Waste Minimization Assessment Procedures:

Module II

UNIT 1:
WASTE MINIMIZATION ASSESSMENT PROCEDURES WITH SELF-TESTING EXERCISES

FOR THE INSPECTOR

A joint project of

- University Extension, University of California, Riverside
- California Department of Toxic Substances Control, Alternative Technology Division
- United States Environmental Protection Agency
WASTE MINIMIZATION ASSESSMENT PROCEDURES

MODULE II

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JOINT PROJECT OF
UNIVERSITY EXTENSION
UNIVERSITY OF CALIFORNIA, RIVERSIDE
ALTERNATIVE TECHNOLOGY DIVISION
CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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* Official Notice can be found in Appendix D of Unit One and Appendix C of Unit Two.
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INTRODUCTION

Recent public concern over risks to health and damage to the environment on a global scale has pressured local, state, and federal governments to adopt ways of limiting the generation of hazardous wastes at their sources. Waste minimization and pollution prevention concepts must become a primary consideration of all businesses in light of shrinking landfill capacity, potential for groundwater contamination, rising liability and disposal costs, and air quality issues.

Waste minimization and pollution prevention practices can be promoted by a public-private partnership between industry and government. The role of the inspector in the waste minimization process, as a provider of resource materials and information to generators of hazardous waste, is critical to help industry achieve waste minimization goals within the complex regulatory framework. This module discusses the various aspects and approaches an inspector can use to promote waste minimization and pollution prevention. With the use of the attached outline of Waste Minimization Assessment Procedures, inspectors will become familiar with instructions and background information to assist industry in the compilation of essential facts that will prompt waste minimization and pollution prevention strategies. Further detailed procedures can be found in the EPA Waste Minimization Opportunity Assessment Manual and in the Waste Reduction Assessment and Technology Transfer Training Manual prepared by the University of Tennessee Center for Industrial Services.

The legal impetus for waste minimization is found in the Resource Conservation and Recovery Act (RCRA), as amended by the U.S. Congress, in November, 1984. The following is an excerpt from the legislative intent:

"The Congress hereby declares it to be the national policy of the United States, that, wherever feasible, the generation of hazardous waste is to be reduced or eliminated as expeditiously as possible. Waste nevertheless generated should be treated, stored, or disposed of so as to minimize the present and future threat to human health and the environment."

The Hazardous and Solid Waste Amendments (HSWA) to RCRA (1986) also mandate that generators establish waste minimization programs. The existence of such a program is verified by the generator's signature on each Hazardous Waste Manifest and in the generator's Biennial Report.

In addition, the California Hazardous Waste Source Reduction and Management Review Act of 1989 (SB 14), requires that generators examine current hazardous waste generation processes for hazardous waste source reduction opportunities and create a plan to implement workable alternatives. Generators must also prepare a Hazardous Waste Management Performance Report with sufficient detail to convey an understanding of the hazardous waste management approaches used at the site. Businesses that generate more than 12,000 kg of hazardous waste or 12 kg of extremely hazardous waste in a calendar year are required to develop, implement, and update a Source Reduction Evaluation Review and Plan, Plan Summary, and Report as specified by the California Department of Health Services.
All generators can benefit from a waste minimization program. And, even though some facilities may not be affected by the requirements of SB 14, they should be encouraged to implement such a program.

This module will consist of two units:

UNIT ONE

1. Provides the inspector with information to assist the generator in conducting a self-assessment.

UNIT TWO

2. Provides the generator with a handbook of procedures for conducting his/her own self-assessment and introduces the provisions of California's SB 14. (Note: This preparation for compliance is not a substitute for reviewing the law, regulations and the guidance manual for SB 14.)

3. Provides the generator and inspector with a thought-provoking checklist for beginning a self-assessment.
This chapter will:

Explain the inspector's role in the waste minimization assessment process as a:

- Provider of information
- Recipient of information

Chapter 1

INSPECTOR'S ROLE IN HAZARDOUS WASTE MINIMIZATION ASSESSMENT

Waste minimization is a win-win situation for regulators and generators, which results in reduced regulation, disposal costs, and liability for the facility and reduced risk to public health and the environment. The extent of the inspector's role in the waste minimization activities will vary depending on the size and resources of the facility, the orientation and policy of the inspector's department, the inspector's knowledge of the industry, and the time allotted to the inspector for waste minimization activities. The hazardous waste inspector can make a valuable contribution to waste minimization efforts in his/her regular inspection activities by acting as a resource for the facilities working on waste minimization programs.

A. PROVIDER OF INFORMATION

The inspector and his/her department act as valuable resources by providing critical information to a facility regarding waste minimization alternatives. In fact, the inspector may be the individual who initially motivates a company to explore the possibilities of waste minimization.

By Offering Examples: The motivation to explore waste minimization options may happen quite naturally during the process of sharing success stories of similar companies that have minimized waste thus reducing costs and the need to comply with certain regulations.

By Suggesting Resources: Many information resources are available to generators. These include industry trade associations, governmental agencies, educational institutions and private organizations. Information is in the form of classes, seminars, publications or contacts with other businesses which are working to solve similar problems. Generators should be advised to check with their trade associations, vendors and suppliers, educational institutions and chambers of commerce for information about classes or technical displays available to them. The California Department of Health Services, Alternative Technology Division has a wealth of written technical information available on the subject of waste minimization, including a bibliography which was developed in conjunction with this project. Some counties and some educational institutions have begun to develop resource centers on the topic of hazardous waste. The EPA has a small business ombudsman hotline and a technical assistance hotline or an
electronic bulletin board for current information. These information resources are constantly expanding; be sure to keep up to date on what is available to the generators in your jurisdiction. Appendix C contains references to many of these resources.

By explaining legal requirements: As the hazardous waste laws and regulations evolve in the 1990's, generators may be unaware of, as well as overwhelmed by, their legal responsibility to look for waste minimization alternatives within their business. Taking a few moments to discuss the intent and requirements of Senate Bill 14 could make a world of difference for both you and the generator.

B. INFORMATION RESOURCE TO YOUR DEPARTMENT

The inspector is a key factor in an agency's awareness of its regulated industries' activities. The field situations that an inspector documents and shares with other agency personnel influence the department's perceptions of the regulated public and can help to shape department policy.

Document your successes: Share your success stories within your department. If a generator undertakes a significant waste minimization program, document the business's activities and your involvement. Such documentation should include:

- changes in raw materials and processes;
- changes in projected waste streams and disposal methods;
- technical specifications, claims, and limitations on new equipment;
- documentation of waste disposal such as, receipts and manifests; and
- a cost-benefit analysis of waste minimization.

Problems: Potential problems may arise when an inspector gives advice to a business. The inspector must be very careful not to step beyond the boundaries of his/her expertise and authority. And, because of the advisor vs. regulator conflict, regulatory requirements must be clearly distinguished from helpful advice. A well articulated department policy with standardized waste assessment procedures can help prevent confusion.

Inspectors must be aware of the potential barriers facing industry. Most generators are not aware of the various waste minimization methodologies and new technologies associated with waste minimization. Once this information is in hand, the lack of available capital to implement equipment changes and process modifications may hinder the generator's ability to continue waste minimization efforts. With the constant changes in regulations, a generator may hesitate to make changes requiring significant expenditures or complicated permits. However, some studies suggest the major barrier to the implementation of waste minimization practices in industry is a lack of motivation.
C. LIAISON WITH OTHER AGENCIES IN WASTE MINIMIZATION

Agencies such as air quality management districts, sewerage entities, public works departments, and regional water quality control boards regulate hazardous waste generators. Waste minimization activities may come within their jurisdiction. In view of the focused nature of these entities, it is important to remember that the goal of waste minimization is to reduce hazardous waste in all media, not simply transfer pollutants from one environmental medium to another. Inspectors can help facilities achieve waste minimization within the regulatory constraints of other agencies by being alert to the potential for transfer of pollutants between environmental media and by maintaining contacts and referral sources with these agencies.

D. SITE INSPECTOR

Whether an inspection is oriented toward waste minimization or whether waste minimization is just one component of an overall site inspection, the inspection is a key opportunity for the inspector to identify waste minimization possibilities and options.

In some cases, unnecessary generation of waste is linked to management practices that are not only poor housekeeping, but also constitute violations of the law. Consistent enforcement of regulations prohibiting co-mingling wastes, discarding hazardous wastes to the ground, unlabeled and open containers, and leaking containers can be a major incentive to reduce hazardous wastes by improved management and operations. A generator that has been required to dispose of contaminated soil, mixed wastes, and "mystery" wastes (unknowns) is more likely to appreciate the economic incentives for proper hazardous waste management and waste minimization.

The actual inspection is usually conducted in the presence of a plant manager or operator who is most familiar with hazardous materials inventory management, the processes using hazardous materials, and hazardous waste handling, storage and disposal practices. It may be beneficial, however, to arrange to have the business manager accompany you in order to discuss the alternative waste management possibilities and company hazardous waste management policy. This not only allows you to educate a manager unfamiliar with hazardous waste management, but provides an opportunity to open the lines of communication between the business manager and the plant manager in the facility setting. You can also learn valuable information about costs associated with hazardous wastes and company perceptions of barriers to waste minimization.

To assist the generator in making decisions regarding processes and waste minimization measures specific to the generator, EPA's simplified waste minimization worksheets are included in Appendix B. Note that not all of the forms will be used with every operation.
Chapter 2
OUTLINE OF WASTE MINIMIZATION ASSESSMENT PROCEDURES

A. INTRODUCTION TO WASTE ASSESSMENT

A waste assessment is used to diagnose how a facility can reduce or recycle wastes. It is an essential first step in any waste minimization program and is the responsibility of the generator, not the inspector. However, the inspector should be familiar with waste minimization procedures and be able to answer the generators' questions about them.

Purposes of waste minimization include:

- Reducing waste disposal costs through analyzing waste generation trends;
- Reducing production costs through changing the process or the materials;
- Reducing or eliminating future liability;
- Increasing environmental awareness for all employees;
- Complying with RCRA, and state and local hazardous waste laws including the Hazardous Waste Source Reduction and Management Review Act of 1989 (SB 14);
- Assessing and clarifying training needs and responsibilities for all employees; and
- Demonstrating concern for worker and community health and safety.

The size and type of a business should help determine specific waste assessment procedures. Suggested general steps for assessing waste minimization by the generator are to:

- Prepare background material for the assessment;
- Identify waste streams;
- Select waste streams for detailed analysis;
- Conduct a detailed site inspection to collect data on selected waste streams and process data;
Develop a series of potential waste minimization options:
- evaluate preliminary options (including developing preliminary cost estimates), and
- rank options by: (1) effectiveness in reducing waste, (2) extent of current use in the industry, and (3) potential for future use at the facility;
- Present preliminary results to plant personnel along with a ranking of options;
- Prepare a final report, including recommendations to plant management;
- Develop an implementation plan and schedule; and
- Conduct periodic reviews and updates of assessment.

B. ASSESSMENT PERSON OR TEAM

A facility assessment provides the technical and economic information for selecting appropriate waste minimization techniques. The first task for businesses is to select an assessment team. The specific make-up and number of members will vary depending on the size, complexity, and resources of the company. In a small business, the assessment team may be limited to one or two individuals responsible for the facility operations. Each team should include people with direct responsibility and knowledge of the particular waste streams or areas of the plant. In addition to the internal staff, a business could consider using outside people, especially in the assessment and implementation phases. They may be trade association representatives, consultants, or experts from a different facility of the same company. In large multi-division companies, a centralized staff of experts at the corporate headquarters may be available. One or more “outsiders” can bring in new ideas and provide an objective viewpoint. An outsider also is more likely to counteract bias due to “inbreeding” or the “sacred cow” syndrome. This bias may occur, for example, when an old process area, rich in history, undergoes assessment.

Consultants from outside the company can bring a wide variety of experience and expertise to a waste minimization assessment. Consultants may be especially useful to smaller companies who may not have in-house expertise in the relevant waste minimization techniques and technologies.

C. COLLECTING AND COMPILING DATA

Questions that an information gathering effort will attempt to answer include:
- What are the waste streams generated from the business? And how much is generated?
- Which processes or operations do these waste streams come from?
- Which wastes are classified as hazardous and which are not? What makes them hazardous?
What are the input materials used to generate waste streams of a particular process or area?

How much of a particular input material enters each waste stream?

How much of a raw material can be accounted for through fugitive losses?

How efficient is the 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?

Based on the collected information, a general flow diagram or material balance for each process step is developed. The diagram should clearly identify the source, type, quantity, and concentration of each identified waste stream. This information can be used to develop the plant survey and to identify data gaps, sampling points, problem areas, and data conflicts.

D. IDENTIFY CANDIDATE WASTE STREAMS

One of the first tasks of a waste minimization assessment by the generator is to identify the business's waste streams. Some information on waste quantities is readily available from the completed hazardous waste manifests. These include the description and quantity of hazardous waste shipped to an offsite hazardous waste treatment facility. However, manifests often lack such information as chemical analysis of the waste, specific source of the waste, and the time period during which the waste is generated. Also, manifests do not cover wastewater effluents, air emissions, or nonhazardous solid wastes.

Once the assessment person or team has reviewed all the background information, the business's waste streams must be listed. This should be completed before the plant is surveyed by the assessment team or person. Waste streams to consider include:

- Hazardous wastes;
- Air emissions, including stack and fugitive emissions (e.g., tank evaporation losses);
- Nonhazardous solid wastes; and
- Wastewater effluents.

The assessor should then prepare a checklist specifically for that business. The checklist will insure that all pertinent information is collected. The list can contain objectives, questions and issues to be resolved, and/or further information requirements. To summarize, the checklist should include:

- A full description of all waste streams and points of origin -- to be verified;
- A list of all waste minimization practices already in place identified during the pre-inspection review -- to be verified and evaluated;
- A list of potential waste minimization options identified during pre-assessment --to be verified; and
- A list of other opportunities for reducing waste that might work for the specific type of business being assessed.

E. SITE INSPECTION

A site inspection is an essential part of the waste minimization assessment. Frequently this coincides with a government inspector's visit to the facility. As such an inspector, you may be able to offer assistance to the generator in performing the waste minimization assessment.

Although the collected information regarding selected waste streams is critical to gaining an understanding of the processes involved, seeing the site is important in order to witness the actual operation. In performing the site inspection, try to follow the process from the point where raw materials enter the area to the point where the products and the wastes leave the area. Recognize that the plant's waste treatment area itself may also offer opportunities to minimize waste.

Listed below are some useful guidelines for the site inspection:

- Schedule the inspection to coincide with the particular operation that is of interest such as batch sampling, batch dumping, or start-up and shut down operations.
- Interview the operators and foremen. Assess their awareness of the waste generation aspects of the operation. Note their familiarity with the impacts their operation may have on other operations.
- Observe the housekeeping aspects of the operation. Check for signs of spills or leaks. Assess the overall cleanliness of the site. You may suggest secondary containment for hazardous materials storage areas, especially where materials are dispensed.
- Look for good operating practices that can be implemented with little cost and in all areas of a plant, including production, maintenance operations and in raw material and product storage.
- Observe the storage areas for proper container management. Labelling, use of sound containers, and keeping containers closed, help to prevent deterioration and contamination of expensive raw materials. Improperly managed hazardous materials can easily become hazardous wastes.
- Ask to review training documents. All personnel involved with hazardous materials and wastes should be trained in proper materials and waste handling.

Included in this module (Unit Two, pp. 19-25) is a checklist which is designed for the generator, but can be most useful for the inspector as well. The inspector should be familiar with this handout and be able to use the questions during an inspection.
EVALUATION AND SELECTION OF WASTE MINIMIZATION TECHNIQUES

Procedures to evaluate and select waste minimization techniques will depend on the complexity of the manufacturing process and the quantity and variety of waste generated. Successful approaches for businesses range from simple group discussions to complex computer modeling techniques. However, all approaches will contain the same basic steps:

- List waste streams;
- Identify potential waste minimization techniques for each waste stream;
- Evaluate the regulatory, technical, and economic aspects of each technique; and
- Select the most cost-effective waste minimization technique(s) for each waste stream.

Select Options

Once the sources of waste generation are determined, the assessment process enters the creative phase. The objective of this phase is to generate a set of waste minimization options for further consideration.

At this stage in the assessment process, it is not recommended to consider in detail the technical or economic feasibility of any particular option. A list based on a broad range of general opportunities should be developed, including:

- Improved housekeeping and waste handling, segregation, and storage;
- Inventory control of raw material supplies;
- Raw material substitutions;
- Changes in processes, equipment, or operations to no waste or low waste technologies;
- Reclaiming, recycling, and reusing of waste streams and scrap materials; and
- Listing the business's waste in waste exchanges.

The generator can use these basic approaches to identify specific opportunities to reduce waste.

Rank Waste Minimization Options

A successful assessment will identify many waste minimization options. At this point, identifying those options that offer real potential to reduce waste and its related costs is essential.

Setting initial priorities does not require detailed cost-effectiveness analysis. Some waste minimization options are obviously easier and less expensive to implement than others. Businesses should consider the potential
disadvantages of any waste minimization actions. If these actions generate new wastes those wastes should be evaluated including possible difficulties encountered with their disposal.

Results and Option Rankings

The business should then discuss the results of the first screening and the ranking of waste minimization actions with plant personnel and company management. The screening activity should promote the successful options for technical and economic feasibility analyses. During the screening procedure, assessors should consider the following questions:

- What is the main benefit gained by implementing this option (e.g., economics, compliance, liability, workplace safety, etc.)?
- Does the necessary technology exist to develop the option?
- How much does it cost? Is it cost effective?
- Can the option be implemented within a reasonable amount of time without disrupting production?
- Does the option have a good "track record"? If not, is there convincing evidence that the option will work as required?
- Does the option have a good chance of success? (A successful start for a waste minimization program will gain the program wider acceptance and facilitate its progress.)
- What other benefits will occur?

These discussions should lead to the final ranking of the most reasonable options. Some options (such as procedural changes) may be inexpensive and quickly implemented without further evaluation. The screening procedure should take into account the ease of implementation. If an option is clearly desirable and inexpensive, the business should adopt it.

G. FINAL REPORT

The final report contains recommendations for the feasible options. A general outline for the final report would include the following:

- General operation characteristics:
  - description of business,
  - size of business,
  - services provided by the business,
  - raw materials used,
  - wastes generated,
  - equipment used,
  - current disposal practices,
  - material losses, and
  - prioritized sites of significant waste generation;

- Waste minimization management options:
  - general operating practices, and
  - specific management options.
A good final report can be an important tool for implementing a project. It is particularly helpful in justifying funding for the project. In presenting the feasibility analyses, the generator will find it useful to evaluate the project under different scenarios. For example, compare a project's profitability under optimistic and pessimistic assumptions (such as increasing waste disposal costs). Sensitivity analyses indicating the effect of key variables on profitability are also useful.

H. IMPLEMENTATION AND EVALUATION

Implement plan

Once the minimization techniques are identified by the assessment team or person, an implementation plan should be developed for each waste stream. This should include information on the implementation schedule, equipment needs, training needs, implementation requirements, management requirements, and cost estimates.

The assessment report can help in obtaining company funding for waste minimization projects. Because projects are not always sold on their technical merits alone, a clear description of all benefits can help edge a proposed project past other projects competing for funding. The champions of the waste minimization assessment program should be flexible enough to develop alternatives or modifications.

After the option has been implemented, it remains to be seen how effective the option actually turns out to be. Options that do not measure up to their original performance expectations may require reworking. Getting warranties from vendors prior to installing the new equipment can be suggested and can help reach waste minimization goals.

Documents from the follow-up evaluation provide important information for future uses of the option in their facilities. The experience gained in implementing an option at one facility can be used to reduce the problems and costs of implementing options at subsequent facilities, especially when the nature of the facilities is similar.

I. CONDUCT PERIODIC REVIEWS AND UPDATE ASSESSMENTS

Implement plan

The waste assessment is a critically important first step toward waste minimization. A thorough waste assessment will result in the selection of economically feasible waste minimization options. Such an assessment will require a good working understanding of the waste minimization approaches and practices discussed throughout this manual. However, for the business to gain the benefits of waste minimization, it must implement recommendations of the program and review their implementation.

Accounting procedures will have an effect on the evaluation of implemented waste minimization techniques. By charging waste costs directly to the processes generating them, companies can determine where waste has been reduced in a cost effective manner. They
might reconsider previous decisions once they realize that the cost of managing that waste directly influences the cost of production.

The frequency with which assessments are done will depend on the program's budget, the business's budgeting cycle, and special circumstances such as:

- A change in raw material or product requirements;
- Higher waste management costs;
- New regulations;
- New technology; and
- A major event with undesirable environmental consequences (such as a major spill).

Aside from the special circumstances, a business should conduct a new series of assessments each fiscal year.
WASTE MINIMIZATION ASSESSMENT
FOR THE INSPECTOR

SELF-TESTING EXERCISES

Instructions: Read through each question carefully and write your answer on a separate sheet of paper. After completing the self-test check your answer to each question by rereading the corresponding section of the chapter.

Questions:

1.1 Describe your role as the inspector in the waste minimization process.

1.2 What is the purpose of the waste minimization assessment?

1.3 In selecting the assessment team, a facility may consider seeking assistance from outside. List some advantages and disadvantages to using “outside” personnel in the waste minimization assessment process.

1.4 Eight (8) steps are suggested for conducting a waste minimization assessment. Name seven (7) of these.

1.5 In the text, six (6) guidelines for the waste minimization assessment site inspection are listed. What are they?
Appendix A

Business Processes and Selected
Waste Minimization Opportunities
### Selected Waste Reduction Opportunities

#### Low Cost Options
- Eliminate system leaks (both liquid and vapor)
- Replace door gasket on button trap
- Maintain hose couplings and exhaust ducts
- Monitor vapor losses
- Check air relief valves for proper closures
- Train employees
- Train employees
- Segregate solvent wastes to enhance recycling
- Use old solvent for pre-soak to extend life of fresh solvent
- Increase freeboard height on solvent tank to reduce air emissions
- Control drag-out to reduce evaporative losses and spills
- Keep lids on tanks and containers to reduce spills and air emission
- Substitute materials
- Same as degreasing (see above)
- Recycle lead-acid batteries
- Use water-based paint instead of oil-based
- Keep used oils and solvent separate to enhance recycling
- Train employees
- Promote rigid inventory control
- Purchase only what you need

#### Higher Cost Options
- Install carbon adsorption unit to reclaim solvent from air emissions
- Install solvent distillation unit
- Install filter recovery unit
- Utilize azeotropic conditioning to recover cleaning solvent
- Install chillers to reduce losses to air
- Install solvent recovery system
- Use pressure water wash system to clean parts without solvent
- Change to mechanical cleaning process
- Change to mechanical cleaning process
- Eliminate the need for cleaning

#### Additional Options
- Equip containers with overflow alarms
- Install leak detection devices
- Install float valves and drip guard
- Redesign workspace to improve materials handling and storage
- Construct separate containment zones for materials storage

#### Promote Practices
- Promote work practices that conserve raw materials
- Reduce overspray by controlling nozzle adjustment and pressure in spray gun
- Use water-based paints
- Mix only what materials you need
- Institute rigid inventory control policies
- Train employees

- Use plastic beads to strip paints
- Purchase solvent recovery unit
- Install spray booth
- Use non-phenolic strippers to control waste production
- Install on-site paint mixers to control waste production
- Install on-site paint mixers to control material usage
- Use electrostatic sprayguns to control overspray or high volume-low pressure guns
<table>
<thead>
<tr>
<th>BUSINESS PROCESS</th>
<th>TYPE OF BUSINESS</th>
<th>TYPE OF WASTE GENERATED</th>
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<tr>
<td>Printing</td>
<td>Commercial facilities</td>
<td>Solvent evaporation</td>
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<td>Newspapers</td>
<td>Materials spills</td>
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<td>Cooperatives</td>
<td>Wastewater discharges</td>
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<td>Nonprofit groups</td>
<td>Waste inks</td>
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<td>Government agencies</td>
<td>Clean up wastes</td>
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<td>Spills</td>
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<td>Bad batches</td>
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<td>Purchasing</td>
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<tr>
<td>Keep lids on containers to prevent evaporation</td>
<td>Install an electrolytic silver recovery unit and a metallic</td>
<td></td>
</tr>
<tr>
<td>Squeegee and reuse excess ink from presses and silk</td>
<td>replacement unit to capture silver from wastewater</td>
<td></td>
</tr>
<tr>
<td>screens before cleaning</td>
<td>Use solvent recovery unit</td>
<td></td>
</tr>
<tr>
<td>Dedicate one press for toxic pigments and inks</td>
<td>Install hoods to capture solvent emissions</td>
<td></td>
</tr>
<tr>
<td>Use water-based inks where possible</td>
<td>Convert to UV-curable inks</td>
<td></td>
</tr>
<tr>
<td>Recycle dirty rags</td>
<td>Switch to water-based inks</td>
<td></td>
</tr>
<tr>
<td>Train employees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Institute purchase order policy to control inventory</td>
<td>Conduct annual comprehensive purchasing audits to</td>
<td></td>
</tr>
<tr>
<td>Keep accurate records on material usage</td>
<td>determine other waste reduction opportunities</td>
<td></td>
</tr>
<tr>
<td>Order materials in appropriately sized containers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitor materials for losses during handling and storage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Request information on waste reduction from vendors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Train employees</td>
<td>Install electrolytic silver recovery unit</td>
<td></td>
</tr>
<tr>
<td>Obtain MSDSs from suppliers for all materials</td>
<td>Install metallic replacement unit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(units can work together)</td>
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</tr>
<tr>
<td>Use non-absorbing “twin checks” to control drag-out</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use floating lids on fixer and bleach to control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>evaporation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ensure proper chemical make-up in process baths</td>
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<td></td>
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<tr>
<td>Monitor silver content in wastewater</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Train employees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improve housekeeping, maintenance and education to</td>
<td>Modify business equipment to control wastes at the</td>
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</tr>
<tr>
<td>control waste production</td>
<td>source, during the production process</td>
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<tr>
<td>Keep good records to identify types and amounts of</td>
<td>Use new technology to recycle wastes</td>
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<tr>
<td>waste, and to help control inventory</td>
<td>Exchange wastes whenever possible</td>
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<tr>
<td>Substitute non-toxic materials for hazardous and toxic</td>
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<tr>
<td>materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycle whenever possible</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Train employees</td>
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Appendix B
Simplified Waste Minimization Assessment Worksheets

The worksheets that follow are designed to facilitate a simplified WM assessment procedure. The table below lists the worksheets, according to the particular phase of the program, and a brief description of the purpose of the worksheets. The worksheets here are presented as supporting only a preliminary effort at minimizing waste, or in a situation where a more formal rigorous assessment is not warranted.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Number and Title</th>
<th>Purpose/Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment Phase (Section 3)</td>
<td>S1. Assessment Overview</td>
<td>Summarizes the overall assessment procedure.</td>
</tr>
<tr>
<td></td>
<td>S2. Site Description</td>
<td>Lists background information about the facility, including location, products, and operations.</td>
</tr>
<tr>
<td></td>
<td>S3. Process Information</td>
<td>This is a checklist of useful process information to look for before starting the assessment.</td>
</tr>
<tr>
<td></td>
<td>S4. Input Materials Summary</td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>S5. Products Summary</td>
<td>Identifies hazardous components, production rate, revenues, and other information about products.</td>
</tr>
<tr>
<td></td>
<td>S6. Waste Stream Summary</td>
<td>Summarizes all of the information collected for each waste stream. This sheet is also used to prioritize waste streams to assess.</td>
</tr>
<tr>
<td></td>
<td>S7. Option Generation</td>
<td>Records options proposed during brainstorming or nominal group technique sessions. Includes the rationale for proposing each option.</td>
</tr>
<tr>
<td></td>
<td>S8. Option Description</td>
<td>Describes and summarizes information about a proposed option. Also notes approval of promising options.</td>
</tr>
<tr>
<td>Feasibility Analysis Phase (Section 4)</td>
<td>S9. Profitability</td>
<td>This worksheet is used to identify capital and operating costs and to calculate the payback period.</td>
</tr>
</tbody>
</table>
Begin the Waste Minimization Assessment Program

PLANNING AND ORGANIZATION
- Get management commitment
- Set overall assessment program goals
- Organize assessment program task force

ASSESSMENT PHASE
- Compile process and facility data
- Prioritize and select assessment targets
- Select people for assessment teams
- Review data and inspect site
- General options
- Screen and select options for further study

FEASIBILITY ANALYSIS PHASE
- Technical evaluation
- Economic evaluation
- Select options for implementation

IMPLEMENTATION
- Justify projects and obtain funding
- Installation (equipment)
- Implementation (procedure)
- Evaluate performance

Successfully operating waste minimization projects
<p>| | |</p>
<table>
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<tbody>
<tr>
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</tr>
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<td>Street Address:</td>
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<tr>
<td>City:</td>
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<tr>
<td>State/ZIP Code:</td>
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<tr>
<td>Telephone:</td>
<td>( )</td>
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<tr>
<td>Major Products</td>
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<td>SIC Codes:</td>
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<td>EPA Generator Number:</td>
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<tr>
<td>Major Unit or:</td>
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<tr>
<td>Product or:</td>
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<tr>
<td>Operations:</td>
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<td></td>
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<tr>
<td>Facilities/Equipment Age:</td>
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## PROCESS INFORMATION

### Process Unit/Operation:

- **Operation Type:**
  - □ Continuous
  - □ Discrete
  - □ Batch or Semi-Batch
  - □ Other

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<tr>
<th>Document</th>
<th>Complete (Y/N)</th>
<th>Current? (Y/N)</th>
<th>Last Revision</th>
<th>Used in this Report (Y/N)</th>
<th>Document Number</th>
<th>Location</th>
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<td>Process Flow Diagram</td>
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<tr>
<td>Material/Energy Balance</td>
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<td>Design</td>
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<td>Operating</td>
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<td>Flow/Amount Measurements</td>
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<td>Process Description</td>
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<td>Operating Manuals</td>
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<td>Equipment List</td>
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<td>Equipment Specifications</td>
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<td>Piping &amp; Instrument Diagrams</td>
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<td>Plot &amp; Elevation Plan(s)</td>
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<td>Work Flow Diagrams</td>
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<td>Emission Inventories</td>
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<td>Annual/Biennial Reports</td>
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<td>Environmental Audit Reports</td>
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<td>Permit/Permit Applications</td>
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<tr>
<td>Batch Sheet(s)</td>
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<td>Materials Application Diagrams</td>
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<td>Product Composition Sheets</td>
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<td>Material Safety Data Sheets</td>
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<td>Inventory Records</td>
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<td>Operator Logs</td>
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<td>Production Schedules</td>
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## INPUT MATERIALS SUMMARY

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<th>Attribute</th>
<th>Description</th>
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<tbody>
<tr>
<td>Name/ID</td>
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<tr>
<td>Source Supplier</td>
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<tr>
<td>Component/Attribute of Concern</td>
<td></td>
</tr>
<tr>
<td>Annual Consumption Rate</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td></td>
</tr>
<tr>
<td>Component(s) of Concern</td>
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<tr>
<td>Purchase Price, $ per</td>
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<tr>
<td>Overall Annual Cost</td>
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</tr>
<tr>
<td>Delivery Mode 1</td>
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</tr>
<tr>
<td>Shipping Container Size &amp; Type 2</td>
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<tr>
<td>Storage Mode 3</td>
<td></td>
</tr>
<tr>
<td>Transfer Mode 4</td>
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</tr>
<tr>
<td>Empty Container Disposal/Management 5</td>
<td></td>
</tr>
<tr>
<td>Shelf Life</td>
<td></td>
</tr>
<tr>
<td>Supplier Would</td>
<td></td>
</tr>
<tr>
<td>- accept expired material (Y/N)</td>
<td></td>
</tr>
<tr>
<td>- accept shipping containers (Y/N)</td>
<td></td>
</tr>
<tr>
<td>- revise expiration date (Y/N)</td>
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</tr>
<tr>
<td>Acceptable Substitute(s), if any</td>
<td></td>
</tr>
</tbody>
</table>

1 e.g., pipeline, tank car, 100 bbl. tank truck, truck, etc.
2 e.g., 55 gal drum, 100 lb. paper bag, tank etc.
3 e.g., outdoor, warehouse, underground, aboveground, etc.
4 e.g., pump, forklift, pneumatic transport, conveyor, etc.
5 e.g., crush and landfill, clean and recycle, return to supplier, etc.
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
<th>Stream No.</th>
<th>Stream No.</th>
<th>Stream No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name/ID</td>
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<tr>
<td>Component/Attribute of Concern</td>
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<tr>
<td>Annual Consumption Rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Component(s) of Concern</td>
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<td>Annual Revenues, $</td>
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<tr>
<td>Shipping Mode</td>
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<tr>
<td>Shipping Container Size &amp; Type</td>
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<td>Onsite Storage Mode</td>
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<td>Containers Returnable (Y/N)</td>
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<td>Shelf Life</td>
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<td>Rework Possible (Y/N)</td>
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<tr>
<td>Customer Would</td>
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<tr>
<td>- relax specification (Y/N)</td>
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<tr>
<td>- accept larger containers (Y/N)</td>
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## WORKSHEET S6
### WASTE STREAM SUMMARY

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<th>Attribute</th>
<th>Description</th>
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<td>Waste ID/Name:</td>
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<tr>
<td>Source/Origin</td>
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<tr>
<td>Component(s) of Concern</td>
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<tr>
<td>Annual Generation Rate (units)</td>
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<tr>
<td>Overall</td>
<td></td>
</tr>
<tr>
<td>Component(s) of Concern</td>
<td></td>
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<tr>
<td>Cost of Disposal</td>
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</tr>
<tr>
<td>Unit Cost ($ per: )</td>
<td></td>
</tr>
<tr>
<td>Overall (per year)</td>
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<tr>
<td>Method of Management¹</td>
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<tr>
<td>Priority Rating Criteria²</td>
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<tr>
<td>Regulatory Compliance</td>
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<tr>
<td>Treatment/Disposal Cost</td>
<td></td>
</tr>
<tr>
<td>Potential Liability</td>
<td></td>
</tr>
<tr>
<td>Waste Quantity Generated</td>
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<tr>
<td>Waste Hazard</td>
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<td>Safety Hazard</td>
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<tr>
<td>Minimization Potential</td>
<td></td>
</tr>
<tr>
<td>Potential to Remove Bottleneck</td>
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</tr>
<tr>
<td>Potential By-product Recovery</td>
<td></td>
</tr>
<tr>
<td>Sum of Priority Rating Scores</td>
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</tr>
<tr>
<td>Rating (R)</td>
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<td>R X W</td>
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<tr>
<td>Rating (R)</td>
<td></td>
</tr>
<tr>
<td>R X W</td>
<td></td>
</tr>
</tbody>
</table>

Notes:  
1. For example, sanitary landfill, hazardous waste landfill, onsite recycle, incineration, combustion with heat recovery, distillation, dewatering, etc.
2. Rate each stream in each category on a scale from 0 (none) to 10 (high).
**WORKSHEET S7**

**OPTIONAL GENERATION**

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<th>Priority Rank</th>
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</table>

<table>
<thead>
<tr>
<th>Meeting Format (e.g., brainstorming, nominal group technique)</th>
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<table>
<thead>
<tr>
<th>Meeting Coordinator</th>
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<table>
<thead>
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<th>Meeting Participants</th>
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<table>
<thead>
<tr>
<th>List Suggested Option</th>
<th>Rationale/Remarks on Option</th>
</tr>
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<tbody>
<tr>
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**WASTE MINIMIZATION ASSESSMENT PROCEDURES**

30
### OPTION DESCRIPTION

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<th>Option Name:</th>
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<tbody>
<tr>
<td>Briefly describe the option</td>
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<tr>
<td>Waste Stream(s) Affected:</td>
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<tr>
<td>Input Material(s) Affected:</td>
<td></td>
</tr>
<tr>
<td>Product(s) Affected:</td>
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</tr>
<tr>
<td>Indicate Type:</td>
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</tr>
<tr>
<td>☐ Source Reduction</td>
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<tr>
<td>☐ Equipment-Related Change</td>
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<tr>
<td>☐ Personnel/Procedure-Related Change</td>
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<tr>
<td>☐ Materials-Related Change</td>
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</tr>
<tr>
<td>☐ Recycling/Reuse</td>
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<tr>
<td>☐ Onsite</td>
<td>Materials reused for original purpose</td>
</tr>
<tr>
<td>☐ Offsite</td>
<td>Material used for a lower-quality purpose</td>
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<tr>
<td></td>
<td>Material sold</td>
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<tr>
<td></td>
<td>Material burned for heat recovery</td>
</tr>
</tbody>
</table>

Originally proposed by: ___________________________ Date: __________
Reviewed by: ___________________________ Date: __________
Approved for study? yes no, by: ___________________________
Reason for Acceptance or Rejection: ___________________________
### PROFITABILITY

#### Capital Costs
- Purchased Equipment
- Materials
- Installation
- Utility Connections
- Engineering
- Start-up and Training
- Other Capital Costs
  - Total Capital Costs

#### Incremental Annual Operating Costs
- Change in Disposal Costs
- Change in Raw Material Costs
- Change in Other Costs
  - Annual Net Operating Cost Savings

Payback Period (in years) = \( \frac{\text{Total Capital Costs}}{\text{Annual Net Operating Cost Savings}} \)
APPENDIX C
AGENCIES TO CONTACT FOR MORE INFORMATION

Governmental Agencies

California Department of Health Services
Alternative Technology Division
Toxic Substances Control Program
714/744 P Street
PO Box 942732
Sacramento, CA 94234-7320
(916) 322-3670 or (916) 324-1807

U.S. Environmental Protection Agency
401 M Street, NW
Washington, DC 20460
Office of Pollution Prevention: (202) 382-4335
Office of Solid Waste: (202) 382-4627
Reference Library: (202) 382-5921
Library Loan: (202) 475-7767

U.S. Environmental Protection Agency
Pollution Prevention Information Clearinghouse
Hotline Services
RCRA/Superfund Hotline: (800) 424-9346
Small Business Ombudsman (SBO) Hotline: (800) 368-5888
PPIC Technical Assistance: (703) 821-4800

Asbestos and Small Business Ombudsman
EPA section that makes available many EPA publications on environmental trends, requirements and regulations to small business and the general public.

United States EPA
Asbestos and Small Business Ombudsman
401 M Street, SW (A-149C)
Washington, DC 20460
(800) 368-5888

US EPA Office of Research and Development: Center for Environmental Research Information (CERI)
Office will provide single copy documents by phone or multiple copies by letter. These are publications from the US EPA division responsible for research.

United States EPA
CERI/Publications Office
26 Martin Luther King Drive
Cincinnati, OH 45268
(513) 569-7562
US EPA Pollution Prevention Office
US EPA office responsible for guidance and policy on cross-media approaches to pollution prevention.

United States EPA
Pollution Prevention Office
401 M Street, SW (PM-219)
Washington, DC 20460
(202) 382-4335

US EPA Public Information Center (PIC)
Answers general inquiries about EPA programs and activities through the distribution of general, nontechnical information materials.

United States EPA
Public Information Center (PIC)
401 M Street, SW
Washington, DC 20460
(202) 382-2080

US EPA RCRA Information Center (RIC)
US EPA center that provides information on RCRA policy and regulations.

United States EPA
RCRA Information Center (RIC)
Office of Solid Waste (WH-562)
401 M Street, SW
Washington, DC 20460
(202) 475-9327

US EPA Waste Minimization Office
US EPA office that develops policy and programs for RCRA waste minimization.

United States EPA
Waste Minimization Office
401 M Street, SW
Washington, DC 20460
(202) 382-4807

U.S. Environmental Protection Agency
The Pollution Prevention Resource Center
Region IX Library
75 Hawthorne Street, 13th Floor
San Francisco, CA 94105
(415) 744-1519, Monday through Friday, 8:30 am to 5 pm
Informational Services

CHMR - Center for Hazardous Materials Research Center
The University of Pittsburgh's research center on hazardous waste issues.

Center for Hazardous Materials Research Center
University of Pittsburgh Applied Research Center
320 William Pitt Way
Pittsburgh, PA 15238

Environmental Quality Institute
University of North Carolina at Asheville's international center on environmental issues.

UNC Asheville
Environmental Quality Institute
One University Heights
Asheville, NC 28804-3299
(704) 251-6104

MnTap - Minnesota Technical Assistance Program
The University of Minnesota's technical information services to businesses concerning hazardous waste minimization.

University of Minnesota
PO Box 197 Mayo, 420 Delaware Street SE
Minneapolis, MN 55455
(612) 625-4949
(800) 247-0015 (MN only)

NC Pollution Prevention Pays Program
Technical assistance program that helps businesses solve hazardous waste reduction problems.

Pollution Prevention Pays Program
Department of Natural Resources and Community Development
PO Box 27687
512 North Salisbury Street
Raleigh, NC 27611
(919) 733-7015
TASU - Technical Assistance Support Unit
The NC information agency that provides technical assistance to business dealing with hazardous waste.

Technical Assistance Support Unit
Solid and Hazardous Waste Management Branch
Division of Health Services
NC Department of Human Resources
PO Box 2091
Raleigh, NC 27602-2091
(919) 733-2178

Tennessee Hazardous Waste Minimization Program
State agency that provides information for hazardous waste management.

Tennessee Dept. of Economic and Community Development
Division of Existing Industry Services
7th Floor, 320 6th Avenue North
Nashville, TN 37219
(615) 741-1888

Tennessee Valley Authority - Waste Management and Environmental Services Program
Federally funded agency that manages the Tennessee Valley River watershed. This division provides training programs in solid waste management.

TVA
Waste Management and Environmental Services Program
Division of Land and Economic Resources
2d44 Old City Hall
601 West Summit Hill Drive
Knoxville, TN 37902
(615) 632-6419

Tennessee's Center for Industrial Services (CIS)
University of Tennessee's technical assistance program provided to businesses desiring to reduce their hazardous waste.

Center for Industrial Services
Suite 401
226 Capitol Boulevard Building
University of Tennessee
Nashville, TN 37219-1804
(615) 242-2456
Trade Associations and Professional Organizations

This list is not an exhaustive representation of all trade and professional organizations and does not constitute an endorsement by the California Department of Health Services or the University of California Regents.

Adhesive and Sealant Council
1627 K Street, NW, Suite 1000
Washington, DC 20006
(202) 452-1500

Adhesive Manufacturers Association
111 East Wacker Drive
Chicago, IL 60601
(312) 644-6610

Air Pollution Control Association
Box 2861
Pittsburgh, PA 15230
(412) 232-3444

Alliance of Metalworking Industries
1100 17th Street, NW
Washington, DC 20036
(202) 223-2431

Alternative Wastewater Management Asso.
Box 3215
Williamsport, PA 17701
(717) 326-3396

American Academy of Environmental Engineers
132 Holiday Court, Suite 206
Annapolis, MD 21401
(301) 266-3311

American Cast Metals Association
455 State Street
De Plaines, IL 60016
(312) 299-9160

American Ceramic Society
757 Brookside Plaza Drive
Westerville, OH 43081-6136
(614) 890-4700

American Conference of Governmental Industrial Hygienists
6500 Glenway Avenue, Bldg. D-7
Cincinnati, OH 45211
(513) 661-7881

American Electroplaters & Surface Finishers Society
Central Florida Research Park
12644 Research Parkway
Orlando, FL 32826

Association of Industrial Metallizers, Coaters and Laminators
2604 Pennington Drive
Wilmington, DE 19810
(302) 475-7079

Chemical Coaters Association
Box 241
Wheaton, IL 60189
(312) 668-0949

Chemical Manufacturers Association
2501 M Street, NW
Washington, DC 20037
(202) 887-1100

Copper Development Association
2 Greenwich Office Park
Box 1840
Greenwich, CT 06836
(203) 625-8210

Dry Color Manufacturers
PO Box 20839
Alexandria, VA 22320-1839
(703) 684-4044

Ductile Iron Society
615 Sherwood Parkway
Mountainside, NJ 07092
(201) 232-3080

Farm Equipment Man's Association
243 North Lindberg Boulevard
St. Louis, MO 63141
(314) 991-0702

Federation of Societies for Coatings Technology
1315 Walnut Street
Philadelphia, PA 19107
(215) 545-1506

APPENDIX C: AGENCIES TO CONTACT FOR MORE INFORMATION
National Paint & Coatings Association  
1500 Rhode Island Avenue, NW  
Washington, DC 20005  
(202) 462-6272

National Resource Recovery Association  
1620 Eye Street, NW  
Washington, DC 20006  
(202) 293-7330

National Solid Wastes Management Association  
1730 Rhode Island Avenue, NW  
Suite 1000  
Washington, DC 20036  
(202) 659-4613

Porcelain Enameling Association  
1111 North 19th Street, Suite 10  
Arlington, VA 22209  
(703) 527-5257

Powder Coating Institute  
1800 Diagonal Road, #600  
Alexandria, VA 22314  
(703) 684-4409

Sealant and Waterproofers Institute  
3101 Roadway, Suite 300  
Kansas City, MO 64111  
(816) 561-8230

Society of Manufacturing Engineers  
One SME Drive  
Box 930  
Dearborn, MI 48121  
(313) 271-1500

Steel Shipping Container Institute  
2204 Morris Avenue  
Union, NJ 07083  
(201) 688-8750

Synthetic Organic Chemical Manufacturers Association  
1330 Connecticut Avenue, NW  
Washington, DC 20036  
(202) 659-0060

United Pesticide Formulator and Distributors Association  
Prentiss Drug & Chemical  
3609 Shallowford Road  
Atlanta, GA 30340  
(404) 458-1055

Valve Manufacturers Association of America  
1050 17th Street, NW  
Suite 700  
Washington, DC 20036  
(202) 331-8105

APPENDIX C: AGENCIES TO CONTACT FOR MORE INFORMATION
APPENDIX D

NOTICE

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