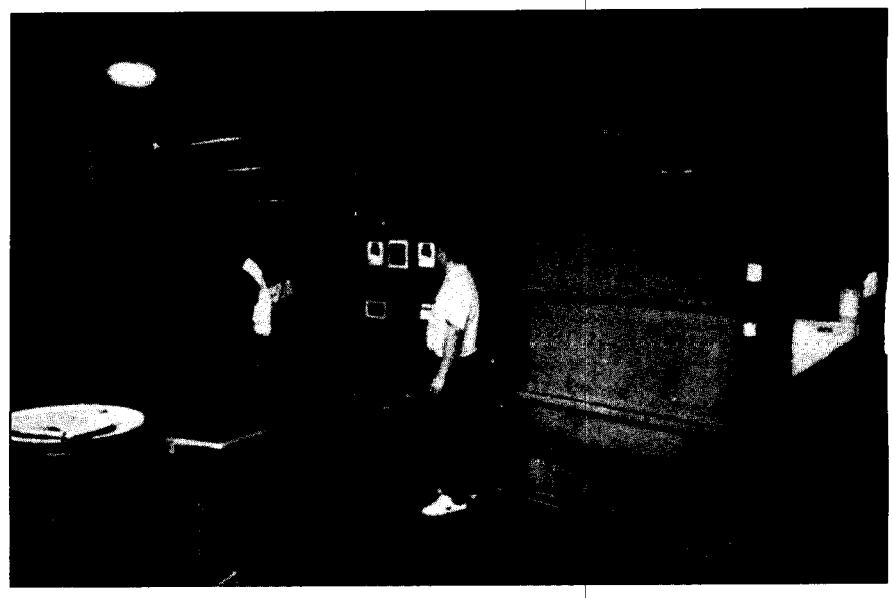
Waste Treatment overview

by Jerry Murray, West Coast Editor

...and water recycling.

Some of the water from Cleopatra's bath is running around in your plant. Nature has purified it several times and distributed it very widely in the 2,000 years since Cleo died. These days we can't afford to wait that long for good water. Our industry has got to have control of its lifeblood.

Enough technology is already in place for us to gain this control, but it takes investment to accomplish the twofold task of extracting our wastes and reusing our water. Although payback for the investment can be measured in dollars, the true payback is becoming simple survival (Figure 1). Some shops are frantically trying to catch up in the race for survival, while others are improving on the start they got years ago.



A combination of inclined plate clarification, filtration, and ultrafiltration treats segregated streams bearing organics and other wastes from hot-air leveling and board-washing operations at Solder Station #1 (Anaheim, CA). A full-time operator is needed to run the system designed by Paul Torres, at left, a former Orange County Sanitation District employee.

AERO DDL

Way back in 1988, Aero DDL (Anaheim, CA) was paying to have a lot of sludge hauled to sites over which it had little control, and recycling essentially zero percent of its water. In charge of the company's facilities, Mark Kowalski worked with Toxic Recovery Systems International (Ontario, Canada) to design a system that, with many variations, by now has become an industry standard. In short, rinses are made more efficient, wastewaters are segregated, IX (ion exchange) and electrowinning technologies are used to purify process water and convert dissolved copper to its metallic form, and city water only replenishes losses. The system at Aero looked so good on paper that Orange County helped fund the project to show other plants what could be done. The system has worked so well in practice that Aero's disposable wastes have been reduced by 90%, the final 10% of its wastes are recyclable, and 70'% of its water loops back through the system to make more circuit boards.

"We are constantly working out ways to wring out a few more drops, which we do as it becomes economically warranted. With what we've learned, and with three chemical engineers now on our environmental staff, we'll eventually recycle 95% of our water," Kowalski said.

HERCO TECHNOLOGY

In 1990, before breaking ground for its new PCB plant, Herco Technology Co p. (San Diego, CA) set a water recycling goal of 85%. Working with Memtek (Billerica, MA) and using IX with a technology that an employee from the County Water Authority once described as "wasteful," Herco is reaching that goal. The technology in question, RO (reverse osmosis), was referred to as wasteful by the conventionally thinking water expert because an RO system is conventionally used to separate city water into two streams of about the same volume. The permeate, which is 95% or more pure, can be used for process water or as IX feedwater. The reject stream, containing 95% or more of the hard water salts, is sent down the drain as waste. But at Herco, city

water is purified in IX columns, and the regeneration solutions from these columns feed one of the company's RO units. These concentrated solutions are separated into a small, extremely concentrated brine stream, which goes down the drain, and a permeate stream pure enough to he used as either process water or as IX feed stock,

This unusual application of a standard water technology exemplifies the water- and waste-saving opportunities present in every plant. There is, of course, much more to Herco's water treatment technology than RO and IX. Additional IX and electrowinning are in place, countercurrent rinses are used, plating racks maximize panel drainage, and photoelectric cells shut down etchant and rinse *flows* each time a board passes.

The importance of every waste-saving possibility was first made clear to Charles Herring, Herco's chief engineer, as the plant was being designed, Over and over, visiting municipal water authorities stressed recycling. They discussed looping treated waste streams back through the plant. Some water experts stressed mass balance, the simple concept that everything entering a plant must, in one form or another, eventually leave the plant. The help of these experts was combined with the Herring family's vast PCB experience to maximize conservation and optimize savings. Now, even in the midst of the California drought, Herco finds itself able to cope with diminishing water supplies.

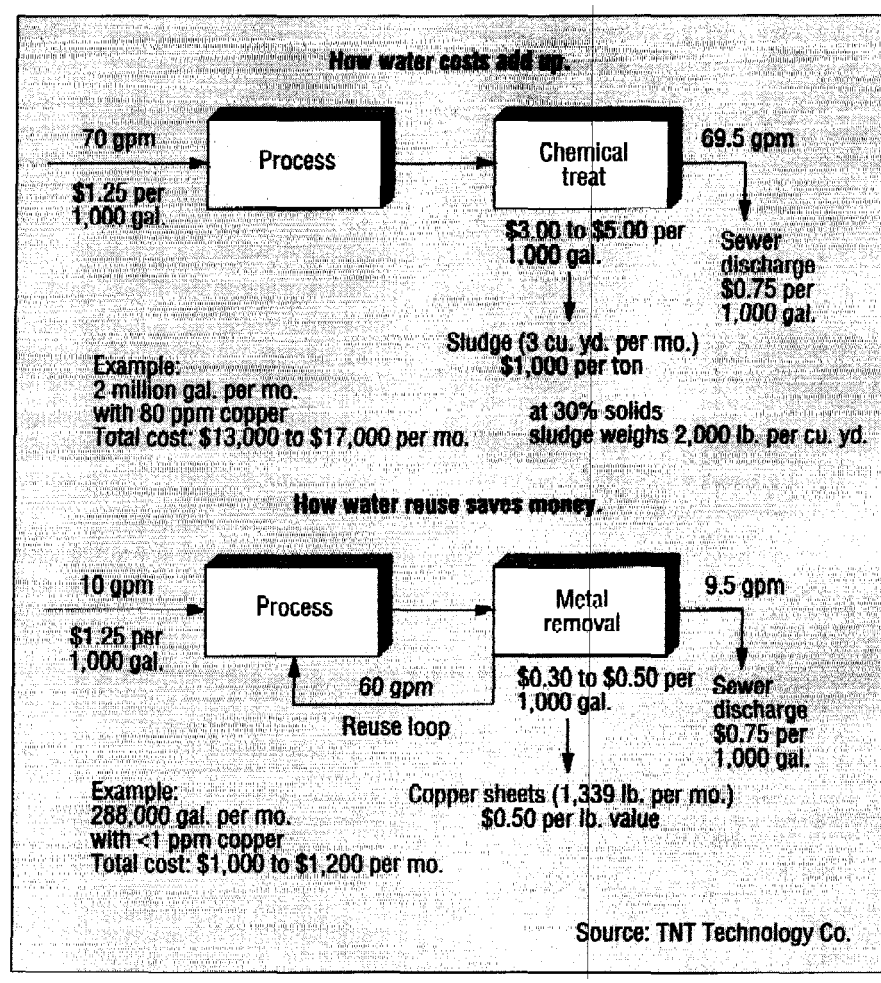


Figure 1. *How water reuse* **saves** *money.*

ACTION CIRCUITS

After 25 years in the PCB business, a gradual awareness **of** conservation and waste management has become a full commitment for Action Circuits (Danbury, CT) president Randy Kline. A local consultant as well as excellent cooperation from suppliers (like MacDermid and Napco) and from the state of Connecticut have enabled Kline and his 50 employees to approach their goal of 90/90% reductions in water consumption and waste generation.

Six Action employees work on conservation and waste management either full- or part-time, and much of the company's conservation equipment has come from within, Using discarded rectifiers am-l stainless steel lamination plates, Action's maintenance crew constructed an effective electrowinning system that only cost the company $1,500. Twelve countercurrent rinse chambers were built on the company's ammoniacal etcher. Following further in-house modifications, what was once the company's largest water consumer and sludge producer now generates just 40 gallons of waste per day, which MacDermid picks up for recycling. Noting Action Circuits' progress, the state of Connecticut helped out with a $5,000 grant. As Kline works toward the 90/90% goal, an additional $50,000 may be provided by federal agencies.

Like Aero DDL, Action relied in the past on sludge generation, filtration, and hauling. "First we reduced water consumption, then waste, then reclaimed all we could into something productive" said Kline. "We'll never be completely out of sludge generation, but we're thinking about making building materials-bricks out of

what little sludge remains. It all used to be pie in the sky, but now we believe strict conservation is not only practical but as necessary as a plant's utilities. And as we've proven, there are practical, easy answers for a limited amount of money."

At the start of the project, Kline brought in a local waste treatment consulting firm, IPC, to conduct a thorough plant survey. This initial survey has been followed by monthly surveys and meetings in which new technologies may be suggested by IPC. In the interest of objectivity, however, no equipment is purchased from Action's consultant. Napco provided the IX columns and resins most suitable for Action's needs, and MacDermid continues to contribute more than Kline ever expected.

HELP FROM MACDERMID

MacDermid (Waterbury, CT), a neighbor as well as a supplier, had just committed itself to a full environmental program when Action began its new 90/90% project. MacDermid's president and board chairman visited Action Circuits often, questioned how MacDermid could help, and offered the services of electronics product manager Cynthia Retallick. She provided analytical resources, worked closely with state authorities and with Action's consultant, and got an inside look at problems common to all PCB shops. Some benefits gained by MacDermid—and by their customers—have been a peroxide sulfuric microetch regeneration system, the Piranha unit that eats up bad copper ions, and the emergence of Retallick as an authority on national environmental compliance issues.

"Environmental assistance is a service-intensive operation," said Retallick. "Conflicting state laws complicate matters. All of our salespeople have to know the environmental laws in their area, and all of our customers' operations are unique. Each plant has its own philosophies about quantity and purity of rinse water, and to further complicate matters, a city can change the source of its water without notifying its users." Retallick and others feel the country's environmental laws will be standardized by 2000.

SUPPLIERS DO THEIR PART

All suppliers of PCB chemistries are helping their customers meet local regulations and do so economically. Enthone-OMI (New Haven, CT) has an environmental staff for internal and customer use. The company will pick up and recycle its customers' Enstrip solutions, and it has developed OSCER (on-site copper and EDTA reclamation) for use in treating electroless copper baths. OSCER may be of particular benefit in Europe, where EDTA has lately been seen as a hazard—metals complexed with the chelating agent have been found in fish. Olin Corp. (West Paterson, NJ) offers its Black Hole process to help eliminate the industry's reliance on EDTA-bearing electroless copper baths.

Shipley's (Newton, MA) emerging Crimson process may also obviate problems with EDTA, as it provides an alternate chemistry for direct plating PTH technology. Shipley's Eagle process is said to be developing to a point where no water rinsing is needed. LeaRonal (Freeport, NY) formulates nonpolluting chemistries, such as its fluoroborate-free solder plating solutions. But as Shipley's Marty Harris points out, chemical suppliers can't take all the chemistry out of their wares. For example, because of its uniformly flat deposits, the company's Solderposit is in great demand by SMT PCB assemblers, who do not really care that the process generates lead sludge in the fabrication shop. Shipley's compromise solution is to do all it can to extend the life of the bath. Dynachem (Tustin, CA) gives its customers the advice needed to minimize their products' wastes. It also offers RS-1230, RS-12131, and RS-1232 chemistries for aqueous and semi-aqueous primary imaging dry film and older mask treatment with Dynachem's Advantage 2000.

NEW IDE S EMERGING

Many lever environmental aids are being developed. FSL (Finishing Services Ltd., Irvine, TX), a U.K-based firm, gained success in this country with a new electrolytic method for regenerating cupric chloride. Now, wit equal ingenuity and waste treatment in mind from the start, FSL has developed what appears to be a better method for stripping resists. The conventional resist stripper, bearing additives like chelating alkanolamines and glycol ethers, is replaced with a hot potassium hydroxide solution. When used in an FSL-designed machine, the new method strips resists more controllably, in larger flakes that are easier to filter from the environmentally safer solution. FSL's high-temperature stripping method has received rapid and widespread U.S. acceptance.

An older technology, first used in the steel industry and recently adapted for PCB makers, is also finding acceptance. Although the IX resins used in the Reconflo system by Eco-Tec (Toronto, Canada) are specific for metal ions, it is the system's mechanic 1 aspects that provide the ability to reach lower levels of effluent copper while using half the regenerant normally needed. All IX resins swell when taking on metal ions, but since only about 15 to 20% of normal resin volume is used in an Eco-Tec system, swelling and attendant fracture of resin beads is minimized. Top and bottom screens hold the resin in place so more efficient countercurrent regeneration can be performed

without fluidizing the bed and causing further destruction of the resins.

With this small, contained resin volume, automatic regeneration takes place in two minutes rather than several hours, so the Reconflo system needs no backup column. The system is working well at Hewlett Packard's Boise, ID, plant, and Du Pent (Wilmington, DE) is distributing Reconflo to the electronics industry. Du Pent, in an environmentally responsible position throughout the world, also offers its Ecopact and Eco-Sep recovery and recycling program for Riston and Vacrel resists, and its Silver Manager Program for recycling fixer and film waste.

SUMMARY

Time was when a circuit board shop took care of its wastes with a clarifier, a filter press, and a person in dirty coveralls with a shovel. That person has been replaced by a couple of chemical engineers with a computer and a marvelous array of catalogs from which to choose additional plant equipment. Waste management experts, chemistry suppliers, and water recycling consultants are eager to help. From Las Cruces, NM, Bio-Recovery Systems covers the entire country although TNT Technology is based in Tempe, AZ, the company recently designed and built a waste treatment plant for a PCB shop in China; and every telephone book now lists local consultants.

New water technologies are coming out of the woodwork and old ones are being spruced up. Advanced Recovery Systems (Baldwin Park, CA) offers liquid ion exchange. Ionpure Technology Corp. (Lowell, MA) has an electrodeionization process that operates in conjunction with membranes and electric current. Updated versions of electrodialysis are now being used by semiconductor engineers and designers.

A new and complex industry has intruded upon the already complex PCB industry. It comes with legal complications, additional costs, new nomenclature, and constantly changing requirements, and it is altogether as fascinating gas the thought of drinking 2,000- ear-old water. Like it or not, you'd get get involved because your company's survival depends on responsible waste treatment and water recycling. ■