SESSION B –

FIBRE LINE

1.) Turboscrubber – Bleach Plant Scrubber Application:

Rohan Bandekar, P.Eng. Process Engineer – **Noram Engineering & Constructors Ltd**.

Many pulp and paper plants around the world are facing increased pressure from environmental agencies and stakeholders to reduce emissions in the form of ClO2 and sometimes Cl2. It is standard to measure and report these emissions during continuous operation, but many producers are also experiencing increasingly stringent emission targets for the duration of plant start-up. During plant start-up many plants experience spikes in ClO2 concentrations, and the "green smoke" or stack opacity from ClO2 slippage can be another concern.

Currently the pulp and paper industry uses mostly two kinds of scrubbers for bleach plant vent gases, packed bed scrubbers or horizontal duct mist scrubbers. Packed bed scrubbers plug often and require a shutdown for acid cleaning whereas horizontal duct mist scrubber nozzles are prone to nozzle plugging. The use of E-stage effluent as a scrubbing medium is extensively pursued by the industry as it is freely available but is not widely practiced due to fibers creating problems for both types of scrubbers. Turboscrubber® provides guaranteed blockage free operation while using E-stage filtrate and hence provides a significant advantage over other type of scrubbers used in bleach plant.

TurboScrubber® technology has inherently higher mass and heat transfer rates for a given gas-side pressure drop, compared to other gas-liquid contacting technologies. Hence it offers the possibilities of ClO2 emission reduction, continuous and start-up emission reductions, and the use of scrubbing slurries- all achievable in one process unit operation with a smaller foot print than other scrubbing technologies.

The TurboScrubber® fluidized bed technology, licensed by NORAM, has been successfully applied to a wide range of Cl2 and ClO2 scrubbing applications, and can potentially be used with great effect in the pulp and paper industry. This paper provides an overview of the TurboScrubber® technology, discusses kinetics of ClO2 and Cl2 absorption in water and NaOH solution, and discusses some of the technical features of TurboScrubber® technology and equipment.

2.) Wash Press & Papricycle Installation:

Honey Nampak, P.Eng, Technical Services Superintendent – **Nanaimo Forest Products, Ltd. (in conjunction with Valmet)**

Bleaching chemicals are one of the major costs in Kraft Pulping. To improve overall chemical usage, the ECF bleach plant (O D_0 E_{OP} D_1 E_P D_2) with a vacuum washer after each bleaching stage was studied. The brown stock washer (Chemiwasher) was found to be inefficient at higher production rates or certain pulp grades. As a result, high COD carry over to the mini-O2 stage, and consequently to Pre-bleach vacuum washer, caused production bottleneck and increased chemical use to reach quality targets.

A wash press was installed in the pre-bleach wash position while the existing vacuum washer was repurposed to create an additional bleaching stage (Papricycle stage). The wash press discharge consistency of

30% resulted in a 50% COD decrease to the D0 stage which subsequently reduced ClO_2 demand the in D_0 stage as well as NaOH usage in the extraction stage. The mill implemented the installation and reconfiguration in 2 stages:

1) Wash press installation after O2-delignification stage (O D_0 E_{OP} D_1 E_P D_2)
2) Papricycle stage and washer startup (O D_0 PAP E_{OP} D_1 E_P D_2)

The separation of both phases of the project has given useful information on wash press and Papricycle chemical savings. So far, over 20% chemical and steam savings have been realized. Another significant benefit of better washing is a 10% higher maximum production rate throughout the bleach plant.
Operators are also able to resume production target rates after a shutdown with significantly less time as compared to the previous configuration.

3.) <u>Fibre Species & Chip Screening Effects on Yield & Kappa Update</u>:
Ralph Lunn, Senior Process Engineer – **Mercer, Celgar**

At Mercer Celgar, we are surrounded by mixed forest types. Positives include a reduced susceptibility to epidemic disease, and from a pulping perspective, the ability to custom blend particular species to give a desired physical property such as tensile or tear. Negatives include different chemical and physical fibre characteristics, which can make producing a uniform product (kappa number, yield, strength) with the different species a real challenge.

Previous work by Tasman at Paprican (now FPInnovations) explored the effects different species have on digester kappa and cooking yield, developing seven constants for use in kappa and yield calculations. But one set of data was missing – for hemlock. As this makes up about 25% of our furnish, it was felt to be important to develop the necessary parameters to include it with the other species. So laboratory cooking was completed by Theo Radiotis' group at FPInnovations, using hemlock provided by Celgar. The subsequent use of the kappa and yield equations can graphically illustrate the differences between various species, and suggests the opportunity for yield gains at a target kappa.

Another critical determinant of cooking yield is chip size classification. "Accepts" (< 10 mm thick, > 7mm long) give a better yield than overs, pins, or fines, but how much better? When new capital projects are considered in the chip screening area, the yield of each size class becomes critical for any justification. Limited data in the literature prompted Celgar to undertake a series of lab cooks for each size class, for each of our three primary species, in order to determine the yield for each case.

4.) <u>Online Monitoring of Wood Chip Chemical Composition Using A Near-Infared (NIR) Analyzer</u>: Guillaume Hans, Senior Scientist – **FPInnovations**

Historically, on-line and real-time measurement of wood chip properties in the pulp and paper industry has been a challenge and has hampered the development of advanced process control strategies. Based on the principle of near-infrared (NIR) spectroscopy, FPInnovations has developed an on-line (over-the-conveyor belt) analyzer that can characterize wood chip extractives, lignin and holocellulose content simultaneously and in addition to other properties such as moisture content. Through the combination of various NIR spectra processing methods, the calibration models developed achieved high prediction accuracies, with root mean square errors (RMSEs) of ±0.22%, ±0.55% and ±0.61% for extractives, lignin and holocellulose, respectively. Furthermore, the models were desensitized to the influence of moisture content and temperature to ensure their robustness, which is critical for on-line applications under harsh industrial conditions. The on-line prediction of wood chip chemical composition using the developed NIR analyzer was demonstrated over 7 months in a kraft pulp mill processing both hardwood and softwood chips. In the future, this new technology will help leveraging innovative applications to optimize pulp mill operations, maximize fibre valorization, minimize waste, facilitate troubleshooting, better manage the chip supply and better assess its quality.

5.) Design Of Reliable Storage Bins For Hog & Chips:

Jamil Bundalli, P.Eng, Director - **Kamengo Technologies, Inc.**

In the 1950s, Dr. Andrew Jenike, at the University of Utah, developed the theory of using a bulk material's flow properties to design storage bins that self-empty with only the aid of gravity. The material flow properties that Jenike was interested in included the shear strength the bulk material gained when compressed under load as well as the bulk material's internal angle of friction. Jenike's research, which focused on granules and powders, revolutionized the way the mining and pharmaceutical industries design storage bins.

In the 1980s, researchers at an independent research institute located on the campus of the University of British Columbia led a 15-year research program to either prove or disprove whether Jenike's theories apply to fibrous materials, such as hog fuel and wood chips, as well as cohesive materials, such as lime. The aim of the research, which was funded by the Government of Canada's ENFOR (ENergy from the FORest) program, was aimed at supporting Canada's pulp and paper industry to resolve critical materials handling challenges.

The research conducted on the campus of the University of British Columbia was hands-on. The team built a full-size bin and developed new bench test equipment needed to characterize the flow properties of different species of hog fuel and wood chips. The research not only demonstrated that Jenike's theories apply to the design of storage bins for fibrous materials, but also demonstrated safe and reliable bin geometries for handling hog fuel and wood chips. In addition, the research uncovered the negative effects that the behaviour of the feeder can have in causing bin plugging and inconsistent feed.

The critical outcomes of the research included both a scientifically grounded approach to determining correct storage bin geometry for sticky, fibrous and cohesive materials, as well as the Kamengo Feeder, which was designed to resolve the key shortcomings of conventional feeders. The research team was spun out into a new company, Kamengo, which was tasked with extending and commercializing the research developed over the previous 15 years.

This presentation will review the research conducted on the campus of the University of British Columbia, including the research process and outcomes. Specifically, the presentation will review the three root causes of bin plugging and intermittent feed identified by the research team. These three root causes include:

1. poor bin geometry;

2. compaction of the stored bulk material by the feeder; and,
3. uneven discharge from the storage bin.

To support the reader's understanding of Jenike's theories and how they are applied to the design of storage bins, the presentation will also outline key concepts such as mass flow (first-in, first-out discharge) versus funnel flow (first-in, last-out discharge), as well as the effect of bin shape, material temperature, material time at rest, and material moisture content on bin design. The presentation will highlight case studies that demonstrate how the research and its outcomes were applied in the design of new equipment as well as retrofit equipment suffering from chronic plugging.