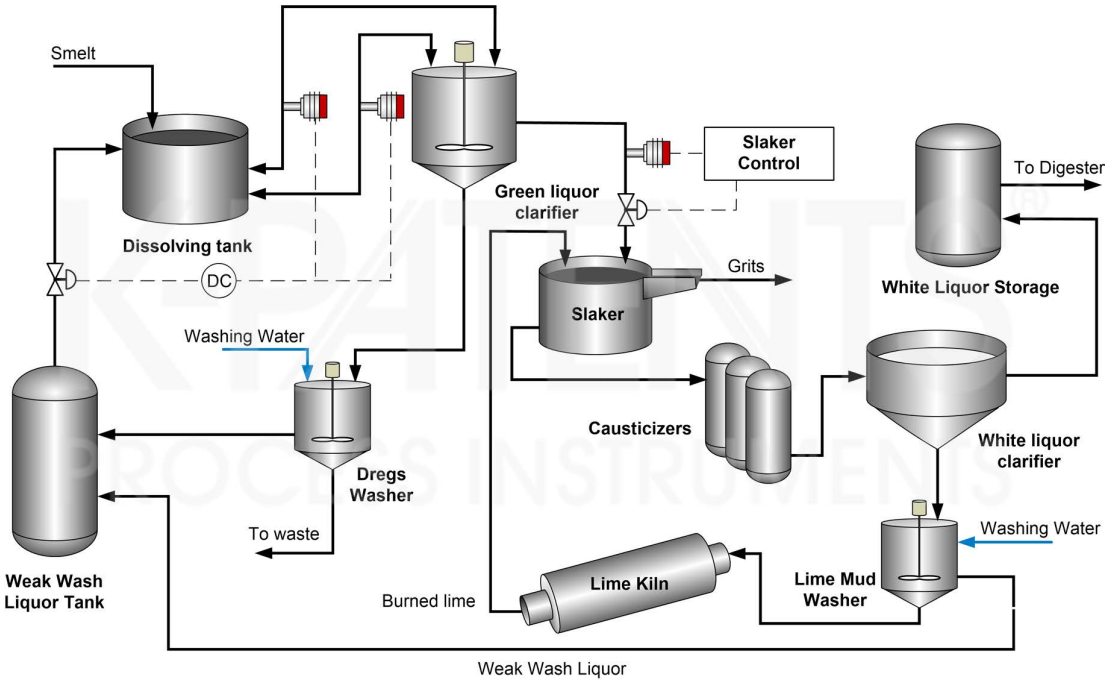
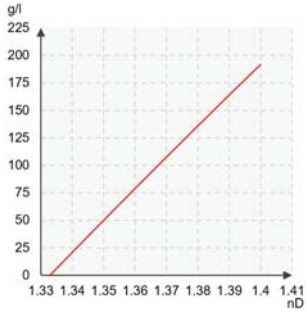



# GREEN LIQUOR

**Typical end products**

Unbleached kraft pulp, bleached kraft pulp.

**Chemical curve: R.I. per Green liquor density g/l at ref. temp. of 20˚C**




## Introduction

The Chemical Recovery Process ensures the operation and economic viability of the mill by regenerating the pulping chemicals from the inorganics dissolved in the spent liquor, and by burning the organic material to generate steam. The process consists of an evaporation plant, the recovery boiler and the causticizing plant.

In the causticizing plant sodium carbonate ($Na_2CO_3$) is converted into the active cooking chemical, sodium hydroxide (NaOH). The process can be divided in three main parts: slaking, causticizing and liquor preparation. The result is the white liquor which is used in the digester. A quality white liquor with consistent and high strength improves the productivity of the whole mill.

## Application

The smelt from the recovery boiler is dissolved in weak wash in the dissolving tank to produce *green liquor*. The raw green liquor, consisting mostly of sodium carbonate and sodium sulfide, is commonly pumped into a stabilization tank to even out fluctuations in density and temperature and ensure a more constant liquor composition to the causticizing area.

The green liquor clarifier aims to obtain a good clarified green liquor for the slaker. This also reduces dregs carryover which causes problems with downstream equipment. In the slaker, the clarified green liquor is brought into contact with reburned lime. This slaking reaction converts the green liquor into white liquor by converting sodium carbonate into sodium hydroxide, an active pulping chemical. Impurities known as grits are also separated at this stage. The mixture moves on to the causticizes to provide enough resident time for increasing the causticizing degree to 80-82 %.

The white liquor is produced by the separation of the lime mud, $CaCO_3$, a by-product of causticizing, which is converted back into lime using a lime kiln.

The causticizing process is controlled by controlling the slaker operation, which in turn depends on the concentration of the raw green liquor's Total Titratable Alkali (TTA). The goal is to stabilize the density or TTA concentration in the green liquor feed to the slaker to avoid overliming and ensure a safe operation. TTA measurements in the main green liquor lines (from dissolving tank and clarifier) are required for control purposes.

## Instrumentation and installation

The K-Patents SAFE-DRIVE™ Process Refractometer PR-23-SD measures the density or TTA concentration of green liquor at two stages of the process: after the green liquor dissolving tank and after the green liquor clarifier.

The refractometer's sensor is mounted directly in the pipelines for in-line measurements allowing real-time and active control to meet the target TTA.

Pirssonite formation in the pipe walls is a frequent problem for instrumentation in green liquor application. This may be as much as an inch per week. Traditional methods such as density meters and *dP* are not reliable due to constant scaling inside the instrument's tubes and drifting of the measurement.

The SAFE-DRIVE refractometer has been designed for accurate measurement in these difficult scaling conditions. The digital measurement is unaffected by bubbles, suspended particles or color changes to the green liquor. Automatic prism wash keeps the prism clean, securing representative samples and continuous information for real-time control. Typical measurement range is 100 150 g/l (6.0-8.5 lb/ft3) and the process temperature is 85 ºC (185 ºF).

Effective causticizing control improves the quality and stability of white liquor, decreases operating costs and increases pulping efficiency. Well performed lime dosage control reduces the recirculation flow of lime in the process, leading to less lime reburning in the lime kiln and decreased energy consumption.

| Instrumentation | Description |
|---|---|
|  | K-Patents SAFE-DRIVE Process Refractometer PR-23-SD for measuring black liquor dry solids and green liquor density or TTA in kraft chemical recovery 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. |
| **Automatic prism wash** | Prism wash with high-pressure water. The components of a high-pressure water system are a sensor with integral water nozzle mounted at the sensor head, a high-pressure pump together with a power relay unit and an indicating transmitter equipped with relays. |
| **Measurement range** | Refractive Index (nD) 1.3200 – 1.5300, corresponding to 0-100 % by weight. |