Process Controls SalesNet
pH Applications

pH Control in Paper Machine Headbox

Background
Additives such as resins and other paper-sizing materials are blended into the paper stock (furnish) to provide better dry-fiber binding and improved wet tensile strength characteristics in the finished paper sheet. Normally, this stock coming to the wet end of a paper machine has a higher pH than desired. The pH is reduced by adding alum or sulfuric acid or both as a flocculation agent to precipitate these resins during the paper sheet-forming process. An alum solution is the most common acidifier, particularly when sizing is used in the furnish. The aluminum ion present in the alum solution performs an important function in binding size particles to paper fibers when pH is held at the correct value, generally around 4.5 pH. However, the pH may be adjusted and controlled at whatever value is required by local conditions to secure optimum overall results.

Problem
Because of the buffering action of alum, a point is reached where addition of large amounts of alum causes no appreciable change in the pH. Sulfuric acid can be added to trim the pH to its required value, but near that value, precisely controlled flow is required.

Precise control of pH is further complicated in that the same paper machine is used to produce a variety of paper grades. Consequently, optimum flow rates of alum change, and control parameters vary from one grade to the next. Furthermore, pH of the raw stock is constantly changing; it can swing from 7.5 to 10.0. Therefore alum or acid cannot simply be added to control pH at fixed rates.

pH Control
Effective measurement and control of pH requires equipment that can stand up to the abrasive action of the stock and compensate for the non-linearity of the neutralization curve while providing continuous measurement. In addition, a control valve is needed with sufficient rangeability to handle the lowest and the highest flow demands equally well.

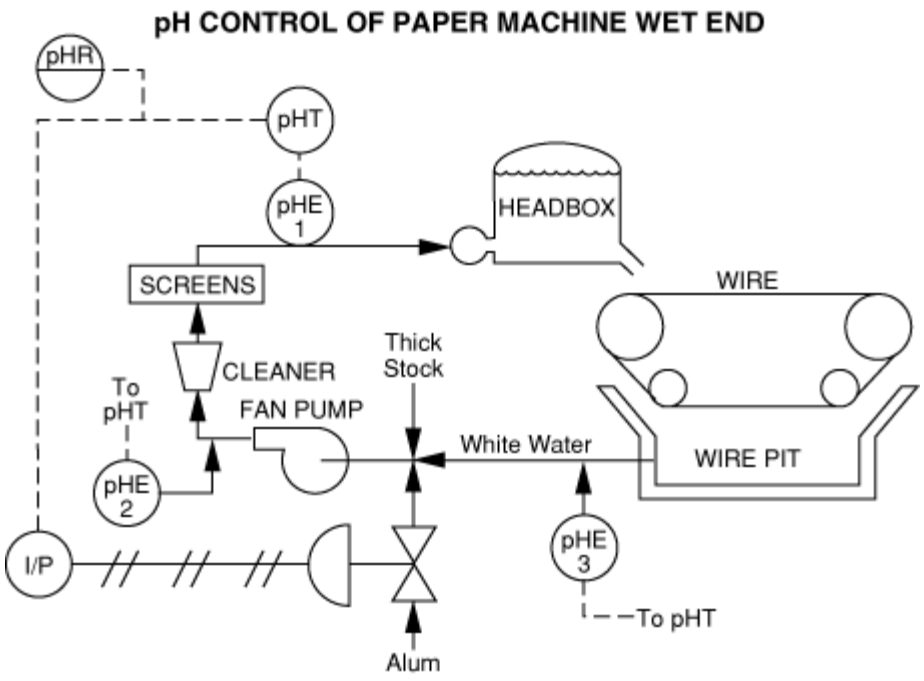

figure 1 - Diagram of paper machine headbox

Depending on the type of wet-end configuration, the pH measurement can be made at several locations. Figure 1 schematically shows three such points. To improve pH control response and for pH readings closer to the paper-machine sheet-forming wire, it is desirable to measure the pH somewhere in the stock line feeding the headbox (pHE-1). This is the recommended location. An alternate location (pHE-2), measures the stock in the discharge from the fan pump, and another alternative (pHE-3) is located in the white water from the trays. Of the two alternatives, (pHE-2) reflects changes in pH sooner, but the installation is more difficult. The other alternative (pHE-3) reacts to changes in pH later but is preferred by some from the standpoint of convenience. The pH measurement is transmitted to the analyzer/controller, which adjusts the valve regulating the amount of alum solution being added to the stock at the suction side of the wet-end fan pump.

Honeywell's pH Solution

Honeywell's pH control systems include several significant features that provide improvements and benefits in paper machine pH measurement and control. pH control in the area of +/- 0.1 pH units on the stock feed to the headbox are not uncommon. The benefits of these controllers are higher-quality and more uniform product, reduced maintenance of the instrumentation system, less product waste due to paper breaks, and decreased use of chemicals. With a UDC 6300 process controller (Figure 2), which receives a linearized output from a 7082 pH analyzer (Figure 3), these process benefits are achieved through the use of gain scheduling. Up to eight gain-tuning values may be applied to eight process variable (PV) bands for ideal tuning on known nonlinear processes. The UDC 6300 is

figure 2 - UDC 6300 Controller

housed in a DIN-panel-size (72 mm x 144 mm) case for control-room mounting with an IP 65-rated front panel. It also features full PID control with three vertical bar graphs for display of setpoint, process variable, and output, and an optional RS422/485 communications interface.

figure 3 - 7082 pH Analyzer / Controller

With the 7084 pH Analyzer/Controller (Figure 4) these benefits are achieved through characterization of the process titration curve. The characterized output of the pH controller is the linearization of alum demand, which is used as the input to the integral three-mode PID controller. Thus, the proper amount of alum is dispensed into the stock furnish. Also, the 7084 has an "electrolert" warning feature that provides an alarm if a glass measuring electrode should crack or break in the process. Use of this feature can prevent improper amounts of alum from being added in case of electrode failure. Other features include solution temperature compensation, a built-in electrode service timer that reminds personnel to perform routine electrode maintenance, and continuous internal diagnostics.

figure 4 - 7084 pH Analyzer / Controller

Both the 7082 and the 7084 are housed in NEMA 4X weather-proof, hose-down-proof, chemical-resistant Noryl cases that may be mounted at the process to allow for local indication of the stock pH. High-level signal outputs are also available on all of the units, allowing for transmission of the displayed pH value to control-room recorders or DCS inputs.

Life of the electrodes is greatly extended by such design features as solid-state, ion-sensitive field-effect transistor (ISFET) technology, large surface area, and non-fouling diffusion-type reference junctions. Replaceable reference gel and ceramic plugs greatly simplify electrode maintenance, and the Ryton plastic body resists breakage. The electrodes are also designed to withstand higher operating temperatures and pressures.


figure 5 - 7773 Electrode housing

The 7773 Electrode housing (Figure 5) is available in polypropylene or corrosion-resistant Ryton. It is completely submersible or available with the flow-through chamber as shown. This pH electrode assembly also features ultrasonic cleaning with a transducer mounted between the electrodes. This design provides maximum power and prevents electrode fouling for longer periods of time. The polypropylene or Ryton immersion housings contain a preamplifier that converts the high-impedance pH measurement to a low-impedance signal through the

use of a screw-cap connection that is moisture- and humidity-proof.

For more severe stock pH measurement applications and where absolute minimum maintenance is desirable, the fabrication of an overflow sampling chamber permits the use of the 7773 Electrode Holder Immersion Assembly with Continuous Ultrasonic Cleaning.


figure 6 - Durafet pH electrode

For the less severe maintenance applications, the 7777 Durafet® electrode mounting (Figure 6) or the 7774 removable-insertion electrode mounting assembly (Figure 7) mounted in a sample line is suitable. The 7777 electrode housing requires a 3/4-in. NPT fitting, while the 7774 requires a 1¼-in. NPT fitting. Sample line size should be selected to maintain a recommended velocity of 6 to 10 feet per second to provide the maximum cleaning action on the tips of the electrodes. The 7774 pipeline electrode mounting assemblies are suitable for pressures up to 100 psi at temperatures up to 212° F, and the electrode holders are usable in 100% relative humidity environments.

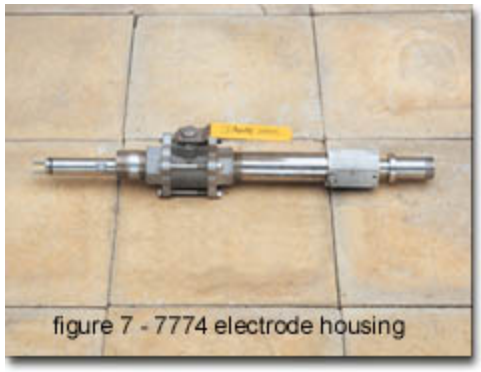
figure 7 - 7774 electrode housing

Results

By adding only as much alum as needed for size activation, one pulp and paper mill realized a savings of 12 lbs. of alum per ton of product. More sulfuric acid was used, but this was more economical than alum, costing only a fifth as much as the alum it replaced. There was also a significant improvement in quality of the final product. Stabilizing conditions at the wet end of the machine also reduced by 50% the standard deviations of wet-strength properties of highly sized product.

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