Fact Sheet

Conductivity Control System Technology
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Background

Product quality in metal plating operations is highly dependent upon how effectively contaminants are rinsed from the work pieces. A common practice in this industry is to continuously run fresh water into the rinse tanks to maintain high rinse water quality. However, this practice often leads to excessive water consumption.

The quality of rinse water can be correlated to the conductivity level in the rinse tank, which rises due to the addition of ionic contaminants dragged in by work pieces. A conductivity control system reduces water consumption by allowing fresh water to flow into a rinse tank only when the conductivity level within the rinse tank exceeds a previously determined value. The conductivity control system thus consists of: 1) a sensor that detects the conductivity level of a solution, 2) an analyzer that monitors the conductivity level relative to a pre-set maximum conductivity value, and 3) a solenoid valve which receives a signal to open (or close) from the analyzer, allowing (or restricting) fresh water into the rinse tank as determined by the conductivity level.

Traditionally, the conductivity sensor had two electrodes exposed to the rinse water, but systems with this type of sensor have had very low user satisfaction. This was usually due to the electrode sensors becoming fouled or encrusted by ions or other charged particles in the water. Thus, operators were frequently required to perform maintenance in order to keep the conductivity control system functioning properly.

Electrodeless conductivity control systems are free of problems associated with fouling because no part of the sensor directly contacts the rinse water. A nonconductive plastic casing surrounds two wire loops that induce and detect a current, which is proportional to conductivity. The reduced maintenance and increased reliability associated with the electrodeless sensors make conductivity control an option to consider for reducing water usage in metal plating operations.

Conductivity Control in Practice

As part of the Illinois Sustainable Technology Center (ISTC) Accelerated Diffusion of Pollution Prevention Technologies (ADOP²T) program, staff engineers worked with API Industries, Inc. to install and monitor electrodeless conductivity control systems in two different rinse tanks. API, a metal plater, was looking for assistance in lowering their water usage and loading on their wastewater treatment system.

When the project began, API already had several conductivity controllers installed on other lines. These controllers were set to keep the rinse tanks at 1000 µS/cm (+/-50 µS/cm). ISTC staff knew from past experience that intermediate rinse tanks could tolerate much higher contaminant

levels. Therefore, the starting point for the first new controller was set at 1200 µS/cm and increased in 400 µS/cm increments twice each week. This allowed the system time to stabilize and gave production personnel time to verify that there were no quality problems as a result of the increase in conductivity. In addition to installing the conductivity control units, solenoid valves were installed at the water supply to turn the water on and off based on conductivity levels in the tanks. Flow meters were also installed in order to monitor water usage. As a safety measure, bypass valves were installed to allow operators to add water should the system fail.

Brief training sessions were held with the line operators and supervisors to let them know what was taking place on the line and assure them that conductivity-controlled rinse water would not cause product quality problems.

The second new controller was installed with the initial conductivity control point at 1600 µS/cm and was raised in two 600 µS/cm increments, followed by two 400 µS/cm increments. No product quality problems were noted. The final conductivity control set point for both tanks was 3600 µS/cm and the control system was configured so that the conductivity within the tanks would remain between 3400 and 3600 µS/cm.

In addition to monitoring the conductivity controllers, the conductivity levels of the five rinse tanks located downstream of the newly adapted tanks were measured on a regular basis. These measurements were important because the increased conductivity levels in the adapted tanks would result in increased conductivity levels in all tanks downstream. It was discovered that conductivity at the line's final rinse tank was 2700 µS/cm. This

was good news as it means that API had a final rinse with higher conductivity than any final rinse tank previously observed by ISTC staff. The fact that this conductivity level still allowed API to produce a quality product also demonstrated that controlling the intermediate rinse tanks at 3600 µS/cm was not a risk to product quality.

Project Results

Water usage at one tank was five gallons per minute (5 gpm) prior to installing the conductivity controller. By maintaining conductivity between 3400 and 3600 µS/cm, the water flow rate was reduced by 92% to 0.4 gpm. Similarly at the second tank, water flow was reduced by 83% from 2 gpm to 0.35 gpm. Based on 24 hours of operation, 6 days per week, this equates to water savings of 2,808,000 gallons per year. Water and sewer costs are $3.22 and $0.45 per 1,000 gallons, respectively. Therefore, water and sewer savings alone amount to $10,883 annually.

The cost for each flow controller was $1,370. Additional material and installation costs brings the installed cost to about $2,000 for each unit. The two systems will pay for themselves in about 4 1/2 months. Taken individually, the first adapted tank would pay for itself in about 3 months, and the second adapted tank would pay for itself in about 9 months. The difference in payback periods is due to the greater water reduction achieved at the first tank.

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