Manufacturer Simplifies Daily Electroforming Process Operation with Automated Instrumentation to Monitor and Control Critical pH Levels of Metal Solution Bath

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Located in Southern California, Phoenix Electroformed Products[**] manufactures reflectors, collectors and cold shields used in searchlights, motion picture projection, medical devices, ultraviolet curing equipment and infrared radiation shields. These products are produced using nickel and/or copper metal in an electroforming/electroplating process. Electroforming is a replication process very similar to electroplating, but with the key difference that the plated material (electroform) is separated from the mandrel surface to leave a free-standing metal article. The process allows the creation of simple or complex shapes that duplicate the detailed features of the original mandrel.

Critical to optimizing the manufacturing process of these metal products is the pH and temperature of the solution in which the products are made. When the pH and temperature are properly controlled, the plated material conforms to the mandrel in a smooth, even layer, producing a very accurate replication. When these parameters are out of balance, the molecular structure of the plated material will change. This change can result in internal stresses causing deviations from the form of the mandrel. Other undesirable effects from chemistry imbalance can include pitting, reduced deposit hardness and more rapid solution breakdown. All these factors can result in scrapping unacceptable pieces as well as using additional chemicals, both of which cost time and money.

Because of the importance of maintaining a properly chemically balanced solution, Phoenix Electroformed Products had been following a strict manual test process that involved spot-checking and taking several samplings of pH levels to obtain an average. These tests were conducted between four and six times per day, absorbing about ten minutes per test. "Monitoring the pH solutions required daily testing with a handheld meter, which needed regular calibration," elaborates Bruce Barnes, Phoenix Electroformed Products' President. "To compound this, when a pH addition was made for solution correction, follow-up tests needed to be performed to verify the effect of the corrective action."

Although the manual method was extremely effective in keeping the solution bath balanced, Phoenix Electroformed was very receptive to GF Piping Systems[***] when approached with the idea of becoming a Beta test site for GF's new pH Sensor line, which, with other products, would also provide an automated solution to replace the manual method of pH/temperature control.

To automate Phoenix Electroformed Product's sampling process and test the new sensors at the same time, GF Piping Systems installed a variety of Signet automated sensing and monitoring instrumentation products. The installation included the 2724 pH Sensor, the 2350 Temperature Sensor, the 2250 Hydrostatic Level Sensor and the 3-2750-3 pH/ORP electronics. A final component of the system, the 3-8900 Multi-Parameter Controller, monitors the pH, temperature and level sensors and provides visual indication and automatic adjustment to ensure proper levels of each.

The pH sensor, temperature sensor and level control sensor were installed in the holding tank of the primary nickel sulfamate plating line. In this system, the solution is pumped from the holding tank

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Holding tank.

through filters to all of the plating cells, and circulated back to the holding tank. Under normal circumstances, the pH of the bath rises over time with use and must be corrected. This rise is due to chemical reactions caused by the plating process, as well as the introduction of deionized water through replenishment and rinsing. As pH levels rise, chemical additions are made to compensate. The pH is measured using the temperature compensation probe (the 2724) at Phoenix's desired bath temperature of 130°F (54.5°C). The acceptable pH range was set at approximately 3.8 to 4.2, which is considered to be the level most suited to the deposition of sulfamate nickel.

3-2250 hydrostatic level sensor.

Temperature can also be used as an effective tool in controlling the internal stress of plated nickel. The 3-2350 Temperature Sensor controls two individual heaters to maintain the plating bath temperature. The 9-kW primary heater is controlled by a single mechanical relay that is programmed with a high set point to deactivate the tanks heater when the temperature increases above the desired temperature of 130°F (54.5°C). A second mechanical relay is programmed with a low set point to activate the backup 12-kW heater during cold periods when the 9-kW heater cannot maintain proper temperature by itself.

To maintain the holding tank's solution level at 15 in. (38 cm), the 3-2250 Hydrostatic Level Sensor with upper and lower level set points is used in conjunction with a solenoid valve and mechanical float valve. These devices work together to maintain the solution level, and therefore concentration, as water evaporation occurs. The level sensor actuates the solenoid valve, which in turn allows deionized water to flow to the float valve, maintaining the specified solution level. The upper level set point on the sensor prevents overfilling of the tank while the low level set point shuts down the circulation pump and heaters in the event of a low level situation.

After three months with the automated system in place, results have been extremely positive "By installing the GF sensors, we can now check the pH and temperature at a glance, both initially and after correction," explains Barnes. "Verification with a handheld meter has been reduced to once per week, significantly reducing the amount of time spent on pH monitoring and correcting, and generally simplifying our overall operation."

With this success, the company now has plans for adding additional automation instrumentation. According to Barnes, "we will be installing a monitor for our deionized water system that will replace the existing resistance indicator lights and water usage meter. We are also interested in the unit to experiment with monitoring our precious metal baths for metal content." ***P&SF***

2724 (Left) and 2350 (Right) sensors.

Electroformed products.