

SECTION THREE

Small Business Waste Reduction Tip Sheets

3.1.1 Common Operations: General Office

Tip Sheet #1

WASTE ORIGIN: **General Operations**

WASTE TYPES: Shipping/Packing Materials and Office Materials

WASTE REDUCTION AND RECYCLING METHODS:

- ! **Office operations** can reduce or eliminate waste from the start:
 - ! Choose suppliers who provide **recyclable packaging and packaging** containing recycled content; reuse shipping/packing materials;
 - ! Improve purchasing and inventory management to **prevent overstocking supplies** that are not used within one month or have limited shelf life;
 - ! Remove company name from **direct-mail** lists;
 - ! Make double-sided copies, reduce **number of paper copies** of receipts, and use recycled copy and register papers;
 - ! Buy products or materials with **recycled content**; reuse materials that would have been disposed of after one use;
 - ! Save **polystyrene “peanuts”** to return to supplier for reuse or donate;
 - ! Shred non-recyclable **paper items for packing materials**;
 - ! Enclose a **note in packages** asking people to reuse packaging materials;
 - ! Encourage **all employees to get involved** in waste reduction programs. Use incentives to involve all staff, and encourage suggestions to improve programs.
- ! Make **recycling** easy for staff and office patrons:
 - ! Provide **separate bins for trash**, one for paper/cardboard, and one for mixed recyclables;
 - ! Create a **list of waste items**, laminate it, and hang it in clear view to tell people the destination of each item.
- ! Use a **recycling and source reduction program** that includes the following:
 - ! **Management must support** the program by allocating staff time and supporting ideas generated by employees;
 - ! **Select a lead person** to be the program manager with planning, implementing, and monitoring responsibility and authority;
 - ! **Involve employees** by encouraging ideas for waste and energy-reduction; support use of e-mail and suggestion boxes for ongoing communication;
 - ! Keep **employees involved**;
 - ! **Publicize attained goals**. Reward efforts by using promotions and incentives.
- ! Join with other businesses for **cooperative hauling** of trash and recyclables. Sharing trash and recycling bins and disposal costs saves money and fosters cooperation.
- ! **Donating usable wastes and recyclables** to community groups fosters goodwill, protects the environment, and is a positive marketing strategy:
 - ! Donate recycled aluminum cans to a **school’s environmental awareness program**. The money can go to teach students about the environment.

- ! Contact area or local recycling companies about **possible free pick up** of recyclables on a regular schedule.
- ! Work with **state, city, or county solid waste officials** to get contacts and ideas for reuse and recycling programs. These agencies can provide technical or financial aid in starting a program.
- ! Use the phonebook and **network with other businesses** to learn about their programs.
- ! Use your recycling and source reduction efforts as a **marketing tool**:
 - ! Local business or government agencies frequently recognize these efforts by sponsoring ***awards and recognition programs.***

Sources:

Fact Sheet: *Business Waste and Recycling: A Guide for the Workplace*, Wisconsin Department of Natural Resources, Waste Reduction and Recycling Program, Bureau of Solid and Hazardous Waste Management, June 1995, PUB-SW-128 95 Rev.

Pollution Prevention: A Guide to Program Implementation, Solid and Hazardous Waste Education Center, University of Wisconsin-Extension, July 1993.

Fact Sheet: *Waste Reduction Tips for the Office*, Inform, Inc., New York, NY.

Fact Sheet: *Popular Source Reduction Actions for Business*, Minnesota Office of Waste Management, October 1992.

3.1.1 Common Operations: General Offices

Tip Sheet #2

WASTE ORIGIN: General Operations

WASTE TYPES: Disposable Office Items, Durable Office Equipment (Photocopiers, Fax Machines, Computers, Typewriters, Coffee Makers, Light Bulbs, Furniture), and Toxic Office Materials

WASTE REDUCTION AND RECYCLING METHODS:

- ! When mailing or shipping, **switch from disposable**, one-time use materials, to reusables:
 - ! Ship your office's materials in **reusable/reused packaging**;
 - ! Encourage suppliers to ship material in **reusable containers**;
 - ! **Reuse envelopes** with metal clasps;
 - ! Use reusable envelopes for **interoffice mail**.
- ! Many **disposable lunchroom, breakroom, or cafeteria items** can become reusables:
 - ! Use **nondisposable tableware** like mugs, silverware, and plates;
 - ! Use **cloth towels** in kitchens and bathrooms;
 - ! Buy **reusable filters** for coffee machines;
 - ! Encourage employees to **reuse lunch bags**;
 - ! Consider purchasing a water cooler to **replace individual bottled water**.
- ! **Typical expendables** can become reusable:
 - ! Buy mechanical **pencils and refillable pens**;
 - ! Buy refillable **tape dispensers**;
 - ! Refill **laser cartridges** and re-ink typewriter ribbons;
 - ! Use **solar-powered** calculators and battery rechargers;
 - ! Use undated, erasable **wall calendars**.
- ! Extend the life of **durable office equipment**:
 - ! **Buy or lease durable and repairable equipment** such as photocopiers, fax machines, computers, typewriters, and coffee makers;
 - ! Consider length and coverage of **warranties and service contracts** when selecting products;
 - ! Give or sell outdated computer systems to a **computer reconditioning/repair business**;
 - ! Recondition or repair older office furniture or **donate it to local charitable groups**;
 - ! Buy **sturdy desk supplies**, such as bookends, file holders, and staplers;
 - ! Use longer lasting **light bulbs**;
 - ! Encourage the building manager to install **reusable air filters** in heating, ventilation, and air conditioning systems.
- ! **Purchase less toxic and nontoxic** alternatives to potentially harmful office materials:
 - ! **Replace aerosol spray** cans with reusable pump-spray bottles;
 - ! Buy cleaning **products with nontoxic content** in large reusable containers, or use homemade cleaners such as vinegar and baking soda;
 - ! Buy products with **less toxic ink and dye**;

- ! Purchase *unbleached paper* products;
- ! Use *low toxic correction fluid* or correction tape;
- ! **When redesigning an office**, use less toxic products:
 - ! Buy equipment that does not require *batteries that can leak* hazardous chemicals:
- ! **Other ways to reduce** office waste can include:
 - ! *Sharing newspapers and magazines* among departments or individual colleagues;
 - ! *Organizing swaps* of unnecessary items from home with co-workers;
 - ! *Donating* food, furniture, and other materials to local organizations like homeless shelters or charities;
 - ! *Sharing source-reduction ideas* among co-workers.
- ! Work with **city or county solid waste officials** to get contacts and ideas for reuse and recycling programs. Using the phonebook, talk with other businesses to learn about their programs.

Sources:

Business Guide for Reducing Solid Waste, U.S. EPA, Solid Waste and Emergency Response, September 1993, EPA/530-K-92-004.

Fact Sheet: *Waste Reduction Tips for the Office*, Inform, Inc., New York, NY.

Fact Sheet: *Popular Source Reduction Actions for Business*, Minnesota Office of Waste Management, October 1992.

Waste Prevention Pays Off: Companies Cut Waste in the Workplace, U.S. EPA, Solid Waste and Emergency Response, November 1993, EPA/530-K-92-005.

3.1.1 Common Operations: General Offices

Tip Sheet #3

WASTE ORIGIN: Light Bulbs and Lighting Fixtures

WASTE TYPES: Fluorescent, Incandescent and High-intensity Discharge Lamps, Chemicals (mercury, lead, and sometimes cadmium), Glass, Aluminum, and Ballasts (PCBs)

WASTE REDUCTION AND RECYCLING METHODS:

- ! **Convert overhead four-bulb** fluorescent fixtures to high-efficiency two-bulb fixtures:
- ! Change to **fluorescent exit sign** bulbs:
 - ! One fluorescent exit sign bulb *outlives six-eight incandescent bulbs*, creates less waste, requires less maintenance, uses 25 percent less electricity, and produces the same amount of light.
- ! Consider using **compact fluorescent table and flood lights**; be sure these units allow the bulb to be replaced separately from the ballast.
- ! **Disposing of lamps requires special handling** to prevent heavy metal discharge into the environment. These types of lamps include:
 - ! **Tube-style and compact globe** shaped fluorescent lamps;
 - ! Many different types of **high-intensity discharge (HID)** lamps, such as:
 - ! *Mercury vapor lamps* producing a blue-white light and often used outside;
 - ! *High-pressure sodium-vapor* lamps which produce a white-yellow light are generally used for street lighting, parking lot lighting, and outdoor security lighting;
 - ! *Low-pressure sodium vapor* lamps emit orange light and are used mainly in commercial settings;
 - ! *Metal halide* lamps are newer, more efficient HID lights found in homes and businesses.
- ! **Businesses that do not recycle their waste lamps** may have to obtain storage, transport and other licenses or approvals from state solid and hazardous waste regulators:
 - ! Contact state, county, local, or city solid and hazardous waste management agencies for current **regulatory requirements** or information on area lamp recycling businesses.
- ! Safe, **on-site lamp collection** and disposal methods include:
 - ! Place waste lamp in **original box or in special cartons** provided by the lamp recycler;
 - ! **Designate a safe, well-marked location** to store waste lamps to avoid breakage or accidental mixing with other wastes;
 - ! Separate and put **broken lamps** in a heavy plastic bag inside a rigid container and handle as a hazardous waste;
 - ! Do not place broken fluorescents in **metal receptacles**. Metal boxes will absorb mercury and will also become hazardous wastes
- ! The U.S. Environmental Protection Agency sponsors a “**Green Lights Program,**” which provides free regulatory and contractor information on lamp and ballast waste disposal if a business is considering a lighting system upgrade (contact the nearest EPA regional office).

Sources:

Briefing Paper: *How to Handle Your Waste Fluorescent Lamps and Incandescent Bulbs*, Wisconsin Department of Natural Resources, Bureau of Solid & Hazardous Waste Management, Hazardous Waste Management Section, 1994, Publ. SW 195-94

Fact Sheet: *What to do with Used Fluorescent and High-intensity Discharge Lamps*, Minnesota Pollution Control Agency, January 1993.

Report: *Lighting Upgrade Waste Disposal*, U.S. EPA, Green Lights Program Lighting Upgrade Manual, February 1992.

3.1.1 Common Operations: General Offices

Tip Sheet #4

WASTE ORIGIN: Paper Use

WASTE TYPES: Photocopy, Laser Printer, Fax, and Memo Paper, File Folders, Paper Towels, Envelopes, and Calendars

WASTE REDUCTION AND RECYCLING METHODS:

- ! Eliminate **unnecessary copies**, notes, and memos by:
 - ! Posting office announcements in central locations on **bulletin boards**;
 - ! Sharing and **circulating** documents;
 - ! Setting up **central filing systems**;
 - ! Reformatting **faxes** to omit cover sheets;
 - ! Editing on the computer **before printing**;
 - ! Storing files on **computer disks**;
 - ! Using **small pieces of paper** for short memos.
- ! Use all paper on **two sides**; whenever possible, by:
 - ! Increasing **two-sided copying**;
 - ! Printing rough drafts and informal memos on the **unused side of draft paper**;
 - ! Loading laser printer paper trays with **draft paper**;
 - ! Reusing draft and computer paper for **notes and scrap paper**.
- ! **Further reduce** paper by:
 - ! **Single space** documents, where possible;
 - ! Setting **margins narrower** for drafts;
 - ! Changing margins to **avoid pages with little text**;
 - ! Using a **smaller type** size;
 - ! Refolding and **reusing file folders**;
 - ! Using **two-way envelopes** if regular correspondence occurs with other facilities;
 - ! Targeting specific audiences for **direct mail** to reduce contributions to direct-mail;
 - ! Avoiding **duplication** on mailing lists.
- ! Encourage **office managers** to buy:
 - ! **Laser printers** that can make double-sided copies;
 - ! A program that allows **faxing from a computer** to avoid print outs;
 - ! Fax machines that use **plain paper**;
 - ! **Narrow-lined** note pads;
 - ! Electronic mail (**e-mail**) systems;
 - ! **Photocopy machines** that are set for two-sided copying (adapt existing machine);
 - ! **Reusable calendars** that are hard-surfaced, perpetual calendars can be wiped clean and reused year after year (used with water-based markers);
 - ! Changing to modern **cotton towel dispensers** in place of paper towels.

Sources:

Fact Sheet: *Waste Reduction Tips for the Office*, Inform, Inc., New York, NY.

Fact Sheet: *Popular Source Reduction Actions for Business*, Minnesota Office of Waste Management, October 1992.

3.1.1 Common Operations: General Offices

Tip Sheet #5

WASTE ORIGIN: **Recyclable Materials**

WASTE TYPES: Shipping/Packing Materials, Office Papers, and Food and Drink Containers

WASTE REDUCTION AND RECYCLING METHODS:

- ! **Office operations** can reduce or eliminate waste from the start:
 - ! Choose suppliers who provide **recyclable packaging and packaging** that contains recycled content; reuse shipping/packing materials;
 - ! Improve purchasing and inventory management to **prevent overstocking** supplies that aren't needed or have limited shelf life;
 - ! Remove company name from **direct-mail lists**;
 - ! Make **double-sided copies**, reduce number of paper copies of receipts, use recycled copy and register papers;
 - ! Buy products or materials with **recycled content**; reuse materials that would have been tossed after one use;
 - ! Buy in **bulk quantities** when appropriate;
 - ! Encourage managers and staff to get **involved in waste reduction programs**; use incentives to involve employees and encourage suggestions to improve programs.
- ! Make **recycling** easy for staff and office patrons:
 - ! Provide **separate bins for trash**, one for paper/cardboard, and one for mixed recyclables:
 - ! *Create a list of waste items*, laminate it, and hang it in clear view to tell staff or patrons the exact destination of every item.
- ! Implement a **recycling and source reduction program** that includes the following key features:
 - ! Management must **support the program** by allocating staff time and supporting ideas generated by employees;
 - ! **Select a lead person** to manage the program; duties could include planning, implementing, and monitoring the program;
 - ! **Involve the employees** by encouraging ideas for waste and energy reduction; support use of e-mail and suggestion boxes for ongoing communication;
 - ! **Keep employees involved**;
 - ! **Publicize attained goals**, reward these efforts; use promotions and incentives.
- ! Join forces with business neighbors to **create cooperative hauling** of trash and recyclables. Sharing the same trash and recycling bins and disposal service saves everybody money and promotes cooperation.
- ! **Donating usable wastes and recyclables** to community groups to foster goodwill, protect the environment, and to create a positive marketing strategy:
 - ! Donate recycled aluminum cans to a **school's environmental awareness program**. The money can go toward teaching students about the environment.

- ! Contact area or local recycling companies about **possible free pick up** of collected recyclables on a regular schedule.
- ! Work with **state, city, or county solid waste officials** to get contacts and ideas for reuse and recycling programs. These agencies can provide technical or financial assistance.
- ! Use the phone book and **network with other businesses** to learn about their programs.
- ! Use your recycling and source reduction efforts as a **marketing tool**:
 - ! Local business or government agencies frequently recognize these efforts by sponsoring ***awards and recognition programs.***

Sources:

Business Guide for Reducing Solid Waste, U.S. EPA, Solid Waste and Emergency Response, September 1993, EPA/530-K-92-004.

Fact Sheet: *Waste Reduction Tips for the Office*, Inform, Inc., New York, NY.

Fact Sheet: *Popular Source Reduction Actions for Business*, Minnesota Office of Waste Management, October 1992.

Waste Prevention Pays Off: Companies Cut Waste in the Workplace, U.S. EPA, Solid Waste and Emergency Response, November 1993, EPA/530-K-92-005.

3.1.2 Common Operations: Groundskeeping/Landscaping

Tip Sheet #1

WASTE ORIGIN: Grounds Maintenance

WASTE TYPES: Grass Clippings, Leaves, Tree Branches, and Brush

WASTE REDUCTION METHODS:

- ! **On-site composting and “grasscycling”** can reduce solid waste volumes and disposal costs by:
 - ! **Leaving grass clippings lie**, significantly reducing waste volume, while conserving soil nutrients and saving fertilizer costs.
 - ! A **mulching mower** can cut the grass into smaller pieces, thereby decomposing faster; regular mowers can be retrofit with mulching blades.
 - ! **Composting** leaves and branches along with grass trimmings and other organic matter, creating soil additive or mulch.
 - ! High quality *compost could be sold* (as mulch, potting soil, landfill cover, or soil amendment) to cover groundskeeping costs.
 - ! *Chipping* other ground debris, like branches, providing mulch to reduce weeds and conserve moisture around interior plants or around landscaped trees, shrubs, and bushes.
- ! Numerous options for **off-site composting** of yard waste can reduce their on-site management and disposal costs:
 - ! Municipalities often serve as **clearinghouses** for excess grass clippings or leaves; this type of exchange could be started more informally between businesses or with community centers.
 - ! **Community-sponsored programs** may allow businesses to place leaves at curbside for pickup.
 - ! **Hauler-sponsored programs** often pay for bagged leaves for commercial composting or landspreading.
 - ! **Drop-off programs** are often sponsored by communities, haulers, nurseries, farmers, or others interested in managing yard waste.
- ! Choose a **low maintenance landscape design**: slow-growing species and evergreens generally create little debris.
- ! State **solid waste laws** often require responsible government agencies to provide information on local yard waste management options; contact the local, county, or state recycling coordinator.
- ! **Other information sources** include local county extension agents, area refuse haulers, or the Yellow Pages, where commercial yard waste processors may be listed.
- ! **Never burn yard waste.** Open leaf burning **produces particulate air pollutants and chemicals** such as phenols and hydrocarbons. These contain toxic, irritant, cancer-causing compounds, and carbon monoxide.

- ! **Wildfires** are usually caused by unregulated yard waste burning. Wildfires cause extensive property loss, are expensive to control and extinguish, and endanger the health and safety of people and animals.

Sources:

Backyard Composting: Your Complete Guide to Recycling Yard Clippings, Harmonious Press; Ojai, CA, 1992.

Business Guide for Reducing Solid Waste, U.S. EPA, Solid Waste and Emergency Response, November 1993, EPA/530-K-92-004.

Composting to Reduce the Waste Stream: A Guide to Small Scale Food and Yard Waste Composting, Northeast Regional Agricultural Engineering Service, Cooperative Extension, 1991, Ithaca.

Home Composting Handbook; Dane County Public Works, University of Wisconsin-Extension, Wisconsin Dept. of Natural Resources; 1992.

Options for Managing Leaves, Solid and Hazardous Waste Education Center, University of Wisconsin-Extension.

Waste Prevention Pays Off: Companies Cut Waste in the Workplace, U.S. EPA, Solid Waste and Emergency Response, November 1993, EPA/530-K-92-005.

3.2.1 Agricultural Business: Farms and Suppliers

Tip Sheet #1

WASTE ORIGIN: General Operations

WASTE TYPES: Petroleum Products and Farm Chemicals

WASTE REDUCTION AND RECYCLING METHODS:

- ! Locate tanks and storage **away from major traffic flow** areas.
- ! Isolate farm **chemical and petroleum storage** tanks from feed, seed, shop, office, and other storage areas.
- ! **Minimize distance** between chemical mixing and loading areas.
- ! Store pesticides and fertilizers in **separate buildings**.
- ! Make a scale drawing of your **site plan** to locate storage tanks, utilities, and other important features. The drawing should include:
 - ! Underground and above-ground **fuel tanks**, other flammable liquid storage tanks, and associated pipelines;
 - ! **Water** wells, fire hydrants, and water lines;
 - ! **Propane** tanks, natural gas lines, and main gas shutoff valve;
 - ! **Sewer** lines, septic tank, and sewage lagoons;
 - ! **Natural features** like drainage pattern of site, ponds, creeks, rivers, lakes, or prevailing seasonal wind directions;
 - ! **Electrical service** lines, transformers, and service disconnect;
 - ! **Containment or pad** areas designated for storage, mixing, or loading;
 - ! **Road**, driveways, property lines, or easements.
- ! **Train employees** in safe handling of farm chemicals, equipment and wastes; laminate and post procedures as easily-read, quick references.
- ! Develop an **emergency response plan**; train employees to handle spills and leaks; post emergency phone numbers for assistance.
- ! Reduce **evaporation loss and chance of spills** with tight-fitting bungs and lids.
- ! Use spigots and pumps for **dispensing new materials** for more precise dispensing and less waste.
- ! Use funnels for **transferring wastes** to storage containers.
- ! Use **tanks and containers** only according to manufacturer's instructions and only for their intended purpose.
- ! Periodically test **overflow alarms on storage tanks**; periodically test and monitor underground tanks for leaks (monitoring wells, vapor monitoring, and automatic tank gauging systems).
- ! Install an adequate **leak-detection system** if an existing tank is near a drinking water well.

Sources:

Fact Sheet 6b: *Petroleum Product and Farm Chemical Storage*, Pollution Prevention Tool Kit, University of Nebraska-Lincoln Cooperative Extension & Biological Systems Engineering, January 1995.

Fact Sheet 6c: *Pollution Prevention: In the Farm Cooperative through Improved Basic Operations*, Pollution Prevention Tool Kit, University of Nebraska-Lincoln Cooperative Extension & Biological Systems Engineering, January 1995.

3.2.1 Agricultural Business: Farms and Suppliers

Tip Sheet #2

WASTE ORIGIN: Chemical Storage, Mixing, and Loading

WASTE TYPES: Fertilizers and Pesticides

STORAGE PRACTICES:

- ! Use **labels on windows or doors** to alert emergency personnel that pesticides, fertilizers, or other products are stored in the structure.
- ! Lock storage areas or buildings to provide **security and prevent accidental spills** or unauthorized use of chemicals.
- ! Store materials on pallets for **clear leak detection**.
- ! Store drums off concrete floors to **prevent corrosion** from moisture.
- ! Use easier to clean and sturdier **steel shelving**.
- ! **Stack containers** according to manufacturer's instructions.
- ! Store **dry products** above liquids.
- ! Store herbicides, insecticides, and fungicides on **separate shelves or areas**.
- ! Arrange storage space so **aisles are wide enough** for safe maneuvering; keep jugs and bags clear from high traffic areas.
- ! **Securely cover** all containers to prevent spills, evaporation loss, or fumes.
- ! Properly store products to **preserve their shelf life**.
- ! **Dry, bulk fertilizer** should be stored on an impermeable surface under cover.

WASTE REDUCTION AND RECYCLING METHODS:

- ! **Train employees** in proper chemical handling procedures; employees should wear proper protective clothing at all times.
- ! Use an **impermeable mixing and loading pad** such as sealed, liquid-tight concrete:
 - ! Pad should have a **sloped surface** with watertight walls and curbs;
 - ! Provide **secondary containment** while transferring liquids to spraying equipment or nurse tanks;
 - ! Provide **independent shallow sumps** in each containment area to prevent cross-contamination from spills;
 - ! **Size of the pad** should allow for containing leaks from bulk tanks, washwater from cleaning equipment, and spills from transferring chemicals to the sprayer or spreader;
 - ! Pad should **not allow stormwater** to enter it.
- ! When **unable to use a mixing and loading pad**:
 - ! Avoid handling pesticides **near a well, stream, or wetland**;
 - ! Protect surfacewater by **using a nurse tank** to transport water to mixing and loading site;
 - ! Prevent chemical buildup in the soil by **moving the mixing site** each year within the field of application.

- ! Avoid mixing **incompatible materials**:
 - ! Read product labels when **combining two or more pesticides** in the same tank;
 - ! Reduce **waste from incompatible** chemicals:
 - ! Perform a *small-jar compatibility test* with the carrier to be used in the field;
 - ! Add a *compatibility agent* to the chemical mixture if recommended.
- ! Use a **backsiphon prevention device** on the well or hydrant water supply; provide a 6-inch air gap between the water hose and top of the sprayer tank.
- ! Use a **closed chemical handling system** that transfers pesticide directly from the storage container to applicator equipment through a hose.
- ! Eliminate **leftover premixed pesticide** by using a direct injection system.
- ! **Triple- or pressure-rinse** empty chemical containers immediately; pour rinsewater back into spray tank (suspension formulas that tend to settle and harden in container may need extra rinsing).

Sources:

Fact Sheet 6d: *Pollution Prevention: In the Farm Cooperative through Improved Chemical Handling and Application*, Pollution Prevention Tool Kit, University of Nebraska-Lincoln Cooperative Extension & Biological Systems Engineering, January 1995.

Worksheet #2: *Assessing the Risk of Groundwater Contamination from Pesticide Storage and Handling*, Farmstead Assistance System (Farm-A-Syst), University of Wisconsin-Extension, July 1991 (G3536-2W).

Worksheet #3: *Assessing the Risk of Groundwater Contamination from Fertilizer Storage and Handling*, Farmstead Assistance System (Farm-A-Syst), University of Wisconsin-Extension, July 1991 (G3536-3W).

3.2.2 Agricultural Business: Pesticide Applicators

Tip Sheet #1

WASTE ORIGIN: General Operations

WASTE TYPES: Petroleum Products and Farm Chemicals

WASTE REDUCTION AND RECYCLING METHODS:

- ! Locate tanks and storage **away from major traffic flow** areas.
- ! Isolate farm **chemical and petroleum storage** tanks from feed, seed, shop, office, and other storage areas.
- ! **Minimize distance** between chemical mixing and loading areas.
- ! Use **separate buildings** for storing pesticides and fertilizers.
- ! Make a scale drawing of your **site plan** showing locations of storage tanks, utilities, and other important features. The drawing should include:
 - ! Underground and above-ground **fuel tanks**, other flammable liquid storage tanks, and associated pipelines;
 - ! **Water** wells, fire hydrants, and water lines;
 - ! **Propane** tanks, natural gas lines, and main gas shutoff valve;
 - ! **Sewer** lines, septic tank, and sewage lagoons;
 - ! **Natural features** like drainage pattern of site, ponds, creeks, rivers, lakes, or prevailing seasonal wind directions;
 - ! **Electrical service** lines, transformers, and service disconnect;
 - ! **Containment or pad** areas designated for storage, mixing, or loading;
 - ! **Road**, driveways, property lines, or easements.
- ! **Train employees** in safe handling of farm chemicals, equipment, and wastes; laminate and post procedures as easily-read, quick references.
- ! Develop an **emergency response plan**; train employees to handle spills and leaks; post emergency phone numbers for assistance.
- ! Reduce **evaporation loss and chance of spills** with tight-fitting bungs and lids.
- ! Use spigots and pumps for **dispensing new materials** for more precise dispensing and less waste.
- ! Use funnels for **transferring wastes** to storage containers.
- ! Use **tanks and containers** only according to manufacturer's instructions and only for their intended purpose.
- ! Periodically test **overflow alarms on storage tanks**; periodically test and monitor underground tanks for leaks (monitoring wells, vapor monitoring, and automatic tank gauging systems).
- ! Install an adequate **leak-detection system** if an existing tank is near a drinking water well.

Sources:

Fact Sheet 6b: *Petroleum Product and Farm Chemical Storage*, Pollution Prevention Tool Kit, University of Nebraska-Lincoln Cooperative Extension & Biological Systems Engineering, January 1995.

Fact Sheet 6c: *Pollution Prevention: In the Farm Cooperative through Improved Basic Operations*, Pollution Prevention Tool Kit, University of Nebraska-Lincoln Cooperative Extension & Biological Systems Engineering, January 1995.

3.2.2 Agricultural Business: Pesticide Applicators

Tip Sheet #2

WASTE ORIGIN: Chemical Storage and Handling

WASTE TYPES: Damaged Chemicals, Expired or Unusable Pesticides, Spills, Residuals in Containers, and Empty Containers/Packages

WASTE REDUCTION AND RECYCLING METHODS:

- ! Buy **only the amount you will use** in one growing season.
- ! **Store chemicals properly:** seal and close, store in original containers, and protect from weather in dry, well-ventilated area.
- ! **Triple rinse all containers** and empty all concentrate into sprayer tank, letting it drain thoroughly (at least 30 seconds) by adding diluent to about 1/4 volume of container, swirl thoroughly, then pour into spray tank.
- ! Purchase chemicals in **reusable, returnable containers** (dedicated, "mini-bulk" containers).
- ! Purchase chemicals in **containers which can be dissolved** in the tank.
- ! Use **Integrated Pest Management (IPM)** techniques such as: crop rotation, disease or pest-resistant crop varieties, and drought-resistant cultivars; maintain plant health through proper watering, fertilization, etc.; accelerate crop maturation (e.g., through early planting); avoid excess fertilizer; mechanical cultivation and use organic/natural pest controls.
 - ! IPM practices for **turf** include proper site selection and preparation, grass selection, timing of seeding, fertilization, irrigation, mowing and verticutting, aerifying, and top-dressing.
- ! Carefully **calculate the volume** you will use and load only this amount.
- ! Keep the end of the fill hose above the fluid level in the spray tank to **prevent back-siphoning**.

Sources:

All Fact Sheets from *Pesticides and Water Quality*, North Carolina Agricultural Extension Service, 1988:

Fact Sheet 1: *Chemigation Practices to Prevent Groundwater Contamination.*

Fact Sheet 2: *Design for In-Field Sprayer Rinse System to Reduce Pesticide Waste.*

Fact Sheet 3: *Pesticide Container Disposal.*

Fact Sheet 4: *Disposal of Unused Pesticides, Tank Mixes and Rinsewater.*

Fact Sheet 6: *Protecting Mountain Springs from Pesticide Contamination.*

Fact Sheet 7: *Preventing Pesticide Pollution of Surface and Ground Water.*

Fact Sheet 8: *Reducing Pesticides and Saving Money Using IPM.*

Fact Sheet 10: *Protecting Groundwater from Contamination by Pesticides.*

Worksheet #2: *Assessing the Risk of Groundwater Contamination From Pesticide Storage and Handling*, Farmstead Assistance System (Farm-A-Syst), University of Wisconsin-Extension, July 1991 (G3536-2W).

3.2.2 Agricultural Business: Pesticide Applicators

Tip Sheet #3

WASTE ORIGIN: Application and Equipment Cleaning

WASTE TYPES: Unused Diluted Sprays and Rinsewater

WASTE REDUCTION AND RECYCLING METHODS:

- ! **Substitute less toxic**, less persistent, or less "leachable" pesticides.
- ! Use **well-timed spraying** only as needed based on accurate pest identification.
- ! Do **remedial spraying** based on field scouting; maintain field maps or records of previous pest problems.
- ! Do not exceed **recommended application rates**.
- ! **Calibrate** application equipment.
- ! Make sure **application rate is uniform** over field; avoid overlapping.
- ! Use **row banding application** techniques where appropriate (e.g., corn).
- ! Strategically **spot treat** where problem exists.
- ! Avoid **wind drift**.
- ! Make sure **equipment is in good working order** at all times; check for leaks.
- ! Use **gravity flow system or pressure flow system** for rinsing sprayer tank and lines before leaving field, spray on field borders, row ends, or back over portion of the crop as long as labelled rates are not exceeded.
- ! Rinse **before pesticide dries** on walls of tank and lines.

Sources:

All Fact Sheets from *Pesticides and Water Quality*, North Carolina Agricultural Extension Service, 1988:

Fact Sheet 1: *Chemigation Practices to Prevent Groundwater Contamination*.

Fact Sheet 2: *Design for In-Field Sprayer Rinse System to Reduce Pesticide Waste*.

Fact Sheet 3: *Pesticide Container Disposal*.

Fact Sheet 4: *Disposal of Unused Pesticides, Tank Mixes and Rinsewater*.

Fact Sheet 6: *Protecting Mountain Springs from Pesticide Contamination*.

Fact Sheet 7: *Preventing Pesticide Pollution of Surface and Ground Water*.

Fact Sheet 8: *Reducing Pesticides and Saving Money Using IPM*.

Fact Sheet 10: *Protecting Groundwater from Contamination by Pesticides*.

Worksheet #2: *Assessing the Risk of Groundwater Contamination from Pesticide Storage and Handling*, Farmstead Assistance System (Farm-A-Syst), University of Wisconsin-Extension, July 1991 (G3536-2W).

3.2.3 Agricultural Business: Food Processing

Tip Sheet #1

WASTE ORIGIN: General Operations

WASTE TYPES: Waste Food and Food By-products

WASTE REDUCTION AND RECYCLING METHODS:

- ! Reduce landfill and wastewater treatment costs by **decreasing waste material and by-products** in production processes:
 - ! Use ***brooms and scrapers*** to clean floors while they are dry before washing down with water;
 - ! Use ***high-pressure spray washes*** during cleanup to conserve water;
 - ! ***Dedicate mixing lines*** to certain products to reduce changeover cleanups;
 - ! ***Minimize spills and leaks*** on the production line to prevent raw materials from becoming wastes.
- ! Use food **by-product as an animal feed**:
 - ! ***Advantages*** over composting or landspreading include: fed to livestock in original form (check with local animal health authorities to see if permit is required), fed in both liquid and solid form, and can be fed all year regardless of weather conditions.
- ! **Composting** by-products creates useful soil additive called humus with the following benefits:
 - ! ***Low transportation costs*** from on-site composting; volume and weight of wastes can be reduced up to 40 percent;
 - ! ***Low capital investment*** is required since composting is a batch process using a simple pile and windrow system for biological breakdown;
 - ! Useful for ***seasonal processors*** like canneries whose wastes may be available for only a short period and not acceptable for livestock producers as feed;
 - ! ***Humus can be stored without spoiling***; raw food by-products cannot.
- ! **Landspreading** incorporates by-products directly into the soil with the following benefits:
 - ! A separate on-site ***compost facility is not necessary***;
 - ! The finished product ***does not have to be stored***;
 - ! Finished product ***does not have to be transported***; it becomes a plant nutrient in the soil.

Sources:

Fact Sheet: *Source Reduction and Management Alternatives for Commercial Food Producers*, Minnesota Technical Assistance Program, Minneapolis, MN, Publ. 12/94-76, December 1994.

Fact Sheet: *Composting and Landspreading Commercial Food Wastes*, Minnesota Technical Assistance Program, Minneapolis, MN, Publ. 12/94-78, December 1994.

On-Farm Composting Handbook, Northeast Regional Agricultural Engineering Service, Cooperative Extension, Ithaca, NY, June 1992, NRAES-54.

3.3.1 Building Trades: Construction/Remodeling

Tip Sheet #1

WASTE ORIGIN: Design and Materials Purchasing

WASTE TYPES: Wood, Drywall (Sheetrock, Gypsum Board), Packaging (Plastic, Paper, and Corrugated Cardboard), Metals, Masonry, and Shingles

WASTE REDUCTION AND RECYCLING METHODS:

- ! Design **floor plans to make efficient use** of whole 4' x 8' panels and standard lumber lengths; design to make efficient use of standard lengths of heating duct materials, metal pipes, wiring, siding, and gutters.
- ! Consider **advanced framing techniques** which reduce and more efficiently use materials.
- ! Use **recycled wood materials or wood alternative**; consult resource guides that list companies selling building materials of recycled, low-toxic, natural, and sustainably harvested forest products.
- ! Consult **building trades publications** promoting resource efficient building.
- ! Ask manufacturers to **reduce unnecessary paper packaging** on their materials; convince manufacturers to deliver items in reusable packaging that can be hauled back to the manufacturer for reuse.
- ! Consult local or state agencies, building trade associations, or other cooperating construction or remodeling firms for **resource efficient designs and techniques**.
- ! Consider **design for disassembly where possible** as an alternative to demolishing the structure when the time comes; easily salvaged building materials can mean future materials sales or a valuable source of materials for volunteer organizations.
- ! **Work with designers, contractors, and suppliers** with a reputation for resource-efficient design and construction.
- ! Choose to **extend the useful life** of a new or existing building:
 - ! Designing with **higher quality, more durable materials** extends life of the structure and allows easier remodeling, preservation, or conversion.

Sources:

Rethinking Debris: Construction and Demolition Waste Reduction and Recycling Tips, Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Draft Document, January 1996.

Builders' Guidebook to Reducing, Reusing and Recycling Residential Construction Waste in Wisconsin, University of Wisconsin-Madison Enterprise Center, October 1993.

Resource Efficient Building: Reducing Material Use, Toxicity and Waste in Design and Construction, Waste Reduction Institute for Training & Applications Research (WRITAR), Minneapolis, MN, March 1995.

3.3.1 Building Trades: Construction/Remodeling

Tip Sheet #2

WASTE TYPES: Construction/Remodeling Phase

WASTE ORIGIN: Wood, Drywall (Sheetrock, Gypsum Board), Packaging (Plastic, Paper, and Corrugated Cardboard), Metals, Masonry, and Shingles

WASTE REDUCTION AND RECYCLING METHODS:

- ! **Coordinate with suppliers** to take back or buy back unused wood, pallets, and crates.
- ! **Order in large quantities** that can be custom cut to fit unusual designs;
- ! Develop **incentive programs** for framing contractors and crews to reduce wood use;
 - ! **Reuse scraps** whenever possible. Small scraps can be used as bridging, splicers, wall components, filler, scabs, and spacers;
 - ! **Talk about source reduction methods** with contractors, subcontractors, and material/product suppliers over the course of the project. Useful information can be used on another construction phase or on the next project.
- ! **Designate a supervisor or worker** on-site whose responsibilities would include overseeing source reduction, recycling, or reuse activities.
- ! **Provide on-site color-coded containers** for specific reusable or recyclable materials; make sure all contractors and subcontractors are involved.
- ! **Reduce drywall use** by keeping all cutoffs in a central, dry location that is easily accessible to workers until every room is fully drywalled.
- ! **Reduce use of corrugated cardboard**, boxboard, brown wrapping paper, office paper, and other waste by:
 - ! **Separating** corrugated cardboard and office paper for selling to a recycler or pickup by municipal recycling program;
 - ! Buy materials like ceiling tiles made from **recycled paper fibers**.
- ! **Reduce metal use** by:
 - ! **Asking homeowners** if they would like to keep scrap for their own future projects;
 - ! **Using damaged metal** construction materials on other projects.

Sources:

Rethinking Debris: Construction and Demolition Waste Reduction and Recycling Tips, Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Draft Document, January 1996.

Builders' Guidebook to Reducing, Reusing and Recycling Residential Construction Waste in Wisconsin, University of Wisconsin-Madison Enterprise Center, October 1993.

Resource Efficient Building: Reducing Material Use, Toxicity and Waste in Design and Construction, Waste Reduction Institute for Training & Applications Research, March 1995.

3.3.1 Building Trades: Construction/Remodeling

Tip Sheet #3

WASTE ORIGIN: Scraps, Damaged Materials and Packaging

WASTE TYPES: Wood, Drywall (Sheetrock, Gypsum Board), Packaging (Plastic, Paper, and Corrugated Cardboard), Metals, Masonry, and Shingles

WASTE REDUCTION AND RECYCLING METHODS:

- ! Coordinate with manufacturers to **take or buy back unused** products.
- ! **Research possible markets** for reusable and recyclable materials.
- ! Establish a construction **waste recycling program**:
 - ! Talk with co-workers and contractors to *drum up interest*;
 - ! Develop specific salvage, reuse, or recycling *guidelines for subcontractors* to follow as part of a contract;
 - ! Set up a *monitoring system* with haulers and subcontractors to track the program's effectiveness;
 - ! Find a *hauler to handle the job*; clearly mark and locate the collection bins;
 - ! Provide *monthly reports* to owner/contractor on amounts of materials salvaged, reused, or recycled and the money saved;
 - ! Establish a *recognition program* to encourage employees participation;
 - ! Develop a *troubleshooting plan*: Check in with haulers to discuss the project, and periodically visit the site.
- ! Contact local or state government agencies about **local options for recycling** building materials:
 - ! Construction site *recycling guides* contain listings of recyclers grouped by materials they process. Guides often include concise descriptions of material specifications and pricing;
 - ! Many *solid waste management programs* exist at the state and local level. These can provide financial or technical start-up assistance for constructing a waste recycling program.
- ! **Recycling markets directories and materials exchange** programs can help find local, state, regional, or national networks to sell, barter, or buy surplus products and unspent materials.
- ! Ask suppliers to haul **scrap drywall** back to their plant and recycle it into new drywall; **donate scrap drywall** to low-income housing projects.
- ! Contact **local scrap/salvage yards** to see if they accept unused metal.
- ! Place an **ad in the local newspaper** for excess materials.
- ! Excess **scrap wood** can often be given to farmers or landscapers to chip for bedding or mulching.

Sources:

Rethinking Debris: Construction and Demolition Waste Reduction and Recycling Tips, Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Draft Document, January 1996.

Builders' Guidebook to Reducing, Reusing and Recycling Residential Construction Waste in Wisconsin, University of Wisconsin-Madison Enterprise Center, October 1993.

Resource Efficient Building: Reducing Material Use, Toxicity and Waste in Design and Construction, Waste Reduction Institute for Training & Applications Research, March 1995.

Promoting Building Industry Recycling: A How-to Guide, Resource Recycling Magazine, December, 1995.

3.3.2 Building Trades: Demolition

Tip Sheet #1

WASTE ORIGIN: Building Maintenance, Repair, or Demolition

WASTE TYPES: Aluminum, Asphalt, Brick and Block, Concrete, Glass, Insulation, Iron and Steel, Lead and Copper Pipes, Plastic, Roofing Materials, Tile, and Wood

WASTE REDUCTION AND RECYCLING METHODS:

- ! **Inspect the site** before demolition begins and list materials to be saved.
- ! **Select demolition methods** and procedures that will promote reuse.
- ! Management can demonstrate its **commitment to waste reduction** and encourage employee participation by:
 - ! **Training employees** in waste reduction techniques;
 - ! Encouraging **employee suggestions**;
 - ! Provide **incentives for employee** participation;
 - ! **Provide resources** necessary to get the job done.
- ! Materials reused from salvage operations **reduces disposal costs and can reduce materials costs** at the construction site. Some of the most easily salvaged items include:
 - ! Bricks and blocks;
 - ! Doors and windows;
 - ! Plumbing fixtures and pipes;
 - ! Electrical fixtures and wiring.
- ! Many **opportunities exist for recycling** demolition waste:
 - ! Create mulch or chips from **wood**, or use wood as fuel;
 - ! Recycling all **glass and plastic**;
 - ! Crush old **concrete** and use it as an aggregate or base material;
 - ! Separate reinforcement **steel** with magnets for sale as scrap metal;
 - ! Remove and recycle **all metal** before demolition, including aluminum siding, steel pipes, copper pipes, and cast iron bath tubs;
 - ! **Investigate new processes** such as heating asbestos and other materials in a high-temperature tunnel oven and creating glass-like material for use in asphalt mixes or as fill.
- ! **Establish a recycling program:**
 - ! Talk with co-workers and contractors to **drum up interest**;
 - ! Develop specific salvage, **reuse, or recycling guidelines for subcontractors** to follow as part of a contract;
 - ! Set up a **monitoring system** with haulers and subcontractors to track the program's effectiveness;
 - ! Find a **hauler to handle the job**;
 - ! Clearly **mark and locate** the collection bins;
 - ! Provide **monthly reports** to owner/contractor on the money saved and the amount of material salvaged, reused, or recycled;

- ! Establish a ***recognition program*** to encourage employee participation;
- ! Develop a ***troubleshooting plan***: Check with haulers to discuss the project, periodically visit the site.
- ! Contact local or state government agencies about **local options for recycling** building materials:
 - ! Construction ***site recycling guides*** contain listings of recyclers grouped by materials they process; guides often include concise descriptions of material specifications and pricing;
 - ! Many ***solid waste management programs*** exist at the state and municipal level, and can provide financial or technical assistance in establishing a construction waste recycling program.
- ! **Recycling markets directories and materials exchanges** programs make can help finding local, state, regional, or national networks to sell, barter, or buy surplus products and unspent materials.
- ! Place an **ad in the local newspaper** for excess or salvage materials.
- ! Ask suppliers to **haul salvaged drywall back** to their plant and recycle it into new drywall; **donate scrap drywall** to low-income housing projects.
- ! Excess **scrap wood** can often be given to farmers or landscapers who chip them for bedding or mulching.

Sources:

Rethinking Debris: Construction and Demolition Waste Reduction and Recycling Tips, Wisconsin Department of Natural Resources, Bureau of Solid and Hazardous Waste Management, Draft Document, January 1996.
 Fact Sheet: *Pollution Prevention: Strategies for Demolition Waste*, Center for Hazardous Materials Research, Pittsburgh, PA.

3.3.3 Building Trades: Painting Contractors

Tip Sheet #1

WASTE ORIGIN: Inventory Control and Materials Handling

WASTE TYPES: Adhesives and Glues, Cements, Epoxies, Glazes, Paints, Paint Stripping Compounds, Paint Thinners, Solvents and Cleaners, Stains, and Varnishes

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use **inventory control** as a simple waste management tool:
 - ! Pay attention to product *label directions for shelf-life* limits and proper storage conditions;
 - ! Inventory *unopened materials* and return unwanted but usable materials to the distributor or manufacturer, whenever possible:
Develop *vendor agreements* to make this a routine procedure.
 - ! Identify any *material that still may be useful*, log it into current inventory for use;
 - ! Use *old paint* as a base coat or primer;
 - ! Mix the same or similar types of paint when *mixing different colors*;
 - ! Reuse the *clean portion of thinner* after it has separated from the contaminants.
 - ! **Donate** unwanted but usable material to community or high school theaters, or community fix-up projects willing to accept them;
 - ! **Materials exchange services** list sources for unwanted specialty and industrial coatings.
- ! **Arrange painting schedules** to reduce wastes from cleaning equipment between tasks, shifts, or color changes.
- ! Properly **maintain painting tools** like rollers, brushes, and sprayers to increase paint transfer efficiency.
- ! **Train employees** to promote efficient, consistent work habits and efficient materials handling.
- ! **Improve recordkeeping** to develop consistent work procedures, reducing guesswork and mistakes.
- ! **Unusable liquid wastes** may be considered hazardous or non-hazardous, but each requires special handling:
 - ! **Combustible liquid wastes**, like oil-based paints, stains, and other petroleum-based liquids require special attention to determine if they are compatible, and whether they can be consolidated into the same disposal container;
 - ! **Waste waterborne liquids** like latex paints and water-based stains should be managed separately from petroleum-based liquids:
 - ! *Older latex paints* may contain mercury-based fungicides (typically phenyl mercuric acetate); they should be tested and handled as a separate hazardous waste;
 - ! *Cleanup wastewater* from small quantities of latex paints or water-based cleaners may be drained into sewer systems if the local treatment plant allows it; do not dump these wastes into storm sewers or septic tank systems;

- ! *Large volumes of nonhazardous latex* paint still may require disposal management by a permitted hazardous waste facility.
- ! **Waste chlorinated solvents**, thinners, and paint strippers should always be managed separately.
- ! **Unusable non-liquid hazardous wastes** (cured hardeners, cements, epoxies, adhesives or glazes) may require disposal of the hardened waste and its container in a larger shipping container called a “lab pack” used by disposal companies.
- ! **Recycle empty plastic or metal containers** whenever possible; contact recycling firms and solid waste haulers to see if they accept old paint-related containers.
- ! **Spray paint cans** and other aerosol cans, if not empty, may be subject to hazardous waste disposal requirements.
- ! **Reusable aerosol containers** may be used to spray a variety of liquids that are available in bulk packages, such as solvents and cleaners (lowers purchase and empty container costs).
- ! Contact state, county, or local solid and hazardous **waste management agencies** for current regulatory requirements or disposal options for paint-related wastes.

Sources:

Fact Sheet: *Management Options for Old Paint and Paint-related Materials*, Minnesota Technical Assistance Program, Minneapolis, MN, Publ. 1/95-69, 1995.

3.4.1 Garment Cleaning: Dry Cleaning

Tip Sheet #1

WASTE ORIGIN: Chemical Storage

WASTE TYPES: Petroleum-based Solvents and Volatile Organic Compound (VOC) Air Emissions

WASTE REDUCTION AND RECYCLING METHODS:

- ! **Tightly seal** bungs and lids on containers.
- ! **Properly label** containers.
- ! Use **spigots or pumps** to dispense new materials.
- ! Use **funnels** when transferring wastes to storage containers.

Sources:

Preventing Pollution in the Drycleaning Business, Fall 1991, U.S. EPA.

Hazardous Waste Reduction Facts: Commercial Dry Cleaners, City of Santa Monica, Dept. of General Services. (WP, Cleaner, Manual), Industrial Waste Section, County Sanitation Districts of Los Angeles County, Whittier, CA, September 1990.

3.4.1 Garment Cleaning: Dry Cleaning

Tip Sheet #2

WASTE ORIGIN: Wet-to-Dry or Dry-to-Dry Cleaning Processes

WASTE TYPE: Machine Lint and Dust, Sludges, Solvent-Contaminated Rags, Solvent Emissions, Spent Cartridge Filters, and Spent Solvents

WASTE REDUCTION AND RECYCLING METHODS:

- ! Regularly **replace gaskets/seals** on dryer dampers, deodorizers, and aeration valves.
- ! **Inspect equipment** for leaks from gasket and hose couplings, flanges, pumps.
- ! Replace faulty or worn **gaskets on button trap** and around cleaning machine door.
- ! adjust in-and-out **condensing coil temperatures** to within 10° F of each other.
- ! Check **air vents** for drippage.
- ! Check **air relief valves** for proper closure.
- ! Repair holes in air and exhaust **ducts**.
- ! After a **filter change**, check gaskets and sealing of new filter.
- ! Monitor **equipment efficiency** (e.g., pounds of clothes cleaned per drum of solvent).
- ! Size loads (neither over- or under-loading) to **maximize solvent efficiency**.
- ! Make sure **cycle is complete** before removing clothes from dryer; do not hang-dry clothes.
- ! Clean **lint screens** regularly to avoid clogging fans and condensers.
- ! Open **button traps and lint gaskets** only long enough to clean.
- ! **Substitute low temperature** laundering for dry cleaning for applicable fabrics.
- ! **Redesign separator** with baffles and decant traps.
- ! Only allow **batch discharge of decant water** from separator after visual inspection.
- ! Consider using some **separator water as a pre-spotter**.
- ! Consider a **refrigerated "dry-to-dry" unit** to replace a wet-to-dry unit to avoid solvent loss in the transfer process.
- ! **Steam out carbon absorber** frequently and allow carbon bed to dry completely before reuse.
- ! **Recover solvents from filter cartridges** by draining the filters (24 hours) and heating/stripping the cartridges to vaporize and capture additional solvent.
- ! Install or retrofit a **solvent recovery system** (either carbon adsorption, refrigeration/condenser).
- ! Add water to **still bottoms** before final boil down to recover additional solvent.
- ! Install solvent **leak detectors**.
- ! Check with **equipment and solvent suppliers** for tips on reducing solvent loss.
- ! Inspect the following areas regularly for leaks:
 - ! hose and pipe connections, valves, fittings, pump, water separator, muck cooler, still; and, cartridge filter housing.

Sources:

Preventing Pollution in the Drycleaning Business, U.S. EPA, Fall 1991.
Hazardous Waste Reduction Facts: Commercial Dry Cleaners, City of Santa Monica, Dept. of General Services.
Dry Cleaning Industry Pollution Prevention Option Checklist (WP, Cleaner, Manual), Industrial Waste Section, County Sanitation Districts of Los Angeles County, Whittier, CA, September 1990.
Clearing the Air on Clean Air — Strategies For Perc Drycleaners: Compliance, Risk Reduction and Pollution Prevention, University of Tennessee Center For Industrial Services, Tennessee Department of Environment and Conservation, 1993.
Source Reduction of Chlorinated Solvents: Dry Cleaning of Fabrics, California Department of Toxic Substances Control, Alternative Technology Division, June 1991.
Proceedings: *EPA Design for the Environment International Roundtable: Pollution Prevention and Control in the Dry Cleaning Industry*; U.S. EPA, Office of Pollution Prevention and Toxics; Economics, Exposure, and Technology Division; November 1992, EPA/774/R-92/002

3.4.2 Garment Cleaning: Wet Cleaning

Tip Sheet #1

WASTE ORIGIN: Wet-to-Dry or Dry-to-Dry Cleaning Processes

WASTE TYPES: Perchloroethylene and other Petroleum-based Solvents

WASTE REDUCTION AND RECYCLING METHODS:

- ! Some state and national government agencies may provide information on **grant and loan programs** to install and operate wet cleaning equipment.
- ! **Wet cleaning** eliminates harmful chemicals. Customer and worker health risks are eliminated, in addition to liability costs of environmental contamination.
- ! Contact wet cleaning **demonstration programs** for free information on financial and technical advantages of this safe cleaning alternative:
 - ! **Center for Neighborhood Technology** in Chicago promotes wet cleaning technology through its “Greener Cleaner” demonstration project. This includes:
 - ! Wet cleaning *workshops*, wet cleaning research newsletter;
 - ! Results from program *tests* on cleaning quality, fabric response, and computerized equipment;
 - ! *Financial information* on labor costs and cleaning pricing.
- ! Since wet cleaning is a new technology, **testing is required to refine the technology** and collect data on customer satisfaction surveys, evaluations of cleaning and finishing quality, and cost analysis:
 - ! Interested dry cleaners considering wet cleaning can use their skill and understanding of fabrics to **volunteer with demonstration projects**.
- ! Contact **trade associations for training opportunities** related to wet cleaning adaption to an existing dry cleaning operation (e.g. International Fabricare Institute, Neighborhood Cleaners Associations).
- ! Contact the U.S. EPA or the National Institute for Occupational Safety and Health for **information on health studies, regulations, and alternatives** to the toxic and highly flammable petroleum-based solvents traditionally used in dry cleaning operations.

Sources:

Fact Sheet: *Straight Answers about Wet Cleaning*, Center for Neighborhood Technology, Chicago, IL.

Fact Sheet: *Wet Cleaning: An Alternative to Dry Cleaning that Is Safe for You, Your Clothes and Your Cleaner*, Center for Neighborhood Technology, Chicago, IL.

Newsletter: *Wet Cleaning Update*, Center for Neighborhood Technology, Chicago, IL, November 1995.

3.5.1 Health Care: Medical Clinics/Offices

Tip Sheet #1

WASTE ORIGIN: Diagnostic Materials and Cleaning Equipment

WASTE TYPES: Alcohols, Developer and Developer Systems Cleaners (Chromium), Pharmacy Supplies, Photographic Wastes, Silver (X-ray Fixer, X-ray Film), Solvent Wastes (Xylene, Xylene-alcohol Mixtures), and Vapor Sterilizer Chemicals (Formaldehyde)

WASTE REDUCTION AND RECYCLING METHODS:

- ! **Control inventory** to reduce both solid and hazardous wastes:
 - ! **Minimize** chemical inventories with “Just-in-Time” purchasing;
 - ! Arrange with a supplier to make **daily deliveries** (eliminates maintaining expensive inventory and minimizes storeroom space);
 - ! Provide area where chemical and liquid wastes **cannot drain to the sewer** in the event of an accident or spill;
 - ! Use the first-in, first-out system to **rotate chemical stocks**, pay attention to expiration dates;
 - ! Buy drugs in container sizes that permit formulation of daily doses with the **least quantity of excess product** leftover;
 - ! **Centralize** chemical and/or drug procurement through one department or person.
- ! Request **recyclable tote containers** from suppliers, whenever possible, to reduce chemical drum waste and disposal costs.
- ! **Separate waste streams** to avoid mixtures of hazardous and nonhazardous liquids (reduce volumes of waste requiring special treatment):
 - ! **Avoid mixing solvent wastes**, like xylene, with alcohols (methyl, ethyl, and isopropyl), chromic acid (glassware cleaner), and water.
- ! **Determine dilution rates of alcohol** that can be discharged to the sanitary sewer system; consult the local publicly-owned treatment works (POTW) on what disposal activities are acceptable.
- ! **Reduce photographic wastes** from imaging equipment, like wastewater containing photographic chemicals and silver from film:
 - ! Extend the **life of fixing baths** by adding ammonium thiosulfate (doubles the allowable concentration of silver buildup in the bath);
 - ! Add acetic acid to fixing baths to keep the **pH of the bath** optimally low.
- ! **Do not mix used X-ray fixer and developer:** dedicate separate containers and treatment methods.
- ! **Used X-ray fixer** can be handled in a couple ways:
 - ! Collect and store in a closed plastic **container** labeled “Hazardous Waste - Used Fixer” with the date fixer was first added;
 - ! Contact a **recycling service** when enough fixer has accumulated (usually 5-10 gallons);

- ! Install a *silver recovery unit* at the end of the X-ray processing unit.
- ! **Used X-ray film** should be placed in a labeled container; silver reclamation companies often take film.
- ! **X-ray developer** can be poured down a drain (sewered) that is connected to a POTW, but not into a septic system.
- ! Contact local or state government agencies with solid and hazardous waste departments for **information on recycling services** and medical/infectious waste transporters/disposers.

Sources:

Fact Sheet: *Managing Waste Generated by Dental Clinics*, Minnesota Technical Assistance Program, Minneapolis, MN, Publ. 2/95-81, 1995.

Newsletter: *Reducing Hospital Waste*, Waste Reduction Assistance Program, University of Tennessee Center for Industrial Services, Vol. 1/No. 4, Winter 1991.

Hospital Waste Reduction Checklist, Solid and Hazardous Waste Education Center, University of Wisconsin-Extension, 1996.

Guide to Pollution Prevention: *Selected Hospital Waste Streams*, U.S. EPA, Center For Environmental Research Information, June 1990, EPA/625/7-90/009.

3.5.2 Health Care: Dental Offices/Clinics

Tip Sheet #1

WASTE ORIGIN: Diagnostic Materials and Cleaning Equipment

WASTE TYPES: Amalgam Developer, Developer Systems Cleaner (Chromium), Lead Foil and Silver/Mercury, Silver (X-ray Fixer, X-ray Film), and Vapor Sterilizer Chemicals (Formaldehyde)

WASTE REDUCTION AND RECYCLING METHODS:

- ! **Do not mix used X-ray fixer and developer:** Dedicate separate containers and treatment methods.
- ! **Used X-ray fixer** can be handled in a couple ways:
 - ! Collect and store in a **closed plastic container** labeled “Hazardous Waste - Used Fixer” with the date fixer was first added;
 - ! Contact a **recycling service** when enough fixer has accumulated (usually 5-10 gallons);
 - ! Install a **silver recovery unit** at the end of the X-ray processing unit.
- ! **Used X-ray film** should be placed in labeled container; silver reclamation companies will often also take film.
- ! **Used lead foil** may be accepted by reclamation companies or recycled through dental supply companies. Label the container as hazardous waste.
- ! **Waste amalgam** should be captured in sink drain screens and recycled:
 - ! Store waste amalgam in a **closed container** labeled as hazardous waste with content and date information;
 - ! Used, **empty amalgam capsules** are non-hazardous and may be disposed of as solid waste.
 - ! **Disposable filters** should be disinfected and may be recycled with the amalgam. Check with your recycler.
 - ! Consider using **non-mercury** containing materials for fillings such as composite.
- ! **Cleaners for developer systems** that contain chromium can be handled in a few ways:
 - ! Install cleaners that **do not contain chromium**;
 - ! Find a **cleaning service** that will clean the developing unit at the clinic and properly dispose of the chromium-containing cleaner;
 - ! Collect and store in a **closed plastic container** labeled as hazardous waste, and contact a recycling service when enough tainted cleaner has accumulated.
- ! **Vapor sterilizer chemicals** may be poured down the drain (sewered) if the local publicly-owned treatment works (POTW) has a sewage treatment system to handle the clinic’s quantity. If not, these chemicals must be disposed of as hazardous waste.
- ! **X-ray developer** can be poured down a drain connected to a POTW, but not into a septic system.

- ! Contact local or state government agencies with hazardous waste departments for **information on silver or amalgam recycling services**, scrap metal reclaimers, and medical/infectious waste transporters/disposers.

Sources:

Fact Sheet: *Managing Waste Generated by Clinics*, Minnesota Technical Assistance Program, Minneapolis, MN, Publ. 2/95-81, 1995.

Newsletter: *Reducing Hospital Waste*, Waste Reduction Assistance Program, University of Tennessee Center for Industrial Services, Vol. 1/No. 4, Winter 1991.

Hospital Waste Reduction Checklist, A Guide to Dentists, Solid and Hazardous Waste Education Center, University of Wisconsin-Extension, 1996.

Guide to Pollution Prevention: Selected Hospital Waste Streams, U.S. EPA, Center For Environmental Research Information, June 1990, EPA/625/7-90/009.

3.5.3 Health Care: Veterinary Clinics

Tip Sheet #1

WASTE ORIGIN: Medications, Cleaning Agents, Diagnostic Operations

WASTE TYPES: Discarded medications, broken thermometers, old batteries, spent cleaners, silver (X-ray fixer and film), lead foil, and chromium (developer system cleaners)

WASTE REDUCTION AND RECYCLING METHODS:

- ! **Reduce or eliminate** use of medications containing mercury:
 - ! Use *alternatives* to dips, wound treatments or vaccines that contain mercury;
 - ! Take *precautions* not to allow mercury containing products into drains leading to the sewer;
- ! Use **mercury-free equipment** whenever possible:
 - ! Use *digital or electronic sensors* and temperature strips instead of mercury thermometers;
 - ! Have *mercury spill kits available* in all areas where mercury containing products are used, and have all persons in that area trained in the use of those kits;
 - ! **Phase out mercury-containing batteries** in equipment and set up in house battery recycling program;
 - ! Use *rechargeable batteries* when possible;
- ! **Review** chemical use and storage practices:
 - ! **Hazardous materials and products** containing silver, cadmium, chromium, copper, cyanide, lead, mercury, nickel, selenium and zinc, for example, should not be discarded to the sanitary sewer — all such materials should be properly labeled and stored with secondary containment;
 - ! **Eliminate** floor waxes and strippers containing zinc;
 - ! **Eliminate** toilet cleaning and disinfection products containing tri-butyl tin;
 - ! **Eliminate** carpet and upholstery cleaners containing tri-butyl tin;
- ! **Review** X-ray fixer, developer and film management practices to eliminate hazardous materials disposal:
 - ! X-ray fixer and developer should not be mixed, but should have separate containers and treatment methods — sell or give away spent fixer and developer to a recycling service, usually after 5 to 10 gallons of fixer have been accumulated;
 - ! Use *silver recovery unit* for the developing system;
 - ! **Used X-ray film** should be placed a in labeled container. Silver recovery companies often take the film also.
- ! **Cleaners** for the developer system that contain chromium can be handled in different ways:
 - ! Use cleaners that **do not contain chromium**.
 - ! **Find a cleaning service** that will clean the developing unit at the clinic and properly dispose of the chromium containing cleaner.

- ! Collect and store in a closed plastic container labeled as hazardous waste and contact a recycling service when enough used cleaner has accumulated.

Sources:

Fact Sheet: *Waste Reduction in the Veterinary Clinic*, Solid and Hazardous Waste Education Center, University of Wisconsin-Extension, 1996.

Guide to Pollution Prevention: Selected Hospital Waste Streams, U.S. EPA, Center for Environmental Research Information, June 1990, EPA/625/7-90/009.

3.6.1 Hospitality Industry: General Operations

Tip Sheet #1

WASTE ORIGIN: Food Preparation, Office Operations, Property Maintenance

WASTE TYPES: Shipping/Packing Materials, Food Scraps, Food and Drink Containers, and Yard Wastes (Grass Clippings, Leaves, Sticks, and Brush)

WASTE REDUCTION AND RECYCLING METHODS:

- ! **Office operations** can reduce or eliminate waste from the start:
 - ! Choose suppliers who provide **recyclable packaging** and packaging that has recycled content in it; reuse shipping/packing materials;
 - ! **Improve purchasing and inventory management** to prevent overstocking supplies that will not be used within one month, or may have limited shelf life;
 - ! Remove company name from **direct-mail** lists;
 - ! Make **double-sided copies**; reduce number of paper copies of receipts; use recycled copy and register papers;
 - ! Buy products or materials with **recycled content**; reuse materials that would have been disposed of after one use;
 - ! Buy in **bulk quantities** when appropriate;
 - ! Refuse to buy meat boxed in **non-recyclable wax-coated corrugated cardboard**;
 - ! Encourage all employees to get involved in **waste reduction programs**; use incentives to involve employees, and encourage suggestions to improve programs.
- ! **Make recycling easy** for staff and patrons by:
 - ! Providing **separate bins for trash**, one for paper/cardboard, and one for mixed recyclables:
 - ! Create a **list of waste items**, laminate it, and hang it in clear view to tell staff or patrons the exact destination of every item.
 - ! Place **recycling bags** in patrons' rooms or cabins; provide appropriate recycling bins on resort grounds, hotel, or motel lobbies;
 - ! A **clear recycling bag** for aluminum cans on the cabin porch; two bags in the kitchen, one for trash and one for recyclables.
- ! Sell **reusable cups or mugs** advertising your business and offer discounts to patrons who bring them in for fillups.
- ! Use **cloth** napkins and tablecloths, **reusable flatware**, and dishes when possible instead of disposable paper or plastic.
- ! **Basic changes in food service** operations can reduce or eliminate many wastes:
 - ! Reduce the size of **paper napkins**;
 - ! Use **paper carry-out** containers;
 - ! Install **customer pumps** for ketchup and other condiments to reduce waste of packets;
 - ! Buy **thinner straws** to limit plastic waste;

- ! **Food scraps** can be ground up in food mulchers and given or sold to farmers for composting to reduce disposal costs.
- ! **Join forces with business neighbors** to cooperatively haul trash and recyclables. Sharing the same trash and recycling bins and disposal costs saves everybody money and promotes cooperation.
- ! **Donating usable wastes and recyclables** to community groups fosters goodwill, protects the environment, and is a positive marketing strategy:
 - ! **Donate** recycled aluminum cans to a school's environmental awareness program; the money can go to hire speakers who teach students about the environment.
- ! **Think landscaping, not landfilling** when grooming property:
 - ! Grass clippings can be run through a *mulching mower* and left on the ground;
 - ! Branches and downed trees can be run through a *wood chipper* and used as mulch in flower beds or spread along trails.
- ! Contact **local and state government agencies** specializing in waste reduction and recycling:
 - ! Many *solid waste management programs* at the state and municipal level can provide financial or technical assistance in establishing a specific waste recycling program.
- ! **Recycling markets directories and materials exchanges** programs can help find local, state, regional, or national networks to sell, barter, or buy surplus products and unspent materials.
- ! Place an **ad in the local newspaper** for excess or salvage materials.

Source:

Fact Sheet: *Eat, Drink, Sleep and Recycle: How the Hospitality Industry Cuts Waste*, Wisconsin Department of Natural Resources, Solid Waste Recycling Section, PUBL IE-203 95.

3.7.1 Manufacturing Common Operations: Coating/Painting

Tip Sheet #1

WASTE ORIGIN: **Paint and Varnish Stripping** (Coating removal from parts before applying a new coat)

WASTE TYPES: Spent Stripper and Waste Abrasives

WASTE REDUCTION AND RECYCLING METHODS:

- ! Avoid adding **excess stripper**.
- ! Use **spent stripper** as rough pre-strip on next item.
- ! Use **abrasive media** for paint stripping.
- ! Use **plastic media** paint stripping.
- ! Use **cryogenic** paint stripping.
- ! Use **wheat starch** media blasting paint stripping.
- ! Use **laser or flash lamp** paint stripping.
- ! Use **thermal** paint stripping.

WASTE ORIGIN: **Coating Application**

WASTE TYPES: Oversprayed Coating Materials. Volatile Organic Compound (VOC) Air Emissions, Solvents, Paint Filters, Masking, and Protective Clothing

WASTE REDUCTION AND RECYCLING METHODS:

- ! **Re-examine** the need for coating, as well as available alternatives.
- ! Use **plastic coatings** instead of paint.
- ! Use **high-solids coating** formulations.
- ! Use **low-VOC powder coatings**.
- ! Use **water-based** coating formulations.
- ! Use **radiation-curable** (UV or IR) coating formulations.
- ! **Pre-inspect** parts to avoid coating obvious rejects.
- ! **Overspray Reduction:**
 - ! Maintain 50 percent overlap between spray patterns.
 - ! Maintain 6- to 8-inch distance **between spray gun and work piece**.
 - ! Maintain **gun speed** of about 250 feet per minute.
 - ! Hold **gun perpendicular** to surface.
 - ! **Trigger gun** at beginning and end of each pass.
 - ! Properly **train operators**.
 - ! Use **robots** for spraying.
 - ! Avoid **excessive air pressure** for coating atomization.

- ! Use **electrostatic spray** systems.
 - ! Use turbine disk or bell air-assisted **airless spray guns** in place of air-spray guns.
 - ! Make sure spray **gun air supply** is free of water, oil, and dirt.
 - ! Install **on-site paint mixers** to control material use.
 - ! Recycle **overspray**.
 - ! Keep **solvent soak tanks** away from heat sources and covered.
 - ! Control bake **oven temperature**.
-

WASTE ORIGIN: Paint Equipment Cleanup

WASTE TYPES: Petroleum-based Solvents and Cleaning Wastes

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use light-to-dark **batch sequencing** to reduce cleanup waste.
- ! Coat **large batches** of similarly coated objects instead of small batches of differently coated objects.
- ! Isolate **solvent-based paint spray booths** from water-based paint spray booths.
- ! **Reuse** cleaning solution or solvent.
- ! Use only **one cleaning solvent**.
- ! **Clean** coating equipment after each use.
- ! **Wipe clean** before solvent cleaning.

Sources:

Auto Body Surface Coating: A Practical Guide to Reducing Air Emissions, Small Business Pollution Prevention Center, Iowa Waste Reduction Center, University of Northern Iowa, 1994.

Facility Pollution Prevention Guide, U.S. EPA, May 1992, EPA/600/R-92/088.

Vehicle Maintenance Pollution Prevention, Small Business Pollution Prevention Center, Iowa Waste Reduction Center, University of Northern Iowa, 1995.

3.7.2 Manufacturing Common Operations: Metal Parts Cleaning

Tip Sheet #1

WASTE ORIGIN: All Cleaning Methods

WASTE TYPES: Petroleum-based Solvents, Volatile Organic Compound (VOC) Air Emissions, and Aqueous Wastes

WASTE REDUCTION AND RECYCLING METHODS:

- ! **Avoid** the need to clean (e.g., shrink wrap metal parts prior to shipment).
 - ! Select the **least hazardous medium** for cleaning.
 - ! Maximize cleaning **efficiency** (e.g., remove oil contaminants prior to welding).
 - ! **Separate** cleaning wastes.
 - ! **Maximize** recycling and reuse of cleaners.
-

WASTE ORIGIN: Abrasive Cleaning

WASTE TYPES: Abrasives and Soils

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use greaseless or water-based **binders** for buffing or polishing.
 - ! Use liquid **spray compositions**.
 - ! Control **water level** in mass finishing equipment.
-

WASTE ORIGIN: Cold Cleaning

WASTE TYPES: Petroleum-based Solvents, Volatile Organic Compound (VOC) Air Emissions, and Soils

WASTE REDUCTION AND RECYCLING METHODS:

- ! Reduce **drag-out**:
 - ! Use proper **racking** to minimize solvent trapped in parts or baskets;
 - ! Increase **drainage** (e.g., with rest shelf, drainage holes);
 - ! Install **drain boards**.
- ! **Cover** when not in use.

Sources:

Guides to Pollution Prevention: The Fabricated Metal Products Industry, U.S. EPA, Office of Research and Development, July 1990, EPA/625/7-90/006.

Guides to Pollution Prevention: The Mechanical Equipment Repair Industry, U.S. EPA, Office of Research and Development, September 1992, EPA/625/R-92/008.

Industrial Cleaning Source Book, Solid and Hazardous Waste Education Center, University of Wisconsin-Extension, September 1993.

Seminar Publication: *Meeting Hazardous Waste Requirements for Metal Finishers*, Center For Environmental Research Information, Office of Research and Development, September 1987, EPA/625/4-87/018.

Waste Minimization in Metal Parts Cleaning, U.S. EPA, Office of Solid Waste, August 1989, EPA/530-SW-89-049.

3.7.2 Manufacturing Common Operations: Metal Parts Cleaning

Tip Sheet #2

WASTE ORIGIN: Aqueous Cleaning

WASTE TYPES: Aqueous Cleaning Solution and Rinse Water

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use **optional methods** like abrasives, water, or steam.
- ! Use **less hazardous** acid or alkaline compounds.
- ! Maintain **solution quality**:
 - ! **Inspect** parts before cleaning;
 - ! **Pre-rinse** parts (e.g., with last rinse stage of cleaning operation, using demineralized water);
 - ! **Avoid** unnecessary loading;
 - ! Provide continuous **heating**;
 - ! Properly make up **solution**;
 - ! **Remove** sludge and soils promptly;
 - ! Routinely **monitor** cleaning solution strength and temperature;
 - ! **Maintain** equipment (e.g., racks free from cracks, rust);
 - ! Reduce **drag-out**.
- ! Increase degree of **rinsing efficiency** while reducing water use:
 - ! Use **de-mineralized water**;
 - ! Use **counterflow rinsing**;
 - ! Use **spray rinsing**;
 - ! Install **fog nozzles**.
- ! **Dry parts** properly (e.g., automated drying ovens).

Sources:

Guides to Pollution Prevention: The Fabricated Metal Products Industry, U.S. EPA, Office of Research and Development, July 1990, EPA/625/7-90/006.

Guides to Pollution Prevention: The Mechanical Equipment Repair Industry, U.S. EPA, Office of Research and Development, September 1992, EPA/625/R-92/008.

Industrial Cleaning Source Book, Solid and Hazardous Waste Education Center, University of Wisconsin-Extension, September 1993.

Seminar Publication: *Meeting Hazardous Waste Requirements for Metal Finishers*, Center For Environmental Research Information, Office of Research and Development, September 1987, EPA/625/4-87/018.

Vehicle Maintenance Pollution Prevention, Iowa Waste Reduction Center, Small Business Pollution Center, University of Northern Iowa, 1995.

Waste Minimization in Metal Parts Cleaning, U.S. EPA, Office of Solid Waste, August 1989, EPA/530-SW-89-049.

3.7.2 Manufacturing Common Operations: Metal Parts Cleaning

Tip Sheet #3

WASTE ORIGIN: Solvent Cleaning

WASTE TYPES: Spent Petroleum-based Solvents, Volatile Organic Compound (VOC) Air Emissions, and Soils

WASTE REDUCTION AND RECYCLING METHODS:

- ! Create cleaning standards.
- ! Replace solvent with **aqueous cleaning** medium.
- ! Use **emulsion** cleaners.
- ! Use **mechanical or thermal** methods.
- ! Use a **less toxic** solvent.
- ! **Standardize** solvent use (minimize different types of solvents used).
- ! **Consolidate** cleaning operations into one centralized degreasing operation.
- ! Maintain **solvent quality**:
 - ! Avoid **contamination** (e.g., with moisture);
 - ! **Don't mix** solvents;
 - ! **Maintain** equipment (e.g., maintain racks and barrels so that corrosion products like rust into solvent are not introduced);
 - ! **Monitor** solvent (e.g., test and add only specific components required);
 - ! Properly add to solvent (e.g., don't **cross-contaminate**);
 - ! Promptly **remove sludge**; use continuous filtering.
- ! Increase **cleaning efficiency**:
 - ! Employ **manual** brushing;
 - ! Increase **agitation** in bath (by use of mechanical agitators; ultrasonic devices, liquid sprays, and liquid jet pump-around arrangements).
- ! Control **evaporative losses**:
 - ! Select **proper location** for cleaning operations (e.g., free of drafts);
 - ! Use **lids** on tanks (roll-type covers on vapor degreasers);
 - ! Monitor **temperature**;
 - ! Avoid using **porous items** (ropes/bags) for handling parts;
 - ! Use **two-stage cleaning** (use dirty solvent for first stage and fresh solvent for second stage);
 - ! Stage solvent usage depending on **level of cleanliness** needed (reuse dirty solvent for parts which do not need to get as clean).
- ! **Recycle** solvents on-site (e.g., with gravity separation, filtration, batch distillation, fractional distillation, or evaporation).

Sources:

Guides to Pollution Prevention: The Fabricated Metal Products Industry, U.S. EPA, Office of Research and Development, July 1990, EPA/625/7-90/006.

Guides to Pollution Prevention: The Mechanical Equipment Repair Industry, U.S. EPA, Office of Research and Development, September 1992, EPA/625/R-92/008.

Industrial Cleaning Source Book, Solid and Hazardous Waste Education Center, University of Wisconsin-Extension, September 1993.

Seminar Publication: *Meeting Hazardous Waste Requirements for Metal Finishers*, Center For Environmental Research Information, Office of Research and Development, September 1987, EPA/625/4-87/018.

Vehicle Maintenance Pollution Prevention, Iowa Waste Reduction Center, Small Business Pollution Center, University of Northern Iowa, 1995.

Waste Minimization in Metal Parts Cleaning, U.S. EPA, Office of Solid Waste, August 1989, EPA/530-SW-89-049.

3.7.2 Manufacturing Common Operations: Metal Parts Cleaning

Tip Sheet #4

WASTE ORIGIN: Solvent Parts Cleaning Operations

WASTE TYPES: Petroleum-based Solvents, Volatile Organic Compound (VOC) Air Emissions, and Soils

WASTE REDUCTION AND RECYCLING METHODS:

- ! Install **lids or silhouettes** on tanks, and cover tanks when not in use.
- ! Use **less toxic** solvents (e.g., dibasic acid esters, terpenes, amines, alcohols).
- ! Substitute less hazardous solvent **degreasers** (e.g., petroleum solvents instead of chlorinated solvents).
- ! Replace solvents with **aqueous cleaners**.
- ! Replace solvents with **mechanical or thermal alternatives** (e.g., air blast systems, dry stripping, and cleaning with blasting media).
- ! **Standardize** type of solvent used in all operations.
- ! Consolidate cold cleaning operations into **centralized vapor degreasing** operation.
- ! Locate cold cleaning tanks away from **heat sources**.
- ! Minimize **vapor diffusion**:
 - ! Check parts for excessive **water contamination**;
 - ! **Cover** water separator;
 - ! Check **water jacket** for proper water flow and temperature on outside of degreaser;
 - ! Extend **freeboard**;
 - ! Use **cold traps** above freeboard chillers;
 - ! Locate **degreasers** away from drafts, windows, fans, or use baffles (air flow over tank should not exceed 131 feet per minute).
- ! Maintain proper **solvent level** in sump.
- ! Control the amount of heat supplied to **vapor degreasers**.
- ! Install safety **limit switches** (condenser flow switch and shut-off device for sump heat and a spray safety switch).
- ! Avoid spraying parts above the **vapor zone or cooling jacket**.
- ! Avoid solvent vapor drag-out by controlling **speed of withdrawal** (less than 11 feet per minute).
- ! Allow sufficient **time** in the degreaser.
- ! **Limit workload size** (use baskets with an area less than 50 percent of degreaser opening).
- ! Avoid **cross-contamination** of solvents (e.g., 1,1,1-Trichloroethane and trichloroethylene).
- ! Use appropriate **makeup solutions** for solvent bath.
- ! Remove **sludge** from solvent tanks frequently.

- ! Extend **solvent life** by pre-cleaning parts by wiping, using air blowers, or pre-dipping in cold mineral spirits dip.
- ! **Reclaim or recover** solvent on- or off-site (gravity separation, filtration, distillation, fuel use).
- ! Distribute parts on **rack** to allow good cleaning and minimize solvent hold-up.
- ! Slow speed of **parts removal** from vapor zone.
- ! **Rotate** parts to allow condensed solvent drop-off.

Sources:

Guides to Pollution Prevention: The Fabricated Metal Products Industry, U.S. EPA, Office of Research and Development, July 1990, EPA/625/7-90/006.

Guides to Pollution Prevention: The Mechanical Equipment Repair Industry, U.S. EPA, Office of Research and Development, September 1992, EPA/625/R-92/008.

Industrial Cleaning Source Book, Solid and Hazardous Waste Education Center, University of Wisconsin-Extension, September 1993.

Seminar Publication: *Meeting Hazardous Waste Requirements for Metal Finishers*, Center For Environmental Research Information, Office of Research and Development, September 1987, EPA/625/4-87/018.

Vehicle Maintenance Pollution Prevention, Iowa Waste Reduction Center, Small Business Pollution Center, University of Northern Iowa, 1995.

Waste Minimization in Metal Parts Cleaning, U.S. EPA, Office of Solid Waste, August 1989, EPA/530-SW-89-049.

3.8.1 Electronics Manufacturing: Common Operations

Tip Sheet #1

WASTE ORIGIN: General Production Processes
Process Immersion Chemical Baths and Spray-Rinse Cabinets

WASTE TYPES: Excessive Water Consumption

WATER REDUCTION AND RECYCLING OPTIONS: *Process or Equipment Modification*

- ! Develop a **cleanliness standard** for printed circuit boards at every process stage to determine the minimum amount of water required for product quality.
- ! **Observe and record production processes** to estimate water use and pressure. Inspect tanks, enclosed cabinet chambers, pumps, pipes, spray nozzles, sumps, and photosensors for operating deficiencies.
- ! **Establish the lowest water flow rate** that produces acceptable results for parallel process lines (produce identical products using identical processes).
- ! **Monitor flow rates** of water supply lines for each process: install additional flow gauges throughout the plant to easily quantify flow-rate reductions and calculate water and cost savings.
- ! Maintain and optimize the **use of photosensors** to restrict water flow rates by:
 - ! Installing photosensors in *spray-rinse chambers* where they do not exist;
 - ! Repairing or replacing *defective photosensors*;
 - ! Performing *routine maintenance* (clean and readjust) to keep photosensors working properly.
- ! **Maintain and optimize** plumbing and other equipment used for directing water flow through the production facility:
 - ! *Eliminate hoses* that supplement supply water to spray rinses;
 - ! *Hard plumb* all water-bearing supply pipes;
 - ! *Improve water movement* in spray cabinets sumps and immersion baths to maximize water rinsing capabilities;
 - ! *Recirculate fresh water rinse* to an earlier rinsing stage using a counterflow method, or reuse it as makeup water for process bath or spray solutions.
- ! Consider **other water conservation methods** including:
 - ! *Flow restrictors* on flowing rinses;
 - ! *Counter-current* rinsing or cascade rinsing systems;
 - ! *Redesign rinsing tanks* for more efficient water use;
 - ! *Fog* rinsing;
 - ! *Reactive* rinsing;
 - ! Rinsing with *purified or softened water*;
 - ! *Dead* rinses;
 - ! *Conductivity* controllers;
 - ! *Agitation* to assure adequate rinsing and homogeneity in rinse tank;

- ! Flow *control valves*;
- ! *Air knives* to reduce dragout.

Sources:

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

EPA Sector Notebook Project: Electronic and Computer Industry, U.S. EPA, Office of Compliance, September 1995, EPA/310-R-95-001. (Also accessible via the Internet at the EPA Sector Notebook Home Page address, <http://es.inel.gov/comply/sector/index.html>).

3.8.1 Electronics Manufacturing: Common Operations

Tip Sheet #2

WASTE ORIGIN: Electroplating Operations

WASTE TYPES: Acid Fumes, Ammonia Fumes, and Volatile Organic Compounds (VOCs)

WASTE REDUCTION AND RECYCLING OPTIONS: *Process or Equipment Modification*

- ! **Modify rinsing methods** to control drag-out by:
 - ! Increasing bath *temperature*;
 - ! Decreasing *withdrawal rate* of parts from plating bath;
 - ! Increasing *drip time* over solution tanks; racking parts to avoid cupping solution within part cavities;
 - ! Drip boards;
 - ! Shaking, vibrating, or passing the parts through an *air knife*, angling drain boards between tanks;
 - ! Using *wetting agents* to decrease surface tension in tank.
- ! **Cost Savings Examples:**
 - ! Using **drip bars**.
Capital Investment: \$100/tank. Savings: \$600/year.
 - ! Using **drain boards** between tanks.
Capital Investment: \$25/tank. Savings: \$450/year.
 - ! Installing **racking**.
Capital Investment: Zero dollars. Operating Costs: Minimal. Savings: \$600/year.
 - ! Employing drag out **recovery tanks**.
Capital Investment: \$500/tank. Savings: \$4,700/year.
 - ! Increasing parts **drainage time**.
 - ! Installing an **ion exchange** system.
Savings: \$1,900/year. Capital Investment: \$78,000. Operating Costs: \$3,200/year.
 - ! Employing a **reverse osmosis** system.
Capital Investment: \$62,000. Savings: \$40,000/year.
- ! **Use water conservation methods** including:
 - ! Flow *restrictors* on flowing rinses;
 - ! **Counter-current** rinsing systems;
 - ! **Fog** or spray rinsing;
 - ! **Reactive** rinsing;
 - ! **Purified** or softened water;
 - ! **Dead** rinses;
 - ! **Conductivity** controllers;
 - ! **Agitation** to assure adequate rinsing and homogeneity in rinse tank;
 - ! Flow *control valves*.

- ! **Install atmospheric evaporator** to reduce metal concentrations.
- ! Install process (e.g., CALFRAN) to reduce pressure of vaporization water cooler temperatures and recycle water by condensing the vapors in another container, thus **concentrating and precipitating solutes out**.
- ! **Use reactive rinsing and multiple drag-out baths.**
Reduce cost of treating spent process baths and rinsewaters, increase lifetime of process baths and reduce the quantity of rinsewater requiring treatment.
- ! Improve control of water level in rinse tanks, improve sludge separation, and enhance **recycling of supernatant** to the process by aerating the sludge.
Savings: \$2,000/year. Waste Savings/Reduction: reduced sludge generation by 32 percent.
- ! Install system (e.g., Low Solids Fluxer) that applies flux to printed wiring boards, leaving little residue and **eliminates the need for cleaning CFCs**.
- ! **Cost Savings Examples:**
 - ! Counter flow rinsing and cascade **rinsing systems**.
Costs: \$75,000 to upgrade existing equipment and purchase new and used equipment.
Waste Savings/Reduction: reduce water use and wastewater treatment costs.
 - ! Installing a **counter-current rinsing** operation.
Capital Investment: \$1,800-2,300. No direct costs. Savings: \$1,350/year.
Waste Savings/Reductions: reduce water use by 90-99 percent.
 - ! Redesigning **rinse tank**.
Capital Investment: \$100. No direct costs. Savings: \$750/year.
- ! **Regenerate plating baths** by activated carbon filtration to remove built up organic contaminants.
Capital Investment: \$9,192. Costs: \$7,973/year. Savings: \$122,420/year.
Waste Savings/Reduction: 10,800 gallons/year. Reduce volume of plating baths disposed and requirements for virgin chemicals.
- ! **Install pH controller** to control the alkaline and acid concentrations in tanks.

Sources:

EPA Sector Notebook Project: Electronic and Computer Industry, U.S. EPA, Office of Compliance, September 1995, EPA/310-R-95-001. (Also accessible via the Internet at the EPA Sector Notebook Home Page address, <http://es.inel.gov/comply/sector/index.html>).

3.8.2 Electronics Manufacturing: Semiconductors

Tip Sheet #1

WASTE ORIGINS: Semiconductor Production Processes (Crystal Preparation, Wafer Fabrication, Final Layering, and Cleaning Assembly)

WASTE TYPES: Spent Process Baths, Sludges, Rinse Waters, and Aqueous Metals

WASTE REDUCTION AND RECYCLING OPTIONS:

! Process or equipment modification examples:

! Installing a system (e.g., the CALFRAN process) to *reduce pressure of vaporization* at cooler temperatures, recycle water by condensing the vapors in another container, and concentrate and precipitate solutes. **Waste Savings/Reduction:** reduce volume and quantity of aqueous waste solutions by recovering pure water.

! Reducing *chrome waste generation* by:

! Treating on-site with caustics and sodium bisulfite to reduce *chrome VI liquid to chrome III* sludge.

! Repairing *water leaks* in process rinse tank to reduce chrome waste.

Capital Investment: \$30,000 for the rain cover, pipe repairs, and on-site treatment system. **Waste Savings/Reduction:** Savings: \$15,000/year in disposal costs, and reduce 95 percent of chrome wastes from 6,000 gallons to two or three drums generated per quarter.

! Raw material substitution examples:

! Replacing *chlorinated solvent baths* with a non-hazardous product to reduce, and later eliminate chlorinated solvent use.

! Recycling examples:

! Converting an *open-top still* into a closed loop system to recycle Freon 113. Costs: \$20,000. **Waste Savings/Reduction:** \$57,000/year in disposal and feedstock costs, and reduce waste volume by 85 percent.

! Using an "Athens" system to *reprocess sulfuric acid* generated during wafer fabrication operations. The acid is heated to boil off water and other impurities, purified through distillation, and pumped back into wet stations to continue wafer processing. **Annual savings/Reductions:** \$2.9 million from not purchasing sulfuric acid and 28 percent reduction in sulfuric acid generated in 1993.

Sources:

EPA Sector Notebook Project: *Electronic and Computer Industry*, U.S. EPA, Office of Compliance, September 1995, EPA/310-R-95-001. (Also accessible via the Internet at the EPA Sector Notebook Home Page address, <http://es.inel.gov/comply/sector/index.html>.)

3.8.3 Electronics Manufacturing: Printed Wiring Boards

Tip Sheet #1

WASTE ORIGINS: All Cleaning Operations (Board Preparation, Electroless Plating, Imaging, and Electroplating)

WASTE TYPES: Spent Process Baths (Etchants, Acid Solutions, Alkaline Solutions, Developing Solutions, Plating Baths, Electroless Copper Baths, Catalysts)
Air Emissions (Volatile Organic Compounds, Acid, and Ammonia Fumes)
Sludges, Rinse Waters, and Aqueous Metals)

WASTE REDUCTION AND RECYCLING OPTIONS:

! **Process or equipment modification examples:**

- ! Installing a system (e.g., Low Solids Fluxer {LSF}) which applies flux to printed wiring boards, leaving little residue, and *eliminating the need for cleaning with CFCs*.
Waste Savings/Reduction: reduce CFC emissions over 50 percent.

! **Material substitution** can reduce cleaning wastes by:

- ! *Substituting for CFC 113* used in defluxing with:
 - ! Fully aqueous system using *water soluble fluxes*;
 - ! Aqueous system using saponifiers to *remove rosin-based fluxes*;
 - ! Semi-aqueous system using **terpenes as a solvent**;
 - ! *Hydrogenated CFCs with chlorinated solvents*.
- ! *Substituting CFC 113* used in hand cleaning boards with:
 - ! Blend of *HCFC and methanol* dispensed from a trigger-grip device that limits the amount of solvent lost to the atmosphere.

Sources:

EPA Sector Notebook Project: Electronic and Computer Industry, U.S. EPA, Office of Compliance, September 1995, EPA/310-R-95-001. (Also accessible via the Internet at the EPA Sector Notebook Home Page address, <http://es.inel.gov/comply/sector/index.html>).

3.8.3 Electronics Manufacturing: Printed Wiring Boards

Tip Sheet #2

WASTE ORIGINS: Board Preparation, Electroless Plating, Imaging, and Electroplating

WASTE TYPES: Spent Process Baths (Etchants, Acid Solutions, Alkaline Solutions, Developing Solutions, Plating Baths, Electroless Copper Baths, Catalysts)
Air Emissions (Volatile Organic Compounds, Acid Fumes, Ammonia Fumes)
Sludges, Rinse Waters, and Aqueous Metals

WASTE REDUCTION AND RECYCLING OPTIONS:

- ! **Process or equipment modifications** can reduce wastes by:
 - ! Modifying *sludge pretreatment* processes by:
 - Adding flow control valves;
 - Installing metal recovery equipment;
 - Adding deionization system;
 - ! Installing a system (e.g., CALFRAN process) to *reduce pressure of vaporization* at cooler temperatures, recycle water by condensing the vapors in another container, concentrate, and precipitate solutes.
Waste Savings/Reduction: reduce volume and quantity of aqueous waste solutions by recovering pure water.
 - ! *Alternatives to wet chemical processes* include:
 - ! *Mechanical cleaning* as an alternative to chemical methods;
 - ! *Process efficiency* improvements for applying photopolymers, printing, and developing;
 - ! *Alternative processes* for connecting the PWB layers together; and
 - ! *Alternatives to lead-based soldering* involving the use of lasers, reactive gases, or ultrasonics.
- ! **Raw material substitution** can reduce wastes by:
 - ! Substituting *semiaqueous or aqueous photoresist* for TCA and methylene chloride resists.
 - ! Substituting *no-clean fluxes*.
 - ! Substituting *aqueous clean fluxes*.
 - ! Substituting *semi-aqueous cleaning materials*.
 - ! Substituting *other solvents* for CFC 113 and TCA during board assembly.
- ! **Waste separation or preparation** can reduce wastes by:
 - ! Separating *wastewater sludge* to prepare for metal recovery.
- ! **Recycling can reduce waste by:**
 - ! *Removing and recovering lead* and tin from boards by electrolysis-chemical precipitation.

Sources:

EPA Sector Notebook Project: Electronic and Computer Industry, U.S. EPA, Office of Compliance, September 1995, EPA/310-R-95-001. (Also accessible via the Internet at the EPA Sector Notebook Home Page address, <http://es.inel.gov/comply/sector/index.html>).

3.8.4 Electronics Manufacturing: Printed Circuit Boards

Tip Sheet #1

WASTE ORIGIN: Fabrication

WASTE TYPES: Spent Process Baths, Sludges, and Rinsewaters

WASTE REDUCTION AND RECYCLING METHODS:

- ! Substitute **drip pans** for rinse tanks.
 - ! Extend chemical process **bath replacement period** through filtration, analysis, and maintenance.
 - ! Introduce low-water demand **spray rinses** on conveyORIZED processes.
 - ! Provide direct recovery of **copper sulfate** from etch/strip processes by cooling and crystallization.
 - ! Replace common **chemical precipitation** with electrochemical reduction processes.
 - ! Reduce **chemical oxidation** demand loading of sewer by changing manufacturing process chemistries.
 - ! Replace **electrochemical reduction** with ion exchange, crystallization, and heavy metal extraction/recovery through electrodeposition techniques.
-

WASTE ORIGIN: Electronic and Final Assembly

WASTE TYPES: Petroleum-based Solvents, Coolants and Oils, Volatile Organic Compound (VOC) Air Emissions, and Shelf-Life Expired Materials

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use **in-line solvent recovery** on vapor degreasers.
- ! Extend **solvent life** by monitoring solvent quality to avoid unnecessary additions of solvent.
- ! Implement **recycling** of glycol coolants and hydraulic oil.
- ! Change to **low-VOC coating** operations.
- ! Install centralized chlorinated **solvent recovery** system.
- ! Implement **shelf-life** sensitive material reduction program.

Source:

Fact Sheet, *Waste Reduction for the Aerospace Industry*, CA DHS Alternative Technology Division, August 1989.

3.8.4 Electronics Manufacturing: Printed Circuit Boards

Tip Sheet #2

WASTE ORIGIN: PC Board Fabrication

WASTE TYPES: General Wastes

WASTE REDUCTION AND RECYCLING METHODS:

- ! Substitute **surface mount** technology.
 - ! Substitute injection molded **substrate** and additive **plating**.
-

WASTE ORIGIN: Cleaning and Surface Preparation

WASTE TYPES: Solvents

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use **abrasives**.
 - ! Use non-chelated **cleaners**.
 - ! Use **mild chelators** if chelators are required in the process.
 - ! Extend **bath life**.
 - ! Improve **rinse efficiency**.
 - ! Use **counter-current cleaning**.
 - ! **Recycle or reuse** cleaners and rinses.
-

WASTE ORIGIN: Pattern Printing and Masking

WASTE TYPES: Acid Fumes, Organic Vapors, Vinyl Polymers, Spent Resist Removal Solution, Spent Acid Solution, and Waste Rinsewater

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use aqueous **processable resist**.
 - ! Do screen printing versus **photolithography**.
 - ! Use dry **photoresist removal**.
 - ! **Recycle or reuse** photoresist stripper.
-

WASTE ORIGIN: Etching

WASTE TYPES: Etching Solutions and Rinsewaters

WASTE REDUCTION AND RECYCLING METHODS:

- ! Eliminate **differential plating**.
- ! Use **dry plasma etching**.
- ! Use **non-chelated etchants**.
- ! Use **non-chrome etchants**.
- ! Use thinner **copper cladding**.
- ! Use pattern instead of **panel plating**.
- ! Use additive instead of **subtractive method**.
- ! **Reuse of recycle** etchants (e.g. through filtration and regeneration).

Sources:

Facility Pollution Prevention Guide, U.S. EPA, May 1992. EPA/6000/R-92/088.

Guides to Pollution Prevention: The Printed Circuit Board Manufacturing Industry, U.S. EPA, Risk Reduction Engineering Laboratory, Center For Environmental Research Information, June 1990, EPA/625/7-90/007.

Hazardous Waste Reduction Facts: Printed Circuit Board Industry, City of Santa Monica, Dept. Of General Services.

Fact Sheet: *Printed Circuit Board Manufacturers*, CA DHS Alternative Technology Division, August 1989.

3.8.4 Electronics Manufacturing: Printed Circuit Boards

Tip Sheet #3

WASTE ORIGIN: Electroplating and Electroless Plating

WASTE TYPES: Plating Solutions, Rinsewater, and Sludges

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use non-cyanide baths and non-cyanide **stress relievers**.
- ! Design and maintain **rack** properly to extend bath life and reduce carryover:
 - ! Use better *precleaning or rinsing*;
 - ! Use *de-mineralized water* as make-up;
 - ! Store *solutions* properly.
- ! Extend **bath life** and reduce **drag-out**:
 - ! Minimize *bath chemical concentration*. Over time, gradually add reagents to prolong life until achieving full strength;
 - ! Increase *bath temperature*;
 - ! Use *wetting agents*;
 - ! Use proper *positioning in rack*;
 - ! Slow withdrawal and sample *drainage*;
 - ! *Computerize or automate* systems;
 - ! Use airstream or fog to rinse *plating solution* into the tank;
 - ! Collect drips between process and rinse tanks with *drain boards*;
 - ! *Recover* drag-out.
- ! Extend bath life; maintain **bath solution** quality:
 - ! Monitor *solution activity*;
 - ! Control *temperature*;
 - ! Use mechanical *agitation*;
 - ! Use continuous *filtration/carbon treatment*, electrolytic dummyming;
 - ! Remove *impurities*.
- ! Properly design and operate **equipment**.
- ! Use **closed-circuit** rinses, spray rinses, and fog nozzles.
- ! Increase **agitation**; use air agitation or work piece agitation.
- ! **Conserve** water:
 - ! Install *turbulence* devices;
 - ! Increase *contact* between water and the board;
 - ! reuse *acid rinse effluent* as influent for alkaline rinse tank;
 - ! Use *countercurrent rinsing*;
 - ! Apply *flow restriction devices* such as pH-controlled and pressure-controlled shutoffs.
- ! Use **de-ionized water** to reduce sludge volume.
- ! Ask supplier to recommend chemicals which **generate less sludge**.

- ! **Recover metal** values.
- ! **Separate** waste streams.

Sources:

Facility Pollution Prevention Guide, U.S. EPA, May 1992. EPA/6000/R-92/088.

Guides to Pollution Prevention: The Printed Circuit Board Manufacturing Industry, U.S. EPA, Risk Reduction Engineering Laboratory, Center For Environmental Research Information, June 1990, EPA/625/7-90/007.

Hazardous Waste Reduction Facts: Printed Circuit Board Industry, City of Santa Monica, Dept. of General Services.

Fact Sheet: *Printed Circuit Board Manufacturers*, CA DHS Alternative Technology Division, August 1989.

3.9.1 Metal Fabrication/Finishing

Tip Sheet #1

WASTE ORIGIN: Metal Surface Finishing and Plating

WASTE TYPES: Cutting Oils and Fluids, Spent Process Baths, Dye Penetrants, Sludges, Solvents, and Rinsewater

WASTE REDUCTION AND RECYCLING METHODS:

- ! Replace cutting oils with **water-soluble coolants**.
- ! Separate **dye penetrants** from water.
- ! Consider **ultrafiltration** for water/organic mixtures.
- ! Phase out 1,1,1-Trichloroethane and flammable solvents and convert to **water-based cleaners**.
- ! Implement **metal recovery** with state-of-the-art ion exchange.
- ! Implement electrochemical **extraction of heavy metals** from water.
- ! Increase **solution life** (e.g., with proper design and maintenance).
- ! Control **viscosity and surface tension** of process solutions.
- ! Use **material or process substitution** (e.g., trivalent chromium instead of hexavalent; chemical vapor deposition).
- ! Use **low-solvent paint** for coating.
- ! Use mechanical **cladding and coating**.
- ! Use cleaning baths as **pH adjusters**.
- ! **Recover metals** from process solutions.

Sources:

Facility Pollution Prevention Guide, U.S. EPA, May 1992, EPA/600/R-92/088.

Fact Sheet, *Waste Reduction for the Aerospace Industry*, CA DHS Alternative Technology Division, August 1989.

Guides to Pollution Prevention: The Fabricated Metal Products Industry, U.S. EPA, July 1990, EPA/625/7-90/006.

Metal Fabricators: Pollution Prevention Opportunities Checklist, Industrial Waste Section, County Sanitation Districts of Los Angeles County, Whittier, CA.

Seminar Publication: *Meeting Hazardous Waste Requirements for Metal Finishers*, U.S. EPA, Office of Research and Development, Center For Environmental Research Information, September 1987, EPA/625/4-87/018.

Waste Minimization in Metal Parts Cleaning, U.S. EPA, Office of Solid Waste, August 1989, EPA/530-SW-89-049.

3.9.1 Metal Fabrication/Finishing

Tip Sheet #2

WASTE ORIGIN: Machining

WASTE TYPES: Metal Working Fluid, Metal Wastes, Dust, and Sludge

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use **water-soluble** metal working fluids.
- ! Use de-mineralized **water make-up**.
- ! Perform regularly scheduled **sump and machine cleaning**.
- ! Perform regularly scheduled **gasket, wiper, and seal maintenance**.
- ! Filter, pasteurize, and treat **metal working fluid for reuse**.
- ! Switch to **synthetic fluids**.
- ! Use **gas coolants** where possible instead of liquid.
- ! Assign **fluid control** responsibility to one person.
- ! Standardize **coolant types** used on machining equipment.
- ! **Reuse or recycle** cutting, cooling, and lubricating oils (skimming, coalescing, hydrocloning, centrifuging, pasteurization, downgrading, filtration, dissolved air flotation).

Sources:

Facility Pollution Prevention Guide, U.S. EPA, May 1992, EPA/600/R-92/088.

Fact Sheet, *Waste Reduction for the Aerospace Industry*, CA DHS Alternative Technology Division, August 1989.

Guides to Pollution Prevention: The Fabricated Metal Products Industry, U.S. EPA, July 1990, EPA/625/7-90/006.

Metal Fabricators: Pollution Prevention Opportunities Checklist, Industrial Waste Section, County Sanitation Districts of Los Angeles County, Whittier, CA.

Seminar Publication: *Meeting Hazardous Waste Requirements for Metal Finishers*, U.S. EPA, Office of Research and Development, Center For Environmental Research Information, September 1987, EPA/625/4-87/018.

Waste Minimization in Metal Parts Cleaning, U.S. EPA, Office of Solid Waste, August 1989, EPA/530-SW-89-049.

3.10.1 Paint Formulating/Manufacturing

Tip Sheet #1

WASTE ORIGIN: Unloading Materials into Mixing Tanks

WASTE TYPES: Leftover Raw Materials and Containers

WASTE REDUCTION AND RECYCLING METHODS:

- ! **Purchase pre-weighed** hazardous materials.
 - ! Quality check incoming **raw material**.
 - ! Install high level **shutoff and flow totalizers** with cutoff.
 - ! **Purge pipelines** before disconnecting when filling tanks.
 - ! Use **reusable/recyclable drums** with liners
-

WASTE ORIGIN: Unloading Pigment

WASTE TYPE: Pigment Dusts and Leftover Pigment in Packages

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use **non-hazardous pigments**.
- ! Use **non-mercury bactericides**.
- ! Use **paste/slurry form** pigments.
- ! Use **high solids formulations**.
- ! Modify **bulk storage tanks** (e.g., use conservation vents, floating roof, nitrogen blanketing, refrigerator condensers, lean-oil or carbon absorbers, vapor compressors).
- ! Install dedicated **baghouse systems**.
- ! **Segregate waste** pigments so they can be reworked.
- ! Use water soluble **bags and liners**.
- ! Use recyclable, lined, or dedicated **containers**.

Sources:

Guides to Pollution Prevention: The Paint Manufacturing Industry, U.S. EPA, June 1990, EPA/625/7-90/005.

Fact Sheet: *Waste Reduction for Paint Formulators*, CA DHS, Alternative Technology Division, December 1989.

3.10.1 Paint Formulating/Manufacturing

Tip Sheet #2

WASTE ORIGIN: Color Matching

WASTE TYPES: Off-spec Materials

WASTE REDUCTION AND RECYCLING METHODS:

- ! **Blend** into new products.
 - ! **Test batch** formulation in lab.
 - ! Sell at a **discount**.
-

WASTE ORIGIN: Grinding and Mixing

WASTE TYPE: Spills and Off-spec Paint

WASTE REDUCTION AND RECYCLING METHODS:

- ! Increase use of **automation**.
 - ! Use appropriate **cleanup methods**.
 - ! **Recycle** back into process.
 - ! Employee **training**.
-

WASTE ORIGIN: Filtering

WASTE TYPE: Spent Filter Cartridges and Bags

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use the **smallest cartridge** possible.
 - ! Use **bag or metal mesh** filters.
 - ! **Reuse** filter bags.
 - ! Improve **pigment** dispersion.
 - ! Increase dedication of **filling units**.
-

Sources:

Guides to Pollution Prevention: The Paint Manufacturing Industry, U.S. EPA, June 1990, EPA/625/7-90/005.

Fact Sheet: *Waste Reduction for Paint Formulators*, CA DHS, Alternative Technology Division, December 1989.

3.10.1 Paint Formulating/Manufacturing

Tip Sheet #3

WASTE ORIGIN: Equipment Cleaning

WASTE TYPES: Waste Rinsewater, Waste Solvent, and Paint Sludge

WASTE REDUCTION AND RECYCLING METHODS:

- ! Schedule production to **minimize cleaning needs** (e.g., light-to-dark batch sequencing).
- ! Increase size of production run.
- ! Avoid **unnecessary cleaning**. Explore eliminating cleaning steps between batches. Disperse pigments only before a batch formulation.
- ! Prevent **paint from drying** in tanks.
- ! **Clean equipment immediately** before paint dries.
- ! Use **mechanical wipers** on mix tanks.
- ! Use **high-pressure, low-volume wash** systems.
- ! Install more **efficient mills** that do not require multi-pass dispersions.
- ! Install **liners** on mix tanks.
- ! Use **foam/plastic "pigs"** to clean lines.
- ! Use **alternative cleaning agents** (e.g., water-based).
- ! Reuse equipment **cleaning wastes**. Collect solvent and use in next compatible batch of paint as part of formulation.
- ! **Collect solvent** and re-distill.
- ! Use **countercurrent rinse** methods.
- ! Increase **spent rinse settling time** or use de-emulsifiers on spent rinses to allow continued use.
- ! **De-water sludge** by filtration or centrifugation to allow continued use of cleaning solution.

Sources:

Guides to Pollution Prevention: The Paint Manufacturing Industry, U.S. EPA, June 1990, EPA/625/7-90/005.

Fact Sheet: *Waste Reduction for Paint Formulators*, CA DHS, Alternative Technology Division, December 1989.

3.11.1 Plastics Manufacturing: Fiber-reinforced Plastics

Tip Sheet #1

WASTE ORIGIN: Raw Material Purchasing and Unloading

WASTE TYPES: Rejected and Excess Raw Materials

WASTE REDUCTION AND RECYCLING METHODS:

- ! Improve **inventory control**.
 - ! Purchase material in **appropriate amounts**.
 - ! Purchase drums which are **returnable** or have plastic liners.
 - ! Return **unused materials** to suppliers.
-

WASTE ORIGIN: Fabrication

WASTE TYPES: Gelcoat Resin and Solvent Overspray

WASTE REDUCTION AND RECYCLING METHODS:

- ! **Test batch** formulation in lab.
 - ! Change **spray-delivered systems** (spray re-orientation and equipment modification e.g., air-assisted technology).
 - ! Use **non-spray resin application** methods (e.g., pre-spray fiber reinforcing, in-house resin impregnation, resin roller dispenser, vacuum bag molding processes, closed mold systems).
-

Source:

Guides to Pollution Prevention: The Fiberglass-Reinforced and Composite Plastics Industry, U.S. EPA, October 1991, EPA/625/7-91/014.

3.11.1 Plastics Manufacturing: Fiber-reinforced Plastics

Tip Sheet #2

WASTE ORIGIN: Piping and Treater Pan at End of Run

WASTE TYPES: Scrap-Solvated and Partially-cured Resins

WASTE REDUCTION AND RECYCLING METHODS:

- ! Modify **resin pan** geometry (no more than 10" wider than fabric).
 - ! Reduce **transfer pipe** diameter size.
-

WASTE ORIGIN: Equipment Cleaning

WASTE TYPES: Petroleum-based Solvents

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use **low-VOC** cleanup solvents.
 - ! Maximize **production runs**; schedule together to reduce need to clean equipment during batches; **schedule product families** in sequence to reduce cleanup between batches.
 - ! Clean equipment **before resin dries**.
 - ! Restrict **solvent issue**.
 - ! Replace solvents with **emulsifiers**.
 - ! Use less toxic, less volatile **substitutes** (biodegradable, water-soluble, resin-bed compatible, recoverable).
 - ! Reduce **rinse solvent** usage.
 - ! Use small lab-type wash bottles or squeegees for **treater pan cleanouts**.
 - ! Use **two-stage cleaning** process (first rinse with dirty solvent, then rinse with fresh solvent).
 - ! **Separate wastes**, keep water out of solvents.
 - ! Store and reuse **cleaning wastes**.
 - ! **Recover** on-site.
-

WASTE ORIGIN: Cleanup

WASTE TYPES: Resin and Solvent Contaminated Floor Sweepings

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use recyclable floor **sweeping compound**.
- ! Reduce **solvent and resin spillage** and overspray. Use alternate material application and fabrication techniques.

Sources:

Guides to Pollution Prevention: The Fiberglass-Reinforced and Composite Plastics Industry, U.S. EPA, October 1991, EPA/625/7-91/014.

3.12.1 Photo Processing Industry: Common Operations

Tip Sheet #1

WASTE ORIGIN: Material Handling and Storage

WASTE TYPES: Empty Containers, Used Film Packages, Outdated Material, and Film and Paper

WASTE REDUCTION AND RECYCLING METHODS:

- ! **Label** all containers with content and use information.
- ! **Test** age-dated material (if expired) for effectiveness.
- ! Recycle empty **containers**.
- ! Recycle spoiled photographic **film and paper**.
- ! Develop a working relationship with one **vendor** to facilitate bulk purchases to return old, off-specification products, or to return containers for refill if possible.
- ! **Monitor and manage** supply ordering process to ensure size and frequency of orders, minimizing outdated materials and waste containers/packaging.

WASTE ORIGIN: Finishing Process

WASTE TYPES: Paper Waste from Damaged Products

WASTE REDUCTION AND RECYCLING METHODS:

- ! **Reduce** paper use.
- ! **Recycle** waste paper.
- ! **Control** storage to minimize damage from handling and humidity.

Sources:

Facility Pollution Prevention Guide, U.S. EPA, May 1992, EPA/600/R-92/088.

Guides to Pollution Prevention: The Commercial Printing Industry; U.S. EPA, August 1990, EPA/625/7-90/008.

Hazardous Waste Management for Printers, New York DEC, Division of Hazardous Substances Regulation, Bureau of Pollution Prevention, September 1991 Draft.

Hazardous Waste Reduction Facts: General Commercial Printers, City of Santa Monica, Dept. of General Services.

Pollution Prevention Opportunities in Printing, U.S. EPA Region III, October 1990.

Printing: Pollution Prevention Opportunities Checklist, Industrial Waste Section, County Sanitation Districts of Los Angeles County, Whittier, CA, December 1990.

Pollution Prevention: Strategies for the Printing Industry, Center for Hazardous Materials Research.

Fact Sheet: *Removing Solvent and Ink from Printer Shop Towels and Disposable Wipes*, MNTAP, 8/91-37.

Fact Sheet: *Waste Reduction for the Commercial Printing Industry*, CA Dept. of Health Services, Toxic Substances Control Program, Alternative Technology Division, April 1990.

Waste Reduction Tips for Printshops, Alaska Health Project, 1987.

3.12.1 Photo Processing Industry: Common Operations

Tip Sheet #2

WASTE ORIGIN: Image Processing

WASTE TYPES: Photographic Chemicals and Silver

WASTE REDUCTION AND RECYCLING METHODS:

- ! Install **meters** (e.g., densitometer) on cameras to ensure good proofs the first time.
- ! Install **no-discharge** ("plumbingless") paper and film developing units.
- ! Protect **process baths** that spoil easily by keeping them containerized.
- ! Don't leave **excess chemicals** on films and plates to extend life of developing solution.
- ! Use **squeegees** to reduce carryover.
- ! Extend **bath life** (e.g., monitor temperature and pH of fixing bath).
- ! Use counter-current **washing**.
- ! Use an **acid stop bath** prior to the fixing bath. Add acetic acid to the fixing bath to keep pH low.
- ! Use **floating lids** on bleach and developer containers.
- ! Consult chemical supplier about adding **ammonium thiosulfate** to fixer to extend fixer bath life.
- ! **Separate** fixer from developer waste.
- ! **Recover** silver and **recycle** chemicals (e.g., metal replacement, chemical precipitation, electrolytic silver recovery systems, ion exchange).
- ! Install **electrowinning unit** on fix bath of photoprocessor; on first rinse, and developer waste streams.
- ! Use **silver-free films**, such as vesicular, diazo, or electrostatic types for contact operations.
- ! Use **electronic pre-press** system to prepare copy.

Sources:

Code of Management Practice for Silver Dischargers, Silver Coalition/Assn. of Metropolitan Sewerage Agencies (AMSA), September 1995.

Environmental Management and Pollution Prevention: A Guide for Photo Processors, Washington State Dept. of Ecology, September 1994, Publ. 94-138.

Facility Pollution Prevention Guide, U.S. EPA, May 1992, EPA/600/R-92/088.

Guides to Pollution Prevention: The Commercial Printing Industry; U.S. EPA, August 1990, EPA/625/7-90/008.

Hazardous Waste Management for Printers, New York DEC, Division of Hazardous Substances Regulation, Bureau of Pollution Prevention, September 1991 Draft.

Hazardous Waste Reduction Facts: General Commercial Printers, City of Santa Monica, Dept. of General Services.

Pollution Prevention Opportunities in Printing, U.S. EPA Region III, October 1990.

Printing: Pollution Prevention Opportunities Checklist, Industrial Waste Section, County Sanitation Districts of Los Angeles County, Whittier, CA, December 1990.

Pollution Prevention: Strategies for the Printing Industry, Center for Hazardous Materials Research.

Fact Sheet: *Removing Solvent and Ink from Printer Shop Towels and Disposable Wipes*, MNTAP, 8/91-37.

Fact Sheet: *Waste Reduction for the Commercial Printing Industry*, CA Dept. of Health Services, Toxic Substances Control Program, Alternative Technology Division, April 1990.

Waste Reduction Tips for Printers, Alaska Health Project, 1987.

Fact Sheet: *Opportunities for Printers to Reduce Image Processing Costs by Minimizing Waste and Recovering Silver*, University of Wisconsin-Extension, Solid and Hazardous Waste Education Center, 425.WP.9604, 1996.

3.12.2 Photo Processing Industry: Custom/Retail Labs

Tip Sheet #1

WASTE ORIGIN: **Film and Print Processing** (Color and B&W Films and Papers), **Color Film**, **Color Paper**, and **B&W Film and Paper**

WASTE TYPES: Spent Process Chemicals (Developer, Fixer, Bleach Fix), Contaminated Washwaters, Silver Concentration of Spent Process Chemicals, and Washwaters

WASTE REDUCTION AND RECYCLING METHODS:

- ! Reduce **wash water volume** using automatic timer controls.
- ! Use **metal replacement cartridges** (MRCs) for silver recovery, both as a standalone method or with other recovery technologies.
- ! Use an **electrowinning device for silver recovery**; appropriate equipment type depends on the solution volume or flow rate, the concentration of silver, and the level of automation and design sophistication desired.
- ! Use an electrowinning device with metal replacement **cartridges tailing** (polishes the effluent from straight electrowinning).
- ! Use a dedicated electrolytic unit to desilver **spent fixer**. Use a unit used only for recycling fixer, since the recovery process must be done continuously rather than in batch process. (Batch treatment results in an inconsistent chemical composition, compromising processing control.)
- ! Recycle **bleach fix** using a continuous electrolytic system and a three-step desilvering process with metal replacement cartridges (desilvering, restoring bleaching ability, replenish strength of film, and paper processing chemicals).
- ! Whenever possible, regenerate **color developer**. Work with photochemical supplier for most appropriate chemicals and equipment.
- ! Contact **local or state solid and hazardous waste agencies** for:
 - ! Vendor information on **small silver recovery units**;
 - ! Lists of area **silver recycling services**, silver recoverers, or silver refiner;
 - ! Environmental **compliance records** of in- and out-of-state silver refiners;
 - ! Technical assistance.
- ! Contact **other photo finishers** about their experiences with silver recoverers, recyclers and refiners; contact any references provided by the recoverer or recycler; talk with some area generators that were not specified as references.

Sources:

Code of Management Practice for Silver Dischargers, Silver Coalition/Assn. of Metropolitan Sewerage Agencies (AMSA), September 1995.

Environmental Management and Pollution Prevention: A Guide for Photo Processors, Washington State Department of Ecology, September 1994, Publ. 94-138.

Fact Sheet: *Opportunities for Printers to Reduce Image Processing Costs by Minimizing Waste and Recovering Silver*, University of Wisconsin-Extension, Solid and Hazardous Waste Education Center.
Project Summary: *Waste Minimization Opportunity Assessment: A Photofinishing Facility*, U.S. EPA, Publ. EPA/600/S2-91/039.

3.13.1 Printing Industry:

Lithography, Flexography, Gravure, or Letterpress Printing

Tip Sheet #1

WASTE ORIGIN: Platemaking

WASTE TYPES: Damaged Plates, Developed Film, and Outdated Materials

WASTE REDUCTION METHODS:

- ! Increase use of **electronic imaging**.
- ! Consider using **laser platemaking**.
- ! Use **automatic plate processors** to monitor bath conditions and automatically replenish chemicals.
- ! Use **pre-sensitized lithographic plates** processed with water only.
- ! Use **plastic or photopolymer plates** processed with a water-based solution.
- ! Use **electrostatic-paper plates** made directly from art work and used on duplicator presses.
- ! Use **water-based developers**.
- ! Use **non-chromate etchants**.
- ! Prolong **oxidation process baths** by reducing air exposure.
- ! Recycle **spent plates**.

Sources:

Environmental Management and Pollution Prevention: A Guide for Photo Processors, Washington State Department of Ecology, September 1994, Publ. 94-138.

Facility Pollution Prevention Guide, U.S. EPA, May 1992, EPA/600/R-92/088.

Guides to Pollution Prevention: The Commercial Printing Industry; U.S. EPA, August 1990, EPA/625/7-90/008.

Hazardous Waste Management for Printers, New York DEC, Division of Hazardous Substances Regulation, Bureau of Pollution Prevention, September 1991 Draft.

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Pollution Prevention Opportunities in Printing, U.S. EPA Region III, October 1990.

Printing: Pollution Prevention Opportunities Checklist, Industrial Waste Section, County Sanitation Districts of Los Angeles County, Whittier, CA, December 1990.

Hazardous Waste Reduction Facts, General Commercial Printers, City of Santa Monica Dept. of General Services.

Pollution Prevention: Strategies for the Printing Industry, Center for Hazardous Materials Research.

Fact Sheet: *Removing Solvent and Ink from Printer Shop Towels and Disposable Wipes*, MNTAP, 8/91-37.

Fact Sheet: *Waste Reduction for the Commercial Printing Industry*, CA Dept. of Health Services, Toxic Substances Control Program, Alternative Technology Division, April 1990.

Waste Reduction Tips for Printshops, Alaska Health Project, 1987.

3.13.1 Printing Industry:

Lithography, Flexography, Gravure, or Letterpress Printing

Tip Sheet #2

WASTE ORIGIN: Platemaking

WASTE TYPES: Acids, Alkali, Solvents, Plate Coatings, Developers, and Rinsewater

WASTE REDUCTION METHODS:

- ! Use **washless processing** systems.
- ! Use better **operating practices** (e.g, frequently monitor bath pH, temperature, and solution strength to extend life).
- ! Use **floating lids** on bleach and developer tanks.
- ! Use **countercurrent washing** sequence instead of parallel rinse systems.
- ! **Reduce drag-out** (e.g., use drain boards; remove plates slowly and smoothly, place parts on racks to maximize drainage, maximize drip time to the extent that plate quality is not affected).
- ! Use **squeegees** to reduce carryover.
- ! Substitute **iron-EDTA** for ferrocyanide.
- ! Remove **heavy metals** from wastewater.
- ! Recover **silver** and recycle chemicals.

Sources:

Environmental Management and Pollution Prevention: A Guide for Photo Processors, Washington State Department of Ecology, September 1994, Publ. 94-138.

Facility Pollution Prevention Guide, U.S. EPA, May 1992, EPA/600/R-92/088.

Guides to Pollution Prevention: The Commercial Printing Industry; U.S. EPA, August 1990, EPA/625/7-90/008.

Hazardous Waste Management for Printers, New York DEC, Division of Hazardous Substances Regulation, Bureau of Pollution Prevention, September 1991 Draft.

Hazardous Waste Reduction Facts: General Commercial Printers, City of Santa Monica, Dept. of General Services.

Pollution Prevention Opportunities in Printing, U.S. EPA Region III, October 1990.

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Pollution Prevention: Strategies for the Printing Industry, Center for Hazardous Materials Research.

Fact Sheet: *Removing Solvent and Ink from Printer Shop Towels and Disposable Wipes*, MNTAP, 8/91-37.

Fact Sheet: *Waste Reduction for the Commercial Printing Industry*, CA Dept. of Health Services, Toxic Substances Control Program, Alternative Technology Division, April 1990. *Waste Reduction Tips for Printshops*, Alaska Health Project, 1987.

Fact Sheet: *Opportunities for Printers to Reduce Image Processing Costs by Minimizing Waste and Recovering Silver*, University of Wisconsin-Extension, Solid and Hazardous Waste Education Center. 425.WP.9604, 1996.

3.13.1 Printing Industry:

Lithography, Flexography, Gravure, or Letterpress Printing

Tip Sheet #3

WASTE ORIGIN: Makeready

WASTE TYPES: Waste Ink and Wastepaper

WASTE REDUCTION METHODS:

EQUIPMENT:

- ! Use **automatic plate benders**, scanners, or other plate fitting parameters affecting proper registration.
- ! Use **automatic plate scanners** for web or sheet-fed offset presses.
- ! Use **automatic ink key** setting systems.
- ! Use **automatic (computerized) registration** systems for gravure, web offset, etc.
- ! Use **ink/water sensors** to optimize ratio.
- ! Install **web break detectors**.
- ! Use **automatic web splicers**.

PROCESS:

- ! Implement accurate **counting methods**.
- ! Prepare only the **quantity of ink** needed for a press run.
- ! Clean **ink fountains** only if different color is used or if ink might dry out between runs.
- ! Return **unemulsified inks** to their containers.
- ! Donate **unemulsified inks** to trade schools, colleges, etc.
- ! Use **water-based ink or water-borne inks** instead of solvent-based inks when possible (not applicable to lithography).
- ! If you must use solvent-based inks, choose **low-VOC inks**.
- ! Use inks with low or zero levels of **toxic metals** (lead, barium, cadmium, chromium).
- ! Use **soybean oil inks** if possible.
- ! Use **UV-curable ink**.
- ! Use **Electron Beam Drying** on web presses.
- ! Prevent **ink drying and skin formation** through non-drying aerosol sprays.
- ! Test use of **non-skinning ink** formulations.
- ! Store and **reseal ink** properly.
- ! Save **old inks** and market as "house" colors.
- ! Recycle **waste ink** (e.g., to make black ink); smaller operations can coordinate with large plants or newspapers (using rubber/oil based ink) to recycle.
- ! Return liquid **ink to supplier** to be recycled as feedstock.

Sources:

Facility Pollution Prevention Guide, U.S. EPA, May 1992, EPA/600/R-92/088.

Guides to Pollution Prevention: The Commercial Printing Industry; U.S. EPA, August 1990, EPA/625/7-90/008.

Hazardous Waste Management for Printers, New York DEC, Division of Hazardous Substances Regulation, Bureau of Pollution Prevention, September 1991 Draft.

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Fact Sheet: *Waste Reduction for the Commercial Printing Industry*, CA Dept. of Health Services, Toxic Substances Control Program, Alternative Technology Division, April 1990.

Waste Reduction Tips for Printshops, Alaska Health Project, 1987.

Fact Sheet: *Lithographic Ink Wastes: How to Reduce, Reuse, and Recycle Ink Waste*, University of Wisconsin-Extension, Solid and Hazardous Waste Education Center. 425.WP.9508, 1966.

3.13.1 Printing Industry

Lithography, Flexography, Gravure, or Letterpress Printing

Tip Sheet #4

WASTE ORIGIN: Printing and Finishing Operations

WASTE TYPES: Lubricating Oils, Test Production, Waste Inks, Bad Printings, Clean-up Solvent, Empty Ink Containers, Rags, and Used Blankets

WASTE REDUCTION METHODS:

- ! Install **web break detectors**.
- ! **Monitor press** performance.
- ! Check **roller blade** condition and angle.
- ! Use better **operating practices**.
- ! Improve **start-up** procedures.
- ! Use **fountain solutions** that do not contain isopropyl alcohol (IPA) or have low concentrations of IPA.
- ! Use **automatic ink leveler**.
- ! **Schedule runs** to reduce color changeover (e.g., use standard ink sequence to eliminate the need to change ink rotation, fountain cleaning).
- ! **Do not mix** hazardous solvent/ink wastes with non-hazardous solvent/ink wastes.
- ! Use **automatic blanket cleaning** systems.
- ! Use **alternative solvents** (e.g., less-toxic or less flammable blanket washes — acetic acid, hexane, or detergent based).
- ! Use **soaps and detergents** instead of solvents when possible.
- ! **Wipe off excess ink** before cleaning equipment with solvents.
- ! Use **solvents only** for cleaning inks and oils.
- ! Draw **only enough solvent** needed to complete cleaning task. Control solvent use by using plunging cans that moisten but do not soak towels, or by using squeeze bottles to moisten towel.
- ! Apply **solvent directly to roller blanket** with squeeze bottle.
- ! Use **press wipes** as long as possible; use dirty wipes for the first pass, and clean wipes for the second.
- ! Physically **dry wiper rags** (squeegee or spin, use hand-operated or mop wringer, explosion proof centrifuge, hand squeeze); **recover or recycle squeezings and drippings**, send dirty rags to approved industrial laundries.
- ! Install **solvent hoods** to recapture solvent losses from presses.
- ! Clean trays in a **parts washing unit** using recirculating solvent.
- ! **Separate solvent** according to color and type of ink. Reuse collected wastes to thin future batches of same ink.
- ! Recycle **waste solvent**.
- ! Separate and recycle **used oil**.

Sources:

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- Hazardous Waste Management for Printers*, New York DEC, Division of Hazardous Substances Regulation, Bureau of Pollution Prevention, September 1991 Draft.
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- Fact Sheet: *Waste Reduction for the Commercial Printing Industry*, CA Dept. of Health Services, Toxic Substances Control Program, Alternative Technology Division, April 1990.
- Waste Reduction Tips for Printshops*, Alaska Health Project, 1987.
- Fact Sheet: *Management of Solvents and Wipes in the Printing Industry*, University of Wisconsin-Extension, Solid and Hazardous Waste Education Center. 425.WP.9410, 1994.
- Fact Sheet: *Waste Reduction Opportunities for Printers*, University of Wisconsin-Extension, Solid and Hazardous Waste Education Center. 425.WP.9408, 1994.
- Fact Sheet: *Opportunities for Printers to Reduce Image Processing Costs by Minimizing Waste and Recovering Silver*, University of Wisconsin-Extension, Solid and hazardous Waste Education Center. 425.WP.9604, 1996.
- Fact Sheet: *Lithographic Ink Wastes: How to Reduce, Reuse, and Recycle Ink Waste*, University of Wisconsin-Extension, Solid and Hazardous Waste Education Center. 425.WP.9508, 1995.

3.13.2 Printing Industry: Screen Printing

Tip Sheet #1

WASTE ORIGIN: General Operations

WASTE TYPES: Volatile Organic Compound (VOC) Emissions (Air and Water), Cleaning Solvents, and Solvent-based Inks

WASTE REDUCTION METHODS:

- ! **Proper material management** and use can reduce hazardous wastes by:
 - ! Keeping chemicals in *safety cans or covered containers* between uses minimizes chemical losses from evaporation and spills;
 - ! *Separating chemical wastes* into clearly marked, easily accessible containers for both hazardous and non-hazardous wastes;
 - ! Using plunger cans, squeeze bottles, or *specialized spraying equipment* to concentrate the area on which the chemicals are applied;
 - ! Using a **pump to transfer** cleaning and reclamation solutions from large containers to smaller containers to reduce the potential for spills;
 - ! Using **manual spot application** of chemicals rather than cleaning the entire screen, when appropriate;
 - ! Evaluating and experimenting with *dilution of solutions* that contain chemicals and water may allow chemical reduction without losing efficiency.
 - ! Recapturing printing ink by squeezing screen prior to washing.
- ! **Inventory controls** may help waste reduction by:
 - ! Minimizing the amount of *chemicals available on the shop floor* to encourage materials conservation;
 - ! **Centralizing chemical storage and distribution** can give employees incentive to use less;
 - ! **Maintaining accurate records** of chemical and material use, along with waste generation rates, helps identify and prioritize waste reduction opportunities;
 - ! Switching to **non-aerosol products**, especially refillable substitutes, whenever possible;
 - ! Finding **alternative screen cleaning solutions**, like traditional ink removers; consult suppliers of ink, emulsion, and haze remover solutions to identify suitable material substitutes.
- ! **Equipment modifications or additions** can help reduce hazardous wastes and emissions by:
 - ! Using operator-controlled *adjustable sprayers* to minimize and reduce the amount of chemical solution applied;
 - ! **Controlling the overspray** of cleaning/reclaiming solutions with a washout booth allows the capture and possible reuse of chemicals;
 - ! **Separating contaminants** from screen cleaning and reclamation effluent through

- distillation with a solvent still is effective in recycling and reusing hazardous chemicals;
1. ***Using a filtration/recirculation system*** to remove particulates, heavy metals, hydrocarbons, and other waste products filters cleaning solutions for reuse.

Sources:

Environmental Management and Pollution Prevention: A Guide for Screen Printers, Washington State Dept. of Ecology, September 1994, Publ. 94-137.

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Cleaner Technologies Substitutes Assessment: Screen Printing Screen Reclamation, Draft, September 1994, EPA744R-94-005.

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Screen Printing Case Study 2: Technology Alternatives for Screen Reclamation, Draft, October 1994.

Screen Printing Case Study 3: Chemical Alternatives for Screen Reclamation, Draft, October 1994.

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

3.13.2 Printing Industry: Screen Printing

Tip Sheet #2

WASTE ORIGIN: Film Processing

WASTE TYPES: Scrap Film, Processing Chemicals (Developer, Fixer, PMT Activator), and Washwater (Silver)

WASTE REDUCTION METHODS:

- ! Reduce wastes associated with **film developer solutions** by:
 - ! Purchasing developer solutions that contain *less than one percent hydroquinone*;
 - ! Not putting developer into used fixers when using *chemical recovery cartridges* (CRCs); CRCs can plug and cause dangerous pressure build up;
 - ! *Not putting developer* into a septic system, storm drain, dry well, or onto the ground.
 - ! Not disposing of *unused or past shelf-life developer* to the sanitary sewer unless granted permission from the local sewer utility;
- ! Reduce the discharge of **silver-contaminated fixer** by:
 - ! Attaching *labels* to used fixer containers that identify this hazardous waste;
 - ! Not disposing of *unused or past shelf-life developer* to the sanitary sewer unless granted permission from the local sewer utility;
 - ! Doing *on-site recovery*:
 - ! Comply with hazardous waste and sewer *discharge limits* by routinely testing fixer effluent through a lab accredited for silver analysis;
 - ! Get *approval from the local sewer authority* to discharge the remaining effluent.
- ! Reduce the **silver wastes produced by activator solutions** used for making photo mechanical transfers (PMTs) by:
 - ! Not adding activator to used fixer; the *high pH of the activator* may interfere with proper silver recovery;
 - ! Not disposing of *unused or past shelf life PMT activator* to the sanitary sewer unless granted permission from the local sewer utility;
 - ! *Not putting activator into* a septic system, storm drain, dry well, or onto the ground
- ! Reduce silver wastes from both **processed and unprocessed scrap film** by:
 - ! *Recycling* accumulated scraps with participating film manufacturers, silver recovers, film product recycling, and film collection firms;
 - ! *Not soaking scrap film* in used fixer to remove silver; a coating of leachable fixer may make the scrap film a hazardous waste;
 - ! Asking the on-site silver recovery equipment *supplier* if they will take scrap film.
- ! When using **on-site silver recovery units**, like the common electrolytic units combined with metallic replacement or chemical recovery cartridges (CRCs), properly maintain and operate CRCs by:
 - ! Using *two CRCs in series* with the electrolytic recovery unit to meet hazardous waste or sewer discharge limits;

- ! Installing a *sample valve* between the two canisters to allow testing of the CRCs effectiveness;
- ! **Monitoring the flow rate** of used solutions into the CRCs for proper operation (usually between one and three gallons per hour); use a metered pump system or a restricted gravity feed system and keep flow rates at manufacturers' recommendations;
- ! **Testing CRC outflow** for compliance with silver discharge limits; keep a file with all test data to compare proper process and equipment operation.

Sources:

Environmental Management and Pollution Prevention: A Guide for Screen Printers, Washington State Dept. of Ecology, September 1994, Publ. 94-137.

Screen Printers: A Guide to Reducing Hazardous Waste and Air Emissions When Cleaning and Reclaiming Used Screens, Draft, Solid and Hazardous Waste Education Center, University of Wisconsin-Extension, March 1996.

U.S. EPA Design For The Environment Screen Printing Project Documents:

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Screen Printing Case Study 2: Technology Alternatives for Screen Reclamation, Draft, October 1994.

Screen Printing Case Study 3: Chemical Alternatives for Screen Reclamation, Draft, October 1994.

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

3.13.2 Printing Industry: Screen Printing

Tip Sheet #3

WASTE ORIGIN: Screen Reclamation (Screen Cleaning Chemicals)
Ink Removal, Emulsion (Stencil) Removal, Haze (Ghost Image or Ink Stain) Removal

WASTE TYPES: Screen Solvent Cleaners (Acetone; Methanol, Methyl Ethyl Ketone; Toluene; 1,1,1-Trichloroethane, Xylene), Screen Degreasers, and Numerous Hazardous Volatile Organic Compounds (VOCs)

WASTE REDUCTION METHODS:

- ! Work with vendors to **find comparable cleaning alternatives** for ink and emulsion removers:
 - ! Avoid using “*F-listed*” solvents, EPA-classified solvents considered hazardous wastes when used alone or when mixed with volumes of wash water;
 - ! **Suitable substitutes should have a high flashpoint** (greater than 140°F) along with a low VOC content (less than 30 percent);
 - ! Determine if *substitute cleaners, once spent*, need to be managed as hazardous waste;
 - ! **Alternative ink remover** that greatly reduce chemical risks include: diethylene glycol series ethers, propylene glycol series ethers, n-methyl pyrrolidone (NMP), and ethoxylated nonylphenol.
- ! **Screen management practices** can be effective in reducing hazardous wastes by:
 - ! **Avoiding delays in cleaning** and reclaiming screens makes ink, emulsion, and haze easier to remove. Removing ink and emulsion immediately after printing reduces haze remover use after ink dries;
 - ! Removing **extra ink from screens** with a scraper or spatula before using ink remover;
 - ! Drying **solvent-coated screens** before washing them in water;
 - ! Not **cleaning screens directly over a sink or drain**; use a separate solvent cleaning station that allows collection of any leftover solvent for reuse, recycling, or disposal;
 - ! **Disposing of small or worn out screens** to reduce chemical use, labor costs, and worker exposure, needed to clean and reclaim the screens
- ! Use a **solvent pump can** instead of pouring solvent from a jug minimizes workers’ chemical exposure.
- ! **Do not mix solvent wastes**; do not store products or wastes together. Store solvents away from heat sources
- ! Use a **haze remover** with a pH under 12.5; do not put haze remover waste in the garbage if the pH is over 12.5.
- ! **Screen degreasers** used during screen preparation and after screen reclamation should not contain chlorinated solvents; chlorinated solvent degreaser rinsate must be managed as hazardous waste.

- ! Consider **potential alternative screen reclamation technologies** to eliminate hazardous chemical cleaners:
 - ! **High-pressure screen washers** can eliminate use of ink and emulsion removers;
 - ! **Automatic screen washers** can reduce solvent losses, reduce labor costs, and reduce worker exposure;
 - ! **Dry media blasting** with plastics, wheat starch, ice, or carbon dioxide (dry ice);
 - ! **Wet media blasting** with high pressure water, or high pressure water along with sodium bicarbonate (baking soda);
 - ! **Pulse light energy** technologies using laser and flashlamp methods;
 - ! **Stripping methods** including sanding, heat gun stripping, and cryogenic methods.

Sources:

Environmental Management and Pollution Prevention: A Guide for Screen Printers, Washington State Dept. of Ecology, September 1994, Publ. 94-137.

Screen Printers: A Guide to Reducing Hazardous Waste and Air Emissions When Cleaning and Reclaiming Used Screens, Draft, Solid and Hazardous Waste Education Center, University of Wisconsin-Extension, March 1996.

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Designing Solutions for Screen Printers, March 1995, EPA744-F-95-003.

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Screen Printing Case Study 2: Technology Alternatives for Screen Reclamation, Draft, October 1994.

Screen Printing Case Study 3: Chemical Alternatives for Screen Reclamation, Draft, October 1994.

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

Fact Sheet: *Screen Printers: A Guide to Reducing Hazardous Waste and Air Emissions When Cleaning & Reclaiming Used Screens*. 425.WP.9606, 1996.

3.13.2 Printing Industry: Screen Printing

Tip Sheet #4

WASTE ORIGIN: Screen Printing Waste Inks

WASTE TYPES: Heavy Metals Pigments (Barium, Cadmium, Chromium, Lead, Silver, Etc.)
Solvent-based Ink Liquids (Ethanol, Isopropanol, Ethylene Glycol, Xylene, Toluene, etc.), and Volatile Organic Compound (VOC) Air and Water Emissions

WASTE REDUCTION METHODS:

- ! **Stock** only as much ink as needed for the near future.
- ! If using **colored inks**, ask your vendor for inks that contain little or no heavy metals; ask if your vendor can reblend inks.
- ! Check **material safety data sheets** (MSDSs) to see if stocked inks contain ignitable solvents or heavy metals.
- ! **Scrape or drain cans**; make sure ink and mixing containers are empty before disposal.
- ! **Remove ink** from stir sticks using a scraper or spatula instead of solvent and shop towels; use reusable stainless steel, plastic, or wooden stir sticks.
- ! **Do not leave wooden stir sticks** sitting in cans of ink, as they can absorb additives and solvents and degrade ink quality.
- ! **Remove as much ink** as possible from adhesive tape and screens with a scraper or spatula, returning excess ink to the original or waste container.
- ! **Never put ink into** a sanitary sewer, storm drain, septic system, dry well, or onto the ground.

Sources:

Environmental Management and Pollution Prevention: A Guide for Screen Printers, Washington State Dept. of Ecology, September 1994, Publ. 94-137.

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

3.13.2 Printing Industry: Screen Printing

Tip Sheet #5

WASTE ORIGIN: General Cleanup Operations

WASTE TYPES: Screen Cleaning or Degreasing Solvents (Ink, Emulsion or Haze Removers), Waste Inks (Heavy Metals and Solvent-based Inks), Parts and Tools Cleaning Solvents (Mineral Spirits, Stoddard Solvent, Naphtha, Xylene), and Volatile Organic Compound (VOC) Air and Water Emissions

WASTE REDUCTION METHODS:

- ! **Equipment modifications or additions** may help decrease wastes and emissions by capturing chemicals on-site:
 - ! **Operator-controlled adjustable sprayers** allow close control of the amount and direction of cleaning chemical sprays;
 - ! **Washout booths** focus cleaning/reclaiming solutions in a small area and minimize solvent loss to shop air, captures chemical overspray, and allows their reuse;
 - ! An **in-process solvent still** separates contaminants from cleaning effluent through distillation for effective reuse and recycling of spent solvents;
 - ! **Filtration/recirculation systems** can remove particulates, heavy metals, hydrocarbons and other waste products from ink, emulsion and haze removers for cleaner reuse.
- ! **Disposable shop towels contaminated** with inks and solvents may become hazardous wastes. Check and comply with state-specific requirements.
- ! **Use cloth towels or wipes** which can be cleaned and reused:
 - ! Reduce the **size** of the towel or wipe for more efficient use; reduce solvent use;
 - ! **Reuse** shop towels to reduce ink remover use; reuse the final wipe rag from the previous screen as the first pass wipe on the next screen;
 - ! **Squeeze excess solvent out** of used towels; collect and reuse for initial cleanup, followed by clean solvent for final cleanup;
 - ! **Do not saturate towels** with solvents or use shop towel containers to dispose of waste ink or solvents;
 - ! **Reuse or recycle cleaning solvents** by using an explosion-proof centrifuge or gravity draining;
 - ! Promptly place waste shop towels in a **separate, labeled container** which can be covered and is fireproof; do not throw dirty towels into the dumpster;
 - ! Check with the local sewer district near the **laundry service** used to verify if the laundry is meeting local discharge limits.
- ! **Routinely test wash waters** for chemical content; do not dispose of waste water to sanitary sewers without knowing local discharge limits.
- ! **Non-empty aerosol/spray cans** containing hazardous chemicals must be disposed as hazardous waste; do not throw into the dumpster; return defective cans to the supplier.

Sources:

Environmental Management and Pollution Prevention: A Guide for Screen Printers, Washington State Dept. of Ecology, September 1994, Publ. 94-137.

Screen Printers: A Guide to Reducing Hazardous Waste and Air Emissions When Cleaning and Reclaiming Used Screens, Draft, Solid and Hazardous Waste Education Center, University of Wisconsin-Extension, March 1996.

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

Fact Sheet: *Management of Solvents and Wipes in the Printing Industry*, University of Wisconsin-Extension, Solid and Hazardous Waste Education Center. 425.WP.9410, 1994.

3.14.1 Research/Educational Institutions: Laboratories and Science Departments

Tip Sheet #1

WASTE ORIGIN: Laboratories/Science Departments

WASTE TYPES: Various Used and Unfed Chemicals, Acids, Bases, and Metals, and Reaction Products from Experiments

WASTE REDUCTION AND RECYCLING METHODS:

- ! Establish **centralized purchasing** program.
- ! Share **surplus chemicals**.
- ! **Computerize inventory**; keep a running inventory of unused chemicals for use by other departments.
- ! Buy smaller quantities of **reagent chemicals**.
- ! Properly **label containers**.
- ! Use first-in, first-out **inventory management** practices.
- ! Return **excess material** to supplier.
- ! Scale down **experiments**.
- ! Pre-weigh **chemicals**.
- ! Increase **instrumental analyses** over wet chemistry.
- ! Eliminate **toxic chemical** use.
- ! Substitute **less toxic chemicals** (e.g, sodium hypochlorite for sodium dichromate, alcohols instead of benzenes, cyclohexane for carbon tetrachloride, stearic acid for acetamide).
- ! Use **specialty detergents** (instead of chromic or sulfuric acid) to clean glassware.
- ! Standardize **solvents** and recycle whenever possible.
- ! Keep individual **waste streams** separate.
- ! Recover metal from catalyst.

Sources:

Guides to Pollution Prevention: Research and Educational Institutions, U.S. EPA, June 1990, EPA/625/7-90/010.
Hazardous Waste Minimization Self-Assessment Guide for Vocational Institutions, Colleges and Universities, Wisconsin Department of Natural Resources, Hazardous Waste Minimization Program.

3.14.2 Research/Educational Institutions: Fine Arts

Tip Sheet #1

WASTE ORIGIN: Arts, Theater Arts, Scenery, Printing Shops

WASTE TYPES: Oil-based Paints, Acids, Solvents, Metals in Glazes, Inks, Silver, Developing, and Fixing Chemicals

WASTE REDUCTION AND RECYCLING METHODS:

- ! Eliminate **oil-based paint** use; replace with water-based paint.
- ! Use proper **spray paint techniques** (e.g., use high transfer efficiency guns; overlap spraying pattern by 50 percent; maintain a distance of 6-8" from work piece; hold gun perpendicular to surface; trigger the gun at the beginning and end of each stroke).
- ! Use fully-enclosed **gun cleaning** station.
- ! Reuse **cleanup solvent** as thinner for next compatible batch of paint.
- ! Use **less hazardous cleaners** (e.g., biodegradable aqueous or detergent cleaners).
- ! Recover photographic **silver**.
- ! Eliminate use of **lead-based glaze**.

Sources:

Guides to Pollution Prevention: Research and Educational Institutions, U.S. EPA, Office of Research and Development, June 1990, EPA/625/7-90/010.

Hazardous Waste Minimization Self-Assessment Guide for Vocational Institutions, Colleges and Universities, Wisconsin Department of Natural Resources, Hazardous Waste Minimization Program.

3.14.3 Research/Educational Institutions: Maintenance and Industrial Arts

Tip Sheet #1

WASTE ORIGIN: Maintenance/Industrial Arts/Other Vocational Course Shops

WASTE TYPES: Stains, Degreasing Solvents, Solvents, Oil, Wood Preservatives, Grease, Dyes, Pesticides, Ketones, Paints, and Metal Dust

WASTE REDUCTION AND RECYCLING METHODS:

- ! Eliminate **oil-based** paint use; replace with water-based paint.
- ! Use proper **spray paint techniques**.
- ! Standardize **machine oil**.
- ! Use and manage water-based **cutting fluids**.
- ! Use alkalize or less hazardous **solvent degreasers**.
- ! Keep **vapor degreaser** covered.
- ! Operate **degreaser** properly.
- ! Avoid **unnecessary cleaning** of parts.
- ! Use **two-stage cleaning** (use dirty solvent for initial cleaning, fresh solvent for final cleaning).

Sources:

Guides to Pollution Prevention: The Paint Manufacturing Industry, U.S. EPA, Risk Reduction Engineering Laboratory, Center For Environmental Research Information, June 1990, EPA/625/7-90/005.

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Hazardous Waste Minimization Self-Assessment Guide for Vocational Institutions, Colleges and Universities, Wisconsin Department of Natural Resources, Hazardous Waste Minimization Program.

3.15.1 Retail/Warehouse: General Merchandise Stores

Tip Sheet #1

WASTE ORIGIN: **Recyclable Materials**

WASTE TYPES: Shipping/Packing Materials, Office Papers, and Food and Drink Containers

WASTE REDUCTION AND RECYCLING METHODS:

- ! **Office operations** can reduce or eliminate waste from the start:
 - ! Choose suppliers who provide **recyclable packaging and packaging** with recycled content in it, reuse shipping/packing materials;
 - ! Improve **purchasing and inventory management** to prevent overstocking unnecessary supplies that may have limited shelf life;
 - ! Remove company name from **direct mail** lists;
 - ! Make double-sided copies; reduce **number of paper copies** of receipts; use recycled copy and register papers;
 - ! Buy products or materials with **recycled content**; reuse materials that would have been tossed after one use;
 - ! Buy in **bulk quantities** when appropriate;
 - ! Save **polystyrene “peanuts”** to return to supplier for reuse, or donate;
 - ! Shred **non-recyclable paper** items for packing materials;
 - ! Enclose a **note in packages** asking recipients to reuse packaging materials;
 - ! Encourage employees to get involved in **waste reduction programs**; use incentives to involve staff; encourage suggestions to improve programs.
- ! **Make recycling easy** for staff and office patrons:
 - ! Provide **separate bins for trash**, one for paper/cardboard, and one for mixed recyclables;
 - ! Create a **list of waste items**, laminate it, and hang it in clear view to tell staff or patrons the exact destination of every item.
- ! Implement a **recycling and source reduction program** that can include the following key features:
 - ! Management must **support the program** by allocating staff time and supporting ideas generated by employees;
 - ! Select a **lead person** to act as contact to manage the program; duties could include planning, implementing, and monitoring the program;
 - ! Involve employees by **encouraging ideas** for waste and energy reduction, and encourage using e-mail and suggestion boxes for ongoing communication;
 - ! Keep **employees involved**;
 - ! **Publicize attained goals**, reward these efforts, and use promotions and incentives.
- ! Join forces with business neighbors to **create cooperative hauling** of trash and recyclables; sharing the same trash and recycling bins and disposal costs saves everybody money and promotes cooperation.

- ! **Donate** usable wastes and recyclables to community groups. This fosters goodwill, protects the environment, and is a positive marketing strategy:
 - ! Donate recycled aluminum cans to a *school's environmental awareness program*; the money can go to teach students about the environment.
- ! Contact area or local recycling companies about **possible free pick up** of collected recyclables on a regular schedule.
- ! Work with **state, city, or county solid waste officials** to get contacts and ideas for reuse and recycling programs; these agencies can provide technical or financial assistance in setting up a program.
- ! Use the phonebook and **network with other businesses** to learn about their programs.
- ! Use your recycling and source reduction efforts as a **marketing tool**:
 - ! Local business or government agencies frequently recognize these efforts by sponsoring *awards and recognition programs*.

Sources:

Fact Sheet: *Waste Reduction Tips for the Office*, Inform, Inc., New York, NY.

Fact Sheet: *Popular Source Reduction Actions for Business*, Minnesota Office of Waste Management, October 1992.

Fact Sheet: *Business Waste and Recycling: A Guide for the Workplace*, Wisconsin Department of Natural Resources, Waste Reduction and Recycling Program, Bureau of Solid and Hazardous Waste Management, June 1995, PUB-SW-128 95Rev.

3.15.2 Retail/Warehouse: Food Retail Outlets

Tip Sheet #1

WASTE ORIGIN: **General Operations**

WASTE TYPES: Papers, Plastics, and Food Products

WASTE REDUCTION AND RECYCLING METHODS:

- ! Implement a **source reduction program**; key features to include:
 - ! Management must **support the program** by allocating staff time and supporting ideas generated by employees;
 - ! Select a **lead person** to manage the program; duties could include program planning, implementing, and monitoring;
 - ! Involve the employees by **encouraging ideas** for waste and energy reduction measures, support use of e-mail and suggestion boxes for ongoing communication;
 - ! **Keep employees involved**;
 - ! **Publicize attained goals**, reward these efforts with promotions and incentives.
- ! **Office and break rooms** provide many waste reduction opportunities:
 - ! Encourage use of **washable mugs, plates, and utensils**;
 - ! Reuse **scrap paper** for note pads; recycle office paper, store ads, cardboard, cans, and glass;
 - ! Make **double-sided copies**; consider using electronic mail or routing memos rather than making copies of them;
 - ! Re-ink **printer ribbons** for reuse;
 - ! Refill **laser printer** and personal copier toner cartridges;
 - ! Purchase **post-consumer recycled products**, like office paper, store ads, and receipt rolls;
 - ! Use **electric hand dryers** or cloth towel dispensers in rest rooms.
- ! Avoid stocking **products that are excessively packaged**; work with store managers and buyers to be aware of this goal.
- ! Close the **recycling loop** by stocking products packaged in or made of recycled materials; work with store managers and buyers to be aware of this goal.
- ! **Food wastes** can be handled in creative ways:
 - ! **Donate** older, hard-to-sell but edible bakery goods to food banks or other charities;
 - ! Give **non-edible, perishable food** to pig farmers (consult county offices and public health officials for help in complying with all regulations).
- ! Provide **consumer initiatives** for waste reduction:
 - ! **Educate consumers** about waste reduction through signage, brochures, ads, etc.;
 - ! Sell **canvas or other reusable bags** or boxes. Give credit to customers who reuse them;
 - ! Sell **returnables and bulk food**;
 - ! Provide **collection of recyclables** at the store for plastic bags and aluminum cans;
 - ! Let customers know the good things the store is doing for the **environment**;

- ! Contact public agencies working with solid waste management for information on *consumer education programs*.
- ! **Energy reduction** reduces energy bills and power plant emissions, and conserves fuel resources by:
 - ! Replacing *incandescent light bulbs* with fluorescent bulbs (exit sign lights, too);
 - ! Installing *low-flow nozzles* on faucets;
 - ! *Maintaining* refrigerators and freezers;
 - ! Purchasing new, *energy-efficient equipment*;
 - ! Lowering *water heater* temperature;
 - ! *Insulating* effectively.
- ! Work with city or county solid waste officials to get contacts and ideas for **reuse and recycling programs**; use the phone book, and **network with other businesses** to learn about their programs.

Source:

Fact Sheet: *Waste Reduction for Grocery Stores*, Minnesota Office of Waste Management, September, 1992.

3.15.3 Retail/Warehouse: Paint Retailers

Tip Sheet #1

WASTE ORIGIN: Inventory Control and Materials Handling

WASTE TYPES: Paints, Solvents and Cleaners, Paint Thinners, Cements, Stains, Epoxies, Varnishes, Glazes, Paint Stripping Compounds, Adhesives, and Glues

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use **inventory control** as a simple waste management tool:
 - ! Follow label directions carefully for *shelf-life limits* and proper storage conditions;
 - ! Inventory *unopened materials* and, when possible, return unwanted, usable materials to the distributor or manufacturer:
 - ! Develop agreements with *vendors* to make this a routine procedure.
 - ! Identify any material that still may be useful and log it into *current inventory* for use:
 - ! Use *old paint* as a base coat or primer;
 - ! Mix the same or similar types of paint when *mixing different colors*;
 - ! Reuse the *clean portion of thinner* after it has separated from the contaminants.
 - ! **Donate** unwanted but usable material to community or high school theaters, or community fix-up projects willing to accept them;
 - ! **Materials exchange services** list sources for unwanted specialty and industrial coatings.
- ! **Unusable liquid wastes** may be considered as hazardous or non-hazardous, but each requires special handling:
 - ! **Combustible liquid wastes**, like oil-based paints and stains and other petroleum-based liquids, require special attention to determine compatibility and whether they can be consolidated into the same disposal container;
 - ! **Waste waterborne liquids** like latex paints and water-based stains should be managed separately from petroleum-based liquids;
 - ! **Older latex paints** may contain mercury-based fungicides (typically phenyl mercuric acetate), and should be tested and handled as a separate hazardous waste;
 - ! **Cleanup wastewater** from small quantities of latex paints or water-based cleaners may be drained into sewer systems if the local treatment plant grants permission or has no such restriction. Do not dump these wastes in storm sewers or septic tank systems;
 - ! **Large volumes of non-hazardous latex** paint still may require disposal management by a permitted hazardous waste facility.
 - ! **Waste chlorinated solvents**, thinners, and paint strippers should always be managed separately.
- ! **Unusable non-liquid hazardous wastes** (cured hardeners, cements, epoxies, adhesives, or glazes) may require disposal of the hardened waste and its container in a larger shipping container called a “lab pack” used by disposal companies.
- ! Recycle **empty plastic or metal containers**, when possible. Contact recycling firms and solid waste haulers to see if they accept old paint-related containers.

- ! **Spray paint cans** and other aerosol cans, if not empty, may be subject to hazardous waste disposal requirements.
- ! **Reusable aerosol containers** may be used to spray a variety of liquids that are available in bulk packages, such as solvents and cleaners. This lowers the purchase and empty container costs.
- ! Contact state, county, or local solid and hazardous waste management agencies for **current regulatory requirements or disposal options** for paint-related wastes.

Sources:

Fact Sheet: *Management Options for Old Paint and Paint-related Materials*, Minnesota Technical Assistance Program, Minneapolis, MN, Publ. 1/95-69.

Guides to Pollution Prevention: The Paint Manufacturing Industry, U.S. EPA, Risk Reduction Engineering Laboratory, Center For Environmental Research Information, June 1990, EPA/625/7-90/005.

3.16.1 Vehicle Maintenance: General Operations

Tip Sheet #1

WASTE ORIGIN: Maintenance

WASTE TYPES: Spent Fluids (Oil, Coolant, Transmission Fluids), Rebuildable Parts, Batteries, CFC-12, and Catalytic Converters

WASTE REDUCTION AND RECYCLING METHODS:

- ! **Separate** to promote potential for recycling (e.g., store used oil in separate oil storage tank; don't contaminate it with degreasers or absorbents).
- ! Use recyclable brand of **radiator fluid** and collect flushing liquid for reuse.
- ! Use brake fluid, transmission fluid, etc., which do not contain **chlorinated hydrocarbons**.
- ! Install **collection/drip pans** under vehicles.
- ! If unbroken, sell **batteries** to an off-site recycler.
- ! Use **longer-life batteries**.
- ! Purchase state and locally **approved recycling equipment** to recover refrigerant (e.g., an air-tight machine that collects refrigerant as liquid, then reuse on-site or recycle off-site).
- ! Recycle for **precious metal recovery**.

Sources:

Best Management Practices for Automotive Related Industries, Santa Clara Valley Pollution Control Program, CA.

Guides to Pollution Prevention: The Automotive Repair Industry, U.S. EPA, October 1991, EPA/625/7-91/013.

Guides to Pollution Prevention: The Automotive Refinishing Industry, U.S. EPA, October 1991, EPA/625/7-91/016.

Guides to Pollution Prevention: The Mechanical Equipment Repair Industry, U.S. EPA, September 1992, EPA/625/R-92/008.

Vehicle Maintenance: A Self-Assessment Guide to Waste Prevention, Education and Management, Wisconsin Department of Natural Resources, Hazardous Waste Minimization Program, 2nd ed., 1993, PUBL-SW-188.

Vehicle Maintenance Pollution Prevention, Small Business Pollution Prevention Center, Iowa Waste Reduction Center, University of Northern Iowa, 1995.

3.16.1 Vehicle Maintenance: General Operations

Tip Sheet #2

WASTE ORIGIN: Parts Cleaning

WASTE TYPES: Solvent Baths, Air Emissions, and Carburetor Cleaner

WASTE REDUCTION AND RECYCLING METHODS:

- ! Minimize **surfaces exposed** to grease and oil.
- ! Determine **how clean** parts need to be.
- ! Use **less hazardous solvents** (e.g., water-based binders).
- ! Increase **cleaning efficiency**.
- ! Use **liquid spray compositions** rather than bars for better control.
- ! **Pre-rinse parts** using hot tank or jet spray washers.
- ! Use **enclosed parts washers** with filters which use hot water and detergents.
- ! Use **solvents** properly (e.g., don't use to clean floors).
- ! Minimize **amount of cleaning solution** used.
- ! Monitor **solvent composition**.
- ! Operate **solvent sinks** properly and keep plugged when not in use.
- ! Use **drip trays** and allow for more drainage time.
- ! Keep **lids closed** when not in use.
- ! Don't leave **solvent stream** running.
- ! Contract with a service company to **maintain solvent sinks**.
- ! Install on-site **solvent recovery** equipment.
- ! Use **re-formulated carburetor cleaner** compound without 1,1,1-Trichloroethane (TCA).
- ! Use **drip pans** to collect excess cleaning fluids and drain into containers to allow particles to settle out. Reuse excess fluids.

Sources:

Best Management Practices for Automotive Related Industries, Santa Clara Valley Pollution Control Program, CA.

Guides to Pollution Prevention: The Automotive Repair Industry, U.S. EPA, October 1991, EPA/625/7-91/013.

Guides to Pollution Prevention: The Automotive Refinishing Industry, U.S. EPA, October 1991, EPA/625/7-91/016.

Guides to Pollution Prevention: The Mechanical Equipment Repair Industry, U.S. EPA, September 1992, EPA/625/R-92/008.

Vehicle Maintenance: A Self-Assessment Guide to Waste Prevention, Education and Management, Wisconsin Department of Natural Resources, Hazardous Waste Minimization Program, 2nd ed., 1993, PUBL-SW-188.

Vehicle Maintenance Pollution Prevention, Small Business Pollution Prevention Center, Iowa Waste Reduction Center, University of Northern Iowa, 1995.

3.16.1 Vehicle Maintenance: General Operations

Tip Sheet #3

WASTE ORIGIN: Parts Cleaning

WASTE TYPES: Aqueous Baths

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use **detergent-based cleaning** solutions instead of caustic cleaners.
- ! Install **lids** on tanks.
- ! Use **dry pre-cleaning methods** such as wire brushing.
- ! Maintain **solution quality** by monitoring composition.
- ! **Maintain equipment** in proper working order.
- ! **Filter solids** from the bath on a continuous basis.
- ! Use filter bag on slipstream from **jet spray washes**.
- ! **Screen solids** before they reach the waste sump.
- ! Use **two-stage parts cleaning** sequence.
- ! Install or convert free-running rinses to **still rinse**.
- ! Use a hot tank or jet spray **washer lease service**.
- ! Switch to **bake-off ovens** (e.g., high temperature ovens used with dry abrasive "shot blast" cleaners).

Sources:

Best Management Practices for Automotive Related Industries, Santa Clara Valley Pollution Control Program, CA.

Guides to Pollution Prevention: The Automotive Repair Industry, U.S. EPA, October 1991, EPA/625/7-91/013.

Guides to Pollution Prevention: The Automotive Refinishing Industry, U.S. EPA, October 1991, EPA/625/7-91/016.

Guides to Pollution Prevention: The Mechanical Equipment Repair Industry, U.S. EPA, September 1992, EPA/625/R-92/008.

Vehicle Maintenance: A Self-Assessment Guide to Waste Prevention, Education and Management, Wisconsin Department of Natural Resources, Hazardous Waste Minimization Program, 2nd ed., 1993, PUBL-SW-188.

Vehicle Maintenance Pollution Prevention, Small Business Pollution Prevention Center, Iowa Waste Reduction Center, University of Northern Iowa, 1995.

3.16.1 Vehicle Maintenance: General Operations

Tip Sheet #4

WASTE ORIGIN: Shop Cleanup

WASTE TYPES: Outdated Supplies, Dirty Rags, Sawdust, Alkaline Floor Cleaner, and Clarifier Sludges

WASTE REDUCTION AND RECYCLING METHODS:

- ! Computerize **inventory control**; use first-in, first-out inventory management.
- ! Minimize **storage quantities**.
- ! Perform routine storage area **inspections**.
- ! Use **good housekeeping** measures to reduce leaks and spills.
- ! Lease rags from a **laundry cleaning service**.
- ! Use **rags or other absorbents** to their limit.
- ! Use good **housekeeping incentives** to reduce spills and leaks such as an award program for the worker with the cleanest bay.
- ! Use **drip trays** under leaking cars and removed parts.
- ! Properly store **waste materials** (use pallet/containment systems and install self-closing non-leak safety faucets on portable waste oil drums).
- ! Don't flush **dust or floor sweepings** to a clarifier unit.

Sources:

Vehicle Maintenance Pollution Prevention, Small Business Pollution Prevention Center, Iowa Waste Reduction Center, University of Northern Iowa, 1995.

Vehicle Maintenance: A Self-Assessment Guide to Waste Prevention, Education and Management, Wisconsin Department of Natural Resources, Hazardous Waste Minimization Program, 2nd ed., 1993, PUBL-SW-188.

Guides to Pollution Prevention: The Automotive Repair Industry, U.S. EPA, October 1991, EPA/625/7-91/013.

Guides to Pollution Prevention: The Automotive Refinishing Industry, U.S. EPA, October 1991, EPA/625/7-91/016.

Guides to Pollution Prevention: The Mechanical Equipment Repair Industry, U.S. EPA, September 1992, EPA/625/R-92/008.

3.16.2 Vehicle Maintenance: Autobody Repair

Tip Sheet #1

WASTE ORIGIN: Paint Stripping

WASTE TYPES: Solvents and Paints

WASTE REDUCTION AND RECYCLING METHODS:

- ! Avoid **unnecessary overspray**.
 - ! **Clean equipment** regularly.
 - ! Use **mechanical paint stripping system** such as plastic blast media.
 - ! Use non-phenolic or non-acid **stripper**.
-

WASTE ORIGIN: Patching

WASTE TYPES: Filler Waste and Sand Dust

WASTE REDUCTION AND RECYCLING METHODS:

- ! Control inventory rigidly to minimize harmful **chemical filler** use.
 - ! Sweep or vacuum; **don't flush** to street or clarifier.
-

WASTE ORIGIN: Paint Application

WASTE TYPES: Paint Waste, Spent Solvents, and VOC Emissions

WASTE REDUCTION AND RECYCLING METHODS:

- ! Control inventory rigidly to reduce **thinner** use.
- ! Practice better **housekeeping** to reduce leaks and spills.
- ! Mix **paint** according to need.
- ! Use **high transfer efficiency equipment** (e.g., equipment with low over-spray).
- ! Keep air pressure low and **spray gun** perpendicular to increase accuracy.
- ! Provide **operator training**.
- ! Practice proper **equipment cleaning** methods.
- ! Use fully-enclosed **gun cleaning** station.
- ! Reuse **cleanup solvent** in next compatible batch of paint.
- ! Recycle **solvent** on-site.
- ! Recycle solvent off-site using **thinner leasing agreements**.
- ! Contact **waste exchanges**.
- ! Make **leftover paint** available to customer.
- ! Use recyclable **paint filters**.
- ! Use **styrofoam filters**.

Sources:

Best Management Practices for Automotive Related Industries, Santa Clara Valley Pollution Control Program, CA.

Guides to Pollution Prevention: The Automotive Repair Industry, U.S. EPA, October 1991, EPA/625/7-91/013.

Guides to Pollution Prevention: The Automotive Refinishing Industry, U.S. EPA, October 1991, EPA/625/7-91/016.

Guides to Pollution Prevention: The Mechanical Equipment Repair Industry, U.S. EPA, September 1992, EPA/625/R-92/008.

Vehicle Maintenance: A Self-Assessment Guide to Waste Prevention, Education and Management, Wisconsin Department of Natural Resources, Hazardous Waste Minimization Program, 2nd ed., 1993, PUBL-SW-188.

Vehicle Maintenance Pollution Prevention, Small Business Pollution Prevention Center, Iowa Waste Reduction Center, University of Northern Iowa, 1995.

3.16.3 Vehicle Maintenance: Marine Service and Repair

Tip Sheet #1

WASTE ORIGIN: Equipment and Parts Cleaning

WASTE TYPES: Solvents

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use **dry precleaning**.
 - ! Use **two-stage rinse** (pre-rinse in dirty solvent).
 - ! **Cover** tanks.
 - ! **Separate** cleaning agents.
 - ! **Recycle** solvents.
 - ! Replace solvent cleaners with **detergents** when possible.
-

WASTE ORIGIN: Engine Repair

WASTE TYPES: Degreasers, Solvents, and Oils

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use **aqueous degreasers**.
 - ! Use **longer-lasting fluids**.
 - ! Use dedicated **solvent sinks** for parts washing; plug when not in use.
 - ! **Separate** spent engine and lube oils.
 - ! **Recycle** oils and solvents.
-

WASTE ORIGIN: Machining

WASTE TYPES: Cutting and Lubricating Fluids

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use water soluble **cutting fluids**.
 - ! **Recycle** cutting and lubricating fluids.
-

WASTE ORIGIN: Vessel Cleaning

WASTE TYPES: Cleaners

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use **detergent** cleaning agents.
-

WASTE ORIGIN: Refueling

WASTE TYPE: Spilled Fuel

WASTE REDUCTION AND RECYCLING METHODS:

- ! Watch the fuel tank to avoid **overfilling**.
 - ! Be sure **fuel flow** has stopped before removing the fuel nozzle from the fill pipe.
 - ! Provide a **drip pan** from the fuel nozzle.
 - ! Be sure the proper type of fuel is selected to avoid **cross-contamination**.
 - ! Practice **preventive maintenance** on the entire fueling system.
-

Sources:

Guides to Pollution Prevention: The Marine Maintenance and Repair Industry, U.S. EPA, October 1991, EPA/625/7-91/015.

Pollution Prevention for Marinas and Boat Yards: Best Management Practices for Wisconsin Operators, Solid and Hazardous Waste Education Center, University of Wisconsin-Extension, December 1994.

3.16.4 Vehicle Maintenance: Radiator Repair

Tip Sheet #1

WASTE ORIGIN: Draining and Boil Out

WASTE TYPES: Motor Oils, Coolants, and Antifreeze

WASTE REDUCTION AND RECYCLING METHODS:

- ! Collect, separate, and **recycle**.
- ! **Drain** radiator well.
- ! Remove as much oil as possible from oil cooler using compressed air to **minimize drag-out**.
- ! Provide **hang bars** over tank.
- ! Provide **drain board between tanks** and divert liquid bank into source tank.
- ! **Pre-rinse radiator** over boil out tank using fog spray (high-pressure, low-water flow rate).
- ! Maintain and monitor **boil-out tank**.
- ! Use **compressed air** to blow out residual alkaline solution after removing from boil-out tank, then collect and return to tank.
- ! Use **washwater** as make-up to boil-out tank.
- ! Increase **temperature** (e.g., to 160° F) to increase evaporation.
- ! Carefully **monitor** and only add minimum required types and quantity of chemicals.
- ! Use chemical or physical **treatment system** to remove oil, metals, and solids. Reuse the wastewater.

WASTE ORIGIN: Flushing Booth

WASTE TYPE: Contaminated Rinsewater

WASTE REDUCTION AND RECYCLING METHODS:

- ! Blow out residual **caustic solution** to tank with compressed air to minimize drag-out to flushing booth.
 - ! Reuse flushing booth **rinses** for boil-out tank make-up.
 - ! Use high-pressure and lower **water flow**.
-

WASTE ORIGIN: Testing

WASTE TYPES: Tank Clean-out Sludges, Test Tank Dumps

WASTE REDUCTION AND RECYCLING METHODS:

- ! Reuse **test tank water** in flushing booth.
- ! Use **smaller test tanks** for efficient operation.
- ! Correct **cloudiness** (too much solid deposition) by improving rinsing of radiator before placing radiator in test tank.
- ! Filter (using simple bag or cartridge filter) or settle **solids from solution** instead of dumping.

WASTE ORIGIN: Soldering

WASTE TYPES: Used Solder and Waste Flux

WASTE REDUCTION AND RECYCLING METHODS:

- ! Reduce use of **flux** containing complexing or chelating compounds.
- ! Use a **low-zinc flux**.
- ! Solder in a **separate area** (not over test tank), or catch before solder falls into tank.

Sources:

Best Management Practices for Automotive Related Industries, Santa Clara Valley Pollution Control Program, CA.

Guides to Pollution Prevention: The Automotive Repair Industry, U.S. EPA, October 1991, EPA/625/7-91/013.

Guides to Pollution Prevention: The Mechanical Equipment Repair Industry, U.S. EPA, September 1992, EPA/625/R-92/008.

Pollution Prevention Tips, Waste Reduction Options: Radiator Service Firms, NC Dept. of Environment, Health and Natural Resources, Office of Waste Reduction, Raleigh, NC.

Radiator Repair Industry: Pollution Prevention Opportunities Checklist, Industrial Waste Section, Los Angeles County Sanitation Districts, Whittier, CA, October 1990.

Vehicle Maintenance: A Self-Assessment Guide to Waste Prevention, Education and Management, Wisconsin Department of Natural Resources, Hazardous Waste Minimization Program, 2nd ed., 1993, PUBL-SW-188.

Vehicle Maintenance Pollution Prevention, Small Business Pollution Prevention Center, Iowa Waste Reduction Center, University of Northern Iowa, 1995.

3.17.1 Wood Products Industry: Wood Finishing

Tip Sheet #1

WASTE ORIGIN: Wood Finishing

WASTE TYPES: Volatile Organic Compound (VOC) Air Emissions, Liquid Wastes (Spent Stains, Wash Coats, Fillers, Sealers, Glazes, Topcoats, Solvents, and Spray Booth Wastewater)

WASTE REDUCTION AND RECYCLING METHODS:

- ! Use **waterborne**, or “hybrid” coatings with a combination of water and conventional solvents.
- ! Use **high solids solvent-based coatings** with a high solids concentration range of 35-40 percent. Three basic types of high-solids coatings are: two-component ambient temperature cured, one-component heat converted, and high-solids thermoplastic solvent borne coatings.
- ! Use **polyester/polyurethane-based coatings** including styrene derived polyester of 100 percent solids cured by ultraviolet (UV) radiation, and acrylic polyester (30-50 percent solids) which are cured by catalytic reaction or UV radiation.
- ! Use **carbon dioxide-based coatings** to decrease viscosity and enhance atomization. Replace all or most of the solvents used in the conventional spray coatings application.
- ! Use **radiant cure coatings**, such as acrylate-based materials and epoxies, and either UV, electron beam (EB), or infrared (IR) radiation for rapid polymerization.
- ! Use **high volume, low pressure (HVL) spray guns** to reduce overspray, less bounce back, and better transfer efficiency (40-70 percent).
- ! Use **airless spray systems** to atomize the coating without introducing a pressurized air flow.
- ! Use **air-assisted airless spray** to combine compressed air atomization with airless atomization.
- ! Use **electrostatic technology** to create a high coating transfer efficiency of 35-70 percent for spray guns, and 60-90 percent for rotary disk (centrifugal force) applicators.
- ! Use **vacuum coating technology** for maximum coating efficiency and almost total elimination of waste coating and VOC emissions.
- ! Use a **dip coating system** for excellent transfer efficiency and reduced wastes.
- ! Use **flow coating** technology to direct the coating at the surface of the wood for high transfer efficiency and reduced wastes.
- ! **Curtain coating systems** allow controlled rates of material flow and excess coating material is trapped in a reservoir and recirculated with minimal waste.
- ! **Roll coating** applies rollers to a flat wood surface for high transfer efficiency while allowing the use of high solids coatings. It also lends itself to UC or EB curing.

Source:

Pollution Prevention for Wood Finishing and Manufacturing, University of Wisconsin-Extension, Solid and Hazardous Waste Education Center, December 1994.

Pollution Prevention in the Finishing of Wood Furniture, Commonwealth of Virginia, Department of Environmental Quality, Waste Reduction Assistance Program, October 1993.