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EC95-740 Pollution Prevention: A Tool Kit for Metal Finishers

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University of Nebraska Cooperative Extension EC 95-740-S

Pollution Prevention

Helping Your Business and the Environment

A Tool Kit for Metal Finishers

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Kenneth R. Bolen, Director of Cooperative Extension, University of Nebraska, Institute of Agriculture and Natural Resources.

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While technical reviewers provided guidance in copy revisions and assisted in assuring accuracy of content, the views expressed in these tool kits are those of the authors and do not necessarily reflect the views of either the technical reviewers or the agencies they represent.

Technical review was provided by Todd MacFadden and Karen Bucklin Sanchez, Montana State University; Becky Shannon, Missouri Department of Natural Resources; Theresa Hodges, Kansas Department of Health and Environment; and John Steinauer, Nebraska Department of Environmental Quality.

The Great Plains-Rocky Mountain Hazardous Substance Research Center, US Environmental Protection Agency Region VII, as well as the Biological Systems Engineering Department, the Center for Infrastructure Research, and the Water Center at the University of Nebraska provided partial support for this project.

These materials were written by Jan Hygnstrom under the direction of M.F. Dahab and W.E. Woldt, Biological Systems Engineering, LW Chase Hall, University of Nebraska-Lincoln 68583-0726. Special thanks to Sheila Smith, Biological Systems Engineering artist, for help in layout and design.

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Please let us know what you think of these materials. A postage-paid self-folding evaluation is included for your use. Please call Wayne Woldt at (402) 472-8656 if it is missing.

The Pollution Prevention Tool Kits are industry-specific. Tool Kits are available for the following industries:

- Autobody Repair
- Vehicle Maintenance
- Drycleaning
- Metal Finishing
- Farm Cooperatives

For ordering and price information, contact :

Cooperative Extension Publications Distribution
Room 105 Agriculture Communications Building
PO Box 830918
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Telephone: (402) 472-9713

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Would you like to:

✓ Reduce your operating costs by using fewer materials and supplies?

✓ Reduce hazardous and nonhazardous waste transportation and disposal costs?

✓ Reduce liability and risks associated with hazardous waste?

✓ Reduce the paperwork and record keeping requirements associated with hazardous waste?

✓ Improve workplace safety and employee health?

✓ Help safeguard the environment?

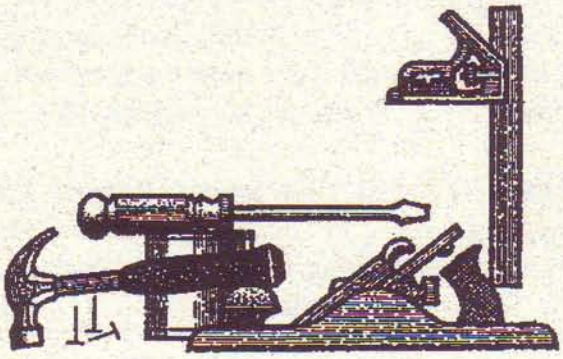
✓ Improve your company's image?

✓ Increase your company's business activities?

If you answered "*Yes*," to any of the above questions, you may want to look at the materials in this pollution prevention tool kit.

It's called a tool kit because it contains information, or tools, to help you prevent pollution in your business. The tools will help you identify wastes, both hazardous and nonhazardous, that your business produces. You will be able to look at your operation in a different light, keeping pollution prevention in mind.

The first tools will help you understand what pollution prevention is, how it can benefit your business, and characteristics of successful programs. Later tools contain pollution prevention ideas that are specific to your business.



Incidentally, as you read through materials, you'll notice the words pollution and waste are used interchangeably. Any waste, whether it's the paper you don't need anymore or hazardous waste like spent solvents, has the potential to become pollution. By reducing the waste your business generates, you're reducing the chances that you'll be polluting your neighborhood, your community, your environment.

A Look at What's Ahead

1a Pollution Prevention Contacts for EPA Regions VII and VIII. This chart lists telephone numbers and addresses of people who work with pollution prevention. Use this if you need information specific to your state or EPA region.

2 Why the Concern About Waste? And just what is pollution prevention anyway?

3 Getting Off to a Good Start. Some successful pollution prevention program strategies are given, as well as reasons why some programs never get off the ground.

4 Hazardous Waste. The ultimate goal is to not produce any sort of waste. In the meantime, the hazardous waste your business produces subjects you to some special regulations.

5 Material Safety Data Sheets. You can learn a great deal about the materials your business uses by understanding what Material Safety Data Sheets are and what they say.

5a Material Safety Data Sheets-A Closer Look. There's more information than meets the eye. Take the time to understand the terms in the MSDS and you'll be better equipped to make sound decisions involving use, handling, and storage of hazardous materials.

6 Pollution Prevention Strategies for Your Business, Through Changes in:

Housekeeping and Maintenance
Inventory
Basic Operations
Equipment
Raw Materials
Process Technology

Waste Exchanges and Recycling

7 Ready to Begin Preventing Pollution? This is a series of worksheets to help you collect and analyze information on your business.

Analyzing Pollution Prevention Options
Pollution Prevention Program Review

8 Yard Waste, A Growing Concern. Yard wastes from homes and businesses account for a large percentage of our waste. If your business has a green space, here are some ideas to make it greener, in terms of lawn health and reduced waste production.

9 Blow Your Horn! Publicize Your Pollution Prevention Efforts. Publicity and rewards, both within your business and the community are two methods for sustaining a pollution prevention effort.

10 Worksheets: A more in-depth look at

Waste Assessment
Costs of Processes
Screening Pollution Prevention Options
Technical Feasibility
Economic Feasibility
Pollution Prevention Option Summary
Evaluation of Pollution Prevention Project

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Pollution Prevention Contacts for EPA Regions VII and VIII

Your city or county health department may have information about local programs and contacts. Another good source of information is your state Clean Air Act Small Business Advocate, or local Extension office.

EPA Region VII Steve Wurtz US EPA Region VII 726 Minnesota Avenue Kansas City, KS 66101 (913) 551-7315		
IA	Jim Olson Iowa Waste Reduction Center 75 Biology Research Complex University of Northern Iowa Cedar Falls, IA 50614-0185 (319) 273-2079	Larry Gibson Waste Reduction Assistance Program Iowa Dept. of Natural Resources Wallace State Office Building Des Moines, IA 50319 (515) 281-8489
KS	Michelle Feenstra Kansas State University Engineering Extension Manhatten, KS 66506 (913) 532-6026	Theresa Hodges, Pollution Prev. Director Dept. of Health and Environment Forbes Field, Bldg. 740 Topeka, KS 66620-0001 (913) 296-6603
MO	John Atkinson, Engineering Extension University of Missouri W 1000 SBE Columbia, MO 65211 (314) 882-8880	Becky Shannon Missouri Dept. of Natural Resources P.O. Box 176 Jefferson City, MO 65102 (314) 526-6627
NE	Wayne Woldt University of Nebraska-Lincoln L.W. Chase Hall Lincoln, NE 68583-0726 (402) 472-8656	Wanda Blasnitz, Pol. Prev. Coordinator Nebraska Dept. of Environmental Quality P.O. Box 98922 Lincoln, NE 68509-8922 (402) 471-2266

EPA Region VIII Marie Zanowick 999 18th Street, Suite 500 Denver CO 80202-2405 (303) 294-1065		
CO	Harry Edwards Waste Minimization Center Colorado State University Dept. of Mechanical Engineering Fort Collins, CO 80523 (303) 491-5317	Neil Kolwey, Pollution Prevention Program Colorado Department of Health HMWMD-B2 4300 Cherry Creek Dr. S Denver, CO 80222-1530 (303) 692-3309
MT	Karen Bucklin Sanchez Pollution Prevention Coordinator Montana State University Extension Service Taylor Hall Bozeman, MT 59717-0312 (406) 994-3451	Don Vidrine Solid & Hazardous Waste Bureau Dept. of Health & Environmental Sciences Cogswell Building Helena, MT 59620 (406) 444-1430
ND	Jeffrey L. Burgess Environmental Health Section Dept. of Health & Consolidated Laboratories 1200 Missouri Ave Rm 201 Bismarck, ND 58502-5520 (701) 221-5150	Neil Knatterud Dept. of Health & Consolidated Laboratories Division of Waste Manag. 1200 Missouri Avenue P.O. Box 5520 Bismarck, ND 58502-5520 (701) 221-5166
SD	Carrie Jacobson Office of Waste Management Dept. of Environment & Natural Resources 523 E Capitol Ave Pierre, SD 57501 (605) 773-3153	Vonni Kallemeyn Office of Waste Management Dept. of Environment & Natural Resources 523 E Capital Ave. Pierre, SD 57501 (605) 773-6035
UT	Kitt Farrell-Poe Ag. Tech. & Ed. Systems Utah State University Logan, Utah 84322-2300 (801) 750-3389	Sonja Wallace & Stephanie Bernkopf Dept. of Environmental Quality PO Box 144810, 168 N 1950 W Salt Lake City, UT 84114-4810 (801) 536-4477
WY	Pat Gallagher Senior Environmental Analyst Solid Waste & Hazardous Waste Div. Department of Environmental Quality 122 W 25th St Cheyenne, WY 82002 (307) 777-7752	Joe Hiller Extension Water Specialist P.O. Box 3354 University of Wyoming-Laramie Laramie, WY 82071 (307) 766-2196

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Pollution Prevention

Helping Your Business and the Environment

Number 2 University of Nebraska-Lincoln Cooperative Extension & Biological Systems Engineering January 1995

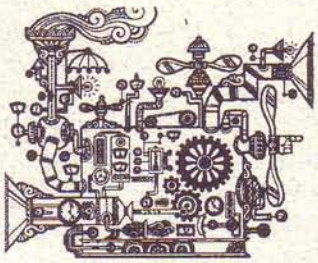
Why the Concern About Waste?

For some businesses, waste disposal costs are going through the roof.

As a business owner, you've noticed waste disposal costs climb year by year. Along with that have come increased regulations from federal, state, and local governments, especially in the area of hazardous waste. How did we get to this point?

Throughout early history, it was common practice to get rid of waste by pitching it on the land or down the river. As people became frustrated with the flies or rodents and even ill due to diseases resulting from waste, we learned to carry it farther from our homes and businesses. Later, burning and burial offered solutions.

Over the years, new technology was developed. We learned how to make plastics from petroleum. This opened a whole new world to us, from unbreakable cups to artificial hearts. Plastics solved some problems of earlier packaging types; plastic is light and unbreakable. Because of plastic packaging, we have less food waste, but unfortunately, we have the packaging waste on our hands.



As technology has developed, our waste has changed.

With the development of affordable computers, people felt that written documents would become history. Information and correspondence would be transmitted by computer disk, or over telephone wires. Now, we realize that computers have allowed us to generate more documents at a faster rate. The result: more paper waste.

We also learned how to make materials that can kill pests, clean our homes, keep our autos running, and generally make life easier. The manufacturing by-products and leftover materials were disposed of like our other wastes, thrown in a dump or down a drain. Some of these materials and disposal methods have come back to haunt us.

> Love Canal became a symbol of the nation's toxic waste problems in the late 1970s when chemicals dumped there 30 years earlier began leaking into yards and basements. An estimated 2,500 people had to leave their homes.

The Superfund was developed to put these waste "ghosts" to rest. Billions of dollars are spent cleaning up abandoned hazardous waste sites, and, unfortunately, the list of sites is growing, not shrinking.

Until recently, the focus has been on pollution control.

The Environmental Protection Agency (EPA) came into existence in 1970, due to concern about what was happening to our environment. Its focus has been on what to do with pollution after it is generated. How can it be handled, treated, and disposed of so that our land, water, and public health are not harmed? As a result of these efforts, the U.S. has made progress in cleaning up our water and air. Lake Erie, declared dead in the 70s, has come back to life. Lead air emissions have decreased by 96% since 1970, due mainly to the phase-out of leaded gasoline. In almost every category of air pollution, emissions have either leveled off or declined since 1970.

In order to continue making progress toward the goal of a clean, healthy environment, the EPA has focused on a new approach called pollution prevention. So what exactly is it? If you want an official definition, pollution prevention is the elimination or reduction in waste quantities or toxicities at the point of generation. The simple definition is *"try not to make pollution in the first place."* Rather than control waste once it is generated, don't make it. Period. This approach is so obvious, it's amazing we didn't consider it sooner!

Pollution Prevention: Try not to make waste in the first place.

If we don't make waste, we don't have to figure out where to store it. We don't have to pay for handling, transporting, treating, or disposal of it. We don't have to deal with the regulatory red tape, especially where hazardous materials are concerned.

Pollution Prevention: What It Isn't

Pollution prevention is not changing waste from one form to another. Burning paper waste in an outdoor burn barrel instead of throwing it in the landfill merely changes the form of pollution from solid waste to air pollution. And, incidentally, in some areas burn barrels are illegal.

Pollution prevention is not treatment to detoxify or to recover energy. Nor is pollution prevention disposal. These are examples of pollution control instead of prevention.

Because it may take time to reduce or eliminate pollutants, those generated should be reused or recycled in an environmentally safe manner. As a last resort, in the absence of feasible prevention or recycling opportunities, waste should be treated and/or disposed of in such a way as to reduce the risk to public health, safety, welfare, and the environment. Considering that rural areas may not have the recycling options due to prohibitive transportation costs, pollution prevention is a wise choice.

And pollution prevention works

Pollution prevention has increased business profits.

Throughout the U.S., as businesses have watched waste disposal costs soar, some have tried to reduce the amount of waste produced. In many cases, by just altering a few methods for minimal cost, they've seen dramatic results - decreased waste and increased profits.

● The Washington State University's Office of Publications and Printing began a 5-year program in 1991 to reduce the amount of hazardous and nonhazardous waste produced. They chose to implement all the components of the program in one year and reduced hazardous wastes and toxic air emissions by 97%. Overall, their waste reduction program saved them $95,000 in one year.

● A Minnesota manufacturer of cabs for agricultural and construction equipment spent $270 for equipment and labor, and saved $13,000 annually on solvent purchase and disposal.

● A tool company in North Carolina changed its manufacturing process to recover nickel from wastewater. This change cost $1,000, which was recovered in 5 weeks. The company sees an annual savings of $10,000 due to the switch.

Pollution prevention benefits include

- reduced raw material costs
- reduced treatment and disposal costs
- reduced liability
- reduced paperwork
- improved business image
- safer workplace

Even very small businesses can profit from pollution prevention. A family-owned autobody repair shop employing 17 people saved $4,800 a year by using a still to reclaim spent solvents on-site. The payback period for the still was less than one year. The amount of solvents sent off-site for treatment or disposal decreased by 80%. The owner of this company believes that improvements made due to environmental issues resulted in safer working conditions for his employees. This in turn led to higher quality work and greater efficiency, which has attracted more business.

By using pollution prevention methods, your business will be more efficient. Face it, waste started out as a resource that you paid money for, whether it's that paper you threw out, or spent solvents from cleaning machine parts.

If you eliminate hazardous waste generation, you get out from under the regulations. Wouldn't life be simpler without manifests for hazardous waste? The solution is not to get rid of the manifest system. It has an important role in making sure hazardous waste is handled safely. The solution is to not generate hazardous waste.

You are responsible for waste generated by your business, even after it leaves your premises. By not generating waste, you escape the liability associated with it.

There are other benefits to using pollution prevention opportunities. You will create a safer working environment. This in turn increases employee morale and productivity.

The public, which includes your customers, has a concern for the environment and its quality. By adopting pollution prevention methods, you will improve community relations and improve your business image. Your company may be better able to compete in the marketplace if you not only use pollution prevention methods, but publicize your efforts.

Pollution prevention strategies include changes in:

- housekeeping and maintenance
- inventory methods
- equipment
- raw materials
- process technology

Many of the general pollution prevention methods are simple to implement, and not costly. Take a close look at your housekeeping and maintenance procedures, as well as how you handle your inventory. You may also be able to modify your equipment to make it more efficient. Perhaps new equipment would save money in the long run, especially if there are fewer waste disposal costs to pay. There may be less toxic raw materials available to substitute for those you presently use. Later tools will take a closer look at these pollution prevention strategies.

The next tool will give you ideas on how to successfully implement pollution prevention in your business.

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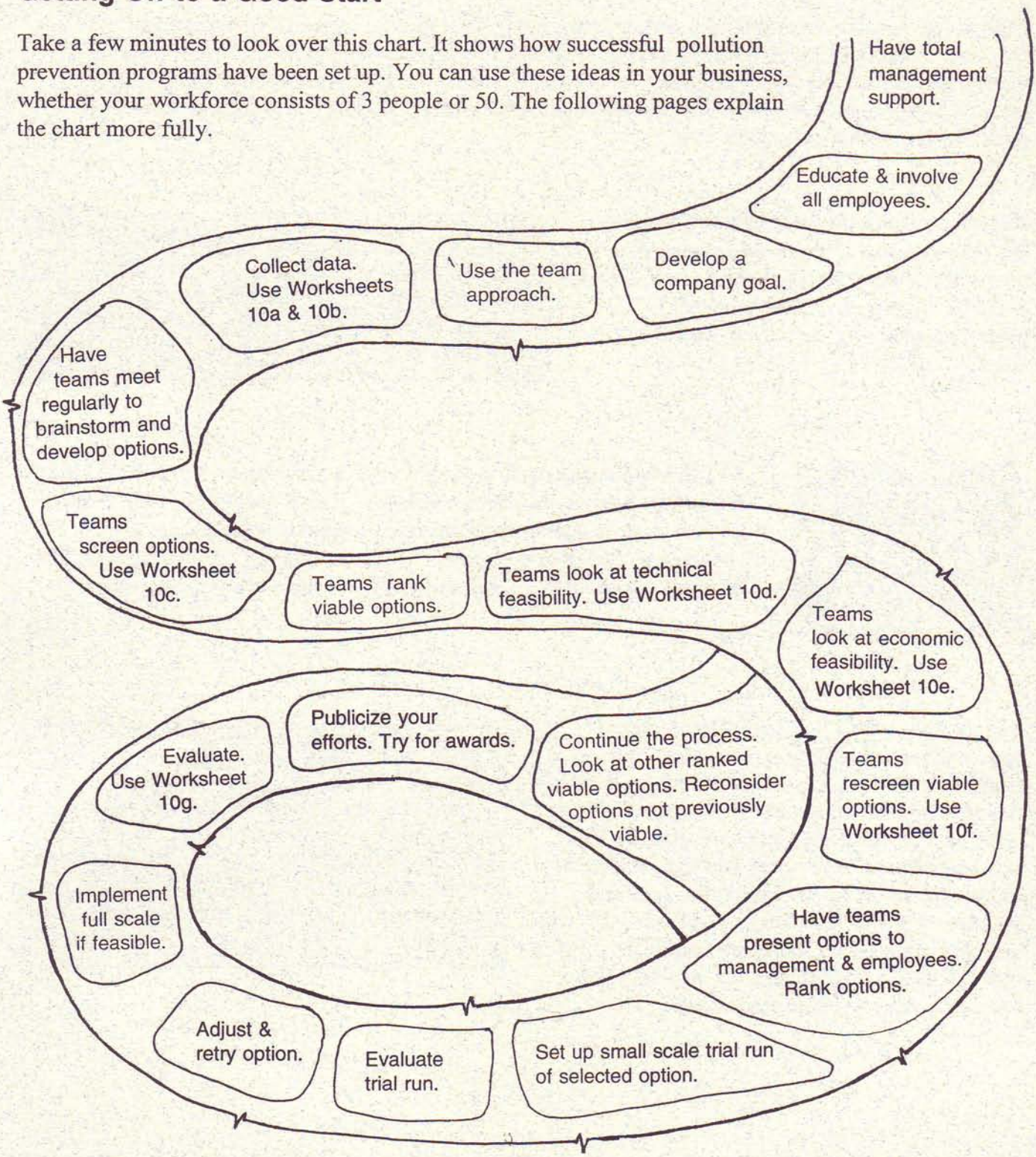
Pollution Prevention

Helping Your Business and the Environment

Number 3 University of Nebraska-Lincoln Cooperative Extension & Biological Systems Engineering January 1995

Getting Off to a Good Start

Take a few minutes to look over this chart. It shows how successful pollution prevention programs have been set up. You can use these ideas in your business, whether your workforce consists of 3 people or 50. The following pages explain the chart more fully.



Have total management support.
In some cases, pollution prevention may have been brought to the attention of management by a concerned employee. To show your commitment, write a policy on pollution prevention in your business. A sample appears at right.

> At Acme Printing Company, we believe a clean, healthy environment is very important. We are committed to preventing pollution through eliminating or reducing our use of toxic materials, conserving energy, and reducing wastes.

Educate & involve all employees from the beginning. Just as total support of management is necessary, employee involvement is crucial to an effective program. Employees have the hands-on experience and see the direct results of production methods. Once they understand the pollution prevention concept, they will be invaluable in generating ideas. Who better to include in making plans for preventing pollution?

Develop a company goal to work toward.
Set measurable and obtainable goals. You may want to decrease your solid waste output by 25% in one year. Or reduce your hazardous waste by 10% every year for 5 years.

> One ambitious business set a goal of zero hazardous waste in 10 years. They realized that they may not ever reach that goal, but they wanted to get as close as possible. And they *are* seeing results.

Use the team approach to divide work and maintain motivation. Large businesses have teams. Each consists of 6 to 8 people from different departments, including maintenance, accounting, management, and production. Different viewpoints and knowledge of various parts of the business are shared. A small business may have everyone on one team.

Collect data. This will help you identify opportunities for pollution prevention, and establish a baseline for measuring progress. Many business owners are amazed at the actual dollars spent on waste management and disposal. You may want to use Worksheet 10a and conduct a waste assessment to determine the types and amounts of waste generated. Worksheet 10b will help you get a handle on where money is spent in your business. This information will help you evaluate pollution prevention options.

> Some businesses have incorporated a cost allocation system. Departments and managers are charged for pollution control and waste management costs. Labor costs, liability, regulatory compliance, disposal and oversight costs should be included. This provides real incentive to prevent pollution.

Have teams meet regularly. First, they'll brainstorm. This involves dreaming up as many pollution prevention ideas as possible. Ideas are not judged or evaluated at this point. Just keep generating ideas.

Screen options. Have teams use worksheet 10c to determine which options should be considered further.

Rank viable options. Have each team rank their options. Some may not be viable at this time. Shelve those for future consideration.

Look at technical feasibility. Use worksheet 10d to have teams determine whether the technology exists for the viable option. Shelve those which are not technically feasible for a later date.

Look at economic feasibility. Use worksheet 10e to have teams determine whether the option is economically feasible. Shelve those which are not feasible now for consideration later.

Within your business, let everyone know how close you are to your goal. Post a sign or pass a memo showing waste reduction results. Many businesses embark on a paper recycling program, and educate everyone about how to recycle. Often, after the initial contact, the employees never hear if the program is continuing, much less if their efforts are having an impact. This reduces the motivation to continue recycling. The same is true of pollution prevention.

Rescreen viable options. Have teams use worksheet 10f to look those options over again. Each team should select one option to follow through.

Have teams present options to management and employees. Rank these. Implement simple ideas first, to gain support for the program. Start with one or two basic ideas to get everyone working together. This will reap benefits quickly and provide motivation to do more.

Set up small scale trial run of selected option. The team may have to do additional research and legwork. After they feel enough information has been collected, try implementing the option on a small scale.

Reward employees periodically for their pollution prevention efforts and ideas. Tool 9 has some ideas.

Evaluate. After the trial run, sit down and talk over the results. Are there any areas that need special attention?

Adjust and retry the option. Make any adjustments that may make the option run more smoothly. Run another trial. If you feel it really is feasible....

Implement full scale. Try the option throughout your business.

Evaluate option. Use worksheet 10g. Determine whether the option was successful. Did you prevent pollution? Improve worker safety? Realize economic benefits? Reduce your liability?

Monitor progress periodically and revise goals if needed. It is important to keep track of your efforts and see if you're really on track. If you were unrealistic in your goals, revise them and make them more attainable.

Publicize your efforts. Tell your community what you're up to. If you have succeeded in reducing your waste generation by 25%, let people know. This shows your concern for the environment and your neighbors. Tool 9 has some ideas.

Apply for local, state, regional, or national awards. Even if you don't win, you may get ideas for more pollution prevention possibilities just by going through the application process. Tool 9 has information on this, too.

Barriers to a Successful Pollution Prevention Program

What are some potential barriers to developing and maintaining a successful pollution prevention program? If you are aware of them and plan for them, your chances of preventing pollution, reducing waste management costs, reducing liability, improving your business image, and improving workplace safety will be greater.

If you don't have management and employee support, a successful program will be a tough row to hoe. You can demonstrate management support by developing a written company policy on pollution prevention, setting goals for reducing waste, and publicizing and rewarding success.

People who are resistant to change will be difficult to deal with. For pollution prevention to work, people will have to look at business operations with a fresh eye. Forget that "it's always been done this way." You have to be willing to experiment a bit to get the kinks out, and test new ways of doing things.

Taking on too much at once may doom your pollution prevention program from the start. Set a goal and pace yourself. Try simple options first. As you gain experience and have some successful projects under your belt, look at more difficult options.

The next tool explains what hazardous waste is. You'll see why reducing or eliminating its generation may be in your business's best interests.

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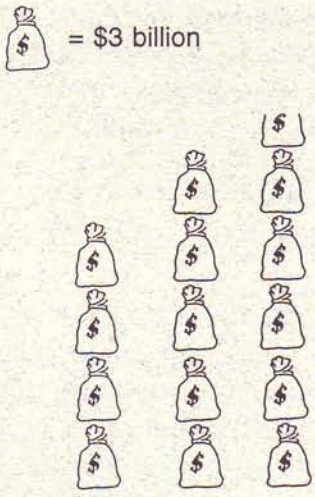
Pollution Prevention

Helping Your Business and the Environment

Number 4 University of Nebraska-Lincoln Cooperative Extension & Biological Systems Engineering January 1995

Hazardous Waste and Your Business

Money Spent on Hazardous Waste Management Services in the US (includes analytical, environmental consulting, design and engineering, remediation construction, transportation, storage, and disposal costs).



*Estimates by William T. Lorenz & Co.

Ignoring hazardous waste regulations is a serious matter. Besides endangering public health and the environment, improper handling of hazardous waste can bring fines and even jail sentences, as the article at the bottom of this page shows. This tool gives you an idea of some of the regulations hazardous waste generators must deal with. As you'll see, there are benefits to pollution prevention - not producing hazardous waste. In trying to reach that goal, the less hazardous waste your business generates, the lower the number of regulations you'll have to deal with. That means savings in terms of time and money. But first.....

What is Hazardous Waste?

Although reducing the amount of any waste your business produces will benefit you, there is special concern about hazardous wastes. These are wastes that can cause injury or death. They may also damage or pollute land, air, or water. Hazardous wastes are regulated by federal and state laws.

The following information, taken from federal hazardous waste regulations is meant to give you an idea of what a hazardous waste generator must do for compliance. Your state and local regulations will be *at least* this stringent, never more lenient. For more information on your state hazardous waste regulations, contact your Cooperative Extension office, Health Department, or Environmental Agency.

Polluters Get Jail Terms, Fines

The production manager of a metal coating facility was sentenced to 40 months in prison after a jury found him guilty of burying drums of spent solvents at the facility. The president and an officer of the parent company are awaiting trial.

The chief executive officer of an industrial waste trap cleaning company was sentenced to three years in prison and his firm fined $1 million. He knowingly discharged wastes that were prohibited by the Clean Water Act into the city's sewer system.

A dry cleaning businessman went to jail owing $30,000 in state fines for dumping carcinogenic waste into a village water supply. He also faces 300 days of electronic home detention.

Names and locations purposely omitted.

How do I know if a waste is hazardous?

There are 3 main ways a waste falls into the hazardous category.

1. Listed wastes - appear on any one of four lists of hazardous wastes contained in the Resource Conservation and Recovery Act (RCRA). These have been listed because they contain any number of toxic materials that have been shown to be harmful to the environment, or they exhibit one of the characteristics described below. Listed wastes may be generated from manufacturing processes or may consist of discarded commercial chemical products.

2. Characteristic wastes - have one or more of the following characteristics:

Ignitable

A. *Ignitable* - have a flash point of less than 140° F. The flash point of a liquid is the lowest temperature at which it can release enough flammable vapor to ignite. Ignitables can be liquids, solids, flammable gases, or oxidizers. At standard temperature and pressure, non-liquid ignitables may cause fire through friction, absorption of moisture, or spontaneous chemical changes. Some ignitable hazardous wastes include kerosene, mineral spirits, toluene, and xylene.

Reactive

C. *Reactive* - unstable or undergo rapid or violent chemical reaction when exposed to heat, pressure, water, or other materials. The reactions may produce toxic fumes or gases. Chromic acids, perchlorates, and peroxides fall into this category.

Corrosive

B. *Corrosive* - extremely alkaline (pH greater than or equal to 12.5) or extremely acidic (pH less than or equal to 2), or can corrode steel at a rate of greater than 0.25 inches per year. These dissolve skin, metals, and other materials. Special containers are necessary to resist corrosion. Corrosive wastes include waste rust removers, waste acidic or alkaline cleaning fluids, and waste battery acid.

Toxic

D. *Toxic* - contain high concentrations of some heavy metals such as lead, cadmium, or mercury; or contain certain pesticides. This is determined through testing with the Toxics Characteristic Leaching Procedure (TCLP). Toxic wastes can cause cancer, kidney damage, birth defects, and blood disease.

3. Mixtures -

- of listed hazardous waste and non-hazardous waste.
- of a characteristic hazardous waste and a non-hazardous waste if it exhibits a characteristic (ignitable, corrosive, reactive, or toxic).

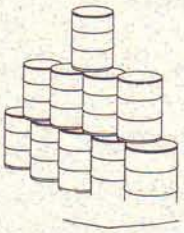
It is your responsibility to determine whether your wastes are hazardous. The **Material Safety Data Sheet (MSDS)** that you receive for each hazardous material you purchase is a good place to look for information. The amount of hazardous waste your business produces will determine the amount of paperwork and regulations you must comply with. Tools 5 and 5a have more on the MSDS.

Some wastes are called *acutely* hazardous. These are wastes so dangerous in small amounts that the EPA regulates them in the same way as large amounts of other hazardous wastes. Dioxin-containing wastes and some pesticide wastes fall into this group.

The amount of hazardous waste your business generates and stores determines what category your business falls into: Conditionally Exempt, Small Quantity, or Large Quantity Generator. Each category has certain regulations that the generators must comply with. *These names and amounts may vary by state. Be certain to check your state's.* These are the federal categories:

Conditionally Exempt Generators produce no more than 220 lbs (about 25 gal) of hazardous waste and no more than 2.2 pounds of acutely hazardous waste per month. No more than 2,200 lbs of hazardous waste can be stored on your property.

Small Quantity Generators produce between 220 and 2,200 pounds (between 25 to less than 300 gal) of hazardous waste and no more than 2.2 lbs of acutely hazardous waste per month.



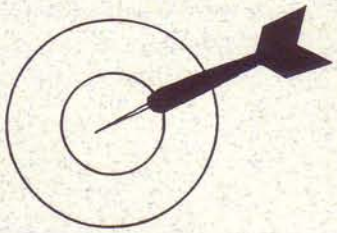
Large Quantity Generators produce 2,200 pounds (about 300 gal) or more of hazardous waste or more than 2.2 lbs or acutely hazardous waste per month.

The next section of this tool gives the federal guidelines for determining what wastes to include when calculating hazardous waste totals. Be sure to look at your state and local regulations to determine what wastes must be included and what wastes need not be.

A chart summarizing federal hazardous waste generator requirements is included to give you an idea of the regulations you must comply with, depending on the amount of hazardous waste your business generates. Again, be sure to check state and local regulations.

There is a great deal of paperwork involved with managing hazardous waste. Besides the paperwork, time must be spent training employees, inspecting storage areas, and keeping up with changing regulations. If you didn't generate hazardous waste, these regulations would not apply to you.

That makes zero hazardous waste production a pretty good target to aim for.



Calculating Hazardous Waste Totals

Listed below are federal requirements for calculating hazardous waste totals. Remember, your state and local requirements may be more strict. Contact your local Cooperative Extension office, Health Department or Environmental agency for state and local regulations.

When calculating hazardous waste totals:

What wastes do I include?

All listed and characteristic wastes that you:

- accumulate on-site for any period of time prior to subsequent management.
- package and transport off-site.
- place directly in a regulated on-site treatment or disposal unit.
- generate as still bottoms or sludges and remove from product storage tanks.

Do not include wastes that:

- are specifically exempt from counting, such as used oil that has not been mixed with hazardous waste or spent lead-acid batteries that will be sent off-site for reclamation.

- may be left in the bottom of containers that have been completely emptied through conventional means, such as pouring or pumping. Containers are considered empty if no more than 1 inch of residue remains, or no more than 3% by weight remains in a container that holds 110 gallons or less, or no more than 0.3% by weight remains in a container that holds more than 110 gallons. Acutely hazardous waste containers must be more thoroughly cleaned by triple-rinsing with an appropriate solvent.

- are discharged directly to a public utility that treats industrial and domestic sewage, without being stored or accumulated first. However, this discharge must comply with the Clean Water Act.

- you reclaim continuously on-site without storing prior to reclamation, such as dry cleaning solvents. Any residues removed from the dry cleaning machine and any spent cartridge filters must be counted, however.

- you manage in an elementary neutralization unit, which is a regulated tank, container, or transport vehicle designed to contain or neutralize corrosive wastes.

- you manage in a totally enclosed treatment unit or a wastewater treatment unit.

- you have already counted once during the calendar month and treated on-site or reclaimed in some manner and used again.

- are left as residue in the bottom of product storage tanks if the residue is not removed from the product tank.

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Federal Regulation	Fully Regulated Generators- Generate ≥2,200 lbs HW or ≥2.2 lbs AHW per month	Small Quantity Generators- Generate >220 lbs but <2,200 lbs HW, and <2.2 lbs AHW per month	Conditionally Exempt Generators- Generate <220 lbs HW and <2.2 lbs AHW per month
Waste minimization	Certify on each manifest that you have a waste minimization program in place, as required by state. Complete annual reports as required by state.	Same as fully regulated generator if required by state. Program strongly recommended to reduce liability, HW disposal costs.	No federal requirement. Check state and local regulations. Strongly recommended. Annual reports if required, with documentation.
Training	Each employee who handles hazardous waste must be thoroughly trained in -regulatory compliance. -emergency response. -emergency equipment.	Employees must be familiar with proper waste handling and emergency procedures.	No federal requirement. Check state, local regulations. Strongly recommended for employee and community safety.
Emergency Response	Contingency plan. Preparedness/prevention requirements. Incident reports to EPA. Emergency procedures.	Preparedness/prevention requirements. Emergency procedures.	No federal requirement. Check state, local regulations. Strongly recommended for employee and community safety, as well as liability concerns.
Reporting	Exception reports (file within 45 days). Quarterly reports (within 45 days of calendar quarter). Expanded fourth quarter report. Periodic survey.	Exception letter (filed within 60 days). Quarterly reports (within 45 days of calendar quarter). Expanded fourth quarter report. Periodic survey.	No federal requirement. Check state, local regulations.
Recordkeeping	Manifests for 3 years. Exception reports for 3 years. Test results/sample analyses (3 yrs) Training documentation. Inspection logs. Biennial reports. Land Disposal Restrictions.	Manifests for 3 years. Exception reports for 3 years. Test results/sample analyses (3 yrs). Inspection logs. Land Disposal Restrictions.	No federal requirement. Check state, local regulations. Records on HW disposal quantities, costs are important for your business to note progress in pollution prevention, waste minimization.

Abbreviations

AHW Acutely hazardous waste
HW Hazardous waste
EPA Environmental Protection Agency
RCRA Resource Conservation and Recovery Act
TSD Treatment, Storage and Disposal Facility

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Pollution Prevention

Helping Your Business and the Environment

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Material Safety Data Sheets

One important source of information is the Material Safety Data Sheet (MSDS). It lists the ingredients in a hazardous product, the hazards to safety and health, and the precautions to follow when using the product. Employers who use, store, or manufacture hazardous materials are required by law to make the MSDS available to all employees who could be exposed to the material.

Manufacturers of hazardous materials are required to provide accurate product information, yet the quality of information may vary, depending on the thoroughness of the manufacturer. Do not consider the MSDS to be a complete source of information for a product. Instead, consider it a starting point for learning about the material.

The information on the MSDS will help you in determining whether waste containing any of the material is hazardous.

You probably receive the MSDS for any hazardous products you use from the distributor when you receive supplies. If you don't, call or write to the manufacturer or distributor of the product and request a recent copy. Indicate your intended use for the product, so the correct information will be sent. A responsible business should respond to your request.

The MSDS must contain some basic information, although the format may vary from one manufacturer to another. There are eight major sections, described below. In any section, the letters ND means the information has not been determined and NA means not applicable.

Look at an MSDS from your files while reading this tool. Read the brief summary of each of the sections. These should be similar to those on your MSDS, but remember, there will be some variation. Get to know the product you use in your business by answering the questions.

1. Material Manufacturer and Identification

This section gives the name, address, and emergency telephone number of the product's manufacturer. The chemical name or trade name of the product is given. If the product is a mixture of several chemicals, only its trade name will be listed. Is a Chemical Abstract Service number given? This number allows you to find more information from other sources, such as library books. When was the MSDS prepared?

2. Hazardous Ingredients/Identity Information

This section lists the product ingredients which have been determined to be hazardous. The percentage, by weight, of each ingredient is listed, using the chemical or common name. Does your MSDS tell at what concentration the material could produce a health hazard? This information is based on research using test animals in laboratory experiments. One abbreviation you may see in this section or section 6 Health Hazard Data is **TLV**, or Threshold Limit Value. This is the recommended airborne concentration that nearly all workers can be exposed to without adverse effects. In general, the lower the TLV, the greater the potential for adverse health effects.

As you read your MSDS, you may find 3 types of TLVs listed.

Time Weighted Average (TLV/TWA)- the recommended exposure concentration for a normal 8-hour workday, 40-hour workweek. If the MSDS lists only TLV, it usually refers to this value.

Short Term Exposure Limit (TLV/STEL)- the recommended exposure concentration above the TWA for a limited number of 15-minute exposure periods.

Ceiling Exposure Limit (TLV/C)- the recommended exposure concentration that should not be exceeded at any time during the work period.

TLVs are not guarantees.

✓ They do not take into consideration exposure values for children, pregnant women, hypersensitive individuals, or other high risk groups.

✓ They do not apply to shifts longer than 8-hours or to people who live and work in the same environment.

✓ TLVs may be revised as new studies reveal hazards that were previously undetected.

✓ There are some substances known to be toxic that have no TLVs because of insufficient data to measure the risk from exposure.

3. Physical and Chemical Data

This section describes the physical characteristics of the product. Is it a liquid, solid, or gas at room temperature? What is the evaporation rate? Does the vapor rise or settle? Does the product dissolve in water? Information on the odor and appearance can help you to verify that you have the correct MSDS.

4. Fire and Explosion Hazard Data

This section describes the circumstances under which the product may ignite or explode. What is the flash point, the lowest temperature at which the material can release enough flammable vapor to ignite? What are the recommended extinguishing media, materials that should be used to put out a fire? These may include foam, water, carbon dioxide, or dry chemical. Are there special fire fighting procedures to follow? Is special protective equipment needed?

5. Reactivity Data

This section tells how the product will react under particular environmental conditions. Will it decompose over time? Will heat or sunlight cause a dangerous reaction, producing a toxic or flammable substance? This section will also indicate which chemicals are incompatible with the product, and should not come in contact with it. This information is important when choosing safe storage conditions.

6. Health Hazard

This section provides a combined estimate of the total known hazards of the product. It describes routes of exposure and effects of short and long-term exposure. What are the signs, symptoms, or diseases that may result from overexposure? Are any medical conditions generally recognized as being aggravated by exposure to the product? What emergency and first aid procedures should be followed in case of overexposure? This section may also indicate whether the hazardous product is listed in the National Toxicology Program (NTP) Annual Report on Carcinogens or is a potential carcinogen according to the International Agency for Research on Cancer or by Occupational Safety and Health Administration.

Hazardous substances may enter the body through one or more of these routes:

Ingestion - eating or drinking contaminated substances or contaminated food or water.

Inhalation - breathing in hazardous gases, vapors, dusts, and sprays.

Skin contact/absorption - Hazardous products containing corrosives or irritants can injure the skin and may be slowly absorbed into the body tissues and bloodstream. Some hazardous substances, such as solvents, can be absorbed by skin contact without damaging the skin. Many hazardous products may cause eye damage if splashed into the eye, a particularly vulnerable area.

7. Precautions for Safe Handling and Use

This section tells the safest known ways to handle the material. Are there special procedures for cleaning up spills and leaks? How should you dispose of the product? In general, information on disposal is not supplied in detail because local, state, and federal regulations vary. This section also provides information that might not be listed elsewhere, such as storage information and cleaning or disposing of contaminated clothing.

8. Control Measures

This section describes personal protective equipment, work practices, and ventilation procedures to use when working with the product. Are special gloves or respiratory protection recommended? Is eye protection suggested?

Your MSDS may have additional sections, such as **Special Precautions** or **Regulatory Information**.

Now that you've become familiar with the MSDS, find out what some of the terms, like LD50 and vapor density mean. The next tool, Taking a Closer Look at the MSDS, will help you better understand some of the characteristics of the hazardous materials used in your business. Is a material with an LD50 of 500 mg/kg more toxic than one with an LD50 of 400 mg/kg? If a material is heavier than air, does it pose more of a health hazard to children and pets? You can find this in the MSDS if you know where and how to look.

> It is important that you and your employees do not take hazardous materials lightly, for safety and liability reasons. You may decide to look for a less hazardous material to meet your needs.

Adapted from *Identifying Product Hazards: Material Safety Data Sheets,* copyright 1991 by the University of Missouri's Household Hazardous Waste Project, 1031 E. Battlefield, Suite 214, Springfield, MO 68507.

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Pollution Prevention

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Take a Closer Look at the MSDS

■ Some terms and abbreviations you may find in the Hazardous Ingredients/Identity Section include:

Permissible Exposure Limit (PEL)- the amount of an airborne substance that most healthy adult workers can be exposed to at work without adverse effect.

LD50- the lethal dose that will kill 50% of the test animals in laboratory experiments through either skin contact or ingestion. The lab results are used to estimate the toxicity to humans by adjusting the results to human body weight and characteristics. Researchers are usually conservative in their estimates because different species react differently.

LC50- the lethal airborne concentration that will kill 50% of the test animals when administered in a single exposure in a specific time period.

ppm- measure of concentration in parts per million.

mg/m^3- milligrams of chemical substance per cubic meter of air, to measure concentrations for dusts, gases, or mists.

S (skin)- indicates that the substance may be absorbed through the skin, mucous membranes, and eyes.

mg/kg- milligrams of solids or liquids per kilogram of body weight, usually given by ingestion or injection.

■ Some terms you may find in the Physical and Chemical Data section include:

Vapor pressure- indicates how easily a liquid will evaporate. It is measured in millimeters of mercury (mm Hg). Liquids with higher vapor pressures require better ventilation. A liquid is considered volatile when its vapor pressure exceeds 5 or 6 mm Hg.

Vapor density- the weight of a vapor or gas compared to an equal volume of air. Air is rated as 1. Vapors heavier than air have a density greater than 1. They accumulate in low areas where they may pose health hazards to small children and pets, and may create fire hazards. Toluene has a vapor density of 3.2.

Specific gravity- the ratio of the weight of a product's known volume to the weight of an equal volume of water. A specific gravity of greater than 1 means the substance will sink in water; less than 1 means it will float. Most flammable liquids are lighter than water.

Evaporation rate- the rate at which a product will change from a liquid to a gas when compared to the evaporation rate of a known material. Normal butyl acetate, which has an evaporation rate of 1, is commonly used for comparison. A slow evaporation rate is considered less than 0.8. Water has a rate of 0.3. A fast evaporation rate is greater than 3.0. Acetone is 5.6. Fast evaporating solvents can release hazardous amounts of vapors into the air quickly and should only be used in well-ventilated areas with appropriate safety equipment.

Percent volatile- the percentage of a liquid or solid that will evaporate at 70°F (unless another temperature is indicated). If the percentage exceeds 10%, be sure to use the product in a well-ventilated area.

Solubility in water- the quantity of a product that will dissolve in water at room temperature. Gases with low water solubilities are more likely to reach the deep tissues of the lungs. High solubility gases are more likely to dissolve into the moist mucous membranes of the upper airways.

Solubility in water may be expressed as:
Negligible less than 0.1%
Slight 0.1 to 1%
Moderate 1 to 10%
Appreciable more than 10%
Complete 100%.

■ Some terms and abbreviations you may find in the Fire and Explosion Hazard Data Section include:

Flammable limits- the lowest and highest concentrations of vapor or gas in the air that will ignite when exposed to a spark or flame. The lower flammable limit is LFL or LEL and upper is UFL or UEL. Products with a wide flammable limit such as ethyl ether, 1.9-3.6, may ignite either near or far from an ignition source. Products with a narrow flammable limit may ignite only near the ignition source. When considering the explosion hazards, the LFL is the most important. The lower the LFL, the less of a substance needed in the air before it can ignite.

Flash point- the lowest temperature at which the liquid gives off enough vapors to form an ignitable mixture with the air above its surface when exposed to an ignition source. A product with a flash point near or below 100°F is particularly dangerous because exposure to any ignition source, such as a spark from static electricity or a burning cigarette, may set off a fire or explosion. Gasoline has a flash point of -50°F.

Unusual fire and explosion hazards- tells what toxic or irritant gases may be released in a fire.

■ Some terms and abbreviations you may find in the Reactivity Data Section include:

Stability- indicates whether the product will decompose over time and the environmental conditions, such as heat or direct sunlight, that may cause a dangerous reaction.

Incompatibility- indicates which chemicals should not come in contact with the product. Any materials that are identified as incompatible should be stored and used separately.

Hazardous decomposition products- indicates which hazardous substances may be released during fires or from decomposition.

Hazardous polymerization- a process by which the molecules of a chemical can combine to form larger molecules, called polymers. If this chemical reaction happens too quickly, it may produce a great amount of heat, which may result in a fire or explosion. This type of reaction, under controlled conditions, is commonly used to produce plastics and usually requires heat or a catalyst. If a polymerization hazard exists, specific storage instructions and the shelf life of the chemical should be listed.

■ Some terms you may find in the Health Hazard Data Section include:

Acute health effects- signs and symptoms such as headaches, dizziness, skin or eye irritation, vomiting, coma, or death, that result from a single exposure. Symptoms usually occur shortly after exposure.

Chronic health effects- gradual and occur through repeated exposure over an extended period of time. Chronic effects include cancer, liver or kidney damage, birth defects, or central nervous system damage.

Acute effects are usually reported in more detail than chronic effects because more research has been conducted on acute effects. Isolating the long-term effects of a single chemical is difficult because individuals are exposed to toxic substances from a variety of sources, there may be a lapse in time between exposure and the development of symptoms, and symptoms may vary from one person to another.

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Pollution Prevention

Helping Your Business and the Environment

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In the Metal Finishing Plant through Improved Housekeeping, Maintenance, Purchase and Inventory

Just modifying your general housekeeping and maintenance practices, and how you handle purchases and inventory may reduce the amount of hazardous and nonhazardous waste your business generates. Even the packaging or form that your supplies are purchased in can make a difference. These are some areas where you may see big dollar savings with little, if any, monetary investment.

The following pages have some pollution prevention techniques for you to consider. Take a pencil and check off the practices you already use. Put a question mark near those you want to consider for future pollution prevention efforts. After you finish reading all the options, go back to those with question marks. Rank them according to ease of implementation, and whether they will affect the wastes your business generates in the greatest volume or those that are hazardous.

Good Housekeeping

☐ Do you maintain plating racks, baskets, and anodes to prevent contaminating process baths? Remove them from baths when not in use.

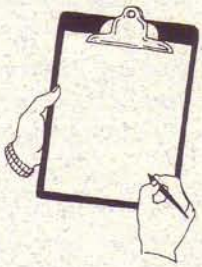
- Preventing foreign materials from entering a bath prolongs its life.

☐ Do you keep storage and work areas clean and well organized?

- Reduces the chance for accidents.
- Increases efficiency. By knowing where materials and tools are, time is not wasted searching for them.
- Saves money. Dollars are not wasted purchasing duplicates.
- Spills and leaks are more noticeable. You can react quickly, before leaks and spills get out of hand.

☐ Do you keep track of where spills have occurred? Keep a chart handy to mark down this information. Look at the areas and see how to avoid future spills.

- Reduces loss of materials.
- Saves time and money spent on cleanup.



☐ Do you use absorbents to clean up minor fluid leaks and spills?

- Reuse until it no longer absorbs. Used absorbent may be hazardous waste, either because it contains hazardous materials or it exhibits a hazardous waste characteristic.

Maintenance

As much as 40% of solvents are lost due to evaporation, equipment leaks, spills, or inappropriate usage. Not only are these health hazards, but you're wasting solvent and losing money. A regular maintenance schedule may help you reduce the amount of waste your business generates.

> Find the small leaks before they become large and lead to waste problems and exposures. Ben Franklin said, *"Small leaks sink big ships."* Small expenses, like raw materials lost due to leaks, can add up.

☐ Do you check for leaks regularly? Use your senses to save money. Be careful, however; some of those leaking materials may be hazardous. Your plant may have vapor or liquid leaks if you can:

- smell chemical odors.
- see pools or droplets.
- hear hissing noises.

Some areas to inspect for leaks and cleanliness on a weekly basis include:

- ▫ raw material storage areas
- ▫ cleaning and process baths
- ▫ pumps
- ▫ pipes and hoses, couplings
- ▫ tanks and tank liners
- ▫ waste storage areas
- ▫ filters
- ▫ fittings, valves
- ▫ racks and baskets
- ▫ steam coils and heat exchangers

☐ While looking for signs of leaks, do you check that equipment is operating properly? Have equipment on a good maintenance schedule to help keep it operating properly.

- Reduces the chance of making off-spec products.

☐ Do you have a regular schedule for monitoring the temperature, metal concentrations, and pH of baths?

- Keeps you on top of product quality.

Purchase and Inventory

Think about how you purchase materials. A large inventory ties up money that might be needed elsewhere in your business. Stockpiling materials also increases the opportunity for leaks or spills.

☐ Do you factor in waste management costs when purchasing materials?

- Raw materials that generate hazardous waste cost more than just the purchase price.

☐ Can you reduce the number of raw materials ordered by getting multi-purpose materials?

☐ Do you order materials in appropriate unit sizes to reduce your inventory?

- Ordering smaller containers of infrequently used materials reduces the chance that they will become outdated in storage. Taking advantage of volume discounts can lead to stockpiling hazardous materials, which may eventually require disposal as hazardous waste.
- Ordering larger containers of frequently used materials reduces the number of small containers that must be managed.

☐ Can you purchase materials in returnable containers? Check with your suppliers on a frequent basis, as they may see a change and forget to let you know.

☐ Do you limit the number of samples you accept from chemical suppliers?
- Unused samples may become waste. Ask suppliers to take back unused samples they provide.

☐ Can you buy materials on an as-needed basis?
- Reduces the amount you have to store, and reduces the opportunity for leaks.

☐ Can you purchase liquids instead of aerosols?
- Eliminates aerosol propellants, improving working conditions.

☐ Do you inspect all materials upon delivery?
- Immediately return unacceptable materials to the supplier. Broken packaging or expired materials may increase *your* waste load.

A railroad line switched from aerosol lubricants to refillable plastic spray bottles and saved $15,000 per year. In addition to reduced costs, they helped improve air quality by no longer emitting aerosol propellants into the air.

☐ Do you check that all purchases have legible labels?
- Efficiency increases.
- Reduces the chance of using the wrong material. The wrong material could ruin a batch or your equipment.
- Containers of hazardous materials in your plant, by law, must be clearly labeled.

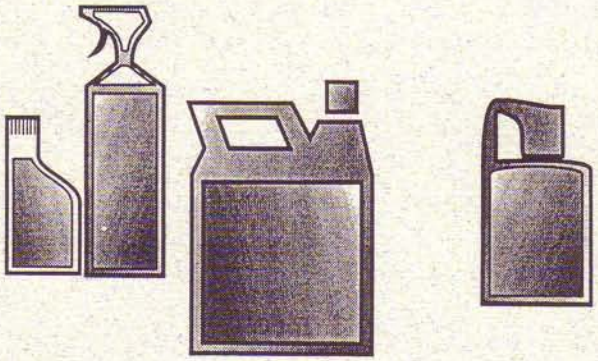
☐ Do you make sure a Material Safety Data Sheet (MSDS) accompanies each hazardous material?
- Employees who may be exposed to hazardous materials should know where they are and how to use them. *Not only is this important for employee safety, it is required by the Occupational Health and Safety Administration (OSHA).*

☐ Do you rotate stock and use dated materials on a FIFO (first in-first out) basis?
- Reduces the possibility of having materials exceed expiration dates.

☐ Does your inventory system allow you to track the amount and age of raw materials in storage?
- A computerized system may ultimately save money by reducing waste and overpurchases.

☐ Do you track the amount of raw materials used by keeping good records?
- Allows you to measure reduction in use.
- If someone consistently uses more materials, consider holding training sessions.

☐ Are inventory controls used to assure that chemicals in a container are completely used before opening a new container?
- Reduces the number of partially full containers in storage.
- Less chance of having materials exceed expiration dates.



☐ Can you make arrangements to return expired material to supplier?
- If you decide to use old material, test it for effectiveness first.

Raw Material Storage

☐ Do you limit access to raw materials?
- Encourages conservation of materials.

☐ Are storage tanks and containers large enough?
- Reduces the chance for overflows.

☐ Are aisles wide enough to make material transfer easy?
- Reduces chance for spills, and lets you spot leaks quickly.

☐ Do you check that shelving is sturdy and hasn't weakened?

☐ Are all materials securely covered?
- Reduces the chance of spills.
- Reduces loss of liquids due to evaporation.

☐ Are materials stacked according to manufacturer's specifications?
- Prevents damage from improper weight distribution.

☐ Do you store products in locations that will preserve their shelf life?
- The MSDS tells proper storage conditions for specific materials. For example, some materials should not be exposed to direct sunlight or high temperatures.
- Contact your local fire or county health department for special measures that may be required to safely store waste oil and flammable materials.

☐ Do you segregate different hazardous substances in storage?
- Prevents cross-contamination and mixing of incompatible materials.

☐ Do you store materials on pallets so that you can easily check for leaks?
- Store drums off concrete floors to reduce the chance of corrosion from moisture.

☐ Do you have secondary containment, such as curbing, in case of a leak? Do you have emergency equipment such as dams and pigs ready for immediate use in case of spills and leaks?

☐ Are hazardous materials stored where accidental spills or leaks will not contaminate storm and sewer drains?

Even your storage methods can affect your waste generation. Think about how you store both your raw materials and your waste. You may be creating more waste unnecessarily.

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Pollution Prevention

Helping Your Business and the Environment

Number 6b University of Nebraska-Lincoln Cooperative Extension & Biological Systems Engineering January 1995

In Metal Finishing through Improved Basic Operations

Often, we do things a certain way because that's how we were trained. We may not even know *why* we do it that way. Maybe the real reason for how it was done in the past no longer applies.

Every so often it may be a good idea to step back and look at how we do even simple tasks in a business. Is there a good reason behind it? Is it just a habit?

The following pages have some pollution prevention techniques to consider in the metal finishing industry. Use that pencil again and check off the practices you already use. Put a question mark by those you want to consider. After you finish reading all the ideas, go back to the ideas with question marks and rank them according to ease of implementation and those that will affect your largest or most hazardous waste streams.

Ever heard of the man who always cut the ends off the roast prior to baking it? When asked why, he wasn't sure. He had a number of ideas, but realized it was because his mother taught him. When his mother was asked why she did it that way, she also had lots of ideas. All in all, she admitted that was how her mother taught her to bake a roast. The grandmother was questioned. She replied, "I cut off the ends so the roast would fit in my pan."

☐ Do you train employees about safe handling of materials and wastes?

☐ Are procedures for using equipment written in simple form for quick reference?
- Laminate and post for easy access.

☐ Have you assigned a limited number of employees to handle and mix chemicals?
- Increases consistency of process baths.
- Reduces number of off-spec products and therefore decreases waste.

☐ Do you have spigots and pumps for dispensing liquids?
- More precise dispensing and less spills.

☐ Do you have rakes or other clean, specially designated tools for retrieving workpieces that have accidentally fallen into plating baths?
- Prevents foreign materials from contaminating baths.

☐ Do you filter solutions to remove grit and other suspended solids?
- Extends life of plating chemicals.

☐ Do you have a policy of only using raw materials for intended use?
- Use the correct and least toxic material for the job. For example, don't use solvents for cleaning floors. It's more expensive and probably more hazardous than a detergent.

☐ Are containers closed with tight fitting lids and bungs when they're not being used?
- Reduces evaporation losses.
- Reduces chance of spills or contamination with other materials.

☐ Do you moisten rags when needed with a squeeze bottle instead of soaking rags in solvent?
- A little solvent goes a long way. Save solvent and money.

☐ Do you collect recyclable or reusable liquids from rags?
- Wring out with a hand-operated or mop wringer.
- Another idea is to use separate labeled rag containers for each material. Put a wire rack in the bottom of each container so the liquid can drain out.
- Collect and reuse or recycle the materials.

☐ Are rags collected and cleaned through a laundry service for reuse?
- Rags used to absorb hazardous materials may need to be treated as hazardous waste. Contact your commercial launderer to find out what materials it can handle.

☐ Do you inspect all parts before plating? Surfaces should be clean, dry, and free of rust and mill scale. If parts are consistently oil-covered, check the machining operation. Can they modify their process to produce a cleaner part?
- Avoids producing a poor quality product.
- Prolongs the life of rinse and process baths.

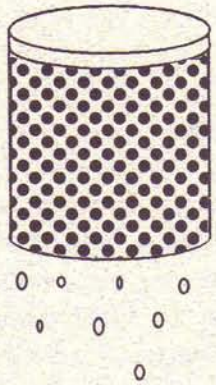
☐ Do you mechanically clean parts with a wire brush whenever possible?
- Reduces solvent usage.

☐ Do you use a pre-wash or wipe using old solvent for very dirty parts?
- Reuses old solvents and extends the life of fresh solvent baths.

Water and chemicals must be added to alkaline baths periodically to replace evaporation and drag-out loss. However, the effectiveness of the bath will eventually decline as it is used. Once this point is reached, instead of dumping the entire bath, partially dump the bath and add fresh chemicals and water. As the life of the bath lengthens, the concentration of chemicals in the bath-replenishing solution are increased. Eventually, the additional chemicals will need to be added at a rate that is greater than the savings from the dumping the bath and mixing a new solution, at which point the entire bath should be dumped.

Drag out

Drag out, liquids and chemicals that are carried on workpieces from one tank to another, ultimately shorten the life of baths. There are a number of methods to reduce drag out. Many are inexpensive to implement.



☐ Do you have a slow workpiece removal rate and allow maximum drip time to reduce drag-out? Allow for drain time over the bath.The faster the removal from the process bath, the thicker the film on the workpiece and the greater the drag out. Drain times of 10 seconds or more have been used successfully, and have cut drag-out by 67%.

☐ Can you install spray rinses? Using rinses directly over the plating baths removes much of the drag-out with a minimum of water, and washes the drag-out directly back into the plating bath. The spray rinses use a small amount of water, and you may be able to adjust the flow rate so it equals the evaporation rates from the plating bath.

☐ Do you use wetting agents in your plating baths? They can reduce drag-out by as much as 50% by reducing surface tension. However, wetting agents can create foaming in process baths, which may not be compatible with waste treatment systems. Test wetting agents carefully to see how they will effect both your plating baths and waste treatment systems.

☐ Do you position workpieces to keep drag out to a minimum? Orient the workpieces so that liquids can drain freely as you remove them from baths. Remove cup-shaped parts from the bath so the cup faces down to increase drainage of the plating solution. Tilt parts so that fluid will flow off the part. Position workpieces so that only a small surface area comes in contact with the solution surface as they are removed from the process bath.

☐ Can you reduce the metal concentration in your plating baths? This decreases the amount of metal that would be dragged out. For example, concentrations as low as 29 ounces of chromium per gallon have been used effectively in plating shops.

> To find the lowest process bath concentration that will provide adequate product quality, mix a new process bath at a slightly lower concentration than is normally used. As you replenish the bath, continue to reduce the chemical concentration until product quality begins to be affected. You will be able to identify the lowest possible chemical concentration that will produce a good quality product.

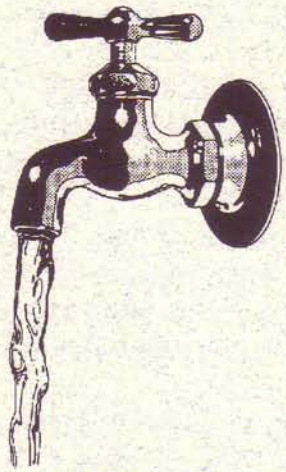
☐ Can you increase the plating bath temperatures? This lowers the viscosity of the plating solution so that it drains off the part more easily. Be aware, however, that very high temperatures will break down brighteners and increase carbonate buildup in cyanide solutions. The evaporation rate from the process tank will increase. To counteract the evaporation, add water from a rinse tank.

☐ Have you looked into using air knives above process tanks? Air is blown onto the surface of the workpieces as the rack is raised from the tank. This helps fluids drain back into the tank.

☐ Do you have drain boards between process and rinse tanks?
- Collects drag-out and routes it back to the process tank.

Water Use

By reducing drag out using the suggestions listed on the previous page, you've reduced the amount of chemicals going into the rinse water. This means you don't have to replenish the rinse water as often, and you'll have less sludge. Reduced water, sewage, and sludge disposal fees will save money.



Another way to save water and money is to improve rinse efficiency. Some of the following ideas may work in your rinse process.

☐ Can you move the workpiece rack or agitate or circulate the water in the tank?

☐ Can you raise and lower the pieces into and out of the rinse tank more than once?

☐ Can you force air or water into the immersion rinse tank to agitate the water?

☐ Can you keep the workpiece in the rinsewater for a longer period of time?

☐ Do you turn off rinse water when tanks are not being used?

The next tool, 6c, covers equipment modifications that may reduce your water usage.

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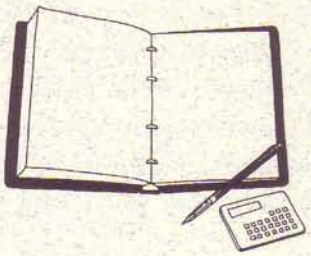
Pollution Prevention

Helping Your Business and the Environment

Number 6c University of Nebraska-Lincoln Cooperative Extension & Biological Systems Engineering January 1995

In the Metal Finishing Plant through Equipment Changes



Generally, the newer the equipment, the more efficient it is in terms of energy and solvent use. As you purchase new equipment, consider the cost of waste management when you make your decision. You may be able to modify existing equipment to save water and reduce waste generation.

☐ Do you evaluate equipment before purchase to find the best non-polluting equipment available that you can afford?

- Consider long-term savings in reduced waste handling and disposal.

☐ Have you installed flow control valves and meters?

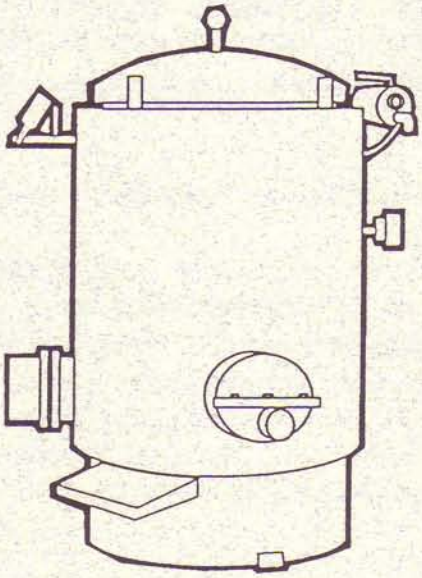
- Allow you to monitor flow rates and keep track of progress in reducing water use.

☐ Do you have water-based pressure washing systems instead of parts washers that use solvents? Pressure washers clean parts with hot water and detergent at high pressures. Depending on the type of detergent used, the wastewater generated by this will be less hazardous than solvents, or may not be hazardous at all. Contact local wastewater authorities prior to purchase, however, to see if any local regulations restrict hot soap wastewater discharge to the sanitary sewer.

- Reduces solvent use.

☐ Do you recover solvents with an on-site distillation unit?

- May recover as much as 80% of your solvents for reuse, reducing solvent purchase and disposal costs.



☐ Have you installed ventilation hoods over baths to further protect workers?

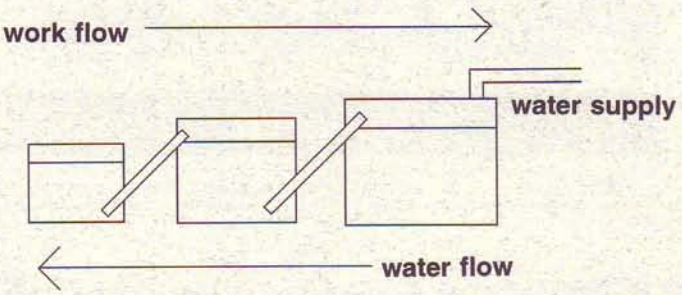
- Install so evaporative plating solutions are not drawn through the workers' breathing zone.

☐ Do you have high level or overflow alarms on all plating and rinse tanks?

- Avoid accidental overflows.

☐ Can you incorporate a counter-current rinse system? The workpieces travel down the plating line and are rinsed in cleaner and cleaner rinse water in a series of rinse tanks. To conserve water, rinse water is added to the line in a flow that is opposite or counter to the direction that the workpieces travel.

- Reduces water usage.



Wastewater from metal finishing processes contain contaminants that may be both toxic and valuable. In the past, material recovery was not considered economical. Now, there is a greater incentive, from an environmental as well as economical standpoint.

Recovered metals can be returned to baths, sold to a reclaimer, or returned to suppliers.

To determine if you can economically justify metal recovery in your metal finishing plant, consider these factors:

✔ the volume of the waste containing the metals.
✔ the concentration of the metals.
✔ the potential to reuse some of the metal salts.
✔ treatment and disposal costs.

Have you looked into any of the following equipment to recover metal from process baths?

☐ Electrolytic Metal Recovery Units

These units are used to recover gold, silver, tin, copper, zinc, solder alloy, and cadmium. A direct electric current is passed through a solution containing metal by cathode plates and insoluble anodes.

Bath and rinse solutions in electroplating plants work well for this process because they contain salts, strong acids, or strong bases, which are all good electrical conductors. As the current flows from the anode to the cathode, the positive metallic ions are attracted to the cathode plate and settle there. Those ions will continue to be deposited on the cathode plate as long as there is electrical current and a sufficient quantity of electrolytes.

☐ High Surface Area Electrowinning/Electrorefining Units

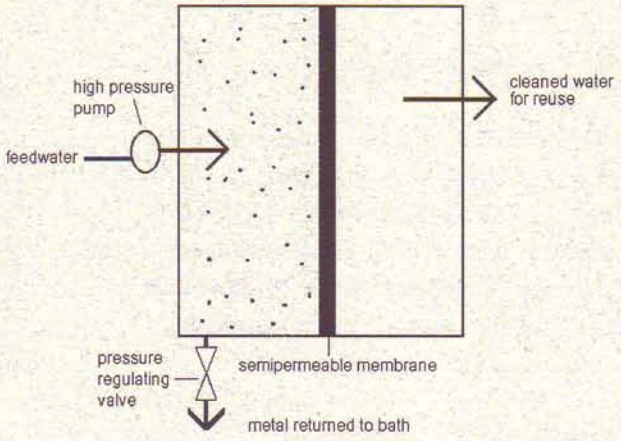
This equipment operates on the same principle as electrolytic recovery units, using an electrical current to draw metal ions out of solution. The solution that contains metal is pumped through a carbon fiber cathode, which acts as the plating surface. To recover the metals, the carbon fiber cathode is removed and placed in the electrorefiner. The current is reversed, and the metal is plated onto a stainless steel starter sheet. These systems can be used to recover a wide variety of metals, including gold, silver, tin, copper, zinc, solder alloy, and cadmium as well as to regenerate many types of solutions.

☐ Evaporators

Water is evaporated from the collected rinse water, and when the concentration of the chemicals remaining in solution is high enough, it is returned to the plating bath. Water vapor is condensed and can be collected and reused in the rinse water system. Energy is needed to evaporate off the excess water, so these systems are expensive to use for large volumes of rinse water. Counter-current rinse systems can be used to concentrate plating chemicals to the point where an evaporator is efficient.

☐ Reverse Osmosis Units

In the natural world, water flows from a dilute solution to a concentrated solution until a balance or equilibrium is reached. An easy way to remember this is the saying "water follows salt." When you eat salty popcorn, you get thirsty. Reverse osmosis, often called RO, is just the opposite of this. Pressure is used to force water through a special membrane, so it moves from a concentrated solution to a dilute solution. The membrane has tiny pores that allow water molecules to pass through, but stop larger molecules such as dissolved minerals and other materials.



RO treatment has been successfully used in treating rinse water from Watts nickel plating baths and other metal finishes. New types of membranes are constantly being developed, so the list of uses for RO units in metal finishing is growing. An RO unit uses about 200 times less energy than an evaporator. The RO membranes are delicate, however, and typically cannot withstand extreme pHs. The product water usually contains less than 10% of the dissolved solids present in the wastewater streams, so it can be returned to the last rinse tank. The concentrate is returned to the plating bath.

☐ Ion Exchangers

Ion exchangers use materials, called resins, that react with ion solutions and selectively replace some of their own ions with those from solution. If you have a water softener in your home, you already are familiar with one type of ion exchanger. Calcium and magnesium in hard water are replaced with sodium on the resin. After a few days, the resin can't absorb any more calcium or magnesium ions, and it is recharged with salt pellets that you put in the brine tank. The resin is regenerated, meaning the sodium ions replace those calcium and magnesium ions, converting the resin back to its original composition. The ion exchange unit allows for the reconcentration of chemicals, and reuse of rinse water.

In metal finishing, ion exchange can be used to recover drag out from a dilute rinse solution. The chemical solution passes through a series of resin beds that selectively remove cations and anions. As the rinse water passes through a resin bed, the resin exchanges ions with the inorganic compounds in the rinse water. The metals are recovered by cleaning the resin with an acid or alkaline solution, and the treated water can be returned to the rinse system for reuse.

Ion exchange units can be effective for dilute waste streams and are less delicate than RO systems. First, however, water must be filtered to remove oil, grease and dirt. Ion exchange units are used to treat rinse water from chromic acid baths.

☐ Ion Transfer Units

These units consist of a number of ion transfer cells. A stainless steel mesh cathode makes up the outside of each cell, and is lined with a half-inch thick polyester-based membrane. The membrane encloses an anode compartment which contains a platinum-plated titanium anode.

Electroplaters who have installed ion transfer units have found that savings in chromium replacement and reduced water usage help offset initial capital costs for installing the ion transfer system. Some have reported an 80 to 90% reduction in chrome usage and a 99% decrease in water usage.

A pump draws rinse water into tanks containing the cells. A rectifier supplies 25 volts of direct current across the cell electrodes, causing the chromate and sulfate ions to pass through the membrane and enter the anode compartment. The clean rinse water overflows the ion transfer tanks and returns by gravity to the original rinse tank. The solution with the chromate and sulfate ions is drained from the anode compartments and transferred as needed to the chrome acid plating tank.

Order the EPA *Guide to Pollution Prevention, The Metal Finishing Industry* for more information on these processes and other pollution prevention ideas. The free 70-page booklet is available from the EPA by calling (513) 569-7562. Ask for document EPA/625/R-92/011.

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Pollution Prevention

Helping Your Business and the Environment

Number 6d University of Nebraska-Lincoln Cooperative Extension & Biological Systems Engineering January 1995

In the Metal Finishing Plant through Raw Material Substitution and Changes in Process Technology

Raw Material Substitution

One way to prevent pollution is to substitute non-hazardous or less hazardous materials for those you presently use. This can reduce or even eliminate hazardous waste generation from your business. Look into substitutes carefully. Ask questions and get documentation.

Consider the strategies listed below. Check off the practices you already use. Put a question mark by those you want to consider. After you finish reading all the ideas, go back to those with question marks and rank them according to their ease of implementation, and whether they will affect your largest or most hazardous waste streams.

When considering substitute raw materials, ask questions. Has the material been used in similar situations? Can you contact other customers to learn how the substitute materials worked for them? Is there a MSDS sheet for the substitute? Could this material become regulated in the future? Will a substitute affect any equipment warranties? Will the waste stream be minimized?

Will a substitute solve one problem but create another?

Solvents and Substitutes

Although they are excellent cleaners, organic solvents are hazardous to human health and the environment. Solvents, particularly chlorinated solvents, may be toxic, flammable, highly volatile, dissolve landfill liners, and contribute to smog development or ozone depletion.

Chlorinated solvents typically have *chlor* or *chloro* in the name. Because of problems associated with their use and disposal, you may want to investigate using other types of cleaners.

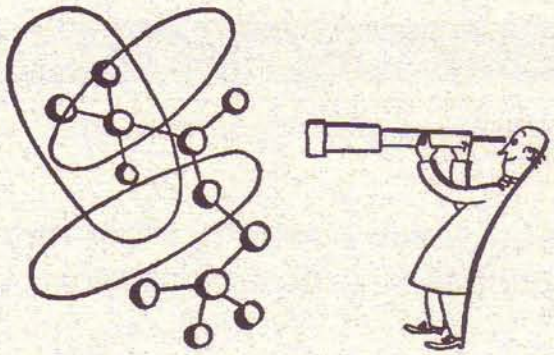
Whenever considering a substitute, remember to look at the MSDS. Although less toxic, some substitutes may still have low flash points, making them hazardous, or their emissions may be regulated for their volatile organic compound (VOC) content.

But don't stop at the MSDS. Ask questions of anyone who may be affected by a substitution. For example, alkaline or detergent substitutes may be difficult for a wastewater treatment system to handle, so be sure to consult with wastewater personnel.

Other Substitutes

☐ Can you use deionized, distilled, or reverse osmosis water instead of tap water in process baths and rinse water?

- Calcium, iron, magnesium, manganese, chlorine, carbonates, and phosphates found in tap water reduce rinse water efficiency, interfere with drag out recovery, and increase the frequency of process bath dumping.



Selecting substitutes requires time and effort, but you'll be rewarded with less toxic waste and safer working conditions.

Have you considered replacing raw materials with those that reduce the amount or toxicity of the waste your business generates? Some options are listed below.

☐ Have you investigated hexavalent chromium substitutes? Trivalent chromium can be substituted for the more toxic hexavalent chromium, although the finish has a different luster. The chromium concentration in trivalent chromium plating bath is typically less than 1 ounce per gallon while hexavalent chromium concentrations are 15 to 40 ounces per gallon.

- Lower heavy metal concentrations mean less chrome drag out and lower water treatment costs.
- Trivalent systems generate less hazardous sludge.
- Reduces sludge quantities, resulting in reduced hauling and disposal costs.
- Avoids the need to reduce hexavalent chrome wastes to their trivalent state. Since three pounds of sodium metabisulfite are required to reduce each pound of chromic acid, chemical purchases decrease by switching to a trivalent system.

☐ Can you use non-chelated process chemicals? Chelators allow metal ions to remain in solution beyond their normal solubility limit. They are usually found in baths used for metal etching, cleaning, and selective electroless plating. Once the chelating compounds enter wastewater, they make it difficult to remove metal contaminants during treatment. That means additional chemicals must be used, which in turn end up in the sludge and contribute to the volume of hazardous waste sludge. Also, many spent process baths containing chelators cannot be treated on-site and are drummed for off-site disposal, adding to waste disposal costs.

Non-chelated chemistries can be used in many processes where it you don't need to keep metal in solution. Allow the metals to precipitate, then filter the process bath to remove solids. Non-chelated chemistries are less feasible, however, where chelators play a significant role in the chemical processes that allow the plating bath to function.

Ferric sulfide is a common treatment chemical that precipitates metals from chelated complexes. The iron will also settle out as a metal precipitate and, unfortunately, can significantly increase the sludge volume.

☐ Have you looked into cyanide substitution? Cyanide compounds can be replaced with less toxic compounds such as zinc chloride and pyro-phosphate copper. Chloride or sulfate-based compounds may serve as replacements. Waste streams containing free cyanide are typically treated by an alkaline chlorination process using sodium hypochlorate and chlorine. Ferric sulfide precipitation is commonly used for treating complex cyanides, but these chemicals contribute to sludge volume during wastewater treatment. Noncyanide processes can reduce hazardous waste sludge generation by eliminating a treatment step. Replacement chemistries are available for most cyanide-containing process baths, except for copper strike baths used in copper plating.

- Simplifies wastewater treatment.
- Saves in chemical costs.
- Reduces sludge generation.

☐ Have you tried citric or terpene cleaners for cleaning, degreasing, or parts washing? Terpenes are oils isolated from plants through gentle heating or steam distillation. They are less toxic and more biodegradable than most solvents. Limonene cleaners are terpenes made of oils of lemon or orange.

- Decreases hazardous waste disposal costs if non-hazardous substitutes are used.

☐ Do you try to use multi-purpose materials?

- Using a few basic products may decrease employee confusion.
- Reduces the number of rarely-used products. These typically are the kinds of materials that are stored beyond the shelf-life date.

☐ Can you substitute detergent-based or water-based cleaners for solvent-based cleaners?

- Some of these may have regulatory, health and safety concerns of their own, so be certain you read the MSDS.

☐ Can you use high pressure hot water or steam cleaners instead of solvent for parts cleaning? These have limited application, however, since they are useful primarily for rough cleaning of metal parts.

☐ Can you use non-aerosol forms of products?

- Reduces air emissions, improving the working environment for your employees.

☐ Can an alkaline cleaner replace solvents for degreasing operations? After proper treatment, hot alkaline baths used for degreasing may be discharged to the sanitary sewer system. Be certain to call your local wastewater authorities to find out what restrictions may apply to your operation. Sludge generated from hot alkaline baths has less volume than wastes generated by solvent degreasing, but still may be hazardous.

☐ Have you considered replacing paper towels with reusable cloth?

- Remember to contact your commercial laundry service to discuss what materials may be on the cloth.

Changes in Process Technology

In 1992, a major battery manufacturer changed their production process, which resulted in a 29% decrease in hazardous waste generation. Two other process changes reduced waste by another 75,000 pounds annually, with a savings of about $40,000 per year.

A change in technology can be one of the most expensive pollution prevention strategies to implement, but the benefits can also be big. As your business becomes more involved in preventing pollution, you may think of new production methods that warrant testing. Obviously, there are risks in changing processes, so ideas must be tested thoroughly to see if they are economically and environmentally sound. Above all, your customers have to be happy with the result. Some of this testing can require a great deal of time and money. There are programs, such as the EPA's *Design for the Environment* (DfE), to help.

The goal of DfE is to facilitate information exchange and research on pollution prevention efforts. It works with businesses and trade associations to evaluate the risks, performance, and costs of alternative chemicals, processes, and technologies.

As part of the Surface Finishing Project, Design for the Environment (DfE), is working with industry to develop an auditing tool to enable small businesses in the metal stamping, metal finishing, and screw machine industries to improve their efficiency and environmental performance. DfE is also working with the National Institute of Standards and Technology to supply technical assistance providers in the metal finishing industry with information on alternative manufacturing processes.

For more information on DfE activities, contact DfE at (202) 260-1678.

A number of new technologies are possible candidates to replace electroplating, including ion vapor deposition and thermal spray processes.

Ion vapor deposition has been used to deposit aluminum coatings as a replacement for cadmium. The aluminum is evaporated and partially ionized before it is deposited on the part to be plated. No hazardous wastes are generated in the process, and the aluminum can be scraped off chamber walls for reuse. Health and safety risks are much lower than those from traditional cadmium plating.

Thermal spray processes use heat from chemical energy or an external heat source like a propane flame to put thermoplastic coatings on parts. This energy is transferred to powder particles as heat and accelerates them toward the part to be plated. The thermal (heat) and kinetic (motion) energy produce a well-bonded, smooth coating. No volatile organic compounds or toxic fumes are produced.

Your trade association is an excellent source of information on new technologies.

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Pollution Prevention

Helping Your Business and the Environment

Number 6e University of Nebraska-Lincoln Cooperative Extension & Biological Systems Engineering January 1995

Waste Exchanges and Recycling Options for the Metal Finishing Plant

The goal of pollution prevention is to not generate pollution or waste in the first place. Due to old equipment and capital shortages, or lack of substitute raw materials and new technology, however, it may take time to reach that goal. In the meantime, try to find someone who may be able to reuse your waste through an exchange program, or recycle your waste.

To make recycling or reuse easier, it is important that you handle wastes correctly. Train employees to avoid mixing different types of materials.

☐ Do you segregate wastes?

- Mixing hazardous wastes together may make reusing or recycling impossible.
- Mixing hazardous and nonhazardous wastes increases the volume of hazardous wastes and therefore disposal costs. Your formerly non-hazardous waste becomes hazardous and must be handled as such.
- Your hazardous waste generator status may be affected.

Some materials to segregate include:

☐ processing baths from wastewater streams

☐ spent solvent wastes from aqueous waste

☐ cyanide wastes.

☐ chromium wastes.

☐ chlorinated from non-chlorinated solvents.

One laboratory was paying $350 per 55 gallon barrel to dispose of solvents. By segregating chlorinated and non-chlorinated solvents, they were able to dispose of non-chlorinated solvents at a cost of $94 per barrel. Their annual solvent disposal bill dropped from $33,000 per quarter to $18,000. Further waste segregation and pollution prevention practices reduced their quarterly disposal bill to $9,000.

Waste Exchanges

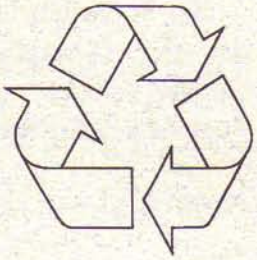
Take a look at the materials your business throws away. If you aren't able to reuse them, consider that some may be valuable to another business. Through a waste exchange program you may be able to sell, trade, or give away materials you had considered waste. On the flip side, an exchange program may also help you locate another company's "waste" that you can use. Consider both your hazardous and nonhazardous waste streams.

Refer to **Tool 1a, Pollution Prevention Contacts for EPA Regions VII and VIII,** to find out if your area has a waste exchange. An exchange program could put you in contact with a business in need of a material that you consider a waste.

Here's how a typical waste exchange works:

•You provide the waste exchange with information about the materials your business typically disposes of as waste.
•The exchange searches for companies or organizations that you can work with.
•After identifying companies or organizations that may benefit from the exchange, all the involved parties are contacted.
•You negotiate the transfer.
Usually the identities of the generators and potential users remain confidential by using a special code system.

Recycling



☐ Can you return waste solutions to the manufacturer for recycling?

☐ Are metals in spent process baths reclaimed? Tool 6c describes different metal recovery systems.

☐ Does your hazardous waste handler reclaim solvent? Contract with a solvent tank maintenance service to come to your business periodically. They will remove the solvent and sludge from your tank and replace it with clean solvent. Or, spent solvents can be sent off-site to a commercial recycler. Generally 70-80% of the solvent can be reprocessed and sold back to you at a reduced cost.

☐ Have you looked into purchasing your own distillation unit? Commercial solvent recovery units are available in various sizes. Although it depends on your solvent use rate and the still you purchase, many businesses have had stills pay for themselves in less than 2 years.

- Reduce the solvent purchases.
- Reduce the amount of waste that has to be managed.

☐ Do you recycle metals such as aluminum and steel?

☐ Do you recycle cardboard? Give small amounts to a business or charity willing to pick it up. Large amounts can be baled and sold.

☐ Do you make sure that all containers are completely drained of hazardous materials so that they are legally empty and therefore not a hazardous waste?

- You should not reuse product containers unless they have been adequately rinsed and are used to store the same or compatible materials.

☐ Can you reuse container rinse water in process baths?

☐ Can you reuse and/or recycle 55 gallon drums? See if you can return empty drums to the supplier.

☐ Do you use both sides of a sheet of paper before recycling or disposal?

- Reduces paper purchase and disposal costs.

> A large corporation saved 1,182 reams of paper and $3,500 in landfill costs by switching to 2-sided copying.

Don't forget about considering recycled content and recyclability when choosing your supplies and suppliers. Here are a few ideas to consider:

☐ Are there reusable or recyclable alternatives for any of your supplies, including paper, envelopes, and office file folders?

☐ Are there recycled content alternatives? These are products that contain recycled material. Those that indicate "post-consumer recycled content" mean that the material has been through the consumer's hands.

☐ Are your suppliers willing to expand their use of reusable, recyclable, or recycled content containers?

☐ Do you segregate waste streams for recycling and treatment, and keep non-hazardous material from becoming contaminated?

- Mixed wastes are harder, if not impossible, to recycle.

Hazardous Waste Handling and Disposal

☐ Do you store hazardous wastes indoors or in a covered area to prevent moisture from seeping in?

- Moisture could increase the volume of your hazardous waste, making you pay more for disposal.
- Check with your local fire department about storage of flammable materials.

☐ Is hazardous waste stored in a safe location out of major traffic areas?
- The less activity the better for preventing accidental spills or leaks.

☐ Are hazardous wastes stored and labeled according to state and federal regulations?
- Contact your local health department or state environmental agency to stay in compliance with regulations. And when you reduce the amount of hazardous waste you generate, the number of regulations you'll have to deal with may also go down.

☐ Are hazardous wastes stored where accidental spills or leaks will not contaminate storm and sewer drains?

☐ Do you have secondary containment, such as curbing, in case of a leak?
- Have emergency equipment such as dams and pigs ready for immediate use.
- Train employees to use them properly.

☐ Do you contract with qualified and licensed hazardous waste handlers to properly dispose of your hazardous wastes?
- Remember that you have cradle to grave liability for the wastes, from the time they become wastes until they no longer exist.

So What's Next?

Hopefully, you have discovered some new ideas to help prevent pollution in your business. Hang on to this set of sheets for the time being. They'll be helpful when you are considering and prioritizing pollution prevention options.

But first, it's important to know what wastes and what quantities of those wastes your business generates. The next tool will help you assess your wastes. Think twice if you're tempted to skip that tool. A waste assessment can provide you with valuable information.

A waste assessment will help you:

✓ identify what wastes your business produces.

✓ establish a baseline for measuring progress and evaluating your pollution prevention program.

✓ decide which wastes to target for pollution prevention first. You will know what wastes are produced in the greatest volumes, and those that have the greatest toxicity.

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Pollution Prevention

Helping Your Business and the Environment

Number 7 University of Nebraska-Lincoln Cooperative Extension & Biological Systems Engineering January 1995

Ready to Begin Preventing Pollution?

First, find out what types and quantities of wastes your business is producing. This is important, as it helps you pinpoint where you can prevent pollution, and gives you a baseline for evaluating progress.

Remember that wastes started out as raw materials somewhere in your business. Not only are you paying for waste disposal, you are paying for raw materials that weren't fully used.

This tool will help you collect and analyze information for pollution prevention. If you want a more in-depth assessment and analysis of options, see Tools10a-g.

One way to look at how much waste your business generates is to look at each process within your company. Some processes in the metal finishing industry include:

Purchasing
Shipping and receiving
Storage and inventory
Office/recordkeeping
Customer service
Parts cleaning
Metal finishing
Equipment repair
Janitorial/facility maintenance

Cost Identification

Realizing what waste is costing your business will make pollution prevention more valuable to you. To determine whether a pollution prevention option is economically favorable, you have to know what processes within your business cost at present.

Record the estimated annual capital, operational, and disposal costs associated with each business process. This will help when evaluating the cost effectiveness of possible pollution prevention options.

Process: _____

1. Annual operating costs (including labor, materials, maintenance) $_____
2. Annual capital costs (includes equipment, planning, installation) $_____
3. Annual disposal costs (transportation, fees, regulatory compliance) $_____

Total Annual costs $_____

Next, check the types of wastes generated by the processes you identified. Copy this form as needed. Record the estimated quantity of waste generated by each process.

Process: _____

Waste type	Amount/month	Waste type	Amount/month
Air emissions	_____	Spoiled batches	_____
Evaporation losses	_____	Wastewater	_____
Maintenance losses	_____	Corrosive waste	_____
Solid waste	_____	Reactive waste	_____
Out-dated stock	_____	Ignitable waste	_____
Overspray	_____	Toxic waste	_____
Spills	_____	Other	_____

Process: _____

Waste type	Amount/month	Waste type	Amount/month
Air emissions	_____	Spoiled batches	_____
Evaporation losses	_____	Wastewater	_____
Maintenance losses	_____	Corrosive waste	_____
Solid waste	_____	Reactive waste	_____
Out-dated stock	_____	Ignitable waste	_____
Overspray	_____	Toxic waste	_____
Spills	_____	Other	_____

Now that you have a handle on what wastes your business produces, try to target some for pollution prevention. You'll probably want to work on those that are the most hazardous, or produced in the largest quantities.

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Number 7a University of Nebraska-Lincoln Cooperative Extension & Biological Systems Engineering January 1995

Analyzing Pollution Prevention Options

Look at your list of wastes, and then go back to waste prevention options listed in Tool 6. Here are some points to consider as you note feasible options. Check those that apply, and put a question mark by those you need to look into further.

Pollution prevention option: _____

☐ Will the option affect your most hazardous or largest waste streams?

☐ Is the option easy to implement?

☐ Does the technology have a track record?

☐ Are there case studies describing the application of the option in the industry?

☐ Do you know if the option requires different raw materials than previously used? What types and amounts?

_____

_____

☐ Will those different raw materials be less hazardous?

☐ Can you determine annual operating costs and capital costs of the option?

Operating cost estimate $_____

Capital cost estimate $_____

☐ Do you know if the option will produce waste? What types and how much?

_____

_____

☐ Will the waste be less hazardous than that produced before implementing the option?

☐ Are you sure that the option does not shift waste to a different form, or to a different process within your business?

Don't exclude any option until it has been analyzed completely. High tech options are not always the best, especially at first. If you're just beginning a pollution prevention program, you'll see positive results quickly if you select an option that is easy to implement. This will give everyone incentive to continue. Many businesses first prevent pollution through simple changes in business procedures such as improved housekeeping and waste segregation. As they gain experience, they move on to more challenging options.

Take a closer look at those options to see if they are economically and technically feasible. Again, check those that apply. Put a question mark by those you're unsure of, and try to find the answer.

Pollution prevention option: _____

Economic Evaluation

☐ Is this option within your price range, considering both capital and ongoing operation costs?

☐ Does this option have an acceptable payback period?

☐ Does this option reduce your raw material costs?

☐ Does this option reduce your utilities costs?

☐ Does this option reduce material and waste storage costs?

☐ Does this option reduce regulatory compliance costs?

☐ Will this option reduce the costs associated with worker injury or illness?

☐ Will this option reduce your insurance premiums?

☐ Will this option reduce your waste disposal costs?

Technical Evaluation

☐ Does this option have a proven track record?

☐ Will this option maintain product quality?

☐ Are you ready to handle new training procedures and expertise if required?

☐ Can you add additional staff if required?

☐ Will this option create less waste?

☐ Are you certain this option will not simply shift waste to another form?

☐ Is your plant layout and design capable of incorporating this option?

☐ Do you know if this option will require any down time for implementation?
How much? _____

☐ Will the vendor guarantee this option?

☐ Will this option improve or maintain worker safety and health?

☐ Are new material handling, storage or disposal techniques required?

☐ Are materials and parts readily available?

☐ Can this option be easily serviced?

☐ Are other businesses using this option?

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Pollution Prevention

Helping Your Business and the Environment

Number 7b University of Nebraska-Lincoln Cooperative Extension & Biological Systems Engineering January 1995

Pollution Prevention Program Review

An effective pollution prevention program is ongoing. It is important to step back and evaluate what you've accomplished, and set new goals. The following questions will help keep you on track. Place a check by those you've done, and a question mark by those that need further attention.

☐ Have you implemented all the previously defined options?

☐ Does pollution prevention remain a priority for workers and management?

Have your pollution prevention efforts reduced costs through:

☐ Reduction of raw material costs?

☐ Savings on pollution control equipment?

☐ Reduced compliance costs?

☐ Reduced disposal costs?

☐ Improved worker safety and health?

☐ Reduced insurance costs?

☐ Other _____

How effective have your efforts been at reducing the following types of wastes?

	Amount per year		Amount per year
Air emissions	_____	Solid wastes	_____
Evaporative wastes	_____	Spills/container leaks	_____
Hazardous waste	_____	Spoiled production runs	_____
Heat/energy losses	_____	System leaks	_____
Maintenance waste	_____	Wastewater	_____
Out-dated stock	_____	Other _____	_____
Overspray	_____	Other _____	_____

☐ Do you have an ongoing education plan to keep pollution prevention in employee's minds?

☐ Have you recognized employees or management for efforts?

☐ Have you publicized your efforts within the community, in your industry?

☐ Have you applied for awards?

Pollution Prevention

Helping Your Business and the Environment

Number 8 University of Nebraska-Lincoln Cooperative Extension & Biological Systems Engineering January 1995

Yard Waste, A Growing Concern

Nearly 20% (by weight, 10% by volume) of the solid waste from our homes and businesses consists of yard trimmings - grass clippings, leaves, brush, and tree prunings. The amount of yard trimmings generated varies considerably by region, season, and even from year to year.

During peak months, primarily summer and fall, yard trimmings can represent as much as 25 to 50% of the municipal solid waste. Grass clippings account for over half of all the yard trimmings generated.

If your business maintains a yard, here are a few ideas you can use to reduce the waste it causes. Think about recycling grass clippings back to your lawn, composting leaves, and using water wisely.

Your Cooperative Extension office may have more detailed information specific to your area.

Returning Grass Clippings to the Turf Will Save You Time and Money

In a Fort Worth, Texas pilot project, participants found that since bagging clippings was no longer necessary, they spent an average of 38% less time on each mowing.

✓ Because it is not necessary to stop every 10 minutes to empty the mower bag or rake the lawn after you finish mowing, you can mow a lawn in 1/3 less time. Although you'll mow more frequently, the time spent on each mowing session and the overall mowing time will be reduced.

✓ Grass clippings contain about 3-4% nitrogen by weight, about 25% of the lawn's fertilizer needs. This can save about one fertilizer application every year.

✓ If you leave lawn clippings on the lawn, you no longer need to purchase plastic bags for lawn clippings. This saves money over a year's time.

✓ Grass clippings increase the amount of organic matter found in the soil. This increases the soil's ability to hold moisture and nutrients in sandy soils, and improves drainage in heavy soils. All in all, your lawn will be healthier.

If you need to redo your lawn, consider planting a grass or perennial that fits your site and climate conditions. Some are more heat and drought tolerant than others. Plants native to your area usually fare best.

Recycling Grass Clippings Back to Your Lawn Makes Good Sense for Many Reasons

✓ Yard trimmings take up valuable landfill space, about 3.5 cubic yards per ton.

✓ Yard trimmings are banned from landfills in some areas. By mid 1995, 20 states will have landfill bans on yard trimmings, the second largest component of the solid waste stream.

✓ Yard trimmings are expensive to transport and bury. For example, in Omaha, Nebraska, taxpayers pay $48 per ton to collect, haul, and landfill waste.

✓ Yard trimmings contribute to explosive methane production in the landfill. Although organic materials in a landfill breakdown or decompose very slowly, decomposition does occur. One of the by-products of decomposition is methane gas.

✓ Because lawn clippings are made of up to 90% water, grass clippings can contribute to leachate problems in the landfill, potentially causing groundwater contamination.

Making the Switch

To help your grass stay healthy, or to get it in better shape, do not remove more than one third of the blade, and no more than one inch total height at any one time. For example, if your lawn is 3 inches from soil to the tip of the grass blade, you can remove 1/3 of it, or 1 inch. If your mower doesn't allow you to return clippings to the lawn, put the clippings on a compost pile.

Fertilization Plan

The rate of fertilizer application, the frequency of application, and the source of nitrogen will determine how fast the lawn grows. For slow, even growth, use a fertilizer containing either sulfur-coated urea or urea formaldehyde as a nitrogen source rather than those such as ammonium sulfate, urea or ammonium nitrate that tend to produce a very fast growth for short periods. This is important for early summer applications. Check the fertilizer label to determine the specific nitrogen source.

Water Use

In the summer, a great deal of water is used on lawns. Make every drop count.

• Place your sprinklers so that you are watering lawn, not driveways, sidewalks, or gutters.

• Avoid watering on windy days when sprinkler coverage is difficult to predict. More water is probably carried off into the atmosphere than reaches the lawn.

• Water early in the morning so less water is lost to evaporation. Don't water in the evening; you'll just encourage plant diseases.

• Turn sprinklers off if water is running off the lawn and onto the sidewalk or road. Let the moisture soak in, and begin watering in an hour if more is needed.

• Water deeply and less frequently. Lawns watered too frequently develop shallow root systems, making them more susceptible to grub damage and heat or drought stress.

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Blow Your Horn! Publicize Your Pollution Prevention Efforts

Pollution prevention helps your business by reducing waste collection and disposal costs. Your customers and your community also benefit by having a cleaner environment.

You can help develop your image as a business that cares about the environment by telling the public about your efforts. Concern for the environment and its quality ranks high in national surveys. Your ability to compete in the marketplace may improve if you use pollution prevention methods. Let the public know what you are doing.

✓ Document your waste reduction successes in annual reports, company brochures, advertizing, and press releases. And show that you hold true to your commitment. Print documents on both sides of the paper. Use paper made from post-consumer recycled materials, material that has been used by the consumer and then recycled. Try to use paper that is easily recycled. Also, request inks that don't contain heavy metals.

✓ Share your successes with trade associations, local government, local environmental organizations, and other community groups.

✓ Identify your products that are made from recycled materials. Indicate what percentage of post-consumer recycled material was used to make the product.

✓ Of course, minimal packaging is appreciated. Try to avoid excessive packaging so your customers aren't stuck with a lot of waste. If you need packaging, try to use materials that can be recycled in your area. Again, let the public know that you're trying to reduce waste.

✓ Promote the use of environmentally friendly materials. Let your customers know that you choose to avoid the use of hazardous or toxic substances in your business.

✓ Contact your local newspaper, as well as TV and radio stations to find out if they have an "Environmental Hero" spot, telling of local efforts to help the environment.

Invite a news reporter to see what you've accomplished in pollution prevention. You may want to submit your own article. Remember those important W's: *Who, What, Where, When* and *Why*. A sample news release appears below.

Local Printing Business Prevents Pollution

The ACME Printing Company has embarked on a pollution prevention project, reducing the amount of waste produced. They recently switched from petroleum-based to soy-based inks in their printing processes. By doing so, the presses can be cleaned with water-soluble solutions instead of traditional solvents that the oil-based inks require.

In addition, soybean oil is a renewable product, raised right here in the U.S. This type of ink reduces our dependence on foreign petroleum products.

PRINTED WITH SOY INK™

Acme Printing company also announces a new line of recycled paper stock available for printing. The paper has 100% post-consumer content, meaning all the fiber used to make it has been through the hands of the public. This new line allows the community to complete the recycling loop; people have more opportunities to purchase recycled paper locally.

Awards and Grants

There are grants and awards for pollution prevention efforts. Consider applying for a grant if you want to try a pollution prevention idea but just can't find the money for it. Awards are available to recognize successes. There may be stiff competition for these, but that makes them all the more prestigious. Just the process of applying for grants and awards can help pull members of your business together as a team, and can be a useful enterprise in itself.

Grants and awards may be available on the local level in your area. Contact your city or county health department, public utilities, Cooperative Extension office, or local citizen environmental groups. If they have no grants or awards to offer, they may be able to point you in the right direction.

The following page lists some grants and awards available. Incidentally, many states were developing recognition programs for pollution prevention efforts when this publication went to press. Write or call those contacts listed in Tool 1a to learn if more awards or grants are available.

Remember to Reward Your Employees

Do you have in-house recognition for good ideas, great efforts, and dedication to the pollution prevention cause? A certificate of recognition, a party, a meal out, a reserved parking space, or even free movie passes are a few ideas to consider. Let people know you appreciate their help in preventing pollution. Some businesses feel that involvement in pollution prevention ranks high enough to be used as criteria when raises and promotions are considered.

State Pollution Prevention Awards and Grants

Iowa Landfill Alternatives Grant Program. Grants from the Waste Management Authority Division of the Department of Natural Resources provide assistance in initiating or expanding solid waste management projects that are innovative and offer alternatives to landfilling. Application deadlines are the first Monday in June and the first Monday in December. For more information, contact:

Tom Anderson (515) 281-8623 or Jeff Geerts (515) 281-8176
Iowa Department of Natural Resources
Waste Management Assistance Division
Wallace State Office Building
900 East Grand Avenue
Des Moines, Iowa 50319

Iowa Governor's Waste Reduction Award. This is granted to Iowa businesses or industries that have implemented a waste reduction project with the best demonstrated environmental, economic, and safety benefits. Awards are given in three categories: large manufacturing facility, small manufacturing facility, and non-manufacturing business. The deadline for nominations is in June. Contact the Waste Management Assistance Division at (800) 367-1025 or Iowa's Waste Reduction Center at (800) 422-3109 for more information.

Kansas Pollution Prevention Award Program. The Kansas Department of Health and Environment invites all sectors of society to participate in the Kansas Pollution Prevention Award Program. This annual state-wide program recognizes excellence in efforts to work toward a cleaner environment. The following levels of activity are recognized:
Pledge- Participants pledge to practice pollution prevention.
Shareholder- Participants prepare a pollution prevention plan and establish reduction goals.
Pacesetter- The organization implements their pollution prevention plan and documents the reduction of pollutants or conservation of resources.
Trendsetter- The organization has demonstrated pollution prevention measures that are easily shared with similar organizations.
Innovator- The highest level of participation, the organization receiving this award has continued pollution prevention activities within and also promotes pollution prevention in the community.
Pledge cards, summaries or reports of Pollution prevention activities must be received in the Office of Pollution Prevention by July 1. For more information, contact:

Director, Office of Pollution Prevention
Kansas Department of Health and Environment
Office of Science and Support
Forbes Field, Building 740
Topeka, KS 66620.

National Awards, Grants and Programs

NICE^3 Does your company have a technology idea that could save energy, prevent pollution, and improve your industry's bottom line? If so, you may be able to apply for assistance through a program cosponsored by the US Department of Energy (DOE) and the US EPA. This program, known as the National Industrial Competitiveness through Efficiency: Energy, Environment, and Economics encourages industry to reduce industrial waste at its source or use waste productively. To request a brochure or project proposal solicitation packet (#DE-PS49-94R90001), call Eric Hass, DOE, Denver, CO (303) 275-4728 or Sharon Riegel, EPA, Denver, CO (303) 293-1471.

33/50 Corporations involved with this voluntary EPA program pledge to reduce their emissions of 17 high-priority toxic chemicals by 33% at the end of 1992 and 50% by 1995. All of the targeted chemicals are on the EPA Toxic Release Inventory. Don't hesitate to become involved; the 1992 goal was an interim target and data on the 1995 goal will not be released until 1997. There is plenty of time for your business to get involved. For more information, call Carl Walter, EPA Region VII (913) 551-7600, or Kerry Whitford, EPA Region VIII (303) 294-7684.

Green Lights This voluntary US EPA program encourages the use of energy-efficient lighting to reduce pollution. Green Lights provides informational tools to help corporations make informed upgrade decisions. It has developed a registry of financing resources available to all Green Lights participants. For more information, contact US EPA, Green Lights 6202J, 401 M Street, SW, Washington, DC 20460 (202) 775-6650.

SBIR The Small Business Innovation Research Program is a highly competitive 3-phase award system that provides qualified small businesses with opportunities to propose innovative ideas that meet the specific research needs of the Federal Government. US-owned and based firms with less than 500 employees are eligible to compete. To get on the SBIR mailing list for announcements, call (202) 205-7777 or write to:

Small Business Administration
409 3rd Street SE
Washington DC 20416

Waste Wi$e is a voluntary program sponsored by the EPA. Companies that become members commit to making significant progress in the areas of waste prevention, recycling, and buying or manufacturing recycled products. For more information, call 1-800-EPAWISE and ask for the brochure *Waste Wi$e: EPA's Voluntary Program for Reducing Business Solid Waste.*

Consider these ideas as you apply for awards or grants:

✓ Be sure you read the criteria carefully. Some pollution prevention programs may consider only source reduction, which are methods of eliminating the generation of pollution. Some may also consider waste exchanges and recycling. Make sure you understand what the grants and awards are offered for.
✓ Follow directions. If the form asks for 1 page of double-spaced, typed information, don't submit 2 pages of handwritten material.
✓ Be clear and concise. Put yourself in the grantor's shoes.
✓ Meet all deadlines. Start early so you have time to fill out applications and check them over.

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Pollution Prevention

Helping Your Business and the Environment

Number 10a University of Nebraska-Lincoln Cooperative Extension & Biological Systems Engineering January 1995

Metal Finishing Hazardous and Non-hazardous Waste Assessment

Copy this form and use a separate one for each process or area in the metal finishing plant. Some processes typically associated with hazardous waste include chemical storage, plating, parts cleaning and facility maintenance. Don't forget to look at the nonhazardous waste your business generates when considering waste reduction opportunities. Check out your office and break areas.

Process or area: _____

Date: _____

Write down all hazardous materials used in the process or area identified above. Include amounts used per month for future reference. Consider replacing these with non-hazardous substitutes as they become available. Refer to your MSDS for help.

Hazardous materials	Amount used (lbs or gal/month)	Where does it go? (product, waste)

Wastes

Hazardous Wastes: These wastes may cause or significantly contribute to serious illness or death, or pose a substantial threat to human health or the environment when managed improperly.

Hazardous wastes that metal finishing plants may generate include:
spent solvents, spent process baths, bath sludge, rinse water, cleaning rags, and lubrication oils.

Hazardous waste	Amount per month

Non-hazardous wastes: These are wastes that often are sent to a licensed sanitary landfill. You may be able to reduce the amount of waste produced, recycle it, or find another business or institution that could reuse it. Check the box if it is present in your business waste stream. Those in **bold** are typically easy to find recycling outlets for.

Material	Estimated % of waste stream
PAPER	
☐ **green bar computer**	_____
☐ **white form feed**	_____
☐ **white letterhead**	_____
☐ **white copy**	_____
☐ **white ledger pads**	_____
☐ **cash register receipts**	_____
☐ **adding machine tape**	_____
☐ **white envelopes**	_____
☐ colored copy paper	_____
☐ yellow legal pads	_____
☐ colored letterhead	_____
☐ message pads	_____
☐ **newsprint**	_____
☐ junk mail	_____
☐ magazines	_____
☐ window envelopes	_____
☐ stick-on notes	_____
☐ cardboard	_____
☐ paper plates/cups	_____
☐ napkins/towels	_____
☐ tissue	_____
☐ wax-coated paper	_____
☐ plastic-coated paper	_____
☐ carbon paper	_____
☐ **OTHER**	_____
☐ **OTHER**	_____
☐ **OTHER**	_____

Material	Estimated % of waste stream
PLASTICS	
☐ **PETE (#1)**	_____
☐ HDPE pigmented (#2)	_____
☐ **HDPE transparent (#2)**	_____
☐ HDPE film (#2)	_____
☐ LDPE film (#4)	_____
☐ vinyl bottles (#3)	_____
☐ polypropylene bottles (#5)	_____
☐ polystyrene foam (#6)	_____
☐ rigid polystyrene (#6)	_____
☐ other plastics (#7)	_____
ALUMINUM	
☐ **cans**	_____
☐ foil	_____
☐ other (rain gutters)	_____
STEEL	
☐ **steel cans**	_____
☐ off-spec products	_____
☐ other steel (strapping)	_____
GLASS	
☐ **clear**	_____
☐ **brown**	_____
☐ **green**	_____
YARD TRIMMINGS	
☐ grass clippings	_____
☐ leaves and brush	_____

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Pollution Prevention

Helping Your Business and the Environment

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Costs of Processes

Copy this form and use a separate one for each process or area in your business. Use estimates where actual costs are not available. This information is important for determining economic feasibility of pollution prevention options, and for measuring the success of your efforts.

Process or Area: _____

Date: _____

Operating Costs

Hazardous materials (See MSDS)	Cost per month
	Subtotal

Labor and equipment	Cost per month
	Subtotal

Utilities	Cost per month
	Subtotal

Hazardous waste handling and storage	Cost per month
	Subtotal

Hazardous waste treatment	Cost per month
	Subtotal

Hazardous waste disposal	Cost per month
	Subtotal

Non-hazardous waste handling and storage	Cost per month
_____	_____
_____	_____
	Subtotal _____

Non-hazardous waste disposal	Cost per month
_____	_____
_____	_____
	Subtotal _____

Other costs	Cost per month
_____	_____
_____	_____
_____	_____
_____	_____
	Subtotal _____

Total monthly operating costs (add all subtotals) _____

x 12 months per year

Annual operating costs _____

Capital and Additional Costs

This section summarizes your annual capital and miscellaneous costs for each process as it presently exists.

Equipment purchase	$_____	Permitting	$_____
Construction/installation	$_____	Contracting	$_____
Connections to utilities	$_____	Training	$_____
Engineering	$_____	Start-up	$_____
Other	$_____	Other	$_____

Total annual capital and additional costs $_____

Total Costs for Process

Annual operating costs	$_____
Annual capital costs	$_____
Total costs	$_____

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Helping Your Business and the Environment

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Screening Pollution Prevention Options

Copy this form and use a separate one for each pollution prevention option you are considering for your business.

Pollution Prevention Option:

_____

Proposed by: _____ **Date:**____

Briefly describe the option:

What will be affected by the option?	Estimated impact
☐ Hazardous material (name)	
_____	_____
_____	_____
☐ Hazardous waste	
_____	_____
_____	_____
☐ Non-hazardous waste	
_____	_____
_____	_____
☐ Product	
_____	_____
_____	_____

What type of option is this?

- ☐ Change in housekeeping or maintenance
- ☐ Inventory change
- ☐ Equipment change
- ☐ Raw material change
- ☐ Process change

> Although recycling and waste exchanges mean that you haven't eliminated waste generation, these options are preferable to disposal.

- ☐ Recycling
- ☐ Reuse off-site

Has this option been tried before in a similar workplace setting? ☐ Yes ☐ No ☐ Uncertain

Is this a policy change? ☐ Yes ☐ No

Are there equipment/material requirements? ☐ Yes ☐ No

Are there any other requirements?

- ☐ Facility modifications
- ☐ Utility requirements
- ☐ Special storage or handling
- ☐ Testing requirements
- ☐ Regulatory impacts

Option approved for further evaluation: ☐ Yes ☐ No Date: _____

Reason for acceptance or non-acceptance:

Reconsider at later date? ☐ Yes ☐ No

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Pollution Prevention

Helping Your Business and the Environment

Number 10d University of Nebraska-Lincoln Cooperative Extension & Biological Systems Engineering January 1995

Technical Feasibility

Here are questions to help you determine if those pollution prevention options that passed the initial screening phase are technically feasible. Copy this form and use a separate one for each pollution prevention option that has passed the screening phase.

Pollution Prevention Option:

_____

Proposed by: _____ **Date:**_____

Briefly describe the option:

Type of option: ☐ Equipment related ☐ Process related

☐ Raw material related ☐ Personnel related

Why do you think this option is feasible?

What areas and personnel are affected?

Are required space and utilities available? ☐ No ☐ Yes ☐ Uncertain

Will production quality or services be affected? ☐ No ☐ Yes ☐ Uncertain

If yes, how much? ☐ Low impact ☐ Medium impact ☐ High impact

Will production or services be stopped to modify or install a new system?
☐ No ☐ Yes ☐ Uncertain

If yes, how much? ☐ Hour ☐ Day ☐ Week

Describe any new training procedures or special expertise required to operate or maintain the new system:

Are new material handling, storage, or disposal techniques required?
☐ No ☐ Yes ☐ Uncertain

If yes, explain briefly.

Does the system create other environmental or health and safety problems?
☐ No ☐ Yes ☐ Uncertain

If yes, explain briefly.

Other considerations or limitations:

Option approved for further evaluation: ☐ Yes ☐ No Date: _____

Reason for acceptance or non-acceptance:

Reconsider at later date? ☐ Yes ☐ No

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Economic Feasibility

Here are questions to help you determine if those pollution prevention options that passed the initial screening phase are economically feasible. Copy this form and use a separate one for each pollution prevention option that has passed the screening phase.

Pollution Prevention Option:

_____

Proposed by:_____ **Date:**_____

Briefly describe the option:

Operating Costs and Savings

Estimate monthly increases or decreases in operating costs attributable to the option.	Increase	Decrease
Hazardous material purchase	$ _____	$ _____
Non-hazardous raw material purchase	$ _____	$ _____
Labor and equipment	$ _____	$ _____
Health and safety	$ _____	$ _____
Quality assurance	$ _____	$ _____
Insurance	$ _____	$ _____
Liability	$ _____	$ _____
Training	$ _____	$ _____
Utilities	$ _____	$ _____
Hazardous waste handling and storage	$ _____	$ _____
Hazardous waste treatment	$ _____	$ _____
Hazardous waste disposal	$ _____	$ _____
Non-hazardous waste handling and storage	$ _____	$ _____
Non-hazardous waste disposal	$ _____	$ _____
Other	$ _____	$ _____
Totals	$ _____	$ _____

Capital Costs

Estimate capital costs of implementing the option.

	Cost
Equipment purchase	$ _____
Construction/installation	$ _____
Connections to utilities	$ _____
Engineering	$ _____
Permitting	$ _____
Contracting	$ _____
Training	$ _____
Start-up	$ _____
Other	$ _____
Total capital costs	$ _____

New revenues

Estimate all new revenues that would result from implementing the option. Potential revenue sources include recovered products from recycling, usable by-products, and increased sales of products.

Source of revenue	Revenue per month
_____	$ _____
_____	$ _____
_____	$ _____
_____	$ _____
Total revenues	$ _____

Option approved for further evaluation: ☐ Yes ☐ No Date: _____

Reason for acceptance or non-acceptance:

Reconsider at later date? ☐ Yes ☐ No

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Pollution Prevention Option Summary

Copy this form and use a separate one for each pollution prevention option in your business. Keep a copy in your files for future reference. You may choose to use an option at a later date, or you may think of modifications.

Pollution Prevention Option:

_____

Proposed by: _____ **Date:** _____

Briefly describe the option:

Why did you select or not select this option?

Is this option technically feasible at this time? ☐ Yes ☐ No

In the future? ☐ Yes ☐ No

Is this option economically feasible? ☐ Yes ☐ No

In the future? ☐ Yes ☐ No

Estimate the reduction that will be achieved. Choose the measurement that is easiest.

☐ Hazardous material	_____ pounds	_____ gallons	_____ %
☐ Hazardous waste	_____ pounds	_____ gallons	_____ %
☐ Non-hazardous waste	_____ pounds	_____ gallons	_____ %

If you decided not to implement change, did you still provide positive feedback for the idea, and relate that the idea was worth looking into? ☐ Yes ☐ No

Additional notes:

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Pollution Prevention

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Number 10g University of Nebraska-Lincoln Cooperative Extension & Biological Systems Engineering January 1995

Evaluation of Pollution Prevention Project

This sheet will help you evaluate each pollution prevention project your business undertakes. Make copies of this blank form to use with each one. Keep this on file to monitor the progress your business is making in preventing pollution.

Pollution Prevention Option Implemented:

_____

Proposed by:_____ **Date:**_____

What waste stream or hazardous material was targeted? _____

Why? ☐ Regulated as hazardous waste ☐ Largest volume ☐ Most costly

☐ Affected employee health ☐ Waste reduction method was easy to implement

What change was implemented?

Pollution Prevention Technique Involved:

☐ General housekeeping
☐ Maintenance
☐ Storage
☐ Inventory
☐ Basic operations
☐ Equipment modification
☐ New equipment purchase
☐ Raw material substitution
☐ Process modification
☐ In-house reuse
☐ Off-site recycling
☐ Waste exchange

Were difficulties encountered during trial implementation? Explain.

Were these overcome? ☐ Yes ☐ No

How?

The Bottom Line

	Cost of waste disposal	Amount of waste
Prior to change	$_____	_____
— After change	$_____	_____
Net change	$_____	_____

Cost of implementation _____

How were the following affected?

Product quality/customer satisfaction	☐ Increase	☐ Decrease	☐ No change
Production	☐ Increase	☐ Decrease	☐ No change
Worker/workplace safety	☐ Increase	☐ Decrease	☐ No change
Waste generation	☐ Increase	☐ Decrease	☐ No change
Business liability for pollution	☐ Increase	☐ Decrease	☐ No change
Business image within the community	☐ Improve	☐ Decrease	☐ No change
Worker morale	☐ Increase	☐ Decrease	☐ No change
Costs of handling waste	☐ Increase	☐ Decrease	☐ No change

Did you feel project was successful? ☐ Yes ☐ No Why or why not?

Did you publicize the pollution prevention project within the following:
☐ Business ☐ Trade Association ☐ Community

How? ☐ Newspaper article ☐ TV spot ☐ Radio spot ☐ Trade association meeting
☐ Trade magazine ☐ Other

Was recognition given to the person who generated the idea? ☐ Yes ☐ No

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Evaluation of Pollution Prevention Tool Kit

Your feedback is important to us! Please take a minute to answer the following questions on both sides of this sheet. Then fold, secure with tape, and mail. Thanks!

1. The materials in the tool kit:	No		Some		Yes
were helpful in understanding pollution prevention.	1	2	3	4	5
helped me incorporate pollution prevention into my business.	1	2	3	4	5
helped me reduce the amount of waste produced at my business.	1	2	3	4	5

By how much? _____ pounds per month.
_____ gallons per month.

2. Read each of the statements below and rank yourself at the present time. Next, think back to your understanding about each statement before using the tool kit. Circle the appropriate numbers using the following key:

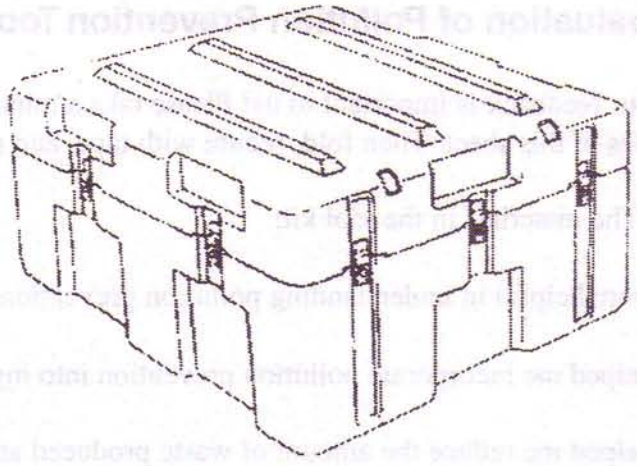
1 = no understanding/involvement
2 = little understanding/involvement
3 = moderate understanding/involvement
4 = good understanding/involvement
5 = excellent understanding/involvement

How would you describe your understanding of:

	After using materials					Before using materials				
the concept of pollution prevention?	1	2	3	4	5	1	2	3	4	5
pollution prevention methods: including good housekeeping, purchase and inventory, changes in equipment, raw material substitution, changes in technology?	1	2	3	4	5	1	2	3	4	5
economic benefits of pollution prevention?	1	2	3	4	5	1	2	3	4	5
environmental benefits of pollution prevention?	1	2	3	4	5	1	2	3	4	5
implementing pollution prevention in a business?	1	2	3	4	5	1	2	3	4	5

3. What Tool Kit did you receive?

- ☐ Drycleaning
- ☐ Metal finishing
- ☐ Autobody repair
- ☐ Vehicle maintenance
- ☐ Farm Cooperative



4. In what state are you located? _____

5. How many people does your business employ full-time? _____ part-time? _____

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