Drainage and Pitch Control System and their impact on fibre properties

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Abstract

This paper summarizes our efforts developing a methodology to screen the better products suitable for drainage on the drying machine and pitch control, given by the combination of two chemicals in a Dual Program. The better drainage is verified with the evaluation of the water removal speed at the properly device. As long as one of the chemicals has an absorption property, it is also seen a significant reduction on pitch counts.

Keywords: drainage, pitch, laboratory methodology.

Introduction

In the pulp market there is a commercial demand for higher pH, both for the final product and for the bleaching sequence, and it becomes a huge challenge increasing the pH at the drying machine without losing productivity and/or increasing drying costs.

This study was done with Kraft bleached cellulosic pulps that were produced in an industrial scale. The methodology was developed and improved during two years, in an interaction with several pulp manufacturers in Brazil, who collaborated both in providing the material for the study and with technical questions, which contributed to the direction of the task for the best possible result, compared to the actual operation of the productive process.

In laboratory, the drainage was evaluated under vacuum with the Dynamic Drainage Analyzer (DDA) from Pulpeye Company, and industrial products were tested in order to reduce the drain time of the cellulosic pulp. A collateral effect of our drainage technology is a great reduction of pitch content in the cellulosic pulp. This effect was measured with a flow cytometer.

All laboratory methodology was adapted to provide data compared to those found in the process and in the drying machine.

Experimental

The great challenge when you run a lab trial is to find the correct tool to achieve the expected result. Axchem used an equipment, called DDA to run these trials (see picture 1).

DDA, measures the drainage under vacuum. A typical curve obtained is as followed. The drainage time in this report correspond at the inflection point of the curve which indicated that vacuum is broken via the air passing through the paper mat (figure 1). (See Reference 1 for more background).

Picture 1: DDA 5

Drainage

Drainage is measured as the time from the start of the run until air starts being sucked through the sheet. The drainage value is automatically computed.

The drainage is affected by many factors, for example, grammage, vacuum, sample volume, consistency, type of stock, temperature, wire, and chemicals. It is usually desirable to use the same furnish consistency as in the mill. However, for furnishes with high freeness and fast drainage it can improve the experimental accuracy if a higher solids content or larger sample volumes are used. For slow draining furnishes dilute to get a better measurement of the drainage time.

Dry solids

It is often interesting to know the effects of retention chemicals on the solids content on the mat. This can be estimated in an experiment by taking the formed sheet and determining its wet and dry weight.

To get useful data on the dry solids in the formed sheet demands a lot of operator skill. The problem is that as soon as the experiment stops the sheet starts rewetting and logically it must be removed quickly and in exactly the same manner for each experiment.

Permeability

The permeability value is automatically measured by the DDA. It is defined as the vacuum produced by the formed sheet and at the end of the experiment.

Pitch

The pitch is the accumulation of these compounds, bound to inorganic materials and different proportions, which is embedded in the equipment and can form spots on the leaves of pulp produced and in the papers formed in the process. Factors such as wood, cooking conditions, pulp washing and process water quality Influence on pitch frequency (SANSIGOLO et al., 2010).

The pitch droplets have "Brownian" motion, constant motion and disordered, and are perfectly spherical, unlike other colloidal particles of the pulp. Other non-perfectly spherical particles exhibit turbulence, evidencing its non-perfect sphericity, differing from the "pitch" (CAMARA, 2003).

A Flow Cytometer is used to measure the number of pitch particles in the sample (see figure 2). Flow cytometry is a technique used to count, examine, and classify microscopic particles suspended in flowing liquid medium. It allows the analysis of several parameters simultaneously, being also known by multiparametric flow cytometry. Through an optical-electronic detection device, it is possible to analyze the physical and / or chemical characteristics of a single cell.

Modern flow cytometers are able to analyze several thousand particles every second, in "real time," and can actively separate and isolate particles having specified properties. A flow cytometer is similar to a microscope, except that, instead of producing an image of the cell, flow cytometry offers "high-throughput" (for a large number of cells) automated quantification of set parameters. To analyze solid tissues, a single-cell suspension must first be prepared. (See Reference 2 for more background).

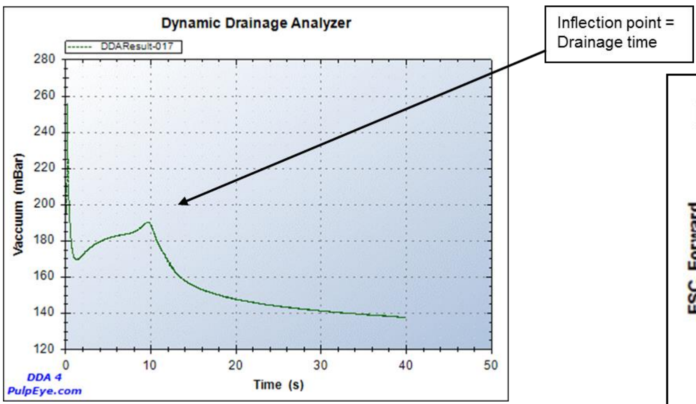


Figure 1: Graph generated by DDA

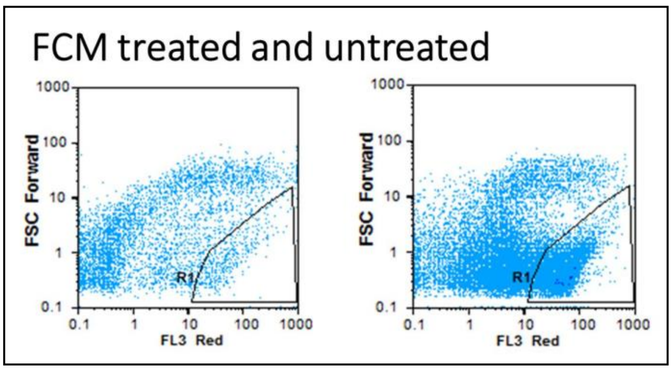


Figure 2: Comparison between treated and untreated samples

Fibre Scanning

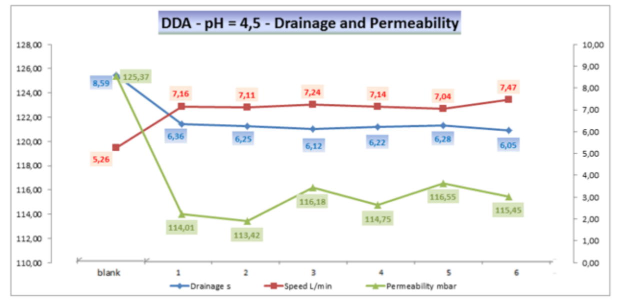
Due to the natural birefringence of wood pulp fibres, the polarization of circularly-polarized light changes as it passes through as individual intact wood pulp fibre, depending on its cell wall thickness and fibril angle.

Results and Discussion

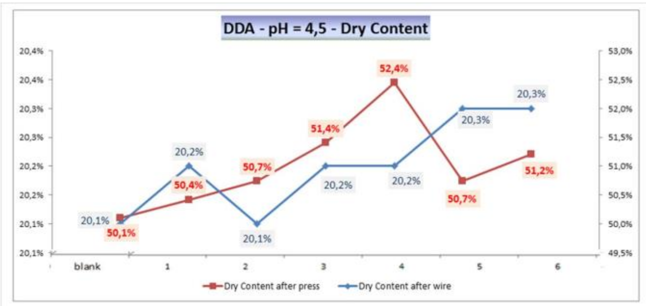
This laboratory trial was conduct in the facilities of an important Brazilian bleached pulp mill. In this evaluation, two features were search in the same product: best drainage and less pitch content. A dual with PAM and microparticle was used. The most significant ones are shown here, numbered 1 to 6.

#1 - @ pH 4.5

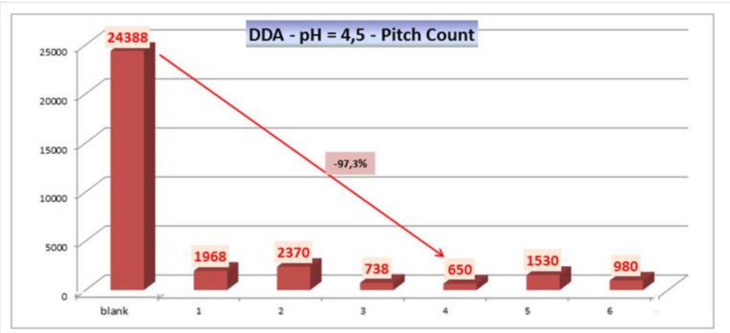
In the first lab evaluation the pH was kept at the same level of the machine headbox (4.5). Several parameters were measured to characterize the pulp: drainage time, drainage speed, permeability, turbidity, cationic demand, conductivity, pitch count, dry content. The most important ones are shown in the following graphs (see 1 to 3):



Graphic 1: A better drainage was achieved at pH 4.5



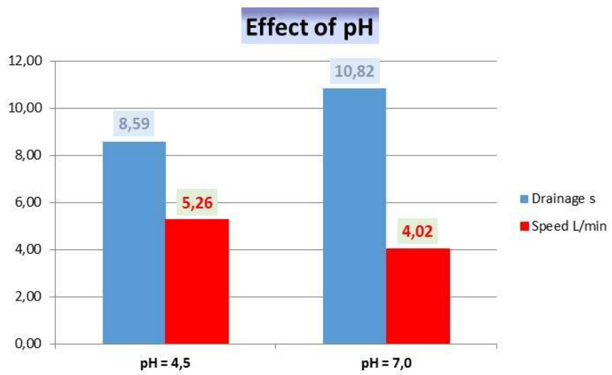
Graphic 2: A higher dry content after the press at pH 4.5



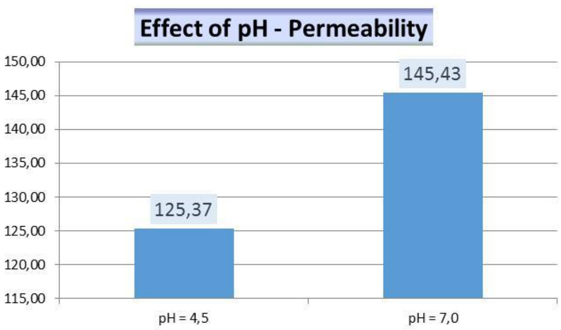
Graphic 3: Less pitch in the system at pH 4.5

pH effect

A higher pH brought less drainage and higher permeability in the reference pulp (blank), as seen below (see graphics 4 and 5):



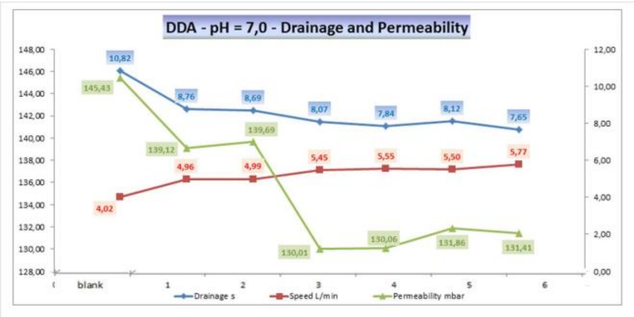
Graphic 4: Effect on drainage



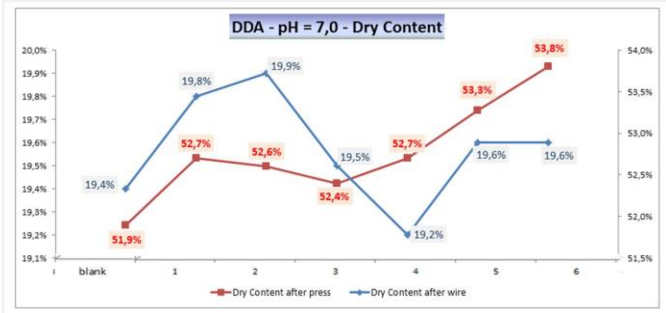
Graphic 5: Effect on permeability

#2 - @ pH 7.0

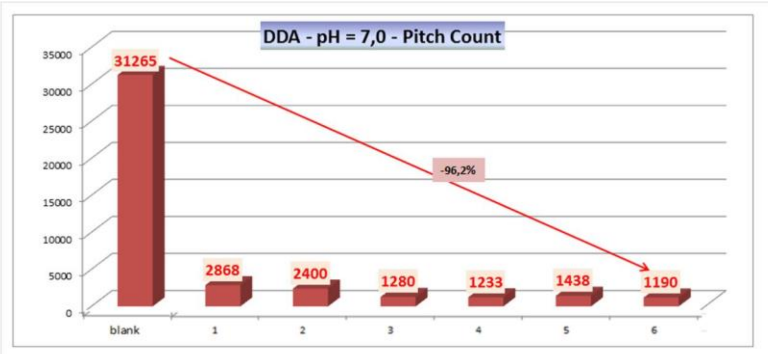
In the second lab evaluation pH was raised to 7.0. This higher pH was obtained adding NaOH without correction with an acid to avoid changing the salts content in the slurry. The same measurements of the first step were done (see graphs 6 to 8):



Graphic 6: A better drainage was achieved at pH 7.0

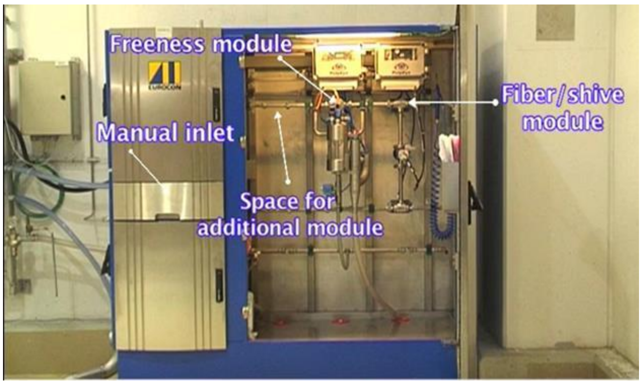


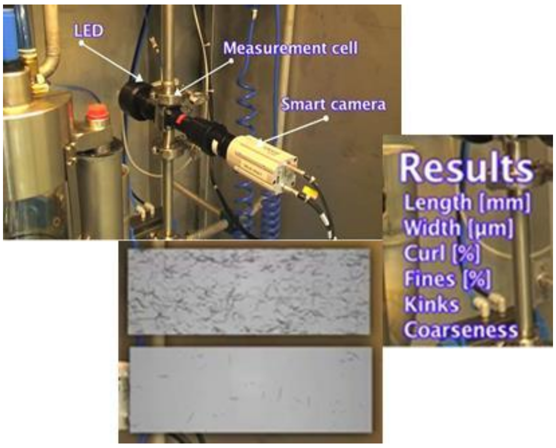
Graphic 7: A higher dry content after the press at pH 7.0



Graphic 8: Less pitch in the system at pH 7.0

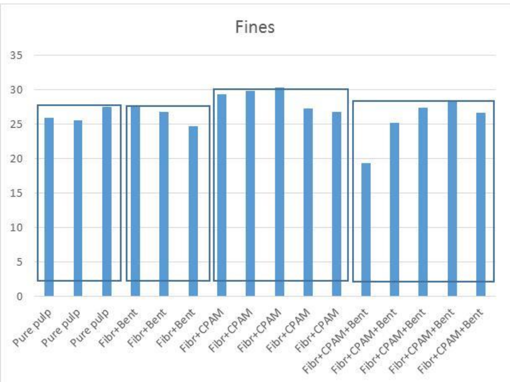
After screening the products in lab to select the correct Drainage Program, the best one was sent to PulpEye Company in Sweden to perform a fibre scanning in a “Fibre and Shive Module” (see picture 2).



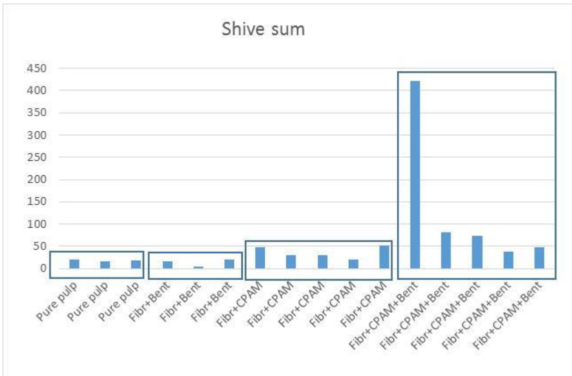


Picture 2: Fibre and Shive Module

Below are two of the graphs and pictures generated by the equipment in 4 conditions: pure pulp, pulp and microparticle, pulp and PAM; pulp, PAM and microparticle.

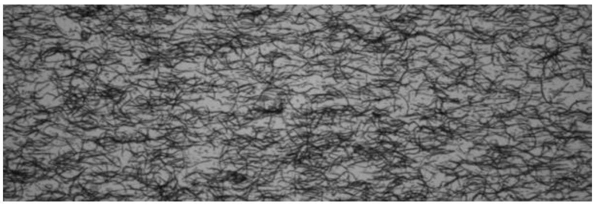


Graphic 9: Fines

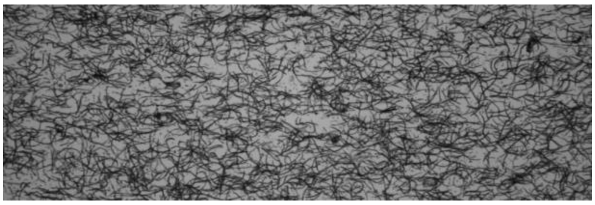


Graphic 10: Shive Sum

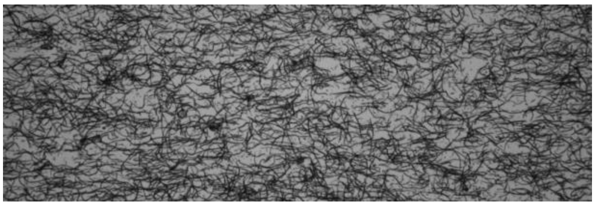
Fibre Analyzer: Distribution



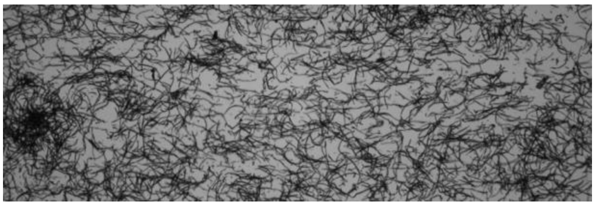
Picture 3: Pure Pulp



Picture 5: Pulp + CPAM



Picture 4: Pulp + Microparticle



Picture 6: Pulp + CPAM + Microparticle

The Fibre Scanning provided the following results:

- ✓ Solely microparticle has no effect on the fibre properties.
- ✓ CPAM has an initial effect on fibre properties - higher shive sum (aggregation of fibres =flocculation), higher fines and length of fibres. The effect is however declining with reaction time.
- ✓ CPAM and microparticle together has the largest effect on fibre properties – much higher shive sum, “longer” fibres and lower fines share. As for CPAM, the effect is declining with reaction time.
- ✓ The retention system effects the distributions of fines and length which explains the changes in fines and fibre length

Conclusions

The laboratory tests, carried out in a systematized manner, made evident the influence of the chemicals used to increase drainage and reduce pitch in the system. The Chemical Program even promoted the same drainage performance or even better at pH 7.0 than without the chemicals at pH 4,5.

The fibre scanning Corroborated the results obtained in the tests performed, as the flocculation behavior as a function of the chemicals used. This demonstrates the potential of its practical application.

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