Kraft Pulping

Industry: Pulp and Paper
Product: Inductive Conductivity Meters

Introduction

The kraft process (also known as kraft pulping or sulfate process) describes a technology for conversion of wood into wood pulp consisting of almost pure cellulose fibers. Wood chips are by harsh chemicals (white liquor) to produce pulp and spent liquor (black liquor). The spent liquor is later regenerated to white liquor in the causticizer. Today, the process is used in approximately 80% of paper production. Those companies using the Kraft process are easy to recognize by their strong, offensive smell. This is because one of the byproducts of the process is hydrogen sulfide gas and other sulfur gas compounds. Kraft pulping uses less than 50% of the tree. The rest ends up as sludge which is burned, spread on land or land field.

Since the amount of bleach needed is related to the lignin content of the pulp, the Kappa number can be used to monitor the effectiveness of the lignin-extraction phase of the pulping process. The Kappa determines the lignins relative hardness, bleach ability, or degree of dezincification of the pulp. It estimates the amount of chemicals required during bleaching of wood pulp to obtain a pulp with a desired degree of whiteness. Measuring conductivity in the recirculation zone of a continuous digester can provide control feedback and lower variability in the Kappa number of the product pulp.

Process

The Kraft Process is a cyclical, self-sustaining process. As a result of the process, a byproduct called black liquor is formed. Wood chips are fed into a digester where they are impregnated with the cooking liquors (white and black liquor). The black liquor is the spent cooking liquor that is a combination of the removed lignin, water, and chemicals used in the extraction process. The inorganic portion of the black liquor, white liquor, is the regenerated mixture of
sodium hydroxide and sodium sulfide produced in the
recover process that is vital to delignification.

The wood chips remain in the digester for several hours are
130 to 180ºC to allow for the maximum delignification as
possible. Under these conditions lignin and some
hemicellulose degrade to give fragments that are soluble in
the strongly basic liquid. The remaining solid pulp is
collected and washed. The remaining stock is quite brown
and color and is know as “brown stock”. This material goes
further into the manufacturing process to later be bleached
and become the end product.

While the wood chips reside in the digester the sodium
hydroxide and sodium sulfide are consumed by the acetic
and lignin components in the wood chips. To make sure that
the white liquor is not completely consumed a conductivity
value and be measured and correlated with an acceptable
Kappa number range. This allows the feed rate of the white
liquor to the digester to be adjusted and maintained at a
certain conductivity value throughout the digestion process.

Product Recommendations

Yokogawa recommends using the ISC450G Inductive
Conductivity sensor to measure the alkali concentration in
black liquor because the sensor has proven to be rugged
and reliable with a minimum of maintenance needed. The
Yokogawa ISC40G sensor comes in two different chemical
resistant materials PEEK and Teflon, along with various
process connection capabilities. This allows for a wide range
of flexibility for installation from threaded to flanged to flow
thru.

The Yokogawa EXA ISC202 series transmitter is housed in a
robust chromated cast aluminum housing, coated with a
Epoxy-polyester makes it the ideal 2-wire transmitter for
mounting directly on-site, even under tough environmental
conditions. Yokogawa has implemented three leading
process Fieldbus technologies in their 202 series: HART®,
Foundation Fieldbus H1 and Profibus PA. The Yokogawa
EXA ISC202 series transmitter is housed in a robust cast
aluminum case with chemically resistant coating, cover with
flexible polycarbonate window.

Transmitter
2-wire conductivity measurement system ISC202
4-wire conductivity measurement system ISC450

Sensor/ Holder
ISC40FS/ISC40FF Insertion of Flow-thru assembly
ISC40PR Retractable assembly
ISC40G General Purpose Sensor
ISC40S Intrinsically Safe Sensor

Note: For additional information or assistance on this
application, please contact the Yokogawa Analytical Product
Marketing.

1.) Lignin or lignen is a complex chemical compound most
commonly derived from wood, and an integral part of the
secondary cell walls of plants and some algae. Its most
commonly noted function is the support through
strengthening of wood (xylem cells) in trees.

2.) Kappa number is the volume (in milliliters) of 0.1 N
potassium permanganate solution consumed by one gram of
moisture-free pulp under the conditions specified in the