4.4.1 Electronics Manufacturing: Printed Circuits Boards

Case Study #1

BUSINESS: **Electrotek; Oak Creek, Wisconsin**
WASTE ORIGIN: **Printed Circuit Board Production**
WASTE TYPES: Acidic Lead and Copper Solutions and Toxic Organic Solvents (Methylene Chloride; 1,1,1-Trichloroethane)

COMPANY BACKGROUND

Electrotek is a 140-employee company which manufactures single-sided, double-sided, and multi-layered printed circuit boards.

MOTIVATION

Minimize toxic waste discharges to air and water. Identify toxic pollutants and assess new, cleaner technologies.

STRATEGIES

Work with other industries, government, and environmental groups. Assign a company safety and environmental manager to coordinate pollution prevention activities. Commit time, money**,** and expertise to implement innovative manufacturing technologies and pollution prevention strategies.

ORIGINAL PROCESS

Generated acidic lead and copper into the waste stream along with toxic organic solvents like methylene chloride and 1,1,1-Trichlorethane (TCA).

NEW PROCESS

Eliminated waste ionic lead by substituting a hot-air leveling process for an electrolytic tin/lead plating process. Worked with the Greater Milwaukee Toxics Minimization Task Force to identify toxic pollutants and assess new manufacturing technologies. Co-produced and featured in a training video showing Electrotek's solutions for eliminating acidic lead, copper, and toxic organic solvents from its waste stream. The company also became involved with the Southeast Wisconsin Toxics Reduction Project to help develop tools and strategies for promoting inter-agency and inter-industry working relationships to address environmental concerns.

RESULTS

Waste Reduction

Eliminated acidic lead, copper, and toxic organic solvents from manufacturing waste stream.

Economics (Information not available.)

HEALTH & SAFETY BENEFITS

Eliminating toxic chemicals from the waste stream increased worker health and reduced company pollution liability. Ethylene chloride is a suspected carcinogen, an eye and severe skin irritant, and is mildly toxic when inhaled. TCA is a skin irritant, moderately toxic if ingested or inhaled, and can cause cardiac arrest if massively inhaled.

TECHNOLOGY TRANSFER

Substituted a hot-air leveling process for a toxic waste-producing electrolytic tin/lead plating process.

PROBLEMS

Changing certain manufacturing specifications caused some customers to leave Electrotek.

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Case Study #2

BUSINESS: **Advanced Circuits, Inc. (ACI); Roseville, Minnesota**
WASTE ORIGIN: **Multilayer Printed Circuit Board Production**
WASTE TYPE: Excessive Water Consumption

COMPANY BACKGROUND

ACI's Roseville facility manufactures multilayer circuit boards for products such as pagers, cellular phones, and personal computers.

MOTIVATION

The City of Roseville increased sewer accessibility charges (SAC) from $800 per SAC unit (274 gallons per day) in 1991 to $850 per SAC unit in 1995. Also, 1995 costs to use and sewer the city water were $3.46 per 1,000 gallons. ACI's Roseville facility used approximately 470,000 gallons of water daily. ACI wanted to expand its operations, which would also significantly increase its water demand and costs.

STRATEGIES

Water conservation would reduce associated costs and ensure supply, and allow for future demands with the facility expansion. At the same time, conservation measures would prevent the possibility of exceeding the water volume available from the City of Roseville. ACI assessed how it used water by observing production processes and measuring or estimating water use and pressure. It also inspected tanks, enclosed cabinet chambers, pumps, pipes, spray nozzles, sumps and photosensors for operating deficiencies. Water flow rates and pressures for each process were recorded over a period of eight weeks to get quantitative averages. Process and equipment alternatives were researched to optimize water use.

ORIGINAL PROCESS

Circuit boards undergo numerous production steps which require water. Water is used in process chemical baths and for removing soils and residues from boards in both immersion baths and enclosed spray cabinets. Soils and residues include: pumice and alkaline cleaners; copper etchants; catalysts; plating solutions; sensitizers; and wet- and dry-film photoresists, solvents, developers, and strippers.

NEW PROCESS

Cleanliness standards for circuit boards at every process stage now determine minimum water demands. A lowest water flow rate was established on several parallel process lines that would not adversely affect circuit board quality. Additional flow gauges installed throughout the plant allow for easy measurement of flow rate reductions and for calculating water and cost savings. ACI also uses photosensors on its process lines to decrease the length of rinse times, using only necessary water. Similar photosensors are at work in spray-rinse chambers were they did not exist before. Plumbing is maintained and optimized for efficient water flow through the facility.

This maximizes rinsing capabilities of the water through improved process water movement and recirculation of rinse waters. ACI plans further use of water reuse and reduction systems in its facility expansion.

RESULTS

Waste Reduction

Water use reduced by 30,000 gallons/day (by October 1995), or 10,950,000 gallons/year. Future planned equipment optimization could reduce water use by another 22,000 gallons/day (for a future total reduction of 52,000 gallons/day, or 18,300,000 gallons/year).

Economics

Capital Costs: Approximately $8,000 in equipment and installation.

Operating/Maintenance Savings:

1995 water use savings: $38,000.

Estimated future annual water use savings: $63,000 per year.

Saved one-time sewer accessibility charge (by maintaining use at 1991 levels): $225,000.

Payback Period: Three months.

Source:

Water Conservation in Printed Circuit Board Manufacturing, Vol. 11, No. 1, Source Quarterly Newsletter, Minnesota Technical Assistance Program, University of Minnesota, Winter 1996.