Charlotte Plating Facility Conquers Zero Discharge Challenge

With more than 25 years' experience in providing high-quality products and services to the food processing, military, aircraft and mass transportation industries, Amplate, Inc. of Charlotte, NC, found itself faced with a challenge. Regulations concerning wastewater disposal requirements had changed dramatically, and Amplate needed to become a non-disposal facility practically overnight—or go out of business. The company's new owners faced this challenge head-on, researching alternatives and implementing changes that would ultimately convert the plant to zero discharge ... within a month's time.

Amplate, Inc. is a MIL-Spec house that offers heat-chemical coating processes such as:

- Black oxide
- Chromate conversion
- Passivation
- Electroless nickel

The shop also provides electroplating of cadmium, including cadmium and nickel combinations, nickel (both bright and sulfamate types), and industrial hard chromium, as well as decorative chromium and zinc.

Although the company specializes in rack plating, it also has the ability to handle barrel work on a small scale. Because of the success surrounding its conversion to a zero-discharge facility, Amplate has been building and engineering waste treatment systems for a variety of other businesses for the past three years.

Wastewater Issues Prompted Zero-discharge Effort

According to David French, president, when he and David Overcash, vice president, purchased Amplate in 1989, waste treatment was fairly simple. "Rinsewater coming from the plating process was pH-adjusted, allowed to settle, and filtered through a vacuum filter table," said French. The filtrate was then stored in a large holding tank and hauled to the local POTW. "In early January 1990," French continued, "we were informed by our POTW that we could no longer haul wastewater unless we submitted extensive analytical information on each batch, and then waited several weeks for approval."

Because the company was hauling water at least once a week, complying with this requirement would have been impossible. "We were being put out of business," said French, "because we were unable to connect to the sewer."

The only option available at that point was to find a way to recycle and become a closed-loop facility. Because they had been in business only a short time, the prospects for continuing in business seemed very slim—time was *not* on their side. The city would not allow another drop of water to be hauled ... and the shop was using a couple of hundred gallons of water daily. When the facility's holding capacity was within two days of being "maxed out," French and Overcash began shutting down processes and telling their customers to look for other vendors.

A Glimmer of Hope

While looking through a trade magazine, David Overcash saw an advertisement for an atmospheric evaporator. He remembered seeing one of those in their shop—disconnected and buried under years of dust. The unit was recovered, cleaned up and put into service, and Amplate began to evaporate water. Within two weeks, the shop was able to stay ahead of its water usage. They were back in business! There was, however, one serious drawback. "We were only able to plate as fast as we could evaporate," said French.

Efficiency Efforts Result in Creative Recycling

The company began to experiment with ways to recycle water, searching for a systematic approach to reducing and reusing water in the plant. It was obvious that if water could be used more than once, it would be extremely beneficial.

Wayne Billings, plant manager, noted that if the same water could be used twice, or even three times, the plant could effectively double or triple its waste treatment capacity. "Waste treatment needs," Billings said, "were going to be in direct proportion to the amount of recycling we could accomplish."

The company examined all avenues available—microfiltration, ultrafiltration, ion exchange, reverse osmosis and every other technology conceivable. Each appeared to have advantages over what was currently being done at the plant, but—without exception—they all worked on the premise of using the water only once, then discharging. In addition, none of these systems was affordable to a company the size of Amplate. There had to be another way.

Small Changes Can Make a Big Difference

The company began to question everything: Its chemistry, rinsing methods, work flow ... even the chemicals used to adjust the pH in the waste treatment were examined for possible alternatives. Water conservation and recycling would be the key to continued growth—and it was becoming obvious that even small changes could have far-reaching effects. The ultimate goal of zero discharge involved implementing several different methods of water conservation.

Counter-current Rinsing & Ion Exchange System

Although there are a number of fairly easy ways to remove metals from rinsewater, most methods require adding chemicals to the water. If the water is to be reused, it makes sense that the addition of chemicals would have negative effects. The company therefore chose to use ion exchange to clean up and recycle its metals rinsewater.

This method employs counter-current rinsing and a closed-loop ion exchange system to purify the water. After being overflowed into a side tank, the water is pumped through a pre-filter and then a cation column to remove the metals, followed by an anion column for further purification before finally being returned to the first cascading rinse tank for re-use. Once the ion exchange columns are exhausted, they are shipped off-site for regeneration, allowing the company to avoid any problems created by the regenerate.

Alkaline & Acid Bath Rinsewater Treatment & Reuse

The real key to Amplate's waste treatment system is the company's electrocoagulation unit.* The system recycles rinsewater from the cleaner section and the acid pickle sections of the plating line. This unit has the ability to precipitate soluble contaminants from the rinsewater—with limited use of chemicals—through an ionic generator that uses ultraviolet light and a small rectifier. The UV light adds oxygen to the water stream, which then passes two probes that are powered by the rectifier. The floc starts to build on the probes, which reverse polarity every few minutes. When the polarity reverses, the accumulated floc is released, to be captured downstream by a conventional filter. The only drawback to this system, says French, is that total cleanup of the water cannot be accomplished in one single pass through the ion column. The company therefore uses a batch treatment approach to apply this technology.

The final cleanup of the rinsewater is accomplished by passing the water through an activated carbon filter to remove any organic present. The water is then sent to a holding tank prior to being pumped back to the plating line.

Bath-life Extension

An intregal part of any waste-treatment system is bath-life extension. By doubling the life of a bath, therefore, waste treatment needs are cut in half. The most dramatic example of bath-life extension on the plating line has been with the shop's alkaline cleaners. By applying three basic principles—proper selection of chemicals, in-tank filtration to remove insoluble contaminants, and treatment of other contaminants (such as trivalent chromium)—the cleaner bath life has been effectively extended from three months to more than 18 months before waste treatment is required.

Another example comes from the acid pickles, where a coagulant is being used that effectively removes metal contamination without the usual pH adjustment. By treating the acid tanks every six to eight weeks, the facility has not needed to dump an acid tank in more than three years.

Alternatives to Cr Electroplating

The company recommends to its customers that they consider using electroless nickel (EN) as a possible replacement for hard chromium. Most of the customers have embraced this coating as a good, and even sometimes superior, alternative to hard chromium, because EN plates evenly and accurately without the use of auxiliary anodes. It is also superior in corrosion resistance and flexibility, and the thickness accuracy of the coating eliminates any need for machining after plating.

No coating is perfect, however, and EN has two main drawbacks:

- EN cannot be easily applied in thicknesses over .0025 in.
- EN is somewhat inferior in cases of extreme abrasion resistance, because it cannot be hardened above 64 Rockwell on the "C" scale.

A large company in South Carolina approched Amplate for help with its hard chromium line. The company purchases numerous die plates and fixtures each month (in 91 different configurations), and was plating with .0001–.0002 in. of thin, dense chromium. The shop was experiencing severe problems with turnaround, special fixtures, auxiliary anode requirements, light corrosion, and consistency of appearance.

After two months of testing, their entire product line was converted to .00045–.00055 in. EN. The company reports that the change has resulted in a greatly improved product and a cost reduction of just over nine percent.

In 1995, Amplate, Inc. was presented with the Governor's Award of Excellence by the state of North Carolina:

"For outstanding achievement in waste reduction Small Business Category"

The plaque is signed by Governor James B. Hunt, Jr., and Jonathan B. Howes, secretary, North Carolina Department of Environment, Health and Natural Resources (DEHNR).

In addition, the company's success story has been documented in a video produced by the DEHNR's Office of Waste Reduction.

Bottom Line: Recycling Results in Savings

Amplate's waste treatment program has increased its business volume more than five-fold, and has cut actual waste disposal and its associated costs in the following ways:

- Water disposal has been reduced from 63,000+ gal to zero
- TCE usage has dropped from 14,000+ lb/yr to < 2,600 lb/yr
- F006 yearly shipments have changed from 13,500 lb landfilled to 6,500 lb recycled
- Acid purchase is now < 15 percent of what had been required to run the facility

Although it is difficult, French admits, to put a dollar figure on the "total" savings the company now realizes, he notes that in the area of F006 disposal alone, Amplate's costs have dropped more than 90 percent. Now *that's* an impressive figure. **P&SF**

** PASCO, Hillsborough, NC*