes Southern Pine as its feedstock. The biorefinery is comprised of a hemicellulose extraction plant, an ethanol plant utilizing hemicelluloses as feedstock, and a kraft pulp mill that processes the wood after extraction of hemicelluloses to produce cellulose fibers. The study analyzed the overall energy balances within the plant – including steam, electrical, biomass and fossil fuel. The results of this study suggest that fuel-grade ethanol can be produced economically, with a break-even cost of \$1.10-\$1.15. The break-even cost is sensitive to the cost of wood, and the market prices of cellulose fiber and electrical power produced on-site. Quantitative assessments of the impacts of these variables are presented.

57- 2    2:00 pm    **Effect of Hot Water Pre-Extraction on Alkaline Pulping of Hardwoods**

Todd Bolton, State University of New York, Speaker  
Raymond C. Francis, Empire State Paper Res. Inst.  
Thomas E. Amidon and Todd S. Bolton, State University of New York  
Hot water pre-extraction (acidolysis) of hardwood chips increases the rate of alkaline pulping by a factor of 2-10 depending on the severity of the acidolysis. ECF bleaching of kraft pulps from pre-extracted chips is superior to pulps from un-extracted chips and the tensile-tear relationships are equivalent for bleached pulps. Lignin was leached from un-extracted chips and from chips treated with hot water at 140°C, 150°C and 160°C. The leaching was conducted with 0.1M NaOH at room temperature. Lignin leached into solution was determined by UV absorbance at 205 nm. After 26 hours the absorbance of the solutions were 0.1, 0.4, 0.65, and 1.05 for the un-extracted, 140°C, 150°C, and 160°C extracted chips, respectively. Studies are on-going with the aim of discovering the mechanism(s) responsible for the higher reaction and/or diffusion rate of lignin after acidolysis.

57 - 3 2:30 pm

**Pre-Extraction of Southern Pine Chips with Hot Water**

Sung Hoon Yoon, University of Maine, Speaker  
Adriaan Van Heiningen, University of Maine

Southern pine wood chips were contacted with pressurized hot water at temperatures of 170, 180 and 190°C for various times. The time-temperature effect on the extract yield could be well described by the H-factor approach. A maximum of about 11.5% of the wood mass was extracted as polymeric hemicellulose at an H-factor of about 1,000 and 8% at an H-factor of about 500, with a minor removal of lignin (0.5% on od wood) and cellulose (0.3% on od wood). The pH of the final extract controls both the extraction yield as well as the properties of the extracted wood. Conventional kraft cooking results of the pre-extracted softwood chips will be compared to reference cooks on regular chips cooked to the same kappa number.

57 - 4 3:00 pm

**Evaluating Biorefinery Options: Synergy in Energy Demand & Carbon-Hydrogen yield**

Farminster Anand, Georgia Inst. of Technology, Speaker  
Matthew Realf, Georgia Inst. of Technology  
Kristina Lisa and Charles E. Courchene, IPST at Georgia Tech

We have considered two significantly different technological alternatives for the expansion of pulp and paper mills. First, the pre-extraction of hemicellulose from the wood to produce ethanol through fermentation route and second, the replacement of Kraft cycle by MSSAQ pulping followed by B/L gasification, which leads to the opportunity to produce various transportation fuels. The two technologies lead to production of different transportation fuels as will many of the possible alternatives for biorefineries. Hence in order to make rational comparisons without extremely detailed design calculations, we have evaluated the two alternatives on the basis of carbon and hydrogen yields and the opportunities for synergy between the energy demands and supplies of such systems with those of the mill. It is hoped that these simpler measures of system performance will give us tools to evaluate biorefinery options more simply than full techno-economic evaluations that will rely heavily on information that may be known poorly, if at all.

57 - 5 3:30 pm

**Downstream Process Effects Related to Wood Chip Pre-Extractions**

Patrick E. Hazlewood, IPST at Georgia Tech, Speaker

Pre-extraction of wood chips may result in previously undefined downstream process disruptions. The current work investigates the impact of extractive removal from wood chips on downstream process corrosion as a result of black liquor modification. Using wood chips taken from two southeastern North American mills the impact of wood chip weathering and early extraction on process corrosion is evaluated.

11/8/2006  
Session: 58

1:30:p.m. - 3:30:p.m.  
**Process Issues in Corrosion Problems**

**Session Chair**

Steve Lukezich, MeadWestvaco

58-1 1:30

**Corrosion in Wastewater Treatment Plants at Pulp and Paper Mills**

David Bennett, Corrosion Probe, Speaker

58 - 1 2:00 pm

**Biogenic H<sub>2</sub>SO<sub>4</sub> Corrosion of Concrete in Pure Oxygen Activated Sludge Bioreactors**

Joseph R. Kish, PAPRICAN, Speaker  
Douglas L. Singbeil, PAPRICAN

Significant concrete corrosion occurred within the headspace of a pure oxygen activated sludge treatment (OAS) bioreactor treating pulp mill effluent. To assist the mill, a study was undertaken to (i) review of the relevant literature to validate the suspected mechanism of biogenic H<sub>2</sub>SO<sub>4</sub> corrosion, and (ii) compare bioreactor input effluent solutions to identify the process condition(s) most likely responsible for the biogenic H<sub>2</sub>SO<sub>4</sub> corrosion. This paper documents the results of the study and discusses the implications.

58 - 3 2:30 pm **Process Corrosion Related to Wood Chip Extractives**  
Patrick Hazlewood, IPST at Georgia Tech., Speaker  
Preet M. Singh, IPST at Georgia Tech  
Jeffery S. Hsieh, Georgia Inst. of Technology  
The current work investigates the impact of wood species and extractives on downstream process corrosion as a result of black liquor modification. Wood chips taken from two southeastern North American mills are evaluated on the impact of wood chip weathering and early extraction on process corrosion. Initial results indicate that an increase in corrosion of up to 50 times may be experienced in hardwoods and up to 3.5 times in softwoods.

58- 4 3:00 pm **In Situ Investigation on the Effect of Anthraquinone on Corrosion In a Continuous Digester**  
Winston Shim, Corrosion Service Co. Ltd., Speaker  
Darvin Mattila, Georgia-Pacific Corporation  
A dramatic rise in corrosion rate in the lower zone of a Lo-Solids® Kamyrr continuous digester was observed during a routine maintenance shutdown. Metal loss as high as 195 mils over an 11 month operation period prior to the shutdown was evident. Anthraquinone (AQ), introduced a few years earlier in the pulping process, was suspected to be the cause. The effect of AQ on corrosion rate of the digester was studied in situ by electrochemical techniques. Digester operating parameters investigated were AQ addition, white liquor concentration and temperature on a real time basis. Based on the results of this study, an operating strategy was recommended for corrosion mitigation. Ultrasonic thickness measurements confirmed the effectiveness of this strategy.

**11/8/2006** 1:30:p.m. - 3:00:p.m.  
**Session: 59** **Making Functional Modifications to Pulp**  
Session Chair: Brian Brogdon, Kemira

59 - 1 1:30 pm **Process Variables of Pulp Alkali Pretreatment on Absorbency Improvement**  
Jan X. Pekarovic, Western Michigan University, Speaker  
John H. Cameron, Western Michigan University  
Miro Suchy, Western Michigan University.  
The beneficial effect of pretreatment of fibers with sodium hydroxide commonly referred as mercerization process is shown. The treatment of fibers with sodium hydroxide can be carried out at different levels of reagent concentration, reaction time, and at different consistency. The sodium hydroxide concentration and pulp consistency have the strongest influence impact on every single dependable variable. In central composite experimental design various dependent variables are chosen – WRV, Specific absorbency, Wicking height, horizontal/plain absorbency, etc.

59 - 2 2:00 pm **Caustic Treatment of the Pulp: Washing Efficiency and Caustic Recovery Study**  
Miro Suchy Western Michigan University, Speaker  
John H. Cameron, Peter E. Parker, and Jan X. Pekarovic, Western Michigan University  
Pulp, a cellulosic material manufactured from naturally abundant renewable matter, with favorable absorption properties and biodegradable, is a popular material in the personal care products industry. The benefit of caustic treatment on changing cellulose properties has been long known. One of the purposes of this treatment is to increase the bulk and absorption properties of personal care products. The actual treatment, its modifications and optimal conditions are well described and documented. The challenges associated with the process include effective caustic removal from the pulp and recovery of the generated diluted caustic solution. The objective of this study is a systematic analysis of caustic treatment of bleached pulp, including a flow diagram and corresponding mass and energy balances. A major focus of this investigation is to evaluate the pulp washing efficiency and subsequent caustic recovery. Using computer simulations software, washing efficiency and material balances, with emphasis on sodium balance and distribution, were carried out. Computer generated data may be supported by measurement of sodium levels in washing filtrate. Using generated and measured data, alternative separation processes, more specifically membrane separation processes - Reverse Osmosis - is being evaluated as potential candidates for caustic recovery.

59 - 3 2:30 pm **Influence of Wood and Dissolving Pulp Properties on the Carboxymethyl Cellulose (CMC) Reaction**  
Ulf H. Germgard, Karlstad University, Speaker  
Pulp made from wood can be used to produce paper but also to produce cellulose derivatives like carboxymethyl cellulose (CMC). Pulping is usually done as a sulfite cook on spruce but prehydrolysed kraft is an option. The paper discusses important wood and pulping parameters that influence the properties of CMC like its reactivity and includes a simple mechanism for the CMC reaction.