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WASTE MINIMIZATION PRACTICES AT TWO CCA WOOD-TREATMENT PLANTS

by

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FOREWORD

Today's rapidly developing and changing technologies and industrial products and practices frequently carry with them the increased generation of materials that, if improperly dealt with, can threaten both public health and the environment. The U.S. Environmental Protection Agency (EPA) is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, the agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. These laws direct the EPA to perform research to define our environmental problems, measure the impacts, and search for solutions.

The Risk Reduction Engineering Laboratory is responsible for planning, implementing, and managing research, development, and demonstration programs to provide an authoritative, defensible engineering basis in support of the policies, programs, and regulations of the EPA with respect to drinking water, wastewater, pesticides, toxic substances, solid and hazardous wastes, Superfund-related activities, and pollution prevention. This publication is one of the products of that research and provides a vital communication link between the researcher and the user community.

Passage of the Pollution Prevention Act of 1990 marked a strong change in the U.S. policies concerning the generation of hazardous and nonhazardous wastes. This bill implements the national objective of pollution prevention by establishing a source reduction program at the EPA and by assisting States in providing information and technical assistance regarding source reduction. In support of the emphasis on pollution prevention, the "Waste Reduction Innovative Technology Evaluation (WRITE) Program" has been designed to identify, evaluate, and/or demonstrate new ideas and technologies that lead to waste reduction. The WRITE Program emphasizes source reduction and on-site recycling. These methods reduce or eliminate transportation, handling, treatment, and disposal of hazardous materials in the environment. The technology evaluation project discussed in this report emphasizes the study and development of methods to reduce waste and prevent pollution.

E. Timothy Oppelt, Director
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ABSTRACT

Two chromated copper arsenate (CCA) wood-treatment plants were assessed for their waste minimization practices. These practices have been reflected in several areas, including facility designs, process controls, and management practices. The objectives were to estimate the amount of hazardous wastes that a well-designed and well-maintained CCA treatment plant would generate, and to examine the possibility of pollution prevention and waste reduction in a CCA plant. The information collected will be used to develop a pollution prevention guide that will assist wood treaters in identifying ways to prevent pollution and reduce wastes.

This assessment report was submitted in partial fulfillment of Contract Number 68-C0-0003, Work Assignment 2-36, under the sponsorship of the U.S. Environmental Protection Agency. This report covers a period from September 1992 to September 1993, and the study was completed as of June 30, 1993.

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ACKNOWLEDGMENTS

The U.S. Environmental Protection Agency and Battelle acknowledge the important contribution made by Michael Charles of the American Wood Preservers' Institute, in identifying and recommending two CCA treatment plants for this assessment project. William Price, president of Madison Wood Preservers, Inc. at Madison, Virginia, and Joe Granger, General Manager of Universal Forest Products Ranson Plant at Ranson, West Virginia, are acknowledged for providing support for the on-site assessment, and for reviewing this assessment report. Ian Stalker, Vice President of Universal Forest Products, also reviewed this report. Additional reviewers include S. Garry Howell of the U.S. Environmental Protection Agency; Darrel Nicholson of Mississippi State University, Mississippi Forest Products Laboratory; and Rodney De Groot of the U.S. Department of Agriculture, Forest Products Laboratory in Madison, Wisconsin.

SECTION 1

INTRODUCTION

The wood-treatment industry uses about 70% of the arsenic consumed in the United States (Loebenstein, 1991; 1992). Most of this is used to produce chromated copper arsenate (CCA). Different formulations of CCA have been known as some of the most effective wood preservatives for the treatment of lumber, timber, and other wood products for aboveground and ground-contact applications. However, because of the toxicity and carcinogenicity of arsenic and chromium, CCA may pose potential threats to human health and the environment.

The U.S. Environmental Protection Agency (EPA) is currently evaluating the waste reduction and pollution prevention potential of an alternative wood preservative system. This evaluation project is part of the ongoing Resource Conservation and Recovery Act (RCRA) Problem Wastes Technology Evaluation Program. The program evaluates, in typical industrial and agricultural workplace environments, innovative technologies that demonstrate a potential to either reduce or eliminate the use of RCRA metals, including arsenic, or to minimize the RCRA problem wastes through recycling and recovery.

The evaluation will be performed at one wood treatment plant having side-by-side treatment capabilities for CCA and the alternative preservative system. However, the site selected for that study may not represent the best case or even a good example of efficient use of CCA. For comparison, EPA asked that CCA use be investigated at two other sites identified by an industry trade group as having excellent management practices (inventory control, spill prevention, recycling, etc.) and highly efficient use of CCA. EPA's objectives are to develop a complete, unbiased view of the CCA wood-treating industry, to estimate the amount of hazardous wastes that a well-maintained CCA treatment plant would generate, and to examine the possibility of using CCA more efficiently. The information collected will be used to develop a pollution prevention guide that will assist wood treaters in identifying ways to prevent pollution and reduce wastes. The guide will provide options for improving the efficiency of existing operations and, when feasible, implementing newer pollution prevention technologies.

This document reports the results of the assessments. The two CCA plants assessed were identified and recommended by the American Wood Preservers' Institute (AWPI). Madison Wood Preservers, Inc. (MW) is located in Madison, Virginia. Universal Forest Products, Inc. Ranson Plant (RP) is located in Ranson, West Virginia. Both plants are privately owned, large-sized wood treaters that use only CCA as wood preservative. The plant visits were conducted in Madison on February 4-5, 1993, and in Ranson on February 8-9, 1993.

SECTION 2

ASSESSMENT METHODOLOGY

The procedures outlined in the assessment phase of EPA's *Waste Minimization Opportunity Assessment Manual* (U.S. EPA, 1988) were used as a guide for the CCA plant assessments. The original assessment phase involves six steps:

1. Collect process and facility data.
2. Prioritize and select assessment targets.
3. Select assessment team.
4. Review data and inspect site.
5. Generate options.
6. Screen and select options for further study.

However, a simplified approach was taken during the assessments at the two CCA plants. The steps involving process and facility data collection, assessment targets selection, and data evaluation (Steps 1, 2, and 3) were combined with the site inspection (Step 4). The steps involving waste minimization (WM) options generation, screening, and selection (Steps 5 and 6) were omitted because the purpose of this assessment project is not to develop WM options.

Before the plant visits, letters were sent to the plant owner/General Manager, briefly stating the purpose of the project, the goals of the plant visits, the assessment approach, and the expected use of the assessment results. Upon arrival at the plants, the site visitors reviewed and discussed these subjects with the plant management. During the discussions and plant tours, emphasis was placed on the sources of wood-preserving contamination, treatment processes and facilities, and WM practices. Typical questions asked to facilitate the information gathering effort are listed below:

- What wastestreams are generated from the plant? What quantity of wastes do these contain?
- Which processes or operations generate these wastestreams?
- Which wastes are classified as hazardous and which are not?
- What input materials are used that generate the wastestreams of a particular process or plant area?
- How much of a specific input material enters each wastestream?
- How much of a raw material can be accounted for through fugitive losses?

- How efficient is each waste-generating process?

- Are unnecessary wastes generated by mixing otherwise recyclable hazardous wastes with other process wastes?

- What types of housekeeping practices are used to limit the quantity of wastes generated?

- What types of process controls are used to improve process efficiency?

Notes were taken during the discussions and plant tours. Additional information gathered fell into several categories:

- Design documents
- Raw material and production information
- Environmental information
- Economic information.

Design documents included process flow diagrams, operating manuals and process descriptions, equipment data sheets, and equipment layouts. The raw material and production information included material safety data sheets, product and raw material inventory records, operator data logs, operating procedures, and production schedules. The environmental information included hazardous waste manifests, emission inventories, hazardous waste reports, waste analyses, environmental audit reports, and permits and/or permit applications. The economic information included disposal costs, product and raw material costs, and operating and maintenance costs.

The WM assessment worksheets 4 to 10 in the *Waste Minimization Opportunity Assessment Manual* were used to facilitate the assessment process. The title and purpose of these worksheets are summarized in Table 1. The worksheets are presented in Appendix A.

TABLE 1. LIST OF WASTE MINIMIZATION ASSESSMENT WORKSHEETS

Number	Title	Purpose
4	Site Description	Lists background information about the facility, including location, products, and operations.
5	Personnel	Records information about the personnel who work in the area to be assessed.
6	Process Information	Provides a checklist of useful process information to look for before starting the assessment.
7	Input Materials Summary	Records input material information for a specific production or process area. This includes name, supplier, hazardous component or properties, cost, delivery and shelf-life information, and possible substitutes.
8	Products Summary	Identifies hazardous components, production rate, revenues, and other information about products.
9	Individual Waste Stream Characterization	Records source, hazard, generation rate, disposal cost, and method of treatment or disposal for each wastestream.
10	Waste Stream Summary	Summarizes all of the information collected for each wastestream. This sheet is also used to prioritize wastestreams to assess.

SECTION 3

DESCRIPTION OF THE PLANTS

This section describes the wood-treating facilities, wood-treating processes, and wood-drying and storage facilities of the two CCA treatment plants visited on February 4-5, and February 8-9, 1993.

MADISON WOOD PRESERVERS, INC.

Madison Wood Preservers, Inc. (MW) was founded in 1959 and has been in continuous operation at the same location ever since. It is located on a 75-acre lot in a rural area in Madison, Virginia (on U.S. Route 29, about 25 miles north of Charlottesville, Virginia). The company was one of the original Wolman licensees with Koppers Co. (now Hickson), which is one of the three major CCA chemical and equipment suppliers in the USA. The original thrust of MW's business was supplying pressure-treated agricultural fencing. Its main products now include CCA-treated lumber, timber, and other related forest products. The company hires 65 employees. Its 1992 production volume was 50 million board feet; the annual production projected for 1993 is 60 million board feet. Its around-the-clock capacity is 365 million board feet per year.

Old Treatment Plant

Madison Wood Preservers' original treatment plant consisted of three pressure-treating cylinders. The first cylinder (5 ft x 32 ft), installed in 1959, could treat 8,000 to 10,000 board feet/charge/day. The second and the third cylinders (6 ft x 50 ft) were added in 1962 and 1977, respectively, to keep up with the demand for treated fencing and other CCA-treated wood products. In 1980, the two older cylinders were lengthened and installed with automated controls in a new building.

In 1992, one of these cylinders was relocated into MW's new treatment plant. Other equipment in the old treatment plant is being dismantled for disposal or resale.

New Treatment Plant

In 1991, MW invested 5.5 million dollars to build a new treatment plant. The company decided not to upgrade its old facilities because the old facilities were spread out and were poorly designed for efficient material handling, and because more stringent regulations such as the new drip pad requirements in 40 CFR Part 265, Subpart W, and the stormwater runoff regulations are pending. Compliance with these regulations by retrofitting would cost approximately 20% of the cost of building a new treatment plant. The new plant is housed in a single building that covers an area of 4⅓ acres. The plant is the largest treating facility of its type in the USA. Figure 1 shows the plant's side view, and Figure 2 shows the plant layout.

The design and engineering of the new plant was done primarily by Hickson Corporation in Atlanta, which provided services in areas such as electrical, mechanical, chemical, and environmental engineering, and in industrial hygiene. The overall design for the new plant incorporates the basic concept of "containment, capturing, recycling, and prevention." The company has emphasized "prevention" according to the belief that "it is easier to prevent than to correct." The plant thus incorporates many safety features that are not expected to become law for at least several more years. As a result, the Virginia Water Pollution Control Board has rated this facility as a pollution abatement facility.

Overview of Wood-Treating Operations

Figure 3 shows a flow diagram of the wood-treating operations at MW. Truckloads of lumber arrive at the receiving area located in the open yard just outside of the northeast corner of the treatment plant. There the shipment loads are inspected to determine if they meet the required specifications and are undamaged. MW requires that all loads of lumber be covered by tarpaulins during transit to reduce the amount of road dust and grime reaching the lumber. The company has stopped buying lumber from sawmills that do not keep their lumber neat and clean. If needed, the lumber may be power-washed and debris removed before it is forklifted into the untreated-wood storage area in the treatment plant.

Before treatment, lumber is rebanded with plastic strapping into appropriate size units. Wood crosspieces (2-in x 2-in) are used to avoid lumber damage during forklifting (see Figure 4). The lumber units thus prepared are end-squeezed to ensure neat packing (see Figure 5), and individual pieces of lumber in each lumber unit are tagged. The tagged lumber units are then forklifted to the lumber-handling system where the untreated lumber units are placed parallel to the treating cylinder to form a line of < 100 linear ft. The entire length of

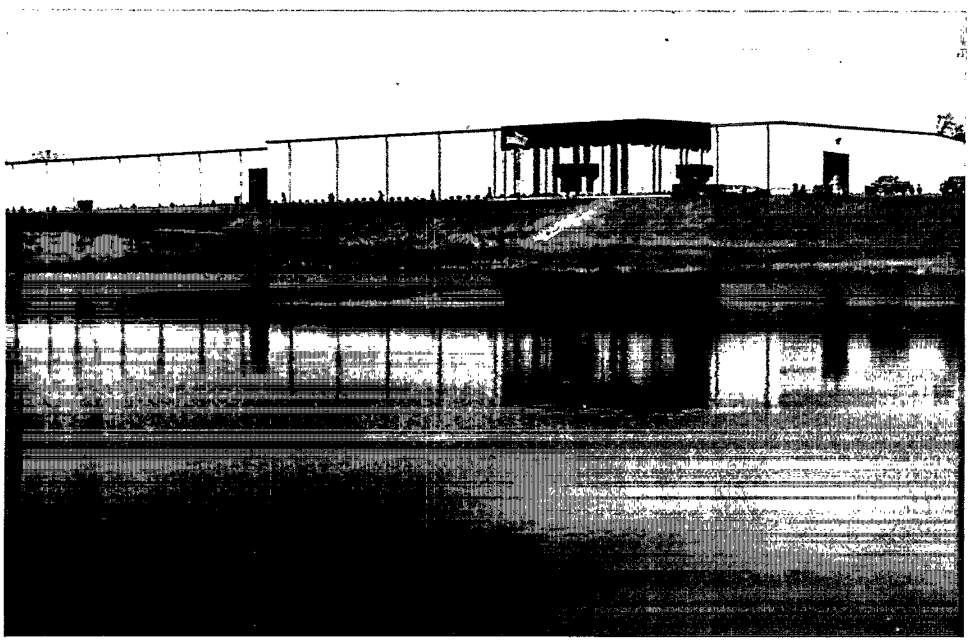


Figure 1. A side view of Madison Wood Preservers' new treatment plant.

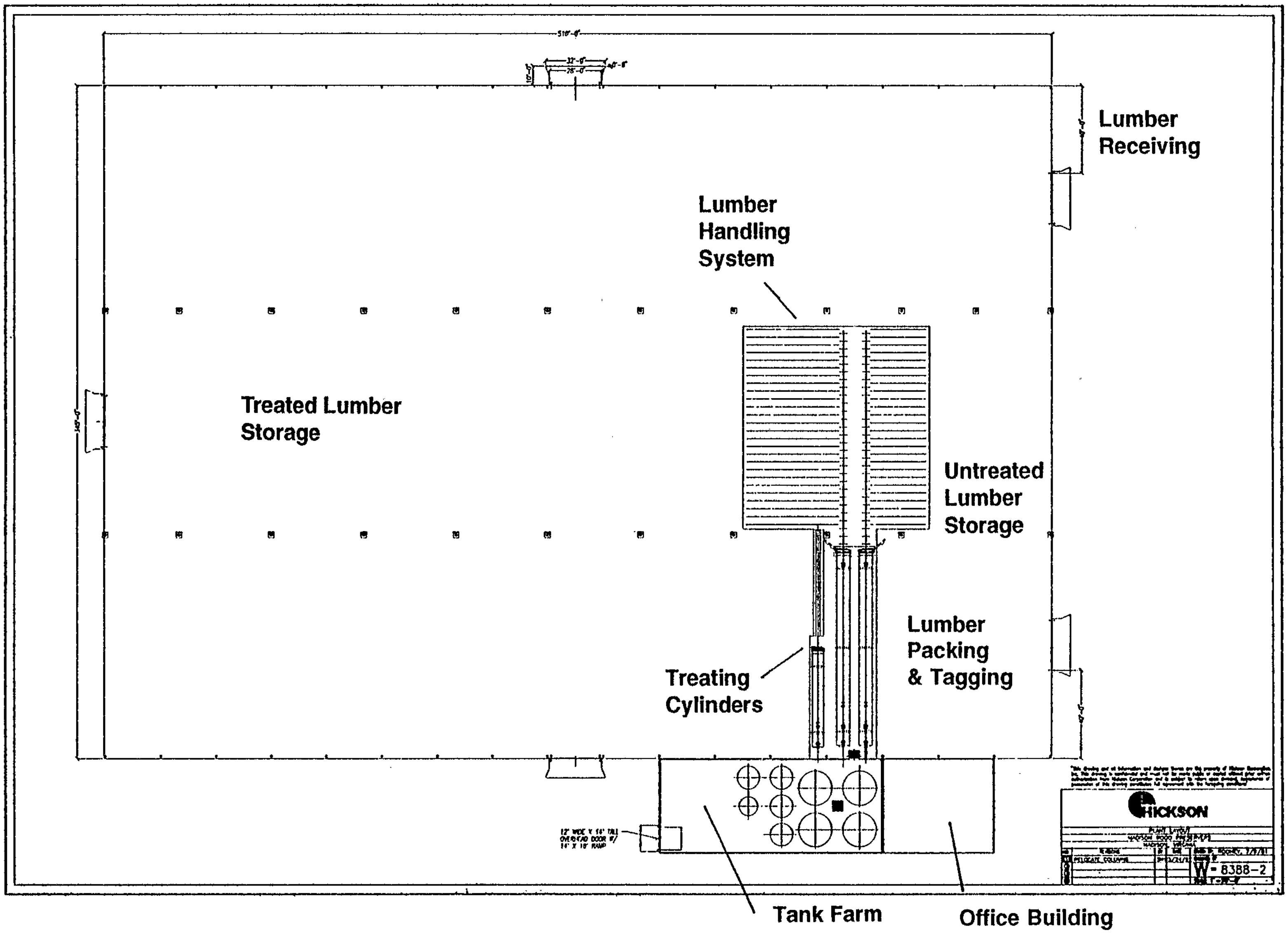


Figure 2. Madison Wood Preservers' new treatment plant layout.

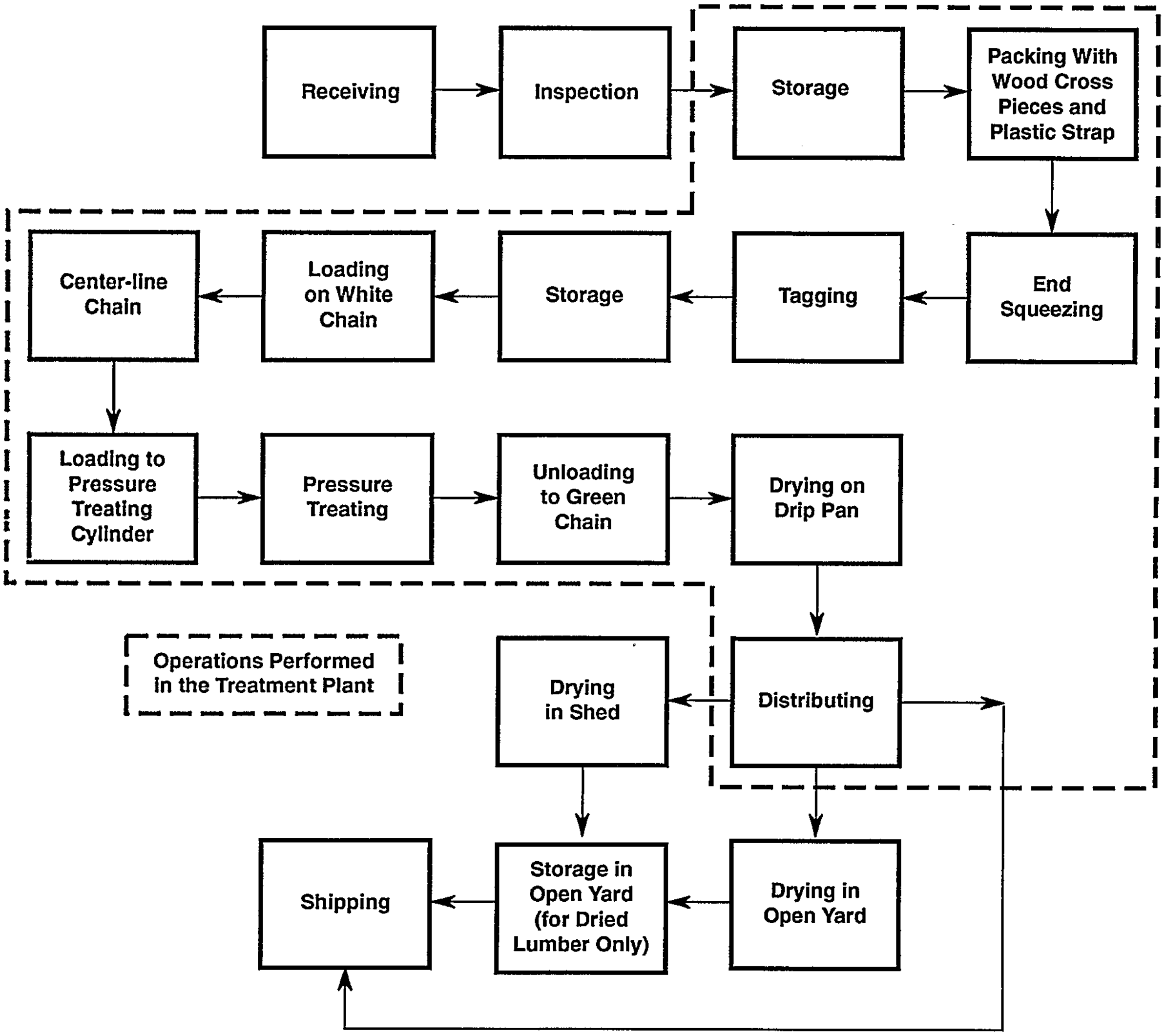


Figure 3. Flow diagram of wood-treating operations at Madison Wood Preservers.

Figure 4. Lumber banding with plastic straps and wood crosspieces.

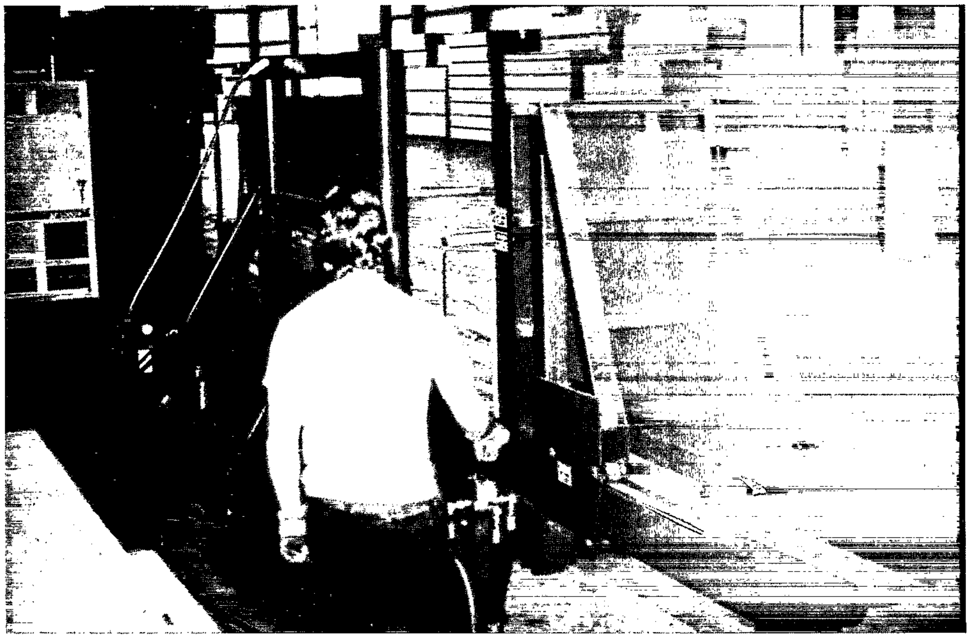


Figure 5. Lumber end-squeezing.

the untreated lumber units is moved by an automatic chain conveying system. The lumber handling system is divided into three areas designated by the terms "white chain," "center-line chain," and "green chain." The untreated lumber stays in the white chain area until treatment.

A treatment cycle begins with moving the untreated lumber units to the center-line chain, loading them into the pressure-treating cylinder, unloading the freshly treated lumber units back to the center-line chain, and moving them to the green chain. The freshly treated lumber units then remain on the green chain for at least 1 to 2 days before being forklifted to drying sheds or to the storage areas in the treatment plant.

Treatment Plant Building

The building shell of the new treatment plant contains 33 trailer loads of steel that provide a snow load of 30 lb and a wind load of 80 mph (with no tributary load reductions allowed). The eight roof fans provide a complete air exchange every 15 min. The concrete floor that covers the entire plant area contains more than 5,000 yd^3 of reinforced concrete with a minimum thickness of 8 inches.

Lumber Handling System

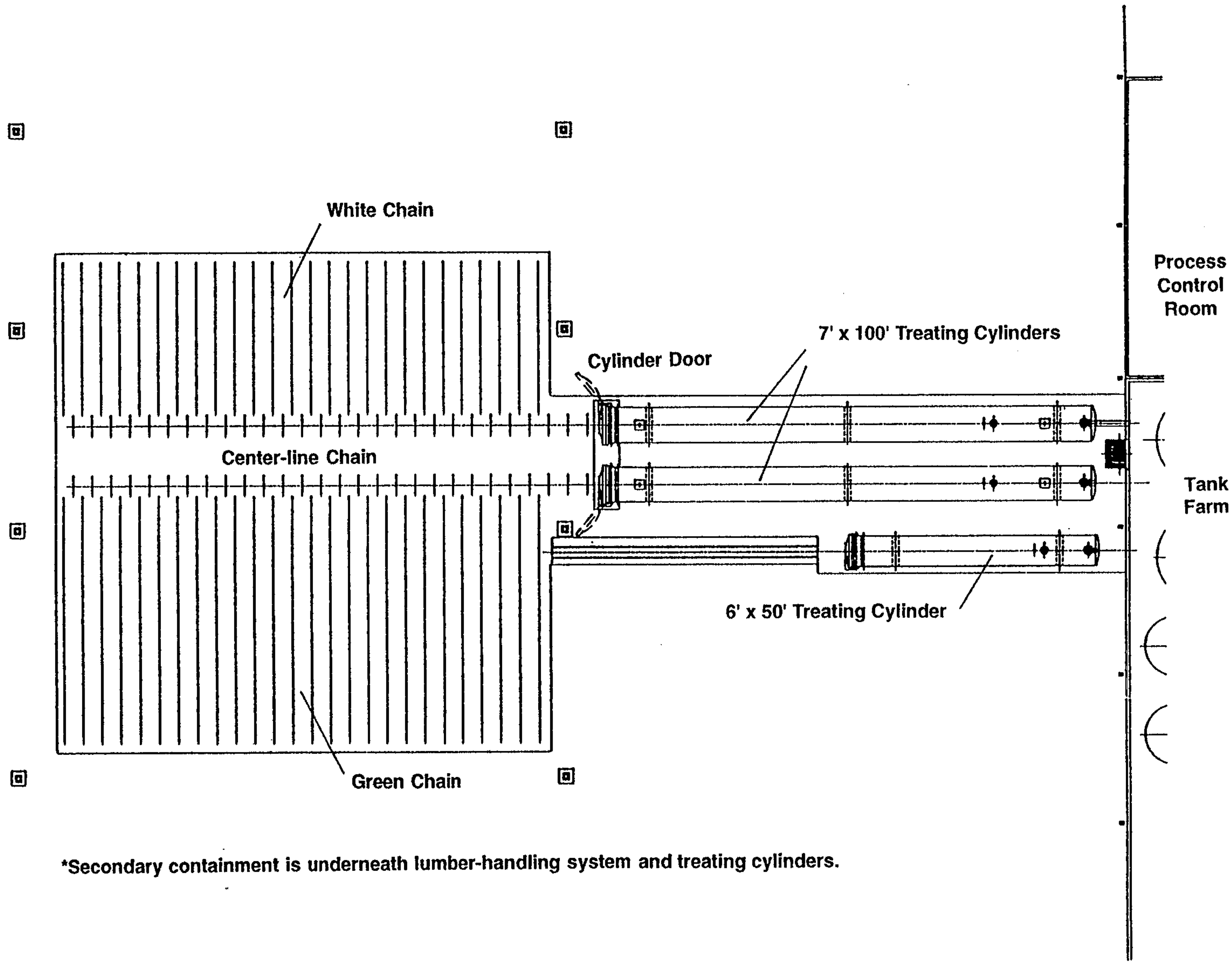
The lumber handling system (LHS) was designed and manufactured by Automated Lumber Handling, Inc. of Lenoir, North Carolina. The LHS replaces the conventional forklift/rail-tram system with an automatic chain conveying system to load and unload lumber before and after pressure treatment (see Figure 6 for a system layout). As the LHS moves untreated and freshly treated lumber units with the chains, it also intercepts chemical drips from the cylinder doors and the freshly treated wood with a 100 ft x 104 ft elevated drip pan (see Figure 7). Thus, the LHS eliminates the need for both human and equipment traffic on the drip pad and removes any chance of tracking chemicals off the drip pad.

The drip pan is elevated 4 ft off a recessed floor that covers the areas beneath the drip pan and the three treating cylinders. The 8-in-thick concrete floor is coated with an impermeable Plasite™ surface coating. The recessed areas form the secondary containment, which is designed to retain accidental chemical spills from the drip pan, the treating cylinders, and the primary containment in the tank farm (see page 13). The drip pan and the Plasite™-coated concrete floor provide two levels of protection against chemical spills and contamination.

The three related assemblies of the automatic chain conveying system move the lumber sideways through the treatment cycle. The white chain assembly moves untreated lumber from the white chain to the center-line chain. The center-line chain assembly loads/unloads lumber both to and from the treating cylinders. The green chain assembly moves freshly treated lumber from the center-line chain to the green chain, where the freshly treated lumber is placed for at least 1 to 2 days before being forklifted to storage or to drying. The chemicals intercepted by the drip pan are hosed down 3 to 4 times a year.

Pressure-Treating Facilities

The new treating facilities consist of three parallel treatment cylinders (two 7 ft x 100 ft [24,000 gal], see Figure 8, and one 6 ft x 50 ft [10,000 gal]). Each has one vacuum compressor pump, one high-pressure pump, and one strip pump. The two 7 ft x 100 ft cylinders (manufactured by Addison, Inc., Addison, Alabama) are supported on concrete piers on the recessed floor. Each of these cylinders treats 25,000 board feet of lumber or timber/charge. On average, 4 to 5 charges may be treated per 8-hour shift. The 6 ft x 50 ft cylinder treats only 10,000 board feet/charge and is used primarily for posts and specialty lumber.



*Secondary containment is underneath lumber-handling system and treating cylinders.

Figure 6. Lumber-handling system layout.

Figure 7. **Automatic chain conveying system and drip pan above the recessed floor for lumber moving, drippage intercepting, and spill retaining, respectively.**

Each cylinder is equipped with a series of powered rollers driven by three 20-horsepower (hp) motors mounted on the outside of the cylinders. The powered rollers along with the center-line chain conveyors transfer lumber into and out of the cylinders without using forklifts and rail-tram. The treating cylinders are tilted slightly towards the working tanks and the tank farm so that excessive drippage does not occur when the cylinder doors are opened.

The treating cylinders are equipped with the largest pumps (e.g., up to 150 hp) in the wood-treating industry. These pumps are used to perform rapid cycle treatment, which produces lightweight products with less dripping. The rapid cycle treatment is achieved by using 12-in fill lines to move the CCA work solution at rates up to 8,000 gpm to the 7 ft x 100 ft cylinders. A similar treatment can be performed on the 6 ft x 50 ft cylinder using a 6-in fill line. The CCA chemicals can be impregnated into wood cells in less than 4 min, allowing more time for fixation with wood cells. Further, the large pressure pumps can reach 175 psi in the cylinder in less than 3 min. The large vacuum pumps pull vacuum up to 27 in Hg in the cylinder within 1 to 2 min. The strip pumps continuously pull chemicals back to the work tanks.

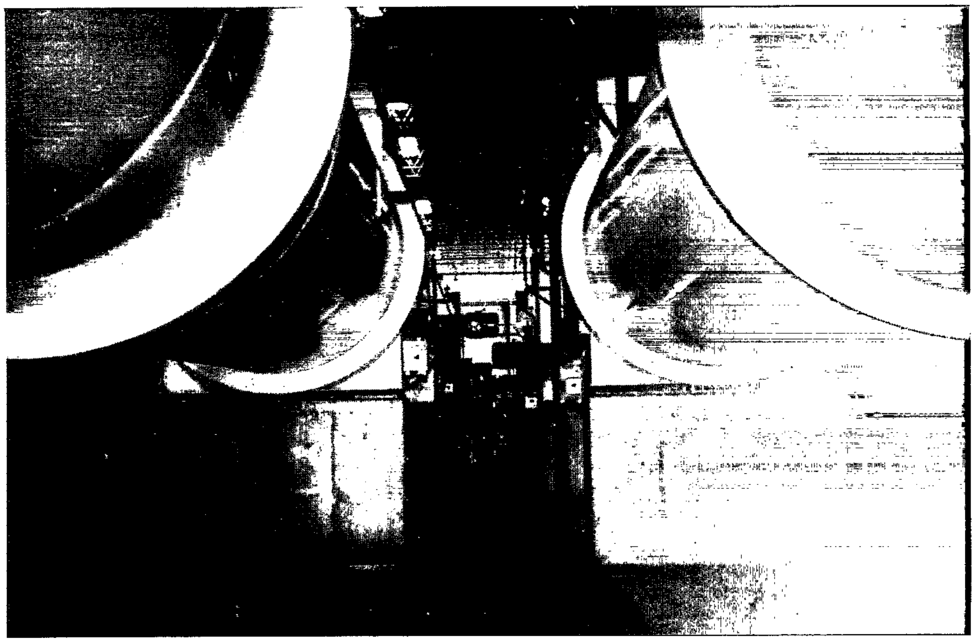


Figure 8. Two 7′ x 100′ treating cylinders on concrete piers above the recessed floor.

Tank Farm

The tank farm is housed in a heated building adjacent to the cylinder area of the treatment plant. The 120 ft x 50 ft building is completely surrounded by 18-in-high, 8.5-in-wide concrete retaining walls. The surrounding area forms the primary containment which can retain up to 40,000 gal of liquid, equivalent to the volume of one large CCA work tank. The retaining wall separating the tank farm and the neighboring treating cylinder area has a 6-in-deep, 36-ft-long cutout that functions as a weir to allow liquid to overflow from the primary containment to the secondary containment during major chemical spills (such as multiple tank ruptures). The primary and the secondary containments have a total capacity equivalent to the total volume of liquid stored in the tank farm. The concrete floor of the primary containment has an impermeable epoxy surface coating and an 80-mil underground liner. The lined area is divided into six sections; each is sloped to a sump where a leakage detection system is installed.

The tank farm is composed of four 41,858-gal tanks (each 18 ft diameter and 22 ft high), four 18,603-gal tanks (each 12 ft diameter and 22 ft high), and one 12,914-gal tank (10 ft diameter and 22 ft high) (see Figure 9 for a layout). The four 41,858-gal tanks are painted light green and are CCA work tanks for the two larger cylinders (i.e., two for each). The four 18,603-gal tanks are also painted light green: two serve as work tanks for the smaller cylinder, one holds effluent (or makeup water), and one is empty. The 12,914-gal tank is painted dark green and holds CCA concentrate. This tank is raised off the concrete floor and has a cone-shaped bottom. The tip and the side of the cone are 29 in and 45 in off the floor, respectively. The elevated tank and the cone-shaped bottom facilitate inspection and allow visual reference in case of a leak (see Figure 10). The 12-ft-wide, 14-ft-tall doorway and the 14 ft x 10 ft ramp located at the southwest corner of the tank farm building

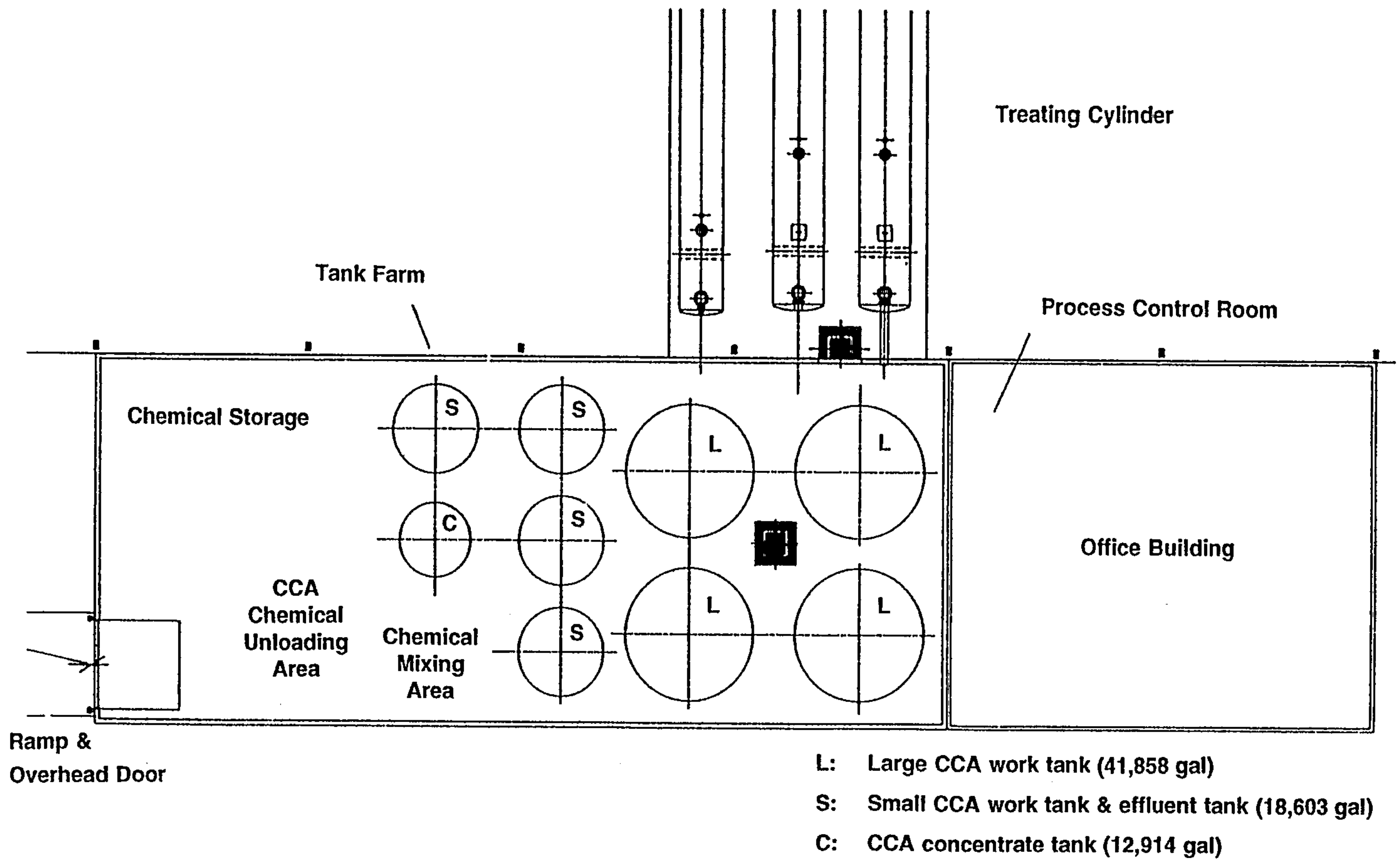


Figure 9. Tank farm layout.

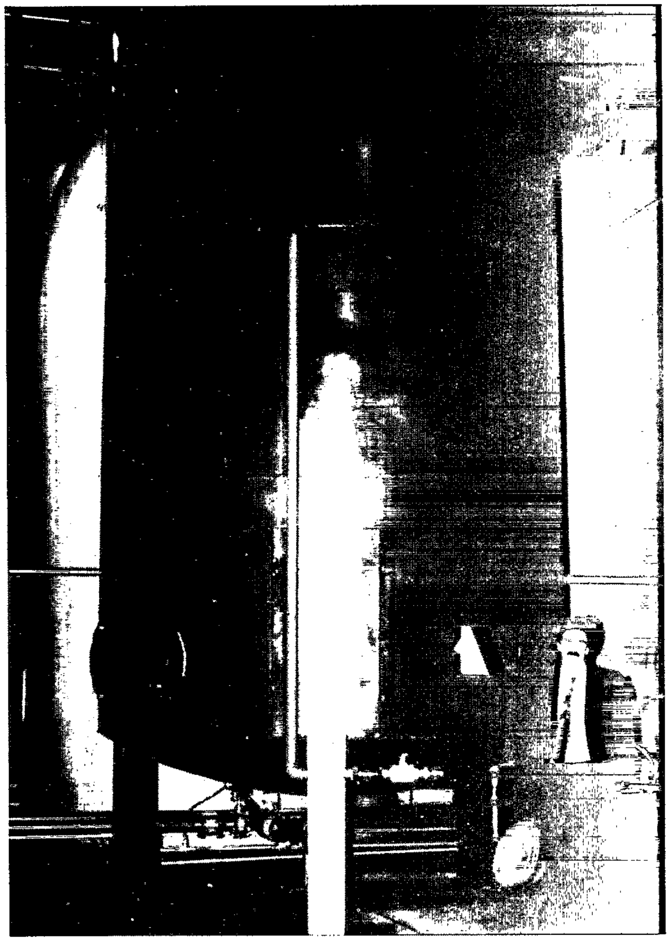


Figure 10. Elevated CCA concentrate tank with cone-shaped bottom.

serve as a passage for chemical tankers to unload CCA concentrate inside the tank farm. The unloading point has a quick hookup design to prevent release of chemical spills.

Chemical mixing is performed with a computer-controlled enclosed system (see Figure 11) in the tank farm. A wax emulsion and a mold inhibitor are metered into the CCA work solution in different proportions, depending on the product and customer requirements. The treating solution contains 1.5-2.0% CCA active ingredients and 10-15 ppm mold inhibitor. The use of this automatic mixing system eliminates the need for workers to enter the tank farm on a regular basis. Moreover, the tank farm has automatic temperature, pressure, and safety switches that allow remote monitoring and control.

All chemicals used by MW are supplied by Osmose Corporation (Griffin, Georgia). In 1992, the annual consumption of 50% CCA concentrate was 1,057,620 oxide pounds, equivalent to about 46 tanker loads. The annual consumption of the wax emulsion was 322,500 lbs, or 120 totes (8 trailer loads of totes at 15 to 16 totes/load). The 1992 consumption of mold inhibitor was 3,850 lbs, or 14 drums (275 lbs/drum). Because the wax

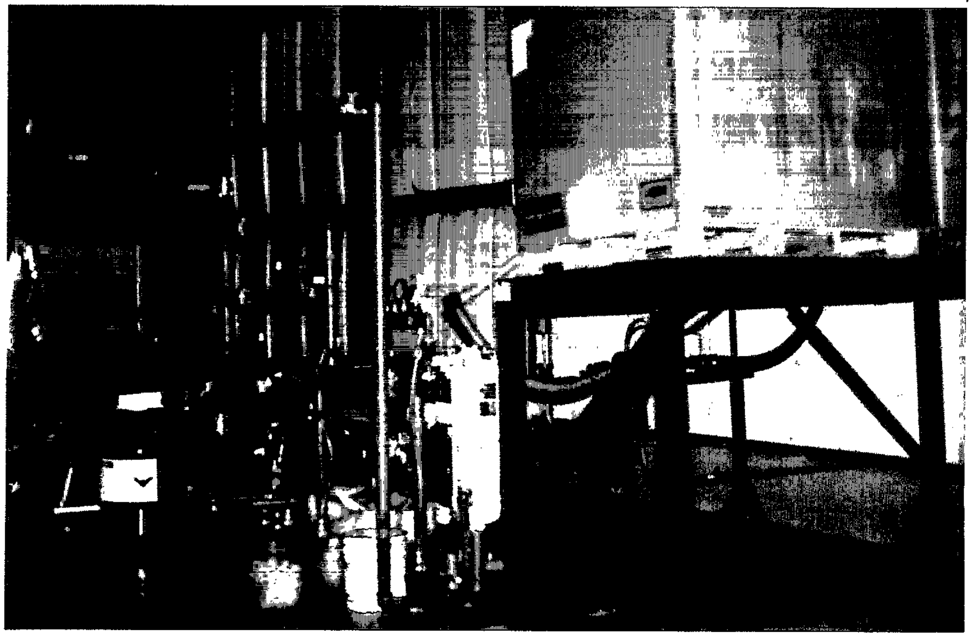


Figure 11. Enclosed chemical mixing system with the large wax tote on the metal stand, bag filter cartridge by the metal stand, and mold inhibitor drums at the far end.

emulsion causes the treated lumber to drip more than that treated without it, MW has eliminated the use of wax emulsion for 2 in x 8 in and wider lumber.

Chemical drips and washdown water collected from the drip pan, and water used to clean, rinse, or wash chemical containers, parts, or equipment, are combined and filtered through 10-μm polyester bag filters before being returned to the effluent (or makeup water) tank for reuse. The recycled solution is metered and the volume recorded so that any problems may be monitored, controlled, and/or eliminated. The filter bags are cleaned daily; the solids removed from the filter bags are disposed of as hazardous wastes. MW estimates two drums of hazardous wastes per year from this source.

The tank farm acts as a single point source for all venting from the cylinders and the chemical tanks. There are no vents from the tank farm building to the outside atmosphere. Because all cylinder air emissions are returned to the work tanks, any mists or droplets would be captured and contained in the work tanks. Therefore, no additional air pollution control devices are needed in the tank farm. Virginia Department of Air Pollution Control (DAPC) requires CCA treatment plants to obtain emission permits if arsenic emissions exceed 0.013 lb/hr. MW would emit 0.0139 lb arsenic/yr (including 0.00832 lb/yr from both 7 ft x 100 ft cylinders, 0.00143 lb/yr from 6 ft x 50 ft cylinder, and 0.00413 lb/yr from all work tanks) if the plant operates around the clock for 365 days a year. Therefore, the plant is exempt from DAPC permitting requirements.

Process Control

The computerized pressure-treating process is controlled and monitored by Hickson treatment control panels in a control room located in the northwest corner of the office building. The control room has a direct access to the tank farm and to the treatment plant. A treatment cycle includes the steps to:

- Apply initial vacuum
- Fill the cylinder under vacuum with CCA work solution
- Exert high pressure
- Slowly release pressure
- Blow back CCA work solution to the CCA work tank
- Apply final vacuum
- Strip residual CCA work solution to the CCA work tank.

The time required to complete a treatment cycle varies with wood density, dimensions, retention requirements, and treatment methods. The modified full-cell method is used for most treatments; the semi-full-cell method is used for denser materials and timber (including 4 in x 4 in, 6 in x 6 in, and 8 in x 8 in dimensions). A typical process flow diagram is presented in Figure 12; the related treatment conditions are listed in Table 2.

The treatment conditions are controlled by a computer set up to achieve both proper chemical retention and minimum drippage. Inputs to the computer include location of sawmills; density, grades, sizes, and past treatability of the wood product; treatment records of previous runs; etc. Among the most important treatment conditions are pressure levels and durations during the high-pressure treatment, time for pressure release, and initial and final vacuum. High pressure at 150 to 165 psi over a period of 5 to 8 min normally is applied to the wood being treated. It is important not to overtreat because overpressuring could collapse wood cells, causing excessive dripping, especially if a refusal point is reached. After the high-pressure treatment, pressure is slowly released to atmospheric pressure in 8 to 15 min. The vacuum pumps pull vacuum up to 27 in Hg within 1 to 2 min. The final vacuum is applied over a period of up to 2 hrs. All of these conditions serve to reduce the amount of dripping from the treated products.

The treated products are analyzed for chemical retention using an X-ray fluorescence analyzer. The analytical results report total and individual oxide retention (as CrO_3, CuO, and As_2O_5) in lb/ft^3.

Wood Drying and Storage

The freshly treated lumber remains on the green chain for 1 to 2 days to allow drips to stop. The lumber is then transferred to the storage areas or a drying shed for further drying. About 70% of the plant production is kept in the inside storage areas in the treatment plant. The other 30% is dried after treatment to 19% moisture content (M.C.) which is done in the drying shed. Up to 0.5 million board feet of outdoor wood is placed in orderly stacks in the shed (see Figure 13), through which air circulates. The air is drawn by 72 electrical fans installed on one side of the shed. Under favorable weather conditions (about 65°F and 45% relative humidity [RH]), it takes from 2 to 2.5 weeks for the wood to dry down to the required maximum moisture content (about 19%). Currently, the shed's capacity is enough to hold 0.75 million board feet. About 25% of the lumber is dried in stacks on the open yard. The wood stacks dried in the open yard are covered with paper to avoid direct exposure to rainfall.

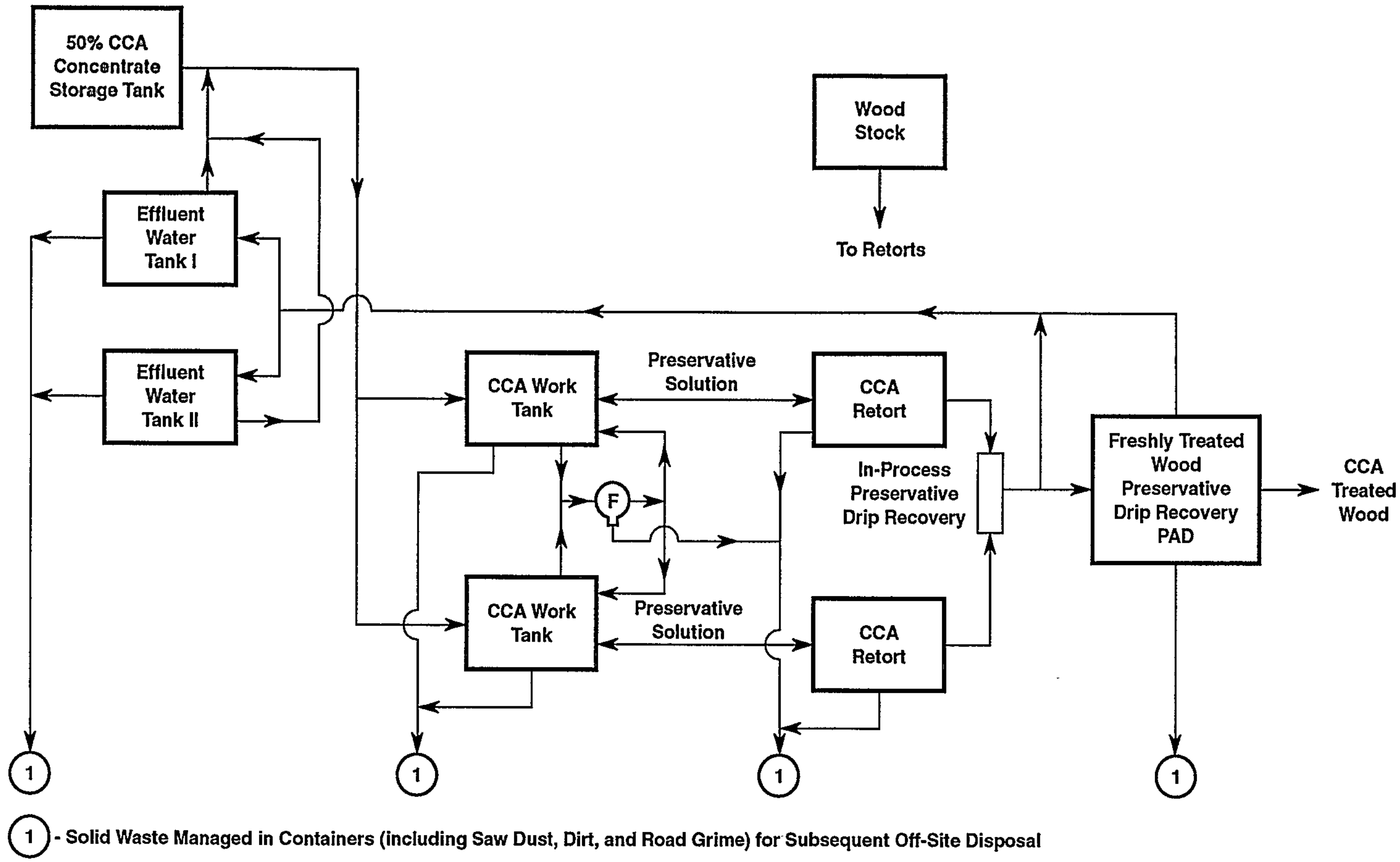


Figure 12. Typical process flow diagram for a two-cylinder CCA pressure-treating facility.

TABLE 2. TREATMENT CONDITIONS OF TYPICAL PRESSURE-TREATING PROCESSES

	Process Conditions	
Pressure-Treating Cycle	Modified Full-Cell Method	Semi-Full-Cell Method
Initial Vacuum	10-14 in Hg for 10 min	27 in Hg for 12 min
Filling Cylinder via Vacuum	4 min	4 min
Applying Pressure	150-165 psi for 5-8 min	150-165 psi for 5-8 min
Slow-Pressure Release	8-15 min	N/A
Blowing Back	10 psi for 3 min	10 psi for 3 min
Final Vacuum	27 in Hg for 60-120 min	27 in Hg for 0-30 min
Final Stripping	0-30 sec	0-30 sec

N/A - not applicable

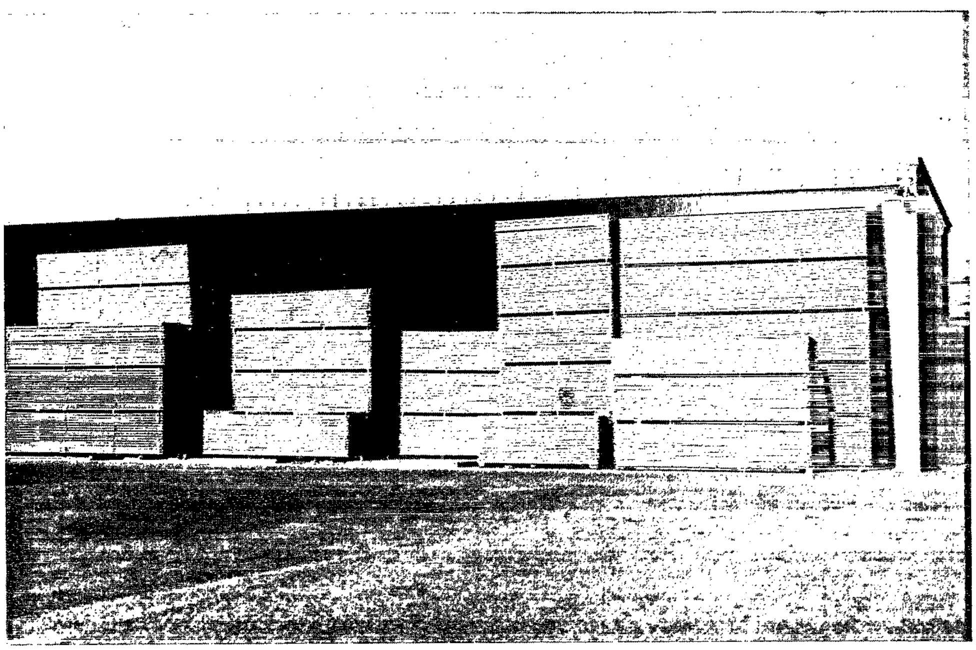


Figure 13. The drying shed.

UNIVERSAL FOREST PRODUCTS, INC., RANSON TREATMENT FACILITY

Universal Forest Products, Inc. owns 10 wood-treating facilities and 27 forest products manufacturing facilities. The company was founded in 1955. The company does business across the country. The Ranson Plant (RP) was built in 1988 and has been in business continuously since then. The plant's 15-acre lot is located in a rural area in Ranson, West Virginia, which is about 80 miles northwest of Washington, DC. The RP lot layout is presented in Figure 14, which shows the relative location of the shipping and receiving areas, sawmills, wood stacking room, treatment plant, drying sheds, wood storage yard, and offices.

The plant operates in two shifts and treats about 55 million board feet per year of Southern Yellow Pine (SYP) boards, decking, dimensional, lumber, and timber. The plant's full capacity is 70 million board feet. The plant employs 35 and 60 employees during the winter and summer seasons, respectively.

Overview of Wood-Treating Operations

Figure 15 presents a flow diagram of the RP wood-treating operations. Untreated lumber arriving in bulk units by railroad cars is tagged and stored in the unpaved open yard. The lumber is then restacked by a stacker (see Figure 16), banded with plastic strap (see Figure 17), and left in the open yard until moved for treatment. When the lumber units are moved for treatment, they are forklifted to the conditioning building and placed parallel to the rail/trench (see Figure 18). The units are then loaded onto trams by forklifts, fastened with heavy-duty belts, and pulled into the treating cylinder by a motor cable. After treatment, the freshly treated lumber units are pulled out of the cylinder, forklifted to the conditioning area (or drip pad) and allowed to drip on the conditioning area for 1 to 3 days (average 30 hrs). The treated wood stacks are then transferred by forklift to one of the three drying sheds or to the open yard.

Pressure Treatment Plant

The treatment plant is composed of a cylinder room, a conditioning building, and a process control room. The cylinder room is a long, narrow structure annexed to the east side of the main conditioning building. The cylinder room contains the pressure-treating facility, including one 6.5 ft x 82 ft (or 20,000-gal) treating cylinder, one rectangular combination tank (40 ft x 10 ft x 10 ft), one primary work tank (40 ft x 10 ft x 6.9 ft), pumps, pipes, and an underground pit. The conditioning building has a rail/trench system which divides the conditioning building into two separate areas: the lumber loading area and the conditioning area (or drip pad). The entire complex (cylinder room and conditioning building) is underlined with a continuous 30 mil plastic liner. The treatment plant was designed by Rentokil, a company acquired by Chemical Specialties, Inc. (CSI) in Charlotte, North Carolina. The treatment plant layout is shown in Figure 19.

Cylinder Room

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 towards the opposite direction of the cylinder door. The combination tank sits on a concrete floor. In 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. Directly underneath the cylinder

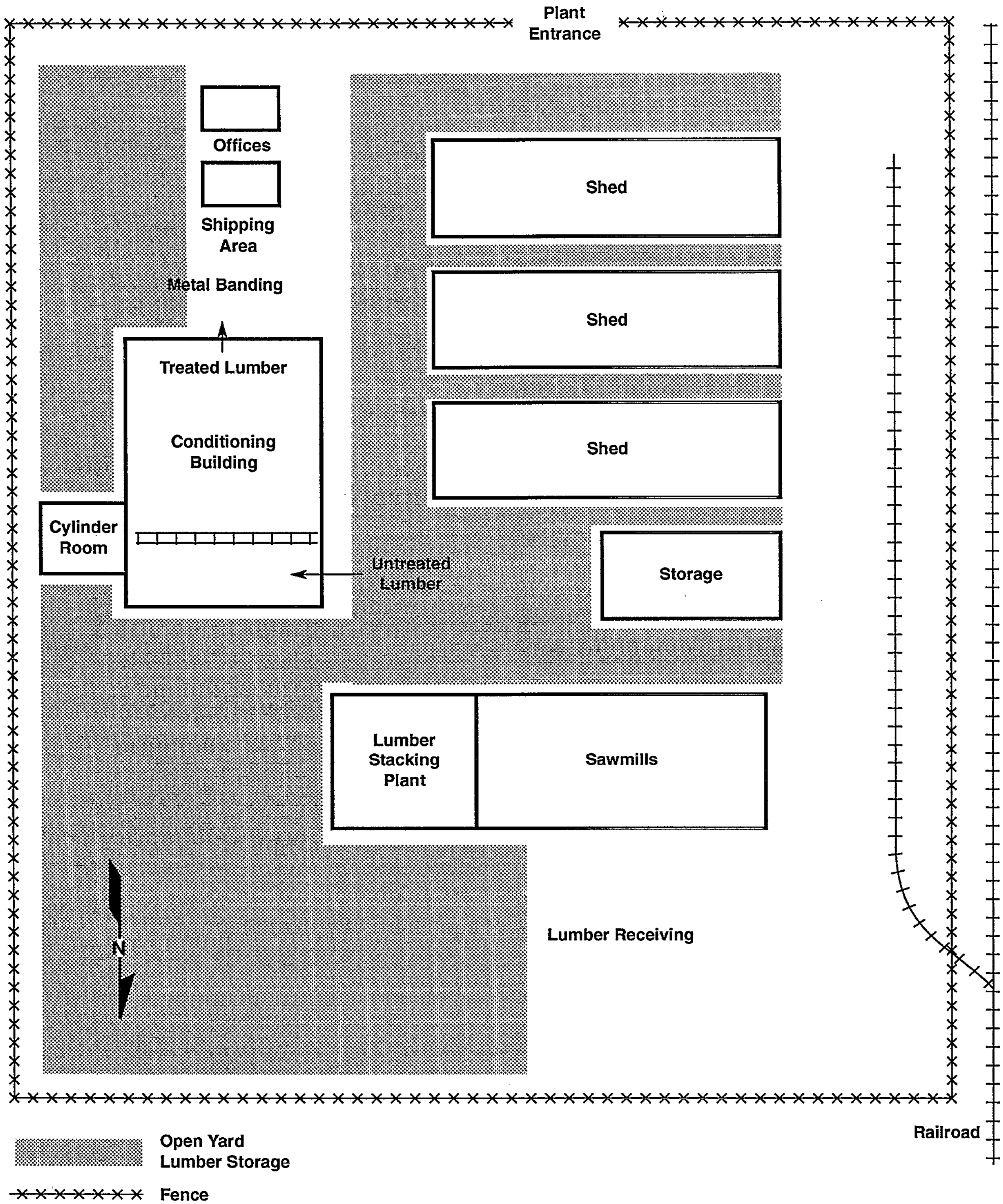


Figure 14. Ranson plant layout (not scaled).

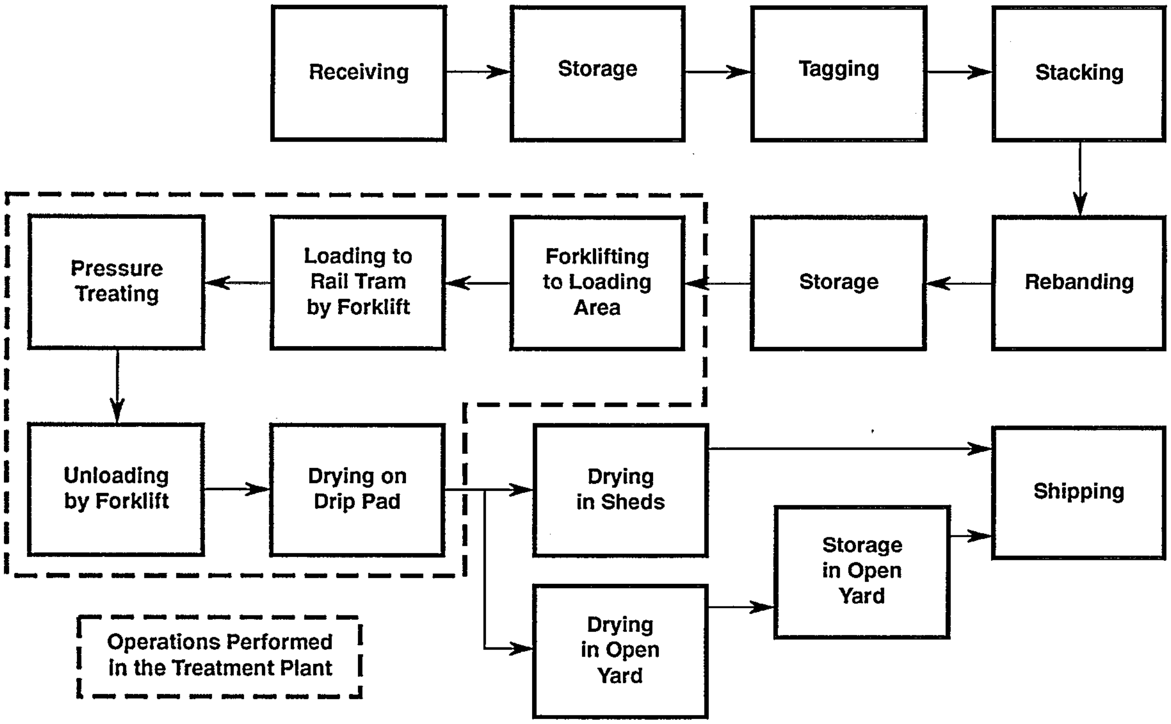


Figure 15. Flow diagram of wood-treating operations at Ranson plant.

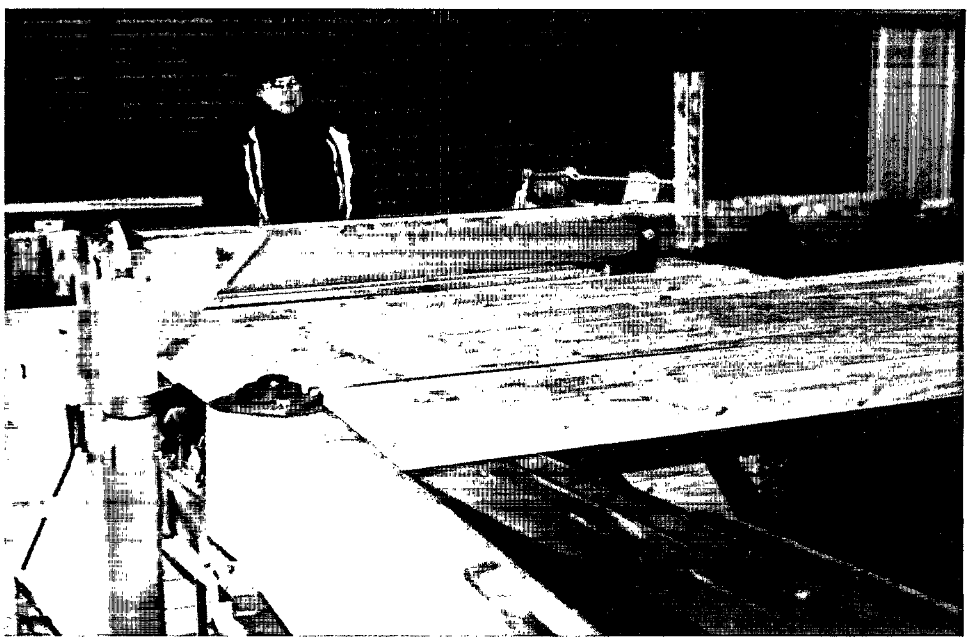


Figure 16. Lumber restacking by a stacker.

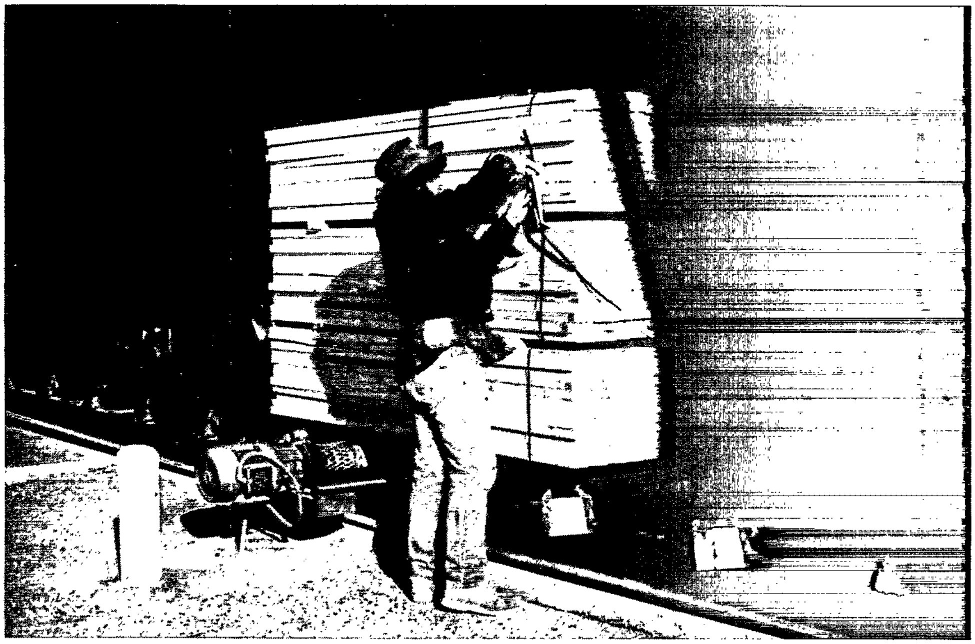


Figure 17. Lumber banding with plastic strap.

is a wooden deck separating the ground level and the underground pits and primary work tank. The cylinder room is heated to normal room temperature.

The combination tank is made of 0.25-in steel. The tank is subdivided into four compartments of different sizes: the 4,500-gal compartment contains 60% CCA concentrate; the 11,400-gal compartment contains water; the 16,000-gal compartment is a secondary storage for the CCA work solution; and the 120-gal compartment is a CCA metering tank. The primary work tank sits in the long section of an L-shaped underground pit (see Figure 20) underneath the cylinder and the wooden deck. The tank holds up to 22,000 gal CCA work solution.

A mold inhibitor (MOLD-EX® H.E.$_{14}$ Wood Mildewcide) is metered into the CCA work solution in the cylinder room (see Figure 21). A typical CCA work solution contains 1.65% CCA active ingredients and 10 ppm mold inhibitor. Occasionally, a wax emulsion (Ultra Wood Concentrate Water Repellent Additive) is added to the CCA work solution to treat products that must be water repellent. The solution is prepared by sequentially adding the wax emulsion, CCA concentrate, and water into the primary work tank and agitating the mixture by opening the primary mixing valve and turning the pressure pump from automatic to manual for 2 to 3 min.

All chemicals are supplied by CSI. In 1992, the annual consumption of the 60% CCA Type-C Concentrate was 90,000 gal (or 840,600 oxide pounds), equivalent to 37 tanker loads. The mold inhibitor consumption was 500 gal, or 15 drums of 35-gal capacity. The wax consumption was 5,000 gal, or 18 totes.

The front (door) pit underneath the cylinder door consists of one 24 ft x 4 ft x 6.9 ft concrete pit with one 8 ft x 3 ft x 3 ft steel liner and one 4 ft x 2 ft x 2 ft steel spillover extension. The concrete pit is coated with a sealer and lined with a layer of plastic liner. The 0.25-in steel liner sits in the front (door) pit and is positioned directly under the

Figure 18. Rail/trench system, lumber loading area (left), and chemical-covered drip pad or conditioning area (right).

cylinder door. The steel liner with four splash guards can hold up to 500 gal of liquid. The overflow from the steel liner is spilled over into the 100-gal spillover extension. Three pumps installed separately at the spillover extension, the steel liner, and the front pit transfer the liquid to the primary work tank for reuse. Below the cylinder is the longer section of the large L-shaped concrete pit measuring approximately 76 ft x 12 ft x 6.9 ft (long section of the L) and 10 ft x 24 ft x 6.9 ft (short section of the L) (see Figure 20). As mentioned above, the primary work tank sits in the long section of the L.

A two-stage automatic alarm system is installed to monitor and alert any chemical spills in the underground pits. If liquid threatens to overflow the steel liner, a red light flashes in the control room to warn plant operators. If liquid spills over to the front (door) or main (L-shaped) pit areas, an automatic telephone calling sequence is triggered. Two levels of plant management are called at home to alert them to the spills. A third call is made to a 24-hour answering service, which initiates calls in sequence according to a list of 12 numbers, until someone responds to the overflow.

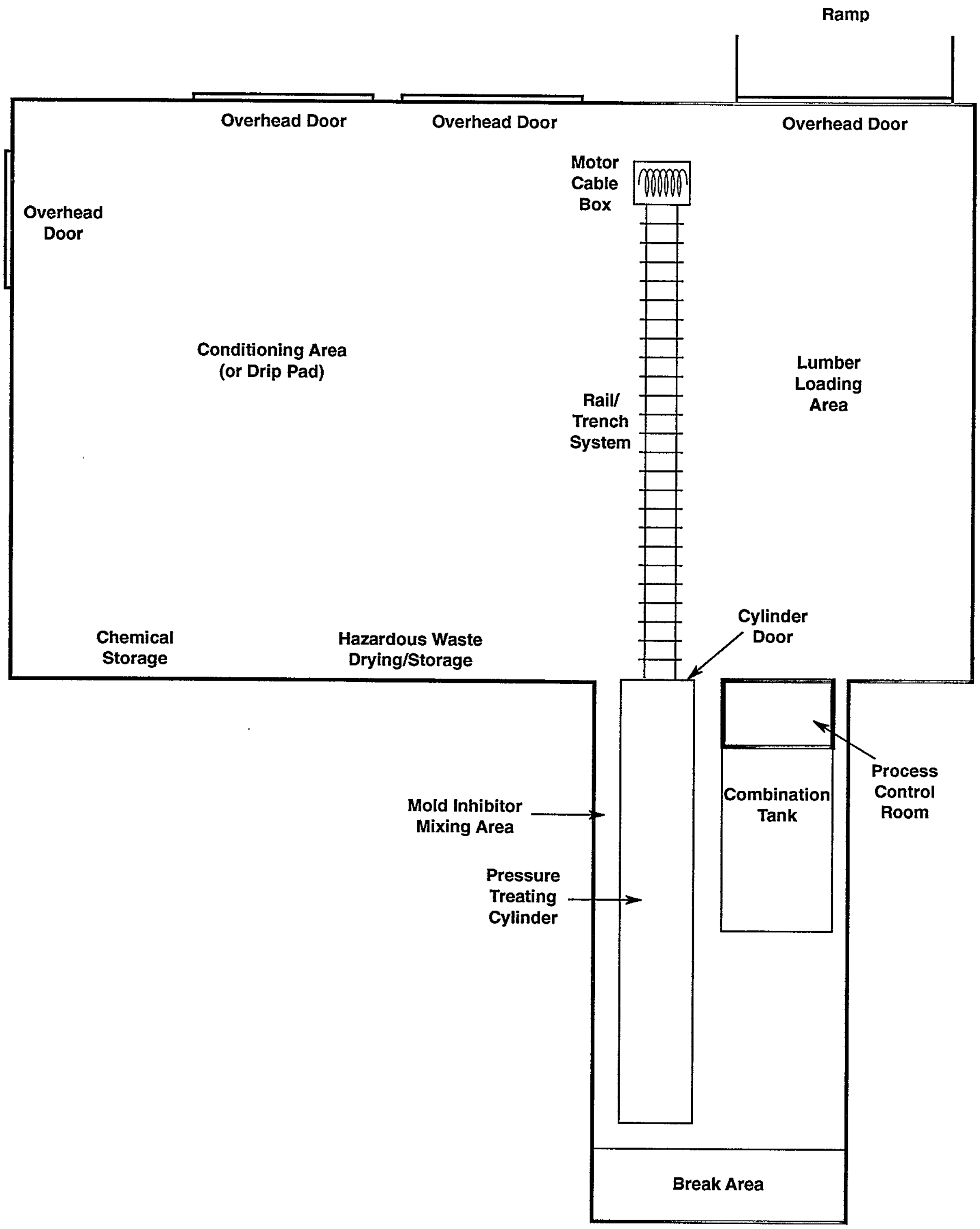


Figure 19. Treatment plant layout at Ranson (not scaled).

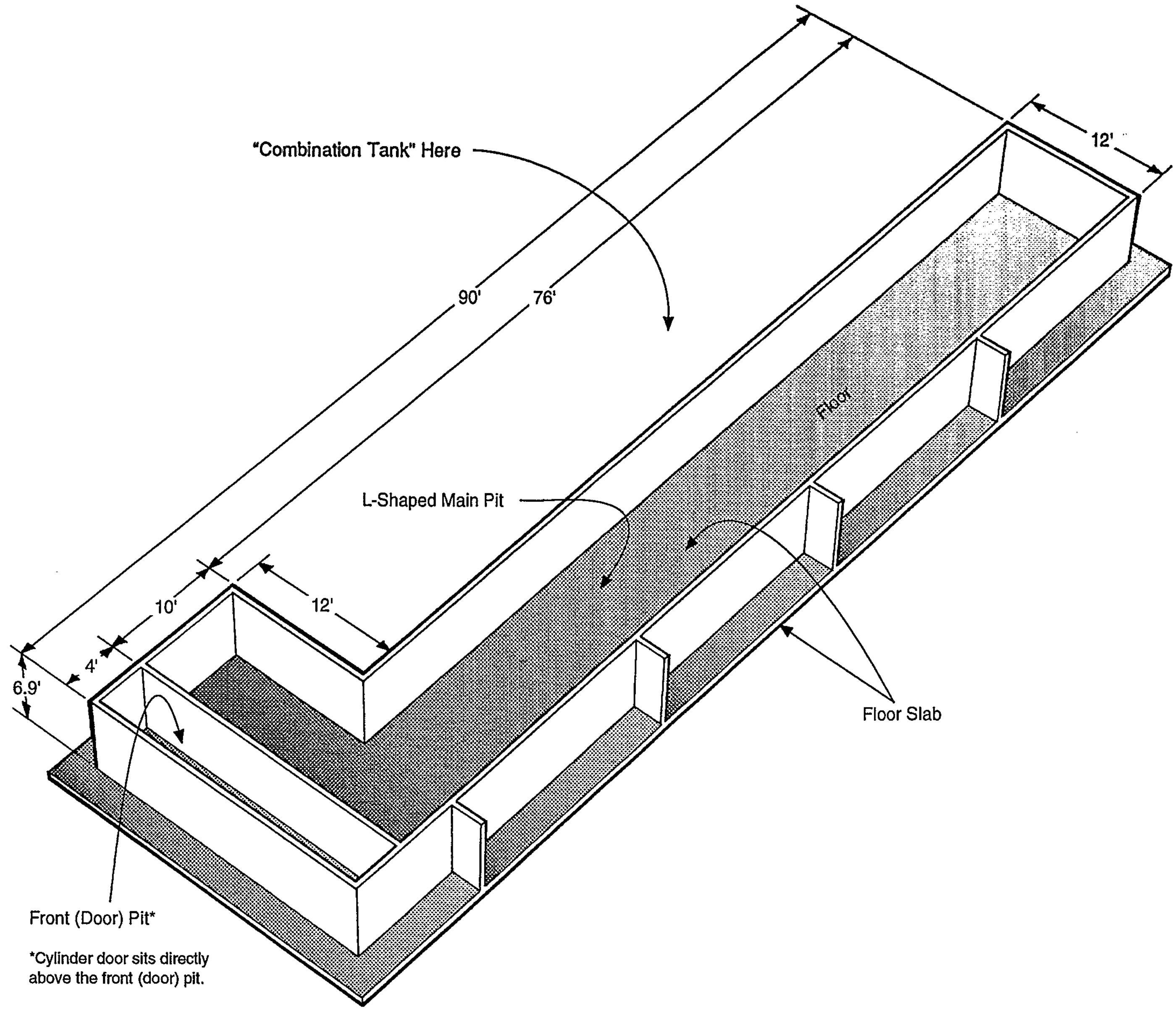


Figure 20. Underground pits.

Figure 21. Floor slab separating treating cylinder and underground pit and underground CCA primary tank (not shown). Mold inhibitor in drums is fed at the cylinder side.

Conditioning Building

The conditioning building is used primarily for lumber loading, lumber unloading, drippage interception, and treated lumber conditioning. The building is divided by a 1-ft wide, 90-ft long, and 4- to 12-in-deep concrete trench that slopes towards the cylinder room (see Figure 18). Two rails at 34 in apart are laid on top of the trench. Trams loaded with untreated or treated lumber are pulled onto or off the cylinder by a motor cable. The motor cable box is located opposite the cylinder door. The entire building is covered with a concrete floor. The area north of the trench is the lumber loading area, and the area south is the conditioning area (or drip pad). The concrete floor of the lumber loading area is 8 in higher than that of the conditioning area.

Operators wearing rubber boots walk around the freshly treated lumber units after treatment to unfasten the belts from the treated units and transfer the treated units from the trams to the conditioning area using forklifts. To facilitate dripping, the lumber units are placed with a slight angle on the drip pad (see Figure 22). The treated lumber units remain

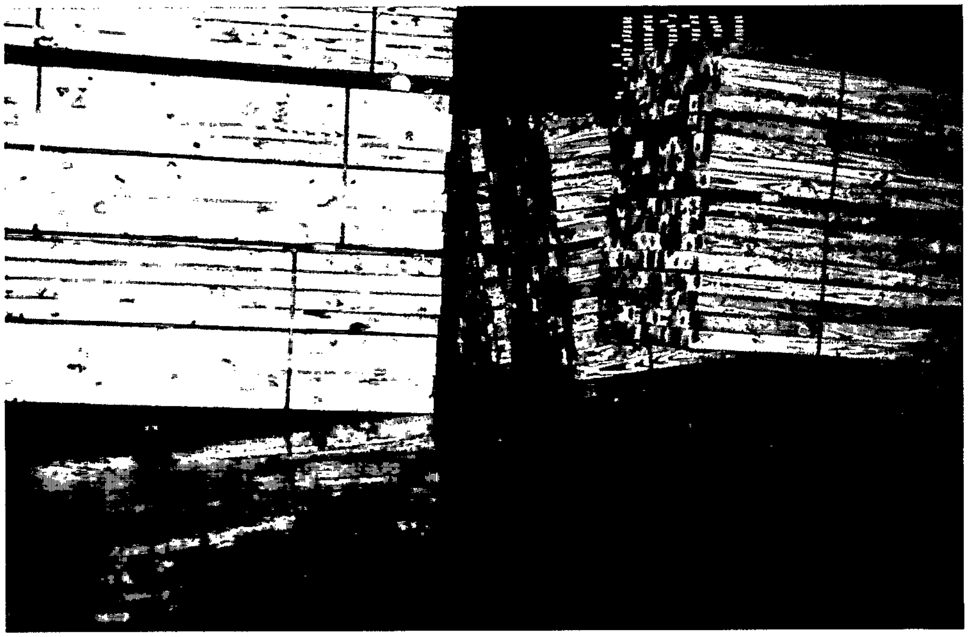


Figure 22. Freshly treated lumber units on drip pad.

on the conditioning area pad for 1 to 3 days before being forklifted to the drying sheds or to the open yard for further drying or storage.

The conditioning area is hosed down daily. Chemicals and washdown water are directed towards the trench and filtered through a wire screen at the end of the trench. The filtered solution flows into the underground steel liner. Wood chips, debris, and sludge intercepted in the trench (see Figure 23) are shoveled weekly to a two-screen setup for air drying (see Figure 24). 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 conditioning building is insulated and heated in the winter by a gas-fired make-up air heater/blower. In summer, the blower can be used to circulate air, augmented by electric fans installed on the side walls. The vents from the cylinders, the combination tank, and the primary work tank are all directed to the conditioning building. Universal Forest Products monitors the arsenic emission annually. The arsenic concentrations in air have been consistently below 5 $\mu g/m^3$.

Process Control Room

The process control room located at the northwest corner of the cylinder room has immediate access to the cylinder room and conditioning building. The control room has a simple setup, including a set of visible volume meters, a process control panel, and a small laboratory bench. The modified full-cell method is used for most treatment. Typically, the treatment begins with chemical flooding under vacuum. Two 12-in pipes are used to transfer enough CCA work solution to flood the cylinder in 3 min. A pressure of up to 175 psi is then exerted on the lumber for 4 to 8 min (until correct absorption of CCA liquid has occurred).

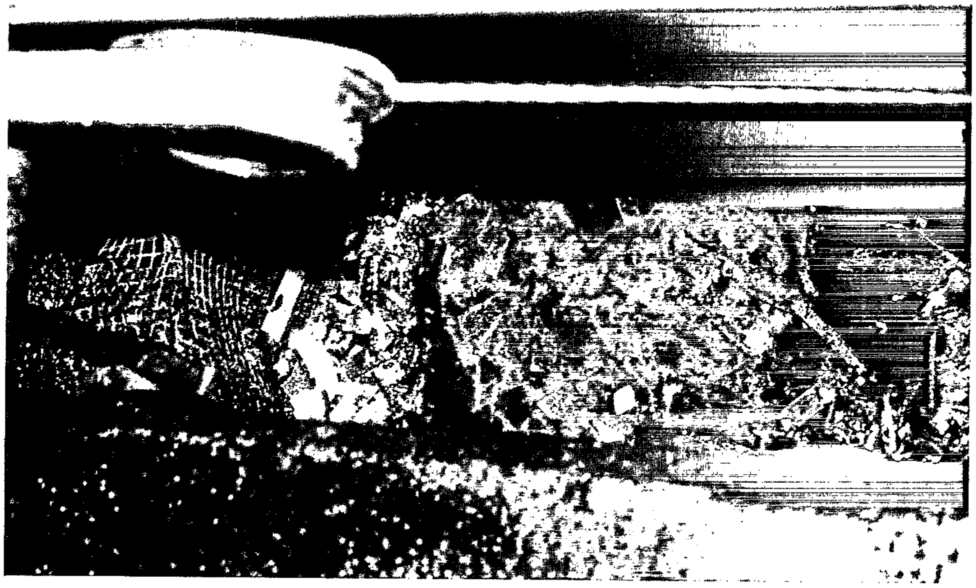


Figure 23. Sludge, wood chips, and debris in trench.

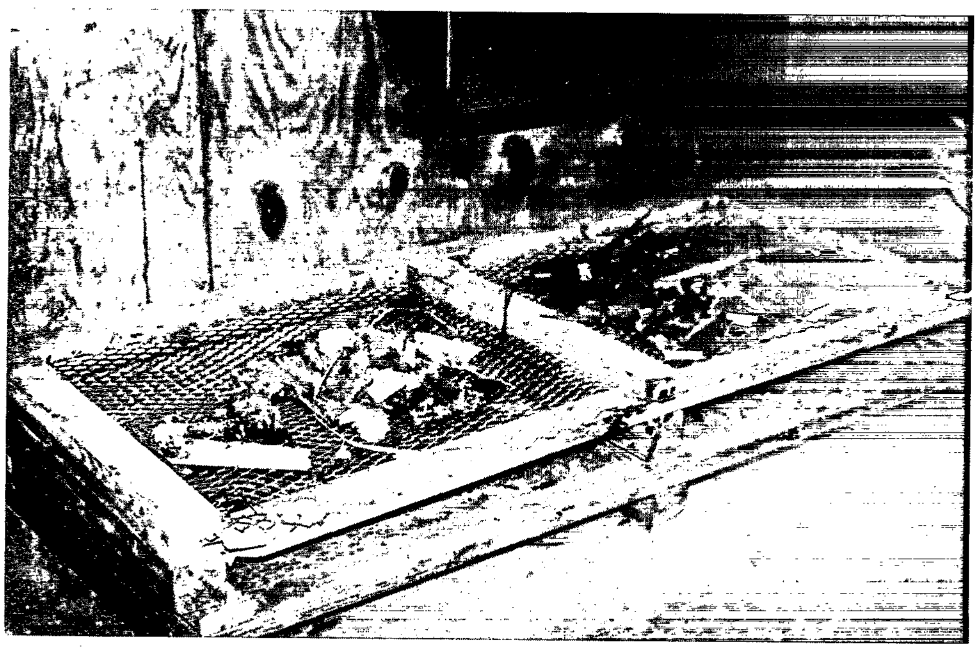


Figure 24. Two-screen setup for solid waste air drying.

An initial drain of chemical follows and lasts for 3 min. A final vacuum of 28 in Hg is applied for 20 to 30 min. A final drain lasts for 3 to 5 min.

The treated products are analyzed for chemical retention using an X-ray fluorescence analyzer. The analysis reports total and individual oxide retention (as CrO_3, CuO, and As_2O_6) in lb/ft^3.

SECTION 4

WASTE MINIMIZATION PRACTICES

Both Madison Wood Preservers, Inc. and Universal Forest Products Ranson Plant have adapted a number of waste minimization (WM) practices that have greatly improved the plants' ability to prevent pollution and reduce wastes. The WM practices have been reflected in several areas, including facility designs, process controls, and management practices. This section describes these WM practices and explains how they affect pollution prevention and waste reduction.

FACILITY DESIGNS

The treatment plants have incorporated many pollution prevention designs, including enclosed treatment buildings, covered drip pads, a drip pan, an automatic lumber handling system, power rollers, a tank farm, spill containments, and air ventilation systems.

Enclosed Treatment Buildings

Both treatment plants are housed in enclosed structures, which provide shelters for chemical storage and mixing, lumber handling and treating, process control, and/or lumber conditioning and drying. The enclosed treatment buildings protect chemicals, treating facilities, freshly treated wood, and drip pads from direct exposure to the ambient weather conditions, thereby reducing the possibility of chemical contamination to the environment.

Covered Drip Pads and Drip Pan

Both treatment plants have a concrete floor covering the entire plant. The MW plant has an elevated metal drip pan. The concrete floor has an impermeable Plasite™ surface coating. The drip pan intercepts chemicals dripping from the cylinder doors and freshly treated lumber; therefore, no direct contact between the chemicals and the concrete floor would ever occur unless there is a major chemical spill. The recessed floor covers the areas under both the drip pan and the three treating cylinders. The recessed floor can function as a chemical spill containment to retain spilled liquid that overflows from the primary containment in the tank farm.

The unique design of the drip pan and the lumber-conveying system eliminates the need for human and equipment traffic during lumber handling and treating. Because chemicals are not tracked from the drip pan and the drip pad, hazardous wastes generated in the treatment plant are significantly reduced.

The chemicals intercepted by the drip pan 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. Therefore, no sludge accumulation would be expected in the treating cylinders and CCA work tanks.

In contrast, the lumber-handling operations at RP require both people and equipment operating on the conditioning area (or drip pad) where a significant amount of chemicals accumulate (see Figure 18). The operations involve transferring freshly treated lumber units from trams to the conditioning area by forklifts. The tires of the dedicated forklifts may be soaked in chemical solutions, but the vehicle is confined to the conditioning area to avoid tracking of chemicals to the surrounding areas. Operators wearing rubber boots must walk on chemicals over the areas by the cylinder door, the trench, and the drip pad. As a result, chemicals can often be tracked inadvertently from the drip pad to the surrounding areas, such as the lumber-loading area, process control room, and cylinder room. It is also possible to further track chemicals into the break room (next to the cylinder room) and to the areas outside of the treatment plant. Additional access to the break room is provided from the outside yard to prevent tracking of chemicals to that location.

Automatic Lumber Handling System and Power Rollers

MW uses the automatic lumber handling system and power rollers for its lumber loading and unloading operations. The automatic lumber handling system transfers lumber units from the white chain to the center-line chain and to the green chain by chain conveyors. The power rollers and the center-line chain transfer lumber units into and out of the treating cylinders (see Figure 25). The treated lumber units remain on the green chain until dripping ceases. This method of lumber handling abandons the conventional forklift and rail-tram system, thereby eliminating any direct contact between people and chemicals and between equipment and chemicals.

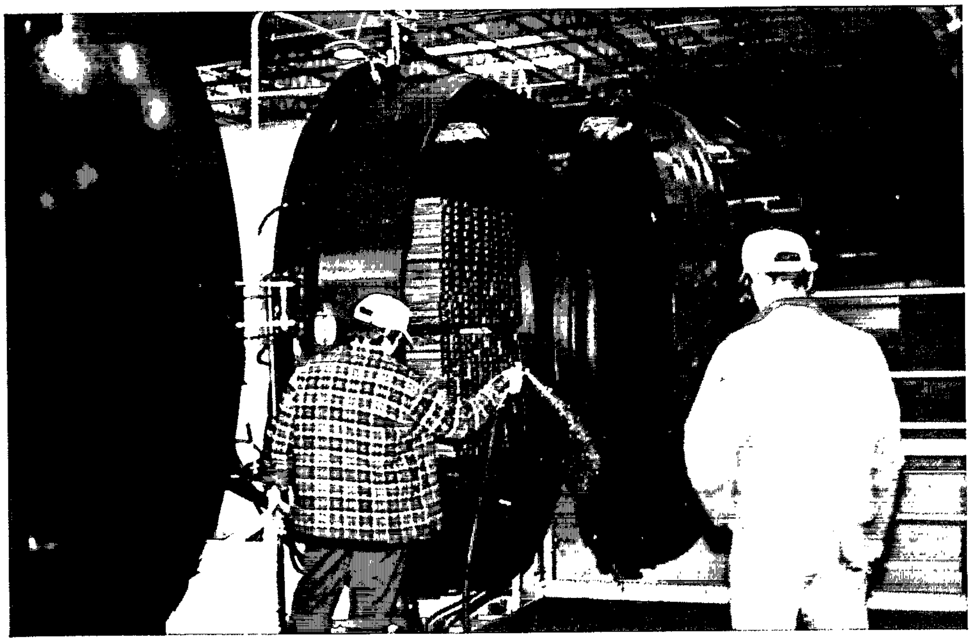


Figure 25. Cylinder door opened right after treatment. Treated lumber will be removed from the cylinder by powered rollers and lumber handling system (not shown).

RP uses the conventional forklift and rail-tram system for lumber handling. Operators hose down daily the conditioning area, the trench, and the areas surrounding the cylinder door. The sludge, debris, and wood chips intercepted in the trench are shoveled weekly and air-dried on a two-screen setup before being disposed of.

Tank Farm and Spill Containments

MW places all of its chemical tankage in a heated building, or tank farm. The tank farm incorporates several effective pollution prevention designs, including the primary spill containment, elevated CCA concentrate tank, CCA concentrate inside unloading point, enclosed chemical mixing system, and remote monitoring and control capabilities.

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 containments 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 is coated with a layer of impermeable coating and lined with an 80-mil liner. The lined area is monitored by six detection systems for chemical leakage.

The CCA concentrate tank is elevated off the concrete floor with a cone-shaped bottom. The elevated tank and cone-shaped bottom facilitate inspection and allow 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 right next to the concentrate tank, thus preventing any release of chemical spills to the uncontrolled areas. All CCA work tanks sit 1 in off the concrete floor on metal strips to aid in detection of chemical leaks.

Chemical mixing is carried out in a computer-controlled enclosed system. In addition, the tank farm has automatic temperature, pressure, and safety switches for remote monitoring and control. These designs eliminate the need for workers to enter the tank farm on a regular basis, thus reducing worker exposure to the chemicals.

The more conventional RP design does not include a separate building for its combination tank and the primary CCA work tank. However, the concrete pits are large enough (about 60,000 gal capacity) to hold the maximum possible content of the combination tank and primary work tank at one time (about 54,000 gal). In addition, the conditioning building floor is designed as a secondary containment. In the event of a catastrophic failure of a water line, this area can hold an additional 25,000 gal of liquid before overflow to the uncontrolled areas could occur. If the spills are minor, the three pumps equipped to the underground pit would transfer the liquid to the primary or secondary work tank. The automatic alarm/telephoning system provides further protection against chemical buildup in the pits.

The underground pits are covered with a wooden deck, and access to the pits is restricted to three access positions with a fixed ladder. The rectangular combination tank sitting on a concrete floor is surrounded by a retaining wall on one side and the process control room on the other side. The primary work tank lies in the L-shaped underground pit underneath the wooden deck. All of these areas are not readily seen from the treatment plant level. Therefore, monitoring of chemical leaks would not be as easy as at MW. However, RP does have a remote monitoring and control system in place.

Air Ventilation Systems

MW's treatment building has eight roof fans that provide a complete air exchange every 15 min. The tank farm is used as a single point source for all venting from the cylinders and chemical tanks. Because the plant incorporates designs to minimize mist or droplet emissions from the cylinders and work tanks, no additional air pollution control devices are installed in the tank farm. The plant is exempt from DAPC permitting requirements because its arsenic emission is much lower than the regulated limit.

RP directs the vents from the cylinder, combination tank, and primary work tank to the conditioning building. The conditioning building has air ventilation in the form of makeup air through the heater/blower and fans on the outside walls.

PROCESS CONTROLS

The treatment processes at MW are carefully controlled to ensure proper chemical retention and minimal dripping. Several process control methods are used and are summarized as follows:

- CCA oxides are used to enhance chemical fixation in wood.

- The treatment processes are computer-controlled and monitored.

- Lightweight products that drip less are produced via rapid cycle treatment. The treatment is performed by feeding the treating cylinders with CCA work solution at rates up to 8,000 gpm. The industry's largest pumps and 12-in fill lines are used to facilitate this process. CCA chemicals are pushed into wood cells in less than 4 min.

- High pressure at 150 to 165 psi over a period of 5 to 8 min is applied to the products treated. These treatment conditions eliminate excessive dripping.

- After the high-pressure treatment, a slow-pressure release follows immediately and lasts for about 8 to 15 min. This also results in less dripping.

- Large vacuum pumps pull vacuum up to 27 in Hg within only 1 to 2 min. The final vacuum lasts up to a period of 2 hrs. This again reduces the amount of dripping from the treated products.

- The strip pumps continuously remove residual chemical solutions back to the CCA work tank. This results in less dripping when opening the cylinder doors.

- The treating cylinders are slightly tilted toward the work tank. This, again, allows less dripping when opening the cylinder doors.

- The 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's training programs are in place for continuous improvement of treatment controls and skills.

RP's treatment conditions are similar to those used by MW, except that the pressure release after the high-pressure treatment lasts for only 3 min and the final vacuum lasts for only 20 to 30 min.

MANAGEMENT PRACTICES

Several management practices adapted by both treatment plants have a significant impact on pollution prevention and waste reduction. These practices include pretreatment quality control, improved housekeeping, resource recovery and recycling, and operator training.

Pretreatment Quality Control

Pretreatment quality control (PQC) is considered as one of MW's most important methods to control waste volume. PQC begins even before the lumber reaches the plant. For example, MW does not buy lumber from sawmills that do not keep lumber neat and clean. MW also requires that all truckloads of lumber be tarped during transit to reduce the amount of road dust and grime on the lumber. (MW estimates that having loads tarped reduces hazardous wastes by 3 to 4 drums per year.) Upon arrival, shipment loads are inspected by experienced inspectors to determine if they meet specifications and are without unwanted damages. Off-grade or damaged lumber is returned to the shipping sawmills to reduce waste volume. When necessary, the lumber will be power-washed and wood chips and debris removed before it is forklifted into the treatment plant. The wood chips and debris removed at the receiving area are disposed of as a nonhazardous waste.

PQC can significantly reduce the quantity of hazardous wastes by:

- Reducing the quantity of sludge generated in the treating cylinder, chemical work tanks, and/or bag filters.
- Reducing the quantity of unsalable, out-of-spec, and/or damaged wood products that would have to be disposed of as a hazardous waste.
- Reducing the quantity of wood chips and debris that have been inadvertently treated and, then, must be disposed of as a hazardous waste.

Improved Housekeeping

Although the contribution of improved housekeeping to overall waste minimization is difficult to quantify, simple housekeeping improvements may provide low- or no-cost opportunities for reducing waste. MW considers housekeeping an integral part of its waste minimization effort. The following housekeeping items are practiced at the MW plant:

- The concrete floor in the treatment building is vacuum-swept daily by a riding power vac and manually swept in areas inaccessible to the power vac.

- High-grade rubber tires are used on forklifts. Currently MW is using white solid rubber tires to reduce/eliminate tire marks on the concrete floor (see Figure 26), which, in turn, reduces waste volume generated in the plant.

- MW inspects regularly the concentrate tank, work tanks, automatic chemical mixing system, treating cylinders, drip pan, lumber-handling system, and spill containments for chemical leaks and spills. These areas are kept neat and clean. No chemicals, liquid puddles, or debris are observed throughout these areas.

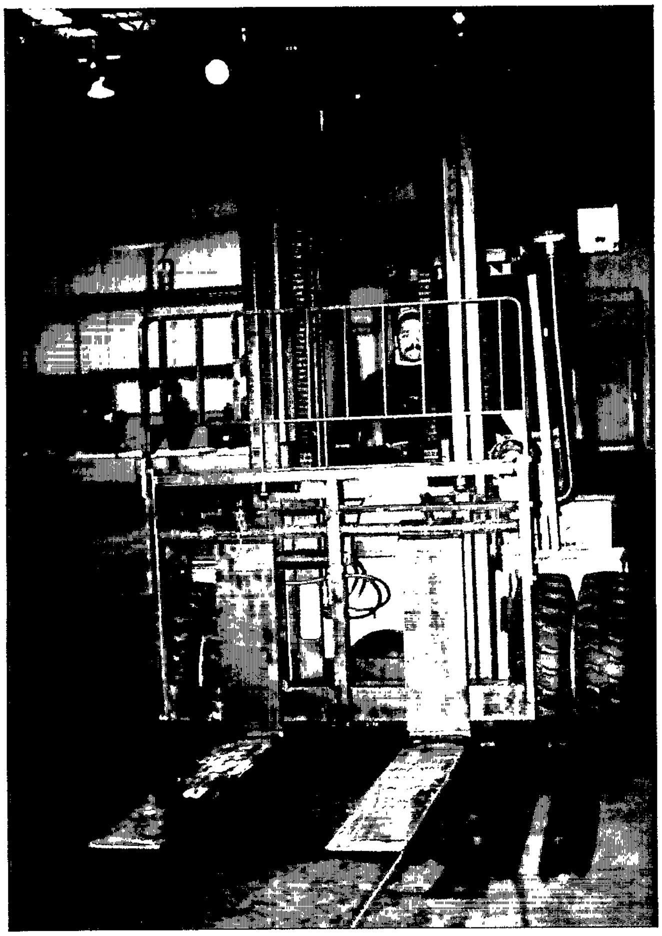


Figure 26. Tire marks on concrete floor as a result of forklift operations.

- 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 any chemical dripping.

- Lumber, treated or untreated, is stacked neatly on the lumber-handling system, in the treatment building (see Figure 27), or in the warehouse storage yard to prevent the treated products from being damaged and becoming unsalable. Any damaged products, wood chips, and debris can be disposed of only as hazardous wastes.

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

- Wood crosspieces are used to separate wood units and to avoid damage to wood by forklift (see Figure 4).

- The treated lumber, after remaining on the lumber-handling system for 1 to 2 days, is removed for further drying either in the same treatment building or in the drying shed (for outdoor products only). Because of space shortage, about 25% of the outdoor products are placed in the open yard for open-air drying. The lumber stacks in the open yard are covered with paper to provide some protection from direct exposure to rain. The paper covering reduces the amount of arsenic and chromium being leached into stormwater runoff.

Figure 27. Neatly stacked lumber units in the treatment plant.

Resource Recovery and Recycling

Both treatment plants are zero-discharge facilities, which recycle chemical drips, spills, rinse water, and washdown water as a process water. MW also recycles most of its waste materials and chemical containers. Some examples are:

- Metal banding used to fasten truckloads of lumber in transit. MW makes 3.5¢/lb by recycling the metal banding.

- Plastic banding used to reband lumber before treatment. The plastic banding is chopped into 2-in pieces and stored in large cardboard containers before recycling (see Figure 28). MW makes 8¢/lb by recycling the plastic banding.

- Wood crosspieces separating wood units. MW has a rebate program with the manufacturer.

- Wax totes. MW returns empty totes to the manufacture (36 to 40 totes per trailer load) and receives $50/tote rebate on wax refill. The damaged totes are rinsed for use as containers.

- Mold inhibitor containers. These containers are rinsed for use as regular storage containers.

- Wood trim and strips from milling operations. The 1-in x 2-in strips are used to produce lattice (see Figure 29).

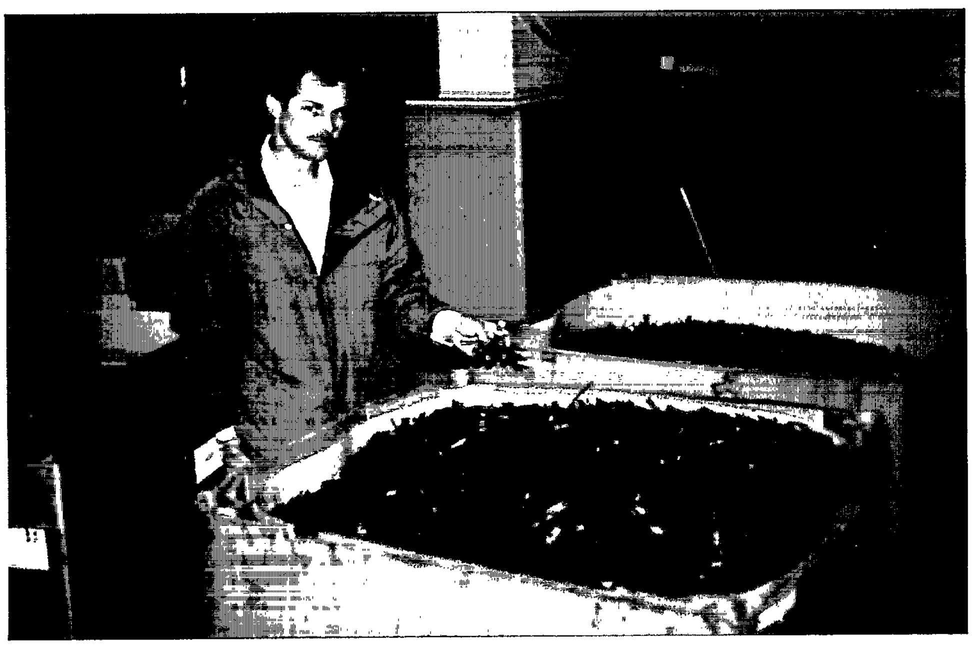


Figure 28. Chopped plastic banding stored in large cardboard boxes for recycling.

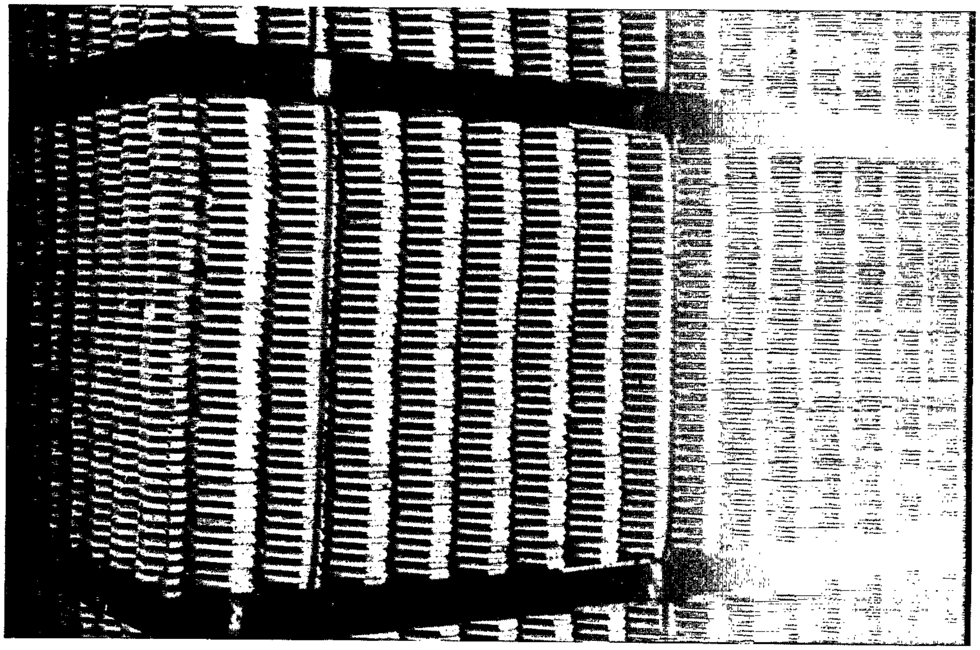


Figure 29. Stack of 1′ x 2′ lattice produced from wood trims and strips from milling operations.

RP disposes of most of its chemical containers and wood trim and strips from its milling operations.

Operator Training

MW and RP believe that to have a good operator training program in place is another way to reduce waste. For example, a well-trained operator has better knowledge of the treatment processes and his/her equipment, thus reducing the risks of producing inadequately treated products or causing unneeded damage to the treated products. This knowledge results in reduced waste volume.

SECTION 5

HAZARDOUS WASTES GENERATED

This section describes the hazardous wastes generated by the two treatment plants.

HAZARDOUS WASTES GENERATED BY MADISON WOOD PRESERVERS

MW generated nine and six 55-gal drums of hazardous waste in 1991 and 1992, respectively. Some of this hazardous waste was associated with shutting down the old plant and moving over to the new plant. The projected waste volume to be generated by the new treatment plant in 1993 is two to four drums, or one drum every 90 days. The waste is composed of sludge removed from the filter bags, pump screens, and under the cylinder door traps, dust, tags, and miscellaneous items. The disposal cost is about $200/drum. The disposal is triggered by the U.S. EPA 90-day time guideline.

MW's EPA generator number is VAD003086360. Its SIC Code is 2491.

HAZARDOUS WASTES GENERATED BY UNIVERSAL FOREST PRODUCTS RANSON PLANT

RP generates four drums/yr hazardous waste, or about one drum per 90 days. The waste is collected from the bottom screen of the 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 of the two-screen setup typically are disposed of as nonhazardous wastes. RP does, however, verify the toxicity characteristics of these large items by the Toxicity Characteristics Leaching Procedure (TCLP).

RP's EPA generator number is WVD982364309. Its EPA profile number is RVF BD101.

SECTION 6

REFERENCES

Loebenstein, J. R. 1991. "Arsenic." *Minerals Yearbook*. U.S. Department of Interior, Bureau of Mines, Washington, D.C.

Loebenstein, J. R. 1992. "Arsenic: Supply, Demand, and the Environment." *Proc. Arsenic & Mercury: Workshop on Removal, Recovery, Treatment, and Disposal.* Alexandria, Virginia, August, 17-20.

U.S. Environmental Protection Agency (U.S. EPA). 1988. *Waste Minimization Opportunity Assessment Manual*. EPA/625/7-88/003, Hazardous Waste Engineering Research Laboratory, Office of Research and Development, Cincinnati, Ohio.

APPENDIX A

WASTE MINIMIZATION ASSESSMENT WORKSHEETS

Firm ____	Waste Minimization Assessment	Prepared By ____
Site ____		Checked By ____
Date ____	Proj. No. ____	Sheet 1 of 1 Page ___ of ___

WORKSHEET 4

SITE DESCRIPTION

EPA

Firm:

Plant:

Department:

Area:

Street Address:

City:

State/ZIP Code:

Telephone: (   )

Major Products:

SIC Codes:

EPA Generator Number :

Major Unit or:

Product or:

Operations:

Facilities/Equipment Age:

Firm ______	**Waste Minimization Assessment**	Prepared By ______
Site ______		Checked By ______
Date ______	Proj. No. ______	Sheet 1 of 1 Page ___ of ___

WORKSHEET 5

PERSONNEL

EPA

Attribute	Overall	Department/Area			
Total Staff					
Direct Supv. Staff					
Management					
Average Age, yrs.					
Annual Turnover Rate %					
Seniority, yrs.					
Yrs. of Formal Education					
Training, hrs./yr.					
Additional Remarks					

Firm ______________	**Waste Minimization Assessment**	Prepared By ______________
Site ______________		Checked By ______________
Date ______________	Proj. No. ______________	Sheet 1 of 1 Page ___ of ___

WORKSHEET 6

PROCESS INFORMATION

EPA

Process Unit/Operation: ______________________________

Operation Type: ☐ Continuous ☐ Discrete ☐ Batch or Semi-Batch ☐ Other ______________

Document	Status					
	Complete? (Y/N)	Current? (Y/N)	Last Revision	Used in this Report (Y/N)	Document Number	Location
Process Flow Diagram						
Material/Energy Balance						
Design						
Operating						
Flow/Amount Measurements						
Stream						
Analyses/Assays						
Stream						
Process Description						
Operating Manuals						
Equipment List						
Equipment Specifications						
Piping & Instrument Diagrams						
Plot and Elevation Plan(s)						
Work Flow Diagrams						
Hazardous Waste Manifests						
Emission Inventories						
Annual/Biennial Reports						
Environmental Audit Reports						
Permit/Permit Applications						
Batch Sheet(s)						
Materials Application Diagrams						
Product Composition Sheets						
Material Safety Data Sheets						
Inventory Records						
Operator Logs						
Production Schedules						

Firm ____	Waste Minimization Assessment	Prepared By ____
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WORKSHEET 7

INPUT MATERIALS SUMMARY

EPA

Attribute	Description[1]		
	Stream No.____	Stream No.____	Stream No.____
Name/ID			
Source/Supplier			
Component/Attribute of Concern			
Annual Consumption Rate			
Overall			
Component(s) of Concern			
Purchase Price, $ per ____			
Overall Annual Cost			
Delivery Mode[2]			
Shipping Container Size & Type[3]			
Storage Mode[4]			
Transfer Mode[5]			
Empty Container Disposal/Management[6]			
Shelf Life			
Supplier Would			
- accept expired material (Y/N)			
- accept shipping containers (Y/N)			
- revise expiration date (Y/N)			
Acceptable Substitute(s), if any			
Alternate Supplier(s)			

1 stream numbers, if applicable, should correspond to those used on process flow diagrams.
2 e.g., pipeline, tank car, 100 bbl. tank truck, truck, etc.
3 e.g., 55 gal. drum, 100 lb. paper bag, tank, etc.
4 e.g., outdoor, warehouse, underground, aboveground, etc.
5 e.g., pump, forklift, pneumatic transport, conveyor, etc.
6 e.g., crush and landfill, clean and recycle, return to supplier, etc.

Firm ____	Waste Minimization Assessment	Prepared By ____
Site ____		Checked By ____
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WORKSHEET 8

PRODUCTS SUMMARY

EPA

Attribute	Description[1]		
	Stream No.____	Stream No.____	Stream No.____
Name/ID			
Component/Attribute of Concern			
Annual Production Rate			
Overall			
Component(s) of Concern			
Annual Revenues, $ ______			
Shipping Mode			
Shipping Container Size & Type			
Onsite Storage Mode			
Containers Returnable (Y/N)			
Shelf Life			
Rework Possible (Y/N)			
Customer Would			
- relax specification (Y/N)			
- accept larger containers (Y/N)			

1 stream numbers, if applicable, should correspond to those used on process flow diagrams.

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Site ______		Checked By ______
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WORKSHEET 9a

INDIVIDUAL WASTE STREAM CHARACTERIZATION

EPA

1. Waste Stream Name/ID: ______ Stream Number ______
   Process Unit/Operation ______

2. Waste Characteristics (attach additional sheets with composition data, as necessary.)

   ☐ gas ☐ liquid ☐ solid ☐ mixed phase

   Density, lb/cuft ______ High Heating Value, Btu/lb ______
   Viscosity/Consistency ______
   pH ______ ,Flash Point ______ ; % Water ______

3. Waste Leaves Process as:
   ☐ air emission ☐ waste water ☐ solid waste ☐ hazardous waste

4. Occurrence
   ☐ continuous ______
   ☐ discrete ______
   discharge triggered by ☐ chemical analysis ______
   ☐ other (describe) ______
   Type: ☐ periodic ______ length of period: ______
   ☐ sporadic (irregular occurrence)
   ☐ non-recurrent

5. Generation Rate
   Annual ______ lbs per year
   Maximum ______ lbs per ______
   Average ______ lbs per ______
   Frequency ______ batches per ______
   Batch Size ______ average ______ range

Firm ______	**Waste Minimization Assessment**	Prepared By ______
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WORKSHEET 9b

INDIVIDUAL WASTE STREAM CHARACTERIZATION

(continued)

EPA

6. Waste Origins/Sources

Fill out this worksheet to identify the origin of the waste. If the waste is a mixture of waste streams, fill out a sheet for each of the individual waste streams.

Is the waste mixed with other wastes? ☐ Yes ☐ No

Describe how the waste is generated.

______

Example: Formation and removal of an undesirable compound, removal of an unconverted input material, depletion of a key component (e.g., drag-out), equipment cleaning waste, obsolete input material, spoiled batch and production run, spill or leak cleanup, evaporative loss, breathing or venting losses, etc.

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WORKSHEET 9c

INDIVIDUAL WASTE STREAM CHARACTERIZATION

(continued)

EPA

Waste Stream ______

7. Management Method

Leaves site in
- ☐ bulk ______
- ☐ roll off bins ______
- ☐ 55 gal drums ______
- ☐ other (describe) ______

Disposal Frequency ______

Applicable Regulations[1] ______

Regulatory Classification[2] ______

Managed
- ☐ onsite ☐ offsite
- ☐ commercial TSDF ______
- ☐ own TSDF ______
- ☐ other (describe) ______

Recycling
- ☐ direct use/re-use ______
- ☐ energy recovery ______
- ☐ redistilled ______
- ☐ other (describe) ______

reclaimed material returned to site?

☐ Yes ☐ No ☐ used by others

residue yield ______

residue disposal/repository ______

Note[1] list federal, state & local regulations, (e.g., RCRA, TSCA, etc.)

Note[2] list pertinent regulatory classification (e.g., RCRA - Listed K011 waste, etc.)

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WORKSHEET 9d

INDIVIDUAL WASTE STREAM CHARACTERIZATION

(continued)

EPA

Waste Stream ____

7. **Management Method (continued)**

Treatment

- [ ] biological ____
- [ ] oxidation/reduction ____
- [ ] incineration ____
- [ ] pH adjustment ____
- [ ] precipitation ____
- [ ] solidification ____
- [ ] other (describe) ____

residue disposal/repository ____

Final Disposition

- [ ] landfill ____
- [ ] pond ____
- [ ] lagoon ____
- [ ] deep well ____
- [ ] ocean ____
- [ ] other (describe) ____

Costs as of ____ (quarter and year)

Cost Element:	Unit Price $ per ___	Reference/Source:
Onsite Storage & Handling		
Pretreatment		
Container		
Transportation Fee		
Disposal Fee		
Local Taxes		
State Tax		
Federal Tax		
Total Disposal Cost		

Firm ______	Waste Minimization Assessment	Prepared By ______
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WORKSHEET 10

WASTE STREAM SUMMARY

EPA

Attribute		Description[1]					
		Stream No. ____		Stream No. ____		Stream No. ____	
Waste ID/Name:							
Source/Origin							
Component/or Property of Concern							
Annual Generation Rate (units ______)							
Overall							
Component(s) of Concern							
Cost of Disposal							
Unit Cost ($ per: ______)							
Overall (per year)							
Method of Management[2]							
Priority Rating Criteria[3]	Relative Wt. (W)	Rating (R)	R x W	Rating (R)	R x W	Rating (R)	R x W
Regulatory Compliance							
Treatment/Disposal Cost							
Potential Liability							
Waste Quantity Generated							
Waste Hazard							
Safety Hazard							
Minimization Potential							
Potential to Remove Bottleneck							
Potential By-product Recovery							
Sum of Priority Rating Scores		$\Sigma(R \times W)$		$\Sigma(R \times W)$		$\Sigma(R \times W)$	
Priority Rank							

Notes: 1. Stream numbers, if applicable, should correspond to those used on process flow diagrams.

2. For example, sanitary landfill, hazardous waste landfill, onsite recycle, incineration, combustion with heat recovery, distillation, dewatering, etc.

3. Rate each stream in each category on a scale from 0 (none) to 10 (high).

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