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Guides to Pollution Prevention

Wood Preserving Industry

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November 1993

GUIDES TO POLLUTION PREVENTION:
Wood Preserving Industry

RISK REDUCTION ENGINEERING LABORATORY
AND
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NOTICE

This guide has been subjected to U.S. Environmental Protection Agency peer and administrative review, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the U.S. Environmental Protection Agency, nor does mention of trade names, commercial products, or processes constitute endorsement or recommendation for use.

This document is intended as advisory guidance only to the wood preserving industry in developing approaches for pollution prevention. Compliance with environmental and occupational safety and health laws is the responsibility of each individual business and is not the focus of this document.

Worksheets are provided for conducting waste minimization assessments of wood preserving plants. Users are encouraged to duplicate portions of this publication as needed to implement a waste minimization program.

FOREWORD

This guide provides an overview of the wood preserving industry and presents options for minimizing waste generation through source reduction and recycling. Treatment with both oilborne and waterborne preservatives is discussed in this guide. However, because, in the United States, the majority of wood is treated with chromated copper arsenate, the guide focuses on waterborne preservatives.

Process wastewater, surface runoff water, and sludge are possible sources of contamination in the wood preserving industry, although in waterborne processes the majority of wastewater is reused. Process wastewater includes water from conditioning, kiln drying, treated wood washing, accumulations in doors or retort sumps, preservative formulation recovery, and rinsing. Surface runoff water flows from nonprocess areas, such as treated wood storage yards. Sludge consists of oil-water emulsions, water/debris mixtures, and wood debris. Reducing the amount of this waste will benefit both the wood preserving industry and the environment.

ACKNOWLEDGMENTS

This guide is based in part on waste minimization assessments (Waste *Minimization Practices at Two CCA Wood-Treatment Plants)* conducted by Battelle for the U.S. Environmental Protection Agency (EPA). Battelle expanded the CCA waste minimization report under subcontract to EPA (USEPA Contract 68-CO-0003) to produce this guide. Battelle personnel contributing to the guide include Bob Olfenbuttel, work assignment manager; Leslie Hughes, task leader; Abraham Chen, technical engineer; and Bea Weaver, production editor.

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SECTION 1
INTRODUCTION

This guide is designed to provide the wood preserving industry with waste minimization options. It also provides worksheets for carrying out waste minimization assessments. The guide is intended for use by the wood preserving industry and regulatory agency representatives, industry suppliers, and consultants.

In the following sections of this manual you will find:

- A profile of the wood preserving industry and the processes used in it (Section 2)
- Waste minimization options for the industry (Section 3)
- Waste minimization assessment worksheets (Section 4)
- Appendices, containing
  - — Case studies of waste generation and waste minimization practices of three facilities
  - — Where to get help: sources of useful technical and regulatory information

The worksheets are the result of updating and expanding a CCA waste minimization study by Battelle (Chen and Olfenbuttel 1993). Waste generation and management practices were surveyed, and potential waste minimization options were identified.

Overview of Waste Minimization

Waste minimization is a policy specifically mandated by the U.S. Congress in the 1984 Hazardous and Solid Waste Amendments to the Resource Conservation and Recovery Act (RCRA). As the federal agency responsible for writing regulations under RCRA, the U.S. Environmental Protection Agency (EPA) has an interest in ensuring that new methods and approaches are developed for minimizing hazardous waste and that such information is made available to the industries concerned. This guide is one of the approaches EPA is using to provide industry-specific information about hazardous waste minimization. The options and procedures outlined can also be used in efforts to minimize other wastes generated in a business.

In the working definition used by EPA, waste minimization consists of source reduction and recycling. Of the two approaches, source reduction is usually considered preferable to recycling. While a few states consider treatment of waste an approach to waste minimization, EPA does not; and thus treatment is not addressed in this guide.

Facility Planning for Pollution Prevention

With the Pollution Prevention Act of 1990, the U.S. Congress established pollution prevention as a "national objective." To encourage the adoption of pollution prevention measures in industry, EPA published the *Facility Pollution Prevention Guide* (USEPA 1992) as a successor to the *Waste Minimization Opportunity Assessment Manual* (USEPA 1988), which was a general manual for waste minimization. The *Waste Minimization Opportunity Assessment Manual* explained how to conduct waste minimization assessments and develop options for reducing the amount of hazardous waste generated at a facility.

The *Facility Pollution Prevention Guide* expands *the* scope of the *Waste Minimization Opportunity Assessment (WMOA) Manual* to emphasize "multimedia" pollution prevention. It explains the management strategies needed to incorporate pollution prevention into company policies and how to establish a company-wide pollution prevention program, conduct assessments, implement options, and make the program an ongoing one. It is intended to help small- to medium-sized production facilities develop broad-based, multimedia pollution prevention programs. Methods of evaluating, adjusting, and maintaining the program are described. Later chapters deal with cost analysis for pollution prevention projects and with the roles of product design and energy conservation in pollution prevention. Appendices consist of materials that will support the pollution prevention effort such as assessment worksheets and sources of additional information.

The method described in the WMOA Manual is generally the same as the method for carrying out facility pollution prevention planning. It is a systematic procedure for identifying ways to reduce or eliminate waste. The four phases of a waste minimization opportunity assessment are planning and organization, assessment, feasibility analysis, and implementation. The steps involved in conducting a waste minimization assessment are outlined in Figure 1 and presented in more detail below. Briefly, the assessment consists of a careful review of a facility's operations and waste streams and selection of specific areas to assess. After a particular waste stream or area is established as the WMOA focus, a number of options with the potential to minimize waste are developed and screened. The technical and economic feasibility of the selection options are then evaluated. Finally, the most promising options are selected for implementation.

PLANNING AND ORGANIZATION PHASE

Essential elements of planning and organization for a waste minimization program are getting management commitment for the program, setting waste **minimiza**ion goals, and organizing an assessment program task force.

ASSESSMENT PHASE

The assessment phase involves a number of steps:

- Collect process and facility data
- Prioritize and select assessment targets
- Select assessment team
- Review data and inspect site
- Generate options
- Screen and select options for feasibility study.

Collect Process and Facility Data

The waste streams at a facility should be identified and characterized. Information about waste streams may be available on hazardous waste manifests, National Pollutant Discharge Elimination System (NPDES) reports, routine sampling programs, and other sources.

Developing a basic understanding of the processes that generate waste at a facility is essential to the WMOA process. Flow diagrams should be prepared to identify the quantity, types, and rates of waste generating processes. Also, preparing material balances for the different processes can be useful in tracking various process components and identifying losses or emissions that may have been unaccounted for previously.

Prioritize and Select Assessment Targets

Ideally, **all** waste streams in a facility should be evaluated for potential waste minimization opportunities. With limited resources, however, the facility manager may need to concentrate waste minimization efforts in a specific area. Such considerations as quantity of waste, hazardous properties of the waste, regulations, safety of employees, economics, and other characteristics need to be evaluated in selecting target streams or operations.

Select Assessment Team

The team should include people with direct responsibility for and knowledge of the particular waste stream or area of the facility being addressed. Equipment operators and people involved in routine waste management should not be ignored.

Review Data and Inspect Site

The assessment team evaluates process data in advance of the inspection. The inspection should follow the target process from the point where raw materials enter to the point where products and wastes leave. The team should **identify** the suspected sources of waste. This may include the production process, maintenance, operations, and storage areas. The

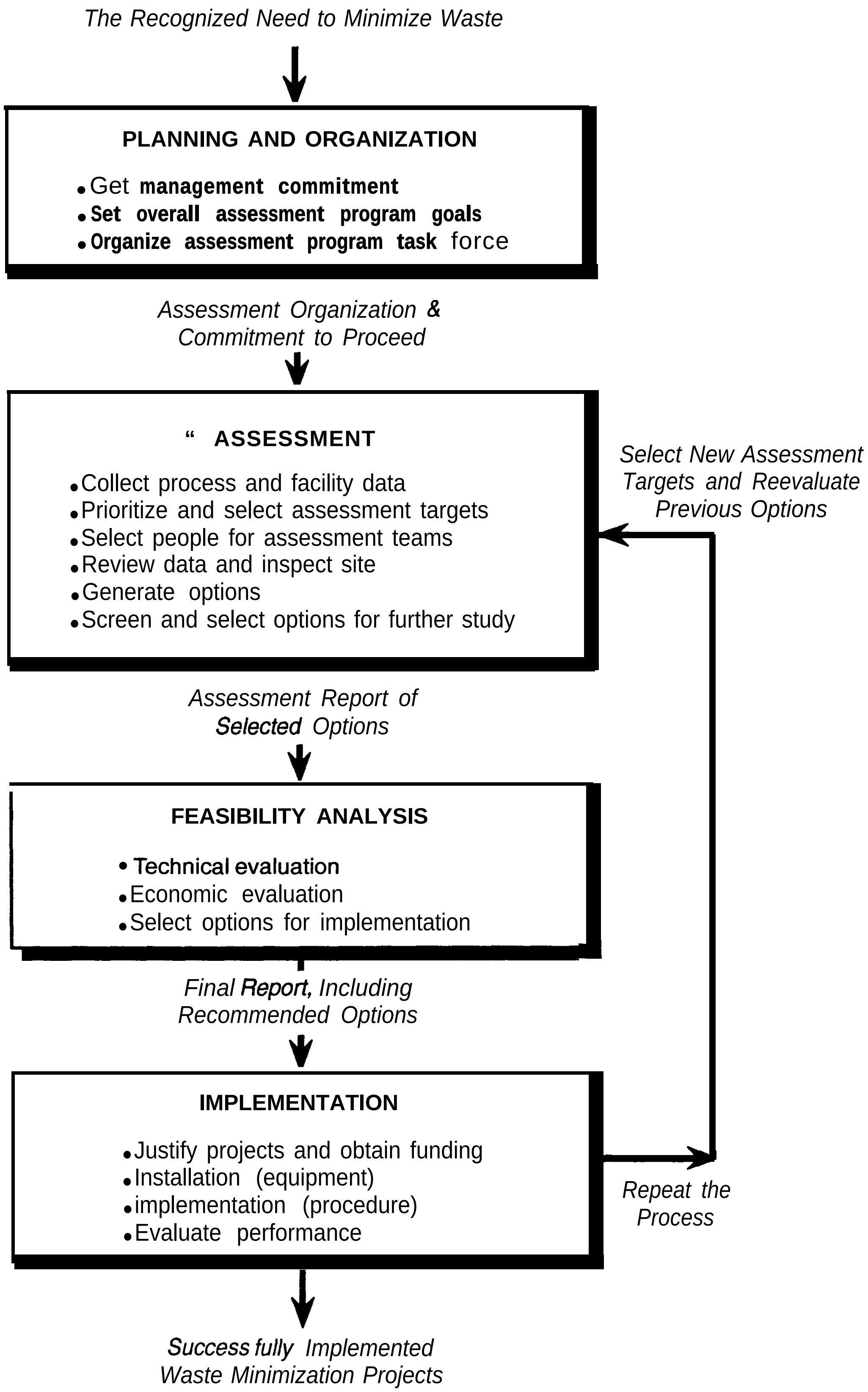

Figure 1. Waste Minimization Assessment Procedure

inspection may result in the formation of preliminary conclusions about waste minimization opportunities. Full confirmation of these conclusions may require additional data collection, analysis, and/or site visits.

Generate Options

The objective of this step is to generate a comprehensive set of waste minimization options for further consideration. Since technical and economic concerns will be considered in the later feasibility step, no options are ruled out at this" time. Information from the site inspection, as well as trade associations, government agencies, technical and trade reports, equipment vendors, consultants, and plant engineers and operators may serve as sources of ideas for waste minimization options.

Both source reduction and recycling options should be considered. Source reduction may be accomplished through good operating practices, technology changes, input material changes, and product changes. Recycling includes use and reuse of water, solvents, rinsates, and other recyclable materials, where appropriate.

Screen and Select Options for Further Study

This screening process is intended to select the most promising options for a full technical and economic feasibility study. Through either an informal review or a quantitative decision-making process, options that appear marginal, impractical, or inferior are eliminated from consideration.

FEASIBILITY ANALYSIS PHASE

An option must be shown to be technically and economically feasible to merit serious consideration for adoption at a facility. A technical evaluation determines whether a proposed option will work in a specific application. Both process and equipment changes need to be assessed for their overall effects on waste quantity and product quality. A major concern is the impact of any proposed changes on the product license. Minor changes may be implemented rather easily, but major changes may require review and approval of the revised process. The time required for this activity may make some options impossible.

An economic evaluation is carried out using standard measures of profitability, such as payback period, - return on investment, and net present value. As in any project, the cost elements of a waste minimization project can be broken down into capital costs and operating costs. Savings and changes in revenue and waste disposal costs also need to be considered, as do present and future cost avoidances. In cases of increasingly stringent government requirements, actions that may increase the cost of production may be necessary.

IMPLEMENTATION PHASE

An option that passes both technical and economic feasibility reviews should be implemented. The project can be turned over to the appropriate group for execution while the WMOA team, with management support, continues the process of tracking wastes and identifying other opportunities for waste minimization. Periodic reassessments may be conducted to see if the anticipated waste regulations were achieved. Data can be tracked and reported for each implemented idea in terms such as pounds of waste per production unit. Either initial investigations of waste minimization opportunities or the reassessments can be conducted using the worksheets in this manual.

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SECTION 2
PROFILE OF THE WOOD PRESERVING INDUSTRY

Industry Description

The wood preserving industry in the United States is over a hundred years old. Preserved wood is used primarily in the construction, railroad, and utilities industries to prevent rotting when wood is exposed to damp soil, standing water, or rain and as protection against termites and marine borers. While wood may be treated with either oilborne or waterborne preservatives, over the years the industry has turned more and more to waterborne preservatives. In 1988, 23 percent of the wood treated in the United States was treated with oilborne preservatives. The volume of wood treated with waterborne preservatives was 75 percent. Table 1 shows the volume of wood treated in 1988 by product and type of preservative. Approximately 600 million cubic feet of wood are treated with wood preservatives and fire retardants each year (USEPA 1992).

Process Description

Historically, the wood-preserving industry has used three major preservative systems: creosote, pentachlorophenol (PCP), and waterborne inorganic. Creosote and pentachlorophenol are the major oilborne preservatives used in the industry. These organic preservatives are used primarily for older processes, such as for treating crossties, crossarms, and utility poles. The most commonly used inorganic (waterborne) preservatives are chromated copper arsenate (CCA) and ammoniacal copper-zinc-arsenate (ACZA).

Creosote is an oily, translucent, brown to black liquid. It is applied either at full strength or diluted with petroleum oil or coal tar. Creosote is denser than water and is produced from the high temperature carbonization of bituminous coal. It contains approximately 85 percent polynuclear aromatic hydrocarbons (PAHs), 10 percent phenolic compounds, and 5 percent nitrogen-, sulfur-, or oxygen-containing heterocycles.

Technical grade PCP contains

- PCP (85 to 90 percent)
- 2,3,4,6- tetrachlorophenol (4 to 8 percent)
- higher chlorophenols (2 to 6 percent)
- dioxins and furans (O. 1 percent).

CCA and ACZA derive, in part, from arsenic acid, copper oxide, and chromic acid. Table 2 shows the standardized formulations of CCA and ACZA and the ranges in proportion of the chemical compounds they contain.

Creosote was first used in the 1870s to treat crossties with a full-cell treatment process, which was developed in 1838. The first waterborne preservative (acid copper chromate) was used in 1929, and soon afterward a new oilborne preservative (pentachlorophenol) was introduced in 1931. Before the end of the decade, two more waterborne preservatives (CCA and ammoniacal copper arsenate) were developed (Barnes and Nicholas 1992).

The majority of wood treated with waterborne preservatives is treated with CCA. CCA is shipped to treating plants as a 50 or 60 percent concentrate, which is stored in a concentrate storage tank and, when needed, is diluted with water in a work tank to 1 to 2 percent.

Wood can be preserved with creosote, PCP, and waterborne preservatives using pressure treating processes. Non-pressure treating processes can also be used for some preservatives but are not used to treat wood with CCA. Standard treatment specifications for various commodities and wood products are found in the American Wood Preservers' Association *Standards (1992).*

PRESSURE TREATING PROCESSES

Treatment in a pressure cylinder (Figure 2) is the preferred commercial approach for preserving wood. Pressure treating processes include full-cell or modified full-cell processes and the empty-cell process.

Table 1. Production of Treated Wood in the United States, 1988[a]

	Volume of Wood Treated (1,000 cu ft)			
Products	Creosote solutions	Pentachloro-phenol	Waterborne preservatives	Fire retardants
Crossties	56,990	780	—	—
Switch and bridge ties	6,315	—	—	
Poles	14,675	41,778	14,738	—
Crossarms	122	1,229	122	—
Piling	3,734	108	5,859	—
Fence posts	1,242	1,356	9,805	—
Lumber	3,113	1,251	350,220	5,283
Timbers	2,850	1,283	40,884	—
Plywood	—	17	8,732	3,956
Other products	1,441	68	20,206	991
Total products 1988	90,482	47.870	450,566	10,230
Total products 1987[d]	97,822	48,557	418,984	10,618

[a]Estimate based on reported production of 476 treating plants plus estimated production of 100 nonreporting plants. 1987 production data added for comparison.
[b]Creosote, creosote-coal tar, and creosote-petroleum.
[c]CCA, ACZA, ACC, and CZC.
'Wood Preservation Statistics, 1987.
Source: USEPA 1992.

The full-cell process is used to obtain maximum retention of preservative. The empty-cell process is used to obtain deep penetration, with relatively low retention of preservative. Waterborne preservatives are generally applied by the full-cell or modified full-cell processes. For treatment with oilborne preservatives, the empty-cell process is used whenever possible.

In the full-cell (Bethel) pressure treating process, an initial vacuum is applied to remove air from the cylinder and the wood cells. Preservative is then transferred to the cylinder through piping from the preservative work tank without breaking the vacuum. Hydrostatic or pneumatic pressure is applied until the preservative permeates the wood or until the desired retention is obtained. The excess preservative is returned to the work tank for reuse. Preservative temperatures during the pressure period usually do not exceed the temperatures specified below:

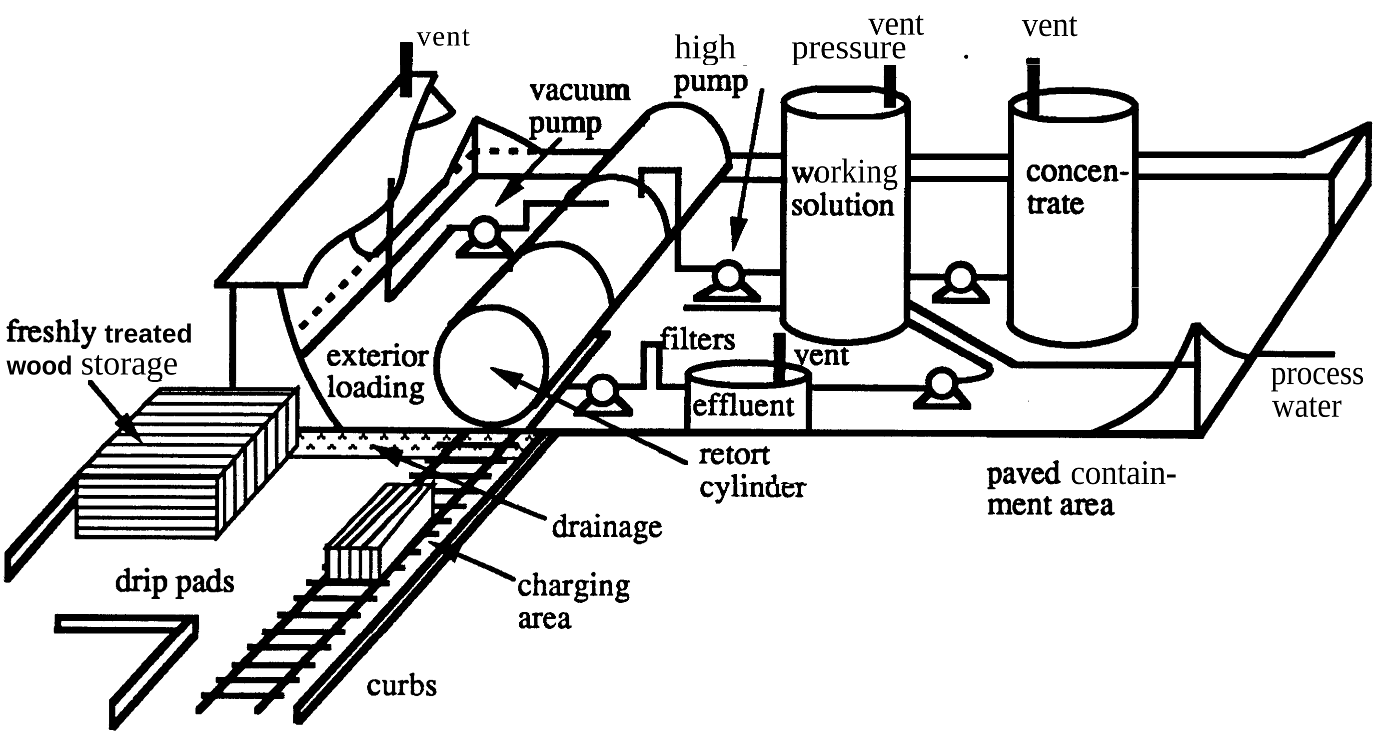
Oilborne Preservatives	2OO-21O"F
Waterborne Preservatives	
ACZA	150°F
CCA	Ambient

A final vacuum may be applied to remove excess preservative. The treated wood is removed from the cylinder and placed on a drip pad where it remains until dripping has ceased. For waterborne preservatives, all solution dripping onto the pad, as well as washdown water, flows to a collection sump. It is then transferred to a dilution water tank. The dilution

Table 2. CCA and ACZA Formulations

Preservative	Compound (%)			
	Chromium (VI) as CrO_3	Copper as Cuo	Zinc as ZnO	Arsenic as As_2O_5
CCA				
Type A				
Standard	65.5	18.1		16.4
Range	59.4-69.3	16.0-20.9		14.7-19.7
Type B				
Standard	35.3	19.6		45.1
Range	33.0-38.0	18.0-22.0		42.0-48.0
Type C				
Standard	47.5	18.5		34.0
Range	44.5-50.5	17.0-21.0		30.0-38.0
ACZA				
Standard		50.0	25.0	25.0
Range		45.0-55.0	22.5-27.5	22.5-27.5

Source: American Wood Preservers' Association 1992



Source: USEPA 1992

Figure 2. Waterborne Wood Preservative Pressure-Treating Facility

water is blended with additional concentrate to make fresh treating solution.

The modified full-cell process differs from the full-cell process in that lower levels of initial vacuum are used. The amount of vacuum is determined by the wood treated and the final retention desired.

Two empty-cell processes are commonly used. In the Rueping empty-cell process, air under pressure is forced into the treating cylinder. Air penetrates the wood before preservative is transferred to the cylinder. Pressure is raised until the desired amount of preservative has been absorbed. Surplus preservative is removed from the wood with a final vacuum. The process is the same in the Lowry empty-cell process, except no initial pressure is applied. In both processes, air compressed in wood drives out part of the preservative absorbed during the pressure period when pressure is released (USDA 1987).

Prior to treatment, wood is usually seasoned in the open air or conditioned in the cylinder. Wood is sometimes incised to increase preservative penetration. Open air drying is used to prepare large stock (i.e., cross ties, poles) for treatment with organic (oilborne) preservatives. Kiln drying is used primarily for waterborne treatment. Steaming, heating, and vapor drying are methods for conditioning wood prior to treatment with oilborne preservatives (USDA 1987).

NON-PRESSURE TREATING PROCESSES

Non-pressure treating processes include thermal; cold soak; and brush, dip, and spray methods. In the thermal process, wood is immersed in hot preservative (such as creosote or PCP) for several hours, followed by soaking at ambient temperature. In cold soaking, wood is immersed in a preservative (e.g., PCP) solution at ambient temperature. In the brush, dip, and spray methods, liquid preservative oil is applied to wood surfaces (USEPA 1992).

Waste Description

Figure 3 and Table 3 show possible sources of pollution from oilborne and waterborne preservative treatment processes, respectively. Waste generated includes process wastewater, surface runoff water, and/or sludges.

Process wastewater includes wastewater from conditioning (retort condensate), kiln drying, treated wood washing, accumulations in doors or retort sumps, preservative formulation recovery, and rinsing. Surface runoff water flows from non-process areas such as treated wood storage yards. Plants treating wood with oilborne preservatives produce large quantities of wastewater, including process water and surface runoff water. Waterborne processes produce little or no process wastewater because drips, rainwater collected in process areas, and water used to clean drip pads are directed to a sump and reused to make fresh working solution. As a result, no contaminated water is discharged as hazardous waste.

Sludges produced by wood-treating plants consist of oil-water emulsions or polymers, bark, sawdust, dirt, wood chips, and debris. The sludges, dirt, and solid waste collected from the drip pads, rail trench, cylinder door pits, and screens to the floor sumps are drummed for disposal at a hazardous landfill. However, landfill disposal is becoming an environmental issue, and restrictions may soon preclude this disposal option (Barnes and Nicholas 1992).

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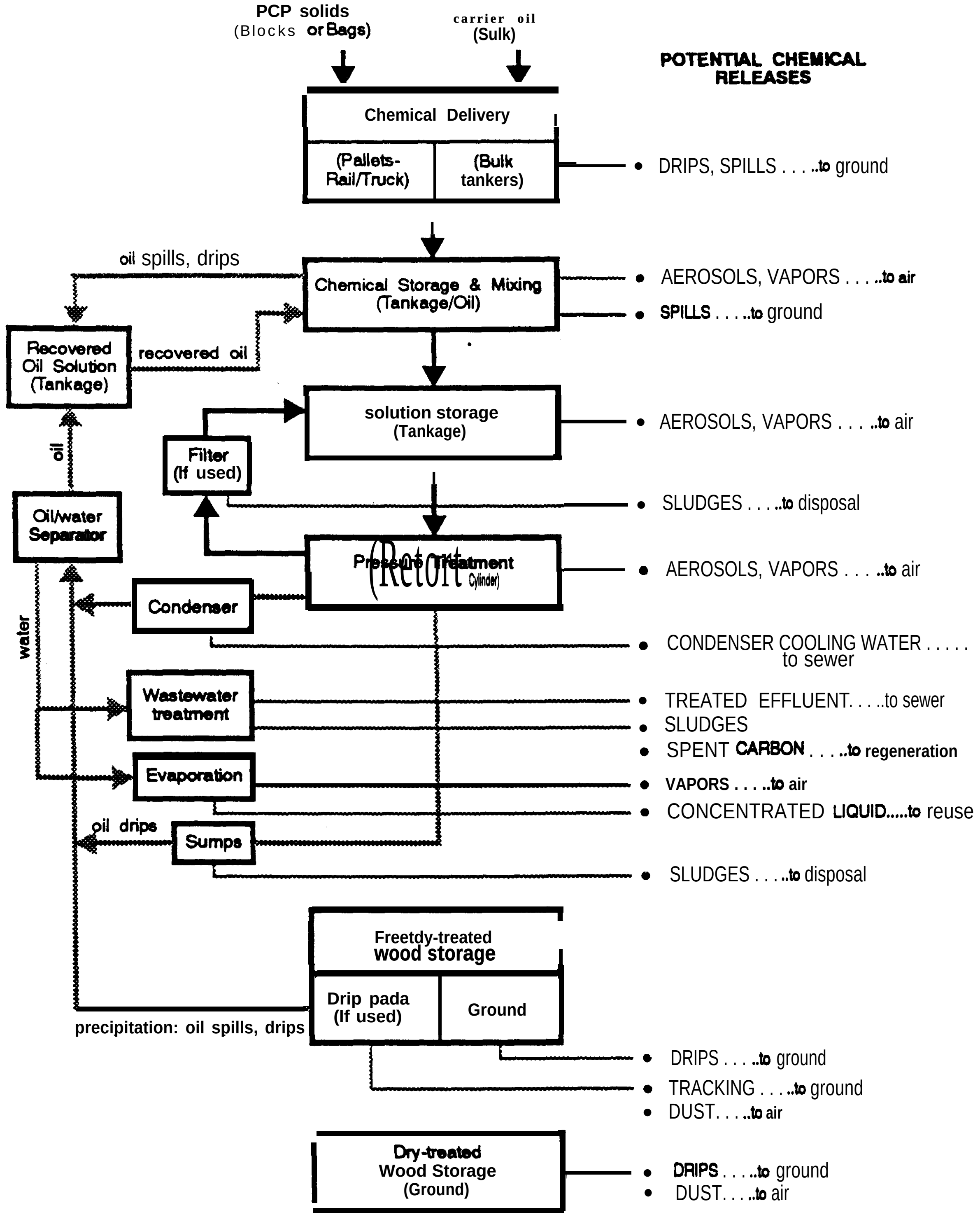


Source: Robert S. Kerr Environmental Research Laboratory
Ada, Oklahoma

Figure 3. Possible Sources of Pollution from Oilborne Preservative Treatment Processes

Table 3. Possible Sources of Pollution from Waterborne Preservative Treatment Processes

Source of Pollution	Potential Chemical Release	Chemical Release Through/ From	Receiving Medium
Chemical delivery by tanker	Drips and spills	Tanker hoses and quick coupler	Drip pad
Chemical concentrate storage	Aerosols and vapors	Process tank or concentrate vent	Air
	Spills	Pipes and valves	Concrete floor
Chemical mixing	Aerosols and vapors	Process tank or work tank vent	Air
	Spills	Pipes and valves	Concrete floor
Working solution storage	Aerosols and vapors	Process tank or work tank vent	Air
	Spills	Pipes and valves	Concrete floor
Pressure treating process			
-Initial vacuum	Aerosols and vapors	Process tank or work tank vent	Air
-Flooding via vacuum	Aerosols and vapors	Process tank or work tank vent	Air
-Pressure treating	Aerosols and vapors	Cylinder door	Air
	Drips	Cylinder door	Door pit
-Pressure relief and blow back	Aerosols and vapors	Process tank or work tank vent	Air
-Final vacuum	Aerosols and vapors	Process tank or work tank vent	Air
-Door opening	Aerosols and vapors	Cylinder door	Air
	Drips	Cylinder door	Door pit
Freshly treated wood storage on drip pad	Drips	Treated wood units	Drip pad
	Dust	Drip pad	Air
Wood storage in open storage yard	Storm water runoff and seepage	Treated wood units	Ground
	Dust	Storage yard	Air

SECTION 3
WASTE MINIMIZATION OPTIONS FOR THE WOOD PRESERVING INDUSTRY

Introduction

Keeping abreast of improved technology will assist the wood preserving industry to identify options to minimize waste. Information sources include trade journals, chemical and equipment suppliers, equipment expositions, conferences, and industry association newsletters. Advancing technology provides economical alternatives that can lead to reduced waste generation and a more cost-efficient operation.

Hazardous waste, worker health and safety, and other environmental and safety requirements change continually at the federal, state, and local levels. The wood preserving industry must keep up to date on these changes and maintain flexibility regarding waste management options.

In 1990 EPA established three new categories of hazardous waste that affect wood treatment plants using PCP, creosote, or inorganic preservatives containing arsenic or chromium. The EPA designated wastewater, process residuals, preservative drippage, and spent formulations from wood preserving processes using these three types of preservatives as hazardous waste. New regulations for the wood preserving industry also establish standards for drip pads.

Recycling and Source Reduction Options

Waterborne preservatives produce less waste than oilborne preservatives because process wastewater is reused rather than discharged. Therefore, waterborne processes significantly reduce waste. In addition, well designed treatment plants, good treatment practices, effective housekeeping, and employee training also help reduce waste at the source. Properly handling and storing preservatives and preservative-treated wood will minimize waste as well as the amount of time spent on waste management.

TREATMENT PLANT DESIGN

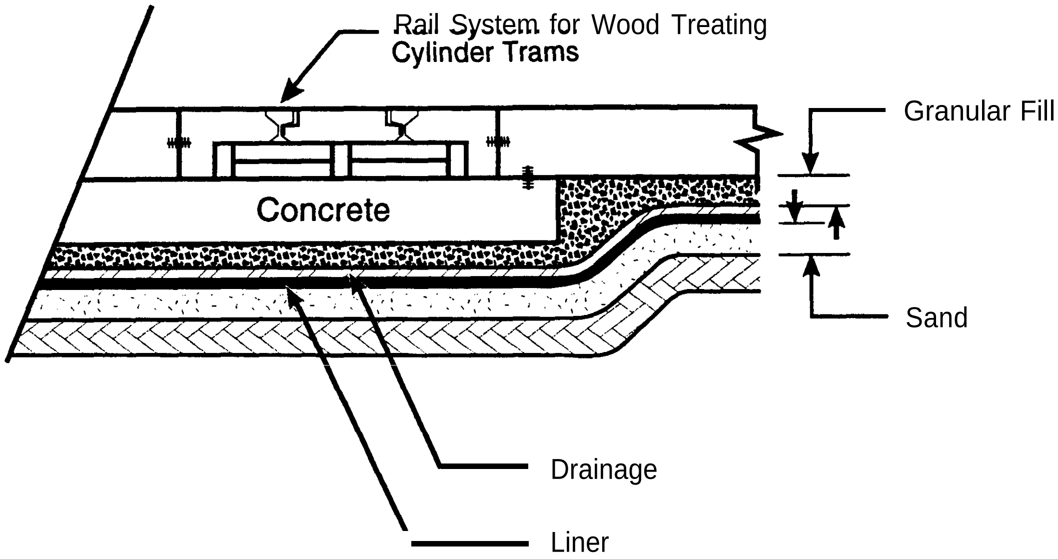
Well designed treatment plants may have enclosed treatment buildings, covered drip pads with liners, automatic lumber handling systems, centralized tank farms with spill containment, and air ventilation systems. Material handling needs based on the commodity produced are important in designing treatment plants. For example, automatic lumber handling systems are not used in a pole-treating operation.

Enclosed treatment buildings protect chemicals, treating facilities, freshly treated wood, and drip pads from direct exposure to ambient weather conditions, thereby reducing possibility of chemical contamination of the environment (Chen and Olfenbuttel 1993).

Covered drip pads with liners (Figure 4) significantly reduce preservative contamination to the surrounding areas. Drip pads intercept chemicals dripping from cylinder doors and from fleshly treated lumber. Drip pads with containment walls or with a recessed floor design increase the likelihood that preservative drips and spills will be contained. Appropriate drip pad slope prevents dripping or spilled preservative from leaving the pad area.

The new Resource Conservation and Recovery Act (RCRA) standards established by the EPA for drip pads (*Federal Register* 1992) require that

- Existing concrete drip pads must be sealed, coated, or covered with a surface material to contain drippage in accordance with 40 CFR 264.573
- New drip pads must have coatings, sealers, or covers that meet the requirements of 40 CFR 264 or be equipped with a liner and leakage detection and collection system
- Drip pad surfaces must be free of cracks, gaps, corrosion, or other deterioration



Adapted from Midgette and Boyer 1992

Figure 4. Drip Pad with Liner

- Drip pads must be cleaned in a manner and frequency to allow weekly inspections

Elevated drip pans on top of drip pads can be used to intercept chemicals dripping from the cylinder door and from freshly treated lumber. The use of elevated drip pans provides additional protection to the surrounding areas.

Automatic lumber handling systems and power rollers for lumber loading and unloading may decrease direct contact between people and preservatives and between equipment (forklifts) and preservatives. As a result, preservatives are not as likely to be transferred outside controlled areas as they are with conventional rail-tram systems.

Plants can be designed so that all chemical tanks are located in a separate area with adequate containment to assure preservative is retained, especially in case of catastrophic failure such as tank rupture and waterline failure. The capacity of containment should be at least equivalent to 150 percent of the liquid stored in the largest chemical tank. Further, using elevated chemical tanks makes it easier to detect leaks.

Provisions should be made to permit transferring preservatives from chemical tankers to concentrate tanks on drip pads or in confined areas. An industry-standard quick coupler or hookup should be used to prevent release of chemicals to uncontrolled areas.

Enclosed, computer-controlled mixing systems and remote monitoring reduce the amount of time workers need to be in the tank farm, eliminate worker exposure to chemicals, and reduce the possibility of transferring chemicals outside the mixing area.

Plants also can be designed to minimize mist or droplet emissions from cylinders and work tanks through the use of air exchange systems and cylinder and tank venting, although these are not required currently for CCA operations.

TREATMENT PRACTICES

Good quality control practices before treatment can reduce the quantity of sludge generated in the treating cylinder, chemical work tanks, or bag filters. Careful inspection of wood stock before treatment also reduces the quantity of unsalable, out-of-spec, or darnaged wood that may have to be disposed of as hazardous waste once it has been treated.

Wood stock that is clean prior to treatment prevents dirt, sawdust, and other debris from accumulating in the treatment system. Therefore, wood should be covered during shipment to reduce the amount of road dust and grime accumulated in transit. Failed or damaged lumber should be returned to the shipper to reduce waste volume. When necessary, lumber should be power-washed and wood chips and debris removed before it enters the treatment plant. The wood chips and debris removed can be disposed of as a nonhazardous waste.

Treatment process controls, such as the following, should be used to reduce dripping:

- Applying high pressure at 150 to 165 psi over a period of 5 to 8 minutes, followed by a slow pressure release of 8 to 15 minutes

- Avoiding excess pressure during treatment

- Applying a final vacuum.

Strip pumps continuously return residual chemical solutions to the work tank, resulting in less dripping when cylinder doors are opened. If treating cylinders are tilted slightly toward the work tank, there is also less dripping when opening the cylinder doors.

Using a dedicated forklift at the drip pads (or washing the wheels of forklifts before they leave the drip pads) avoids the transfer of chemicals to adjacent areas and reduces the volume of dirt, gravel, and other debris tracked onto the pads. Paved areas adjacent to drip pads reduce the amount of dirt that enters the drip pad and treatment system. Holding treated wood on drip pads until dripping has ceased prevents contamination of surrounding areas. Covering wood dried in the open yard after treatment prevents exposure to sun and rainfall.

RECYCLING PRACTICES

Recycling is one of the most effective waste minimization options available to wood preservers. Liquid waste generated at plants using waterborne treatment processes can be reused as process solution. Solutions that drip onto drip pads, rain water collected in the process areas, and the water used to clean drip pads can be directed into a sump for transfer to storage tanks and reuse as diluent in fresh solutions.

Many recycling options are available at plants using oilborne preservatives. For example, steam condensate from creosote treatment can be used as boiler feedwater. In addition, creosote sludge can be used as boiler fuel.

Many waste items in a treatment plant can be recycled as useful materials. For example, metal and plastic banding used to fasten lumber can be recycled, as can the wooden crosspieces separating wood units. Wood trim and strips from milling operations can be used to produce byproducts. Empty wax totes and mold inhibitor containers can also be recycled.

HOUSEKEEPING PRACTICES

Housekeeping is an integral part of waste minimization efforts. The following housekeeping practices can decrease the amount of waste generated during wood treatment:

- Vacuum or manually sweep treatment building floors.

- Regularly inspect the concentrate tank, work tanks, automatic mixing system, treating cylinders, drip pads, lumber-handling equipment, and spill containment for spills and leaks.

- Intercept any chemical dripping when unloading preservative.

- Stack treated or untreated lumber neatly to prevent it from becoming damaged.

- Clearly mark recycling bins and containers.

- Keep drip pads and collection areas clean.

- Clean filters regularly.

- Clean sump pits and drip pads regularly.

- Line or coat sumps to prevent seepage.

- Dike major process areas (including tank farms and drip pads) to prevent migration or overflowing of solutions into adjacent soil.

- Triple rinse empty containers of waterborne preservative and reuse rinse water.

- Inspect storage yards daily; clean up any drippage detected within 24 hours.

TRAINING PRACTICES

All personnel who handle or treat lumber and who manage, maintain, or inspect hazardous waste should be adequately trained. A good operator training program reduces waste because well trained operators reduce the chance of improperly treated products or unnecessary darnage to treated products. In addition, well trained employees will recognize and report potential hazards and understand how to work safely with hazardous materials. Workers who handle preservatives should be trained in the use of protective clothing (such as boots, gloves, and air purifying respirators) to avoid personal exposure to or accidental release of hazardous materials.

STORAGE AND HANDLING PRACTICES

Simple precautions taken while handling and storing preservatives can eliminate the amount of waste requiring disposal or recycling. For example, preservative storage areas should be located at least 50 feet from the property line. Storage areas also should be covered, locked, labeled, and fenced to isolate the preservatives as much as possible. Containers should be kept closed and placed in a base that will contain leaks and spills. Concrete floors prevent contamination in the event of spills.

Containment capacity in storage areas should be at least equivalent to 150 percent of the total volume of the largest tank stored to eliminate possibility of chemical spills over uncontrolled areas. Leaks should be stopped and spills cleaned up as they occur.

Storage areas should be inspected routinely. Detection systems can be used to monitor for leakage. Elevated containers facilitate inspection and allow visual reference in case of a leak. Spills that contain free liquid can be managed by building a dike around the storage area. When dry, hazardous material should be placed in waste drums. If the spill is from a leaking waste drum, place the drum inside a larger recovery drum.

Excess waste should not be accumulated on site. Free liquid should be washed into the sump and reused. Solid waste should be placed in waste drums and disposed of appropriately.

DISPOSAL PRACTICES

Solid waste is generated when treatment solutions come into contact with soil, sawdust, or wood chips. Such waste may accumulate in work tanks, treatment cylinders, sump pits, drip pads, and filter bags.

Drip pads, trenches, and areas surrounding the cylinder doors should be cleaned in a manner and frequency to permit weekly inspection. Sludge, debris, and wood chips intercepted in the trench must be disposed of as hazardous waste.

Waste drums should be kept closed. They should be made of or lined with materials that will not react with or be incompatible with the waste to be stored. Rusting, leaking, or defective drums should not be used. Untreated wood scraps, rocks, banding, etc. should not be drummed with treatment sludge and contaminated soil because they can be disposed through ordinary trash collection or burial.

Solid waste for disposal in landfills must be packaged and labelled in accordance with applicable DOT regulation [49 CFR 173, 178, 179]). Landfills can only accept liquid containing arsenic and chromium if the liquids are treated/stabilized prior to landfilling.

Solidification/stabilization (S/S) is an option for disposing metal-contaminated waste such as CCA. While the data supporting S/S as an option for disposing waste show that the effectiveness of particular binders is dependent on the waste type, it remains a viable treatment option (Cartledge 1992). S/S has not been proven effective for organic waste.

Vitrification is also an option for disposing CCA waste. In the past, glass manufacturing operations added arsenic to assist in removing bubbles formed during the manufacture of glass products. This use of arsenic is obsolete, but the technology has promise for disposing of CCA-contaminated waste (Hnat, Patten, and Jian 1992).

PRESERVATIVE/PROCESS ALTERNATIVES

Waterborne preservatives produce less waste than oilborne preservatives because process water is reused.

Several other preservatives have been proposed as alternatives to the traditional preservatives. For example, wood can be treated with berates using pressure treatment or dip diffusion. However, because they are highly susceptible to leaching, berates cannot be used to preserve wood that will be in contact with the ground or exposed to the weather (e.g., decking) (Davis 1987).

Ammoniacal copper/quaternary ammonium (ACQ) is a proposed preservative. Initial above- ground field test data show that ACQ is effective for softwood and hardwood protection (USEPA 1993). Other alternative preservatives may include copper-8 -quinolinolate (Cu_8), copper naphthenate, zinc naphthanate, quaternary NH_4 compounds (QAC), "and zinc sulfate.

Treatment processes vary in their ability to minimize waste. For example, the empty-cell treatment process uses less carrier oil than the full-cell process for oilborne preservatives. The modified full-cell treatment process reduces the uptake of treating solution and minimizes the amount of dripping for waterborne preservatives (Barnes and Nicholas 1992).

Economic Considerations

In general, implementing waste minimization options will reduce cost of operations in the long run because of increasingly stringent regulations imposed on the industry. Because well designed treatment plants generate less waste, in some cases building a new plant may cost less than modifying an existing plant to meet new RCRA regulations. In other cases only drip pads will have to be upgraded or replaced.

Disposing sludge and solid waste currently costs about $400 to $500 per 55-gallon drum. Recycling is probably the most cost effective means of minimizing waste. Reusing waterborne preservative reduces the amount of preservative that must be purchased and eliminates waste disposal costs. In addition, a plant that produces 9,750 cubic yards of wood scraps could save $1,200 per year by arranging reuse of the scraps as raw material (Kirsch and Maginn 1992). Using tarps to cover wood during transportation could reduce disposal costs by about $600 to $800 a year.

Companies can also make money by recycling waste items, such as metal and plastic banding and empty totes. One major CCA wood preserving plant gets 3.5¢ per pound for metal banding and 8¢ per pound for plastic banding. The plant also receives a $50 rebate on wax tote refills.

Housekeeping improvements provide low cost opportunities for reducing waste. Employee training is another cost effective way to minimize waste.

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SECTION 4
WASTE MINIMIZATION ASSESSMENT WORKSHEETS

The worksheets provided in this section are intended to assist the wood preserving industry in systematically evaluating waste generating processes and in identifying waste minimization opportunities. These worksheets include only the assessment phase of the procedure described in the EPA *Waste Minimization Opportunity Assessment Manual* and the EPA *Facility Pollution Prevention Guide.* A comprehensive waste minimization assessment includes planning and organization, gathering background information, a feasibility study on specific waste minimization options, and an implementation phase. For a full description of waste minimization assessment procedures, refer to the *Facility Pollution Prevention Guide.*

Table 4 lists the worksheets that are provided in this section. After completing the worksheets, the assessment team should evaluate the applicable waste minimization options and develop an implementation plan.

Table 4. List of Waste Minimization Assessment Worksheets

Number	Title	Description
1.	Waste Sources	Form for listing potential sources of waste
2.	Waste Minimization: Treatment Plant Design	Questionnaire on design of overall treatment facility
3.	Option Generation: Treatment Plant Design	Options for improving plant design
4.	Waste Minimization: Treatment Practices	Questionnaire on pretreatment, treatment, and posttreatment of wood
5.	Option Generation: Treatment Practices	Options for minimizing treatment waste
6.	Waste Minimization: Housekeeping Practices	Questionnaire on housekeeping practices
7.	Option Generation: Housekeeping Practices	Options for housekeeping improvements
8.	Waste Minimization: Storage and Disposal Practices	Questionnaire on storing and disposing wood preservatives
9.	Option Generation: Storage and Disposal Practices	Options for storing and disposing preservatives

Plant ______	Waste Minimization Assessment	Prepared by ______
		Checked by ______
Date ______	Proj. No. ______	Sheet___ of ___ Page___ of ___

WORKSHEET
1A

WASTE SOURCES

Waste Source: Plant Design	Significance		
	Low	Medium	High
Poorly Designed Treatment Buildings			
Inadequate Drip Pads			
Inadequate Containment			
Inadequate Floor Sumps/Pits			
Inefficient Lumber Handling System			
Decentralized Storage of Concentrate and Working Solution			
Inefficient/inadequate Preservative Mixing System			
Inadequate Spill Monitoring			
Improperly Unloading Perservative Concentrates			
Unloading Preservative Concentrate in Uncontrolled Areas			
Other			
Waste Source: Treatment			
Inadequate Quality Control Practices			
Damaged or Failed Lumber			
Wood that is not Properly Conditioned			
Treatment Practices that Permit Excessive Dripping			
Inadequately Monitoring Treatment Process			
Other			
Waste Source: Housekeeping			
Leaks, Spills, and Drips			
Dirt and Sludge			
Wood Chips and Debris			
Runoff Water			
Dirty Floors and Drip Pads			
Careless Lumber Handling			
Other			

Plant ________	Waste Minimization Assessment	Prepared by ________
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Date ________	Proj. No. ________	Sheet ___ of ___ Page ___ of ___

WORKSHEET
1B

WASTE SOURCES (Continued)

Waste Source: Storage and Disposal	Significance		
	Low	Medium	High
Poorly Designed Storage Facilities			
Ineffective Containment Measures			
Defective Waste Drums			
Improper Storage and Mixing Practices			
Inadequate Inventory Control			
Lack of Containment in Storage Areas			
Other			

Plant ____________	Waste Minimization Assessment	Prepared by ____________
		Checked by ____________
Date ____________	Proj. No. ____________	Sheet ___ of ___ Page of

WORKSHEET

2A

WASTE MINIMIZATION: Treatment Plant Design

A. Treatment Building

Are treatment facilities enclosed? ☐ Yes ☐ No

What kind of floors are in the treatment area? ____

____

What type of containment is provided? ____

____

Does the containment have a total capacity equivalent to 150 percent of the volume of the largest chemical tank? ☐ Yes ☐ No

Do treatment facilities have a spill monitoring system? ☐ Yes ☐ No

B. Drip Pads

Are elevated drip pans used? ☐ Yes ☐ No

Do drip pads have liners and/or surface coatings? ☐ Yes ☐ No

Are drip pads cracked or deteriorated? ☐ Yes ☐ No

Are areas adjacent to drip pads paved? ☐ Yes ☐ No

Are chemicals tracked from the drip pad to surrounding areas? ☐ Yes ☐ No

Is there a dedicated forklift on drip pads? ☐ Yes ☐ No

C. **Lumber Handling**

How is wood moved into and out of treatment cylinders?

- Automatic conveying system ☐
- Forklift ☐
- Rail and tram ☐

Plant ______	Waste Minimization Assessment	Prepared by ______
		Checked by ______
Date ______	Proj. No. ______	Sheet___ of ___ Page___ of ___

WORKSHEET
2B

WASTE MINIMIZATION:
Treatment Plant Design

D. Preservative Mixing and Storage

Are preservative concentrate and working solutions stored in a centralized area? ☐ Yes ☐ No

Do mixing and storage areas have adequate containment? ☐ Yes ☐ No

Is preservative concentrate unloaded at a confined area with proper unloading devices? ☐ Yes ☐ No

How are preservatives mixed? ______

______

Would computer-controlled mixing systems reduce the amount of time workers need to be in the chemical storage area? ☐ Yes ☐ No

Are workers properly trained to handle hazardous materials? ☐ Yes ☐ No

E. Ventilating

How is the plant ventilated? ______

______

Is the plant designed to minimize emissions? ☐ Yes ☐ No

Are concentrate tanks, work tanks, and mixing tanks ventilated? ☐ Yes ☐ No

Plant ____	Waste Minimization Assessment	Prepared by ____
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WORKSHEET
3

OPTION GENERATION:
Treatment Plant Design

Meeting Format (e.g., brainstorming, nominal group technique) ____

Meeting Coordinator ____

Meeting Participants ____

Suggested Waste Minimization Options	Currently Done Y/N?	Rationale/Remarks on Option
A. Treatment Buildings		
Enclose Treatment Buildings		
Coat Concrete Floors with Impermeable Surface		
Provide Sufficient Primary and Secondary Containment		
Design Facilities so that Leaks and Spills are Immediately Evident		
B. **Drip Pads**		
Use Elevated Drip Pads		
Line Drip Pads		
Curb and Slope Drip Pad Area		
Pave Areas Adjacent to Drip Pads		
Use Stationary Forklifts at Drip Pads		
Seal, Coat, or Cover Drip Pads		
Add Leakage and Detection System		
C. Lumber Handling		
Use Automatic Lumber Handling System		
Use Dedicated Forklifts at Drip Pads		
D. **Preservative Mixing and Storage**		
Store Chemicals in a Centralized Area		
Use Enclosed, Computer-Controlled Mixing Systems		
Provide Containment Equivalent to 150 Percent of Total Volume of the Largest Task		
Provide Training Programs for Workers		
E. **Air Exchange/Venting**		
Use Air Exchange Systems		
Vent Cylinders and Tanks		

Plant ____	Waste Minimization Assessment	Prepared by ____
		Checked by ____
Date ____	Proj. No. ____	Sheet of Page of

WORKSHEET
4A

WASTE MINIMIZATION: Treatment Practices

A. BEFORE TREATMENT

Is wood covered during shipment? ☐ Yes ☐ No

Is untreated wood inspected? ☐ Yes ☐ No

Where is wood stored prior to treatment? ____

Is wood for poles cleaned prior to treatment? ☐ Yes ☐ No

Is wood seasoned or conditioned prior to treatment? ☐ Yes ☐ No

If so, how? ____

B. **DURING TREATMENT**

What preservatives are used in the treatment process? ____

Describe the treatment process used. ____

Are strip pumps used to return residual chemical solution to work tanks? ☐ Yes ☐ No

Is chemical retention monitored for proper treatment? ☐ Yes ☐ No

How is the treatment process monitored? ____

Plant ______	Waste Minimization Assessment	Prepared by ______
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Date ______	Proj. No. ______	Sheet ___ of ___ Page of

WORKSHEET
4B

WASTE MINIMIZATION: Treatment Practices

C. **AFTER** TREATMENT

How is wood dried following treatment? ______

How is treated wood transferred from drip pads to storage yard? ______

Where is wood stored following treatment? ______

Is wood covered when stored in an open yard? ☐ Yes ☐ No

Plant ______	Waste Minimization Assessment	Prepared by ______
		Checked by ______
Date ______	Proj. No. ______	Sheet ___ of ___ Page ___ of ___

WORKSHEET
5

OPTION GENERATION: Treatment Practices

Meeting Format (e.g., brainstorming, nominal group technique) ______
Meeting Coordinator ______
Meeting Participants ______

Suggested Waste Minimization Options	Currently Done Y/N?	Rationale/Remarks on Option
A. Before Treatment		
Inspect Untreated Wood		
Cover Wood During Shipment		
Clean Wood Prior to Treatment		
Season or Condition Wood Prior to Treatment		
B. **During Treatment**		
Use Treatment Process That Minimizes Dripping		
Monitor Chemical Retention		
Use Strip Pumps		
Avoid Excess Pressure During Treatment		
Use Dedicated Forklifts at Drip Pads		
Wash Tires of Nondedicated Forklifts Before Leaving the Drip Pad		
Pave Area Adjacent to Drip Pads		
C. After Treatment		
Keep Wood on Drip Pad Until Dripping Ceases		
Cover Wood in Open Storage Yards		
Store Wood in Enclosed Areas if Possible		
Avoid Tracking Preservative Out of Controlled Areas		

Plant ______	Waste Minimization Assessment	Prepared by ______
Date ______	Proj. No. ______	Checked by ______
		Sheet ___ of ___ Page of

WORKSHEET
6

WASTE MINIMIZATION: Housekeeping Practices

How is lumber stored? ______

How often are sump pits and drip pads cleaned? ______

How often are floors cleaned? ______

How often are filters cleaned? ______

How often are tanks checked for leaks? ______

How are leaks and spills handled? ______

Is chemical dripping intercepted? ☐ Yes ☐ No

Are recycling bins and containers clearly marked? ☐ Yes ☐ No

Are tanks kept clean? ☐ Yes ☐ No

How are empty preservative containers cleaned? ______

Is rinsewater reused? ☐ Yes ☐ No

Plant ______ Date ______	Waste Minimization Assessment Proj. No. ______	Prepared by ______ Checked by ______ Sheet of Page of

WORKSHEET
7

OPTION GENERATION:
Housekeeping Practices

Meeting Format (e.g., brainstorming, nominal group technique) ______
Meeting Coordinator ______
Meeting Participants ______

Suggested Waste Minimization Options	Currently Done Y/N?	Rationale/Remarks on Option
Stack Treated and Untreated Lumber Neatly		
Wash Down Sump Pits, Drip Pads, and Areas Around Cylinder Doors Regularly		
Clean Floors Regularly		
Clean Filters and Tanks Regularly		
Inspect Tanks, Drip Pads, and Treating Cylinders for Leaks Regularly		
Intercept All Chemical Drips and Leaks		
Mark Bins and Containers Clearly		
Use Filtration to Keep Tanks Clean		
Triple Rinse Empty Waterborne Preservative Containers		
Reuse Rinsewater as Process Water Diluent		

Plant ______	Waste Minimization Assessment	Prepared by ______
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WORKSHEET

8A

WASTE MINIMIZATION: Storage and Disposal Practices

How are preservatives stored? ______________________________

Are chemicals stored in a way that minimizes leaks and spills? ☐ Yes ☐ No

How are other materials (wax, mold inhibitors) stored? ______________________________

How far are preservative storage areas from the property line? ______________________________

Are hazardous chemicals stored separately from nonhazardous chemicals? ☐ Yes ☐ No

Are preservative storage areas isolated as much as possible? ☐ Yes ☐ No

Are chemicals protected from the weather? ☐ Yes ☐ No

How often are chemical inventories performed? ______________________________

What is the total capacity of containment? ______________________________

Do storage areas have leak detection systems? ☐ Yes ☐ No

Are storage areas inspected for leaks and spills? ☐ Yes ☐ No

How often are storage areas inspected? ______________________________

How are spills handled? ______________________________

How is liquid waste stored? ______________________________

How is solid waste stored? ______________________________

Plant ____	Waste Minimization Assessment	Prepared by ____
		Checked by ____
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WORKSHEET
8B

WASTE MINIMIZATION:
Storage and Disposal Practices

How are obsolete chemicals disposed? ____

How is liquid waste disposed? ____

How is solid waste disposed? ____

Do storage areas have concrete floors? ☐ Yes ☐ No

Waste Type	Quantity

Plant ____	Waste Minimization Assessment	Prepared by ____
		Checked by ____
Date ____	Proj. No. ____	Sheet ___ of ___ Page ___ of ___

WORKSHEET
9

OPTION GENERATION: Storage and Disposal Practices

Meeting Format (e.g., brainstorming, nominal group technique) ____

Meeting Coordinator ____

Meeting Participants ____

Suggested Waste Minimization Options	Currently Done Y/N?	Rationale/Remarks on Option
Locate Storage Facilities at Least 50 Feet From the Property Line		
Cover, Lock, Label, and Fence Storage Areas		
Keep Containers Closed		
Place Containers in a Base to Contain Leaks and Spills		
Store Hazardous Chemicals Separately from Nonhazardous Chemicals		
Install Concrete Floors		
Provide Containment Equivalent to 150 Percent of the Amount of Liquid Stored in the Largest Tank		
Inspect Storage Areas Routinely for Leaks and Spills		
Clean Up Spills Immediately		
Wash Liquid Spills into Sumps and Reuse		
Drum Untreated Wood Scraps Separately from Treatment Waste		
Elevate Storage Containers		
Build a Dike Around the Storage Area		
Do not Accumulate Large Volumes of Waste		
Properly Package and Label Solid Waste for Disposal		

Appendix A
WOOD PRESERVING INDUSTRY FIELD ASSESSMENTS: CASE STUDIES

In 1993, the EPA published a waste minimization study (prepared by Battelle under contract to the EPA) entitled *Waste Minimization Practices at Two CCA Wood-Treatment Plants* (Chen and Olfenbuttel 1993). The objectives of the study were to

- Estimate the amount of hazardous waste that a well-designed and well-maintained CCA treatment plant would generate

- Examine the possibility of using CCA more efficiently.

This appendix presents summaries of the results of the field assessments performed by Battelle, as well as an assessment published in 1992 by the EPA (Kirsch and Maginn 1992). The summaries presented should not be taken as recommendations or endorsement by the EPA; they are provided as examples only.

These field assessments focus on waste management within the context of existing practices and equipment. The plants described are not necessarily typical, but they provide valuable insight into possible techniques to reduce waste with minimum departure from current practices.

References

Chen, Abraham S. C. and Robert F. Olfenbuttel. 1993. *Waste Minimization Practices at Two CCA Wood-Treatment Plants.* Report to U.S. Environmental Protection Agency, Risk Reduction Engineering Laboratory, Office of Research and Development, Cincinnati, OH.

Kirsch, F. William and J. Clifford Maginn, Jr. 1992. *Waste Minimization Assessment for a Manufacturer Producing Treated Wood Products.* U.S. Environmental Protection Agency, Risk Reduction Engineering Laboratory, Office of Research and Development, Cincinnati, OH.

PLANT A
WASTE MINIMIZATION ASSESSMENT

Plant A has been in continuous operation at the same location since 1959. The plant is located on a 75-acre lot in a rural area. The original thrust of Plant A's business was supplying pressure-treated agricultural fencing. Its main product is now CCA-treated lumber. The company has 65 employees. In 1992, 50 million board feet of wood were treated.

In 1991, Plant A built a new treatment plant. The company decided not to upgrade its old facilities because they were poorly designed for efficient material handling and because more stringent regulations are pending. Compliance with these regulations by retrofitting would cost more than building a new treatment plant. The new plant is a single building that covers 4-1 /3 acres. The new facilities consist of three parallel treatment cylinders, vacuum pumps, high-pressure pumps, air compressors, and strip pumps.

The overall design for the new plant is based on the concept of "containment, capturing, recycling, and prevention" and incorporates many safety features that are not expected to become law for several more years.

Process Description

Lumber arrives at Plant A by truck at the receiving area located in an open yard just outside the treatment plant. The shipments are inspected to assure that they are undamaged and that they meet the required specifications. Plant A requires that lumber be covered by tarpaulins during transit to reduce the amount of road dust and grime reaching the lumber (which eliminates 3 to 4 drums of hazardous waste a year). If necessary, the lumber is power-washed and debris removed before it is forklifted into the untreated-wood storage area in the treatment plant.

The modified full-cell method is used for most treatments; the full-cell method is used for dense materials and timber. Treatment conditions are controlled by a computer programmed to achieve both proper chemical retention and minimum drippage.

Before treatment, lumber is rebanded with plastic strapping into lumber units of the appropriate size. The tagged lumber units are then forklifted to the lumber-handling system where they are placed parallel to the treating cylinders. The untreated lumber units are moved into the cylinders for treatment by an automatic chain conveying system. After treatment, the lumber remains on the conveying system for 1 to 2 days before being forklifted to drying sheds, to the storage areas in the treatment plant, or to the open yard.

Waste Generation

Plant A generated 9 55-gal drums of hazardous waste in 1991 and 6 in 1992. Some of this was a result of shutting down the old plant. The waste volume projected for the new treatment plant in 1993 is 2 to 4 drums, or 0.5 to 1 drum every 90 days. The waste is composed of sludge removed from the filter bags, the pump screens, and under the cylinder door traps; dust; tags; and miscellaneous items.

Waste Minimization Practices

Lumber is handled, treated, and dried, in enclosed structures at Plant A, which protects chemicals, treating facilities, freshly treated wood, and drip pads from direct exposure to ambient weather conditions, thereby reducing the possibility of contaminating the environment.

A concrete floor covers the entire plant. The concrete floor has an impermeable surface coating. An elevated metal drip pan on the drip pad intercepts chemicals dripping from the cylinder doors and from freshly treated lumber; therefore, no direct contact between the chemicals and the concrete floor occurs unless there is a major chemical spill. A recessed floor under both the drip pans and the treating cylinders functions as a secondary containment to retain spills from the drip pad.

The unique design of the drip pan and the lumber-conveying system at Plant A eliminates tracking chemicals from the drip pan and the drip pad. Plant A's automatic lumber handling system and power rollers transfer lumber units into and out of the treating cylinders without forklifts or rail trams. The treated lumber units remain on the conveyer until dripping ceases. This method of lumber handling eliminates any direct contact between people and chemicals and between equipment and chemicals.

Drip pans are hosed down 3 to 4 times a year. The solution is filtered through a 10-µm filter bag before being recycled as makeup water. The recycled solution is metered and the volume recorded so that any problems may be monitored, controlled, or eliminated. The filter bags are cleaned daily; the solids removed from the filter bags are disposed of as hazardous waste (about 2 drums per year).

Plant A's tank farm has primary spill containment, an elevated CCA concentrate tank, an enclosed chemical mixing system, and remote monitoring and control capabilities. The tank farm is in a heated building adjacent to the cylinder area of the treatment plant. The building is completely surrounded by retaining walls, which form the primary containment. The retaining wall separating the tank farm and the neighboring treating cylinder area has a weir to allow liquid to overflow from the primary containment to the secondary containment during major chemical spills (such as tank rupture).

The primary containment in the tank farm is capable of containing chemical spills equivalent to the volume of a large CCA work tank. Overflow from the primary containment can be spilled over to the secondary containment. The total capacity of the primary and secondary containment is equivalent to the total volume of the liquid stored in the tank farm, thus eliminating any possibility of chemical spills over the uncontrolled areas. The concrete floor in the tank farm has an impermeable coating and is lined with an underground liner. The lined area is monitored for chemical leakage by six detection systems.

The elevated CCA concentrate tank has a cone-shaped bottom, which facilitates inspection and allows visual reference in case of a leak. The CCA concentrate can be unloaded from a chemical tanker in the tank farm through an unloading point next to the concentrate tank, thus preventing release of chemical spills to the uncontrolled areas.

Chemicals are mixed in a computer-controlled enclosed system. In addition, the tank farm has automatic temperature, pressure, and safety switches for remote monitoring and control. This design eliminates the need for workers to enter the tank farm on a regular basis, thus reducing worker exposure to the chemicals.

Plant A's treatment building has eight roof fans that exchange air completely every 15 minutes. The tank farm is used as a single point source for all venting from the cylinders and chemical tanks. Because the plant design minimizes mist or droplet emissions from the cylinders and work tanks, no additional air pollution control devices have been installed in the tank farm.

The treatment processes at Plant A are carefully controlled to ensure proper chemical retention and minimal dripping. Several process control methods are used:

- Treatment processes are computer-controlled and monitored.
- Lightweight products that drip less are produced using rapid cycle treatment. Treating cylinders are fed with CCA work solution at rates up to 8,000 gpm. CCA chemicals are pushed into wood cells in less than 4 minutes, allowing time for chemical fixation.
- High pressure at 150 to 165 psi over a period of 5 to 8 minutes is applied, which eliminates excessive dripping.
- After the high-pressure treatment, a slow-pressure release follows immediately and lasts for 8 to 19 minutes, which also results in less dripping.
- Large vacuum pumps pull vacuum up to 27 inches Hg within 1 to 2 minutes. The final vacuum lasts up to 2 hours, which again reduces the amount of dripping from the treated products.
- Oxides are used to enhance chemical fixation in wood.

- Strip pumps continuously return residual chemical solutions to the CCA work tank. This results in less dripping when opening the cylinder doors and in more exact control of final retention.

- Treating cylinders are slightly tilted toward the work tank to reduce dripping when opening the cylinder doors.

- Treated products are analyzed for chemical retention using an X-ray fluorescence analyzer. Proper chemical retention is monitored to ensure that treatment specifications are met and that overtreatment does not occur.

- Research and development and operator training programs are provided for continuous improvement of treatment controls and skills.

Plant A considers housekeeping an integral part of its waste minimization effort:

- The concrete floor in the treatment building is vacuum-swept daily and manually swept whenever necessary.

- Plant A regularly inspects the concentrate tank, work tanks, automatic chemical mixing system, treating cylinders, drip pan, lumber-handling system, and spill containment for chemical leaks and spills.

- The unused mold inhibitor drums and wax totes are stacked neatly in an open area in the tank farm.

- A plastic container is hung under the concentrate unloading point to intercept chemical dripping.

- Lumber, treated or untreated, is stacked neatly on the lumber-handling system, in the treatment building, or in the open storage yard.

- All recycling bins, dumpsters, and containers are clearly marked and placed at locations away from frequent traffic.

- Wooden cross pieces are used to separate wood units and to avoid forklift damage.

- The lumber stacks in the open yard are covered with paper to provide protection from direct exposure to rain. This reduces the amount of arsenic and chromium being leached into stormwater runoff.

Plant A is a zero-discharge facility that recycles chemical drips, spills, rinse water, and washdown water as a process water. Plant A also recycles most of its nonhazardous solid waste and chemical containers.

PLANT B
WASTE MINIMIZATION ASSESSMENT

Plant B has been in business continuously since 1988. The plant operates two shifts and employs 35 people in the winter and 60 in the summer. The plant's 15-acre lot is located in a rural area. Plant B treats 55 million board feet of wood a year.

The treatment plant is composed of a cylinder room, a conditioning building, and a process control room. The cylinder room contains one treating cylinder, one rectangular combination tank, one primary work tank, pumps, pipes, and an underground pit. A rail/trench system divides the conditioning building into two areas: the lumber loading area and the drip pad (or conditioning area).

The concrete trench dividing the conditioning building slopes toward the cylinder room. Two rails are on top of the trench. Trams loaded with untreated or treated lumber are pulled into or out of the cylinder by a motor cable. The control room includes a set of visible volume meters, a process control panel, and a small laboratory bench.

Process Description

Untreated lumber arriving in bulk units by railroad car is tagged and stored in the unpaved open yard. The lumber is restacked by a stacker, banded with plastic strapping, and left in the open yard until treatment. Lumber units to be treated are forklifted to the treatment building and placed parallel to the rail/trench. The units are then loaded onto trams by forklift, fastened with heavy-duty belts, and pulled into the treating cylinder by a motor cable. Treatment conditions at Plant B are similar to those used by Plant A, except that the pressure release after the high-pressure treatment lasts for only 3 minutes and the final vacuum lasts for 20 to 30 minutes.

The modified full-cell method is used to treat most wood at Plant B. Treated products are analyzed for chemical retention using an X-ray fluorescence analyzer. After treatment, the lumber units are pulled out of the cylinder, forklifted to the drip pad, and allowed to drip on the drip pad for 1 to 3 days. To facilitate dripping, the lumber units are placed at a slight angle on the drip pad. The treated wood stacks are then transferred by forklift to one of the three drying sheds or to the open yard.

Both people and equipment operate in the conditioning area at Plant B, where a significant amount of chemicals accumulate. As a result, chemicals may be tracked from the conditioning area to surrounding areas.

Waste Generation

Plant B generates 4 drums per year of hazardous waste, or about one drum every 90 days. The waste is collected from the bottom screen of a two-screen setup and is composed primarily of sludge removed from the trench and from under the cylinder door traps. Wood chips, debris, and other large items collected on the top screen are disposed of as nonhazardous waste.

Waste Minimization Practices

Plant B is housed in enclosed structures, which provide shelter for chemical storage and mixing, lumber handling and treating, process control, and lumber drying. A concrete floor covers the entire plant. The floor has an impermeable surface coating and liner.

The conditioning area is hosed down daily. Chemicals and washdown water are directed toward the trench and filtered through a wire screen at the end of the trench. The filtered solution flows into an underground steel liner, which sits in an underground door pit. Wood chips, debris, and sludge are intercepted in the trench and shoveled weekly to the two-screen setup for air drying. The air-dried solids collected on the top screen are disposed of as nonhazardous waste in a dumpster; the finer solids collected on the bottom screen are disposed of as hazardous waste.

The treating cylinder and combination tank sit side-by-side in the cylinder room. The cylinder lies on four steel supports with a slight tilt away from the cylinder door. The combination tank sits on a concrete floor. Between the cylinder and the combination tank is a narrow walkway. The cylinder and the combination tank are surrounded by retaining walls on the north, south, and east sides. The opening on the west side connects the cylinder room to the conditioning building. A wooden deck underneath the cylinder separates the ground level from the underground pit and an underground primary work tank.

The pit under the cylinder is concrete. Underneath the cylinder door is another concrete pit with a steel liner and a steel spillover extension. The pit is coated with a sealer and lined with plastic. The steel liner is directly under the cylinder door, and the overflow from the liner is spilled into the spillover extension. Pumps at the spillover extension, the steel liner, and the door pit transfer the liquid to the primary work tank for reuse.

The concrete pit is large enough to contain the total volume of liquid in the combination tank and primary work tank. For minor spills, the three pumps associated with the underground pit transfer the liquid to the primary or secondary work tank.

The underground pit and primary work tank are not readily seen from the ground level, making it difficult to monitor chemical leaks. However, Plant B does have a remote monitoring and control system.

Vents from the cylinder, combination tank, and primary work tank are directed to the conditioning building, which has electric fans in the side walls for ventilation.

Plant B recycles chemical drips, spills, rinse water, and washdown water as a process water, but disposes of most of its chemical containers and the wood trim and strips from milling operations.

PLANT C
WASTE MINIMIZATION ASSESSMENT

Plant C produces treated wood products. It operates 8,760 hours a year to process approximately 1,700,000 cubic feet per year of wood.

Process Description

The plant treats crossties and poles with creosote and No. 6 oil in heated pressure cylinders. Lumber is treated with 2 percent chromated copper arsenate (CCA) solution in a pressure cylinder. The raw materials used are the wood products, creosote, No. 6 oil, and chromated copper arsenate. Steam is used to clean the surface of the wood in the creosote treatment cylinders, and ozone is used to destroy phenols in the steam condensate.

The following steps are involved in treating the wood products:

- Crossties and poles are trimmed on the ends and stacked on rail trams, which are pushed into a pressure treatment cylinder.

- A heated mixture of 50 percent (v/v) creosote and No. 6 oil is pumped into the cylinder and pressurized to force the liquids into the wood cells.

- The liquid is drained from the cylinder and held for reuse.

- The cylinder is flooded with steam to clean excess creosote and oil from the surface of the wood. A vacuum is drawn on the cylinder to enhance removal of the liquid from the wood and the cylinder.

- Steam condensate drains to a blowdown tank. Residual creosote and oil that drains when the cylinder is opened is pumped to the blowdown tank. The creosote is separated from the condensate and held for reuse.

Lumber is treated as follows:

- Lumber is stacked on rail trams, which are pushed into a pressure treatment cylinder.

- A closed-loop process with 2 percent CCA is used for treatment. The cylinder is pressurized to 125 psig.

- Solution drained from the cylinder is held for reuse.

Steam condensate from creosote treatment is treated with a flocculent to settle contained creosote, and the pH is adjusted to 3.6 to 4.0. An ozone treatment is used to break down phenols in the steam condensate before it is discharged as industrial wastewater. Creosote wastes are also generated from periodic steam cleaning of the treatment cylinders. No steam is used in cleaning the CCA cylinders. Accumulated waste containing CCA is disposed of as hazardous waste.

Waste Generation

Residual spent CCA solution is collected when cleaning the CCA pressure cylinder and disposed of as hazardous waste. Steam condensate from cleaning creosote-treated crossties and poles to remove excess creosote is treated with a flocculant, settled and decanted, treated with ozone and caustic soda, and discharged as industrial wastewater.

Cleaning the creosote treatment cylinders results in a creosote sludge, part of which is shipped for use as boiler fuel, and the remainder is disposed of as hazardous waste. Chips, bark, and wood trimmings are stored in an open area on leased property before disposal.

Waste Minimization Practices

- Cylindrical tanks holding creosote and CCA have been fitted with conical bottoms for accumulation of sludge, minimizing the need for periodic cleaning.
- The pressure cylinder does not require steam cleaning, lessening the quantity of contaminated waste.
- Storage tanks are heated to maintain proper viscosity and reduce sludge formation.

Appendix B
WHERE TO GET HELP: FURTHER INFORMATION ON POLLUTION PREVENTION

Additional information on source reduction, reuse and recycling approaches to pollution prevention is available in EPA reports listed in this section, and through state programs and regional EPA offices (listed below) that offer technical and/or financial assistance in the areas of pollution prevention and treatment.

Waste exchanges have been established in some areas of the United States to put waste generators in contact with potential users of the waste. Twenty-four exchanges operating in the United States and Canada are listed. Finally, relevant industry associations are listed.

U.S. EPA Reports on Waste Minimization

Facility Pollution Prevention Guide. EPA/600/R-92/088.*

Waste Minimization Opportunity Assessment Manual. EPA/625/7-88/O03 .*

Waste Minimization Audit Report: Case Studies of Corrosive and Heavy Metal Waste Minimization Audit at a Specialty Steel Manufacturing Complex. Executive Summary. EPA No. PB88-1071 80.**

Waste Minimization Audit Report: Case Studies of Minimization of Solvent Waste for Parts Cleaning and from Electronic Capacitor Manufacturing Operation. Executive Summary. EPA No. PB87-227013.**

Waste Minimization Audit Report: Case Studies of Minimization of Cyanide Wastes from Electroplating Operations. Executive Summary. EPA No. PB87-229662.**

Report to Congress: Waste Minimization, Vols. I and II. EPA/530-SW-86-033 and -034 (Washington, D.C.: U.S. EPA, 1986).***

Waste Minimization—Issues and Options, Vols. 1-H... EPA/530-SW-86-041 through -043. (Washington, D. C.: U.S. EPA, 1986.)***

The Guides to Pollution Prevention manuals* describe waste minimization options for specific industries. This is a continuing series which currently includes the following titles:

Guides to Pollution Prevention: Paint Manufacturing Industry. EPA/625/7-90/005.

Guides to Pollution Prevention: The Pesticide Formulating Industry. EPA/625/7-90/004.

Guides to Pollution Prevention: The Commercial Printing Industry. EPA/625/7-90/008.

Guides to Pollution Prevention: The Fabricated Metal Industry. EPA/62517-90/006.

Guides to Pollution Prevention for Selected Hospital Waste Streams. EPA/625/7-90/009.

Guides to Pollution Prevention: Research and Educational Institutions. EPA/625/7-90/010.

Guides to Pollution Prevention: The Printed Circuit Board Manufacturing Industry. EPA/625/7-90/007.

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* Available from EPA CERI Publications Unit (513) 569-7562, 26 West Martin Luther King Drive, Cincinnati, OH, ,45268.

** Executive Summary available from EPA, CERI Publications Unit, (513) 569-7562, 26 West Martin Luther King Drive, Cincinnati, OH, 45268; full report available from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA, 22161.

*** Available from the National Technical Information Service as a five-volume set, NTIS No. PB-87-1 14-328.

Guides to Pollution Prevention: The Pharmaceutical Industry. EPA/625/7-91/017.

Guides to Pollution Prevention: The Photoprocessing Industry. EPA1625/7-91/012.

Guides to Pollution Prevention: The Fiberglass Reinforced and Composite Plastic Industry. EPA/628/7-9 1/014.

Guides to Pollution Prevention: The Automotive Repair Industry. EPA/625/7-91/013.

Guides to Pollution Prevention: The Automotive Refinishin gIndustry, EPA/625/7-91/016.

Guides to Pollution Prevention: The Marine Maintenance and *Repair Industry.* EPA/625/7-91/015.

Guides to Pollution Prevention: The Metal Casting and Heat Treating Industry. EPA/625/R-92/009.

Guides to Pollution Prevention: Mechanical Equipmerit Repair Shops. EPA16251R-921008.

Guides to Pollution Prevention: The Metal Finishing Industry. EPA/625/R-92/Oil.

U.S. EPA Pollution Prevention Information Clearinghouse (PPIC): *Electronic Information Exchange System (EIES)—User Guide, Version 1.1.* EPA/600/ *9-89/086.*

Waste Reduction Technical/ Financial Assistance Programs

The EPA Pollution Prevention Information Clearinghouse (PPIC) was established to encourage waste reduction through technology transfer, education, and public awareness. PPIC collects and disseminates technical and other information about pollution prevention through a telephone hotline and an electronic information exchange network. Indexed bibliographies and abstracts of reports, publications, and case studies about pollution prevention are available, PPIC also lists a calendar of pertinent conferences and seminars, information about activities abroad, and a directory of waste exchanges. Its Pollution Prevention Information Exchange System (PPIES) can be accessed electronically 24 hours a day without fees.

For more information contact:

PPIES Technical Assistance
Science Applications International Corp.
8400 Westpark Drive
McLean, VA 22102
(703) 821-4800

or

U.S. Environmental Protection Agency
401 M Street S.W.
Washington, D.C. 20460

Myles E. Morse
Office of Environmental Engineering and
Technology Demonstration
(202) 260-5748

Priscilla Flattery
Pollution Prevention Office
(202) 260-8383

The EPA's Office of Solid Waste and Emergency Response has a telephone call-in service to answer questions regarding RCRA and Superfund (CERCLA). The telephone numbers are:

(800) 242-9346 (outside the District of Columbia)

(202) 382-3000 (in the District of Columbia)

The following programs offer technical and/or financial assistance for waste minimization and treatment.

Alabama
Hazardous Material Management and Resource
Recovery Program
University of Alabama
P.O. Box 6373
Tuscaloosa, AL 35487-6373
(205) 348-8401

Department of Environmental Management
1751 Federal Drive
Montgomery, AL 36130
(205) 271-7914

Alaska
Alaska Health Project
Waste Reduction Assistance Program
1818 West Northern Lights Boulevard
Anchorage, AK 99501
(907) 276-2864

Arizona
Arizona Department of Economic Planning and Development
1645 West Jefferson Street
Phoenix, AZ 85007
(602) 255-5705

Arkansas
Arkansas Industrial Development Commission
One State Capitol Mall
Little Rock, AR 72201
(501) 371-1370

California
Pollution Prevention, Public and Regulatory Assistance Program
Department of Toxic Substances Control
California State Department of Health Services
P.O. Box 806
Sacramento, CA 95812-0806
(916) 322-3670

Pollution Prevention Program
San Diego County Department of Health Services
Hazardous Materials Management Division
P.O. Box 85261
San Diego, CA 92186-5261
(619) 338-2215

Colorado
Division of Commerce and Development Commission
500 State Centennial Building
Denver, CO 80203
(303) 866-2205

Connecticut
Connecticut Hazardous Waste Management Service
Suite 360
900 Asylum Avenue
Hartford, CT 06105
(203) 244-2007

Connecticut Department of Economic Development
210 Washington Street
Hartford, CT 06106
(203) 566-7196

Delaware
Delaware Department of Community Affairs & Economic Development
630 State College Road
Dover, DE 19901
(302) 736-4201

District of Columbia
U.S. Department of Energy
Conservation and Renewable Energy
Office of Industrial Technologies
Office of Waste Reduction, Waste Material Management Division
Bruce Cranford CE-222
Washington, DC 20585
(202) 586-9496

Pollution Control Financing Staff
Small Business Administration
1441 "L" Street, N.W., Room 808
Washington, DC 20416
(202) 653-2548

Florida
Waste Reduction Assistance Program
Florida Department of Environmental Regulation
2600 Blair Stone Road
Tallahassee, FL 32399-2400
(904) 488-0300

Georgia
Hazardous Waste Technical Assistance Program
Georgia Institute of Technology
Georgia Technical Research Institute
Environmental Health and Safety Division
O'Keefe Building, Room 027
Atlanta, GA 30332
(404) 894-3806

Environmental Protection Division
Georgia Department of Natural Resources
205 Butler Street, S.E., Suite 1154
Atlanta, GA 30334
(404) 656-2833

Guam
Solid and Hazardous Waste Management Program
Guam Environmental Protection Agency
IT&E Harmon Plaza, Complex Unit D-107
130 Rojas Street
Harmon, Guam 96911
(671) 646-8863-5

Hawaii
Department of Planning & Economic Development
Financial Management and Assistance Branch
P.O. Box 2359
Honolulu, HI 96813
(808) .548-4617

Idaho
IDHW-DEQ
Hazardous Materials Bureau
450 West State Street, 3rd Floor
Boise, ID 83720
(208) 334-5879

Illinois
Illinois EPA
Office of Pollution Prevention
2200 Churchill Road
P.O. Box 19276
Springfield, IL 62794-9276
(217) 782-8700

Hazardous Waste Research and Information Center
Illinois Department of Energy and Natural Resources
One East Hazelwood Drive
Champaign, IL 61820
(217) 333-8940

Illinois Waste Elimination Research Center
Pritzker Department of Environmental Engineering
Alumni Memorial Hall, Room 103
Illinois Institute of Technology
3201 South Dearborn
Chicago, IL 60616
(312) 567-3535

Indiana
Environmental Management and Education Program
School of Civil Engineering
Purdue University
2129 Civil Engineering Building
West Lafayette, IN 47907
(317) 494-5036

Indiana Department of Environmental Management
Office of Technical Assistance
P.O. Box 6015
105 South Meridian Street
Indianapolis, IN 46206-6015
(317) 232-8172

Iowa
Center for Industrial Research and Service
Iowa State University
Suite 500, Building 1
2501 North Loop Drive
Ames, IA 50010-8286
(515) 294-3420

Iowa Department of Natural Resources
Air Quality and Solid Waste Protection Bureau
Wallace State Office Building
900 East Grand Avenue
Des Moines, IA 50319-0034
(515) 281-8690

Waste Management Authority
Iowa Department of Natural Resources
Henry A. Wallace Building
900 East Grand
Des Moines, IA 50319
(515) 281-8489

Iowa Waste Reduction Center
University of Northern Iowa
75 Biology Research Complex
Cedar Falls, IA 50614
(319) 273-2079

Kansas
Bureau of Waste Management
Department of Health and Environment
Forbes Field, Building 730
Topeka, KS 66620
(913) 269-1607

Kentucky
Division of Waste Management
Natural Resources and Environmental Protection Cabinet
18 Reilly Road
Frankfort, KY 40601
(502) 564-6716

Kentucky Partners
Room 312 Ernst Hall
University of Louisville
Speed Scientific School
Louisville, KY 40292
(502) 588-7260

Louisiana
Department of Environmental Quality
Office of Solid and Hazardous Waste
P.O. Box 44307
Baton Rouge, LA 70804
(504) 342-1354

Maine
State Planning Office
184 State Street
Augusta, ME 04333
(207) 289-3261

Maryland
Maryland Hazardous Waste Facilities Siting Board
60 West Street, Suite 200 A
Annapolis, MD 21401
(301) 974-3432

Massachusetts
Office of Technical Assistance
Executive Office of Environmental Affairs
100 Cambridge Street, Room 1904
Boston, MA 02202
(617) 727-3260

Source Reduction Program
Massachusetts Department of Environmental Quality Engineering
1 Winter Street
Boston, MA 02108
(617) 292-5982

Michigan
Resource Recovery Section
Department of Natural Resources
P.O. Box 30028
Lansing, MI 48909
(517) 373-0540

Minnesota
Minnesota Pollution Control Agency
Solid and Hazardous Waste Division
520 Lafayette Road
St. Paul, MN 55155
(612) 296-6300

Minnesota Technical Assistance Program
1313 5th Street, S.E., Suite 207
Minneapolis, MN 55414
(612) 627-4646
(800) 247-0015 (in Minnesota)

Mississippi
Waste Reduction & Minimization Program
Bureau of Pollution Control
Department of Environmental Quality
P.O. Box 10385
Jackson, MS 39289-0385
(601) 961-5190

Missouri
State Environmental Improvement and Energy Resources Agency
P.O. Box 744
Jefferson City, MO 65102
(314) 751-4919

Waste Management Program
Missouri Department of Natural Resources
Jefferson Building, 13th Floor.
P.O. Box 176
Jefferson City, MO 65102
(314) 751-3176

Nebraska
Land Quality Division
Nebraska Department of Environmental Control
Box 98922
State House Station
Lincoln, NE 68509-8922
(402) 471-2186

Hazardous Waste Section
Nebraska Department of Environmental Control
P.O. Box 98922
Lincoln, NE 68509-8922
(402) 471-2186

New Jersey
New Jersey Hazardous Waste Facilities Siting Commission
Room 514
28 West State Street
Trenton, NJ 08625
(609) 292-1459
(609) 292-1026

Hazardous Waste Advisement Program
Bureau of Regulation and Classification
New Jersey Department of Environmental Protection
401 East State Street
Trenton, NJ 08625
(609) 292-8341

Risk Reduction Unit
Office of Science and Research
New Jersey Department of Environmental Protection
401 East State Street
Trenton, NJ 08625
(609) 292-8341

New Mexico
Economic Development Department
Bataan Memorial Building
State Capitol Complex
Santa Fe, NM 87503
(505) 827-6207

New York
New York Environmental Facilities Corporation
50 Wolf Road
Albany, NY 12205
(518) 457-4222

North Carolina
Pollution Prevention Pays Program
Department of Natural Resources and Community Development
P.O. Box 27687
512 North Salisbury Street
Raleigh, NC 27611-7687
(919) 733-7015

Governor's Waste Management Board
P.O. Box 27687
325 North Salisbury Street
Raleigh, NC 27611-7687
(9 19) 733-9020

Technical Assistance Unit
Solid and Hazardous Waste Management Branch
North Carolina Department of Human Resources
P.O. Box 2091
306 North Wilmington Street
Raleigh, NC 27602
(919) 733-2178

North Dakota
North Dakota Economic Development Commission
Liberty Memorial Building
State Capitol Grounds
Bismarck, ND 58505
(701) 224-2810

Ohio
Division of Hazardous Waste Management
Division of Solid and Infectious Waste Management
Ohio Environmental Protection Agency
P.O. Box 0149
1800 Watermark Drive
Columbus, OH 43266-0149
(614) 644-2917

Oklahoma
Industrial Waste Elimination Program
Oklahoma State Department of Health
P.O. Box 53551
Oklahoma City, OK 73152
(405) 271-7353

Oregon
Oregon Hazardous Waste Reduction Program
Department of Environmental Quality
811 Southwest Sixth Avenue
Portland, OR 97204
(503) 229-5913
(800) 452-4011 (in Oregon)

Pennsylvania
Pennsylvania Technical Assistance Program
501 F. Orvis Keller Building
University Park, PA 16802
(814) 865-0427

Center of Hazardous Material Research
Subsidiary of the University of Pittsburgh Trust
320 William Pitt Way
Pittsburgh, PA 15238
(412) 826-5320
(800) 334-2467

Puerto Rico
Government of Puerto Rico
Economic Development Administration
BOX 2350
San Juan, PR 00936
(809) 758-4747

Rhode Island
Hazardous Waste Reduction Section
Office of Environmental Management
83 Park Street
Providence, RI 02903
(401) 277-3434
(800) 253-2674 (in Rhode Island)

South Carolina
Center for Waste Minimization
Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201
(803) 734-4715

South Dakota
Department of State Development
P.O. Box 6000
Pierre, SD 57501
(800) 843-8000

Tennessee
Center for Industrial Services
University of Tennessee
Building #401
226 Capitol Boulevard
Nashville, TN 37219-1804
(615) 242-2456

Bureau of Environment
Tennessee Department of Health and Environment
150 9th Avenue North
Nashville, TN 37219-5404
(615) 741-3657

Tennessee Hazardous Waste Minimization Program
Tennessee Department of Economic and Community Development
Division of Existing Industry Services
7th Floor, 320 6th Avenue, North
Nashville, TN 37219
(615) 741-1888

Texas
Texas Economic Development Authority
410 East Fifth Street
Austin, TX 78701
(512) 472-5059

Utah
Utah Division of Economic Development
6150 State Office Building
Salt Lake City, UT 84114
(801) 533-5325

Vermont
Economic Development Department
Pavilion Office Building
Montpelier, VT 05602
(802) 828-3221

Virginia
Office of Policy and Planning
Virginia Department of Waste Management
1 lth Floor, Monroe Building
101 North 14th Street
Richmond, VA 23219
(804) 225-2667

Washington
Hazardous Waste Section
Mail Stop PV-11
Washington Department of Ecology
Olympia, WA 98504-8711
(206) 459-6322

West Virginia
Governor's Office of Economics and Community Development
Building G, Room B-517
Capitol Complex
Charleston, WV 25305
(304) 348-2234

Wisconsin
Bureau of Solid Waste Management
Wisconsin Department of Natural Resources
P.O. BOX 7921
101 South Webster Street
Madison, WI 53707
(608) 267-3763

Wyoming
Solid Waste Management Program
Wyoming Department of Environmental Quality
Herschler Building, 4th Floor, West Wing
122 West 25th Street
Cheyenne, WY 82002
(307) ‘777-7752

Waste Exchanges

Alberta Waste Materials Exchange
Mr. Jim Renick
303A Provincial Building
4920-51 Street
Red Deer, Alberta
CANADA T4N 6KB
(403) 340-7980
FAX: (403) 340-7982

B. A. R. T.E.R. Waste Exchange
Mr. William Nynas
MPIRG
2512 Delaware Street SE
Minneapolis, MN 55414
(612) 627-6811

British Columbia Waste Exchange
Ms. Jill Gillett
1525 West 8th Avenue, Suite 102
Vancouver, B.C.
CANADA V6J 1T5
(604) 731-7222- General Information
(604) 732-9253- Recycler Data Base

California Materials Exchange (CALMAX)
Mr. Dave Sparrow
Local Government Commission
909 12th St., Suite 205
Sacramento, CA 95814
(916) 448-1198
FAX: (916) 448-8246

California Waste Exchange
Ms. Claudia Moore
Alternative Technology Division
Department of Toxic Substances Control
P.O. Box 806
Sacramento, CA 94212-0806
(916) 322-4742

Canadian Chemical Exchange*
Mr. Philippe LaRoche
P.O. Box 1135
Ste-Adele, Quebec
CANADA JOR lLO
(514) 229-6511

Canadian Waste Materials Exchange
ORTECH International
Dr. Robert Laughlin
2395 Speakman Drive
Mississauga, Ontario
CANADA L5K 1B3
(416) 822-4111 (Ext. 265)
FAX: (416) 823-1446

Indiana Waste Exchange
Mr. Jim Britt
Recyclers Trade Network
P.O. Box 454
Carmel, IN 46032
(317) 844-8764

Industrial Materials Exchange
Mr. Bill Lawrence
172 20th Avenue
Seattle, WA 98122
(206) 296-4633
FAX: (206) 296-0188

Industrial Materials Exchange Service
Ms. Diane Shockey
P.O. Box 19276
Springfield, IL 62794-9276
(217) 782-0450
FAX: (217) 524-4193

* For-Profit Waste information Exchange.

Iowa Waste Reduction Center
By-product Waste Search **Service**
Ms. Susan Salterberg
75 BRC
University of Northern Iowa
Cedar **Falls,** IA 50614-0185
(800) 422-3109
(319) 273-2079
FAX: (319) 273-2893

Louisiana/Gulf Coast Waste Exchange
Ms. Rita **Czek**
1419 CEBA
Baton Rouge, LA 70803
(504) 388-8650
FAX: (504) 388-4945

Manitoba Waste Exchange
Ms. Beth **Candlish**
c/o Biomass Energy Institute, Inc.
1329 **Niakwa** Road
Winnipeg, Manitoba
CANADA R2J 3T4
(204) 257-3891

Montana Industrial Waste Exchange
Manager
Montana Chamber of Commerce
P.O. Box 1730
Helena, MT 59624
(406) 442-2405

Northeast Industrial Waste Exchange, Inc.
Mr. Lewis Cutler
90 Presidential Plaza, Suite 122
Syracuse, NY 13202
(3 15) 422-6572
FAX: (315) 422-9051

Ontario Waste Exchange
ORTECH International
Ms. Mary Jane **Hanley**
2395 Speakman Drive
Mississauga, Ontario
CANADA L5K 1B3
(416) 822-4111 (Ext. 512)
FAX: (416) 823-1446

Pacific Materials Exchange
Mr. Bob **Smee**
1522 North Washington, Suite 202
Spokane, WA 99205
(509) 325-0551
FAX: (509) 325-2086

Peel Regional Recycling Assistance
(Publishes Directory of Local **Recyclers)**
Mr. Glen **Milbury**
Regional Municipality of Peel
10 Peel Center Drive
Brarnpton, Ontario
CANADA L6T 4B9
(416) 791-9400

RENEW
Ms. Hope **Castillo**
Texas Water Commission
P.O. Box 13087
Austin, TX 78711-3087
(512) 463-7773
FAX: (512) 475-4599

Southeast Waste Exchange
Ms. Maxie May
Urban Institute
UNCC Station
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