Pollution Prevention Technology Profile

Computer-to-Plate Lithographic Printing

November 7, 2006

Introduction

The purpose of this Technology Profile is to provide an overview of computer-to-plate (CTP) lithographic printing technologies in order to raise awareness of its potential to reduce chemical use and the generation of hazardous waste and wastewater. This profile focuses on the environmental issues related to CTP, also known as direct-to-plate lithographic printing systems, as well as the potential benefits when compared to traditional lithographic printing systems. The Profile provides information about the two main categories of CTP technology: thermal and visible light. Information about chemistry-free and process-free plates is also included. The profile outlines a recent equipment advance - all-in-one systems that both image the plate and print. The Profile contains the following sections:

Note: that this Technology Profile is not intended to be an "endorsement" of these technologies. The appropriateness of the use of a particular CTP technology should be determined on a facility-specific basis. Potential users should contact officials in the state in which the facility is located to determine the state-specific regulatory requirements that could apply. A listing of state contacts in the Northeast is located at the end of this profile.

Lithographic Printing Background

Lithographic printing involves imparting an image onto a plate and then transferring the image onto the substrate, usually paper, via an off-set printing process. Off-set means that the plate and the paper never actually touch, but instead an intermediary roller, known as the blanket is used to take the ink from the plate and then transfer it to the substrate. In a sheet-fed press, the substrate is fed through the press as single sheets, whereas in a web-fed press, the substrate is one continuous roll that is cut later, during post-press operations. Computer-to-plate technology emerged in the 1990s and has been successfully adopted by many large lithographic printing operations. However, penetration into smaller companies has been more limited.

The on-press and post-press operations are basically the same with the traditional and the CTP process. The difference is in the pre-press preparation – essentially in the plate-making operation. The traditional pre-press preparation of the image plates requires a significant amount of time to complete and includes the use of hazardous materials and the generation of hazardous wastes. CTP technology significantly shortens prepress plate preparation, and reduces or eliminates the use of hazardous chemicals and waste generation. However, with most CTP processes, there are still potential environmental and regulatory concerns that should be evaluated and addressed.

Overview – Traditional Lithographic Prepress Process[1,2]

The traditional prepress operation involves assembling the text and/or images in the desired format, typically on a computer and then using photographic techniques to produce a film negative. The film is usually plastic and covered with a light-sensitive coating – a silver halide emulsion. The image is projected onto the film, and then the film is developed to produce a negative from which a printing plate is made. When the exposed film is immersed in the developer solution, the silver halide emulsion is converted to metallic silver in proportion to the amount of exposure it receives. Development is stopped by immersing the film in a sodium thiosulfate fixing bath. Once fixed, the film is rinsed with water and the silver in the non-image area is washed off. A separate film is made for each color to be used on the press.

Traditional plates are made of aluminum or a plastic sheet that is coated with a light-sensitive material that chemically changes to become receptive to ink when exposed to light. The photographic negative and light are used to impart the image onto the plate using a piece of equipment known as an imagesetter. A separate plate is made for each color to be used on the press. Ink adheres to the plate where it is exposed to light (the image area) and does not adhere to the areas of the plate where the plate was not chemically changed (non-image). The plates are then developed. Over time the developing solution can weaken and requires the addition of a replenisher. Eventually the developer is “spent” and must be replaced. Developer chemistry requires frequent monitoring. Typically, maintenance of the processor is performed when the developer is changed out. After fixing and developing, a gum finisher is typically applied to the plate to protect the image - and the plate - during handling and printing.

Aluminum plates are generally more durable than polyester plates and therefore are usually more suitable for jobs that require a larger number of prints – over 20,000 copies. However, aluminum plates are generally more expensive to purchase than polyester plates. Aluminum plates are also better suited to high resolution printing. Polyester plates can produce good quality up to approximately a 175 line screen (uses 175 lines per inch to create the image’s dot pattern).

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[1] U.S. EPA, Profile of the Printing Industry, EPA Office of Compliance Sector Notebook Project, EPA-310-R-95-014, September 1995.
[2] U.S. EPA Region 1, Fit to Print – An Environmental Compliance and Pollution Prevention Manual for New England Lithographers, EPA-901-B-97-001, May 1997.

In the past, polyester plates had problems with stretching during the press run which distorts the image. However, more recent technology advances have overcome this problem.

Table 1 lists the typical wastes associated with traditional pre-press operations. With the exception of a few – cleaners, plate developer, used plates, shop towels and aerosol cans - they are all associated with the film-making process. The main waste of concern from conventional prepress operations is the waste fixer solution – it can contain silver concentrations in the range of 1,500 to 5,000 parts per million (ppm).[3] Due to the high value of silver, most large, and some medium size printers operate an on-site wastewater treatment system to recover it. Small printers usually drum waste fixer and send it to an off-site recycler.

Table 1: Summary of Pre-press Waste Generation[4]

Wastewater	Hazardous Waste	Air Emissions	Solid Wastes
❖ Used, treated fixers ❖ Used developers ❖ Used activators/ stabilizers ❖ Plate developer ❖ Rinse water	❖ Chrome-based system cleaners ❖ Non-empty aerosol cans ❖ Discarded-unused or outdated chemicals ❖ Used, untreated fixers ❖ Used shop towels* ❖ Proofing system chemicals	❖ Volatile organic compounds (VOCs) or toxics emitted from film cleaners ❖ VOCs or toxics emitted from proofing system solvents	❖ Empty containers ❖ Developed or out-dated film ❖ Out-dated materials ❖ Used or damaged plates ❖ Used, empty aerosol cans ❖ Used shop towels*

* Check for state-specific requirements on how shop towels can be handled.

Overview – Computer-To-Plate Lithographic Printing

Computer-To-Plate (CTP) eliminates the use of film to transfer the image to the plate. As the name implies the image is transferred directly from the computer to the plate without the intermediary film-making and imaging steps. CTP involves two components – the plate and the platesetter, as well as the computer hardware and software to run the system. The platesetter receives the image from the computer and imparts it onto the plate. The plate then has the image that is printed onto the substrate. Generally, plates are either made from aluminum or polyester and have a silver halide or photopolymer emulsion coating.

A CTP platesetter uses a laser to change the coating on the plate either physically or chemically. There are two main types of CTP platesetters, thermal and visible light - referring to the type of laser technology used. Thermal CTP technology changes the plate physically by either hardening the image areas or removing the non-image areas (known as ablation). Visible light CTP technology, commonly referred to as violet CTP, changes the plate chemically and the coating in the non-image area is washed from the plate. As with the traditional process, a separate plate is made for each color to be used on the press. In traditional and CTP lithographic

[3] Vermont Agency of Natural Resources, Department of Environmental Conservation, Environmental Assistance Division, <u>A Printer's Guide to Vermont's Environmental Regulations</u>, Fall 1997.
[4] U.S. EPA Region 1, <u>Fit to Print – An Environmental Compliance and Pollution Prevention Manual for New England Lithographers</u>, EPA-901-B-97-001, May 1997.

printing, making the plate is a significant cost, and that cost is fixed no matter how many copies a client wants – the cost per piece decreases as the quantity increases.[5]

CTP Technologies

As stated above, there are two main CTP technologies – visible light and thermal. Chemistry-free, process-free and direct imaging processes do not require a developing or finishing step and are a subset of thermal technologies. When deciding which type of system to use, and then which specific system to purchase, the printer should examine the relative costs and benefits in several areas:

- compatibility with the type of plates used on the press – or ability of press to accommodate different plates
- capital costs - equipment purchase, physical space requirements and associated cost, and installation costs, including new computer and/or software needs
- maintenance costs – reliability, calibration requirements/frequency, and service agreement costs
- material costs – plate costs, as well as chemical costs
- waste disposal costs
- labor costs
- potential to increase revenue – number of plates produced

Visible Light Systems – visible light systems were the first type of CTP technology available and are most closely related to film-based systems. As such, many visible light systems still rely on silver halide coatings, on the plate rather than the film, and still require a fixing or a pre-heat and washing step that produces silver-bearing wastes – although in smaller quantities than in a film process. And the plates must still be developed and finished, similar to the traditional film process. Photopolymer plates are now available for visible light CTP. However, all visible light systems must be operated in an environment where ambient light is tightly controlled – exposure to unwanted light can ruin a plate. Therefore, light-based systems can have a greater difficulty producing consistent plate quality than thermal systems, and fine detail is not as exact at the edges. Visible light systems can generally produce good quality up to approximately a 200 line screen. Visible light systems tend to have lower purchase costs than thermal systems because the laser technology is less costly. Violet laser diodes are the same as those that operate in DVD players - they operate at low energy – most have the capacity to operate at 30-60 milliwatts. Visible light systems are also known as violet systems because virtually all of them operate with a violet laser diode. Violet lasers tend to require less frequent replacement than thermal lasers and system maintenance requirements also tend to be lower.

Thermal Systems – thermal systems use heat to image the plate – once the temperature threshold of the plate is reached, the plate is altered in that spot. There is no overexposure, although plates still require developing and finishing, similar to the traditional film process. Thermal systems do not require that ambient light is controlled – daylight in the prepress area is not a problem.

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[5] CTP differs from digital printing. In digital printing, prints are made directly from the computer without the use of intermediary plates – processes such as offset, inkjet, and toner-based (similar to color photocopying). Digital printing is most suitable for smaller quantities as there is no economy of scale – printing costs are the same for each sheet no matter how many you produce.

Thermal systems can do finer detail more sharply – they can accommodate line screens greater than 200. Thermal lasers operate at much higher energy than violet systems – thermal laser technology can operate in the range of 20-70 watts. Thermal lasers have a higher cost than violet lasers, increasing the capital cost of the system. Thermal lasers tend to require more frequent replacement and system maintenance requirements are greater, often significantly. Plates that work with thermal lasers are typically more expensive than plates for violet systems. Some thermal plates require a pre-heat step before developing.

<u>Chemistry-Free, Process-Free and Direct Imaging Systems</u> - Chemistry-free is a variation of thermal CTP systems where the plate is not developed imaging. Most chemistry-free plates do not require finishing either, but some could still need the gum finisher to protect the image. There is considerable interest in chemistry-free systems for two reasons:

- ❖ Efficiency – the plate does not require developing, and most do not require finishing, eliminating prepress steps. The more steps that are eliminated, the more throughput can be increased and labor requirements decreased. In addition, every production step introduces an opportunity for error. Therefore, eliminating production steps reduces the potential for quality errors.
- ❖ Environmental - chemical use and waste generation are virtually eliminated with chemistry-free systems, lowering purchasing and disposal costs, and regulatory concerns. In addition, worker health and safety concerns are reduced.

The chemistry-free plate is typically aluminum with a special coating that the laser alters in the image area and the plate is rinsed with water. The washout unit might apply a finishing gum to prepare the plate prior to installation on the press. Chemistry-free CTP systems are commercially available from numerous vendors, but are not in widespread use at this time. Plate sizes up to 32 by 44 inches can be accommodated in the currently-available chemistry-free CTP systems. There are a variety of trade-offs to consider when evaluating chemistry-free systems compared to thermal CTP systems where the plates are developed:

- Chemistry-free laser imaging requires more laser energy, so the equipment cost and associated maintenance are greater.
- The cost of chemistry-free plates is higher than for plates that are developed. Generally the number of plates that can be imaged per hour is less than for plates that are developed.
- The durability of the image on chemistry-free plates can also be lower, with plates not maintaining good quality over 100,000 prints.
- However, there can be no chemical purchase or disposal costs which can offset the higher plate cost. And plate development equipment is not needed, freeing up space and lowering operation and maintenance costs.

Process-free systems take chemistry-free systems a step further. The image plates in process-free systems need no rinsing at all. After imaging the unaltered coating on the plate does not require removal or development, so no by-products are generated. The plate moves directly from imaging to the press; further reducing production steps and improving the potential for increased productivity. With process-free systems there is no process water stream that must be managed. However, the plates and imaging equipment tend to be more expensive and complex than chemistry-free systems.

An emerging process, known as Direct Imaging (DI), combines process-free CTP and the offset printing process in one compact piece of equipment. The entire process is automated with no handling of the plates between imaging and printing. Polyester plates are imaged and advanced and mounted on the print cylinders automatically. Therefore, errors associated with misalignment of a plate on the cylinder are eliminated. Blanket cleaning and ink roller resetting are also fully automated. Up to 50 jobs can be queued and the machine moves automatically from one to the next, significantly reducing the time between printing individual jobs. Makeready time and associated paper waste is reduced with the automated system as well.

Plate size is a constraint with DI systems which are currently limited to sheet sizes of a maximum of approximately 13 by 18 inches. DI systems are considered best for shops with a high volume of full color jobs that do not require large printed size and are in quantities of less than 20,000.

Regulatory Requirements[6]

The main benefit of CTP technology is that there is no more film processing chemicals or associated wastes. However, with the exception of chemistry- and process-free systems, thermal and visible light CTP processes still require development of the plate. The plate development step does generate some chemical waste that must be managed properly, as discussed below. In addition, the imaging of thermal plates, including some chemistry- and process-free plates can create air emissions that could be of concern. Used plates and filters must be evaluated to determine if they are a hazardous waste and subject to regulation under RCRA, or that they are a non-hazardous waste that can be disposed in the regular trash. Aluminum plates should be recycled.

<u>Plate Development</u>

Both thermal and violet systems can require plate development. However, not all plates require development. When the plate development process is required, the waste developer generally has a pH of 9.8 to 13.5. Wastes with a pH above 12.5 are considered hazardous wastes under RCRA. If the pH is at or above 12.5, a neutralization system must be used, or the waste must be managed as hazardous waste subject to all the storage, shipment, and administrative requirements of RCRA. Even if the pH is less than 12.5, most local wastewater treatment facilities, also known as publicly-owned treatment works (POTWs) require wastewater discharges to have a pH between 6 and 9, and therefore neutralization treatment is still needed. State agencies and/or POTWs often require notification or a permit for discharges. Printers should contact both the state environmental agency and their local POTW to determine any requirements.

An elementary neutralization process is not considered hazardous waste treatment under RCRA, but the state environmental authority might require notification or a permit. Printers should contact their state environmental agency to determine their requirements for neutralization systems. If the printer uses an evaporator, they cannot send it developer wastes with a pH greater than 12.5. Otherwise, they are illegally treating hazardous waste unless they obtain a RCRA Part B hazardous waste treatment permit.

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[6] Jones, Gary and Mark Flannery, *Environmental Compliance and CTP Systems*, GATFWorld, October 2004, pages 41-44.

The different CTP systems and their associated wastes that are of potential concern, in addition to the plate development wastes discussed above are discussed below.

Visible Laser Plates Using Silver Halide
The effluent from a visible light silver halide process will contain silver in metallic form (not complexed with thiosulfate as it is in conventional film processing). Effluents with silver concentrations above 5 parts per million (ppm) are classified as a hazardous waste under RCRA. In addition, discharging silver to the sewer is regulated by local POTWs, and discharge limits can be lower than 1 ppm. Therefore, the effluent must be treated to remove silver prior to discharge, typically with the use of particulate filters. If the printer uses an evaporator, they cannot send it effluent with a silver concentration above 5 ppm.

Thermal Laser Plates Using Ablation
Ablation is the process of removing the coating from the plate, typically the portion that is not part of the image. This laser process results in particulate and off-gases that must be properly vented and filtered. The units come with a filter, but the system must be adequately maintained and the filter properly disposed. The air emissions from the unit can be strictly regulated and might require a permit from the state environmental agency. Printers should contact their state environmental agency to determine if you need an air permit or to modify an existing one. Some thermal ablation plates also require developing, and some do not. If the plate requires developing, then the considerations associated with that process must be addressed as outlined previously.

Benefits
There are numerous potential benefits associated with CTP when compared with traditional plate-making including: significantly increased productivity; improved print quality; reduced water and chemical use and material purchases; and reduced environmental concerns. Each of these is discussed below.

Improved Productivity: The main motivator for adopting CTP technology is the increase in productivity. Prepress operations under the traditional process required a significant amount of time; particularly for the imagesetting process. CTP eliminates many of the steps required for prepress preparation. For example, one facility reported that they reduced prepress time from an average of 2 hours down to 45 minutes using CTP.[7] The plate-making process itself is also faster with CTP producing 20 to 60 plates per hour, depending on the machine. Since less work is required to produce a plate with CTP, fewer employees are needed to do the same printing job, reducing labor costs. CTP allows a job to be produced faster, reducing turnaround time for the client – increasing customer satisfaction.

The fewer steps that are required between imaging the plate and printing, the less time is required, and the higher productivity can be. Table 2 summarizes the plate making process steps associated with various CTP systems.

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[7] Massachusetts Office of Technical Assistance, *The J.M. Perrone Company Toxics Use Reduction Case Study*, April 2005

Table 2: Plate Making Process Steps[8]

CTP Type	Step 1	Step 2	Step 3	Step 4	Step 5
Pre-Bake Thermal*	Image Plate	Pre-Bake	Develop Plate	Finish	Print
Visible-Light	Image Plate	Fix or Pre-Heat/Wash	Develop Plate	Finish	Print
Thermal	Image Plate	Develop Plate	Finish	Print	
Chemistry-Free	Image Plate	Water Wash	Print		
Process-Free	Image Plate	Print			

* Can also include two additional steps for long-run printing – between steps 4 and 5 can also have a Post-Bake step and a second Finish step before printing.

Improved Print Quality: Another factor prompting the adoption of CTP technology is that the plate image is often improved when compared to the film process. There is less variation in the quality of plate-imaging, particularly for thermal systems. Imaging plates from film can produce "dot gain" where the size of dots increased. By eliminating film imaging, the associated dot gain distortion is eliminated and print quality is improved. Film can get scratched or physically damaged. Film can also be damaged by dust or other ambient artifacts. For example, film can be affected by temperature and humidity changes creating problems on the press. With CTP there can be less rework, again reducing time and costs and increasing customer satisfaction.

Reduced Water and Chemical Use and Material Purchases: Eliminating the film processing step significantly reduces chemical needs and associated purchase costs. Most of prepress chemical and water use is for film development; however, most CTP systems still require plate development. The cost of purchasing and disposing of film is also eliminated.

Reduced Physical Space Needs: CTP systems do not require the floor space for the imagesetter that traditional systems need. In addition, because film negatives are not produced, storage space for the films of active and past jobs is eliminated. Physical space needs for chemistry-free and process-free systems are less than systems that require a developing step. Floor space needs are further reduced by DI systems, which combine the platesetter and printing press into one compact machine.

Reduced Environmental Concerns: Eliminating the film development process removes the largest source of silver in wastewater. Therefore, the sliver recovery process is no longer needed. However, many CTP systems are not without environmental concerns as discussed in the regulatory requirements section.

Improved Work Environment: Eliminating the film development process reduces chemical use and potential worker exposure and health effects. This can improve employee moral and productivity.

Concerns

There are some potential concerns associated with CTP systems when compared with traditional film-based systems, mainly increased cost and technology requirements.

[8] Modified from, John Zarwan, *CTP Plate Making: Understanding the Real Costs*, Figure 3, Page 4, 2003.

Cost: The primary barrier to adopting CTP technology is its capital cost. Generally, visible light systems cost less than thermal systems due to the cost of the laser technology involved. Smaller less sophisticated visible light systems can cost under $50,000 and larger sophisticated thermal systems $100,000 and up. However, as more of the early CTP adopters upgrade their systems, good used systems are becoming available for a lower upfront investment. Plates for CTP systems tend to be slightly more expensive than traditional plates.

Increased Technology Needs: A CTP system is more complex than an imagesetter, requiring equipment to be networked, specialized software, and hardware with adequate electronic file storage for all the digital files. In addition, getting a customer's digital file to work properly can take time and requires that the printer be trained on the use of all the different software that their customers use. These increased technology needs can require expertise that the printer might not initially have. However, storing digital images can be more efficient than storing film, which can require large amounts of physical space.

Case Study – The J.M. Perrone Company[9]

The J.M. Perrone Company is an integrated printing and direct mail marketing firm that employs 125 people. Their conventional film-based prepress operations were labor intensive and had high overhead costs. The company decided to convert to a chemistry-free CTP system to lower overhead and payroll costs and improve employee safety, product quality, and turn-around time. J.M. Perrone purchased a Presstek Dimension 400 CTP imaging system that uses the thermal ablation imaging process and thermal anodized aluminum plates.

Results

- Production time reduced on average from two hours to 45 minutes – a more than 60 percent increase in efficiency
- Improved print quality
- Film and chemical processing eliminated
- Chemical use reduced by 205 gallons per year
- Hazardous waste reduced by 2,370 pounds per year

Implementation Issues

- The press uses 10 percent more water on start-up when using CTP plates compared to the replaced conventional system – once running the press operates similar to other plates

Costs/Savings:

- Saves $1,595 per year in chemical purchase costs
- Saves $9,469 per year in hazardous waste disposal costs
- Saves $80,000 per year in purchase costs for silver-based film
- Reduced production time per job is estimated to save $31.50 per hour not spent

[9] Massachusetts Office of Technical Assistance, *The J.M. Perrone Company Toxics Use Reduction Case Study*, April 2005.

- Plate costs similar to plates used with their old conventional system

Contacts for More Information

Resources and Vendors

Mention of any company, process, product name, or website should not be considered an endorsement by NEWMOA, NEWMOA member states, or U.S. EPA.

Agfa Corp.
www.agfa.com/en/gs/index.jsp
Ridgefield Park Regional Office
100 Challenger Road
Ridgefield, NJ 07660
Tel: (201) 440-2500

Agfa Graphic Systems provides commercial, newspaper and packaging printers with an extensive range of workflow automation, project management, computer-to-film, computer-to-plate and proofing solutions. Graphic Systems produces analog plates as well as thermal, visible light, and chemistry-free digital plates. Agfa offers visible light, thermal and chemistry-free CTP.

Creo, A subsidiary of Kodak
http://graphics.kodak.com
3700 Gilmore Way
Burnaby, British Columbia V5G 4M1 Canada
Tel: (604)-451-2700

Kodak's Graphic Communications Group offers a full range of computer-to-plate (CTP) systems for any type or size of printer. Kodak's Graphic Communications Group also offers a range of plates that integrate with both thermal and violet CTP devices, as well as a new non-process thermal plate.

ECRM
www.ecrm.com
554 Clark Road
Tewksbury, MA 01876
Phone: 978-851-0207 Fax: 978-851-7016

ECRM has developed visible-light and thermal platemakers, including the Mako CTP and DesertCat families of platesetters. ECRM offers high quality violet platesetters with a low cost of ownership.

Escher-Grad Technologies, Inc.
www.escher-grad.com/corp.html
1375 32nd Avenue
Montreal, Quebec, H8T 3H2

Canada
Tel : (514) 636-3195

Escher-Grad produces a range of laser sources used in the graphic arts industry, including high-power infra-red lasers, thermal lasers, visible light lasers, laser-diodes (IR, red, violet), and high-power ultraviolet lasers. Escher-Grad was the first to use inexpensive laser-diodes in high-quality, high-resolution imaging and, when violet laser-diodes became available, Escher-Grad was the first to apply violet laser-diodes to CTP.

Heidelberg USA, Inc.
www.us.heidelberg.com/www/html/en/content/overview1/products/pp_ov
1000 Gutenberg Drive
Kennesaw, GA 30144
Tel: 888-472-9655

Heidelberg Prepress offers a range of CTP and workflow solutions, including the Quicksetter Polyester Family of platesetters, the Prosetter Violet Family of platesetters and the Suprasetter Thermal Family of platesetters.

Presstek
http://www.presstek.com
55 Executive Drive
Hudson, NH 03051
Tel.: (603) 595-7000

Presstek Inc. is a developer and manufacturer of digital laser imaging and chemistry-free plate technologies for the printing and graphic arts industries. Presstek invented and brought to market the world’s first chemistry-free on-press (DI) and off-press (CTP) platemaking process. Presstek’s digital plate products for CTP applications include Anthem, Applause, and PEARLdry. Plates are available in 2-, 4-, and 8-page formats. PEARLdry Plus plates are available for DI Press applications.

RIPit North America
www.ripit.com/ripitnahome.html
7920 Alta Sunrise Dr., Ste. 250
Citrus Heights, CA 95610
Tel: 888-947-4748

RIPit produces platesetters that use a violet laser diode to produce high quality, long running metal printing plates. Other CTP systems output high resolution polyester plates, film and color accurate proofs.

State Technical Assistance Programs

In Connecticut: Kim Trella Department of Environmental Protection 79 Elm Street Hartford, CT 06106 (860) 424-3242 kim.trella@po.state.ct.us	**In Maine:** Peter Cooke Department of Environmental Protection 17 State House Station Augusta, ME 04333 (207) 287-6188 peter.cooke@maine.gov
In Massachusetts: Scott Fortier Office of Technical Assistance 100 Cambridge Street, Suite 900 Boston, MA 02114 (617) 626-1090 scott.fortier@state.ma.us	**In New Hampshire:** Paul Lockwood Department of Environmental Services 6 Hazen Drive Concord, NH 03301 (603) 271-2956 plockwood@des.state.nh.us
In New Jersey: Ruth Foster Department of Environmental Protection 401 East State Street, PO Box 423 Trenton, NJ 08625 (609) 292-3600 ruth.foster@dep.state.nj.us	**In New York:** Dennis Lucia Department of Environmental Conservation Pollution Prevention Unit 625 Broadway Albany, NY 12233-8010 (518)-402-9469 djlucia@gw.dec.state.ny.us
In Rhode Island: Richard Enander Department of Environmental Management 235 Promenade Street Providence, RI 02908 (401) 222-4700, ext. 4411	**In Vermont:** Paul Van Hollebeke Department of Environmental Conservation 103 South Main Street Waterbury, VT 05671 (802) 241- 3629 paul.vanhollebeke@state.vt.us
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The Northeast Waste Management Officials' Association (NEMWOA) is a nonprofit, nonpartisan interstates organization that addresses regional waste and pollution prevention issues. The membership is composed of state environmental agency directors of the hazardous waste, solid waste, waste site cleanup, pollution prevention and underground storage tank programs in Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont. NEWMOA provides a forum for increased communication and cooperation among the member states, a vehicle for the development of unified position on various issues and programs, and a source for research and training.