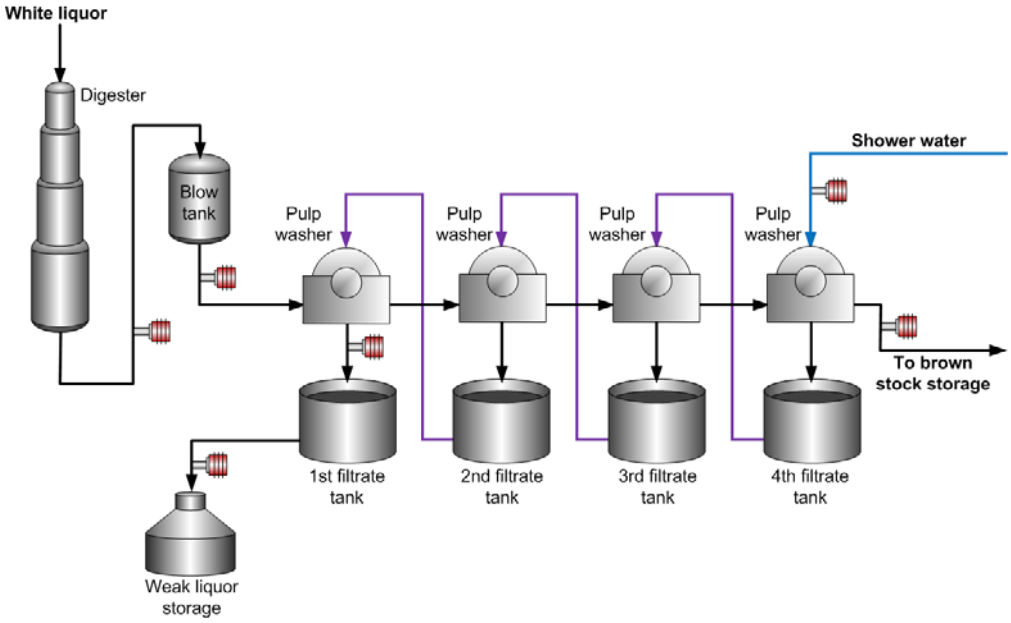
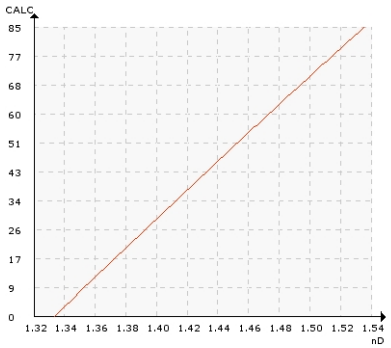


KRAFT PULP

Typical end products

Unbleached kraft pulp, bleached kraft pulp

Chemical curve: R.I. per Black liquor Conc% at Ref. Temp. of 20˚C



Introduction

Due to the economic and environmental pressures, there is a requirement for efficient fresh water usage in chemical pulping and bleaching. Lower levels of wash water consumption have a positive effect on the energy balance of the mill, and will decrease the impact on water resources. However, too low a level of wash water usage can adversely affect washing efficiency and increase chemical consumption in the bleaching process. To address this dilemma and to achieve an effective trade-off between washing efficiency, chemical consumption and energy efficiency, effective tools for the precise control of brown stock washing are needed.

Total dissolved solids (TDS) changes in the incoming flow to the washer can be detected immediately and reliably through K-Patents Process Refractometer measurements. During brown stock bleaching, TDS changes also have a clear effect on chemical consumption through washing loss. Real-time measurement enables precise control of the washing line. This instant information allows the most effective control of the fresh water flow to the washer. With such control systems water usage can be optimized and thus excessive usage is avoided.

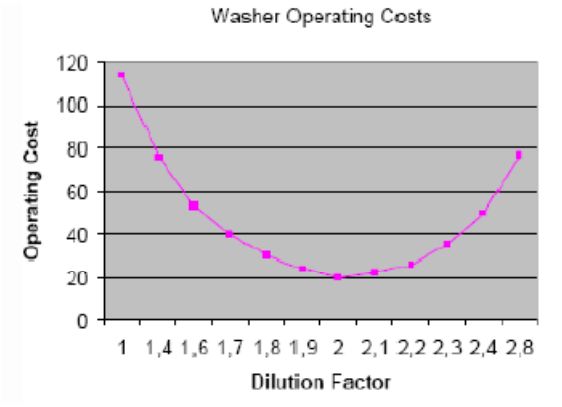
In conclusion, by utilizing K-Patents refractometers and data-analysis tools it is possible to reveal inefficiencies in the washing line and continuously evaluate the washing results, thereby allowing improvements in washing efficiency and a subsequent reduction in water consumption.

Application

Washing during kraft pulping can be divided into two separate areas: brownstock washing and washing in bleaching. The purpose of brown stock washing is to separate and collect the spent cooking liquors from the cellulose fibres.

Not all cooking chemicals are removed and therefore washing efficiency is typically gauged by two parameters: *wash loss* and *dilution factor.* In brownstock washing, wash loss is cooking liquor lost. Dilution factor is the actual quantity of water used in washing compared with the theoretical amount required to displace the liquor from the thickened pulp. A lower dilution factor reduces energy

consumption, while a higher dilution factor normally results in a cleaner pulp. Thorough washing of the pulp reduces the chemical oxygen demand (COD).



As no other method has previously been available, the wash loss measurements have been made in a laboratory using COD test to indirectly measure the amount of organic compounds in water.

Oxygen delignification has become a common step between the cooking and bleaching. This has changed the composition of the used filtrate liquors. Several research studies indicate that the most important component for measuring wash loss is lignin and not COD, since COD is highly influenced by other components present, such as methanol.

There are also other difficulties in using COD or other methods, e.g. conductivity. COD test is an off-line test as conductivity meters cannot directly be used in the pulp stock lines due to pipe scaling. Also, ion composition is different for cooking hardwood and softwood. The K-Patents Process Refractometer PR-23 is the most reliable instrument for efficient brownstock washing control.

The K-Patents Process Refractometer PR-23 is used to measure black liquor solids in the feed and outlet stock lines, as well as the incoming and outgoing filtrate lines. The illustration on the following page shows a typical instrumentation in a Drum Displacer (DD) Washer application.

The key features and savings are:

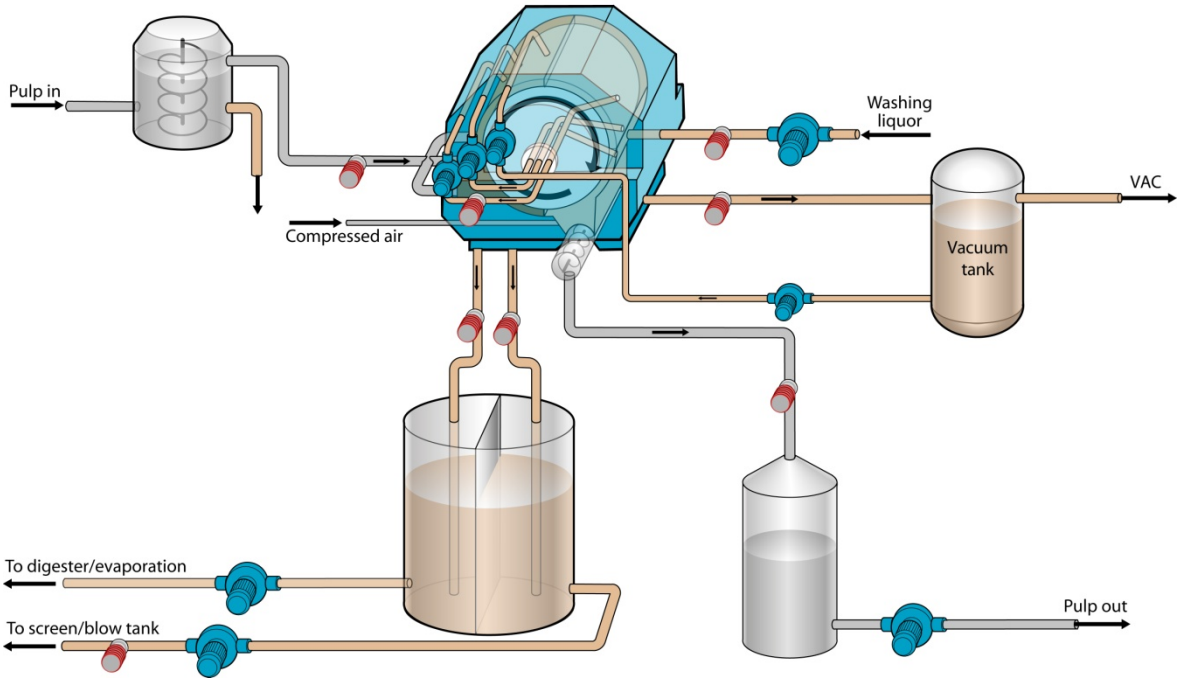
- Increased washing efficiency
- Consistent pulp quality
- Lower bleaching costs
- Increased evaporation efficiency
- Environmental benefits

Instrumentation

K-Patents supplies different sensor models for different applications based on the installation requirements and needs. Typically, the K-Patents refractometer for the pulp washing stock lines is a Retractable SAFE-DRIVE™ Process Refractometer PR-23-SD or flange connection probe type PR-23-GP, and for filtrate lines a clamp connection compact PR-23-AC. The concentration of dissolved solids is determined by making an optical measurement of a solution's Refractive Index (n_D). Refractive Index is analysed using digital optical image analysis and the resultant signal is converted electronically to give a dissolved solids% concentration reading. Because of the digital sensing technology, the readings are unaffected by bubbles, particles, fibres, color, flow, pressure or vibration.

The K-Patents Process Refractometer PR-23's typical accuracy is +/-0.1 %wt in process conditions over the full measurement range.

Some applications may require automatic prism cleaning with high pressure steam 6-10 bar (90-150 psig) or high pressure water 10-100 bar (150-1500 psig). Typical wash times are 5-15 seconds every 10-15 minutes.



DD-Washer with in-line solids meters.

Instrumentation	Description
	K-Patents SAFE-DRIVE™ Process Refractometer PR-23-SD for measuring black liquor dry solids in kraft fiberline process. K-Patents SAFE-DRIVE™ design allows for safe and easy insertion and retraction of the sensor under full operating pressure without having to shut down the process.
	K-Patents Process Refractometer PR-23-GP is an industrial refractometer for large pipe sizes and tanks, cookers, crystallizers and kettles. Installation through a flange or clamp connection.
	K-Patents Compact Refractometer PR-23-AC for small pipe line sizes of 2.5 inch and smaller. The PR-23-AC sensor is installed in the pipe bend. It is angle mounted on the outer corner of the pipe bend directly, or by a flow cell using a 3A Sanitary clamp or Varivent® connection.
Automatic prism wash:	Prism wash with steam or high pressure water.
Measurement range:	Refractive Index (nD) 1.3200 – 1.5300, corresponding to 0-100 % by weight.