

## Environmental Best Management Practices for Small Businesses

### Introduction

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An environmental best management practice (BMP) is an action or combination of actions implemented to reduce the environmental impacts of business operations. There are two types of pollution prevention: source reduction and recycling. Source reduction reduces or eliminates the generation of waste. Recycling takes used materials, modifies their form, and makes them available for future reuse. The BMPs provided in the fact sheets listed below are a combination of source reduction and recycling strategies, which provide economic as well as environmental and safety benefits.

Each BMP fact sheet focuses on a particular sector, and draws information from several sources, which are listed in the endnotes section of each fact sheet. The BMPs listed in each fact sheet may be used as a guide for your business. Depending on your business' individual needs and technical and financial capacities, the BMPs may require modification. When adapting a BMP to your business, it may be necessary to contact your local regulatory agency to determine permit requirements. It is important to note that the BMPs listed in these fact sheets are intended as a starting point for your business' environmental management plan, and are not all-inclusive. Further information is available through links at the end of each fact sheet. For additional information about regional specific BMPs, or BMPs not covered in these fact sheets, contact your local authorities and regulating agencies. It is not expected that each BMP will work in all situations; each small business must factor in their own needs, resources, and capacities to find the ones that work best for them.

The fact sheets are intended to work in conjunction with the Environmental Protection Agency's *Practical Guide to Environmental Management for Small Business* and its companion book, *Documenting Your Environmental Management Plan*. For copies of these guides, please refer to the links provided on this website.

Each fact sheet is divided into five sections:

- 1) **Sector Introduction:** Provides basic background information on environmental impacts associated with the sector.
- 2) **Best Management Practices:** Divided into two or more subsections. Each subsection consists of a paragraph describing a particular environmental impact, followed by a list of BMPs which address the problem.
- 3) **Investments in Technology:** Supplies additional information on technologies mentioned in the BMPs or provides information on new technologies to consider when making your choice of BMPs to use. Information about returns on investment is provided where possible, but the true payback period will vary greatly, dependent upon your situation. To determine if a particular technology is right for your operations contact a local vendor for more information.
- 4) **Case Study:** Demonstrates the effectiveness of a BMP used in a business.
- 5) **Other Sources:** Provides links to BMP information listed in the fact sheet. Also provides additional resources available to small businesses.



# Best Management Practice

## Machine Shop

### Sector Introduction

A wide range of activities takes place in machine shops. Possible machining operations include drilling, boring, milling, punching, band-sawing, CNC drilling and tapping, and surface grinding. Coatings are applied to impart desired characteristics not present in base metal. The BMPs listed in this fact sheet are a starting point for your business. Additional suggestions for a wider range of activities can be found using the links in the “Other Sources” section.

### Best Management Practices

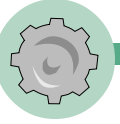
#### Cutting Fluids

Machine shops use and dispose of a significant amount of cutting and grinding fluid. Cutting and grinding fluids can consist of water-soluble or non-soluble petroleum based oils. Cutting fluids improve the life and function of cutting tools by providing cooling and lubrication. The fluid is also used to carry away chips and fines produced in machining and cutting operations. Water is the most efficient way to cool machines, but can cause rusting. Cutting fluids contain oils or chemicals to prevent rust and provide other benefits (i.e., friction reduction).

Buildup of an oil layer in a machine sump encourages the growth of anaerobic bacteria which creates a rotten egg smell (hydrogen sulfide) and can cause skin irritation. The bacteria may make the solution acidic enough to dissolve metal particles creating a hazardous waste. In addition, oil and grease negatively impact water quality.

Coolant baths are often discarded monthly to maintain desired characteristics. The following BMPs relate to extending the life of coolant solutions, to minimize waste and prevent the disposal of these fluids in ways that are not environmentally sound.

- Investigate opportunities to extend the life of machining coolants used by:
  - Filtering out and removing suspended particles;<sup>2</sup>
  - Using de-ionized water to mix coolant concentrate;<sup>2</sup>
  - Adding an oil water separation system to remove oil contamination, or remove floating oil using an absorbent pad or skimmer;<sup>1</sup>
  - Creating procedures to reduce the introduction of contaminants, such as cigarette butts, spit, food, and dirt; and<sup>1</sup>
  - Removing chips, fines, or sludge regularly.<sup>1</sup>
- Remove tramp oil, chips, and fines to prevent septic conditions from occurring in cutting fluids. The treated solution may be suitable for disposal in the municipal sewer treatment system. Be sure to get approval from local wastewater authorities before using this disposal option.<sup>1</sup>
- Consider purchasing a coolant solution recycling unit that offers complete sump maintenance with easy operation. Both portable and non-portable units are available to control concentration, reduce rancidity, extend coolant life, and limit operator dermatitis. Fluid should be recycled every 2 to 3 weeks, and may be usable for one to two years or more.<sup>2</sup>
- Create a system to regularly monitor coolant condition and concentration. Weekly monitoring is the minimum, while daily monitoring is suggested for small sumps or stand-alone machines. Minimizing waste by maintaining machine coolant is the best approach for dealing with waste disposal issues. Properly maintained coolant can greatly increase the time between coolant batch disposals, and can also control the character of the waste produced, both of which will result in cost savings.<sup>2</sup>
- Utilize a refractometer to optimize coolant concentrations. Diluted coolants result in shorter tool life, while rich concentrations result in increased coolant use and thus increased cost as well as problems with foaming.<sup>1</sup>
- Perform daily inspections and routine maintenance of machines to prevent hydraulic and metalworking fluid leaks. As machine gaskets, seals, and wipers become worn and cracked, fluid drips onto the floor, machine parts, or in the case of hydraulic fluids, into the metalworking fluid baths. These leaks require cleanup that results in wastes such as wash water and used absorbent rags or pads. Hydraulic fluids dripping into metalworking fluid baths also provide a



site for bacterial growth, and cause smoke and odor problems, resulting in frequent fluid changing.<sup>1</sup>

### Chips and Fines

One of the primary wastes from metalworking is the chips and fines that result from cutting and grinding metals. These wastes, when left in the sump, promote the growth of bacteria, causing health problems amongst employees and reduce the usefulness of the cooling fluid.

- Completely drain excess cooling fluid from chips prior to recycling using a screen, perforated container, chip wringer, or centrifuge. The drained coolant can then be reused.<sup>2</sup>
- Locate opportunities to recycle chips, fines, and sludge for metal value.<sup>1</sup>

### Metal Coatings

Coatings such as paint are often spray applied to the metals. Alternatively, coatings can be applied by plating parts in zinc, copper, nickel, or chrome solutions. The rinse water produced after the coating process is often hazardous waste.

- Reduce drag-out in plating tanks by:
  - Increasing parts drainage time;<sup>7</sup>
  - Using low pressure air to blow off parts;<sup>7</sup>
  - Using drip bars to hold parts over bath to drain more completely.<sup>4</sup>
- Collect rinse waters to use as make-up water in plating tanks, to reduce both water use and the amount of wastewater produced.<sup>4</sup>
- Create a schedule to monitor plating bath concentrations, to catch problems early to avoid having to dispose of an entire tank. Limit the number of employees allowed to adjust tank concentrations to control fluctuations and prevent errors caused by miscommunication. This can also improve product quality.<sup>12</sup>
- Get permission from your local sewer utility before any rinse water enters the sewer (for example, if you take engine parts out of a hot tank and hose them off directly to a sewer drain).<sup>7</sup>
- Provide covers for solution containers, such as sumps, dip and plating tanks, and cleaning baths. This will decrease the introduction of outside contaminants when the containers are not in use.<sup>1</sup>
- Create reusable masking devices for sprayed parts.

This reduces the amount of solid (possibly hazardous) waste produced and eliminates the use of masking tape or paint. It may also make spray residue more suitable for recycling.<sup>8</sup>

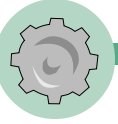
### Degreasing

Degreasing is critical to remove oil, particles, and/or buffing compound contamination. Machine shops have historically used mineral spirits as a solvent to remove grease and oil from tools, parts, and equipment. A large quantity of hazardous waste is usually produced in the process.

- Use the least amount of chemical that will suffice for the task. Create standard operating procedures specifying that solvents should be wiped onto parts using a rag instead of poured onto them.<sup>7</sup>
- Replace mineral spirits and other solvents with a water based solution for cleaning parts. Switching to an aqueous based solution may reduce regulatory requirements, decrease labor required to clean parts, and eliminate unpleasant odors and fumes. If non-emulsifying solutions are used, oils and dirt can be removed, allowing the cutting fluid to be used longer. Solvents keep oils and dirt in solution, and once they become saturated, the solvent can no longer be used.<sup>3</sup>
- Consider installing an affordable solvent recycling still, or have a firm pick up your waste solvent for off-site recycling.<sup>7</sup>

### General

- Use absorbent pads that can be wrung out and reused, to reduce both the amount of waste material produced and the amount of new material that must be purchased.<sup>2</sup>



## Investments in Technology

- Alternative lubricating/cooling methods are available that combine a small amount of cutting tool lubricant with cold air. This new technology offers the potential for increased feed rates, longer tool life through reduced machining temperatures, and greatly reduced lubricant usage. Lubricant use is adjustable, and should vary between zero and four ounces per shift, for an annual use of 12 gallons compared to the traditional system use of 60 gallons per year. Additional benefits of using small quantities of lubricant include less residue remaining on the work piece, and higher scrap values.<sup>11</sup>
- Ultrafiltration may be an option to effectively treat wastewaters or coolants prior to discharge to a sewer system. It is a form of filtration that uses membranes to preferentially separate different fluids or ions. Ultrafiltration uses a low-pressure membrane that is partially permeable to separate high molecular weight compounds from a feed stream. It is most commonly used to separate a solution that has a mixture of some desirable components and some that are not desirable. Since the membranes have larger pores than those used in nanofiltration and reverse osmosis, it is the least costly of the three to operate.<sup>10</sup>

### CASE STUDY A Full Service Machine Shop

A full service machine shop, employing 22 people, operates 35 to 40 machines and runs one shift, Monday through Friday. It experienced waste management costs from \$1,500 to \$2,000 per month due to hazardous waste disposal of spent cutting fluid.

The shop purchases a batch recycling system for \$8,500 and a sump sucker for \$3,750. It also created a Fluid Management Program. Fluid from each machine is recycled at least once a week, and one employee is responsible for fluid recycling and fluid management record keeping.

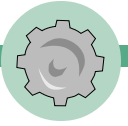
The whole system paid for itself in less than two years, and had the following benefits:

- No waste cutting fluid has been generated at the facility since implementing the program;
- Purchases of fluid concentrate dropped from 250 – 300 gallons per year to 100 gallons per year;
- There have been no incidents of dermatitis among the employees.

Source: Iowa Waste Reduction Center, *Fluid Management for Small Machining Operations*, <http://www.p2pays.org/search/pdf/frame.asp?pdfurl=/ref/15/14636.pdf>

## Other Sources of Information

- <sup>1</sup> Washington State Department of Ecology, Hazardous Waste and Toxics Reduction Program, *Metal Machining Sector – A Pollution Prevention Assessment and Guidance*, <http://www.p2pays.org/ref/05/04272.pdf>
- <sup>2</sup> Pacific Northwest Pollution Prevention Resource Center - Business Assistance, *Metal Machining Industry Resources*, <http://www.pprc.org/pprc/sbap/machine.html>
- <sup>3</sup> U.S. EPA Region 9, Merit Partnership Pollution Prevention Project for Metal Finishers, *Finding An Alternative to Solvent Degreasing – Ultrasonic Aqueous Cleaning*, <http://www.getf.org/file/toolmanager/O16F6952.pdf>
- <sup>4</sup> Connecticut Department of Environmental Protection, *Pollution Prevention Options for Industry*, <http://dep.state.ct.us/wst/p2/industry/p2options.pdf>
- <sup>5</sup> The Organization Resources Counselors and the Metalworking Fluid Stewardship, *Metal Removal Fluids: A Guide to their Management and Control*, <http://www.pmpa.org/agent/desguide/mrfguide.htm>
- <sup>6</sup> Pollution Prevention Resource Exchange, *Waste Reduction in Metal Machining*, <http://wrrc.p2pays.org/industry/metalmach.htm>



- <sup>7</sup> University of Missouri, *Pollution Solutions Waste Reduction Assistance for Businesses: Metal Finishing*, <http://outreach.missouri.edu/polsol/metal.htm>
- <sup>8</sup> U.S. EPA Environmental Research Brief, *Pollution Prevention Assessment for a Manufacturer of Combustion Engine Piston Rings*, <http://www.p2pays.org/ref/03/02819.pdf>
- <sup>9</sup> Environment Canada, Canadian Pollution Prevention Information Clearinghouse, *Metal Finishing Sector*, <http://www.ec.gc.ca/cppic/search/en/createSearch.cfm?ID=115>
- <sup>10</sup> Institute of Advanced Manufacturing Sciences, *Shop Guide to Reduce Wastewater from the Machining and Metal Fabrication Industry*, <http://www.p2pays.org/ref/03/02293.pdf>
- <sup>11</sup> Ohio Environmental Protection Agency, Pollution Prevention Section, *Extending the Life of Metal Working Fluids - Fact Sheet*, <http://www.p2pays.org/ref/01/00072.htm>
- <sup>12</sup> U.S. EPA Region 9 Pollution Prevention Program, *Extending Metal Finishing Bath Life*, <http://www.p2pays.org/ref/02/01301.pdf>
- <sup>13</sup> University of Northern Iowa, Iowa Waste Reduction Center, *Cutting Fluid Management for Small Machining Operations*, <http://www.p2pays.org/search/pdf/frame.asp?pdfurl=/ref/15/14636.pdf>