MEASURING AND MANAGING DIGESTER ALKALI LEVELS

Reliable measurements from inside the digester

ANDRITZ has teamed up with Savcor, a Finnish technology provider specializing in the use of electrochemistry for corrosion prevention and structural health monitoring, and have together developed a novel method to measure alkali levels inside the digester.

At the moment, the only way to measure and monitor residual alkali levels from the digester is from side streams, which include circulation flows. These measurements not only give a late reading, but they also only provide an average reading as it is only a sample that may contain many discharge points. ANDRITZ, with its expert knowledge of the cooking process, and Savcor with its advanced sensor technology, have developed a completely new way to control the digester and cooking process. The system is suitable for both continuous and batch cooking.

During the cooking process, residual alkali strength fluctuates with changes in chip composition due to wood species, moisture, and concentration of cooking chemicals. The new measurement method is based on electrochemistry, measuring the rate of selected electrochemical reactions occurring on the probe surface. With the correct measurement parameters, the reaction rate correlates with alkali concentration and temperature. The temperature effect can be calibrated by measuring the temperature at the tip of each probe, giving additional information of variation inside the digester. The output values of each probe are alkali concentration (g/l) and temperature.

ENVIRONMENTAL BENEFITS

The new measurement technology enables more efficient methods to control the digester and the cooking process. The system is expandable so the mill could start with a smaller amount of sensors and then later add additional sensors based on the results obtained from the measurements. This means mills can start with a smaller investment and build up as the results help to improve digester performance.

MANY BENEFITS

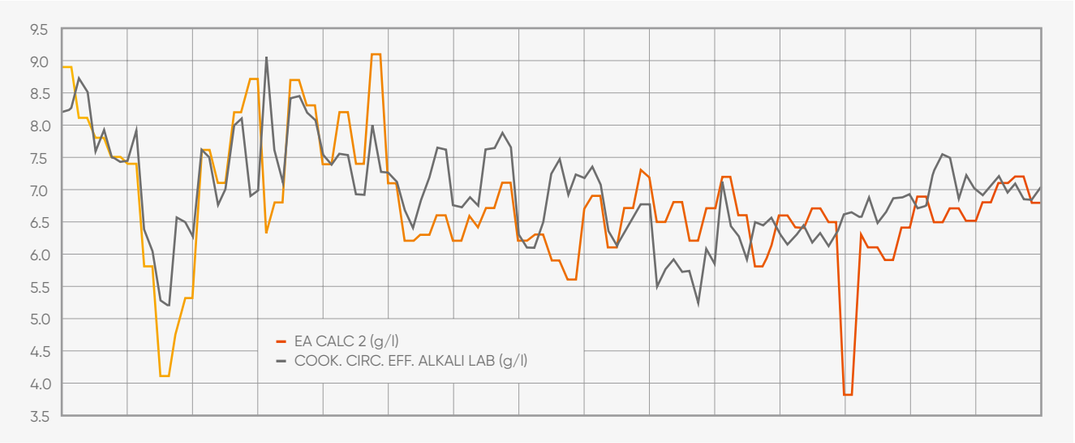
Measurement directly from the digester brings many benefits:

- When measuring on-line there is no delay between the measurement and the result. When lab analysis is needed to verify the result, there may be several hours delay between the sampling and the result from the lab. Added to this, lab results are usually only available during daytime hours.
- By placing several sensors inside the digester, it is possible to create an alkali profile that indicates how the liquors (and chips) are moving inside the digester and how the cooking process is developing over time.
- The cooking process can be controlled based on the measured alkali values → optimal dosing of chemicals. The operators tend to overdose just to be on the safe side, which leads to additional costs and typically decreased quality.
- The cooking process is not stable because the wood chip moisture and size normally varies. The chip quality varies from winter to summer and the harvesting area may also have an effect on how the chips can be cooked. The quality and the strength of the cooking liquor (WL) is also subject to variations depending on several factors. Instead of guessing the correct chemical levels, the measurement system allows a 'window' into the digester to 'see' what happens inside and adjust the cooking parameters accordingly.
- The big challenge with the existing sensors and sample piping has been that the sensors stop functioning due to scale buildup or plugging, so the measurement data is not continuously available. The alkali sensor is self-cleaning. The measurement is based on an electrochemical reaction and the cleaning is also done electrochemically at predetermined intervals so the sensor stays clean. Mill tests have successfully proven this to be the case.

This technology is suitable both for continuous and batch cooking. Similar benefits are achieved in both technologies.

The new system also offers substantial potential to decrease the environmental impact by cooking wood chips in optimal conditions and avoiding chemical overdosing. Excess cooking liquor addition will decrease the Kappa number and yield and will lead to higher alkali residuals, potentially causing corrosion in the evaporation plant. Higher alkali residuals in the pulp out of the digester also decreases washing efficiency downstream, which results in a greater effluent load and corresponding negative environmental impact as well as increased makeup chemical costs.

Conversely, insufficient cooking liquor addition will result in higher than desired Kappa numbers and increased rejects as well as increased risk of lignin precipitation and vessel corrosion, particularly in carbon steel vessels.



Lab measurements vs. on-line

MEASURES DIRECTLY INSIDE THE DIGESTER AND OPTIONALLY FROM CIRCULATION LINES

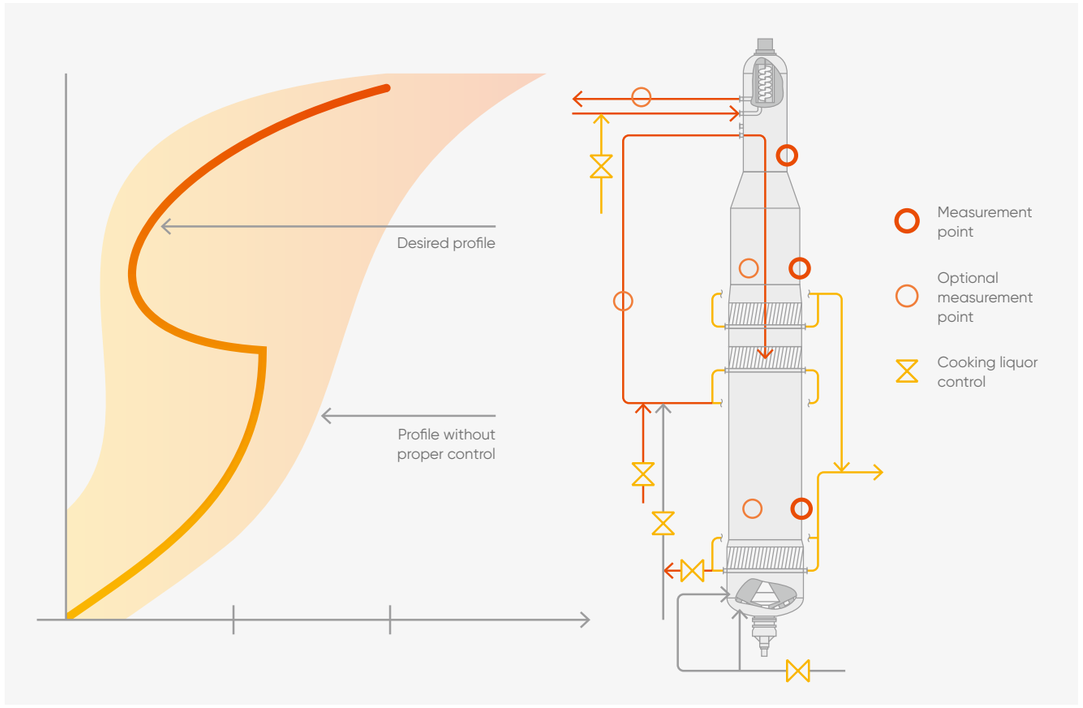
NO CONTINUOUS SAMPLING, NO CHEMICAL ANALYSIS

ON-LINE MEASUREMENT – NO DELAY

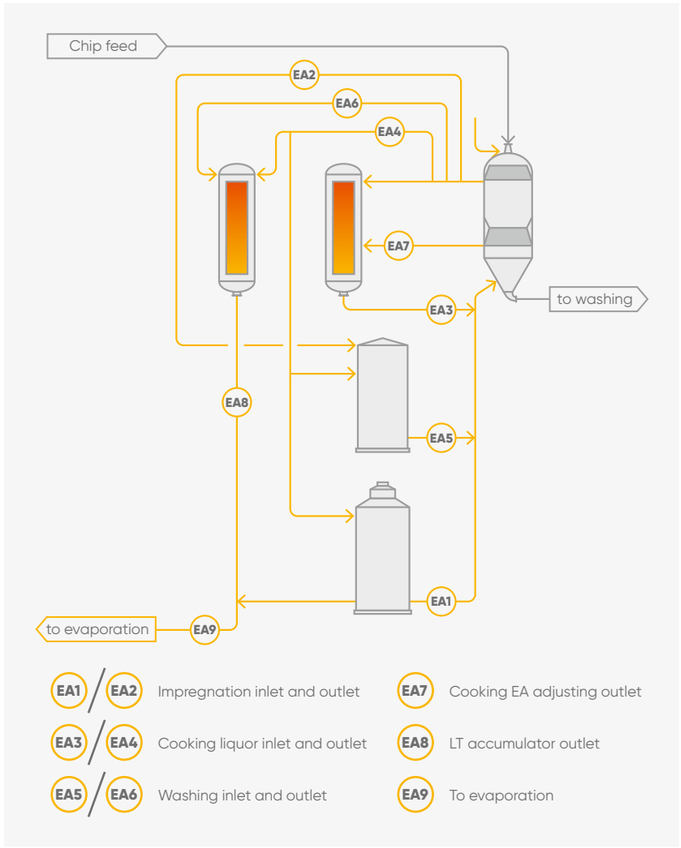
SELF-CLEANING SENSORS

By optimizing the alkali application rate, the mill's environmental impact and carbon footprint can be reduced while simultaneously ensuring maximized yield and pulp quality.

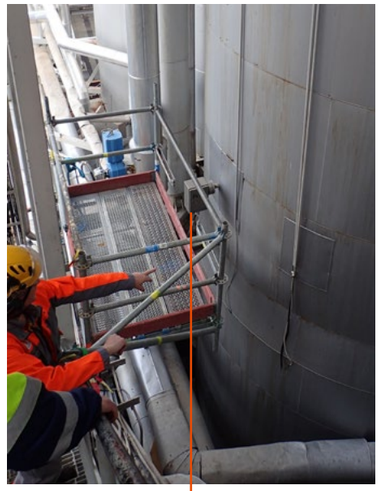
The alkali measurement system is currently in the piloting phase but interest has already resulted in two further installations at customer mills. The technology is being proved to follow alkali levels accurately and provides huge benefits especially for mills that run different grades, have variations in raw materials, or cook different wood species in one cooking line, for instance pine and birch.



Alkali profile with and without on-line measurement and adjustment



Optimizing the batch process with EA measurement



Mill Installation

IN A NUTSHELL

Savcor has been measuring electrochemical phenomena inside digesters for almost 40 years as part of its anodic protection systems, which are designed to prevent digester wall corrosion by passivating the steel with direct current. This experience with corrosion related measurements spawned the idea of measuring alkali concentration, which is a major factor in corrosion potential. The sensor technology was already robust and had a proven track record, but the measurement algorithms required rethinking.

ANDRITZ and Savcor have been working together since the 1990's in reducing the corrosion costs of the kraft pulping process. ANDRITZ has been able to push the development further by relying on Savcor AP system to stop the corrosion. It was only natural to start an even more extensive cooperation in on-line alkali profile measurement, developing a product now marketed under the ANDRITZ brand.

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Sensor after one year of operation shows no scaling on sensor surfaces