United States
Environmental Protection
Agency

Hazardous Waste Engineering
Research Laboratory
Cincinnati, OH 45268

Research and Development

EPA/600/S2-88/025 Aug. 1988

EPA

Project Summary

The EPA Manual for Waste Minimization Opportunity Assessments

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Waste minimization (WM) is fast gaining recognition as a means of contending with the nation's hazardous waste problem and other forms of environmental pollution. Opportunities exist for waste minimization throughout industry and government. The waste minimization assessment procedure described in the full report offers a means of determining a facility's waste situation and identifying and evaluating potential viable options for reducing waste. (In addition to its availability through the National Technical Information Service, this report is being issued as a technology transfer manual, EPA-625/7-88/003.)

This Project Summary was developed by EPA's Hazardous Waste Engineering Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

What is Waste Minimization?

Waste minimization is comprised of source reduction and recycling. Source reduction is defined as any activity that reduces or eliminates the generation of waste at the source, usually within a process. Recycling is defined as the recovery and/or reuse of what would otherwise be a waste material. Figure 1 illustrates the various categories of waste minimization techniques.

The emphasis in this paper is on "hazardous waste." However, all waste streams must be considered when conducting an assessment. This includes air emissions, wastewater, and non-hazardous solid waste. The transfer of pollutants from one medium to another is not waste minimization.

Incentives

There are a variety of incentives for minimizing wastes. These include the following:

- Attractive economics (including reducing waste treatment and disposal costs, and savings in raw material costs)
- Increasing regulations (including landfill disposal regulations, reporting requirements, and permitting requirements for waste treatment)
- Reduced liability (including liability for environmental problems and workplace safety)
- Improved public image and environmental concern

The economic performance of WM projects has been enhanced in recent years by the dramatically increasing costs of waste disposal. Environmental regulations, especially RCRA (Resource Conservation and Recovery Act), have had a major effect on treatment and disposal costs.

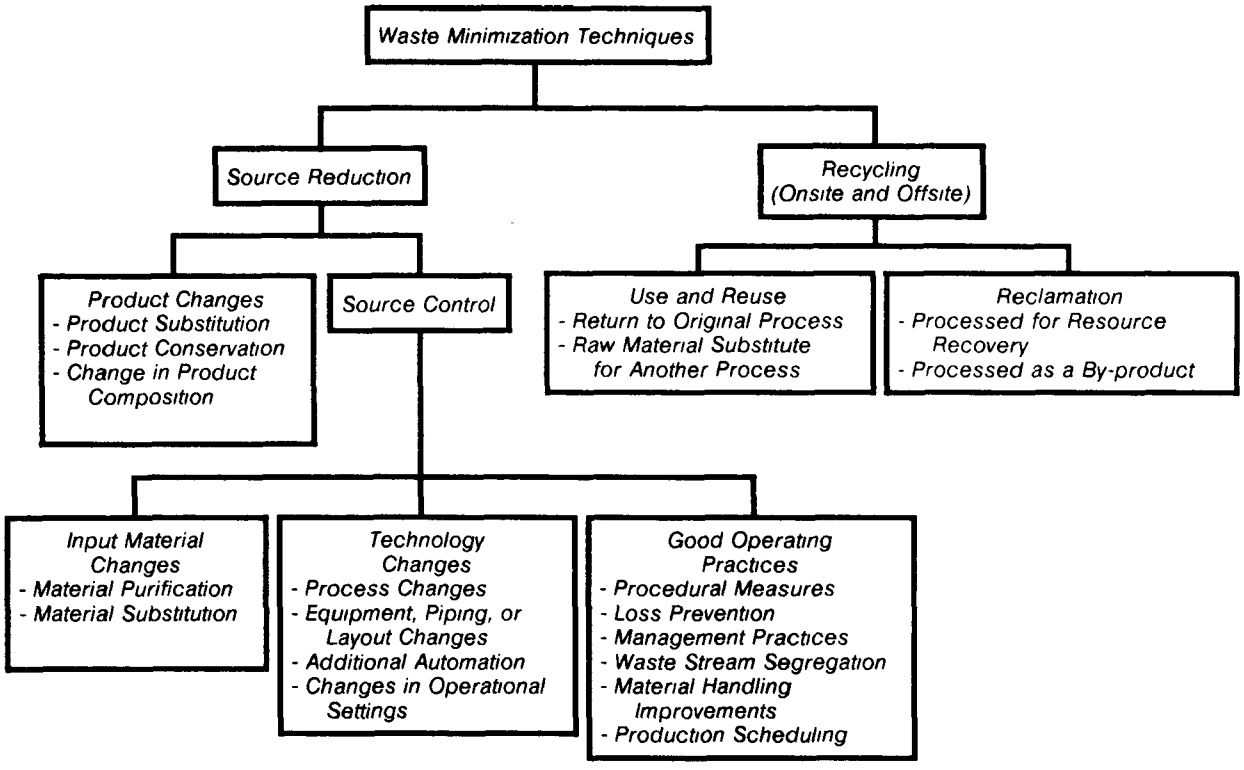

Figure 1. *Waste Minimization Techniques*

The Waste Minimization Assessment Procedure

The waste minimization assessment procedure presented here is a systematic framework that can be used by a facility's own employees to identify WM opportunities. As a structured program, it provides intermediate milestones and a step-by-step procedure to (1) understand the facility's wastes and processes, (2) identify options for reducing waste, and (3) determine which of the options are technically and economically feasible to justify implementation. On the other hand, the procedure should be modified to meet the specific needs of the individual company. As such, this manual should be viewed as a source of ideas and concepts, rather than a rigorous prescription of how to do assessments.

Figure 2 illustrates the WM assessment procedure. The WM assessment procedure is one part of a larger waste minimization program, which is required of hazardous waste generators. Careful planning and organization precedes the assessment itself. The assessment procedure can be split into two major phases:

- Assessment phase (collect information, and identify and screen potential WM options)
- Feasibility analysis step (technical and economic evaluation of the options)

Implementation of the recommended options follows the assessment. The WM program should be viewed as a continuing program, rather than a one-time effort.

Planning and Organization

Careful planning and organization is necessary to bring about a successful WM program. To start the program and maintain momentum and control, it is necessary to obtain management commitment. The program should set general goals by which to measure its effectiveness. Selecting a good program staff is critical to the ultimate success of the program. Since the program is a project organization within the company, a task force provides an effective way of carrying out the program

Assessment Phase

The assessment serves to identify the best options for minimizing waste through a thorough understanding of th waste-generating processes, was streams, and operating procedure Therefore, the assessment task force first major tasks are to collect informatic about the facility's waste stream processes, and operations.

Collecting and Compiling Facilit Information

Information about the facility's was streams can come from a variety sources, such as hazardous wast manifests, biennial reports, environment audits, emission inventories, wast assays, and permits Mass balance should be developed for each of th important waste-generating operatior to identify sources and gain a bett understanding of the wastes' origins

Collecting waste stream data ar constructing mass balances will create basis by which the assessment task ca track the flow and characteristics of th waste streams over time. This will b useful in identifying trends in was generation and will also be critical in th task of measuring the performance implemented WM options later. Th result of the activity is a catalog of was

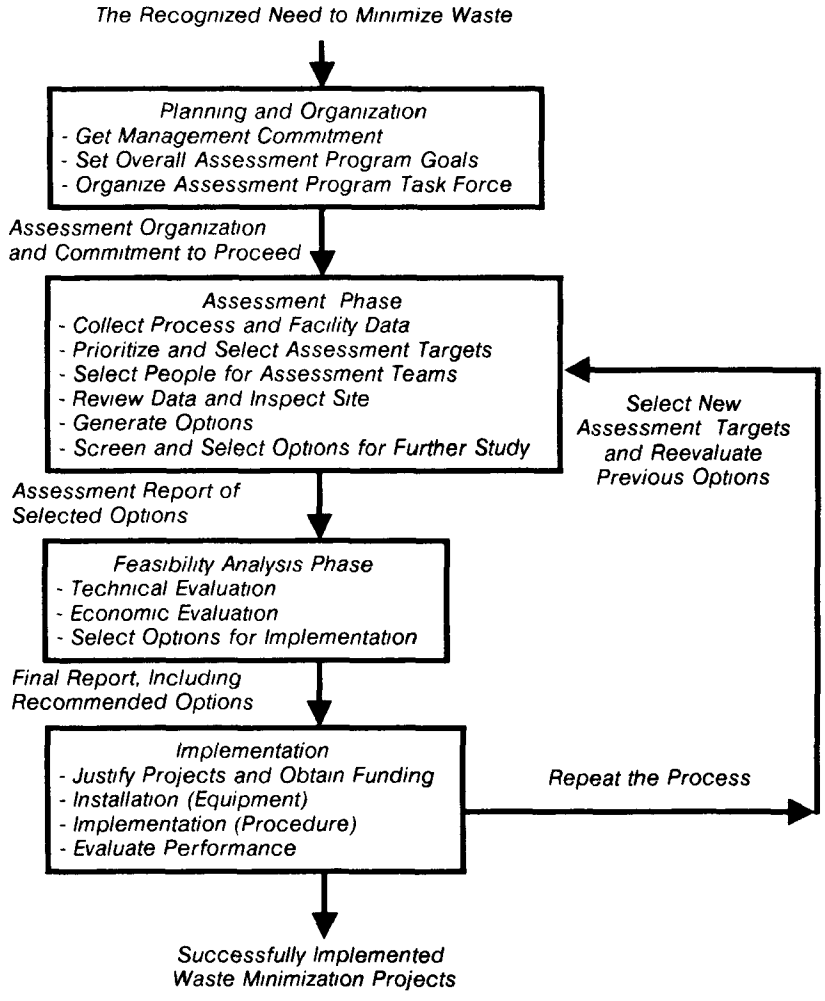

Figure 2. *The Waste Minimization Assessment Procedure*

streams that provides a description of each waste, including quantities, frequency of discharge, composition, cost of management, and other important information.

In addition to data about waste streams, other information is needed to fully understand the facility's operations. This includes the following items.

- Process, equipment, and facility design information
- Environmental reports, assays, manifests, documents, and permits
- Raw material production information
- Operating cost information
- Policy and organizational information

Prioritizing and Selecting Waste Streams to Assess

Ideally, assessments should be conducted on all of the waste-generating operations in a plant. However, in larger plants this often is not practical, considering the limited resources (money, time, and expertise) available. In this case, the assessment program task force should prioritize the streams. Important criteria to consider in prioritizing waste streams and/or facility areas to assess include the following:

- Compliance with current and future environmental regulations
- Disposal cost and/or quantity of the waste
- Hazardous nature of the waste, and other safety considerations
- Potential for (and ease of) minimization
- Potential for removing production or waste treatment bottlenecks
- Available budget and expertise for the waste minimization assessment program

A practical consideration in selecting waste streams for the first assessment is to find those that can be reduced with a good likelihood of success. A successfully implemented WM project will ensure the acceptance of further waste minimization efforts within the organization.

Select Assessment Team Members

The assessment team must include people who are familiar with the area of the facility to be assessed. Including first line operators and production supervisors is recommended. These people may or

may not already be on the assessment program task force. (in a large facility, the task force should have a broad understanding of the facility's operations, while the assessment team should have a specific understanding of the areas to be assessed.) It may be advisable to include people from other parts of the facility that regularly interact with the areas to be assessed.

Site Inspection

Although collecting and reviewing data is important in the assessment, the assessment team must be familiar with the actual operation at the site. To do this requires that the assessment team visit the site during the various stages or cycles of an operation. If all of the assessment team members work at the facility (or are located relatively close by) it is easy for the team members to visit the site. However, if one or more members are from outside of the facility, it is recommended that a formal site inspection be carried out.

The formal inspection serves to resolve all questions raised during the review and to complement that information already obtained and reviewed earlier. The inspection also confirms whether or not the facility actually operates in the way it was originally intended to. This inspection concentrates on understanding how the wastes are generated.

The assessment team should "walk the line" from the beginning of the process to the point where products and wastes leave the facility. Since waste can be generated in receiving and storage areas as well as the production areas, all areas within the site should be visited. The following guidelines will help in organizing an effective site inspection:

- Prepare an agenda in advance.
- Schedule the inspection to coincide with the particular operation of interest.
- Monitor operations at different times during the shift.
- Interview operators, foremen, and supervisors. Assess the operating personnel's awareness of the waste generation aspects of the operation.
- Observe the housekeeping aspects of the operation. Assess the overall cleanliness of the site.
- Review the organizational structure and level of coordination of waste-related activities between the assessed facility area and other related areas.
- Assess the administrative controls.

Generating WM Options

Following the collection of data during the assessment preparation step and the site inspection, the members of the assessment team will have begun to identify possible ways of reducing waste in the assessed area. The generation of options is both a creative and analytical process. While the individual assessment team members may be able to suggest many potential WM options on their own, the process can be enhanced by using some of the common group decision techniques, such as brainstorming. These techniques allow the team to identify options that the individual members might not have come up with on their own.

Identifying potential options requires the expertise of the assessment team members. Much of this knowledge comes from their education and on-the-job experience. Other sources of background information on potential options include the following:

- Trade associations
- Published literature
- Environmental conferences and exhibits
- Equipment vendors
- Plant personnel (especially the operators)
- Federal, state, and local government environmental agencies
- Consultants and/or employees from other facilities

Screening and Selecting the Most Promising Options for More Detailed Evaluation

A successful assessment will result in many WM options being proposed. At this point it is necessary to identify those options which offer a real potential to minimize waste and reduce costs. The screening procedure serves to eliminate those suggested options that are perceived as marginal, impractical, or inferior, without the detailed and more costly feasibility study. The procedures for screening these options can range from an informal decision made by the assessment program manager or a vote of the assessment team, to a weighted sum method that combines relative weights of such factors as operating cost reduction, capital cost requirement, reduction in waste hazard etc.

Some options (such as procedural changes) may involve no capital costs and can be implemented quickly. Th screening procedure should account f the ease of implementation for an optio If such an option is clearly desirable ar indicates a potential cost savings, should be considered for further study outright implementation.

In screening the options, th assessment team determines what th important criteria are in terms of the W assessment program goals ar constraints, and the overall corpora goals and constraints. Examples criteria that can be used include th following:

- Does the necessary technolog exist to develop the option?
- How much will the option reduc waste quantity, hazard, ar treatment/disposal costs?
- How much will the option reduc safety hazards?
- How much will the option reduc the use of input materials?
- What will the impact be on liabili and insurance costs?
- How much does it cost? Is it co effective?
- Can the option be implemente within a reasonable amount time?
- Does the option have a good "trac record"? If not, is there evidenc that the option can work in th case?
- What other benefits will occur?

Feasibility Analysis Phase

The WM options that are successful screened in the assessment step the undergo a more detailed feasibili analysis. The feasibility analysis is n unlike that carried out for any new proje within most organizations. However, ther are some important characteristics consider when evaluating wast minimization projects that are n necessarily considered with other type of projects.

Technical Evaluation

The purpose of the technic evaluation is to be sure that the optic will really work as intended, and wheth it can be implemented with specif facility constraints and produ requirements. Typical criteria for th technical evaluation include the followin

- Will the option work in th application?
- How has it worked in simil applications?

- Is space available? Are utilities available? Or must new utility systems be installed?
- Is the new equipment or procedure compatible with the facility's operating procedures, work flow, and production rates?
- How long will production be stopped in order to install the system?
- Will product quality be maintained or improved?
- Is special expertise required to operate or maintain the new system? Does the vendor provide acceptable service?
- Does the system or procedure create or remove safety hazards?
- Does the system or procedure create other environmental problems?

All affected groups in the facility should contribute to and review the results of the technical evaluation. Prior consultation and review with the affected groups is needed to ensure the viability and acceptance of the option. If the option calls for a change in production methods, the effects on the quality of the final product must be determined. If the project appears infeasible or impractical after the technical evaluation, it is dropped.

Economic Evaluation

The economic evaluation is carried out using the standard measures of profitability, such as payback period or discounted cash flow techniques (internal rate of return and net present value). Each company uses its own economic evaluation procedures and criteria for selecting projects for implementation. In performing the economic evaluation, various costs and savings must be considered. As in any project, the cost elements can be broken down into capital costs and operating costs.

Capital costs for WM projects are similar to most other projects. These costs include not only the fixed capital costs for designing, purchasing, and installing equipment, but also costs for working capital, permitting, training, start-up, and financing charges. As mentioned earlier, it is important to realize that some WM options, such as procedural or materials changes, will not have any capital costs. Also, many source reduction options have the advantage of not requiring environmental permitting in order to be implemented.

WM projects need to show a savings in operating costs to be economically effective. Operating costs and savings typically associated with WM projects include the following:

- Reduced waste treatment, disposal, and reporting costs
- Raw material cost savings
- Insurance and liability savings
- Increased costs (or savings) associated with product quality
- Decreased (or increased) utilities, operating and maintenance costs, and overhead costs
- Increased (or decreased) revenues from changes in production marketable by-products.

Once the capital and operating cost savings have been determined, the project's profitability can be determined using the profitability measures. These methods are discussed in virtually all financial management, cost accounting, and engineering economics textbooks. Those options that require no capital costs should be implemented as soon as savings in operating costs can be shown.

An important consideration of WM projects is their potential to reduce the risk of environmental and safety liabilities for a company. Although these risks can be identified, it is difficult to predict if and when liability problems will occur and the financial impact. It is important that the managers within the company who decide to fund the company's projects be aware of the significance of these risks and factor the risk reduction benefits of waste minimization into these projects. Also, while the profitability of a WM assessment program is important in deciding whether to implement a project, compliance with environmental regulations may be more important, since violation may ultimately result in shutting down the facility, and possible criminal penalties for the company's responsible people.

Final Report

The product of a WM assessment is a report that presents the results of the assessment and technical and economic feasibility analyses. It also contains recommendations to implement the feasible options. A good final report can be an important tool for getting an attractive project implemented. The report should include not only how much the project will cost and its expected performance, but also how it will be done. Important topics to discuss include the following:

- whether the technology or procedure is established, with a mention of successful applications
- the required resources (money, expertise, and manpower) available in-house, and those resources that must be brought in from outside.
- the estimated construction period and production downtime.
- the means by which performance can be evaluated after the project has been implemented.
- the reductions in environmental and safety liability

Before the report is finalized, be sure to review the results with the affected groups. It is important to solicit the support of the affected groups. By having people from these groups assist in preparing and reviewing the report, the chances are increased that the attractive projects are successfully implemented.

Implementation

The implementation of the WM project is not unlike any other project that involves new equipment or procedures. It may be necessary to overcome inertia or resistance to change within the organization. The commitment of management to waste minimization is important at this time.

Once the project has been implemented and operating, it is important to evaluate its performance. Is it performing as expected? If not, should it be abandoned, or is its use still beneficial? What other potential options have been identified through the operation of this option?

Ongoing Program

The WM program should be viewed as a continuing one. As WM options are implemented, the task force should continue to look for new opportunities, assess other waste streams, and consider attractive options that were not pursued earlier. The ultimate goal is to reduce wastes to the maximum extent practical

Conclusion

The waste minimization assessment offers opportunities to reduce operating costs, reduce potential liability, and improve the environment, while improving regulatory compliance The WM assessment procedure results in a careful review of a plant's operations toward reducing wastes The WM program task force should strive to build a waste minimization philosophy within the company. In doing so, the entire company can help to minimize waste.

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The complete report, entitled "The EPA Manual for Waste Minimization Opportunity Assessments," (Order No. PB 88-213 004/AS; Cost: $19.95, subject to change) will be available only from:

National Technical Information Service
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