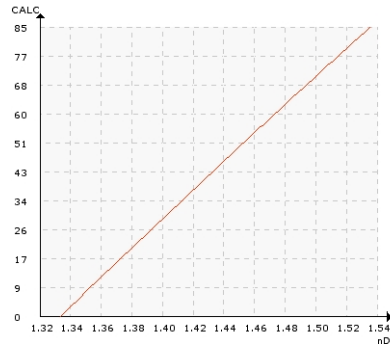


KRAFT PULP

Typical end products

Wood pulp, paper, board

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



Introduction

Wood pulp for paper and board manufacturing can be produced with several different methods. These are chemical pulps, chemi-chemical or chemi-mechanical (NSSC and CTMP) and thermo mechanical pulp (TMP). Refractometer applications are used in the chemical pulp production processes.

The kraft process converts wood into wood pulp, which consists of almost pure cellulose fibres. The process entails treating wood chips in alkaline cooking conditions, which break the bonds that link lignin to cellulose. K-Patents SAFE-DRIVE™ Process Refractometer PR-23-SD is used for various concentration (or dry solids %) measurements in the

recovery and fibre line (brownstock washing) processes.

Process

Wood chips are fed into vessels called digesters that withstand high pressures. Some digesters operate in a batch manner and some in a continuous process, such as the Kamyr digester.

Wood chips are impregnated with cooking liquors. The cooking liquors consist of warm black liquor and white liquor. The warm black liquor is the spent cooking liquor from the blow tank. White liquor is a mixture of sodium hydroxide and sodium sulfide, which are produced in the recovery process.

In a continuous digester the materials are fed at a rate, which allows the pulping reaction to be complete by the time the materials exit the reactor. Typically delignification requires several hours at 130 to 180 °C (266 to 356 °F). Under these conditions lignin and some hemicellulose degrade, creating fragments, which are soluble in the basic liquid.

The solid pulp (about 50% by weight based on the dry wood chips) is collected and washed. At this point, the pulp is quite brown and is known as "brown stock". The combined liquids, known as black liquor, contain lignin fragments, carbohydrates from the breakdown of hemicellulose, sodium carbonate, sodium sulfate and other inorganic salts.

PULP AND PAPER	
APPLICATION NOTE	3.01.00
KRAFT (SULFATE) PULP PROCESS	

Recovery Process

The excess black liquor is about 15 % solids and is concentrated in a multiple effect evaporator. During the first step, the black liquor is about 20 - 30 % solids.

The weak black liquor is further evaporated to 60% or even 80% solids ("heavy black liquor"). It is then burned in the recovery boiler to recover the inorganic chemicals for reuse in the pulping process. Higher solid levels in the concentrated black liquor increase the energy and the recovery cycle's chemical efficiency. With a higher viscosity, the possible precipitation of solids may lead to plugging and fouling of equipment.

The molten salts ("smelt") from the recovery boiler are dissolved in the process water, known as weak wash. This process water, also known as weak white liquor, is composed of all liquors used to wash lime mud and green liquor precipitates. It is kept in a weak wash storage tank. The resulting solution of sodium carbonate and sodium sulfide is known as "green liquor". This liquid is mixed with calcium hydroxide to regenerate the white liquor used in the pulping process.

The recovery boiler also generates high pressure steam, which passes through steam turbine generators to produce electricity and consequently reducing the steam pressure for mill use. Therefore, a modern kraft pulp mill is more than self-sufficient for its electrical energy supply.



Fibre Line and Brown Stock Washing

Incoming wood is debarked and chipped to an optimal size to minimize the fibre damage, and to maximize the impregnation of the cooking liquor. The chips and the cooking liquor are fed into the cooker(s). The cooking is carried out at high temperature and under pressure.

The cooked sulfate pulp passes through the blow line to the blow tank and then on to the washing stage.

During the brown stock washing, the used cooking liquors are separated from the cellulose fibres. Normally a pulp mill has 3-5 washing stages in a series. The pulp passes through further washing stages following oxygen delignification and after each bleaching stage. Several processes are involved: thickening/dilution, displacement and diffusion. The *dilution factor* is the measure of the amount of water actually used in the 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 gives cleaner pulp. Thorough washing of the pulp reduces the *chemical oxygen demand (COD)*.

In a modern mill, brown stock (cellulose fibres containing approximately 5% residual lignin) produced by pulping is first washed to remove some of the dissolved organic material and then further delignified through the bleaching stages.

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.
	K-Patents Digital Divert Control System DD-23 for safe operation of kraft chemical recovery boiler. K-Patents DD-23 system complies strictly with all recommendations of BLRBAC. The DD-23 system includes two K-Patents SAFE-DRIVE™ Refractometer PR-23-SD sensors in the main black liquor line, and two Indicating transmitters and a Divert control unit in an integrated panel. Remote monitoring and event data logging via Ethernet.
Measurement range:	Refractive Index (nD) 1.3200 – 1.5300, corresponding to 0-100 % by weight.