

Measuring pH at the Headbox in the Papermaking Process

Introduction

Monitoring and controlling hydrogen ion activity (pH) of pulp stock is critical in the paper making process. A narrow pH range must be maintained during various phases of production. One area in which pH has a pronounced effect on final paper quality is at the “headbox” at the input section of a papermaking machine.

Background

The headbox is used to physically prepare the pulp stock before it is converted into paper by the papermaking machine. The pulp stock supplied to the headbox has a consistency of between 2% and 5% solids. Today’s advanced papermaking machines can

produce over 650 tons of paper per day. The paper is made in a continuous sheet that is rolled for shipment and eventually cut to size.

The front section of the headbox, called the stock distributor, receives the pulp stock flow from one or more inlet pipes and spreads it uniformly to a width equal to the final paper width. The central portion of the headbox dampens excessive pulp stock flow turbulences and inlet cross flows from the stock distributor, corrects flow inequalities, and directs the stock into the slice (rear portion of headbox). The slice controls the distribution of pulp stock onto the papermaking machine. The stock flows between a stationary lip and a movable lip to ensure an even velocity across the width of the machine and to provide a constant, random fiber distribution.

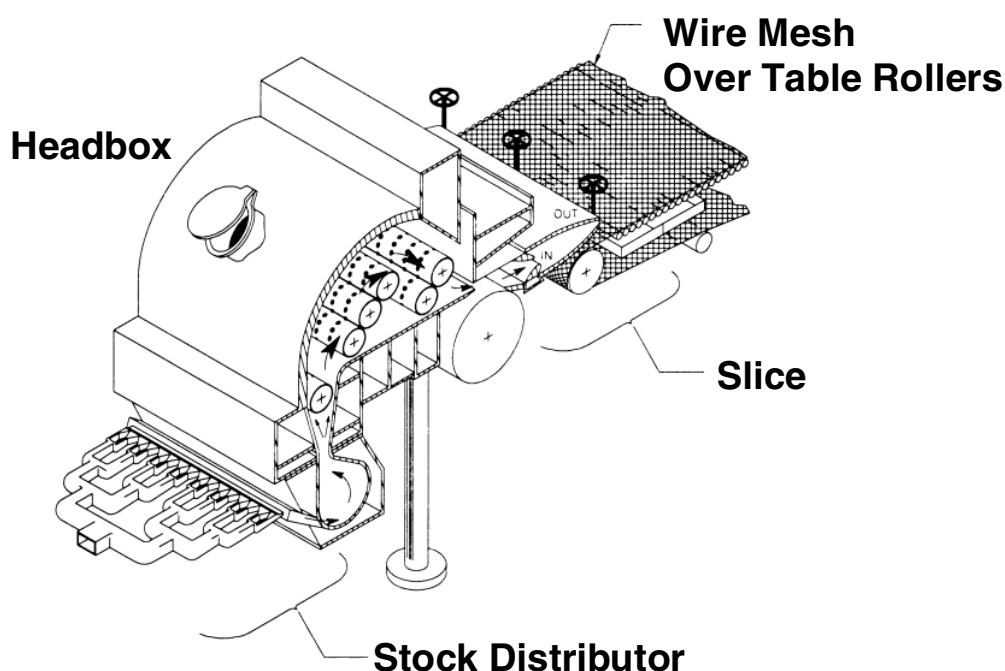


FIGURE 1 -- Input Section of Typical Papermaking Machine

Application

Preparation of pulp stock is crucial in achieving desired paper qualities. A pulp bleaching process may be used to change the natural brown color of the paper to white. Also, the pulp stock may be unbeaten or beaten. Paper made from unbeaten stock is generally not suitable for most uses, whereas paper made from beaten stock has a high density and good strength. Bleaching and beating are an integral part of pulp stock preparation, with both substantially affecting final product quality.

The pH of the pulp stock doesn't affect final product quality as dramatically as bleaching or beating, but it is critical in obtaining desired printability. Most paper produced will have printing ink applied to it. If the paper is too acidic, it will not take printing inks very well.

Pulp stock pH also affects the distribution of paper fibers. At very low or very high pH levels, paper fibers tend to flocculate (form in clumps) which adversely affects paper quality. Pulp stock pH also influences these other factors in the papermaking process:

1. Paper surface characteristics
2. Foaming
3. Brighteners
4. Shade and dye retention (each dye has an optimum pH range for maximum tinctorial value)

The pH of the stock is measured in the pulp stock line that feeds the stock distributor. Depending on the design of the processing equipment, a variety of hardware is available to mount the pH sensor into the line. Since papermaking is a continuous process that cannot be interrupted, insertion mounting is the preferred method. An alternate approach is to flow-through mount the sensor in a bypass line that has isolation valves to allow routine cleaning and replacement, if necessary. Most plants require a continuous 4-20 mA signal proportional to the pH because they typically have control centers that also accept other important monitored parameters from locations throughout the plant.

Summary

pH measurement at the headbox is the final pH check and the last chance to alter the pulp stock before it becomes paper. pH is one of many variables that can significantly influence the characteristics of paper, so it is important that this measurement be accurate, reliable, and continuous.

Recommended Instrumentation

A number of different types of sensors can be used for this application. Selection criteria include cost, convenience, mounting style and personal preference.

- Insertion Mount System (process pipe):
Model 692P3F5A7N pH Transmitter
Model 6070P0 Insertion pH Sensor
MH718 Insertion Hardware (316 SS)
- Flow-through Mount System (sample bypass line):
Model 692P3F5A7N pH Transmitter
Model 6028P0 Convertible pH Sensor (LCP)
MH376 Flow-Through Mounting Hardware (PVC)

References

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Casey, Pulp and Paper -- Chemistry and Chemical Technology, Wiley-Interscience.

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