ABB Analytical – pH Measurement
Chlorine Dioxide Bleaching

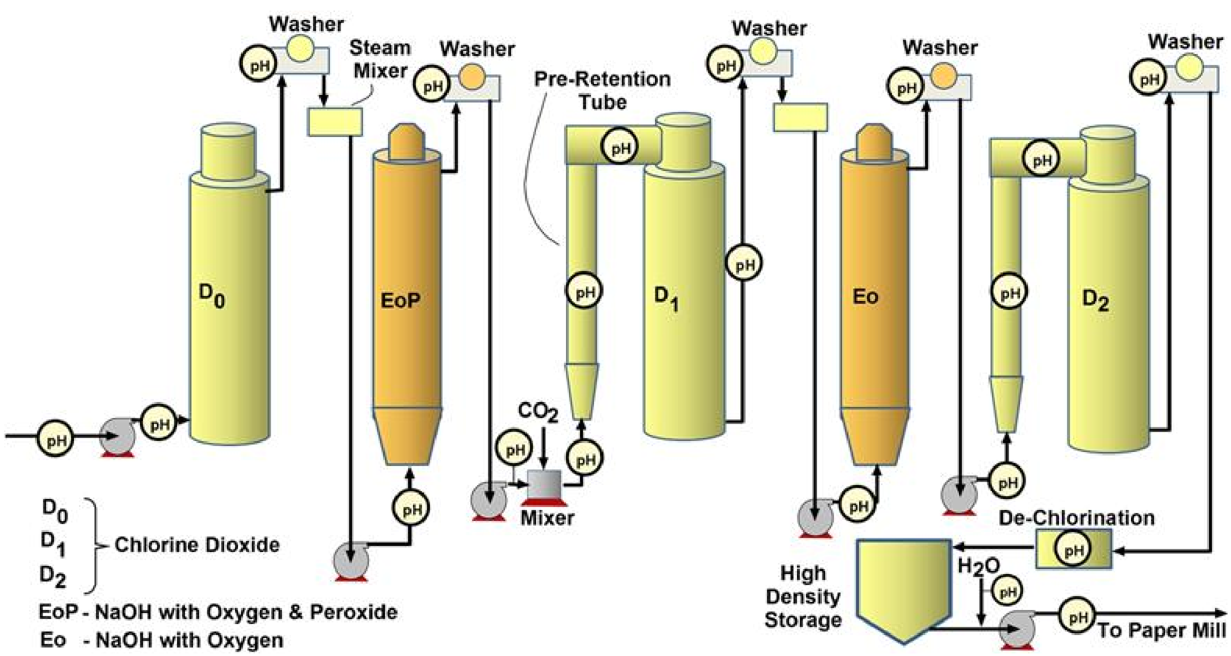
Industry: Pulp and paper

Measurement made easy
Bleaching pulp

Wood first comes into the paper mill, undergoes shredding into chips, and runs through a digester to break it down into pulp--a process called delignification. (Lignin is the substance that binds wood cells). Once through this initial process, the pulp goes to the bleach plant. During bleaching, the pulp experiences a series of alternating chlorine dioxide (ClO_2) and caustic (NaOH) stages. These stages further break down the pulp as well as whiten it to a uniform brightness.

Each stage holds the pulp within a large retention tower where the corresponding chemicals can create the desired effect on the pulp. Addition of oxygen and hydrogen peroxide in the caustic stages helps to increase pulp brightness. As the pulp exits each stage within the bleach plant, it runs through a washer to remove residual chemicals prior to the next stage.

The illustration below provides a rough example of a typical Kraft mill bleach plant process. ClO_2 addition takes place in the D stages; NaOH addition takes place in the E (extraction) stages.



Bleaching variables

Process engineers must consider many control variables to create high quality, consistent pulp stock. These include chemical dosing strength, retention time, and temperature. Chemical usage is extremely high in the bleach plant, so proper process control can result in large cost savings. One major paper company has informed ABB that proper pH control can save upwards of $50,000 USD per month in chemical costs alone.

As a result, most mills consider pH to be the most important control parameter within the bleach plant. Paper strength, brightness, and uniformity are all determined during the bleaching process. A typical bleach plant will have between 15 to 25 pH measurements.

Locating pH measurements

Mills typically measure pH at the inlet to each stage within the bleaching process. These sensors are mounted in the pipelines downstream from the stock pumps. Often additional pH sensors will be mounted in the larger pre-retention piping that leads into the tower on each ClO_2 Stage. The outlet pipeline from each tower will also have pH measurements as will the stock washers. Measurement of pH on the inlet and outlet of the tower gives the process engineer feedback on the effectiveness of the chemical reaction. Mills often add chemicals at each washer stage, so pH measurement within the washer provides a control measurement for proper dosing.

Bleach plants represent extremely challenging pH applications. The E stages are often at 12 pH and higher from caustic addition. Temperatures can be as high as 200°F (95°C). The D stages normally range between 3.5 to 4.0 pH at temperatures of 140°F (60°C) to 180°F (80°C). The pulp stock can abrade the glass pH electrode. Additionally the process engineer must consider insertion depth of the sensor because laminar flow often develops at the pipeline inner diameter when stock flow velocity is low.

The ABB Solution: TB(X)5 Sensors

Most bleach plant applications use inline pH sensors such as ABB TB557, TBX587, and the TB18 Safe-T-Clean valve with the TB561 pH sensor. Taking pH measurements on sample lines and stock extraction devices are less optimal as they add lag time and allow the liquid sample to cool. Cooling can significantly alter solution chemistry before the sensor has a chance to perform its measurement. ABB recommends pH sensors with PTFE and flat glass electrodes to withstand the pulp stock. The acidic D bleaching stages using ClO_2 require titanium hardware to withstand corrosion.

Beyond the descriptions here, consult ABB technical support regarding proper installation of pH sensors into pulp stock lines. ABB offers additional documentation to help in these situations.

The TB557 is an example of a retractable pH sensor commonly used in bleach plant applications.

In thick stock applications (> 8%) the TB18 Safe-T-Clean Valve provides a good alternative to linear insertion style pH systems.

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