APPLICATION Notes GLI International

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Measuring pH and Conductivity in Metal Working/Plating Industries

Introduction

pH and conductivity measurements are very important within several areas of a metal working plant or in the treatment process of a plating operation. A general understanding of how metal working/plating processes operate will help to identify the correct use of these pH and conductivity measurement and control systems.

Overview of Treatment Stages

Generally, metal working facilities will clean parts so that they can be painted or coated with various chemical inhibitors to prevent corrosion. Phosphate coatings (zinc or iron) are used to prepare the metal surface for painting with liquid or powdered paint. Some metal working plants perform a manganese phosphating process, where parts are intentionally oiled for protection.

Plating lines are similar to metal working lines except that a plating tank, which may or may not be monitored for pH, replaces the phosphating tank. Be sure to check sensor material compatibility and temperature limitations for any pH sensor being considered for this purpose. The following illustration shows a typical metal parts processing line for cleaning/phosphating. Regardless of whether dip tanks or spray washers are used, the functional stages of metal parts processing remain the same. Some systems may have an additional one or two tanks when extra cleaning or rinsing is required. As shown below in Figure 1, the sequence of stages and their related functions are:

- **Cleaning (1st Stage):** This first stage is used to initially clean parts. The dip tank or spray washer usually contains a proprietary, alkaline-based cleaning agent.

  Usually plant operators try to continuously monitor and control their dip tank and spray washer systems to optimize chemical usage through automatic chemical feeding. Many times they mistakenly monitor the solution conductivity of this cleaning stage to maintain a stable concentration. A basic understanding of the conductivity measurement reveals why this strategy is unsuccessful.

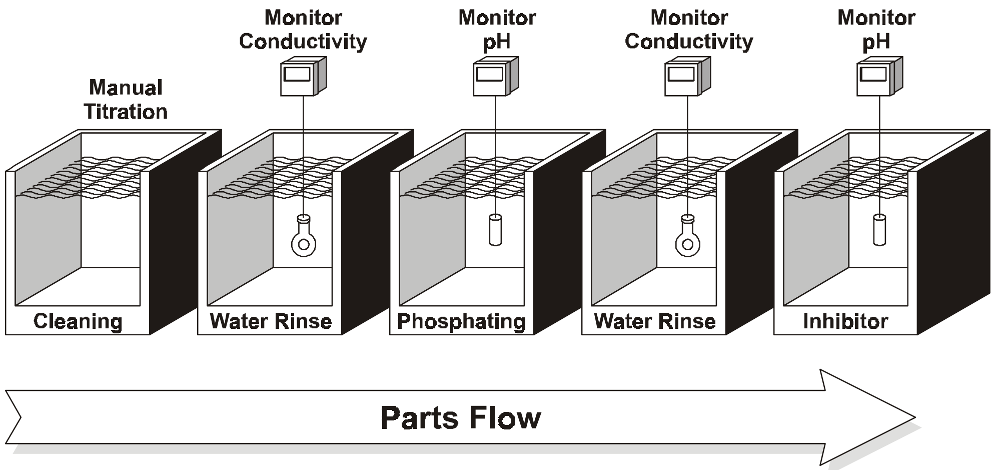

FIGURE 1
Typical Stages Within a Metal Working Process

Since conductivity is not a specific ion measurement, it cannot measure the specific ion of a proprietary chemical used for cleaning. The conductivity measurement will provide the total ion concentration in microSiemens/cm. When monitoring the conductivity in this cleaning stage, the measurement is inaccurate because:

- The contaminants washed off the parts that enter the tank usually increase the total conductivity.
- The proprietary cleaning chemical becomes depleted as it works.
- In the process, there will be a certain amount of carry out from one tank to the next.

These factors may cause the conductivity value to remain the same or possibly increase. Consequently, the measured conductivity is not a true representation of the chemical's concentration. What is actually being measured is an increase in soil loading contaminants and a decrease in the cleaning ability of the cleaning agent. Performing a manual titration is the only way to measure the true concentration.

■ **Water Rinse (2nd Stage):** This stage uses potable water to rinse the parts of loose soils and residual soap used in the cleaning stage.

Monitoring conductivity in rinse water can help save process costs. Some plant operators will overflow rinse tanks on a continuous basis. Other operators will overflow on a timed basis or periodically check the tank. An alternative is to continuously monitor the conductivity of the rinse water to determine the conductivity value at which the rinsing becomes ineffective. Controlling the water solenoid valve with a relay in the GLI analyzer that has a setpoint value slightly below the ineffective range will ultimately save money by reducing process costs and wastewater discharge costs. The savings can be substantial when compared to using the continuous overflow method.

> Rinse Water Recommended System:
>
> Model 3700-series electrodeless conductivity sensor and Model E63 analyzer.

■ **Phosphating (3rd Stage):** This stage prepares the metal for painting. An acid-based zinc or iron phosphate solution is used to etch the metal surface, creating microscopic hills and valleys on the surface of the metal for optimizing paint adhesion.

pH is often monitored in the phosphating stage. Typically, most plants monitor this stage using very inaccurate pH paper, or manual titrations which can be time consuming and expensive.

> Phosphating Recommended System:
>
> Model 6028 Differential LCP pH sensor and Model P63, P53 or P33 analyzer.

■ **Water Rinse (4th Stage):** This water rinse stage uses potable water to remove the residual chemicals from the previous phosphating stage. Conductivity monitoring, just like for the 2nd stage water rinse, can also be used to save costs.

■ **Inhibitor Coating (5th Stage):** During this stage, an inhibitor is applied to the metal parts to prevent corrosion from occurring prior to painting. Different types of inhibitors are used. Some are chromic acid based, and others are less toxic and less polluting.

Depending on the inhibitor, some coating stages can be monitored for pH. Be sure to check sensor material compatibility and temperature limitations for any pH sensor being considered.

> Inhibitor Coating Recommended System:
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> Model 6028 LCP pH sensor and Model P63, P53 or P33 analyzer.

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