

# **SECTION FOUR**

## **Small Business Waste Reduction Case Studies**

## **4.1.1 Agricultural Business: Food Processing**

### *Case Study #1*

**BUSINESS:** Hillshire Farm & Kahn's (HF&K); New London, Wisconsin  
**WASTE ORIGIN:** Meat Processing  
**WASTE TYPES:** Hazardous Waste and Volatile Organic Compound (VOC) Air Emissions, Freon 113, and Solvent-based Parts Washing Solution

#### **COMPANY BACKGROUND**

HF&K processes raw meat into meat products (e.g. sausage, bacon, ham, and lunch meats).

#### **MOTIVATION**

Reduce waste disposal costs, long-term disposal liability, and its regulatory burden.

#### **STRATEGIES**

Eliminate Freon and solvent-based solutions from operations.

#### **ORIGINAL PROCESS**

Freon 113 was used to dissolve the fat in meats in a diagnostic test to determine the fat/lean content of meats. A solvent-based parts washing solution was used in the maintenance area.

#### **NEW PROCESS**

HF&K invested in new infrared technology to determine the fat/lean content of meats. The company also purchased parts washing equipment with a filtration system and converted to a non-hazardous (citrene-based) cleaning solution for the equipment.

#### **RESULTS**

##### **Waste Reduction**

Eliminated Freon 113 from processing operations.

Eliminated use of solvent-based parts washing solutions in operations.

##### **Economics**

**Savings:** Information not available.

**Capital Cost:** Purchased infrared technology equipment and a parts washer.

##### **Operating/Maintenance Cost:**

\$1,000 per year for light bulb replacement in infrared equipment.

\$1,200 per year for non-hazardous cleaning solution and filters.

##### **Payback Period:**

Capital costs for the infrared technology were recovered in two years.

Costs for the parts washer were recovered in less than one year.

#### **HEALTH & SAFETY BENEFITS**

Worker safety was greatly improved since Freon 113 is mildly toxic by ingestion and inhalation, affects the human central nervous system, is a skin irritant, and is combustible when exposed to heat or flame.

**TECHNOLOGY TRANSFER**

The technologies applied at HF&K are commercially available and could be applied in similar situations.

**PROBLEMS**

These waste reduction efforts initially met employee resistance and presented challenges to maintain monitoring test quality and dependability.

## **4.1.1 Agricultural Business: Food Processing**

*Case Study #2*

**BUSINESS:** Frigo Cheese Corporation; Oconto, Falls, Wisconsin  
**WASTE ORIGIN:** Cheesemaking  
**WASTE TYPES:** Liquid By-products and Liquid Salt Whey

### **COMPANY BACKGROUND**

Cheese manufacturing is a biochemical process converting milk to curd to cheese. Whey is a liquid by-product drained from curd and often sold as a food grade additive. Salt is added to the curd to remove additional whey, but is often too salty for use.

### **MOTIVATION**

Landspreading of liquid salt whey increased levels of chlorides in soils and posed a slight risk of crop damage if applied incorrectly. The landspread also posed a logistical burden.

### **STRATEGIES**

Recover salt from the salt whey and reuse it in the production process.

### **ORIGINAL PROCESS**

Frigo Cheese landspread up to approximately 2,000 gallons/day of salt whey.

### **NEW PROCESS**

A salt recovery process modified an evaporator previously used to recover edible whey. This reduced the salt whey wasted by separating pumpable salt whey from water. Salt whey is reused in cheese production, while the recovered water is used for cleaning and other purposes that don't require potable water.

### **RESULTS**

#### **Waste Reduction**

Reduced salt whey production from 2,000 pounds/day to approximately 500 pounds/day.

Reduced salt use from 1,000 pounds/day to 500 to 600 pounds/day.

Recovered 400 to 500 pounds/day of salt whey.

#### **Economics**

**Capital Costs:** \$2,000 for process modification to equipment.

**Operating/Maintenance Cost:** Approximately 3 cents/pound of salt recovered.

**Payback Period:** Two months based on capital cost and annual salt savings of \$12,500.

### **PROBLEMS**

Not all salt whey could be recovered because USDA sanitation concerns restricted reuse of salt whey that has contacted wooden containers. Some concerns over use of recovered salt's effect on cheese chemical composition, flavor, and shelf-life were unfounded.

## **4.2.1 Garment Cleaning: Dry Cleaning**

### *Case Study #1*

**BUSINESS:** Cottage Cleaners; Forest Lake, Minnesota  
**WASTE ORIGIN:** Dry Cleaning Process  
**WASTE TYPES:** Toxic Cleaning Solvents, Air Emissions of VOCs (Primarily Perchloroethylene), and Lint and Filter Wastes (Tainted with Perchloroethylene)

#### **COMPANY BACKGROUND**

Cottage Cleaners is a 10-employee shop providing dry cleaning services to commercial and industrial customers.

#### **MOTIVATION**

Growing evidence shows that the primary chemical used in dry cleaning — perchloroethylene, perc or PCE for short — can pose serious contamination risks to customers, workers, and property. Cottage Cleaners also needed to achieve compliance with OSHA and 1990 Clean Air Act Amendments requirements for perc emissions.

#### **STRATEGIES**

Reduce perc usage in the cleaning process by replacing older, less efficient dry cleaning equipment

#### **ORIGINAL PROCESS**

Cottage Cleaners was losing a large amount of perc from their transfer dry cleaning process. Significant perc loss occurred when clothes were manually transferred from a washing unit to a drying unit. Loss also occurred from leaking gaskets and seals in the older equipment.

#### **NEW PROCESS**

The old transfer dry cleaning machines were replaced with a new, more efficient dry-to-dry machine. Washing and drying are done in the same unit, eliminating perc lost from opening doors and moving clothes. The new machine also is entirely programmable for a variety of cleaning needs. No perc is lost through the new machine's seals and gaskets. The new machine's reclaiming unit also recovers more perc for reuse than the old machine.

#### **RESULTS**

##### **Waste Reduction**

Perchloroethylene use was reduced from 455 gallons/year in 1990, to 38 gallons/year in 1992.

Reduced hazardous waste generated from 750 gallons/year in 1990, to 480 gallons/year in 1992.

##### **Economics**

Capital Cost: \$49,000 purchase cost for new dry-to-dry machine.

**Operating/Maintenance Cost:**

Saved \$2,246 in perc purchase costs in 1992.

Saved \$593 in hazardous waste disposal costs in 1992.

**Payback Period:** Not available.

**HEALTH & SAFETY BENEFITS**

Perchloroethylene exposure to employees was greatly reduced while meeting regulatory compliance. Perc is a suspected carcinogen, is moderately toxic by inhalation, is an eye and severe skin irritant, and has shown experimental teratogenic and reproductive effects.

**PROBLEMS**

Perc releases still occur from the new machine when the lint screen is cleaned and the diatomaceous earth filter is replaced.

## **4.2.1 Garment Cleaning: Dry Cleaning**

*Case Study #2*

**BUSINESS:** Spic and Span, Inc.; Milwaukee, Wisconsin  
**WASTE ORIGIN:** Dry Cleaning Process  
**WASTE TYPES:** Spent Cleaning Chemicals, Petroleum-based Solvents, Volatile Organic Compounds (VOCs) Air Emissions, Lint and Filter Wastes, and Still Bottoms Tainted with VOCs)

### **COMPANY BACKGROUND**

Spic and Span is a retail dry cleaning and commercial laundry service with an industrial uniform and towel rental service.

### **MOTIVATION**

Spic and Span needed to comply with OSHA and 1990 Clean Air Act Amendments requirements for perc emissions.

### **STRATEGIES**

Reduce perc usage in the cleaning process rather than being forced to manage them later. Reduce perc emissions by replacing older, less efficient dry cleaning equipment.

### **ORIGINAL PROCESS**

Spic and Span was losing a large amount of perc from their transfer dry cleaning process. Significant perc loss occurred when damp, solvent-treated clothes were manually transferred from a washing unit to a drying unit. Harmful emissions were also generated from exhausted stack fumes and by leaking gaskets and seals in the older cleaning equipment. The company had to comply with a 120 ton/year emission limit outlined in its operation permit.

### **NEW PROCESS:**

Old transfer dry cleaning machines were replaced with new, efficient self-contained and electronically-controlled machines. Washing and drying are done in the same unit, eliminating perc lost from opening doors and moving clothes. The new machine is fully programmable for various cleaning needs. No perc is lost through the new machine's seals and gaskets.

### **RESULTS**

#### **Waste Reduction**

Reduced VOC emissions and still bottoms.

#### **Economics**

##### **Capital Cost:**

\$700,000 for new equipment and installation, part which was defrayed by selling its VOC credits to a nearby company (see "Problems Encountered" below).

**Operating/Maintenance Savings:**

\$56,000 annual savings from contracted still bottom disposal.

No significant new O&M costs.

**Payback Period:** Not available.

**HEALTH & SAFETY BENEFITS**

Perchloroethylene exposure to employees was greatly reduced, while meeting regulatory compliance. Perc is a suspected carcinogen, is moderately toxic by inhalation, is an eye and severe skin irritant, and has shown experimental teratogenic and reproductive effects.

**TECHNOLOGY TRANSFER**

The new system includes a built-in refrigerated solvent recovery system that condenses and recovers solvent that would otherwise be lost as stack emissions.

**PROBLEMS**

The expense was the only major obstacle. Fortunately, Spic and Span took advantage of an emissions credit trading program overseen by the State of Wisconsin. The program assigns a credit value to an emission reduction achieved by a company. A percentage of the credits can be sold to another company not in compliance, or wishes to expand its operations.

## **4.2.2 Garment Cleaning: Wet Cleaning**

*Case Study #1*

**BUSINESS:** Greener Cleaner; Chicago, Illinois

**WASTE ORIGIN:** Dry Cleaning Process

**WASTE TYPES:** Toxic Cleaning Solvents, Petroleum-based Solvents, and Volatile Organic Compound (VOC) Air Emissions (Primarily Perchloroethylene)

### **COMPANY BACKGROUND**

Greener Cleaner is the first Midwest shop to professionally clean clothes using only wet cleaning.

### **MOTIVATION**

Growing evidence shows that the primary chemical used in dry cleaning — perchloroethylene, perc or PCE for short — can pose serious contamination risks to customers, workers, and property.

### **STRATEGIES**

Convert operations to water-based garment cleaning, using specially designed computer-controlled washing and drying systems.

### **ORIGINAL PROCESS**

Traditional dry cleaning uses petroleum solvents creating air emissions of volatile organic compounds (VOCs). Perchloroethylene is the primary cleaning solvent for its nonflammable properties. Air emissions are generated by exhaust stack fumes, transfer of damp solvent-treated clothes, and leaking machine gaskets and seals.

### **NEW PROCESS**

Wet cleaning uses only mild detergents. Stubborn stains are removed by hand, excess wrinkling often requires pressing, and clothes are dried in equipment where temperature is computer-controlled to prevent shrinking.

### **RESULTS**

#### **Waste Reduction**

Perchloroethylene is eliminated from the cleaning process.

#### **Economics**

Information will be available soon on labor and equipment costs and annual profits. Wet cleaning is more labor intensive than dry cleaning, but Greener Cleaner is able to charge similar prices, such as \$6.50 for a wool suit.

### **HEALTH & SAFETY BENEFITS**

Perchloroethylene is a suspected carcinogen, is moderately toxic by inhalation, is an eye and severe skin irritant, and has shown experimental teratogenic and reproductive effects.

**TECHNOLOGY TRANSFER**

As part of a wet cleaning national demonstration project, Greener Cleaner works with industrial, regulatory, environmental and community groups to assess this new process. This project includes testing and demonstrating wet cleaning in a operation shop, developing training materials, providing accurate cost data and business information, and offering technical assistance to dry cleaners wanting to convert to wet cleaning.

**PROBLEMS**

More extensive tests of wet cleaning are required to measure the cleaning performance on a full range of fabrics. More information is needed on customer satisfaction and claims. More tests are needed to rate how regular wear would affect wet cleaning performance. More equipment and labor cost data are needed.

**TECHNICAL ASSISTANCE**

As part of the demonstration project, Greener Cleaner is working with the U.S. EPA's Dry Cleaning Partnership Program, Chicago's Center for Neighborhood Technology, the International Fabricare Institute, the Neighborhood Cleaner's Association, the Massachusetts Toxics Use Reduction Institute, and Greenpeace. All test information is available to businesses and the general public.

**SOURCE REFERENCE**

For more information on the Greener Cleaner research, contact: The Center for Neighborhood Technology, Bill Eyring, 2125 W. North Avenue, Chicago, IL 60647-9886; or call 312/278-4800, ext. 116; or fax 312/278-3840.

## **4.3.1 Hospitality Industry: Food and Beverage Services**

### *Case Study #1*

**BUSINESS:** Thunderbird Hotel/Totem Pole Restaurant; Bloomington, Minnesota  
**WASTE ORIGIN:** Commercial Restaurant Food Preparation  
**WASTE TYPES:** Solid Wastes, Food, Cardboard, Glass, Aluminum, and Tin

#### **COMPANY BACKGROUND**

The Totem Pole Restaurant prepares meals for its patrons and caters meals for events held at the Thunderbird Hotel.

#### **MOTIVATION**

Reduce waste volumes after disposal costs more than doubled in one year (from \$35.75/ton in 1990 to \$95/ton in 1991).

#### **STRATEGIES**

Monitor food wastes and change preparation processes. Recycle leftover foods and reduce other dumpster materials by recycling, where possible.

#### **ORIGINAL PROCESS**

The restaurant filled its dumpster every five days with food preparation wastes, leftover foods, and food containers and packages. Disposal costs were \$95/ton.

#### **NEW PROCESS**

Food waste is collected for recycling as animal feed by a local food by-product recycling firm. Cardboard, glass, aluminum, and tin are separated and recycled by independent haulers at a cost substantially less than waste disposal costs. A computerized system is used to monitor food inventory, amount of food used per meal, and the percent waste per meal.

#### **RESULTS**

##### **Waste Reduction**

- Reduced volume of restaurant's total waste by 50 percent.
- Reduced dumpster pick up from every five days to once every three to four weeks.
- Recycled 4.75 tons of food waste each month.
- Recycled 4.5 tons of cardboard each month.
- Recycled 2 tons of glass each month.
- Recycled 500 pounds of tin and aluminum each month.

##### **Economics**

**Savings:** \$919.25 per month in disposal costs (\$596.25 for recyclables, \$323.25 for food waste) after recycling costs.

**Capital Cost:** \$5,000 for a one-time purchase price of a cardboard baler.

**Operating/Maintenance Cost:**

\$45/month for cardboard, glass, aluminum, and tin recycling.

\$128/month for food waste recycling.

**Payback Period:** Information not available.

**PROBLEMS**

The program needs daily recycling area management and support of the employees to be effective.

## **4.3.1 Hospitality Industry: Food and Beverage Services**

*Case Study #2*

**BUSINESS:** Mel's Corner Tap; Milwaukee, Wisconsin

**WASTE ORIGIN:** Bar Operations

**WASTE TYPES:** Bottles, Cans, and Cardboard Boxes

### **MOTIVATION**

Reduce volume of waste and associated disposal costs.

### **STRATEGIES**

Establish a cooperative hauling arrangement for waste and recycling materials.

### **ORIGINAL PROCESS**

Mel's paid individual business waste disposal costs.

### **NEW PROCESS**

Mel's joined four business neighbors, all restaurants or bars, to share trash and recycling bins.

### **RESULTS**

#### **Waste Reduction**

Reduced waste hauling costs.

#### **Economics**

**Savings:** \$125 each/month (\$400 to \$275 each month).

**Capital Cost:** None.

**Operating/Maintenance Cost:** None.

**Payback Period:** None.

## **4.3.1 Hospitality Industry: Food and Beverage Services**

*Case Study #3*

**BUSINESS:** Pandl's in Bayside; Milwaukee, Wisconsin

**WASTE ORIGIN:** Food Preparation

**WASTE TYPES:** Food Wastes

### **COMPANY BACKGROUND**

Pandl's is a family-owned 200-seat fine dining restaurant with 85 employees.

### **MOTIVATION**

Reduce waste volumes and associated disposal costs.

### **STRATEGIES**

Reduce the weight of the dumpster by recycling restaurant waste. Reduce energy costs.

### **ORIGINAL PROCESS**

The restaurant threw virtually all wastes into the dumpster, creating 30 cubic yards of waste each week.

### **NEW PROCESS**

Employee involvement through training replaces old habits with new habits focused on recycling and waste reduction. A food compost program recycles restaurant waste to an organic farmer for use as fertilizer. Compactors, bailers, and recycling bins were installed to collect various wastes. Running refrigerator Freon lines through a hot water tank saves energy by cooling the Freon line while heating the water and reducing the condenser workload.

### **RESULTS**

In 1992, Pandl's won an award from the City of Milwaukee for the Five Star Reduction and Recycling Program.

#### **Waste Reduction**

Reduced dumpster wastes by 92 percent by recycling efforts (recycling 27.5 cubic yards of 30 cubic yards produced each week), or 832 cubic yards/year.

Food composting for fertilizer reduced dumpster weight by 1,500 pounds of food waste/pick up.

Recycled 20 to 25 percent of food waste as fertilizer.

#### **Economics**

**Savings:** \$1,800 to \$3,000 estimated annual disposal costs savings.

**Capital Cost:** \$8,000 for compactors, bailers and recycling bins.

**Operating/Maintenance Cost:** Information not available.

**Payback Period:** Information not available.

**TECHNICAL ASSISTANCE**

In 1991, Pandl's received a matching grant of \$20,000 from the state of Wisconsin for a study to find if food waste could be used as a fertilizer.

## **4.3.2 Hospitality Industry: Lodging**

### *Case Study #1*

**BUSINESS: Arbor House — An Environmental Inn; Madison, Wisconsin (238-2981)**

#### **COMPANY BACKGROUND**

Arbor House provides lodging and food services as a bed and breakfast operation. Owners John (Quad/Graphics Enviro Manager) and Kathy Imes began their business in 1994 centered around their desire of “greening” the old-style inn. An integrated annex was added in 1995.

#### **MOTIVATION**

Create a unique bed and breakfast business that was cost efficient, energy efficient, and environmentally sound. The challenge was to make the business economically viable, sustainable, and a working model for similar small businesses interested in environmentally conscious operations.

#### **STRATEGIES**

Perform a “cost analysis” to structure the business to be competitive and profitable. Attract clientele to an establishment by using healthy foods, fabrics, and businesses practices. Use the historical significance of the inn as a community asset.

#### **PREVIOUS USE**

Previous owners operated it as The Old Plough Inn Bed and Breakfast. The building had outdated mechanicals and needed updating. The inn was originally a Civil War era stagecoach house.

#### **CURRENT USE**

The Imes remodeled the old inn as an “ultimate form of recycling,” an adaptive reuse of an historic structure. The green philosophy was also adapted to virtually every aspect of the inn’s operation including cooking, cleaning, textiles, use of space and energy, and choice of less toxic carpet materials and wall coverings. When possible, only natural fiber materials were used. Bed linens are 100 percent cotton.

When carpets were replaced, 100 percent wool carpets were installed with a jute backing. Carpet tacks were used for installation. In the breakfast room/great room, ceramic floor tile is made of 80 percent post-consumer glass. The ceramic tile in the bathrooms are 55 percent post consumer glass. Low flow showerheads and toilets save water use. One room features plant-derived paints and stains. All paints used in the remodeling are natural and non-toxic.

Insulated window treatments are used to enhance the passive cooling and heating. Ceiling fans assist in keeping the rooms cool. In the Annex, 12" thick walls made of Faswall from Ottumwa, Iowa, help keep the building 16° cooler than the outside temperature. Faswall consists of 85 percent old wood pellets and 15 percent Portland cement made into blocks. Hydronic heating

was installed in the Annex, and solar panels supplement the hot water system. There is a communal, wood burning fireplace for additional warmth and ambience.

The flooring at the Arbor House is all natural wood and, where wood was replaced, recycled wood was installed. In the home section, the Ecolon carpeting is used. This is made from old milk jugs made into carpeting. Though it is good quality carpeting, it is not made to withstand business reception area traffic.

## **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-Trichloroethane (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.

## **4.4.1 Electronics Manufacturing: Printed Circuits Boards**

*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.

## **4.5.1 Metal Fabrication: Finishing**

*Case Study #1*

**BUSINESS:** Gehl Company; West Bend, Wisconsin  
**WASTE ORIGIN:** Paint Stripping  
**WASTE TYPES:** Paint Wastes and Sodium Hydroxide Contaminated with Stripped Paint

### **COMPANY BACKGROUND**

Gehl manufactures agricultural implements.

### **MOTIVATION**

Large volumes of paint wastes were classified as hazardous wastes due to high pH levels. This required special handling and expensive disposal costs.

### **STRATEGIES:**

Strip paint using plastic media blasting.

### **ORIGINAL PROCESS**

Gehl stripped paint from parts rejected by quality control before remanufacturing them. These parts were soaked in a hot sodium hydroxide bath to strip paint as a batch process, creating the contaminated wastes.

### **NEW PROCESS**

A plastic media blasting cabinet replaced the stripping bath. The abrasive action of small plastic particles fired at a painted surface strips paint without damaging the surface texture. The paint chips and spent blast media is a non-hazardous solid waste that is landfilled (4,000 pounds per year).

### **RESULTS**

#### **Waste Reduction**

Eliminated 19,000 pounds per year of paint-contaminated sodium hydroxide.

#### **Economics**

**Savings:** \$32,000 estimated annual waste disposal costs.

**Capital Cost:** \$8,000 for the plastic media blasting unit.

**Operating/Maintenance Cost:** Information not available.

**Payback Period:** Three months based on estimated disposal costs.

### **HEALTH & SAFETY BENEFITS**

Worker exposure was significantly reduced by eliminating sodium hydroxide, a corrosive irritant to skin, eyes, and mucous membranes. It is also moderately toxic if ingested.

### **Source:**

U.S. EPA Project Summary: *Reduction of Total Toxic Organic Discharges and VOC Emissions from Paint Stripping Operations Using Plastic Media Blasting.*

## **4.5.1 Metal Fabrication: Finishing**

*Case Study #2*

**BUSINESS:** Snap-on Tools; Kenosha, Wisconsin  
**WASTE ORIGIN:** Sheet Metal Fabrication  
**WASTE TYPE:** Ethylene Glycol Monobutyl Ether (Butyl Cellusolve)

### **COMPANY BACKGROUND**

Snap-on Tools is a hand tool and tool storage rollaway manufacturer.

### **MOTIVATION**

Company operations were discharging large amounts of butyl cellusolve to the local publicly-owned treatment works (POTW), even though the POTW had no difficulty handling the extra strength wastewater.

### **STRATEGIES**

Recover butyl cellusolve through a process modification called ion exchange.

### **ORIGINAL PROCESS**

The company uses an electrocoating paint line with water-based coatings. Ultrafiltration recovers process paint from the rinse tank's effluent, producing concentrated paint for return to the paint bath. The remaining waste rinsewater contained 2 to 3 percent butyl cellusolve that was lost when sewerred.

### **NEW PROCESS**

The recycle loop to the rinse is now closed due to the ion exchange technology which removed a contaminant (isopropyl amine) which used to build up in the system and ruin the rinse bath.

### **RESULTS**

#### **Waste Reduction**

Reduced butyl cellusolve in wastewater from 190,000 pounds in 1989 to 3,500 pounds in 1992.

#### **Economics**

**Savings:** \$54,900 per year due to butyl cellusolve recovery.

At least \$18,000/year on sewer fees.

**Capital Cost:** \$150,000 in 1989.

**Operating/Maintenance Cost:** Information not available.

**Payback Period:** Two years based on total savings of \$72,900/year from butyl cellusolve recovery (\$54,900/year) and sewer fee savings (\$18,000/year).

### **HEALTH & SAFETY BENEFITS**

Butyl cellusolve is moderately toxic if inhaled, is a skin and eye irritant, can cause experimental teratogenic and reproductive effects, and is a flammable liquid when exposed to heat or flame.

**PROBLEMS**

Closing the wastewater loop entirely depended on complete removal of isopropyl amine. Build up of this contaminant in the rinsewater could degrade the quality of the electrocoating finishing.

## **4.5.1 Metal Fabrication: Finishing**

*Case Study #3*

**BUSINESS:** Swing-N-Slide Corporation, Newco Fabrication Division; Janesville, Wisconsin  
**WASTE ORIGIN:** Custom Metal Fabrication  
**WASTE TYPES:** Spray Painting Wastes, Oversprayed Liquid Solvent-based Paints, Solvent Cleaners and Paint Sludges, and Volatile Organic Compound (VOC) Air Emissions

### **COMPANY BACKGROUND**

Newco, with 50 employees, is the leading manufacturer of do-it-yourself swing sets in the nation. The company also is a custom fabricator supplying a variety of industries with components and finished assemblies used in playground equipment, power tools, shelving, hardware, and many other industrial and consumer products.

### **MOTIVATION**

Operations generated large volumes of hazardous paint wastes and air emissions regulatory non-compliance issues.

### **STRATEGIES**

Replace toxic, solvent-based paints with powder paints.

### **ORIGINAL PROCESS**

The company's liquid spray painting operations created large volumes of overspray paint wastes. Air emissions of VOCs from this process were not in compliance, and equipment clean up and color changes generated a lot of hazardous wastes.

### **NEW PROCESS**

In January 1993, a powder paint coating system was installed featuring ten automatic and two manual paint guns. This allows the powder to adhere to the metal parts electrostatically. The finish is made permanent by baking parts in an oven.

### **RESULTS**

#### **Waste Reduction**

- Eliminated 100 percent of oversprayed liquid paint.
- Eliminated 100 percent of solvent cleaners and paint sludge.
- Reduced process hazardous wastes by 33,550 pounds/year.
- Reduced VOC emissions by 22,500 pounds/year.

#### **Economics**

- Savings: At least \$140,670/year.
- At least \$41,000 per year savings due to elimination of hazardous waste streams.
- \$99,670/year savings on labor and materials, including \$23,000/year savings on paint filter

cleaning. Production output tripled.

**Capital Cost:** \$200,000 for powder paint booth.

**Operating/Maintenance Cost:** Information not available.

**Payback Period:** 14 months.

#### **HEALTH & SAFETY BENEFITS**

Employee exposure to hazardous materials was significantly reduced after elimination of suspected cancer-causing chlorinated solvents.

#### **TECHNOLOGY TRANSFER**

A Nordson NHC-S8 Down-Draft Powder Coating Booth was installed to significantly reduce coating wastes. Most powder paints are sprayed at a 96 percent efficiency rate, as opposed to 50 percent efficiency with sprayed liquid paints. The remaining 4 percent waste powder is captured, containerized, and sold to another firm using powder paint.

#### **PROBLEMS**

Minor problems occurred due to lack of employee training using the new paint booth. Powder coatings do not have universal application properties.

## **4.6.1 Plastics Manufacturing: Fiber-reinforced Plastics**

### *Case Study #1*

**BUSINESS:** Sunrise Fiberglass; Wyoming, Minnesota  
**WASTE ORIGIN:** Fiber-reinforced Plastics Production  
**WASTE TYPES:** Styrene Vapor Emissions, Conventional Low-styrene Resins, and Volatile Organic Compound (VOC) Air Emissions

#### **COMPANY BACKGROUND**

Sunrise uses the open-mold procedure to manufacture products ranging from water-directive flumes, to large cabs used for heavy equipment.

#### **MOTIVATION**

Increased government regulation to reduce styrene vapor emissions. Styrene is listed as a hazardous air pollutant by the 1990 Clean Air Act Amendments (CAAA). Worker health concerns by OSHA required companies to reduce styrene vapor exposure limits 50 percent by 1993.

#### **STRATEGIES**

Reduce styrene emissions by using low styrene emission (LSE) resins in place of standard resins in an open-mold FRP operation.

#### **ORIGINAL PROCESS**

Data from the 1989 Toxic Release Inventory (TRI) showed that open-mold FRP operations make up the largest use of styrene resin in Minnesota in terms of number of facilities using the operation, volume of resin consumed, and volume of styrene released to the environment.

#### **NEW PROCESS**

Two low-styrene resins were substituted directly into production without equipment or process changes. A third resin would require modifications to existing spray equipment (approximately \$1,200).

#### **RESULTS**

##### **Waste Reduction**

Styrene emissions reduced from 25 to 45 percent.

##### **Economics**

**Potential Savings:** \$1,800 to \$4,400/year (by reduced need for increased ventilation to meet OSHA exposure standards).

**Operating/Maintenance Cost:** Information not available.

**Payback Period:** None.

**HEALTH & SAFETY BENEFITS**

Styrene is a suspected carcinogen, an experimental poison by ingestion and inhalation, and an eye and skin irritant. Moderately toxic when inhaled, styrene can produce experimental teratogenic and reproductive effects.

**PROBLEMS**

Initial FRP Industry preconceptions about low-styrene resins: cost, specialized process equipment, workability of material, resulting physical properties of the laminate.

## **4.6.2 Plastics Manufacturing: Thermoforming**

### *Case Study #1*

**BUSINESS:** TriEnda Corporation; Portage, Wisconsin  
**WASTE ORIGIN:** Plastics Thermoforming Process  
**WASTE TYPES:** Plastic Production Scraps, Spent Plastic Liquid Color Drums, and Office Materials (Paper, Aluminum Cans, Plastic Strapping, Metals, Poly Bags)

#### **COMPANY BACKGROUND**

TriEnda, founded in 1975, manufactures custom thermoformed products such as shipping pallets and automotive handling trays.

#### **MOTIVATION**

Reduce the company's solid waste and their associated landfill disposal costs.

#### **STRATEGIES**

Evaluate materials used and recommend machinery improvements to cut costs, reduce waste, and conserve energy.

#### **ORIGINAL PROCESS**

The majority of office and production wastes were sent to the landfill. Hazardous wastes from solvent use required special handling requirements and disposal costs. Older plant lighting and machinery technologies required high energy consumption.

#### **NEW PROCESS**

Though involved in recycling since 1975, the company formed a recycling committee in 1990. Commitment to waste reduction is encouraged through all departments. Recycling bins are placed in the plant and office. Production plastic scrap and plastic liquid color drums are ground up and recycled. Customer's scrap or obsolete products are often bought back and recycled. Equipment is cleaned using only recyclable and biodegradable solvents. Heat is reclaimed from machinery and vented to other areas of the plant. Upgraded lighting, motors, and other production equipment doubled energy savings.

#### **RESULTS**

##### **Waste Reduction**

Total company solid waste volume was reduced 91 percent since 1987.

Plastic production waste was reduced from 1.7 million pounds to 215,000 pounds.

Liquid color drum waste was reduced by 99 percent.

Energy savings doubled from 4.1 million kilowatt hour in 1991 to 9.8 million kilowatt hours in 1993.

**Economics (Information not available.)**

## **4.6.2 Plastics Manufacturing: Thermoforming**

*Case Study #2*

**BUSINESS:** Placon Corporation; Madison, Wisconsin  
**WASTE ORIGIN:** Plastics Packaging Manufacturing  
**WASTE TYPES:** Scrap Production Plastics, Production Equipment Wastes (Oil, Cleaning Solvents, Lubricants), Office Materials (Paper, Cardboard, Magazines, Phone Books), Warehouse Materials (Pallets, Metal Packing Bands), and Cafeteria Materials (Plastic and Paper Cups, Paper Hand Towels, and Cleaning Rags)

### **COMPANY BACKGROUND**

Placon manufactures plastics packaging for the consumer household, airline, and retail display industries.

### **MOTIVATION**

Placon's production process generated large volumes of solid and associated disposal costs.

### **STRATEGIES**

Reduce use of raw plastic materials, recycle plastic production scraps, reuse packaging wherever possible; minimize production of plastics with mixed, non-recyclable plastic resins; promote involvement of all departments in waste reduction, recycle, and reuse efforts.

### **NEW PROCESS**

The company uses 10 to 50 percent recycled plastics content in many products. Redesigned products use less material or meet minimum product material requirements. Trim loss was reduced during production. Excess production plastics are ground up and sent to Placon's base supplier for recycling.

### **RESULTS**

#### **Waste Reduction**

Plastic waste reduced 1.394 tons/year.

#### **Economics**

**Savings:** An estimated \$20,328/year based on reduced disposal costs.

**Capital Cost:** \$133,500 for plastic recycling grinders, scale, and forklift.

**Operating/Maintenance Cost:** Information not available.

**Payback Period:** Information not available.

## **4.6.3 Plastics Manufacturing: Printing and Laminating**

### *Case Study #1*

**BUSINESS:** C&H Packaging Company; Merrill, Wisconsin

**WASTE ORIGIN:** Plastics Printing and Laminating

**WASTE TYPES:** Production Scraps (Polyethylene Plastic, Corrugated Cardboard, Packaging Cores), Volatile Organic Compounds (VOCs), Solvent-based Printing Inks, Cleaning Solvents (Methyl Ethyl Ketone), and Laminating Adhesives

**COMPANY BACKGROUND:**

C&H is a quality printer and laminator of flexible plastic packaging used for meat, cheese, and snack foods. Established in 1986, the company employs 85 people.

**MOTIVATION:**

Reduce hazardous VOC wastes and their air emissions. Reduce the company's solid waste volume and associated landfill disposal costs. Comply with clean air environmental regulations.

**STRATEGIES:**

Convert from VOC-based materials and technology to water-based materials and technology.

**ORIGINAL PROCESS:**

The majority of office and production wastes were sent to the landfill. Hazardous wastes required special handling requirements and disposal costs. VOCs released during production must be incinerated to convert them to non-volatile compounds. Fueling the incinerators require large amounts of natural gas.

**NEW PROCESS:**

C&H uses water-based inks in its printing process, also significantly reducing toxic solvent use for most of the press clean ups. The laminating department eliminated VOCs by using a "solids" technology laminator and converted another gravure laminating system to water-based technology. The company encourages customers to return packing materials that can be reused.

**RESULTS:**

**Waste Reduction**

Ink VOC content reduced from 60 percent to less than 5 percent.

Totally eliminated VOCs in laminating adhesives.

All waste polyethylene packaging is recycling.

**Economics (Information not available.)**

## **4.7.1 Printing: Lithographic Printing**

### *Case Study #1*

**BUSINESS:** Herald Review/Itasca Shopper; Grand Rapids, Minnesota  
**WASTE ORIGIN:** Newspaper Printing  
**WASTE TYPES:** Newsprint Paper, Pasteup Paper Pages, Printing Inks, Film Developing Chemicals, and Used Printer Toner Cartridges

#### **COMPANY BACKGROUND:**

The Herald Review/Itasca Shopper is a small newspaper and advertising shopper printing operation.

#### **MOTIVATION**

Save money by reducing the company's volume of solid and hazardous waste. Reduce landfill disposal fees. Reduce raw materials costs.

#### **STRATEGIES**

Recycle and reuse wherever possible. Involve employees in all company departments. Encourage efficient and innovative use of materials.

#### **ORIGINAL PROCESS**

Newsprint rollends were thrown away and waste inks were disposed. The company generated three 12-yard dumpsters of solid waste each week.

#### **NEW PROCESS**

Rollends are saved and sold for to a local ceramics company as packing material. Waste ink was reused by adding different colors to black inks for no reduction in print quality. Film developing chemicals were reused and its usable life extended with additives. The layout department reused page pasteup sheets. The composing staff reused and refilled each toner cartridge three times before buying new cartridges.

#### **RESULTS**

##### **Waste Reduction**

Overall company solid waste was reduced by 97 percent.

Dumpster materials reduced by 26,000/year.

Landfilled material quantity reduced to six 30-gallon cans per week (from 36 cubic yards/week).

Overall paper waste reduced by 7,600 pounds/year.

Reduced pasteup sheet usage by 285 pounds/year.

Saved 250 pounds of ink/year.

## **Economics**

**Capital Costs:** None.

**Operating/Maintenance Cost:**

Saved \$18,000 per year on contracted waste hauling and disposal costs.

Reused ink saved \$2,600/year.

Rollend sales paid for yearly newsprint costs.

Reused film developer saved \$240/year.

Reused pasteup sheets saved \$570/year.

Reused toner cartridges saved \$900/year.

**Payback Period:** None required.

## **4.7.1 Printing: Lithographic Printing**

*Case Study #2*

**BUSINESS:** Heartland Litho; Madison, Wisconsin  
**WASTE ORIGIN:** Lithographic Printing Operations  
**WASTE TYPES:** Printing Papers and Trimmings, Cardboard, Darkroom Materials (Photoprocessing Fluids, Silver), Pressroom Cleaning Solutions (Chlorinated Solvents), Printing Ink (Petroleum-based), and Printing Plates (Aluminum)

### **COMPANY BACKGROUND**

Heartland Litho is a commercial printing company specializing in high-quality color printing.

### **MOTIVATION**

Reduce the large volumes of solid and hazardous wastes generated, reduce their disposal costs.

### **STRATEGIES**

Reduce or eliminate use of toxic inks and solvents, where possible, or recover and recycle solvents. Separate recyclable materials and contract to haul them away. Reuse packing materials, cleaning towels and rags, and wood pallets.

### **ORIGINAL PROCESS:**

Heartland disposed of virtually all operations' wastes into the landfill.

### **NEW PROCESS:**

Promote to customers the use of recycled papers, vegetable-based inks, and efficient use of paper. Recycling companies are contracted to recycle darkroom fluids, waste negative materials for silver, office paper and cardboard, aluminum plates, and soda cans. Reusable towels and rags are handled by a cleaning contract service. Solvent used in parts cleaning is used to flush empty ink cans, recovered, and recycled.

### **RESULTS**

#### **Waste Reduction**

Reduced printing paper and trimmings waste by 14 tons/year.

Reduced cardboard waste by 1.5 tons/year.

Reduced darkroom fluids wastes by 150 gallons/year.

Reduced pressroom solvent wastes by 100 gallons/year.

Ink waste was reduced by 700 pounds/year.

Printing plate waste was reduced by 400 pounds/year.

#### **Economics**

**Savings:** Information not available.

**Capital Cost:** Information not available.

**Operating/Maintenance Cost:** Approximately \$4,000/year, plus labor.

**Payback Period:** Information not available.

## **4.7.1 Printing: Lithographic Printing**

*Case Study #3*

**BUSINESS:** Burton & Mayer, Inc.; Brookfield, Wisconsin  
**WASTE ORIGIN:** Printing Process  
**WASTE TYPES:** Volatile Organic Compound (VOC) Air Emissions, Isopropyl Alcohol, and Petroleum-based Inks

### **COMPANY BACKGROUND**

Burton & Mayer is a commercial and advertising printer of labels, booklets, and brochures. It has 70 employees.

### **MOTIVATION**

Process VOCs produce air emissions into the environment and create health hazards.

### **STRATEGIES**

Convert to alcohol substitutes and vegetable oil-based inks.

### **ORIGINAL PROCESS**

An alcohol fountain solution was used on company printing presses. Most of this solution evaporated, emitting volatile organic compounds.

### **NEW PROCESS**

The company uses soy-based inks which are easier to de-ink when recycled. Printing processes are run alcohol-free by converting several presses and buying two new presses that run waterless.

### **RESULTS**

#### **Waste Reduction**

Totally eliminated alcohol use in presses, down from 1,815 gallons/year in 1991 and 825 gallons/year in 1992.

After converting to vegetable oil-based inks: reduced petroleum oil usage by 85 percent, reduced VOC levels below 10 percent.

**Economics (Information not available.)**

### **HEALTH & SAFETY BENEFITS**

Worker safety was greatly improved by eliminating isopropyl alcohol from the printing process. Isopropyl alcohol is an eye and skin irritant, and is a very dangerous fire hazard when exposed to heat, flame, or oxidizers.

### **TECHNOLOGY TRANSFER**

Waterless printing eliminates the use of alcohol from fountain solutions, reducing VOCs. This printing technology can also improve print quality over standard lithographic printing. However, rollers must be chilled and a special, more expensive plate developing process is required.

**PROBLEMS**

The press converting process took three years to adapt ten machines. Each press needed individual testing to maintain printing quality.

## **4.7.1 Printing: Lithographic Printing**

*Case Study #4*

**BUSINESS:** Quad/Graphics, Inc.; Pewaukee, Wisconsin  
**WASTE ORIGIN:** Printing Processes  
**WASTE TYPES:** Paper, Ink, Plastic, Energy, Volatile Organic Compounds (VOCs), Petroleum-derived Ink Oils, and Methyl Ethyl Ketone (MEK) Vapors

### **COMPANY BACKGROUND**

Quad/Graphics is a privately-owned printer of magazines, catalogs, and commercial products.

### **MOTIVATION**

Waste source reduction through conserving, reusing, and recycling all possible sources.

### **STRATEGIES**

Work with clients and vendors to reduce waste, test new equipment, develop new manufacturing processes and materials, and educate employees on environmental stewardship.

### **ORIGINAL PROCESS**

Large volumes of solid wastes and disposals costs were sent to the landfill. Ink wastes required expensive disposal fees. Air emissions from VOC inks and cleaning solvents threatened worker health and environmental regulations.

### **NEW PROCESS**

A new press cylinder pre-wash cuts use of cleaning solvent in half. The company patented a vegetable oil-based ink that replaces petroleum-based inks. A closed-loop ink system captures up to 90 percent of MEK vapor and condenses it for reuse. Energy conservation projects recover heat and earn energy rebates from utilities.

### **RESULTS**

#### **Waste Reduction**

Paper waste reduced 133,000 tons, saved 220,000 cubic yards of landfill space in 1994.

Ink waste cut 40 percent in five years.

Plastic waste cut by 287 tons by reuse or recycling in 1994

Solvent use reduced from 1,100 gallons/year to 550 gallons/year.

Natural gas use cut for \$20,000 energy rebates in 1994.

MEK use reduced 6,900 gallons/year.

Ink VOCs reduced 10 to 15 percent by vegetable oil-based inks.

## **Economics**

### **Savings:**

Saved \$6.7 million in solid waste landfill fees in 1994.

\$472,000 in utility company energy rebates.

Projected natural gas savings for 1995 are \$236,000.

Saved \$1,000 per ink drum, \$150 per drum in disposal fees.

Saved \$33,114 in plastic purchasing costs, saved \$14,350 in disposal costs in 1994.

MEK costs reduced \$552,000/year.

**Capital Cost:** Information not available.

**Operating/Maintenance Cost:** Information not available.

**Payback Period:** Information not available.

## **HEALTH & SAFETY BENEFITS**

Worker safety was greatly improved by reducing use of VOC materials. MEK is a strong eye and skin irritant, affects the peripheral and central nervous systems, and is a highly flammable liquid.

## **TECHNOLOGY TRANSFER**

A new cylinder pre-wash system cut cleaning solvent use in half. The company developed the "Ecovap" heat recovery system to cut natural gas use. A closed-loop ink system captures up to 90 percent of MEK and condenses it for reuse. Quad/Graphics patented an ink using a mixture of corn, linseed, and soy oils.

## **TECHNICAL ASSISTANCE**

Quad/Graphics joined other businesses and organizations to learn, share, and promote environmental practices: Businesses for Social Responsibility, Buy Recycled Business Alliance, Climate Wise Initiative, and The Great Printer's Project. The company also designed the "Environmental Purchasing Guide" to help other businesses and vendors.

## **4.7.2 Printing: Screen Printing**

*Case Study #1*

**BUSINESS:** Romo Incorporated; De Pere, Wisconsin  
**WASTE ORIGIN:** Screen Reclamation Processes (Ink, Emulsion and Haze Removal)  
**WASTE TYPES:** Volatile Organic Compounds (VOCs), Solvent-based Inks, Screen Cleaners/Ink Cleaning Solvents (Toluene, Methyl Isobutyl Ketone) Emulsion Remover (Sodium Periodate), and Haze Removers (Xylene, Acetone, Mineral Spirits, Cyclohexanone)

### **COMPANY BACKGROUND**

Romo is a commercial screen printing firm that produces a wide variety of products including decals, banners, point-of-purchase displays, and original equipment manufacture.

### **MOTIVATION**

Over the 40 years of its operation, Romo has experienced toughening environmental and health regulations on local, state, and federal levels. Many regulations have required expensive changes or threats of high fines for noncompliance. The company also wanted to reduce its VOC air emissions and contaminated wastewater, while reducing expensive chemical costs and their expensive treatment and disposal.

### **STRATEGIES**

Romo decided to stay ahead of the regulations. This included decreasing the environmental and health impacts of printing chemicals as much as possible without compromising profits and competitiveness. The company focused on three strategies: reducing the volume of all hazardous products used, testing alternative applications techniques, and experimenting with alternative formulations of traditional products. Romo targeted three major waste streams from the screen reclamation process: ink removal (screen cleaning), emulsion (stencil) removal, and haze (“ghost image” or remnant image) removal.

### **ORIGINAL PROCESS**

About 60 percent of the company’s printing is done with traditional solvent-based inks and 40 percent with ultraviolet (UV) curable inks. Wastewater from the reclamation process was washed down the drains directly to a sewage treatment plant. Open tanks of solvent-based cleaning product allowed large amounts of VOCs to evaporate directly into the shop.

### **NEW PROCESS**

An in-process recycling still recovers screen cleaning solvent for reuse within a closed system that does not allow VOC evaporation to the worker’s airspace. A less hazardous, better-performing alternative cleaner is used for press-side cleaning. Screen emulsion removal is primarily done with an extremely high-pressure water blaster instead of chemicals. Immediate cleaning of ink and emulsion drastically decreased the need for haze removal chemicals.

## RESULTS

### Waste Reduction

Solvent recovery reduced screen cleaning solvent use from 20 to 40 gallons/day to one 55-gallon drum every three to four weeks.

Hazardous press-side cleaning products reduced by 70 percent.

Toluene Use reduced from 12,382 pounds in 1991 to 3,611 pounds.

Methyl isobutyl ketone use reduced from 6,098 pounds in 1991 to 1,779 pounds.

Emulsion remover chemicals reduced by 75 percent through use of high-pressure water blaster.

### Economics

**Capital Costs:** \$2,900 for a 5 gallon solvent-recovery still.

\$4,900 for a high pressure water blaster.

**Operating/Maintenance Savings:** Solvent recovery saves \$83 per day, or \$20,750 per year. Saved \$3,800 per year on reduced use of emulsion remover chemicals.

**Payback Period:** Seven weeks on the \$2,900 solvent-recovery still.

Fifteen months on the \$4,900 high pressure water blaster.

## HEALTH AND SAFETY BENEFITS

Many of the solvent-based cleaners and inks used in the screen printing Industry pose adverse health effects to workers through direct skin contact or breathing the evaporating chemicals. Regular skin contact with ink, emulsion, or haze-removing chemicals will cause proven skin and eye irritation and tissue damage. Chemical vapors inhaled into the lungs on a regular basis can produce adverse health conditions. Systemic problems can range from headaches, internal organ damage, nervous system disorders, and possibly cancer. All of these liquids are highly flammable.

## TECHNICAL ASSISTANCE

Romo was helped by local chemical suppliers to formulate less hazardous and more effective cleaners. The U.S. EPA's Design For The Environment (DfE) Program's Printing Project provided assistance through its 33/50 program. The DfE Screen Printing Project was assisted by the Screen Printing Association International (SPAI). To obtain other case studies or more information about the DfE Screen Printing Project, contact: U.S. EPA Pollution Prevention Clearinghouse (PPIC) at 202/260-1023, or fax 202/260-0178.

### Sources:

U.S. EPA Design for the Environment Screen Printing Project Documents:

*Screen Printing Case Study: Reducing the Use of Reclamation Chemicals in Screen Cleaning*, 1993, EPA/744-F-93-015.

*Screen Printing Case Study2: Technology Alternatives for Screen Reclamation*, Draft, October 1994.

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*Screen Printing Case Study 4: Work Practice Alternatives for Screen Reclamation*, Draft, December 1994, EPA/742-F-95-003.

*Designing Solutions for Screen Printers*, U.S. EPA, Pollution Prevention and Toxics, Design For the Environment Screen Printing Project, March 1995, EPA/744-F-95-003.

## **4.8.1 Retail/Warehouse: Food Retail**

### *Case Study #1*

**BUSINESS:** Erickson's Diversified Corporation; Hudson, Wisconsin  
**WASTE ORIGIN:** Grocery Store Operations  
**WASTE TYPES:** Food Wastes, Energy Consumption, Refrigerants, Plastic Milk and Water Containers, and Construction Materials

#### **COMPANY BACKGROUND**

Erickson's is a privately held family- and employee-owned company. It has 1,500 employees in its 17 groceries and pharmacies in Wisconsin and Minnesota.

#### **MOTIVATION**

High waste volumes and associated disposal costs.

#### **STRATEGIES**

A grassroots approach to pollution prevention involves both customers and employees. Each of the 17 stores has a "environment and community" team to devise and implement waste-cutting programs. The grocer's weekly ad flyer contains a column offering consumer tips and encourages customers to recycle. To organize these efforts, Erickson's hired a director of environmental and community action.

#### **NEW PROCESS:**

Food waste is recycled to local pig farmers. Unsold bread and bakery items are donated to local charities. Customers are encouraged to use returnable milk and water containers. Energy management of lighting, heating, air conditioning, and refrigeration includes retrofitting stores with energy-efficient T8 fluorescent bulbs with electronic ballasts and reflectors. In 1994, Erickson's built their first model environmental grocery store using only T8 fluorescent lighting and the newest and environmentally-safest refrigerant available (R-404A) in its new cooling equipment.

#### **RESULTS**

##### **Waste Reduction**

Recycling food wastes has eliminated up to 30 percent of the waste stream in participating stores.

Lighting retrofits in three stores cut each store's energy use for lighting in half, saving 872,000 kilowatt hours annually (700 fewer tons of energy-generating pollutants in the air each year).

**Economics (Information not available.)**

## **4.8.1 Retail/Warehouse: Food Retail**

### *Case Study #2*

**BUSINESS:** Sentry Foods/The Godfrey Company; Waukesha, Wisconsin  
**WASTE ORIGIN:** Supermarket Chain Operations  
**WASTE TYPES:** Office Materials (Paper, Aluminum Cans and Note Pads), Product Packaging (Cardboard Boxes), Customer Bags, Wooden Pallets, and Used Fleet Motor Oil

#### **COMPANY BACKGROUND**

Sentry Foods operates a chain of over 90 supermarkets throughout Wisconsin.

#### **MOTIVATION**

High waste volumes created expensive disposal costs.

#### **STRATEGIES**

Set up company-wide source reduction, materials reuse, and recycling programs for solid and hazardous wastes.

#### **ORIGINAL PROCESS**

Many stores landfilled large volumes of waste.

#### **NEW PROCESS**

Company offices separate all paper and aluminum cans from the waste stream and reuse waste paper for note pads. Recycled materials are purchased for use in private-label products and brown paper shopping bags. Reusable canvas shopping bags are promoted at checkout counters. Warehouse operations recycle corrugated cardboard and wooden pallets. Vehicle shops recycle used motor oil from Sentry's trucking/transportation fleet.

#### **RESULTS**

##### **Waste Reduction**

Reduced cardboard waste by 18,700 tons/year.

Reduced office paper waste by 58 tons/year.

##### **Economics**

**Savings:** Information not available.

**Capital Cost:** Sentry arranged for use of cardboard compactors provided by a recycling firm in exchange for all collected cardboard.

**Operating/Maintenance Cost:** Information not available.

**Payback Period:** Information not available.

## **4.9.1 Vehicle Maintenance: Auto Servicing/Repair**

### *Case Study #1*

**BUSINESS:** Zimbrick Buick; Madison, WI  
**WASTE ORIGIN:** Auto Body Repair/Service  
**WASTE TYPES:** Office and Shop Materials, Paper and Plastic Packaging Materials, Office Paper and Cans, and Shop Materials (Sheet Metal, Tires, Batteries, Oil, Antifreeze, Freon, Alternators, Radiators)

#### **COMPANY BACKGROUND**

Zimbrick operates one of the largest auto body repair shops in the Midwest. Along with its auto service, the dealership generated a large volume of solid and liquid wastes.

#### **MOTIVATION**

Zimbrick wanted to reduce its waste generation and waste disposal costs. Some shop wastes, like Freon, antifreeze, and used motor oil required special disposal considerations and costs.

#### **STRATEGIES**

Managers evaluated the wastestreams and associated disposal costs. Many areas, including office, body repair, and service shops could benefit from source reduction, reuse, and recycle methods.

#### **ORIGINAL PROCESS**

Many containers for liquid products, like windshield washer, antifreeze, and cleaning supplies were routinely thrown away. Hazardous liquid wastes like Freon, antifreeze, and used motor oils were routinely disposed of. Solid wastes like tires, batteries, sheet metal scraps, and corrugated cardboard were trashed. Mostly new automotive parts were stocked.

#### **NEW PROCESS**

Reusable, returnable 55-gallon drums replaced individual plastic containers and individual spray cans. Freon and antifreeze was collected, recharged, and reused. Sheet metal, tires, batteries, oil, corrugated cardboard, and HDPE plastics were recycled. Rebuilt auto parts were stocked whenever possible. Office paper and aluminum cans from all departments were recycled.

#### **RESULTS**

##### **Waste Reduction**

Volume of waste was reduced 2,080 cubic yards/year.

##### **Economics**

**Savings:** \$3,600 (Estimate based on reduced disposal costs.)

**Capital Costs:** \$23,300 (Recycling and Rejuvenating Equipment)

\$10,500 (Five freon recycling units @ \$2,100 each.)

\$12,000 (Three antifreeze rejuvenators @ \$4,000 each.)

\$800 (Plastic recycling bins for office paper and cans.)

**Operating/Maintenance Cost:**

\$3,600 (Annual rental costs for cardboard compactor @ \$300 per month.)

**Payback Period:** Information not available.

## **4.9.1 Vehicle Maintenance: Auto Servicing/Repair**

*Case Study #2*

**BUSINESS:** Broadway of Green Bay; Green Bay, Wisconsin

**WASTE ORIGIN:** Auto Repair

**WASTE TYPES:** Parts Cleaning Solvents and Acetone

### **COMPANY BACKGROUND**

Broadway is an automobile dealership and repair center with 180 employees.

### **MOTIVATION**

Broadway wanted to reduce its waste generation and waste disposal costs. The company also wanted to improve its work environment and become an environmentally-friendly business.

### **STRATEGIES**

Replace solvent cleaners with an aqueous part cleaner.

### **ORIGINAL PROCESS**

Ten parts washers each used a 120-pound drum of solvent. Each drum was changed every two months. Dirty, spent solvent required special handling and additional disposal costs. A hazardous waste management company was contracted to supply and maintain the solvent-based cleaning system.

### **NEW PROCESS**

Biodegradable soap and hot water is used by the new aqueous washer unit. Deposited sludge from cleaning is landfilled as solid waste. Water is reused and discharged to the local sewer system.

### **RESULTS**

#### **Waste Reduction**

Eliminated 60 drums of waste solvent/year.

#### **Economics**

**Savings:** Information not available.

**Capital Costs:** \$4,000 for an aqueous washer unit.

**Operating/Maintenance Cost:** The aqueous cleaning unit is less labor intensive and costs less to operate than the solvent-based system.

**Payback Period:** Less than one year.

### **TECHNOLOGY TRANSFER**

Aqueous washer units are commercially available and can be easily adapted for many uses.

## **4.10.1 Wood Products Industry: Wood Finishing**

### *Case Study #1*

**BUSINESS:** Madison Pre-hung Doors & Pre-finishing; Oregon, Wisconsin  
**WASTE ORIGIN:** Wood Finishing  
**WASTE TYPES:** Volatile Organic Compounds (VOC) Air Emissions and Solid Wastes, Petroleum Solvent-based Finishes and Stains, Waste Solvent-based Cleaners, and Waste Paint Filters

#### **COMPANY BACKGROUND**

Madison Pre-hung Doors & Pre-finishing is an owner-operated small business with 28 employees. It finishes doors, wood trim, and moldings for builders and commercial distributors.

#### **MOTIVATION**

The company needed to comply with OSHA and 1990 Clean Air Act Amendments requirements for VOC emissions.

#### **STRATEGIES**

Find water-based material substitutes that were readily available through commercial suppliers.

#### **ORIGINAL PROCESS**

The company generated 115 tons/year of evaporated VOC air emissions from solvents. A VOC after-burner (thermal oxidizer) was needed to stay in compliance with air regulations. Solid waste was landfilled. Unused solvent was removed by a hazardous waste management company and recycled.

#### **NEW PROCESS**

Water-based finishes were substituted for the solvent-based finishes in the manual application and the automated spray application operations. VOCs have been reduced to less than six tons per year, while production has nearly doubled. Wastewater is removed and discharged into the local publicly-owned treatment works (POTW). A new curtain-coating system eliminates overspray and recycles excess finish. The company also is using non-toxic, biodegradable hydraulic fluid and recycling cardboard.

#### **RESULTS**

##### **Waste Reduction**

Annual VOC air emissions were reduced from 115 tons to 6 tons.

##### **Economics**

###### **Capital Cost:**

Approximately \$6,000 for five new spray guns.

###### **Operating/Maintenance Savings:**

No significant new O&M costs.

Eliminated waste solvent disposal costs.

Eliminated costs associated with operation and maintenance of VOC after-burner.  
Reduced annual insurance premium costs by \$8,000 (by reducing VOC fire risk), while increasing policy coverage by \$350,000.

**Payback Period:** Not available.

#### **HEALTH & SAFETY BENEFITS**

Fire hazard has been drastically reduced. The work environment has improved; employee exposure to hazardous/flammable materials has been reduced. Employees are no longer required to wear safety equipment.

#### **TECHNOLOGY TRANSFER**

Water-based finishes can be readily adopted for use by others doing wood finishing.

#### **PROBLEMS**

Water-based finishes require more labor (extra sanding and more coats of finish) due to some grain raising. To achieve comparable finish quality to that of solvent-based finishes, the company worked with its paint supplier to design a production process to address this problem.

## **4.10.1 Wood Products Industry: Wood Finishing**

*Case Study #2*

**BUSINESS:** Gerry Wood Products; Suring, Wisconsin  
**WASTE ORIGIN:** Furniture Production  
**WASTE TYPES:** Lacquer Coating, Volatile Organic Compounds (VOCs), and Wax Coating Overspray

### **COMPANY BACKGROUND**

Gerry Wood Products manufactures wooden children's furniture and expansion safety gates.

### **MOTIVATION**

Reduce VOC air emissions and associated special air supply and exhaust requirements, and meet and exceed environmental regulatory compliance standards. Reduce hazardous waste disposal costs.

### **STRATEGIES**

Switch to a formulated wax coating process instead of solvent-thinned lacquer coating without a large capital investment.

### **ORIGINAL PROCESS**

Wood parts were finished by a tumbling process using premixed lacquer. The percentage of VOC air emissions were high, and daily clean up generated hazardous wastes. Special air supply and exhaust was required to remove VOCs.

### **NEW PROCESS**

The new formulated wax coating used in the tumbling finishing is a granular solid with no known hazards, and does not produce VOC emissions.

### **RESULTS**

#### **Waste Reduction**

VOC air emissions reduced by 44,800 pounds/year.

Hazardous wastes from daily clean up reduced by 5,000 pounds/year.

#### **Economics**

**Savings:** Over \$200,000/year.

**Capital Cost:** Information not available.

**Operating/Maintenance Cost:** Information not available.

**Payback Period:** Information not available.

### **HEALTH & SAFETY BENEFITS**

VOCs used for finishing can be eye and skin irritants, are suspected carcinogens, may cause internal organ or respiratory system problems, and are typically highly flammable liquids.

## **4.10.1 Wood Products Industry: Wood Finishing**

*Case Study #3*

**BUSINESS:** The Shuttery of Nanik; Wausau, Wisconsin  
**WASTE ORIGIN:** Wood Shutter Manufacturing  
**WASTE TYPES:** Volatile Organic Compounds (VOCs) and Solvent-based Coatings

### **COMPANY BACKGROUND**

The Shuttery produces handcrafted, custom interior wood shutters with 65 employees.

### **MOTIVATION**

Improve worker health and safety for spray painters and nearby workers in the finishing department. Reduce regulatory burden over VOC emissions. Eliminate the need for a flammable material storage area.

### **STRATEGIES**

Convert from solvent-based coatings to waterborne coatings while producing a higher quality wood finish.

### **ORIGINAL PROCESS**

The original coating process consisted of sanding, priming, sanding, and top coating the wood components with solvent-based coatings.

### **NEW PROCESS**

The waterborne coatings are in full production use for all standard coatings, except when specialized high-performance coatings are required. These new coatings are more scratch-resistant and cover twice as much area/gallon of coating.

### **RESULTS**

#### **Waste Reduction**

VOC emissions were cut from 5.97 tons/month in 1992 to 0.5 tons/month in 1995. Hazardous waste volume was reduced from 1,100 pounds/month in 1992 to less than 220 pounds/month in 1995. Coating throughput dropped from 2,026 gallons/month in 1992 to 408 gallons/month in 1995.

#### **Economics**

**Savings:** \$32,600 for first year (eliminated regulatory costs), increased labor costs to maintain equipment.

**Payback Period:** Approximately 8½ years based on above savings projections.

### **HEALTH & SAFETY BENEFITS**

VOCs typically used for finishing can be skin and eye irritants, are suspected carcinogens, may cause internal organ or respiratory system problems, and are typically highly flammable liquids.

**TECHNOLOGY TRANSFER**

The waterborne coating are commercially available, but the Shuttery's coatings have been modified slightly to meet specific coating performance criteria. Other wood finishers could switch to waterborne coatings if their finishing process allow for sanding in between the first and second coat of primer. However, the wood substrate must have structural integrity to avoid distortion, especially for thin wood profiles.

**PROBLEMS**

Grain raising and atmosphere-sensitive coatings were problems in the conversion, but were managed by training paint technicians to identify the exact problem and react appropriately.

## **4.10.2 Wood Products Industry: Wood Treatment**

*Case Study #1*

**BUSINESS:** Rapid Die & Molding Company; Cassville, Wisconsin  
**WASTE ORIGIN:** Loudspeaker Components Manufacturing  
**WASTE TYPES:** Lacquer Volatile Organic Compound (VOC) Solvents, Acetone, Methyl Ethyl Ketone (MEK), and Toluol

### **COMPANY BACKGROUND**

RDM manufactures speaker cones, whizzers, and domes with 165 employees.

### **MOTIVATION**

Use of VOC solvents created large volume of potentially harmful air emissions and expensive hazardous waste disposal costs. Meet and exceed environmental regulatory compliance standards for VOC emissions.

### **STRATEGIES**

Reduce, then totally eliminate VOC solvent usage while still maintaining fiber strength and water resistance of products.

### **ORIGINAL PROCESS**

Formed-paper speaker components, like cones, were dried and dipped in solvent-thinned lacquer, then dried in an oven to evaporate excess solvent.

### **NEW PROCESS**

Non-solvent treatments are added directly to the fiber pulp mix instead of treating the cones with lacquer in an additional process. RDM is currently seeking solvent-free replacements for fire retardance treatment and area-strengthening of cones.

### **RESULTS**

#### **Waste Reduction**

Reduced VOC emissions from 103 tons in 1990 to 49 tons in 1991, 27.5 tons in 1992, to 14 tons in 1993.

Reduced hazardous waste shipment from 32 drums/year to 16 drums/year.

**Economics** (Information not available.)

### **HEALTH & SAFETY BENEFITS**

Acetone, MEK, and toluol can cause varying health problems if inhaled, ingested, or absorbed through skin cuts. All are eye and skin irritants, may cause many systemic problems ranging from headaches, internal organ damage, nervous system disorders, and possibly cancer. All of these liquids are highly flammable.

**TECHNOLOGY TRANSFER**

The cone-shaped die is lowered into a pulp vat where a vacuum strains the fibers out of the water into the die. The new non-solvent cone treatments create a paper emulsion that contains no hazardous solvents.

**PROBLEMS**

A thermal oxidizer to burn solvents was considered, but burning large volumes of VOCs produces tons of carbon dioxide, some levels of carbon monoxide, and other troublesome gases. Customers had to be asked to rate the new emulsion to determine sound quality, durability, and adequate waterproofing of products.

## **4.11.1 Common Operations: General Office**

### *Case Study #1*

**BUSINESS:** Aid Association for Lutherans; Appleton, Wisconsin  
**WASTE ORIGIN:** General Office Operations  
**WASTE TYPES:** Paper Products (Office Papers, Newspaper, Cardboard, Phone Books, Magazines, Dishes, and Cups), Polystyrene Containers, Used Motor Oil, Used Cafeteria Grease and Cooking Oils, Yard Wastes, and Construction Materials

#### **COMPANY BACKGROUND**

Aid Association for Lutherans (AAL) is a fraternal benefits society, providing insurance, benefits, and educational programs to Lutherans and their families.

#### **MOTIVATION**

Reduce wastes and disposal costs.

#### **STRATEGIES**

Source reduction, recycling, and reuse programs through employee education and involvement.

#### **ORIGINAL PROCESS**

The volume of many liquid and solid wastes required expensive disposal costs. Wastes were generated in offices, the cafeteria, vehicle maintenance shop, grounds maintenance, and remodeling activities.

#### **NEW PROCESS**

Employee participation ranged throughout all office operations. Offices recycled all papers. Cafeteria managers replaced paper plates and cups with reusable ceramic ware, while recycling grease and cooking oils with a rendering firm. Used motor oils were recycled. Yard wastes were composted and used for mulch. Construction materials like steel and other metals were collected for recycling.

#### **RESULTS**

##### **Waste Reduction**

Reduced volume of office paper waste 5,250 cubic yards/year.

##### **Economics**

**Savings:** \$10,000 savings estimate based on reduced disposal costs.

**Capital Cost:** \$7,700 for a paper/cardboard compactor.

**Operating/Maintenance Cost:** Information not available.

**Payback Period:** Information not available.

#### **PROBLEMS**

The main problem was achieving total employee participation in waste reduction programs.

## **4.11.1 Common Operations: General Office**

*Case Study #2*

**BUSINESS:** Norand Corporation; Cedar Rapids, Iowa

**WASTE ORIGIN:** Incandescent Office Lighting

**WASTE TYPES:** Energy Consumption

### **COMPANY BACKGROUND**

Norand manufactures sophisticated hand-held computer systems and related equipment. The company manufactures virtually all components and products through machining, fabrication, assembly, plating, soldering, and finishing operations.

### **MOTIVATION**

High electricity costs.

### **STRATEGIES**

Replace inefficient incandescent light bulbs with lower energy-consuming, longer-lived fluorescent bulbs, where possible.

### **ORIGINAL PROCESS**

The company identified 40 locations where traditional incandescent lighting was being used in stairwells.

### **NEW PROCESS**

Incandescent bulbs were replaced with compact fluorescent bulbs that screw directly into existing incandescent fixtures in the stairwells.

### **RESULTS**

#### **Waste Reduction**

Reduced energy consumption.

#### **Economics**

**Savings:** Reduced electricity costs by \$2,954 per year. Reduced maintenance costs of replacing shorter-lived incandescent.

**Capital Cost:** Information not available.

**Operating/Maintenance Cost:** Information not available.

**Payback Period:** Information not available.

### **TECHNOLOGY TRANSFER**

Compact fluorescent bulbs (ballast/bulb unit) are made to fit into traditional incandescent lighting fixtures.

### **PROBLEMS**

The fluorescent units are more expensive than traditional incandescent bulbs.

## **4.11.1 Common Operations: General Office**

*Case Study #3*

**BUSINESS:** University of Wisconsin-Madison Solid Waste Alternatives Project (SWAP); Madison, Wisconsin

**WASTE ORIGIN:** Facilities Operations and Maintenance

**WASTE TYPES:** Office Materials, Furniture, Computer Equipment, and Construction Materials

### **PROJECT BACKGROUND**

Started in November of 1994, and known as the “SWAP Shop,” this university program redefines junk on the UW-Madison Campus by finding new users for tons of formerly discarded property. Materials can include antiquated computers and office supplies to old construction materials.

### **MOTIVATION**

SWAP’s mission is the design of new programs to expand the UW’s procurement of recycled products, reduction of waste at the source, reuse of unwanted materials, and recycling of non-traditional products.

### **STRATEGIES**

The project concentrates on finding new customers for campus property of lower value than surplus property which has traditionally been sent to the landfill. The program differs from existing campus recycling programs that focus on the daily operations of traditional recycling.

### **ORIGINAL PROCESS:**

Most university wastes and unsalable surplus was landfilled.

### **NEW PROCESS**

This unique approach also provides one-on-one outreach and education for university buyers and decision-makers. Offices with unwanted are encouraged to call the SWAP Shop, which will pick up these materials free of charge. The program maintains an interactive World Wide Web site that lists its total inventory.

### **RESULTS**

#### **Waste Reduction**

SWAP has redistributed in its first seven months more than 136,000 pounds of previously “unwanted” property to the UW campus and the public. While much of the material is reused or repaired, some has been broken down into high-grade salvage. These efforts have saved an estimated 60 percent of these reused materials from the landfill.

**Economics**

SWAP charges buyers the market rate for salvage, about 5 cents a pound.

Other SWAP services include an information campaign on environmentally sensitive purchasing (ESP), which helps UW-Madison buyers understand how they can save money and identify recycled or surplus supplies.

**TECHNICAL ASSISTANCE**

SWAP received a Wisconsin Department of Natural Resources matching grant in 1994 for its first year of operation. In 1996, the program merged with the University's surplus services to offer a comprehensive collection and redistribution program.

**SOURCE REFERENCE**

For more information on SWAP, call 608/262-9641 or 608/265-3417; or find its web site at <http://env.fpm.wisc.edu>.

## **4.11.2 Common Operations: Coating/Painting**

### *Case Study #1*

**BUSINESS:** Northern Engraving Corporation; La Crosse, Wisconsin  
**WASTE ORIGIN:** Automotive Trim Manufacturing  
**WASTE TYPES:** Petroleum-based Solvent Coatings, Solvent Cleaners, and Volatile Organic Compound (VOC) Air Emissions

#### **COMPANY BACKGROUND**

Northern Engraving decorates and forms automotive trim and assemblies. The company employs over 2,000 people in Wisconsin, Iowa, and Minnesota.

#### **MOTIVATION**

Reduce volumes of hazardous waste and associated disposal costs, reduce inefficient use of raw materials, and reduce future hazardous waste liabilities.

#### **STRATEGIES**

Improve design and operation of roll coating equipment to reduce paint and clean up wastes.

#### **ORIGINAL PROCESS**

Faceplates are decorated and formed prior to assembly. The process includes applying a primer and topcoat to aluminum sheets, which consist of solvent-based coatings. Several solvent blends were used to clean equipment during and after use.

#### **NEW PROCESS**

Northern Engraving modified its existing roll coater to increase its efficiency and eventually built its own, more efficient coater. Schedules were adjusted to maximize raw material usage and reduce the number of clean ups required. Coating operators were trained in proper use of the new coater.

#### **RESULTS**

##### **Waste Reduction**

Reduced coating wastes from 2,130 gallons/year to 1,400 gallons/year.

Reduced solvent wastes from 1,875 gallons/year to 700 gallons/year.

##### **Economics**

**Savings:** \$15,000 annual savings in raw material and waste disposal costs.

**Capital Cost:** Costs borne internally.

**Operating/Maintenance Cost:** No significant changes.

**Payback Period:** Less than two years.

**HEALTH & SAFETY BENEFITS**

Reducing hydrocarbon-based paint and solvent wastes reduced worker exposure to these suspected carcinogens and eye and skin irritants.

**TECHNOLOGY TRANSFER**

Northern Engraving worked with its suppliers to find ways to reduce roller swelling which reduced coating loss during operations. Realizing that the desired efficiency could not be achieved with existing equipment, the facility constructed its own, more efficient coater.

## **4.11.3 Common Operations: Metal Cleaning**

### *Case Study #1*

**BUSINESS:** Northern Precision Casting; Lake Geneva, Wisconsin

**WASTE ORIGIN:** Investment Casting Process

**WASTE TYPES:** Solvent Cleaner, 1,1,1-Trichlorethane (TCA)

#### **COMPANY BACKGROUND**

Northern Precision Casting (NPC) is an investment casting operation over 150 employees. NPC casts more than 200,000 pounds of metal each month. Casting is done by pouring molten metal into ceramic molds. These molds are made by coating a wax pattern assembly with ceramic material. The wax surfaces must be clean for the ceramic coatings to adhere to the wax material. TCA solvent was used to clean the wax assemblies and would then evaporate, creating fugitive emissions of TCA while leaving a clean wax surface for the ceramic coating process.

#### **MOTIVATION**

The fugitive TCA air emissions caused concern for environmental regulations.

#### **STRATEGIES**

Replaced 1,1,1-TCA with citrus-based non-hazardous solvents.

#### **ORIGINAL PROCESS**

NPC released TCA air emissions of 18,000 pounds from the plant. TCA liquid solvent handling and storage created the potential for leaks or spills.

#### **NEW PROCESS**

NPC tried CFC-111 as a substitute solvent, which lowered but did not eliminate emission levels. Its solvent manufacturer eventually found Latrex citrus-based solvent. This non-hazardous cleaning alternative created a water-soluble liquid waste that could be discharged to the local publicly-owned treatment works (POTW).

#### **RESULTS**

##### **Waste Reduction**

Eliminated annual use of 18,000 pounds of TCA solvent feedstock.

Eliminated 18,000 pounds of annual fugitive TCA air emissions.

##### **Economics**

**Capital Costs:** None.

**Operating/Maintenance Costs:** No significant change.

**Payback Period:** Information not available.

**PROBLEMS**

Solvent substitution raised concerns over potential impact on product quality, but no change resulted. Initially, the citrus-based solvent had an offensive odor to workers, but this was resolved.

## **4.11.3 Common Operations: Metal Cleaning**

*Case Study #2*

**BUSINESS:** Briggs & Stratton; Milwaukee, Wisconsin  
**WASTE ORIGIN:** Small Engine Manufacturing  
**WASTE TYPES:** Chlorinated Metal Cleaning Solvents, Trichloroethylene (TCE), and 1,1,1-Trichloroethane

### **COMPANY BACKGROUND**

Briggs & Stratton manufactures small engines.

### **MOTIVATION**

Fugitive chlorinated solvent air emissions presented serious concerns over worker safety and environmental regulatory compliance. Using chlorinated solvents increased potential liability and costs associated with storage, transportation, and disposal of these hazardous wastes.

### **STRATEGIES**

Replace chlorinated solvents with aqueous detergent for metal parts cleaning.

### **ORIGINAL PROCESS**

The company used a vapor degreasing process to clean metal parts. This process suspended dirty parts above boiling chlorinated solvent to allow solvent vapors to perform cleaning. This process wasted a significant amount of solvent through air emissions and spent cleaning solvent.

### **NEW PROCESS**

The company converted their solvent degreasing unit to an aqueous cleaning system, which substituted a heated water-detergent solution (with rust inhibitor) for chlorinated solvents. Oily residue from parts cleaning is removed from the dirty wash and rinse stream and reused as part of a fuel program. The remaining wastewater was disposed to the local publicly-owned treatment works (POTW).

### **RESULTS**

#### **Waste Reduction**

Eliminated chlorinated solvents and solvent-contaminated machining oils and metal fragments from operations.

Eliminated fugitive air emissions and solvent recycling costs.

#### **Economics**

**Savings:** Information not available.

**Capital Cost:** \$10,000

**Operating/Maintenance Cost:** Information not available.

**Payback Period:** Three months.

**HEALTH & SAFETY BENEFITS**

Worker environment was improved by eliminating chlorinated solvents from operations, since TCE is a suspected carcinogen, mildly toxic by ingestion or inhalation, is an eye and severe skin irritant, and chronic exposure can damage the liver and other organs. Methyl chloroform also is a questionable carcinogen, an eye and skin irritant, and is moderately toxic when ingested or inhaled.

**TECHNOLOGY TRANSFER**

Briggs & Stratton has shared their cleaning technology with other companies, particularly suppliers.

**PROBLEMS**

Metal parts cleaned by aqueous methods are susceptible to rust and corrosion. This required additional installation of an air drying system. The company also had to modify a lower solvent storage tank and heating unit to provide the heat required by the aqueous cleaning process.