Resource for Greening Printing and Publishing
Pollution Prevention Information

Version 1.0
December 2010

Greening Printing and Publishing

Toronto's ChemTRAC program includes an Environmental Reporting and Disclosure Bylaw (Municipal Code Chapter 423) that requires local businesses to track and report their use and release of 25 priority substances. The ChemTRAC program provides an opportunity for you to identify strategies for improving your environmental performance. Strategies include those that reduce the use and release of the 25 priority substances. Strategies may also reduce the use and release of other chemicals that may have a health and/or an environmental impact. This Greening Resource for Printing and Publishing Sector will help you understand the chemicals that you are using and find ways to reduce or eliminate their use. For additional resources, including a Guide to Reporting, visit http://www.toronto.ca/chemtrac/.

Printing and Publishing

The printing sector provides a wide range of products such as newspapers, books, labels, business cards and food wrappers. It prints on paper, metal, glass, plastics, apparel and textile products. The six major types of printing are: lithographic, flexographic, gravure, letterpress, screen and digital.

Priority Substances and Other Chemicals of Concern

Toronto Public Health has identified 25 substances of priority health concern that are commonly used and released by businesses in the City of Toronto. As part of ChemTRAC, the Environmental Reporting and Disclosure Bylaw requires businesses and facilities to track and report on any of the listed priority substances that a facility manufactures, uses or releases to the environment if the amounts are equal to or above the reporting limits. In addition to the priority substances, industrial processes commonly use and release other chemicals of concern that may have a health and/or an environmental impact that are not subject to the by-law.

The Printing and Publishing sector may use and produce some of these priority substances and other chemicals of concern. Each of these chemicals may have an impact on human health and/or the environment. Below are the priority substances and other chemicals of concern that may be used or produced by your facility and its operation. This is not an exhaustive list.

Substances that may be used or produced by your Printing and Publishing Facility

Inks and cleaning products may contain these solvents:	Inks may also contain these heavy metals:
• Benzene • Dichloromethane (methylene chloride) • Formaldehyde • Tetrachloroethylene (perchloroethylene) • Trichloroethylene • Other Volatile Organic Compounds (VOCs) * • Polycyclic aromatic hydrocarbons (PAHs)	• Cadmium • Chromium (hexavalent) (Cr(VI)) • Lead • Mercury
Printing plates may contain these heavy metals:	
• Manganese (in lithographic printing plates) • Nickel	

[1] VOCs are emitted as gases from certain solids or liquids. When combined with nitrous oxides (NOx) in sunlight, smog forms. Common VOCs used and released by the auto repair sector include toluene, xylene, and methyl ethyl ketone, among others. * In Canada one of the principal stationary sources of VOC emissions from solvents comes from the printing and publications industry. VOCs are emitted as gases from certain solids or liquids. When combined with nitrous oxides (NOx) in sunlight, smog forms. VOCs used and released by the printing industry include formaldehyde, isopropyl alcohol, benzene, toluene, xylene, ethanol, methanol, and methyl ethyl ketone, among others.

Understanding Your Company's Impacts: Printing and Publishing

This section provides a snapshot of the main printing activities:

- Imaging
- Plate-Making and Printing
- Post-press Operations

For each activity, the guide shows the raw materials that go into the process and the pollution (waste) that comes out of the process. Symbols show whether the wastes go to air, landfill, sewer systems and/or treatment facilities (liquid wastes).

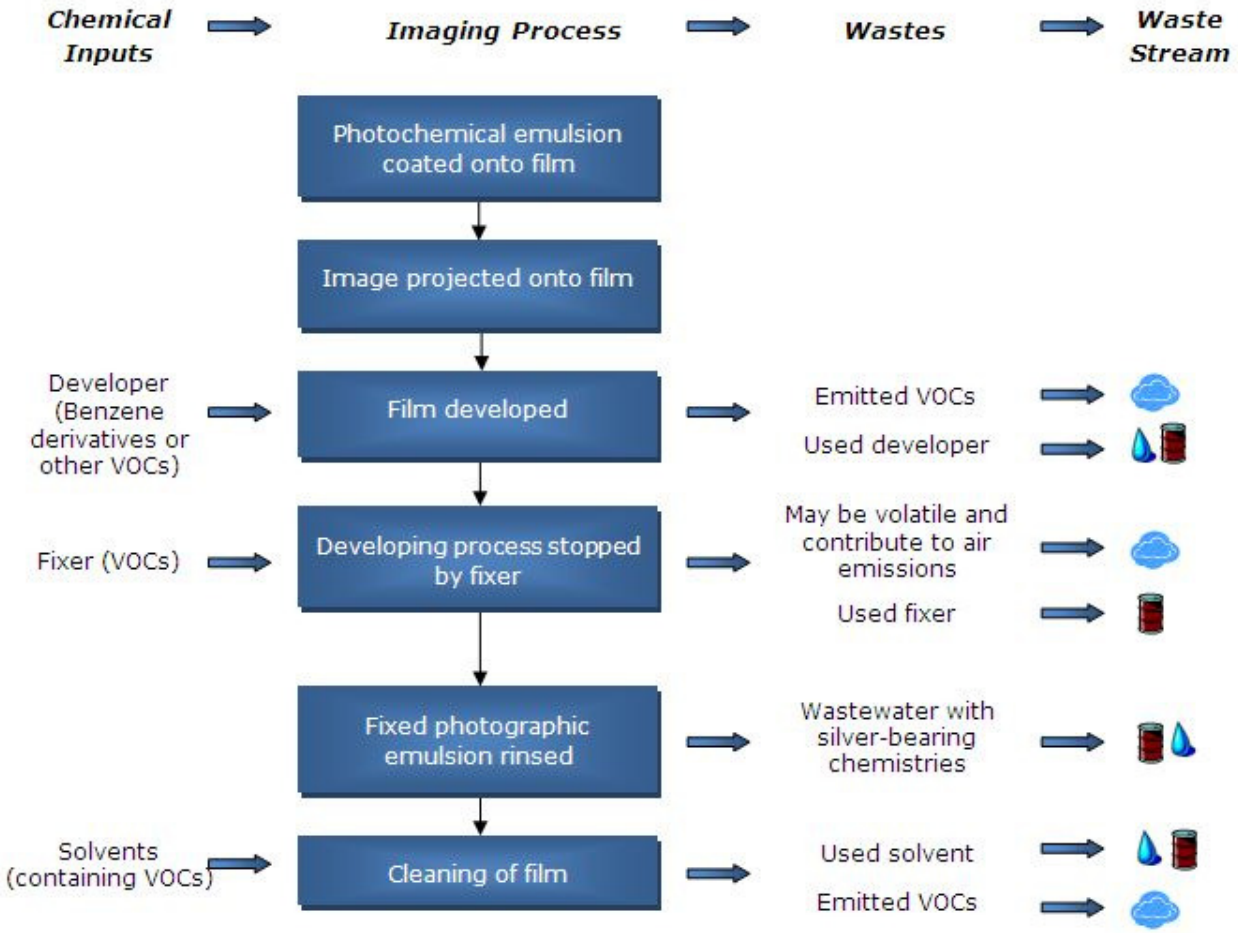
The following diagrams show the raw materials that may go printing and publishing processes and the pollution that may come out of each process. This guide outlines the *general processes* for printing and publishing. Your facility may have more specialized processes or only engage in a subset of these processes; however, it is possible that these priority substances and chemicals of concern may still be present. Symbols show whether the wastes typically go to air, landfill, sewer systems and/or treatment facilities (as liquid or hazardous wastes).

Imaging

Imaging operations are fairly similar for all printing technologies. Most, if not all, printing companies use computers to arrange art and text for imaging the proof. There are three main types of imaging: traditional imaging using film, traditional computer-to-plate technology, and process-less computer-to-plate technology.

Traditional imaging makes a photographic negative (like regular photography) or a photographic positive. Images are projected onto film that has a paper, plastic or glass base covered with a light-sensitive coating called a photographic emulsion. The film is developed when exposed to developer chemicals and the developing action is stopped by immersing the film in a fixing bath. Fixing chemicals are washed from the emulsion in a water bath.

Traditional Imaging Process: Chemical Inputs and Associated Wastes



Symbols used in the flow diagram

In more recent years, some printing companies have shifted their process to a Computer-to-Plate (CtP) technology. There are two main types of CtP technology: visible light systems and thermal. Both types of technology can still require the use of developing and finishing chemicals; however, thermal technology can be chemical-free (no developer or finisher, but plates are rinsed with water after creating the image) or process-free (no rinsing required).

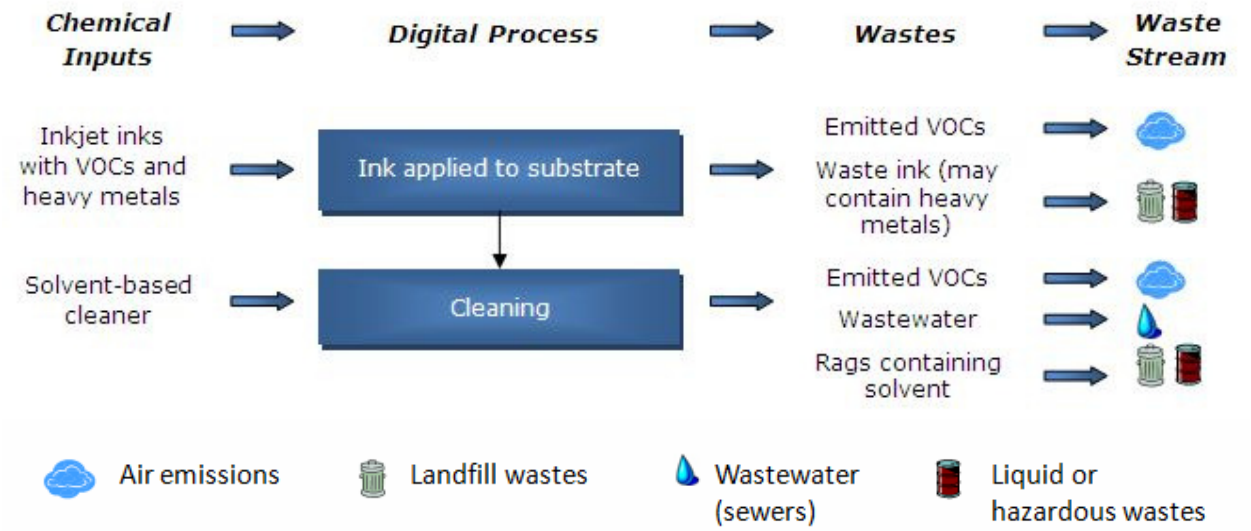
Plate-Making and Printing

Printing plates are produced from the photographic negative or positive created in the imagining process. Unlike the imaging process, ***plate-making and printing techniques of the six major printing processes differ from one another***. See below for a brief overview of each process.

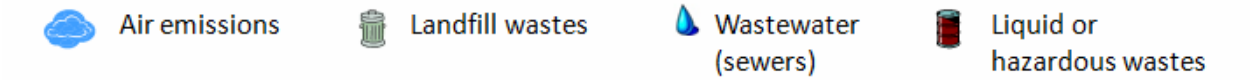
Digital Printing

Digital printing refers to any printing technique that does not need to make film to print. Generally, digital printing uses high-end inkjet, laser and other printing presses to transfer text and images to smooth surfaces, forming a layer on the surface of the substrate. Digital printing generally has less waste than traditional printing methods, but it can still release solvents and generate waste.

Digital Printing Chemical Inputs and Associated Wastes



Symbols used in the flow diagram

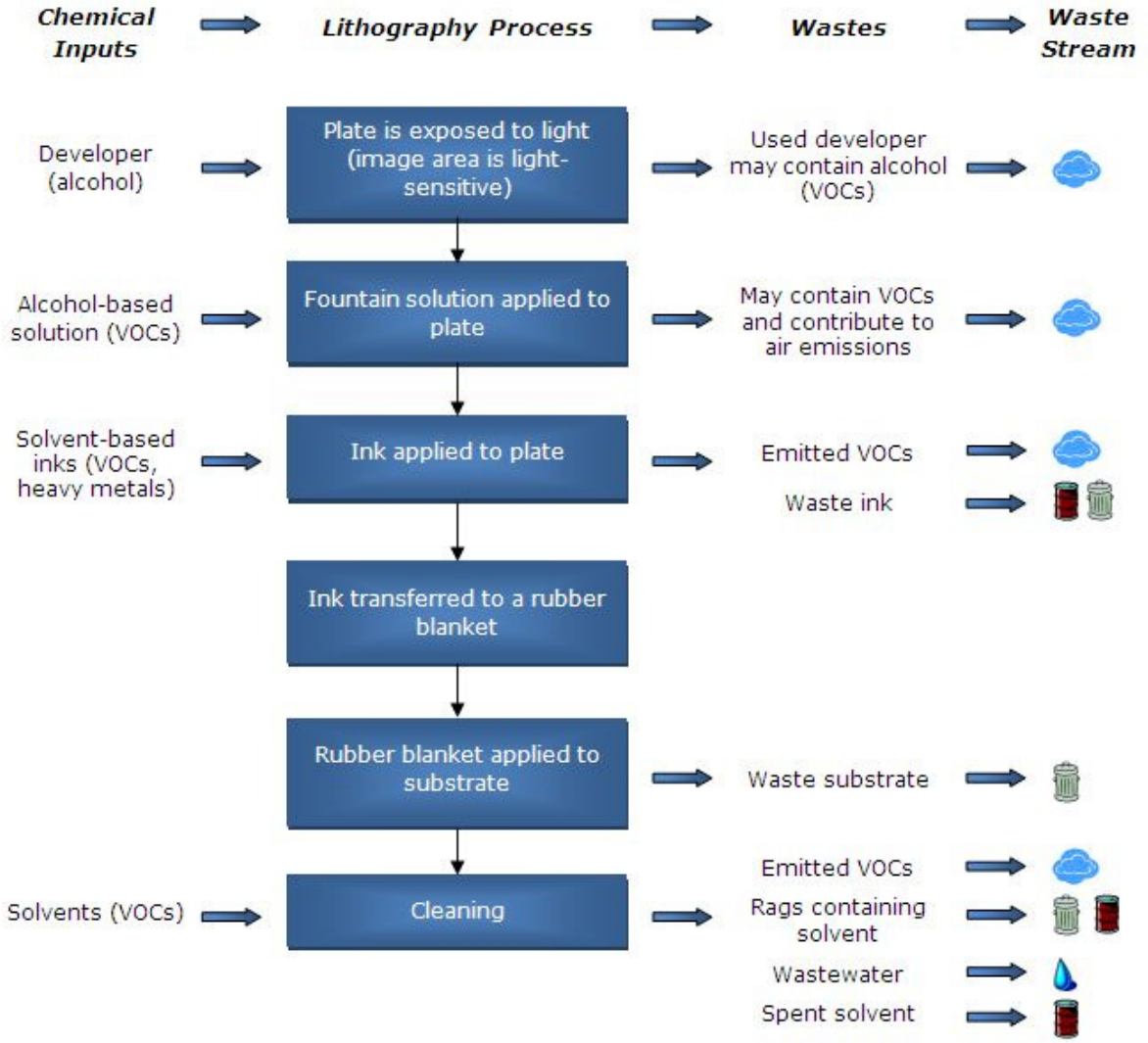


Lithography Plate-making and Printing

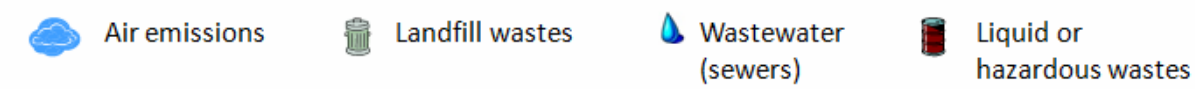
In the lithographic plate-making process, printers use a metal, paper or plastic plate with a light-sensitive chemical coating. Through the photographic negative, the light-sensitive coating is exposed to light, chemically changing the light-exposed areas so that they are now receptive to ink. In other words, the light-exposed areas form the printed image. The areas on the plate that were not exposed are water-receptive.

A fountain solution, which is water-receptive, is applied to the plate to improve the non-image area's ability to repel ink and to control the temperature. Ink is applied to the plate, sticking to the image areas. The image on the plate is transferred (called offsetting) to a rubber roller (the blanket), which then transfers the image to the substrate to be printed (e.g. paper).

Lithographic Plate-making and Printing Process: Chemical Inputs and Associated Wastes



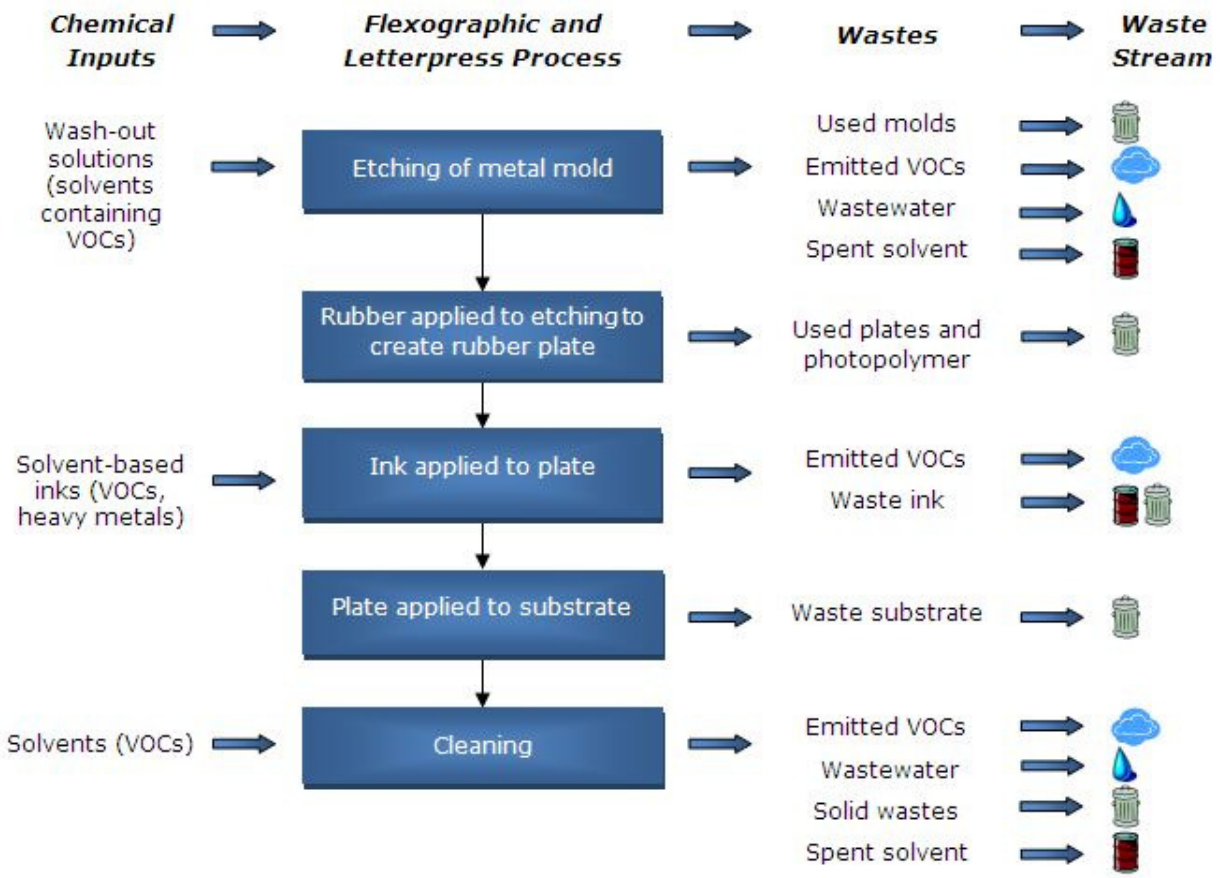
Symbols used in the flow diagram



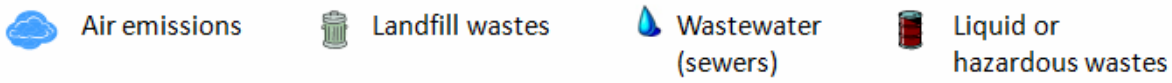
Flexography and Letterpress Plate-making and Printing

Flexographic and letterpress image plates are made using the same methods. The printing process is like a giant rubber stamp. The printer uses a metal mold to make a rubber image plate. The etching (or engraving) occurs through mechanical routing or a photochemical process. In the photochemical process, the metal mold is coated with a light-sensitive chemical. When exposed to light, the coating is developed and the unexposed area is washed away leaving the image and bare metal. When the plate is exposed to acid, the acid eats away at the imaged area and creates the mold. Rubber is pressed into the mold to produce the printing area.

Flexography / Letterpress Plate-making and Printing Process:
Chemical Inputs and Associated Wastes



Symbols used in the flow diagram

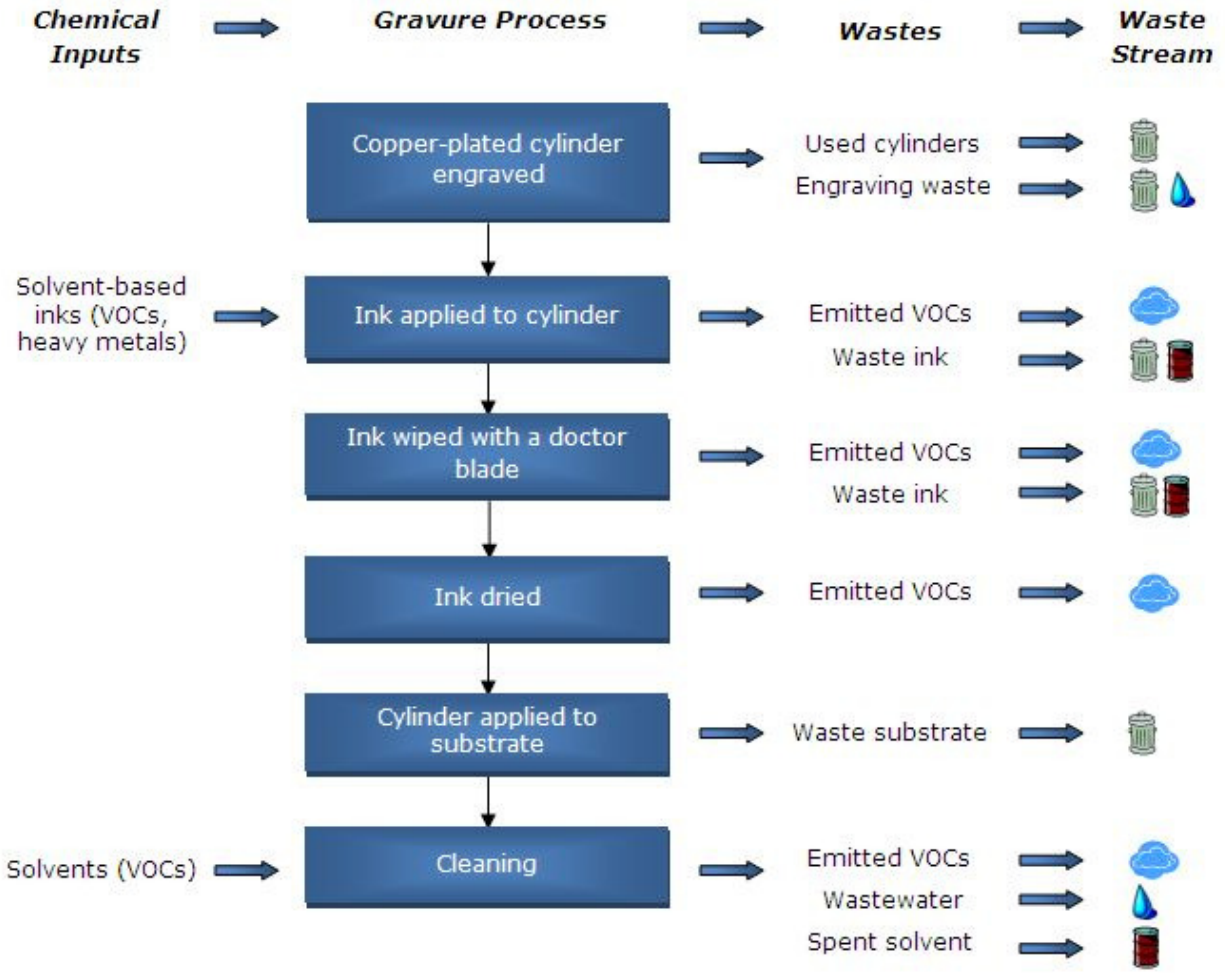


Gravure Plate-making and Printing

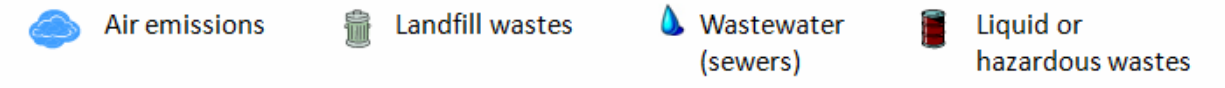
Gravure plates are often steel or plastic cylinders with a copper-plated (or other metal alloy) coating. Images are engraved into the copper. Ink is applied to the cylinder and excess ink is wiped away by a 'doctor blade,' leaving ink only in the engraved image area. The ink is applied to the substrate and the printed substrate is then dried.

Cylinders are reused by mechanically or chemically removing the image from the upper layer of the plate. Water used to rinse the plates during the plating process contains metals (e.g. copper, nickel).

Gravure Plate-making and Printing Process: Chemical Inputs and Associated Wastes



Symbols used in the flow diagram

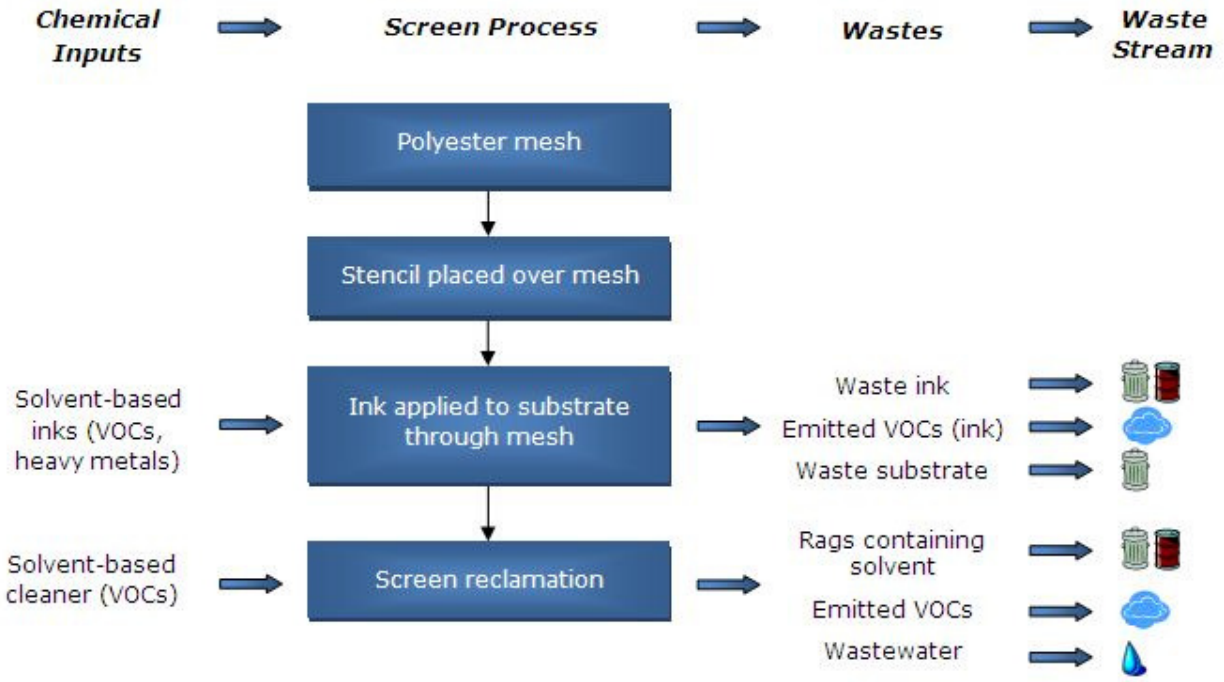


Screen Printing

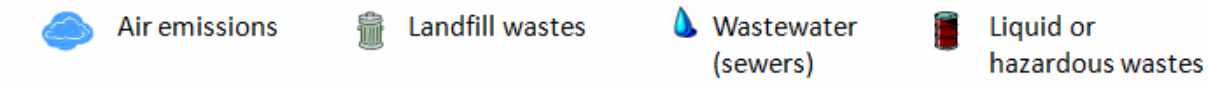
In screen printing, the printer tightly stretches a mesh screen over a frame and applies a stencil to the mesh. The printer applies ink to the screen, forcing the ink through the screen onto the substrate. Inks used for screen printing are either UV-curable, solvent-based, water-based or plastic-based.

Screens are typically reused, or 'reclaimed,' by using rags, highly volatile solvents and rinse water.

Screen Printing Process: Chemical Inputs and Associated Wastes



Symbols used in the flow diagram

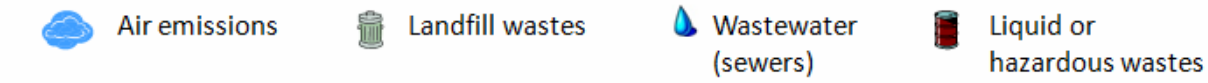


POST-PRESS OPERATIONS

After completing the printing, other activities such as cutting, folding and binding often follow the printing. Glues used in the binding process produce air pollution in the form of VOCs.

Post-press Operations: Chemical Inputs and Associated Wastes

Symbols used in the flow diagram



Pollution Prevention Steps You Can Take

This resource identifies steps you can take to reduce or eliminate your use of the priority substances and other chemicals that may have a health and/or an environmental impact, and to prevent pollution in the Printing and Publishing sector.

The pollution prevention measures identified in this information sheet can reduce costs and/or increase profits.

Pollution Prevention Assessments – A Good First Step

Before you go too far with any given measure, you may want to do a Pollution Prevention Assessment of your business. You may need an outside expert to help. A typical Pollution Prevention Assessment will include mapping process flows, reviewing equipment uses, evaluating the way you use and store chemicals, evaluating the way you use energy, as well as reviewing waste handling practices and discharges. This assessment helps you to identify many pollution prevention opportunities (and any regulatory compliance issues) and decide which steps to take first.

Pollution Prevention - A Key to Good Management

Good management of your chemical purchases, chemical use and waste disposal is very important. You can improve your environmental performance through Pollution Prevention by:

- identifying how you are using the priority substances and other chemicals of concern that may have a health and/or an environmental impact
- figuring out how much you are using of each chemical and estimating the related emissions (see the earlier description for more information on how to estimate chemical use and emissions)
- discussing the options to reduce or to eliminate these chemicals and, where feasible, taking action. Actions could include:
    - using a different product
    - changing how you apply or clean up the chemical product/waste
    - training staff on how best to apply and clean up the chemical product/waste, or
    - installing new technology
    - maintaining equipment to ensure that leaks and general efficiencies are managed
- tracking the amount of chemicals you use and see if it goes down over time, and
- reviewing progress and identifying whether or not you need to make changes to the company's practices and procedures.

Changes you could make in your medical laboratory

The following table lists many options to help you reduce or stop using the priority substances and other chemicals of concern in your facility. Some measures will cost more than others, and some will be easier to implement than others. Employees can implement certain measures by making minor changes in their day-to-day approaches; while others will require management to invest in new technologies.

The table provides a quick and simple way to take stock of what measures your business has already put into place and those measures that your business could apply. In completing the table, you are encouraged to prioritize the actions you would take. While it is not exhaustive, the table identifies many pollution prevention opportunities for printing and publishing. When assessing the options, please consider your facility-specific conditions and how each option might affect pollution releases to the air, land and water.

The table identifies three general types of options and distinguishes each with a symbol:

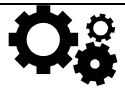
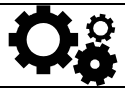
Low-cost, good operating procedures – These measures involve operational and managerial changes that can reduce chemical use. They include simple changes to normal practices, process improvements, as well as training and good housekeeping opportunities. This measure does not need new technology purchases.

Choosing an alternative chemical – These measures involve replacing traditional products (such as solvents and cleaning products) with products that have less harmful properties. The ease and cost of these measures depends on the product and the process used.

New technology or system – These measures involve the installation of a new system, machine or process. The cost varies depending on the technology / system.

See ***More Resources*** for a list of additional resources related to pollution prevention in the printing and publishing sector.

Imaging

Process	Pollution Prevention Opportunities	Type of activity	In place?			What level of priority do we put on implementing this measure? (High, Medium, or Low)
			Yes	No	N/A	
Film Processing	Invest in Computer-to-Plate (CTP) technology. CTP technology reduces or eliminates the use of harmful chemicals and wastes.		☐	☐	☐	H M L
	Substitute less harmful products, such as water-based developers.		☐	☐	☐	H M L
	Use low replenishment chemicals.		☐	☐	☐	H M L
	Use recycled chemicals.		☐	☐	☐	H M L
	Use squeegees or squeegee rollers for all processors.		☐	☐	☐	H M L
	Calibrate replenishment rates on all processing equipment according to manufacturer recommendations to reduce waste.		☐	☐	☐	H M L
Rinsing	Control wash water use with a solenoid so that water only runs when film is being processed.		☐	☐	☐	H M L
	Use counter-current washing systems (when the direction of wash water is opposite to the direction of the film) to reduce wash water in the film.		☐	☐	☐	H M L
	Recycle wash water on-site with membrane technology.		☐	☐	☐	H M L

	Low-cost, good operating procedures		Choosing an alternative chemical		New technology or system

Plate-making and Press

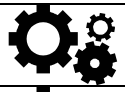
Plate-making

Process	Pollution Prevention Opportunities	Type of activity	In Place?			What level of priority do we put on implementing this measure? (High, Medium, or Low)
			Yes	No	N/A	
Plate Developing	Use water-based plate chemicals instead of solvent-based.		☐	☐	☐	H M L
	Use counter-flow and spray rinsing to reduce water usage and wastewater.		☐	☐	☐	H M L
	Recycle plate processor chemicals on-site or off-site.		☐	☐	☐	H M L
	Equip plate processors with solenoids to minimize wash water usage.		☐	☐	☐	H M L
	Equip plate processors with counters so that chemicals are changed based on plate count.		☐	☐	☐	H M L

Press

Process	Pollution Prevention Opportunities	Type of activity	In Place?			What level of priority do we put on implementing this measure? (High, Medium, or Low)
			Yes	No	N/A	
Fountain Solution (Lithography)	Replace alcohol-based fountain solutions with glycol solutions.		☐	☐	☐	H M L

	Low-cost, good operating procedures		Choosing an alternative chemical		New technology or system

Process	Pollution Prevention Opportunities	Type of activity	In Place?			What level of priority do we put on implementing this measure? (High, Medium, or Low)
			Yes	No	N/A	
	Use coolers if alcohol is used in the fountain solution, to control the temperature and reduce vapours.		☐	☐	☐	H M L
	Install filtration units on re-circulating fountain solution systems.		☐	☐	☐	H M L
	Recycle spent fountain solution on-site or off-site.		☐	☐	☐	H M L
	Reuse fountain solution, reducing liquid industrial waste.		☐	☐	☐	H M L
	Use discharged water for other processes.		☐	☐	☐	H M L
Ink Application and Disposal	Substitute solvent-based inks with vegetable-based, UV-cured, or water-based inks.		☐	☐	☐	H M L
	Use printing inks low in lead, cadmium, mercury or hexavalent chromium (concentration should be less than 100 parts per million (ppm) by weight.)		☐	☐	☐	H M L
	Reduce ink evaporation by installing enclosed doctor blade chambers (flexography).		☐	☐	☐	H M L
	Use computerized ink blending to reduce ink wastage.		☐	☐	☐	H M L
	Use automatic ink fountain levelers on all the presses to optimize inking conditions and reduce ink wastage and copy spoilage.		☐	☐	☐	H M L
	Organize print runs to reduce shifting of colours between units - run light colours first.		☐	☐	☐	H M L

	Low-cost, good operating procedures		Choosing an alternative chemical		New technology or system

Process	Pollution Prevention Opportunities	Type of activity	In Place?			What level of priority do we put on implementing this measure? (High, Medium, or Low)
			Yes	No	N/A	
	Use anti-skinning spray on sheet fed press ink fountains overnight to reduce ink wastage.		☐	☐	☐	H M L
Blanket Cleaning (Lithography)	Substitute high-VOC solvent-based blanket washes with low-VOC washes (vegetable-based or terpenes, made from citrus products).		☐	☐	☐	H M L
	Collect and recycle blanket washing liquid from press buckets. Recycle this liquid on-site or off-site.		☐	☐	☐	H M L
Roller Washing	Substitute high-VOC solvent-based roller washer with low or non-VOC wash-up solutions (e.g. vegetable-based).		☐	☐	☐	H M L
	Recycle parts cleaner either on-site or off-site.		☐	☐	☐	H M L

Post-press

Process	Pollution Prevention Opportunities	Type of activity	In Place?			What level of priority do we put on implementing this measure? (High, Medium, or Low)
			Yes	No	N/A	
Binding	Switch to high-solids and low-VOC glues.		☐	☐	☐	H M L

	Low-cost, good operating procedures		Choosing an alternative chemical		New technology or system

Maintenance, Management, and Good Housekeeping

Process	Pollution Prevention Opportunities	Type of activity	In Place? Yes	No	N/A	What level of priority do we put on implementing this measure? (High, Medium, or Low)		
Purchasing and Inventory	Review suppliers' products regularly to look for the most environmentally-responsible products		☐	☐	☐	H	M	L
	Keep an accurate inventory of products used.		☐	☐	☐	H	M	L
	Store chemicals according to need, with minimum inventory kept on hand.		☐	☐	☐	H	M	L
	Order ink in containers sized for minimum storage time to reduce waste from expired inks.		☐	☐	☐	H	M	L
Cleaning	Substitute less harmful products, such as water-based biodegradable cleaners (no-VOC or low-VOC) or use recyclable solvents.		☐	☐	☐	H	M	L
	Keep track of solvent use by department to identify sources of excessive use and waste.		☐	☐	☐	H	M	L
	Improve manual cleaning practices:							
	• Do not soak rags or cloths in solvent.		☐	☐	☐	H	M	L
	• Use squeeze bottles.		☐	☐	☐	H	M	L
	• Use squeegees and shaped scrapers to remove ink before cleaning with solvent (this reduces how much solvent you need).		☐	☐	☐	H	M	L
	Do not allow rags to dry before being placed in collection cans and keep lids on cans to stop the VOCs from going into the air. Launder (on-site or off-site) and reuse rags that have been used for cleaning to recover solvent.		☐	☐	☐	H	M	L

 Low-cost, good operating procedures	 Choosing an alternative chemical	 New technology or system

Process	Pollution Prevention Opportunities	Type of activity	In Place? Yes	No	N/A	What level of priority do we put on implementing this measure? (High, Medium, or Low)
	Use soap instead of solvents for general cleaning, or cover floors and machine exteriors with paper, plastic or strippable chemical coating.		☐	☐	☐	H M L
	Use other cleaning methods that reduce solvent usage:					
	• Automatic washing systems with automatic wipers or cloth strips.		☐	☐	☐	H M L
	• Dry ice blasting to remove dried ink (similar to sand blasting).		☐	☐	☐	H M L
	• Baking soda blasting to remove ink from anilox rollers. Baking soda is not hazardous, so rinse water can be disposed in the sewer system.		☐	☐	☐	H M L
	• Water-based systems with high-frequency vibrations remove ink from anilox rollers.		☐	☐	☐	H M L
Solvent Recovery	Use a rag centrifuge. When rags are spun, solvent is whisked from the rags. Solvent is collected and can be reused.		☐	☐	☐	H M L
	Use a solvent still to reclaim and recycle used solvent (i.e. solvent is separated from other contaminants). This works well for lithographic printers because only one type of solvent is used for cleaning.		☐	☐	☐	H M L
Storage	Store chemicals according to manufacturer's recommendations.		☐	☐	☐	H M L
	Keep ink containers tightly covered at all times. Properly stored ink prevents skin from forming on the ink and reduces air emissions and waste ink.		☐	☐	☐	H M L
	Keep lids on processing solution tanks to stop		☐	☐	☐	H M L

 Low-cost, good operating procedures	 Choosing an alternative chemical	 New technology or system

Process	Pollution Prevention Opportunities	Type of activity	In Place? Yes	No	N/A	What level of priority do we put on implementing this measure? (High, Medium, or Low)		
	chemical vapours from entering the air.							
	Eliminate all open buckets. Provide solvent in easily used, closed containers.		☐	☐	☐	H	M	L
	Date ink cans when opened to ensure you use them before they expire. Recycle ink pails and cans when they are scraped clean.		☐	☐	☐	H	M	L
	Mark all containers to identify the contents to avoid improper handing or disposal.		☐	☐	☐	H	M	L
Training	Train workers to follow the standard work procedures (such as cleaning and set up), good housekeeping, and correct material handling methods to make sure all operators follow the same steps to reduce chemical use and waste.		☐	☐	☐	H	M	L
Spills	Post a spill response plan so that it is available for all employees.		☐	☐	☐	H	M	L
	Make spill kits available at the chemical storage rooms or racks for easy access.		☐	☐	☐	H	M	L
Other	Ask employees for P2 suggestions.		☐	☐	☐	H	M	L

Contact us to provide your feedback on this resource or to suggest any additional pollution prevention resources (email chemtrac@toronto.ca or call 416-338-7600).

	Low-cost, good operating procedures		Choosing an alternative chemical		New technology or system

More Resources

Alberta Environment. 1997. Waste Minimization Manual: Printing and Publishing Industry. http://environment.gov.ab.ca/info/library/6263.pdf

- *Waste minimization suggestions for printing and publishing companies.*

CleanPrint Canada. 1999. Checksheet for Printers. http://www.envisioncompliance.com/pdf/CleanPrint_Check.pdf

- *A tool to be used by printers to help implement a pollution prevention program.*

Eco-Efficiency Centre. Fact Sheet: Eco-Efficiency in the Printing Industry. http://eco-efficiency.management.dal.ca/Files/Business_Fact_Sheets/Microsoft_Word_-_printing_fs.doc.pdf

- *Suggestions for changes in printing workplace practices, behaviours and technologies to improve a business's environmental and economic performance.*

Northeast Waste Management Officials' Association (NEMWOA). 2006. Pollution Prevention Technology Profile: Computer-to-Plate Lithographic Printing. http://www.newmoa.org/prevention/p2tech/DirectToPlateProfile.pdf

- *An overview of computer-to-plate (CTP) lithographic printing technologies, focusing on the environmental issues related to CTP and potential benefits.*

Pollution Prevention Assistance Division, Georgia Department of Natural Resources. Sector Assessments: An Analysis of Pollution Prevention Opportunities and Impediments in the Printing and Publishing Industry Sector in Georgia. http://www.p2ad.org/documents/ma_printing.html

- *An Analysis of Pollution Prevention Opportunities and Impediments in the Printing and Publishing Industry Sector in Georgia.*

OCETA. Toronto Region Sustainability Program (TRSP) - Case Studies. http://www.oceta.on.ca/TORSUS/

- *Ten case studies are provided on the TRSP website. Each case study highlights one printing company that has undergone a pollution prevention assessment. Assessment findings and P2 recommendations are included.*

U.S. EPA. 1995. Profile of the Printing Industry – Sector Handbook. http://www.epa.gov/Compliance/resources/publications/assistance/sectors/notebooks/printing.html

- *A detailed description of the printing industry, including an industrial process description, chemical release and transfer information, and pollution prevention opportunities.*

U.S. EPA. 1990. Guides to Pollution Prevention: The Commercial Printing Industry. http://www.epa.gov/ttn/chief/old/ap42/ch04/s09/reference/bref11_c04s09_ch2_1995.pdf

- *Identification and analysis of waste minimization methodologies for commercial printers. A detailed technical guide with some dated information.*

Additional relevant resources include:

General P2 Resources

Environment Canada. Pollution Prevention Planning Handbook. http://www.ec.gc.ca/NOPP/DOCS/P2P/hbook/En/index.cfm

- *Detailed information about general pollution prevention planning processes and techniques.*

Do-it-Yourself P2 Tools

Canadian Centre for Pollution Prevention. Environmental Accounting Online Training Tool. http://learning.c2p2online.com/

- *A training tool designed to familiarize participants with the steps and tools available for identifying and estimating the costs and benefits associated with pollution prevention options identified during the pollution prevention planning process.*

P2 Database and Resource Centres

Canadian Pollution Prevention Information Clearinghouse (CPPIC)
http://www.ec.gc.ca/cppic/en/index.cfm

- *An online database that provides access to pollution prevention resources for specific sectors.*

U.S. EPA: Office of Pollution Prevention and Toxics - Design for the Environment (DfE) Program Publications http://www.epa.gov/opptintr/dfe/pubs/index.htm#lithoclean

- *DfE Program publications include a variety of information to help printers operations that are more environmentally sound, safer for workers, and more profitable.*

Certifications

EcoLogo Program. http://www.ecologo.org/en/