Table 4. Waste Minimization Methods for Fabricated Metal Industry Processes

Process	Waste Stream	Source Reduction Options	Recycling Options
Material Handling and Storage		Material Preinspection Proper Storage of Materials Restrict Traffic through Storage Area Inventory Control Purchase Quantities According to Needs	Test Expired Material Usefulness
Machining Wastes	Metalworking Fluid	Use of High Quality Metalworking Fluid Demineralized Water Use Concentration Control Sump and Machine Cleaning Gasket, Wiper and Seal Maintenance Cleaning of Metalworking Fluid Assigning Fluid Control Responsibility	Filtration of Metalworking Fluids Skimming Coalescing Hydrocycloning Centrifuging Pasteurization Downgrading
Parts Cleaning	Solvents	Tank Lid Installation Increase in Freeboard Space Installation of Freeboard Chillers Cross-Contamination Avoidance Appropriate Makeup Solutions Solvent Standardization Consolidating Operations Media Substitution	Gravity Separation Filtration Batch Distillation Fractional Distillation Use as Fuel On- and off-site Recycling
	Aqueous Cleaners	Sludge Removal Use of Dry Cleaning and Stripping Methods Media Substitution	Oil Separation Pickling Bath Recycling
	Abrasives	Use of Greaseless or Water-Based Binders Use of Liquid Sprays Water Level Control Synthetic Abrasives	
	Rinsewater	Rack and Barrel System Design Rinse System Design Spray and Fog Rinses Chemical Rinsing Deionized Water	
Surface Treatment and Plating	Process Solutions	Increasing Solution Life Material Substitution Process Substitution Chemical Coating Mechanical Cladding and Coating	Use of Cleaning Baths as pH Adjusters Metal Recovery Evaporation Reverse Osmosis Ion Exchange Electrolytic Recovery Electrodialysis
	Rinsewater	Reduction in Drag-Out of Process Chemicals: Speed of Withdrawal Surface Treatment Plating Bath Concentrations	Rinsewater Reuse

Table 4. Waste Minimization Methods for Fabricated Metal Industry Processes (cont'd)

Process	Waste Stream	Source Reduction Options	Recycling Options
		Surfactant Use Solution Temperature Workpiece Positioning Drag-Out Recovery System Design Considerations: Rinsetank Design Multiple Rinsing Tanks Reactive Rinsing Fog Nozzles and Sprays Automatic Flow Controls Rinse Bath Agitation	
Surface Treatment and Plating (cont'd)	Treatment Wastes	Precipitating Agents and Other Treatment Chemicals Trivalent Chromium Use Waste Segregation Sludge Dewatering	
	Case Hardening Wastes	Selection of Clean Processes	
Paint Application	Empty Containers	Waste Segregation Bulk Purchasing Minimizing Residuals	
	Paint Application Waste	Overspray Reduction: Equipment Modifications Operator Training Material Substitution Replacing Solvent-Based Coatings with: Water-Based Coatings Radiation-Curable Coatings Powder Coatings	Reusing Solvent Paint Mixtures Recovery through Distillation Recovery through Filtration

Fabricated Metals

Extending Metal Working Fluid Life

In the past, many companies have tended to dispose of their metal working fluids as soon as they showed signs of decreased efficiency or fouling. Often, such disposal is unnecessary and expensive. Through the use of an effective management system, companies can indefinitely extend the life of metalworking fluids, thus saving on the costs of new fluids, and on the disposal cost for the used fluid.

A. Use Deionized or Reverse-Osmosis-Processed Water

Tap water typically contains minerals, ions and bacteria. If tap water is continually used, the mineral content of the metalworking fluid continues to increase. Concentrated minerals can form deposits and soaps that gum up the metalworking process. By using mineral-, ion-, and bacteria-free water, this fouling issue is greatly diminished.

B. Microbial Control

Keeping the sump and metalworking fluid free from impurities that create a habitat conducive to microbial growth is the goal. A fluid and sump cleaning program therefore, helps to extend fluid life. Additional options to extend fluid life include:

- Periodic addition of biocides (as necessary)
- Use of fluids with biostatic properties
- Pasteurization of fluids
- Adjustment of fluid pH to minimize the effects of the bacteria
- Addition of agitation/aeration of sumps during non-use hours

C. Reduce Sources of Contamination

Foreign substances, such as tramp oil, swarf, dissolved minerals, and/or dirt, prevent the metalworking fluid from working effectively. Some contaminants can be reduced at the source through operating changes or increased care.

D. Filtration

In-line filter media, filtering devices, and oil skimmers, may be able to remove certain contaminants, including tramp oil and swarf, from the fluids.

E. Other Options

Investigate the use of other compounds that serve the same purpose (e.g., drawing compounds); the use of alternate cooling methods (e.g., air gun); or the use of alternate processes that do not require metalworking fluids (e.g., waterjet cutting, plasma arc cutting).

F. Solution

Extending the life of cutting fluids can be accomplished in several ways, including filtration, centrifugation, pasteurization, oil skimming, and/or coalescing. Benefits include reduced disposal costs, reduced new cutting oil purchase costs, and reduced labor and machine downtime (clean out) costs.

G. Economics

The main costs involved are the capital cost to purchase the cutting fluid life extension (e.g., recycling) system, and the labor cost to operate the system.

H. Scope of Work and Deliverables

- Implement process changes and/or install equipment that can extend the life of metal cutting fluids.
- Identify process changes and/or equipment options.
- Implement process changes and/or install equipment.

I. References

- http://www.epa.state.oh.us/opp/metalw/fact11.html
- "Extending the Life of Metal Working Fluids" State of Ohio Environmental Protection Agency Fact Sheet, Number 11, March, 1993

Fabricated Metals

Extending Metal Working Fluid Life

Checklist

Does the facility use any type of metal working fluid, e.g., coolants, oils, lubricants?

☐ Yes ☐ No

Could the usage life of the metalworking fluid be improved?

☐ Yes ☐ No

(If No to either, STOP)

1. Do they add tap water to their fluids as opposed to deionized water or reverse-osmosis-processed water?

☐ Yes ☐ No

(If Yes, See A)

2. Do they have problems with microbial spoilage?

☐ Yes ☐ No

(If Yes, See B)

3. Are there opportunities to reduce the sources of contamination?

☐ Yes ☐ No

(If Yes, See C)

4. Are there opportunities to add a filtration process to remove some contaminants?

☐ Yes ☐ No

(If Yes, See D)

5. Are there opportunities to reduce the number of fluids used, or eliminate their use all together?

☐ Yes ☐ No

(If Yes, See E)

Additional Questions

- What are their costs associated with the use and disposal of metal working fluids?
- What are the types of metalworking fluids being used?
- What are the types of contaminants that foul the fluids?

MEDS Links (http://meds.mmtc.org)

- Fabricated Metal
- Cutting Fluid Recycling

Fabricated Metals

Metal Machining Process Improvement

The build-up of heat at the cutting surface is a major issue for metal fabrication facililities. Heat can destroy cutting tools, require the use of expensive special tools, increase cycle times, increase labor costs due to increased cycle times and tool maintenance activities, damage and discolor work pieces, increase downtime due to tool maintenance activities, and increase utility costs due to increased cycle times.

Heat must therefore be reduced in order to efficiently produce quality parts. Two traditional methods involve adding materials such as lead to the metal alloy and adding materials, such as chlorinated and/or sulfured compounds to the cutting fluid. However, due to environmental and health cocerns, these methods are receiving negative attention. To overcome this situation, metal fabrication facilities now have other options.

A. High-Velocity, High-Volume Coolant Pumps

High-velocity, high-volume coolant pumps, coupled with the use of non-chlorinated, non-sulfured oils, apply coolant precisely at the cutting surface to effectively reduce heat, thus leading to increased tool life and decreased cycle times.

B. High-Pressure, High-Volume Coolant Pumps

Similar to high-velocity pumps, high-pressure, high-volume coolant pumps reduce heat at the cutting surface and can lead to longer tool lives and reduced cycle times.

C. Cryogenic Metal Machining

Cryogenic metal machining involves the use of liquid nitrogen, which is injected through a micro-nozzle at the cutting surface.

D. Coatings on Tools

Cutting tools can be coated with materials to extend their useful life.

E. Solution

Replacement of the traditional machining methods with an improved coolant and coolant application process may lead to reduced cycle times and increased tool life. In addition, coatings on tools and cryogenic metal machining have yielded similar results.

F. Economics

Capital and operating costs will vary per chosen technology. A high-volume, high-velocity pump costs in the range of $15,000 - $20,000, plus installation. Non-chlorinated, non-sulfured oils are in the general price range as their more toxic counterparts.

- Through the use of the pump and special oil, a Midwestern precision machined products job shop was recently able to increase tool life in the range of 63-735%, thus leading to a reduction in downtime. The simple payback was calculated to be 7 months.
- A packaged gas supplier received a DOE grant to demonstrate cryogenic metal machining (see www.oit.doe.gov/Access/nice3/AIRPROD.html).

G. Sample Scope of Work and Deliverables

- Investigate options to improve the metal machining process and implement best option.
- Investigate options.
- Test possible options.
- Implement best option.

H. References

- http://www.chipblaster.com/index.html
- http://uaw.org/breaktime/healthsafety/fl3.html

Fabricated Metals

Metal Machining Process Improvement

Checklist

If the facility machines metals, could the useful life of cutting tools or cycle times be improved?

☐ Yes ☐ No
(If No, STOP)

1. Are they using metal alloys containing lead (which is added for lubricity)?

☐ Yes ☐ No
(If Yes, See A and B)

2. Are they using chlorinated and/or sulfured cutting fluids?

☐ Yes ☐ No
(If Yes, See A and B)

3. Are they interested in either eliminating lead-containing metal alloys or chlorinated/sulfured cutting fluids?

☐ Yes ☐ No
(If Yes, See A and B)

4. Are special cutting tools required for their current needs?

☐ Yes ☐ No
(If Yes, See D)

5. Have they ever investigated the use of specialized coolant pumps, cryogenic metal machining, or the application of coatings to their tools?

☐ Yes ☐ No
(If No, See A, B, C, and D)

Additional Questions

- What are current cycle times?
- What are current tool lives?
- What are the costs associated with downtime due to tool maintenance/replacement activities?