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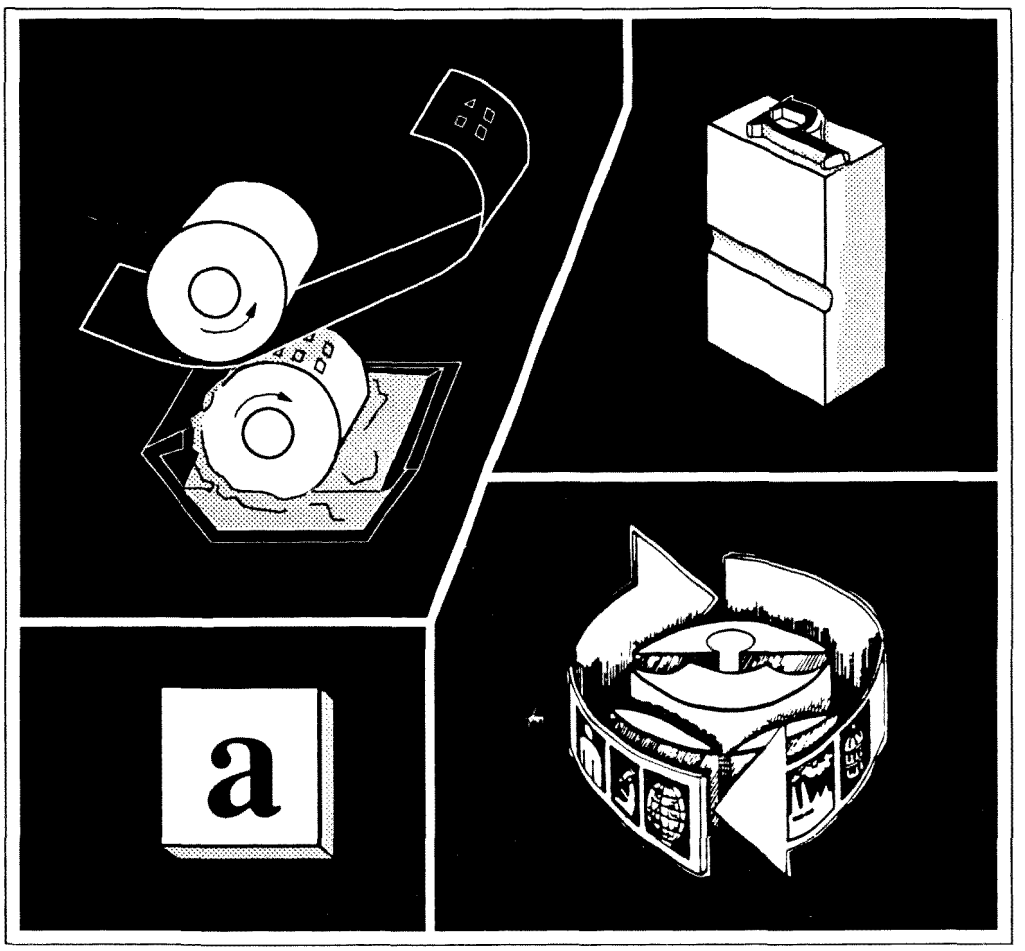
Pollution Prevention In Printing and Allied Industries

Saving Money Through Pollution Prevention



Pollution Prevention In Printing and Allied Industries

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Saving Money Through Pollution Prevention

U.S. Environmental Protection Agency

October 1989

Preface

Pollution Prevention in Printing and Allied Industries is intended to provide you with a brief introduction to pollution prevention, including what it is, how it can put money back into your company's pocket, what its basic elements are, and where you can get additional assistance. This booklet also provides a sample of the various technical options available to a wide range of printing and allied facilities. Typical economics (for example, capital investment, annual savings, and payback periods) are also provided for many of the options.

The technical and economic information in *Pollution Prevention in Printing and Allied Industries* is intended to be representative more than comprehensive. The collection and organization of this information is an ongoing and evolutionary process. The first version of this booklet reflects a sampling of information readily available at the time of preparation. As more pollution prevention activity takes place and technical approaches to pollution prevention change, EPA hopes to update and publish follow-up versions of this booklet.

Pollution Prevention in Printing and Allied Industires is only one of many sources of pollution prevention information available to you from EPA. For additional information about pollution prevention, or to comment on this booklet, call:

- The RCRA/Superfund Hotline, at (800) 424-9346, or (202) 382-3000;
- Myles Morse, of EPA's Pollution Prevention Information Clearinghouse, at (202) 475-7161; or
- James Lounsbury, Director of EPA's Waste Minimization Staff, at (202) 382-4807.

The Purpose of this Booklet

If your printing and allied industry operations generate any wastes, the information in this booklet can help your firm.

POLLUTION PREVENTION CAN:

- Significantly reduce your firm's costs, liabilities, and regulatory burdens associated with waste management; and
- Enhance your firm's efficiency, product quality, and public image.

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The United States Environmental Protection Agency (EPA) developed this booklet to help your firm implement a pollution prevention program. It highlights the various components of a pollution prevention program. It also provides two tables to help you identify specific pollution prevention options, based on the types of processes or operations at your facility. The tables contain technical, cost, and waste reduction information on a variety of options that have actually been used at printing and allied facilities. The information contained in the tables will help you evaluate potential annual savings from numerous pollution prevention techniques.

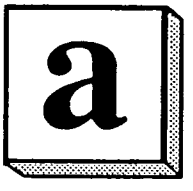
PRINTING AND ALLIED PROCESSES INCLUDE:

- Preparation
  - -- Typesetting
  - -- Lithography
  - -- Letterpress
  - -- Gravure
  - -- Engraving (stationery)
  - -- Photoengraving
- Printing
  - -- Heatset Lithography
  - -- Non-Heatset Lithography
    - Thermography
    - Business Form Printing
    - Sheeted Lithography
  - -- Letterpress Printing (including flexography)
  - -- Gravure Printing
- Finishing Operations
  - -- Looseleaf Binding Manufacturing
  - -- Trade Binding
  - -- Book Binding
  - -- In-House Binding
  - -- Magazine and Catalog Binding

The Information in this Booklet Will Be Helpful to Your Company

This booklet is designed to be most useful to firms that engage in printing operations. You should read this booklet if your firm is involved in printing, or if it is involved in printing-related processes.

This booklet will be useful if your facility uses any materials resulting in the generation of hazardous or non-hazardous wastes. Table I identifies many of the materials typically used by printing and allied facilities and Table II shows what many of these facilities have done to save money.



Your Company Can Save Money by Minimizing the Waste it Generates

In addition to relying on traditional waste management approaches (such as treating or disposing of waste after it has been generated), many facility managers are finding that by minimizing the amount of waste their operations generate they can actually improve their firm's "bottom line."

POLLUTION PREVENTION REDUCES:

- Aggregate costs for raw materials
- Treatment/disposal costs
- Environmental liability and fines

In addition to these economic incentives for pollution prevention, EPA is taking several steps to create additional incentives for firms to reduce their waste generation. Some of EPA's actions include:

- Making technical information available to help firms identify ways of reducing waste generation.
- Supporting the development of State programs to assist firms in their waste reduction efforts.
- Requiring hazardous waste generators, under the Resource Conservation and Recovery Act (RCRA), to certify on their hazardous waste manifests and annual permit reports that they have a "program-in-place" to reduce the volume or quantity and toxicity of their hazardous wastes as much as economically practical.
- Requiring generators to describe on their RCRA biennial reports the efforts they have undertaken during the year to reduce the volume and toxicity of their hazardous waste, and to compare these efforts to previous years.

What is "Pollution Prevention?"

Pollution prevention emphasizes reducing or eliminating any releases of hazardous materials (including hazardous wastes) into the environment through the use of *source reduction* and environmentally-sound *recycling*. A pollution prevention program can be developed by any business that generates wastes. The program might include several elements intended to reduce, to the extent feasible, any air or water discharges, or any solid or hazardous waste that is generated at the facility.

Source reduction is intended to minimize or eliminate the waste at its source, before it is generated or released. *Recycling*, on the other hand, focuses on the *use*, *reuse*, or *reclamation* of the waste as an effective substitute for a commercial product or as an ingredient or feedstock in a process. Recycling by use or reuse involves returning a waste material to either the originating process or another process as a substitute for an input material. Reclamation is the recovery of a valuable material, or removal of impurities, from a waste.

POLLUTION PREVENTION TERMS

Pollution Prevention - Reducing or eliminating discharges and/or emissions to the environment through the use of *source reduction* and environmentally-sound *recycling*.

Source Reduction - Reducing or elimi-nating waste at its point of generation.

Recycling - Reprocessing waste in a way that makes it useful again. Recycling focuses on the *use, reuse,* or *reclamation* of waste.

Use or Reuse - Returning a waste material to the original process that generated the waste or employing it in another process as a substitute for an input material.

Reclamation - Recovering valuable mat-erials or removing impurities from a waste.

Because it is significantly more efficient and less expensive to prevent the generation of waste in the first place, you should consider source reduction to be the most preferable waste management option. Source reduction is followed, in order of decreasing preference, by recycling, treatment (for example, incineration or stabilization), and land disposal.

Many Pollution Prevention Options Are Available

A pollution prevention program might include any number of specific pollution prevention techniques, each with a potentially unlimited range of pollution prevention options. The options under each technique that may be appropriate to your operation are limited only by your ingenuity. Table II provides suggested pollution prevention options that have actually been used in industry. The options are organized by technique. You should use these suggested options only as a starting point for your own creativity. Pollution prevention techniques are described below:

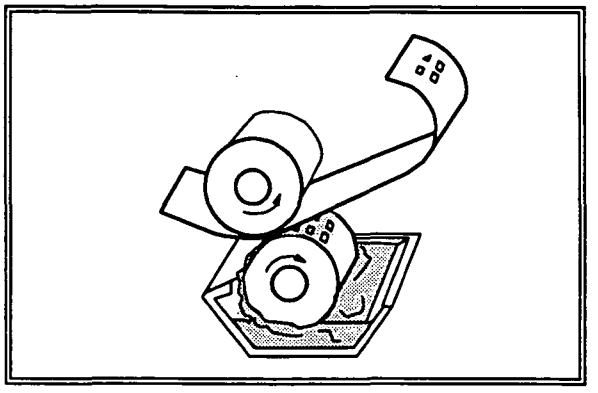
- *Training and supervision* -- involves providing employees with the information and the incentive necessary to effectively minimize waste generation.

  This technique may include ensuring that employees know and practice proper and efficient use of equipment and supplies, and that they are aware of, understand, and support your company's waste minimization goals.

- *Production planning and sequencing* -- requires planning and sequencing your production so that only necessary operations are performed and that no operation is needlessly "undone" by a following operation.

  For example, scheduling printing runs from lighter colors to darker ones in order to reduce the amount of equipment cleaning required between color changes.

- *Process or equipment modification* -- involves changing the process, or the parameters or equipment used in that process, to reduce the amount of waste generated.



For instance, you can reduce ink loses through vaporization by using diaphragm pumps instead of mechanical vane pumps to reduce temperatures, or using high pressure/low volume water sprays to clean ink vats instead of detergents.

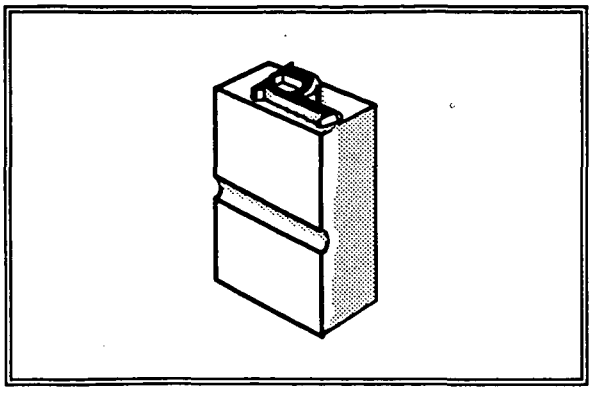
- *Raw material substitution* -- involves replacing existing raw materials with raw materials that will result in the generation of less hazardous waste.

  Examples include using water-based inks instead of solvent-based ones for flexographic and rotogravure printing, using ultraviolet (UV)-curable inks that do not require solvents, and using iron-EDTA bleaches instead of ferrocyanide bleaches to avoid cyanide generation.

- *Loss prevention and housekeeping* -- involves performing preventative maintenance and managing equipment and materials in such a way as to minimize the opportunities for leaks, spills, and other releases of potentially hazardous wastes.

  For example, storing light and heat sensitive materials in a place where they will not spoil, managing inventories of time sensitive materials so as to avoid expiration of shelf-lives, and installing curtains around printing areas to contain fugitive air emissions.

- *Waste segregation and separation* -- involves avoiding the mixing of *different types* of hazardous wastes, and avoiding the mixing of hazardous wastes with non-hazardous wastes. This technique will facilitate the



recovery of hazardous wastes by minimizing the number of different hazardous constituents in any given waste stream and avoiding the contamination of non-hazardous wastes.

This technique includes segregating waste inks by color and waste solvents by type.

- *Recycling* -- involves the use or reuse of a hazardous waste as an effective substitute for a commercial product or as an ingredient or feedstock. This use or reuse can be on-site, or it can be by another user or through a waste exchange.

  Examples of recycling include recovering etching wastes, using waste inks to make black or a house color, and silver or solvent recovery.

The Elements of a Successful Pollution Prevention Program

Experience demonstrates that successful pollution prevention programs have certain common elements. These elements are described below:

- *Support from top management* -- Support for a pollution prevention program should be clearly affirmed by your top management in a written statement. This statement should be circulated among all employees.

- *Explicit program goals and objectives* -- Explicitly identify the goals and objectives for the pollution prevention program in a written statement. The goals should include reducing the volume or toxicity of the waste as much as is technically and economically feasible. The objectives should include a commitment to evaluate technologies, procedures, and personnel training.

- *Accurate waste accounting* -- Carefully track changes over time in the types, amounts, and hazardous constituents of your wastes.

- *Accurate cost accounting* -- Ensure that your firm uses "fully-loaded" costs when accounting for waste management and disposal (i.e., costs should account for all liability, regulatory compliance, permitting, hauling, treatment, and oversight costs).

- *Involvement of all employees* -- Involve all appropriate employees in pollution prevention planning and implementation. You can use rewards and incentives to encourage employee involvement.

- *Exchange of technology and information* -- Encourage exchange of technology and information both within your firm *and* between your firm and others. Firms often contain a wealth of resources and information that results from years of operating experience. Such resources and information can play a major role in the efficient development of a pollution prevention program. Other organizations you should consult include EPA Region's and Headquarter's pollution prevention information clearinghouses, state agencies, trade associations, universities and colleges, nonprofit business assistance organizations, and professional consultants.

- *Periodic pollution prevention assessments* -- Periodically review individual processes (or facilities) to identify new or changing opportunities to undertake pollution prevention.

Basically, you should develop your own program for pollution prevention, and wherever possible, formally define the program in a written document. You should also develop an implementation plan for each of your facilities or processes and periodically review, revise, and

update the program to reflect changing conditions. You will need a method of tracking changes in waste generation rates and accounting for sources of waste. Establishing an effective pollution prevention program is not difficult, but it does require commitment from you and all of your firm's employees, including corporate management.

Where To Go For Information and Help

While it is important that *you* be actively involved in establishing and promoting your firm's pollution prevention program, you may wish to seek the guidance or help of other experts. Some organizations that you may wish to contact include:

- *Trade Associations* -- Often trade associations can provide you with pollution prevention assistance directly, or they can refer you to someone who can.

- *State Waste Management Agencies* -- These agencies often have staff people who are knowledgeable about pollution prevention and are willing to provide assistance.

- *Regional Environmental Protection Agency Offices* -- There are ten Regional Offices of the Environmental Protection Agency. The easiest way to find out which Regional Office is responsible for your area is to call the toll free RCRA/Superfund Hotline (see below) and ask for the telephone number or address of the Regional Office responsible for your area.

- *Environmental Protection Agency* -- Within EPA Headquarters you may conveniently contact any of the following information sources:

  Hazardous Waste Minimization Staff, at (202) 382-4807, can provide technical waste minimization information;

  Waste Minimization Branch, at (513) 569-7529, can assist you with research and development activities regarding waste minimization assessments, innovative technology and pollution prevention evaluations, and activities of the Waste Reduction Institute for Scientists and Engineers;

  Pollution Prevention Office, at (202) 382-4335, can assist you in understanding pollution prevention and provide you with a great deal of pollution prevention information; and the

  Pollution Prevention Information Clearinghouse, which includes a collection of reference literature pertaining to pollution prevention, outreach efforts, the Electronic Information Exchange System, and the RCRA/Superfund Hotline:

  Electronic Information Exchange System (EIES), at (301) 589-8366, is an easy-to-use, interactive PC-based system. Using a personal computer and a modem, you can access EIES to obtain a wide variety of pollution prevention information, including case studies, a calendar of events, a directory of experts, a bibliography of publications, and descriptions of federal and state pollution prevention programs. You can use an interactive message center to pose pollution prevention questions or provide comments to other users. The information in Table II that is followed by an "EIES Number" has come from references that are available to you through EIES. You may examine these references for additional pollution prevention information or ideas.

  RCRA/Superfund Hotline, at (800) 424-9346 (or (202) 382-3000), can answer your pollution prevention questions, help you access information in EIES, and assist you in searching for and obtaining documents.

HAVE YOU TRIED POLLUTION PREVENTION?

If you have tried, or are planning on trying any pollution prevention activity at your facility and would like to share your ideas or experience, use your personal computer to access the Electronic Information Exchange System (EIES) at (301) 589-8366, and let others know! We can all learn from your experience!

How To Use the Pollution Prevention Tables

Two tables are included in this booklet as a quick guide to help you begin identifying specific pollution prevention options. The ideas represented in these tables have been used at actual facilities, resulting in cost savings. **Table I** identifies typical processes and operations in the metal manufacturing industry. This table also identifies typical materials used and types of waste generated for each process.

Table II is also broken down by process and operation. Table II, however, provides pollution prevention options for each process and operation. These pollution prevention options are organized by technique, as described in the previous section. In addition, Table II provides examples of cost and savings realized by other facilities, and additional relevant information.[1] You should use this information to help decide which options would best serve your needs. When properly installed and maintained, none of the options described on Table II should adversely affect the quality of your products and all should reduce your potential liability from improper waste management. The entries in Table II that are followed by an "EIES Number" have come from references that are available to you through EIES. You may request and examine these references for additional pollution prevention information or ideas.

[1]The cost, savings, and waste reduction information provided in Table II is based on actual case studies and reflects the successes of actual metal manufacturing facilities. Because specific applications are highly variable, however, you should use this information only as an indicator of how a particular pollution prevention option may perform under your circumstances.

TABLE I

TYPICAL PRINTING AND ALLIED INDUSTRY OPERATIONS WHICH MAY PRODUCE WASTES

TYPICAL PROCESS OR OPERATION	TYPICAL MATERIALS USED	TYPICAL MATERIAL INGREDIENT	GENERAL TYPES OF WASTE GENERATED
PLATE PREPARATION			
*Counter-Etching to Remove Oxides	• Phosphoric acid	• Phosphoric acid	• Acid/alkaline wastes
*Deep-Etch Coating of Plates	• Deep-etch bath	• Ammonium dichromate, ammonium hydroxide	• Acid/alkaline wastes, heavy metal wastes
*Etching Baths	• Multimetal plate and plate coating	• Ferric chloride (copper), aluminum/zinc chloride/hydrochloric acid (chromium), nitric acid (zinc, magnesium), gum arabic	• Acid/alkaline wastes, heavy metal wastes
Applying Light-sensitive Coating	• Resins, binders, emulsifiers, photosensitizers, gelatin, photoinitiators	• PVA/ammonium dichloromate, polyvinyl cinnamate, fish glue/albumin, silver halide, gelatin, emulsifiers, gum arabic/ammonium dichromate	• Photographic processing wastes
Developing Plates	• Developer	• Lactic acid, zinc chloride, magnesium chloride, hydroquinone	• Photographic processing wastes
*Applying Lacquer	• Resins, solvents, vinyl lacquer, lacquer developers	• PVC, PVA, maleic acid, methyl ethyl ketone, cyclohexanone, isophorone	• Solvent wastes
Using Ink (lithography, letterpress, screen printing, flexography)	• Pigments, dyes, varnish, drier, extender, modifier, fountain solutions	• Titanium oxide, iron blues, molybdated chrome orange, phthalocyanine pigments, oils, hydrocarbon solvents, waxes, cobalt/zinc/manganese oleates, plasticizers, barium-based pigments	• Waste ink and ink sludges with solvents, chromium, lead, barium

* Older Technologies

TABLE I (continued)

TYPICAL PRINTING AND ALLIED INDUSTRY OPERATIONS WHICH MAY PRODUCE WASTES

TYPICAL PROCESS OR OPERATION	TYPICAL MATERIALS USED	TYPICAL MATERIAL INGREDIENT	GENERAL TYPES OF WASTE GENERATED
Making Gravure Cylinders	• Acid plating bath	• Copper, chromic acid, chrome	• Plating wastes
STENCIL PREPARATION FOR SCREEN PRINTING			
Lacquer Stencil Film	• Solvents, polyester film, vinyl film, dyes	• Aliphatic acetates, cellulose-based lacquer, plasticizers	• Solvent wastes
Photographic Stencil Film	• Organic acids, gelatin (pigmented), polyester film base	• Acids, alkalies, peroxide-forming compounds, plasticizers, surfactants	• Acid/alkaline wastes
Photo-emulsion	• Resins, binders, photosensitizers, dyes	• PVA, PVAC, ammonium or potassium bichromate, diazonium compounds	• Photographic processing wastes
Blockout (screen filler)	• Pigmented polymers, solvents, acetates	• Methylene chloride, methanol, methyl cellulose acetates	• Solvent wastes
PHOTOPROCESSING			
Developing Negatives and Prints	• Developer, cleaning agents, wetting agents, fixers, bleaches	• Hydroquinone, ammonium thiosulfate, silver, lead, chromium, cadmium, phenol, toluene, chloroform, ethylbenzene, methylene chloride	• Photographic processing wastes
PRINTING			
Using Ink (lithography, letterpress, screen printing lexography)	• Pigments, dyes, varnish, drier, extender, modifier, fountain solutions, inks, solvents, plates, shellacs	• Titanium oxide, iron blues, molybdated chrome orange, phthalocyanide pigments, oils, hydrocarbon solvents, waxes, cobalt/zinc/manganese oleates, plasticizers, barium-based pigments, acrylic copolymers	• Heavy metal wastes, ink sludges with chromium or lead, ink wastes with metals or organic constituents, and solvent wastes

TABLE I (continued)

TYPICAL PRINTING AND ALLIED INDUSTRY OPERATIONS WHICH MAY PRODUCE WASTES

TYPICAL PROCESS OR OPERATION	TYPICAL MATERIALS USED	TYPICAL MATERIAL INGREDIENT	GENERAL TYPES OF WASTE GENERATED
CLEAN UP			
Washing/ Cleaning Plates, Type, Die, Press Blankets and Rollers	• Alcohols, solvents, rags, alkaline cleaners	• Ethyl alcohol, benzene, toluene, xylene, isopropyl alcohol, methyl ethyl ketone, trichloroethylene, perchloroethylene, carbon tetrachloride, gasoline, naphtha, kerosene	• Acid/alkaline wastes, ink wastes with metals or organic constituents, and solvent wastes

TABLE II

POLLUTION PREVENTION PRACTICES FOR PROCESSES AND OPERATIONS IN PRINTING AND ALLIED INDUSTRIES

POLLUTION PREVENTION TECHNIQUES	POLLUTION PREVENTION OPTIONS	EXAMPLES OF COSTS AND SAVINGS, AND OTHER INFORMATION*
PLATE PREPARATION		
Process Equipment or Equipment Modification	Use counter-current rinsing to reduce cross contamination of baths, increase the ease of recycling process baths, and reduce the quantity of makeup chemicals required.	
	Use commercially available lithographic plates and film that may be processed with water, reducing or eliminating the generation of waste chemicals. [EIES Number 310-001, p. 208]	
Raw Material Substitution	Reduce the need for photographing and reshooting by installing electronic imaging and/or laser platemaking equipment. [EIES Number 005-045, p. 3]	
Recycling	Reclaim old plates by returning them to the manufacturer or metal reclaimer.	
	Recover etching wastes (zinc, magnesium, copper) using a packaged etching waste treatment system. [EIES Number 101-038, p. 331]	
	Recycle type metal (82% lead, 11.5% antimony, 6.5% tin) used in linotype, monotype, and foundry typesetting for the manufacture of letterpress plates. [EIES Number 101-038, p. 331]	
PRINTING		
Production Planning and Sequencing	Use dedicated presses for inks with hazardous pigments or solvents.	
	Schedule printing runs from light colors to darker ones in order to reduce the amount of equipment cleaning required between color changes.	

* The cost, savings, and waste reduction information provided in Table II is based on actual case studies and reflects the successes of actual metal manufacturing facilities. Because specific applications are highly variable, however, you should use this information only as an indicator of how a particular pollution prevention option may perform under your circumstances.

** These options cost less than $30,000 to implement.

TABLE II (continued)

POLLUTION PREVENTION PRACTICES FOR PROCESSES AND OPERATIONS IN PRINTING AND ALLIED INDUSTRIES

POLLUTION PREVENTION TECHNIQUES	POLLUTION PREVENTION OPTIONS	EXAMPLES OF COSTS AND SAVINGS, AND OTHER INFORMATION*
Process or Equipment Modification	For general printing on a continuous web: • change from indirect steam heating to direct gas fired heating; • improve air circulation and web transport in the over; • use heat wheels to pre-heat make-up air.	**Capital Investment:** $284,650. **Annual Savings:** $102,100. **Payback Period:** 2.7 years. **Waste Savings/Reduction:** solvent discharges reduced from 560 tonnes/year to 200 tonnes/year. [EIES Number 400-090, p. 16]
	** Reduce ink losses through vaporization by using diaphragm pumps (instead of mechanical vane pumps), which will reduce ink temperatures from approximately 100°F to approximately 80°F.	**Capital Investment:** $6,000. **Annual Savings:** $7,400 (in recovered solvent). **Payback Period:** 10 months. **Product/ Waste Throughput Information:** 78.2 tons VOCs per year; 20% of lost solvent is recovered. [EIES Number 043-005, pp. 28, 33]
	Install filters on printing presses.	**Waste Savings/Reduction:** ink waste reduced by 30%. [EIES Number 005-043, p. 62]
	Keep ink fountains at their optimal level for good print quality in large web processes by installing automatic ink levellers. [EIES Number 005-045, p. 4]	
Raw Material Substitution	Use water-based inks instead of solvent based inks for flexographic and rotogravure printing processes in order to reduce hazardous waste production (both UV-curable and air drying systems speed drying of water based inks). [EIES Number 310-001, p. 209]	**Annual Savings:** $57,550. **Product/Waste Throughput Information:** 193,600 lbs. ink/year. [EIES Number 043-005, pp. 25, 32]
	Use foamable aqueous inks rather than solvent-type inks during rotogravure printing.	**Operating Cost:** same as solvent system. **Waste Savings/ Reduction:** VOC emissions reduced by 95%. [EIES Number 209-001]
	Avoid heavy-metal based pigments.	
Loss Prevention and Housekeeping	** Install curtains around printing area to trap VOC solvent vapors and limit escape to the atmosphere.	**Capital Investment:** $2,000 ($1,000 per printing press). **Annual Savings:** $11,100. **Payback Period:** 3 months. **Product/Waste Throughput Information:** 78.2 tons VOCs per year; 96,800 lbs. ink per year. [EIES Number 043-005, pp. 25, 28, 32]
	Wipe off excess liquid using squeegees or doctor blades during printing operations.	**Waste Savings/Reduction:** can reduce chemical carry-over by 50%.
	Reuse rinsewater as long as possible by using contaminated rinsewater for initial equipment rinse.	

TABLE II (continued)

POLLUTION PREVENTION PRACTICES FOR PROCESSES AND OPERATIONS IN PRINTING AND ALLIED INDUSTRIES

POLLUTION PREVENTION TECHNIQUES	POLLUTION PREVENTION OPTIONS	EXAMPLES OF COSTS AND SAVINGS, AND OTHER INFORMATION*
	Exercise inventory control: • Do not order more ink than can be used before its shelf life expires. • Completely use a container of ink before opening new one. • Purchase ink in recyclable bulk containers and recycle empty containers.	
	Instead of disposing unused ink portions, reuse them in "house" colors or future production runs.	
	Return all unemulsified inks to their containers. [EIES Number 005-045, p. 4]	
	Reduce waste ink generation by cleaning ink fountains only when changing colors or when the ink might dry out between runs. Fountains can be left with ink overnight if sprayed with special non-drying aerosol materials. [EIES Number 005-045, p. 4]	
Waste Segregation and Separation	Segregate waste ink according to color and type and use to thin future batches of the same ink. [EIES Number 043-005, pp. 28-29]	
Recycling	** Reuse colored and black inks as printing ink for newspaper production (discarded inks can be filtered and mixed with black inks to produce the newspaper ink).	**Capital Investment:** $3,720. **Annual Net Savings:** $10,000. **Product/Waste Throughput Information:** 4,000 tons of newspaper per year. [EIES Number 400-109, p. 1]
		Capital Investment: $28,000. **Annual Savings:** $40,000 in new ink costs. **Product/Waste Throughput Information:** 260,000 lbs. waste ink recovered. [EIES Number 310-001, p. 213]
		Annual Savings: $40,000. **Product/Waste Throughput Information:** 54,000 gallons waste ink recovered. [EIES Number 310-001, p. 212]
		Capital Investment: $8,000. **Annual Savings:** $28,000. **Product/Waste Throughput Information:** 1,200 gallons waste ink recovered. [EIES Number 005-044, p. 41]
	** Recover waste solvents through distillation.	**Capital Investment:** $3,000 for a 5 gallon batch distillation unit. **Payback Period:** less than 1 year. [EIES Number 005-044, p. 60; EIES Number 034-006, pp. 6-7]

TABLE II (continued)

POLLUTION PREVENTION PRACTICES FOR PROCESSES AND OPERATIONS IN PRINTING AND ALLIED INDUSTRIES

POLLUTION PREVENTION TECHNIQUES	POLLUTION PREVENTION OPTIONS	EXAMPLES OF COSTS AND SAVINGS, AND OTHER INFORMATION*
		Capital Investment: $25,000 for a 110 gallon continuous distillation unit. [EIES Number 034-006, pp. 6-7]
		Capital Investment: $240,000. **Operating Cost:** $57,600/ year. **Payback Period:** 8.2 years. [EIES Number, 043-005, pp. 24-31]
		Waste Savings/Reduction: 3.5 tons of liquid waste reduced to 1,100 lbs. [EIES Number 005-044, p. 58]
	Use carbon adsorption to recover waste solvents.	**Annual Savings:** solvent consumption reduced 90%. [EIES Number 101-038]
PHOTOPROCESSING		
Process or Equipment Modification	Use ozone oxidation to regenerate ferric ion instead of using potassium persulfide.	**Waste Savings/Reduction:** can reduce ferrocyanide concentration by 90%. [EIES Number 310-001, p. 165]
	Use counter-current rinsing to reduce cross contamination of baths, increase the ease of recycling process baths, and reduce the quantity of makeup chemicals required.	
	Use a "washless" processing system.	**Capital Investment:** $45,000. **Waste Savings/Reduction:** wastewater reduced by 97%.
	Extend the allowable buildup of silver by adding ammonium thiosulfate to silver contaminated baths. [EIES Number 005-045, p. 3]	
	Use an acid stop bath prior to the fixing bath to reduce the effects of an alkaline developer on the fixing bath's pH. Add acetic acid to the fixing bath to keep the pH low and maximize soluble complexes. [EIES Number 005-045, p. 3]	
	Use flotation lifts on bleach and developer containers to keep them fresh. [EIES Number 005-045, p. 3]	
	Reduce the volume of fixer waste by installing waterless paper and film developing units. [EIES Number 005-045, p. 3]	

TABLE II (continued)

POLLUTION PREVENTION PRACTICES FOR PROCESSES AND OPERATIONS IN PRINTING AND ALLIED INDUSTRIES

POLLUTION PREVENTION TECHNIQUES	POLLUTION PREVENTION OPTIONS	EXAMPLES OF COSTS AND SAVINGS, AND OTHER INFORMATION*
Raw Material Substitution	Use an aqueous developer to avoid developing in TCE and etching in caustic solution when making decals from photo-resist-coated anodized aluminum.	**Annual Savings:** $10,000. **Product/Waste Savings/ Reduction:** 40% reduction in hazardous waste generation. [EIES Number 806-001, p. 7]
	Use silver-free films and carbon black paper systems to reduce the need for silver. Some silverless film does not require a development solution for processing.	
	Eliminate silver in wastes by using silver-free films such as vesicular, diazo, electrostatic,and photopolymer films. [EIES Number 005-045, p. 3]	
	Certain commercial films eliminate high polluting substances from both sides of the film. [EIES Number 101-038, p. 330]	
	Use bismuth as the image carrier instead of silver because of its lower toxicity. [EIES Number 310-001, pp. 156-157]	
Loss Prevention and Housekeeping	Reduce water flow either manually or automatically (using a solenoid valve) when actual photoprocessing stops. [EIES Number 310-001, p. 159]	
	Store photosensitive film and paper properly to avoid inadvertent exposure or waste.	
	Reuse rinsewater as long as possible by using contaminated rinsewaters for an initial equipment rinse.	
	Wipe off excess liquid using squeegees or doctor blades during processing.	**Waste Savings/Reduction:** can reduce chemical carry-over by 50%. [EIES Number 310-001, pp. 158-159]
	Protect process baths that spoil easily by keeping them containerized. [EIES Number 005-045, p. 3]	
	Minimize bad runs and waste by using commercially available continuous monitors. [EIES Number 005-045. p. 3]	

TABLE II (continued)

POLLUTION PREVENTION PRACTICES FOR PROCESSES AND OPERATIONS IN PRINTING AND ALLIED INDUSTRIES

POLLUTION PREVENTION TECHNIQUES	POLLUTION PREVENTION OPTIONS	EXAMPLES OF COSTS AND SAVINGS, AND OTHER INFORMATION*
	Use glass marbles to bring the liquid level in the process baths to the brim each time the liquid is used. [EIES Number 005-045, p. 3]	
Recycling	** Use electrolytic recovery cells to plate pure silver out of the waste stream.	**Capital Investment:** $150 to over $15,000.
		Waste Savings/Reduction: 98% silver recovery from spent fix. [EIES Number 310-001, pp. 163-164]
	** Reclaim metal from silver-bearing effluent with a chemical recovery cartridge. Multiple chemical recovery cartridges in series will increase silver recovery.	**Capital Investment:** cost of cartridges $30-$50.
	** Use chemical precipitation, such as sodium borohydride reduction, to recover heavy metals and to control discharge. [EIES Number 310-001, p. 162]	**Capital Investment:** $7,000 to $10,000. **Operating Costs:** $0.15 per ounce of recovered silver for x-ray fixers; $0.50 per ounce for bleach fixers. **Product/Waste Throughput Information:** 400 gallon capacity treatment system. [EIES Number 507-001, pp. 145-147]
	Recover spent bleach, especially ferricyanide, using: • ozone oxidation, • electrolysis, • persulfate salts, • liquid bromine. [EIES Number 310-001, p. 165]	
	Recycle color developer using oxidation recovery.	**Capital Investment:** $54,200 (1981). **Payback Period:** 2 years. [EIES Number 310-001, p. 169]
	Recycle waste or spoiled photographic film and paper.	**Waste Savings/Reductions:** drummed scrap films can be sold. [EIES Number 101-038, p. 330]
CLEANUP		
Process Equipment or Modification	When cleaning caked-on deposits from the sides of ink vats, save water by using a high pressure spray unit instead of detergent.	**Waste Savings/Reduction:** wash time per vat reduced 52%; volume of waste water generated reduced 54%. [EIES Number 808-001, p. 31]
	** Reduce fountain tray cleaning costs by installing portable fountain cleaning and reclaiming equipment.	**Capital Investment:** $4,000 (1977). **Annual Savings:** $375,000. **Product/Waste Throughput Information:** 18 ink fountains cleaned weekly. **Waste Savings/Reduction:** 80% of ink is recovered. [EIES Number 310-001, pp. 213-214]

TABLE II (continued)

POLLUTION PREVENTION PRACTICES FOR PROCESSES AND OPERATIONS IN PRINTING AND ALLIED INDUSTRIES

POLLUTION PREVENTION TECHNIQUES	POLLUTION PREVENTION OPTIONS	EXAMPLES OF COSTS AND SAVINGS, AND OTHER INFORMATION*
Raw Material Substitution	Use less toxic solvents with press wipes (i.e., nonchlorinated solvents such as alcohol, mineral spirits, water, etc.).	
Loss Prevention and Housekeeping	Do not draw too much cleaning solvent from a drum. Use only as much solvent as required when cleaning.	
	Use press wipes for as long as possible before throwing them out. Use dirty ones for the first pass and clean ones for the final pass. Similarly, use dirty solvents during the first cleaning and fresh solvent for the final cleaning.	
Recycling	Use dual distillation units to transform spent press and roller cleanup solvents into dry, solvent-free cakes. For example:	
	• ** 55 gallon batch still.	**Capital Investment:** $15,000 to $16,000. **Annual Savings:** $24,000. **Payback Period:** less than one year. **Waste Savings/Reduction:** 60%. [EIES Number 034-006, pp. 7-8]
	• ** 20 gallon (continuous) still.	**Capital Investment:** $9,000. **Annual Savings:** $14,400 to $36,000. **Payback Period:** 6 months. **Waste Savings/ Reduction:** 100%. [EIES Number 034-006, pp. 7-8]
	** Distill all waste solvents.	**Capital Investment:** $3,000 (5 gallon batch still). [EIES Number 034-006, p. 6]
		Capital Investment: $25,000 (110 gallon continuous still). [EIES Number 034-006, p. 6]
	Send spent solvents back to the formulator for use in future batches.	
	Clean press-cleaning wash waters by routing them through an ultrafiltration unit (UF) and return them to the process.	**Capital Investment:** $63,000. **Operating Cost:** $19,300. **Savings:** $125,000 (when UF is compared to hauling at $0.10/gallon). **Payback Period:** 1.08 years. **Product/Waste Throughput Information:** 5,000 gallons/day. **Waste Savings/Reduction:** 98% volume reduction. [EIES Number 999-001]