New best practice for alkali profile in pulp cooking

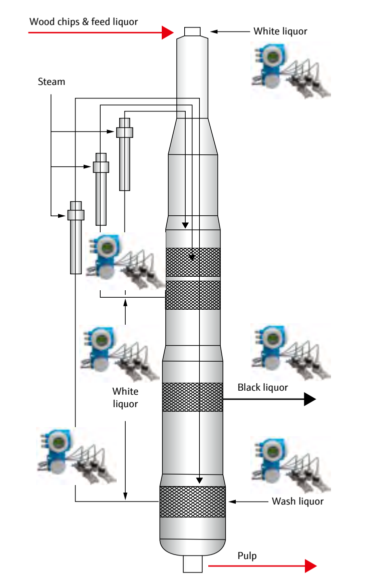
The article describes new technology and discoveries for the benefit of production managers, process engineers and maintenance personnel in cooking plants.

Background

The majority of Swedish cellulose pulp is produced in continuous digesters. When they were first introduced, the cooking liquor was added to the top of the digester. Not unlike batch cookers where cooking chemicals are added before each batch. Later came the modified continuous cooking (MCC) where cooking chemicals are added and removed at several points. Now the control strategy became more complex since a so-called alkali profile became necessary.

Since then, a major challenge on continuous digesters is to measure and control this alkali profile along the digester so that lignin and the wood's resin, fat and terpenes are dissolved out of the wood fiber. All of this has to be done while reaching desired and stable Kappa numbers at the digester outlet, without losses in pulp strength or yield during the wood chips descent through the different cooking zones. This chip column movement has become one of the most important tasks for the operators to monitor.

Liquid to wood chip quantity affects the degree of compaction and can lead to excessive friction that impinges the movement of the chip pile. The defibration is also strongly dependent on time and temperature, which is summarized in the H-factor, the time integral of the cooking temperature. Long response times of 5 hours makes PID control difficult and for the alkali profile one also relies on model predictive control (MPC). >>



Continuous "Kamyr" digester for Kraft Pulp.

>> Input variables

Three very important input variables for the MPC are:
1. Alkali of the cooking liquor
2. Kappa number of the produced pulp
3. Flows to and from the digester and impregnation vessel.

Alkali and Kappa numbers can be sampled and calibrated against the lab in case of deviations.

Liquor flow rates cannot be sampled or calibrated during operation and have therefore constituted an unknown source of error historically.

Only in cases of pure breakdowns, when flow meters obviously break or alarm with error codes, have you been made aware that a measuring tube replacement is necessary, but have had to wait until you can stop and replace them.

The weak link

Flowmeters of the electromagnetic-inductive “magmeter” type are the most common way to measure digester flows. But a relatively unknown problem arises for them when measuring liquids with such a high design temperature as cooking liquor at +180c (356F), since no other industry uses magmeters under such harsh conditions.

The problem can be traced back to the magmeter tube being lined with PTFE or PFA. Parallels can be drawn to membrane technology, where a semipermeable membrane lets certain components through, while others are separated. For molecules to be transported through the membrane, a driving force is required. This can be created by differences in pressure across the membrane, differences in electrical potential, differences in temperature, differences in concentration or differences in osmotic pressure. The liquid that has passed through the membrane is called permeate. This phenomenon has been shown to occur inside magmeters on digester flows.

Meters that look brand new on the outside can have deviated by up to -50% when evaluated, even though they had the more durable PFA liner. A symptom of this that some may recognize is that you can find water in the connection housing of the magmeter tube. Since it is completely pure, clear water, you do not associate it with liner diffusion (liquor is black), but the permeate is just as filtered as in the previous comparison with membrane technology. Since magmeters measure the flow by weak millivolt signals, these are affected by the permeate. They drift slowly and begin to deviate without operators or maintenance personnel noticing.

Ulf Johansson,
Business Driver
Pulp & Paper
Endress+Hauser.

New practice

The company Endress+Hauser has developed an external method that has become the most widely used in Swedish kraft pulp cooking plants and the one with the most references of its kind. The method is 3G acoustic and represents the latest in non-invasive permanent measurement. This avoids the uncertainty of diffusion-damaged magmeter tubes. The Prosonic Flowmeter allows installation with only 2xD straight line from pipe bends. This way you can clamp it on wherever it is easiest to reach without having to build scaffolding. Powerful acoustic contact sensors with advanced signal processing measure through pipe scaling and high TS levels on black liquor.

In recent years, some pulp mills have already moved away from magmeters and switched to vortex (a measurement method for steam and condensate) in order to get a meter completely made of steel, without liner. But since vortex is a technology where a sensor, or pickup as it sometimes referred, is still inside the measuring tube, the maintenance has instead shifted to changing pickups. Early signs of damaged pickups is usually that the vortex meter starts to oscillate on the output signal. They can also be covered by lime mud (in white liquor) so they stop sensing the flow (vortex counts vortices in the flow).

For those who would prefer an inline installation, a flanged inline model that can withstand +200c is also available. Offering an extra +20c greater safety margin than today’s high-temp magmeters that are limited to +180c. The inline model of PROSONIC has also been tested at Swedish pulp mills and is installed exactly the same manner as a magmeter, but is made entirely of 100% acid-proof steel, without a sensitive lining.

PROSONIC reduces maintenance while increasing availability and accuracy of your digester liquor flows.

More information about
Proline Prosonic Flow P 500
https://eh.digital/3MmeB7I

Endress+Hauser AB
Box 1486
171 28 Solna
Besök: Sundbybergsvägen 1

Tel+46 8 555 116 00
info.se@endress.com
www.se.endress.com

Endress+Hauser
People for Process Automation