pH Measurement in Chlorine Dioxide Bleaching in Paper Mills

Process

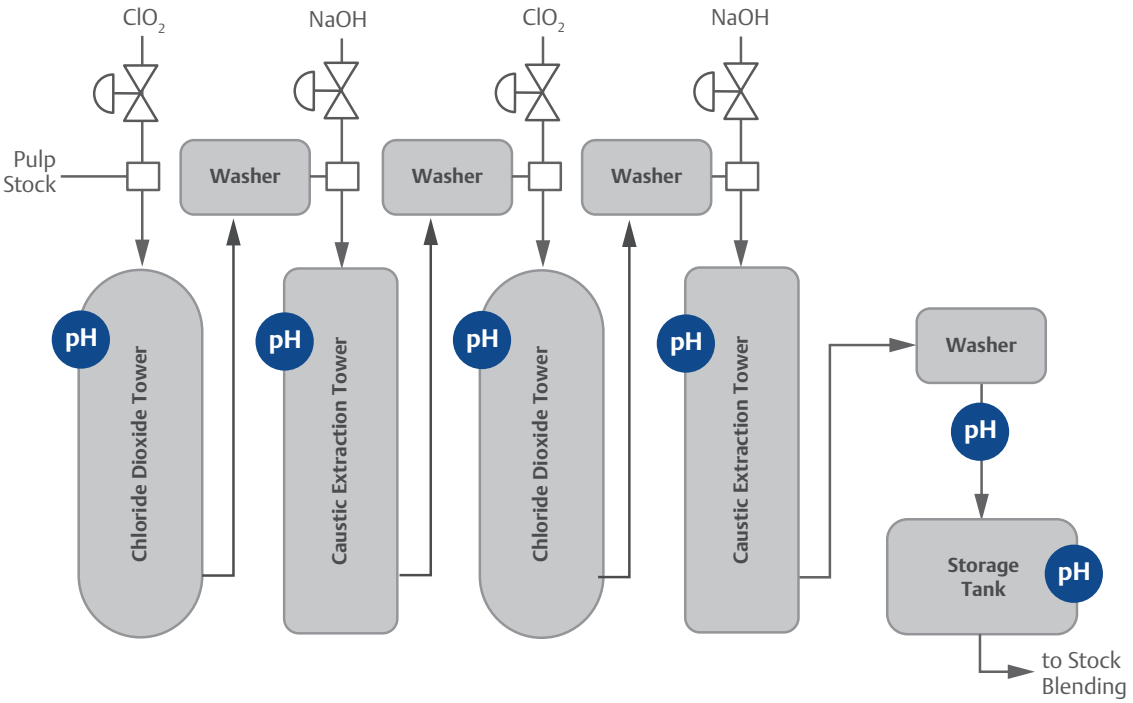
Bleaching is a whitening process used by paper mills to produce paper with high brightness. Chemicals such as chlorine gas, sodium hypochlorite, oxygen, hydrogen peroxide, ozone, and chlorine dioxide are used in various combinations to produce pulp with the desired properties. Limitations on the use of chlorine and hypochlorite have resulted in extensive use of chlorine dioxide as an alternate bleaching chemical. Chlorine dioxide bleaching is sometimes referred to as Elemental Chlorine Free (ECF).

The chlorine dioxide is mixed with the pulp and contacted in each chlorine dioxide tower (see Figure 1) for about one hour. The primary purpose of bleaching is to maximize removal of the lignin binding agents in the pulp without degradation of carbohydrates, which weakens the final paper product. The pH is maintained at relatively low levels (approximately 4 pH) to foster rapid chemical reaction. Higher pH levels require more chlorine dioxide for equivalent bleaching action.

Following bleaching in each chlorine dioxide tower, the reacted lignin is removed by dissolving the lignin under high pH conditions (typically more than 11 pH). Lower pH levels will not dissolve all the lignin. This caustic extraction stage is preceded by a washing

step to reclaim the chlorine dioxide and to minimize carryover of the acidic chemicals. The amount of caustic needed is proportional to the amount of bleach added in the chlorine dioxide tower. Bleach plant sequences vary widely from mill to mill. At least two bleaching stages are generally required to produce the specified brightness, with additional stages needed for more specialized uses. Consistency (% solids) is typically maintained at a high level (up to 10%) to minimize water use. Temperature is controlled around 140 °F (60 °C), and doses of 5% chlorine dioxide are common.

Figure 1 - Chlorine Dioxide Tower Process



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pH/ORP Measurement

pH is measured in the chlorine dioxide towers to control the bleaching reaction conditions. pH is also measured in the extraction stages to control addition of the caustic used for extraction. An oxidation reduction potential (ORP) measurement can be made in the washer between the chlorine dioxide and extraction stages to verify that the chlorine dioxide rinsing is complete. However, using ORP to control chlorine dioxide dosage in the chlorine dioxide tower itself is not effective due to the non-linear character of ORP.

While accurate pH measurement is critical in the chlorine dioxide and extraction stages, these applications are among the most difficult in a pulp mill. The high pulp consistency of the process stream and harsh bleaching chemicals degrade the performance of most general-purpose sensors. The sensors can require frequent cleaning, and they may not be able to withstand the harsh oxidizing environment.

The Emerson Solution

The Rosemount™ RBI pH Sensor is an excellent solution for this application. Multiple isolation chambers behind the reference junction act as barriers to protect the inner reference from contact with the harsh chemicals, while the high surface area of the reference junction resists plugging and maintains the electrolyte flow needed for a stable pH signal. The RBI sensor is available in NPT or retractable mounting configurations and is compatible with all Rosemount Liquid Analysis transmitters, including the Rosemount 56 Dual Channel Transmitter which offers dual sensor inputs, a large full color display, and built in measurement and troubleshooting tips.

Rosemount™ RBI pH Sensor

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