The Impact of Carbamate on Heavy-Metal Reduction

by James Martin

A new approach to treatment proves successful for a Midwestern PCB fabricator.

As a PCB fabrication facility, Circuit Center Inc. (Dayton, OH) is subject to the federal EPA guidelines for all metal finishers. These guidelines are designed primarily for discharge of neutralized waste streams low in heavy metals. The primary metals used in our industry are copper, both electroless and electrolytic, and lead from tin-lead solder plating. Another major source of copper is proprietary ammonia etchant that dissolves away the unnecessary copper from the circuit board laminate.

Because copper plating is the backbone of our industry, discharge limits for this metal have a critical impact. Our industry must also compete in a national and international marketplace where differences in discharge limits can create an important economic advantage for the competition. It is evident that our industry must not only strive to do its environmental duty, but must overcome the differences in discharge limits throughout the country.

When CCI built its new facility in 1983, the newest EPA regulations were scheduled to become effective in 1984. The management of CCI decided to do what it could to minimize the facility's environmental impact. They decided to make the shop solvent-free and hired a supplier to install a waste treatment system. However, when CCI began operations in 1984, it was immediately apparent that some major problems would come up with compliance.

The Federal Categorical Limits stipulated a discharge limit of 4.5 parts per million (ppm) copper and 3.6 ppm lead. These limits posed no real problems for the system; however, local limits became effective in 1986, and these limits of 1.45 ppm copper and 0.36 ppm lead were impossible to meet consistently.

To determine the extent of the problems and arrive at the most effective solution, CCI worked with the local sewer district throughout 1987. It became clear that the original engineering concept and system provided to CCI were inappropriate for the production of circuit boards in a quick-turn prototype shop. The holding pits were severely undersized and to prevent flooding a 25-gpm (gallons per minute) system would have to be operated at 50 to 60 gpm. This increased hydraulic loading resulted in incomplete reaction time and sludge carryover in the clarifier.

At this time, it was discovered that the two largest water streams from the dry-film operations could contain 1.0 to 1.5 ppm copper. These streams were discharged safely at the federal limits but would have to be pretreated to meet the more stringent local limits. Since the holding capacity and treatment system were already overloaded, the addition of 70% more water would pose an insurmountable problem.

The local officials in Montgomery County, OH, were patient and extremely helpful. (After all, they had no desire to close down a portion of their tax base.) However, they had to eventually put CCI on a compliance schedule to ensure discharge compliance. The facility was at a juncture critical for its survival. The building had been constructed around the existing treatment system, so expansion or an increase in equipment was impossible. There was just nowhere to g o .

At this time it was determined that if the system could not be increased, the only alternative was to evaluate how the waste was being treated. If the major problem was sludge carryover, was there any possibility y of reducing the amount of sludge that was being created?

The existing method of pretreatment was to add ferrous sulfate to the acidified stream to remove the chelated copper, and then to neutralize and add aluminum sulfate to help settle the unchelated metals. In effect, CCI was adding 100 lbs. of solids to remove 2 lbs. of metal loading per day. Dubois Chemicals (Cincinnati, OH) was contacted in the hope that if chemistry was the origin of the problem, perhaps a chemical company could solve the problems equipment could not.

Dubois personnel suggested CCI test a product they were developing based on a carbamate completing reaction. the initial trial had appeared promising; however, the daily cost of oversaturation was prohibitive. When CCI was issued its compliance schedule in 1988, the company again contacted Dubois, hoping to meet the schedule through improvement of the carbamate reaction.

To improve the reaction, CCI add-

ed more vessels to the system. The chemical reaction was improved and the polymer was becoming cost-effective. The additional reaction time made any oversaturation unnecessary, and CCI was able to treat 40,000 gallons of water with one quart of polymer rather than 150 lbs. of solids. There still remained the problem of sludge upsets when hydraulic loading increased.

A novel method of reusing this sludge has almost eliminated this problem. By pulling sludge from the clarifier and reintroducing it into the waste stream, CCI has been able to react the polymer completely, the sludge acting as a magnet to draw lighter solids to it. Now, the facility's sludge can reach a density at which it can still settle at a flow rate of 50 to 60 gpm, thereby allowing for better flood control in the holding pits.

The ultimate success of any treatment system can only be judged on the basis of the bottom line. In the past two years, CCI has remained in compliance with the more stringent limits and at times has approached zero discharge. Sludge volume has been reduced, and metal content has been increased from 0.5 to 15% by weight. CCI's recycling company is very pleased with the results.

As opposed to 15 metric tons, they are receiving one metric ton per year at a dramatically increased metal loading. CCI's daily operating costs have dropped and operator maintenance is almost negligible. CCI has certainly benefited from a novel waste treatment method. This method has included heroical breakthrough as well as a new concept for environmental pro tection.

Industry, suppliers, and local environmental agencies must all establish the same goals and fully cooperate to achieve them. The EPA must understand that as it lowers limits finding the technology to achieve compliance becomes very difficult. Daily compliante at these low limits leaves no margin for error; to be truly effective the techno logy must prove itself in the long run. However, if EPA officials remain cooperative, industry and its suppliers can develop the techniques which will make the concept of zero discharge reality. ■

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