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JUNE

PAPERMAKING

Water chemistry challenges in pulping and papermaking — fundamentals and practical insights: Part 1: Water chemistry fundamentals and pH

Przemyslaw Pruszynski, Lebo Xu, and Peter W. Hart

Water is an essential component of the papermaking process. Nevertheless, papermakers often overlook its importance compared to fibers and chemical additives. A better understanding of water properties and chemical interactions associated with water at the wet end leads to a sound foundation for high-quality paper production and smooth operation.

Not all fresh water and process water is the same. Fresh water varies from mill to mill, primarily due to the location and availability of water sources. Some industrial trends, such as enhancing water conservation and production yield, gradually shift process water quality over time.

This research paper serves as a primer on water and water chemistry fundamentals to help the papermaker prepare for the future challenges of increased contamination of process water associated with reduced fresh water usage. It focuses on basic water chemistry definitions and discusses the impact of pH on wet-end operation. It is clear that pH is a fundamental factor that directly affects the process and impacts other factors relevant to the papermaking process. It is crucial to understand what pH represents, how it is measured, how to select the proper pH and carefully control it, and how to closely maintain the process at target setpoints. Understanding the operation's sensitivity to pH change will lead to an appropriate focus on these issues.

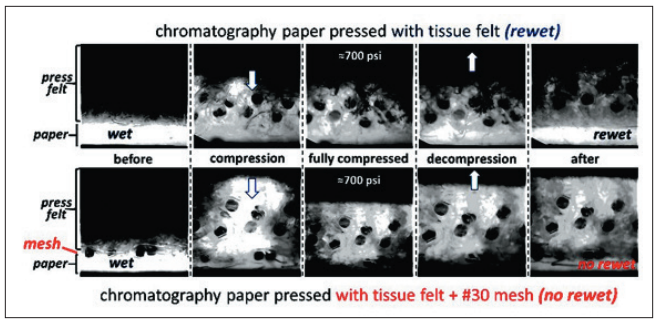
In addition to basic theory, the authors also review onsite experience and practical mill cases. Although critical, pH is not the only chemical parameter impacting papermaking operations. Other factors, such as ionic concentration measured by conductivity, surface, soluble charge, and hardness, are critical and will be discussed in Part II of this series.

By gaining comprehensive and fundamental understanding on how pH affects wet end chemistry, mills can be better prepared to address water challenges and obtain more efficient operation.

PAPERMAKING

Rewet suppression through press felt engineering

Sumner Dudick, Dennis W. Hess, and Victor Breedveld



Frames from videos show how the mesh-added felt (bottom) eliminates paths for water (brightest areas) to rewet the paper.

Due to the immense energy and associated financial cost of drying paper, achieving a drier web entering the dryers is a key objective in paper manufacture. One major research thrust has been finding a way to increase press solids by mitigating or eliminating rewet in the press section. For decades, solutions to this problem have remained elusive.

In this work, researchers develop a novel approach that significantly reduces rewet by rupturing the liquid channels between felt and web. They illustrate the effects that altering the mechanical and surface properties of the press felt matrix have on the stability of these liquid channels.

In a laboratory-scale platen press, researchers observed a 40 percent reduction in the residual water of 120 g/m^2 southern bleached softwood kraft (SBSK) pulp handsheets after pressing, corresponding to an increase in press solids from 48 percent to 61 percent. Furthermore, the researchers observed enhanced dewatering across a range of basis weights, applied pressures, and felt types. In addition to measuring the solids content of pressed sheets, they captured and analyzed video evidence of the mechanisms at play in this improved dewatering technology.

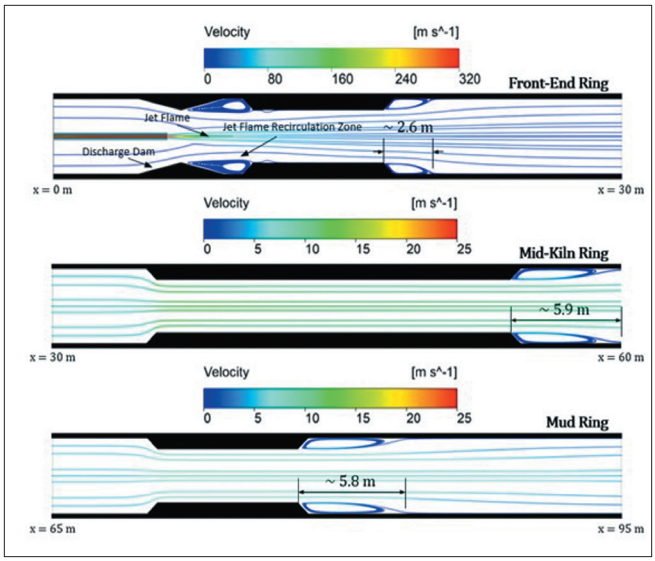
The researchers hope that the papermaking community will use the insights from this novel approach to preventing rewet in the press section in designing press fabrics that increase the energy efficiency of the mill.

RECOVERY CYCLE

Effects of rings on flow and temperature in lime kilns

Patrick Gareau, Markus Bussmann, Nikolai Demartini, and Honghi Tran

A steady state, two-dimensional (2D) axisymmetric model has been developed to help understand how rings form and grow in a typical lime kiln. Rings of varying length, thickness, and geometry at the front and back faces were modeled to study the effects on flue gas flow and temperature.



Streamline plots of flue gas flow through front-end, mid-kiln, and mud rings in a lime kiln.

The results show that ring growth causes the gas velocity to increase and insulates the adjacent refractory, resulting in a lower kiln shell temperature. The results also reveal the formation of recirculation zones immediately downstream of the rings, as well as temperature deviations upstream and downstream of the rings that might promote recarbonation and further ring growth.

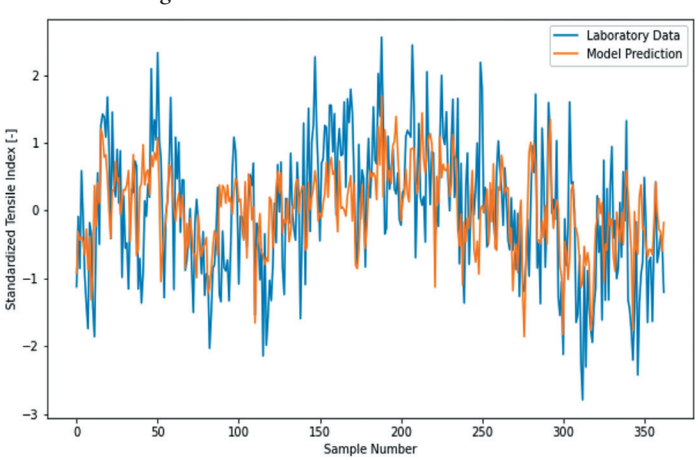
The model was applied to a kiln from a kraft mill with front-end and mid-kiln rings, and good agreement was obtained between the measured and predicted kiln shell temperatures, providing confidence in the modeling. This model can help mills predict how gas flow and kiln temperatures respond to the presence of ring deposits and may provide insights into how rings form and grow.

JULY

PULPING

On the usage of online fiber measurements for predicting bleached eucalyptus kraft pulp tensile index — an industrial case

R.B. Demuner, C.A. Faria, A.A.R. De Almeida, and P.N. Pignaton



Time evolution of model predictions and laboratory data during a period of one year demonstrate that the model can predict tensile index trends.

Cellulose pulp's physical-mechanical properties are determined by laboratory tests obtained from prepared handsheets. However, this procedure is time intensive and presents a lead time until the results are available, hindering its use for monitoring and decision-making in a pulp mill. In this context, developing real-time solutions for prediction of physical-mechanical properties is fundamental.

This research applied a mathematical modeling approach to develop a soft sensor for tensile index monitoring. The mathematical model considers online morphology measurements obtained from the last bleaching stage outlet stream and important process variables for tensile index prediction. The results obtained are satisfactory compared to laboratory results, presenting a mean absolute percentual error of 2.5 percent, which agrees with the laboratory testing method's reproducibility. This paper presents the use of online morphology information to predict pulp physical-mechanical properties in real-time measurements.

PAPERMAKNG

Calender barring review with experiences

Jake Zwart

Damage to roll cover from vibration when nip load went roughly double the design nip load, result in removal of rubber from the cover.

Excessive calender vibration affects all styles of calender stacks, from single to multi-nip; all hard rolls; or a combination of hard and soft rolls. Calender vibration can be forced vibration or self-excited vibration. Forced vibration occurs at the first few harmonics of the calender roll rotational speeds and is caused by imbalance, misalignment, eccentricity, etc. Self-excited vibration, the focus of this paper, occurs at higher frequencies.

Feedback paths for self-excited vibration must be understood in order to ameliorate the problem. This is presented in the context of the historical development of the theory of self-excited feedback mechanisms, followed by a survey of self-excited feedback mechanisms in various types of calender stacks. This paper provides methodology to determine which feedback path is present and techniques to control or eliminate the resulting vibration. To obtain a flavor of the types of problems faced and practical remedial actions, the authors provide a variety of experiences with barring issues.

BLEACHING

Using bleaching stage models for benchmarking softwood ECF bleach plants

Brian N. Brogdon

Steady-state bleaching delignification and brightening models were used to gauge how well elemental chlorine-free (ECF) bleach plants were using chlorine dioxide to bleach 25-kappa softwood brownstocks. Case 1 examined the D0(EOP)D1 portion of Mill 1's five-stage sequence that brightens the pulp to 86 percent ISO. Case 2 studied the D0(EO)D1 portion of Mill 2's four-stage sequence, which brightens the pulp to 82 percent ISO. Case 3 reexamined the same bleach plant several years after it made improvements around the extraction stage.

The models highlighted days in the previously mentioned cases where high bleach usage occurred, presumably because of high brownstock and/or extraction washer carryover, and days where bleach usage was normal. In Case 2, the model estimated that 10 kg of the 44 kg chlorine dioxide/metric ton pulp consumed in bleaching was likely reacting with washer carryover sources; approximately two-thirds of this extra consumption was assumed to be reacting with extraction filtrate. Changes that Mill 2 made (Case 3) reduced the unproductive chlorine dioxide usage from 10 to 5 kg/metric ton pulp.

When the delignification and brightening models were simultaneously solved, the models predicted somewhat different optimized distributions of chlorine dioxide to D0 and D1 vs. actual values used in bleach plants. However, the forecasted chlorine dioxide totals agreed with the actual values when washer carryover sources were considered. This study showed the bleaching models could be used as hypothetical benchmarks for softwood ECF bleach plants.

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JUNE

CELLULOSE

The influence of the fine structure of cellulose on the action of cellulases

Curtis S. Walseth

JULY

CELLULOSE

Investigation of the cellulose-water relationship by the pressure plate method

A.A. Robertsonw