SOFRASER

Inline control
Combustion

Application
Black liquor recovery (concentration for combustion)

Targets: Pulp and paper mills, recovery boilers

Application

In the kraft pulping and recovery process, black liquor is the spent cooking liquor from digesting pulpwood into paper pulp removing lignin, hemicelluloses and other extractives from the wood to free the cellulose fibers. Approximately 7 tons of black liquor is produced to manufacture 1 ton of pulp.
Early kraft pulp mills discharged black liquor to watercourses. Black liquor is toxic to aquatic life and fouls the water. G.H. Tomlinson invented the recovery boiler in the early 1930s and aided the advancement of the kraft process. Black liquor recovery is now standardized in paper mills and creates the necessary energy to generate steam, recover the cooking chemicals, and minimize impact on air and water.
The recovery process can be optimized by burning high solids concentration black liquor in the recovery boiler. Unfortunately, many paper mills prefer to burn black liquors at reduced solids concentration to avoid possible rheological problems caused by an increase in the liquor viscosity. In order to reach optimum recovery ratios, it is imperative to increase the dry content from 14-18% to 65-75% or more by evaporating water. As the water content decreases, viscosity and solids content increase which maximizes the energy output at the burning stage.

Online measurement, monitoring and control of black liquor viscosity are deemed essential for the recovery boiler optimization. However, black liquor viscosity is not routinely measured in most paper mills.

Challenges

Black liquor viscosity is affected by solids concentration above 60% which, in turns, impacts:
- Heat transfer in evaporation units
- Pumping capacity
- Spraying characteristics

Low viscosity black liquor will:
- Enhance the formation of very fine liquor sprays that can be carried into super-heated regions causing fouling and plugging problems
- Greatly increase the risks or burner explosion

High viscosity black liquor will:
- Enhance the formation of large liquor droplets that will burn inefficiently and fall into the char bed. As the bed grows, it will generate thermal activity causing tube cracking and corrosion.
- Increase pumping issues

Moreover, unstable black liquor **concentration** generates:
- Black liquor waste or over consumption
- Cost increases in energy supply
- Stack emissions increases
- Frequent maintenance operations and downtimes in manufacturing
- Production decrease

Viscosity control is crucial in order to stabilize black liquor concentrations prior to entrance in the recovery boiler. This correction creates the necessary energy that determines production capacity and increases the efficiency of the paper mill.

Solution

The installation of a vibrating inline process viscometer – **Sofraser MIVI sensor** - and associated electronic controller after the evaporator / concentrator allows dry extract regulation in the black liquor, letting it either follow operations or, if necessary, return to the evaporation column.

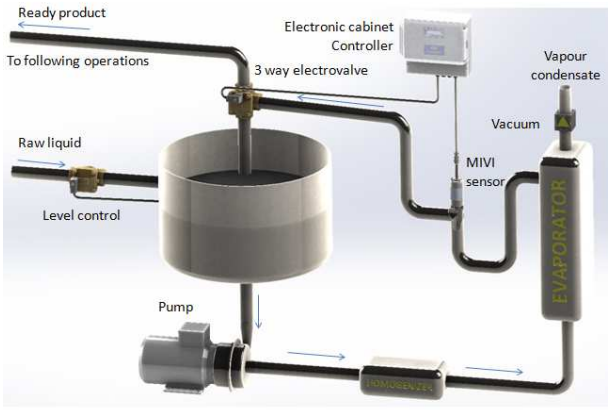
Stabilized concentration yields correct viscosity when the black liquor is heated. It maintains its stability during the combustion process in the recovery furnace and allows consistent atomization.

Installation

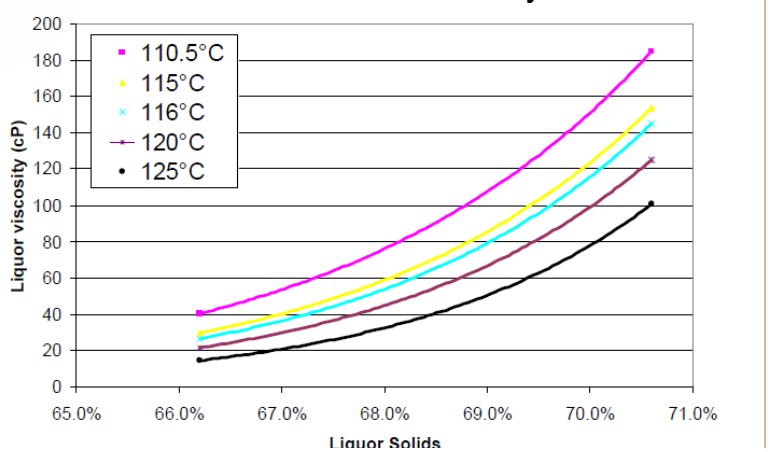
The black liquor circulates in a closed loop as long as the correct concentration is not reached. This closed loop includes a buffer tank, a circulating pump, a homogenizer, a viscosity controller, and a 3 way electro-valve.
The MIVI inline process viscometer:

- is easily fitted after the evaporator
- continuously delivers viscosity and temperature information to the electronic controller
- the controller instantly assures the right concentration by letting the correct product follow operations or by re-integrating it into the evaporation loop

Operation diagram

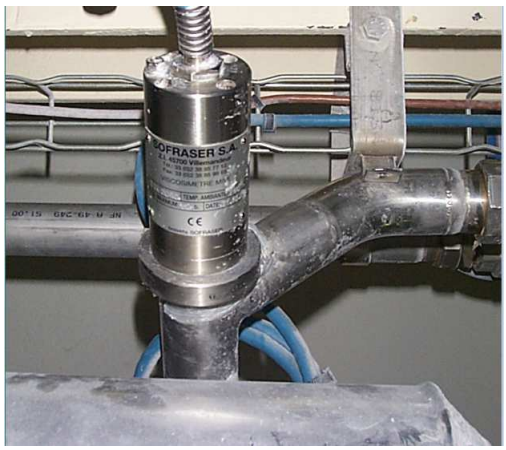


Records: Impact of Temperature and Liquor Solid Concentration on Viscosity



From Paprican, 7th Black Liquor Colloquium, Jyväskylä, Finland, July 31 – August 2, 2006

Onsite installation



Key product characteristics

- Robust over time, no moving parts, no maintenance
- No drift in time
- Easy to clean and uncomplicated access to wetted part
- Large thermal capacity
- Various flow rates are possible
- Corrosion and abrasion resistant materials (316 Ti, Hastelloy…)
- Electronic controller can include high and low viscosity alarms, and / or temperature alarms which improve fail-safe operation
- Many mounting possibilities and pre-sales expertise to allow adaptation to many black liquor compositions and avoid clogging effect