

CURRENT AWARENESS SERVICE

A Quarterly Publication of Central Pulp & Paper Research Institute
July - September (2016)
Vol.15 No.3



CENTRAL PULP & PAPER RESEARCH INSTITUTE
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1. Covey, Geoff (2016). **Selecting the markets for bio-fuels**. APPITA, 69(3), 200-205.

Abstract: Reserves of petroleum will last for at least another twenty-five to fifty years. Therefore drop-in liquid biofuels need only serve a short-term market while new engines are developed which can effectively use bio-fuels which have been less extensively modified and are therefore cheaper and made with greater energy efficiency.

It is also argued that the emphasis should be on initially entering the market segments where the technical and regulatory requirements for the fuels are easily satisfied. Therefore marine and road transport applications are better targets than aviation fuels for market entry.

It is shown that there have been many examples where one fuel type has been replaced by another which was not compatible with existing combustion equipment, and that the change-over time from the old fuel to the new is typically ten to fifteen years in which time existing engines are replaced with types designed for the new fuels.

KEYWORDS : Biofuel, biorefining, biofuel applications, biofuel market.

2. Malton, Stan and O'Driscoll, Wayne (2016). **Evaluating and optimising dryer section performance**. APPITA, 69(3), 206-211.

Abstract: The paper machine dryer section consumes large amounts of steam energy. It also has a significant impact on both production and sheet quality. As a result, mill profitability can be heavily influenced by overall dryer performance.

The drying process, like other papermaking operations, is a complex matrix of interacting components: pocket ventilation, steam distribution and handling, drive system, tail threading, sheet handling, energy recovery, and fabric conditioning, guiding, and tensioning. An evaluation of the dryer section begins with identifying the performance criteria and standards of good dryer section operation. Once defined, a complete set of dryer section measurements, including an analysis of equipment sizing, is performed to assess performance against the defined standards. In this paper recommendations are provided for operational improvements, equipment upgrades, and a checklist of short-term and long-term improvement projects prioritised by the expected economic return. Typical returns come from energy savings, increased drying capacity, reliable dryer drainage, improved dryer section runnability, and enhanced drying uniformity, among other improvements. A comprehensive dryer performance evaluation report identifies improvement opportunities and quantifies the associated benefits.

This paper discusses the benchmarks commonly used when evaluating dryer section performance. Common opportunities for steam efficiency improvements are identified.

3. Lowe, Rob and et. al. (2016). **Multifunctional dry strength additives for improved production efficiency.** APPITA, 69(3), 212-216.

Abstract: The strength of paper has always been a critical sheet parameter; however, it is rarely the ultimate driver for the use of dry strength additives. Often, dry strength additives are used as a tool to balance negative impacts that can come from attempts to lower the total cost of operation. The desire to improve production rates while also reducing raw material costs is driving a growing trend towards lighter basis weights and the increased use of recycled furnishes. This paper examines multifunctional dry strength additives used to improve paper strength per unit of basis weight while lowering the total cost of operation in board and packaging grades.

4. Zhang, Xuejin and et. al. (2016). **Decomposition of hydrogen peroxide by manganese in the presence of lignin.** APPITA, 69(3), 241-246.

Abstract: In this study, the effects of both free manganese ions and manganese in the presence of precipitated lignin on the decomposition of hydrogen peroxide under typical pulp bleaching conditions were investigated. Precipitated lignin was generated by hydrochloric acid, without further purification, and reacted with a Mn solution before testing its effect on peroxide decomposition. A variety of bleaching stabilizers, ethylenediaminetetraacetic acid (EDTA), sodium silicate (Na_2SiO_3) and magnesium sulfate (MgSO_4), were added individually or in combination, to, investigate their effects in controlling the free manganese induced or precipitated lignin-combined manganese induced hydrogen peroxide decomposition. Fourier Transform Infrared Spectroscopy (FT-IR), Elemental Analyses, Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES), were used to study the chemical features of the precipitated lignin-manganese composites, as well as the amount of metal ions presented in the solution or adsorbed on precipitated lignin.

The results showed that the hydrogen peroxide decomposition in the presence of both free manganese and precipitated lignin-combined manganese can be represented by a pseudo-first-order kinetics. The decomposition of hydrogen peroxide by free manganese ion under alkaline condition was significantly greater than when precipitated lignin was present, with pseudo-first-order rate constants of $2.89 \times 10^{-2} \text{ min}^{-1}$ and $6.53 \times 10^{-4} \text{ min}^{-1}$ respectively. EDTA added individually showed the most positive effect on further reducing the decomposition of peroxide in both cases, dropping the pseudo-first-order rate constant (k_{obs}) to $2.57 \times 10^{-4} \text{ min}^{-1}$ in the case of free manganese, and to, $3.44 \times 10^{-4} \text{ min}^{-1}$ in the presence of lignin-combined manganese.

Analysis showed that only a small amount of Mn in solution is complexed by the lignin so a significant amount of free Mn is still present after complexation. Hence it is not clear whether

the complexed Mn is the critical factor in this lignin effect or whether the lignin itself is acting as a peroxide stabilizer.

KEYWORDS: Pulp bleaching, Manganese, Precipitated lignin, lignin-combined manganese, Hydrogen peroxide decomposition, Peroxide stabilizers

5. Joo, Sang Myoung and et. al. (2016). **One Bag Mix of modified tapioca starch as an adhesive for corrugated fiberboard application.** APPITA, 69(3), 247-252.

Abstract: In this study, a One Bag Mix corrugating adhesive (with a modified tapioca starch and pre-mixed additives) was compared to a conventional corn starch adhesive in a Stein-Hall single system.

Significant advantages of the OBM adhesive are demonstrated suggesting a possible reduction in adhesive weight of 17%, improved controllability in practice, and better water resistance.

Keywords: Corrugating adhesive, One Bag Mix (OBM), corrugated fiberboard, Stein-Hall single system, Carrier Starch.

6. Singh, Sonita and et. al. (2016). **Optimisation of froth flotation for removal of wood extractives in paper manufacture.** APPITA, 69(3), 253-263.

Abstract: A laboratory scale froth flotation batch process has been optimised for removal of wood extractives from Pinus radiata thermo-mechanical pulp (TMP) process water. This has provided insight into the mechanism of flotation and has potential for application in industry. The study involved optimisation of surfactant type and concentration, flotation time, airflow, impeller speed, pH, temperature and ionic strength.

Maximum wood extractive removal was achieved by flotation with the addition of 80 mg/L of the cationic surfactant dodecyltrimethylammonium bromide (DoTAB) at pH 5.0 and 60 °C for 20 min with an air flow of 4.5 L/min and impeller speed of 1300 rpm. Under these conditions the removal efficiency of total extractives was close to 95%. Process water treated in this way would be suitable for recirculation in a pulp or paper mill and would result in significant reduction in problems caused by accumulation of wood extractives.

Keywords: froth flotation, wood extractives, pitch, colloid, thermo-mechanical pulp, surfactant, dodecyltrimethylammonium bromide.

7. Magnusson, Hans and et. al. (2016). **Integrating prehydrolysis kraft pulping of softwood and viscose fibre manufacturing.** APPITA, 69(3), 264-272.

Abstract: This work investigates the potential to integrate prehydrolysis kraft pulping with modern viscose manufacturing in order to improve the economic and environmental feasibility of the two processes. The study is largely based on calculations from previously reported data and information obtained from earlier employees of the Svenska Rayon viscose mill of Karlstad, Sweden, but key stages are also tested experimentally. It is concluded that integration of these two processes gives several benefits: the pulp mill can produce the alkali needed for mercerization and dissolution; the chemical recovery system of the kraft mill can take care of the spent liquors from the viscose plant; green liquor from the pulp mill can be used for the recovery of zinc from the spent coagulation liquor; the kraft pulp mill can produce sulfuric acid for the spinning bath of the viscose plant; and energy can be saved since drying of the pulp that would go into the viscose mill is not needed.

Keywords: Biorefinery, integrated production, pre-hydrolysis kraft pulping, regenerated cellulose, viscose process.

8. Nicholson, Daniel J. and et. al. (2016). **Estimation of the S/G ratios of the lignins in three widely used North American hardwoods.** TAPPI, 15(7), 449-456.

ABSTRACT: Sugar maple (*Acer saccharum*), aspen (*Populus tremuloides*), and white birch (*Betula papyrifera*) are three hardwoods that are widely used by the North American pulp and paper industry. Because of their abundance, these species are also likely to be used by some of the biorefinery processes that are being developed. A significant amount of evidence indicates that the syringyl to guaiacyl (S/G) ratio of the lignin in a hardwood is a governing parameter regarding its ease of delignification. Credible data also show that among poplars the S/G ratio of the lignin significantly influences the ease of saccharification of the carbohydrate polymers to sugar monomers. Although the S/G ratio appears to be a key parameter for hardwoods, values accepted by most practitioners are not available for the three species. In this investigation, those ratios were estimated by an extensive literature review followed by S/G determination by nitrobenzene oxidation (NBO) and methoxyl analyses of organosolv lignin (OSL) from the ethanol/water/sulfuric acid pulping process. The S/G values were approximately 1.4 for sugar maple, and 2.0 for aspen and white birch. Data are also included showing that sugar maple and white birch were equally reactive in kraft pulping. Thus, it is unclear whether or not the S/G ratio is indeed a governing parameter in this delignification process.

9. Santos, Ricardo B. and Hart, Peter W. (2016). **Commissioning brownstock washing controls for an evaporator limited mill.** TAPPI, 15(7), 459-464.

ABSTRACT: An automated shower water control system has been implemented to reduce the volume and variability of weak black liquor being sent from the pulp mill to the evaporators. The washing controls attempt to balance the need for consistent and low soda carryover to the bleach plant with consistently high weak black liquor solids being sent to the evaporators. The

washer controls were implemented on two bleachable grade hardwood lines (one with oxygen delignification, one without oxygen delignification) and one pine line. Implementation of the control program resulted in an increase in black liquor solids of 0.6 percentage points for the hardwood lines. Significant foam reduction was realized on the pine line since the pine black liquor solids were able to be consistently maintained just below the soap separation point. Low black liquor solids excursions to the evaporators were eliminated. Bleach plant carryover was stabilized and no negative impact on chemical consumption was noticed when controlling weak black liquor solids to recovery.

10. Niemelaine, Pasi and et. al. (2016). **Corrosion monitoring and root cause identification in high solids concentrators.** TAPPI, 15(7), 467-477.

ABSTRACT: Black liquor high solids (about 80%) concentrators have often been found to suffer from aggressive corrosion. In particular, the first and second effect bodies are susceptible to corrosion attacks resulting in tube leaks and wall thinning, which limit the availability and lifetime of evaporator lines. Corrosion dynamics and construction materials have been studied extensively within the pulp and paper industry to understand the corrosion process. However, it has been challenging to identify root causes for corrosion, which has limited proactive measures to minimize corrosion damage.

Corrosion of the first phase concentrator was studied by defining the potential regions for passive area, stress corrosion cracking, pitting corrosion, and general corrosion. This was achieved by using a technique called polarization scan that reveals ranges for the passive area in which the equipment is naturally protected against corrosion. The open circuit potential, also known as corrosion potential, and linear polarization resistance of the metal were monitored online, which allowed for definition of corrosion risks for stainless steel 304L and duplex stainless steels 2205 and SAF 2906. An online temperature measurement added insight to the analysis. A process diagnostics tool was used to identify root causes of the corrosion attacks. Many of the root causes were related to process conditions triggering corrosion. Once the metal surface was activated, it was difficult to repassivate the metal naturally unless a sufficient potential range was reached.

11. Zhao, Liming and et. al. (2016). **Effects of added materials on black liquor combustion.** TAPPI, 15(7), 479-486.

ABSTRACT: Black liquor is often mixed with various types of materials before being burned in a recovery boiler to meet specific needs of kraft pulp mills. A systematic study was conducted using a thermogravimetric combustor to examine how added materials might affect the

combustion behavior of black liquors obtained from several pulp mills. The results show that adding soap, caustic, white liquor, and sawdust significantly reduces the liquor swelling tendency, thereby requiring a longer time for the liquor to burn completely. Adding makeup saltcake, precipitator ash, sodium sulfate, and biosludge, on the other hand, has little or no effect on the liquor combustion behavior.

12. Sharp, W.B.A and Jones, W.A. (2016). **Evaluation of near-drum thinning data in recovery boiler generating bank tubes.** TAPPI, 15(7), 491-500.

ABSTRACT: Near-drum thinning affects the fireside surface of recovery boiler generating bank tubes near the surface of the mud drum. Although sophisticated thickness scanning equipment has been developed to rapidly make tens of thousands of thickness measurements in the portion of a tube that is vulnerable to near-drum thinning, methods for using these data to evaluate fitness-for-service have not shown similar advances. Non-destructive testing companies typically use a technician's subjective judgment to identify the "thinnest reliable" thickness measurement on each tube. Some mills decide whether tubes can continue in operation or should be plugged or replaced based on this single thickness measurement. However, finite element analysis of the remaining strength of individual tubes thinned in the near-drum area suggests that it is essentially impossible to identify the weakest tubes from simple empirical rules. In the absence of an industry standard for evaluating these data, different mills could reach different conclusions about the fitness-for-service of a tube from the same data set. This paper reviews the technology for scanning the thickness of generating bank tubes and discusses approaches that have been used to identify the tubes most weakened by near-drum thinning and to evaluate the fitness-for-service of individual tubes.

13. Kentta, Eija and et. al. (2016). **Functional surfaces produced by foam coating.** TAPPI, 15(8), 515-521.

ABSTRACT: This paper reports experiments on silica coating formulations that are suitable for application as a thin pigment layer with foam coating technique on a paper web. To understand the foaming properties of nanosilica dispersions, the critical micelle concentration, foam half-life time, and foam bubble size stability were determined with three different foaming agents. The results indicate that the bubble stability measurement is a useful characterization method for foam coating purposes. Pilot foam coating trials were done and the effects of the chosen foaming agents were studied on the properties of the nanosilica-coated paper. The surface hydrophilicity of silica coated paper was related not only to silica pigment, but also to the chemical nature of the foaming agent. Standard paper properties were not affected by the thin silica coating.

14. Raybon, Heath and et. al. (2016). **Examination of the potential to reduce water application rates for hardwood pulp logs stored in wet decks.** TAPPI, 15(8), 523-530.

ABSTRACT: Wet storage of logs under sprinklers is often used to maintain log quality and to provide consistent fiber supply to wood production facilities. Concerns about water use in the southeastern United States have increased interest in refining water application strategies in woodyards. By understanding how the moisture content of stored logs varies over time in response to varying rates of water application, an optimum moisture regime for stored logs could be identified. In this study, experimental trials with nominal water application (100 mm/day) and a 30% reduction in water application were established at two hardwood woodyards in Georgia (Offerman, with sweetgum and yellow poplar, and McBean, with red oak and sweetgum). Variations in log moisture were monitored using time domain reflectometry for 12 months at Offerman and 15 months at McBean. Significant differences between treatments were observed initially, likely resulting from pre-existing differences in the wood before the start of the experiment, but differences in log moisture soon disappeared. Pulping trials conducted using McBean woodyard logs stored for 9, 12, and 15 months found that treatment had no effect on pulp yield, indicating that a 30% reduction in the amount of water applied results in little change in log quality.

15. Gong, Roland and et. al. (2016). **Deinking evaluation using near infrared narrow band digital image analysis.** TAPPI, 15(8), 533-538.

ABSTRACT: The current deinking evaluation methods include visual image analysis (manual and digital) and optical reflectance (using the Kubelka-Munk equation). The mechanism of image analysis is simple: dark ink (mostly black) is isolated from the light background (fiber) and then captured visually or by digital devices. The image analysis methods have inherent limits, such as poor correlation with paper optical properties, and have large variances from sample to sample and side to side. In this paper, an innovative approach that employs a band of near infrared light and a digital imaging device was applied to address these limitations. This approach has advantages for isolating specks from backgrounds, obtaining high quality raw data, and significantly reducing the variances among the handsheets and their sides. By using the ink elimination equation derived from image analysis, reliable ink elimination rates were obtained that were well correlated with paper optical properties. This system was also applied to newspaper deinking evaluation with positive results.

16. Bildik, Ahsen Ezel and et. al. (2016). **Alkyl ketene dimer (AKD) sizing of paper under simplified treatment conditions.** TAPPI, 15(8), 545-552.

ABSTRACT: Alkyl ketene dimer (AKD) has been widely used by manufacturers of paper and paperboard as a hydrophobic sizing agent. Ordinary sizing with AKD involves a complex series of

processes, including emulsification of the waxy AKD material; measures to avoid the agglomeration of the emulsified AKD particles; addition of a stabilized AKD dispersion to papermaking furnish; interactions with various retention aid chemicals to fix the material onto solid surfaces; and various spreading and curing processes that take place during the drying and cooling of the paper product. In the present work, as a means to gain insight into the mechanisms attributable only to the AKD in isolation from the other additives and subprocesses, the AKD wax was dissolved in heptane and applied to filter paper between two aluminum foil layers, followed by evaporation of the solvent and optional heating. Surprisingly, hydrophobic character was obtained regardless of whether or not the treated sheets had been heat cured. Also, for the first time, it was observed that the AKD treatment resulted in a substantial increase in sheet strength, suggesting that the AKD was able to serve as the matrix in an AKD-saturated paper structure. The results add support to past suggestions in the literature that potential covalent interactions cannot account for all of the effects attributable to AKD treatment of paper.

17. Yuan, Hongyou and et. al. (2016). **Effects of silica on chemical recovery in the direct causticization of wheat straw black liquor.** TAPPI, 15(8), 557-566.

ABSTRACT: Straw black liquor is relatively difficult to recover using the Tomlinson process because of the presence of silica in inorganic components. Gasification with direct causticization might serve as a promising alternative; however, the interaction between silica and direct causticization agents needs to be evaluated. In this work, desilication was achieved using a laboratory-scale membrane electrolysis cell adopted from the chlor-alkali industry. Then raw and desilicated straw black liquors were carried out through direct causticization with titanium dioxide (TiO_2) and recycled sodium tri-titanate ($\text{Na}_2 \text{O} \cdot 3\text{TiO}_2$) at 850°C using a tube furnace. The results show that these two agents exhibit different silica transfer mechanisms. When using TiO_2 , approximately 80% of the silica is retained in the solid residue after hydrolysis because of chemical interactions. Almost all of the silica transfers to the hydrolysis-derived white liquor when using $\text{Na}_2 \text{O} \cdot 3\text{TiO}_2$. This means that the process of treating straw black liquor by direct causticization might need additional lime causticization to improve the efficiency of sodium recovery. This observation also indicates that silica will not consume the direct causticization agent $\text{Na}_2 \text{O} \cdot 3\text{TiO}_2$ after the initial step using TiO_2 . The sodium hydroxide (NaOH) yield was 60% when using raw black liquor as the feed to the $\text{Na}_2 \text{O} \cdot 3\text{TiO}_2$ recycling tests and 80% when using desilicated straw black liquor. Considering the NaOH recovered in the electrolysis cell, the total NaOH yields exceed 85% of total titratable alkali. No detectable deterioration of the direct causticization agents was found within the limited number of cycles tested. A greater number of cycles need to be tested at a larger scale to evaluate the feasibility of applying a direct causticization process to straw black liquor.

18. Santosh, Ricardo B. and et. al. (2016). **Bleaching optimization at WestRock mill in Covington, Virginia.** TAPPI, 15(9), 581-585.

ABSTRACT: The WestRock mill in Covington, VA, USA, initiated a long term diagnostic and optimization program for all three of its bleaching lines. Benchmarking studies were used to help identify optimization opportunities. Capital expenditures for mixing improvement filtrate changes, equipment repair, other equipment changes, and species changes were outside the scope of this work. This focus of this paper is the B line, producing southern hard- wood pulp in a D(EP)DD sequence at 88% GE brightness. The benchmarking study and optimization work identified the following opportunities for improved performance: nonoptimal addition of caustic and hydrogen peroxide to the (EP) stage, carryover of D_0 filtrate to the (EP) stage, and carryover of (EP) filtrate to the D_1 stage. As a result of actions the mill undertook to address these opportunities, D_0 kappa factor decreased about 5%, sodium hydroxide consumption in the (EP) stage decreased about 35%, chlorine dioxide consumption in the D_1 stage decreased about 25%, and overall bleaching cost decreased about 15%.

19. Lepage, Hugo and et. al. (2016). **Acoustic analysis of recovery boiler dissolving tank operation and smelt shattering efficiency.** TAPPI, 15(9), 591-596.

ABSTRACT: The interaction of molten smelt and water inside a recovery boiler dissolving tank produces loud noise and can be violent even during normal boiler operation. Inadequate shattering of the smelt stream leads to even more violent interaction, as evidenced by an increased acoustic intensity of the dissolving tank. On rare occasions, a violent dissolving tank can explode, causing equipment damage and even injury to personnel. To warn operators of changes in dissolving tank conditions, an acoustics-based monitoring system could be developed. To assess the feasibility of such a system, acoustic observations were recorded at three pulp mills. Analysis of the recordings indicates that when a smelt stream is not being shattered, the intensity of the dissolving tank soundscape increases significantly and the frequency spectrum changes. We also observed a large variation between different mills both in average intensity and in signal variance. The results of this study suggest that the development of a monitoring system is feasible.

20. Oliveira, Flavia Natalino and et. al. (2016). **Effects of localized environment on eucalyptus clone chemical composition.** TAPPI, 15(9), 599-605.

ABSTRACT: Eucalyptus wood is becoming the most important feedstock for bleached kraft pulp production, particularly in South America. However, pulp manufacturers have observed that some eucalyptus clones are resistant to wind action and others are not. Those lacking wind resistance are prone to breaking, which results in productivity losses. This study aims to investigate a correlation between the chemical composition of eucalyptus clones and their

resistance to wind action. We found differences among the wind-resistant and non-wind-resistant clones, but that the fragility of trees studied for wind resistance does not correlate to the chemical composition of the wood. Four notable differences were observed. First, clones grown at lower altitudes differed from clones grown at higher altitudes in their acetyl, insoluble lignin, and extractives contents, and in their syringyl/guaiacyl (S/G) ratios.

However, we found no relationship among these components and wind susceptibility. Second, soluble lignin content increased with the increase of wind resistance in the high altitude clones. Third, the low altitude clones showed slightly lower xylan content (12.4%) and higher lignin content (29.6%) than the others. Finally, the insoluble lignin content, total acetyl groups, extractives, ash contents, and S/G ratios of the clones were influenced by the region where they were grown.

21. Mullen, Tom (2016). **Using white liquor as the alkali source in oxygen delignification**. TAPPI, 15(9), 609-618.

ABSTRACT: This paper considers the potential impact on oxygen delignification stage performance when unoxidized white liquor and partially oxidized white liquor containing thiosulfate, or (OWL[T]), are used as the alkali source. A literature review was conducted to estimate the oxygen consumption of the pulp, the raw black liquor carryover, and the sulfur compounds in the charged white liquor and in the postoxygen washer filtrate recirculated to the oxygen stage. These values were used to calculate the total oxygen consumption (kg O₂ /bone dry ton [BDT]) as a function of oxygen stage kappa. The maximum oxygen charge was estimated using the generally accepted void volume (Xg) limit of 20%.

A delignification model was developed using an empirical equation for the rate of change of lignin in the pulp as a function of operating parameters. The initial (OH⁻) concentration was adjusted to achieve 40% delignification at 0.70 MPa (100 psig) and 50% delignification at a pressure of 1.03 MPa (150 psig) for a 30 kappa pulp. The model predicted oxygen exhaustion and hence a reduction in achievable kappa at operating pressures of less than 150 psig when OWL(T) was used as the alkali sources and the raw black liquor carryover was 30 kg/BDT

22. Khanna, Harish Kumar. (2016). **A revolution for the paper industry**. TAPPSA, 4, 44-45.

Abstract : This paper demonstrates the constant efforts of Krofta Engineering Limited, India, to reduce freshwater consumption on paper machine showers. By using two solutions - Sedicell and Spray Filter - water can be clarified to less than 50 microns which replace fresh water consumption on paper machine showers and pulp mill operation in all types of paper manufactured by Indian paper mills. The system has been implemented in 30 paper mills with practically no effect on clothing and runnability on paper machine.

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