Progress and Profits

How far have board shops come,

Victoria R. Allies

aste minimization has been driven by 1960s weren't enforced until the 1980s when fines and fees rose and costs became the driver for reductions in sludge generation and water use. The second, more subtle economic driver has been competitive advantage; research has revealed that environmental compliance costs comprise 3 to 12% of PCB manufacturer's gross revenues. Aggressive waste reduction can turn that burden into a competitive pricing advantage.

The stricter discharge limits of the mid-1980s resulted in the replacement of clarifiers by microfiltration in sludge separation systems. As local, state, and federal rules continued to evolve into the 1990s, the PCB industry became frustrated trying to keep pace with the cost of compliance as well as the regulations and the varying interpretations of such. Public disclosure through Community Right-to-Know policies spurred the rush to seriously consider new technologies and to eliminate environmental hazards. Now, business owners and managers get a wake-up call each time the media responds from its frequently antibusiness standpoint to any environmental event. It's been tiresome and it's been scary. But it's changing,

Changing Times

Fortunately, the U.S. EPA got a wake-up call, too. Its "command and control" approach had been effective in reducing pollution, forcing installation of control technology, and protecting human health and ecosystems. These gains, however, came at a cost of about \$1 trillion over the past 20 years. With current pollution control costs estimated at 2% of the U.S. GNP, or \$115 billion annually, the regulators realized the old approach was ineffective in achieving the goal of managing pollution without destroying the polluters. As a result, there has been a trend toward state grants to aid corporate pollution prevention programs and approaches such as design for the environment and the EPA's 33/50 Program. 10 the latter program, manufacturers are voluntarily reducing the environmental release of 17 pollutants on the EPA's Toxics Release Inventory list.

Manufacturers and regulators alike are more realistically weighing the costs/benefits of investing in waste reduction technology. Key elements in these analyses are, "How much [quantity], how bad [toxicity] and what does/will it cost?. "These elements are shown in Figure 1 and Table 1. The bottom line is that board shops must determine the best way to stop handling, generating, and shipping hazardous wastes, while at the same time avoiding costly violations. The twist is that, rather than cash-in-fist, environmental payback may be an insurance policy that the "owner" hopes won't be needed. The cost of public notoriety over a major spill is incalcuable and that's before the lawyers get involved.

How Much Progress?

How can a board shop get ahead of the regulatory game instead of working from behind the ecological 8ball ? How far have some PCB facilities come in reducing



Figure I: Comparison of aggregate wastes generated *before and* after investment *in new* copper solder plating lines

in Waste Reduction

and what's on the horizon?

their hazardous wastes, and what challenges remain? Is it crazy to invest in waste minimization during an economic slump as some manufacturers have done? Here are some case histories that answer some of these questions.

Photocircuits, Glen Cove, NY and Atlanta, GA

Through proactive efforts begun in 1988, this company is now recycling 99% of its wastes. A carbon absorption system that recovers 200,000 gal./year of methylene **chloride** has yielded a one-year ROI. A 1992 panel plate rack design saves \$80,000 annually by eliminating nitric acid rack strip and disposal costs. A sludge dryer purchased in 1993 reduces volume and disposal costs by \$150,000 annually. A screen wash recycle project reuses 500 gal./week of a \$15/gal. solvent. With a two-year ROI, a near-zero-discharge

Table 1. Environmental cost considerations.

Direct: Capital investment and depreciation operation and maintenance	
	Direct labor (operator and environmental staff)
	Maintenance materials and labor
	Materials, chemicals, and supplies
	Services provided by contractors (on site)
	External services provided by POTW,
	hazardous waste disposer
	Fuel and power consumption
	Special studies
	Laboratory support (in house and/or contracted)
	Cost recovery from recycling
Indirect:	Administrative
	Regulatory compliance
	Permitting and record keeping
	Installation and training
	Insurance and taxes
Potential liabilities: Penalties, fines, cleanup costs	
	personal injury/damage claims, PRP
Less tangible:	Public image

plating line in Atlanta recycles 90% of its process water and recovers metallic copper, while meeting a copper discharge limit of less than 0.19 ppm.

An ancillary benefit is the company's recognition by state and federal EPA agencies as a responsible and trustworthy manufacturer. The real impact, however, is that Photocircuits' waste treatment department is becoming a Resource Recovery Profit Center as environmental compliance costs have **been reduced from 3.5%** of gross sales in 1986 to 1.570 in 1993. The projected rate for 1997 is less than 0.1%.

Continental Circuits Corp., Phoenix, AZ

Continental got serious about waste minimization in the mid-1980s. Since then, capital expenditures for environmental equipment have risen from \$1.5 to \$5 million and annual parts and labor expenditures from

> \$500,000 to \$2 million. Has it paid off? A 1991 investment of \$44,000 in ionexchange and electrowinning equipment for copper rinses saves the company roughly \$25,000 per year.

> A grant from the Arizona Department of Environmental Quality (Phoenix. AZ) has helped Continental implement a precipitation and ion exchange system for treating spent stripper and rinses.

> Continental is using alternate chemical reducing agents, recycling scrap PCBs, and segregating declassified hazardous wastes. Over the next three years, new opportunities in over 20 shop areas will focus on production and treatment technologies. One example is a direct plating system, which will eliminate formaldehyde and EDTA copper complexes. Other technologies include advanced electrowinning, spent cupric chloride treatment/regeneration systems, and air emission control

Standards for Environmentally Conscious Manufacturing

John W. Lot:

ssues addressed at the Fall IPC ssession on Environmentally Conscious Manufacturing in the 8 industry included global/national environmental standards and the German, Japanese, and U.S. governmental R&D efforts encouraging "green" manufacturing. Standards discussions were timely because the American National Standards Institute (ANSI) is currently helping U.S. industry determine its position on the new ISO standard, TC-207, that adresses environmental concerns.

The five-part standard covers Environmental Management Systems (EMS), Environmental Audits, Labeling, Life Cycle Analysis, and Environmental Performance Evaluation. Several countries now have EMS versions encompassing policy development, commitment, environmental performance reviews, and a register of applicable legislative and regulatory requirements. While EMS implementation will require audits' standards to ensure regulatory compliance and commitment to continued environmental improvement, questions remain regarding auditing methods.

The labeling standard will deal with a number of existing standards and systems. Three types of labels now exist: Seals, such as Germany's Blue Angel, which indicate a product has passed a host country's environmental criteria; *attributes*, such as "contains 50% recycled material"; and *scorecard*, a list of resources used, energy and water consumed, and waste produced. With several labeling issues still awaiting resolution, the Federal Trade Commission is issuing guidelines and requiring substantiation of product environmental claims. Labeling complex products such as computer and automobiles with many subsystems will require significant flexibility in the standards.

As these issues are resolved and standards rewarding green manufacturing are established, it is the duty of the PCB industry to help guide the standards' formulation and prepare to meet the new ISO and national standards.

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equipment to mee **Arizona's new** air pollution regulations.

Hughes Aircraft, Tucson, AZ

Hughes established a corporate electroplating waste abatement program in 1989. The program includes meeting-s in which environmental and process people share ideas, needs, and data, and prioritize projects. The Tucson plant's industrial water-recycling system handles rinse discharges from PCB, electroplating, and other operations within the 2.5-million-sq.-ft. facility. Approximately 100 million gal./year of water are recycled through a system that includes ultrafiltration, reverse osmosis, and electrodialysis. A new brine concentrator and spray dryer convert wastewater discharges into disposable solids and additional recyclable water. New technology under investigation includes the application of an existing UV-peroxide system for degrading monoethanolamine from spent dry-film stripper solutions. The system is now being used to destruct a fluorescent dye penetrant.

What's in the Future?

The PCB industry's destiny is certain to include more investment in cost-reducing pollution prevention technology, proactive involvement in local/federal regulatory activities, *and a* more widespread adoption of total environmental quality management (TEQM). A TEQMbawd project is-developing in Albuquerque, NM, where Quatro has assembled a public-private partnership with the goal of cl-eating an environmentally friendly PCB manufacturing demonstration factory. The project brings together customers, vendors, federal and state agencies, and laboratories, all with the common objective of showing that systems and technology can exist that merge productivity with the lowest achievable cost of compliance.

Meeting environmental regulations boils down to economics. Proactive involvement helps. How do you become proactive? By implementing next-generation programs and strategies now. Put environmental management into your overall business plans. Make it an integral part of how you do business. And, most important of all, practice what you preach! Employees and neighbors want your environmental programs to succeed and are anxious to help.

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