MI DEQ & RETAP Pollution Prevention (P2) Training

Metal Fabrication: Cutting & Stamping

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Types of Metal Fabrication Wastes

- Corrosive
- Waste Water
- Used Oils
- Solvents
- Sludges
- Metalworking Fluids
- Solid Wastes
Corrosive Wastes

- Spent pickling acids
- Spent alkaline cleaning solutions
- Discarded molten-bath, alkali-salt cleaning mixtures
Sludges

- Treatment of electroplating, heat-treating or anodizing waste water
- Paint-related sludges
- Grinding sludge
- Clean-out solvent or aqueous systems, sumps or grease traps
- Distillation still bottoms
Waste Water

- Electroplating systems
- Anodizing systems
- Parts cleaning systems (acidic or alkaline)
- Water-curtain spray booths
- Paint stripping systems
- Floor washing (Maintenance & Housekeeping)
- Cooling systems & Boiler blow-down
- Domestic sewage
Metalworking Fluids

- Cutting oils: Fortified petroleum oils
- Soluble oils: 30 - 90% oil
- Semi-synthetic fluids: 1 - 30% oil
- Synthetic fluids: 0 - 1% oil
Used Oils

- Metalworking fluids
- Hydraulic oils
- Lubricating oils
- Compressor oils
- Motor oils
- Oil Filters
- Oil-soaked absorbent materials
- Shop Towels
Solvent Wastes

- Degreasing items before Painting or Plating
- Removing metalworking fluids
- Cleaning manufacturing equipment
- Cleanup of painting equipment
- Solvent evaporation
Sources of Solvent Wastes

- Vapor degreasers
- Paint spray booths
- Paint mixing & cleaning stations
- Drying & curing ovens
- Sinks, tubs & vats used for cleaning parts & dies
- Manual cleaning products: rags, containers, sprayers & aerosol cans
Solid Wastes

- Metal Wastes
- Paper Products
- Aerosol cans
- Fluorescent Tubes
- Packaging & Shipping wastes:
  - Wooden pallets, crates & boxes
  - Steel drums, pails, straps & cans
  - Plastic drums, pails, stretch wrap & straps
  - Expanded polystyrene
  - Aluminum cans
Metal Cutting & Stamping

- Key to P2 for both is effective fluid management
- Main types of cutting fluids—pros & cons
- What fluids do
- Components of a fluid environmental management program
- Fluid recycling & disposal
Metal Cutting & Stamping

- Common cutting fluid functions
  - Cool
  - Lubricate
  - Remove fines/cuttings from cutting zone
  - Corrosion protection (esp. ferrous materials)

- Choice of coolant affects tool wear & part quality (surface finish and size).

- No one type of cutting fluid provides best cooling & lubrication. Generally a tradeoff.

- Fewer coolants are easier to manage in a shop.
Types of Fluids
Oil-based (100% petroleum)

- excellent lubricity (cushioning) allows use in severe machining & difficult-to-cut metals
- good rust protection
- easy maintenance
- extended sump life
- resistant to bacterial growth

- poor heat dissipating qualities
- higher fire risk
- mist generation
- limited to low-temperature/low speed & severe cutting operations
- oil on part often requires cleaning
Types of Fluids
Oil-based (60-90% petroleum)

✓ improved cooling capabilities
✓ good lubrication due to oil & water blending
✓ general purpose product for light and medium duty on ferrous & non-ferrous metals

✓ water increases susceptibility to rusting, bacterial growth & evaporative losses
✓ higher maintenance costs
✓ can be difficult to clean (oily film)
Types of Fluids
Synthetic (0% petroleum)

✓ superior cooling & corrosion control
✓ suitable for wide range of machining
✓ reduced misting & foaming
✓ easily separated from workpiece & chips, less dragout & easier cleanup
✓ long service life

✓ moderate to high agitation causes foam & some mist generation
✓ may emulsify tramp oil
✓ may form residue
✓ easily contaminated by other machining fluids
Types of Fluids
Semi-synthetic (2-30% petroleum)

- good corrosion control, cooling & lubrication
- easily separated from workpiece/chips
- long service life
- suitable for many machining operations
- moderate to high agitation causes foam & some mist generation
- may emulsify tramp oil
- may form residue
- easily contaminated by other machining fluids
Costs of Poor Fluid Quality

- Increased machine & tool wear
- Impaired part quality/increased reject costs
- Increased machine downtime
- Increased fluid purchase, mix & disposal costs
- Increased labor costs associated with all the above
Metal Cutting & Stamping
P2 Opportunities

- Use high-quality metalworking fluid
- Select right fluid for job
- Maintain equipment to prevent sump contamination (cleaning sump & machine, gasket, wiper & seal maintenance)
- Proper fluid monitoring & cleaning
- Assigned fluid control responsibility
- Separate metal & fluid waste
Components of a Fluid Management Program (FMP)

- **Commitment from interested parties**
  - Top management (time, money, leadership focus)
  - Employees (“how-to” input)
  - Vendor (technical know-how on fluid/equipment)

- **Defined roles & responsibilities**
  - Initially to gather baseline performance data
  - Then to sustain monitoring, measurement & maintenance of FMP
Components of a Fluid Management Program (FMP)

- Establish operational controls
  - Fluid control points: water quality requirements (e.g., water hardness & dissolved solids), water/concentrate ratios, contaminant levels & pH

- Work instructions
  - roles & responsibilities, control points & how-to measure, mixing & maintaining fluids, annual cleanout
Components of a Fluid Management Program (FMP)

- Contaminants to watch for...
  - Tramp oils—leak into sump from other machine parts. Can be any other oils from machine or parts. Can contribute to next problem...
  - Bacterial growth: problematic in water-miscible fluids. Bacteria lower fluid pH, increasing tool/part corrosion & staining, dissolve chips/fines, possibly making fluid hazardous waste come disposal time
Components of a Fluid Management Program (FMP)

- And how to prevent them…

  - **Tramp oils**
    - Find and fix leaks through proactive preventative maintenance
    - Remove metal chips/fines (i.e., “yellow-bellied sump sucker”)
    - Skim/centrifuge fluid to remove

  - **Bacterial growth**
    - Control water quality (e.g., dissolved minerals)
    - Maintain proper fluid concentration & pH
    - Routine maintenance & cleaning of machines, lines, & sumps
    - Biocide additions
    - Aeration
Components of a Fluid Management Program (FMP)

- Monitoring & measurement-fluid concentration
  - Refractometers: measures fluid concentration by sending light through fluid. The more it refracts or bends, the higher the fluid concentration.
  - Titration: slower but typically more accurate that refractometers for fluid concentration. Less affected by contaminants.
Components of a Fluid Management Program (FMP)

- Monitoring & measurement: pH
  - Litmus paper: quick & inexpensive but accurate to +/- one full pH unit
  - pH meter: more expensive ($50-$200 dollars) but accurate to +/- 0.2 pH units

- Monitoring & measurement: bacteria
  - Plate counts/dipslide tests—both inexpensive. Recommended testing weekly or biweekly especially during program startup
Components of a Fluid Management Program (FMP): Recordkeeping

<table>
<thead>
<tr>
<th>Machine</th>
<th>Sump Capacity</th>
<th>Type of Fluid Used</th>
<th>Date</th>
<th>Initial Parameter Readings for Fresh Fluid</th>
<th>pH =</th>
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<td>Concentration Reading</td>
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**FLUID MANAGEMENT LOG**

<table>
<thead>
<tr>
<th>Date</th>
<th>Fluid Concentration</th>
<th>pH</th>
<th>Biological Monitoring</th>
<th>Rust</th>
<th>Tramp/Excessive Cuttings</th>
<th>Rancidity</th>
<th>Color</th>
<th>Concentrate Added</th>
<th>Water Added</th>
<th>Other Additives</th>
<th>Fluid Changed Out</th>
<th>Problems / General Comments</th>
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Fluid Cleaning & Recycling

- Skimmers
- Coalescers
- Centrifuging
- Hydrocycloning
- Filtration
- Pasteurization
- Flotation
“Cutting-Edge” P2 Opportunities

- Air as fluid replacing cutting oils
- Laser-cutting
- Water-jet cutting
- Plasma-arc welding
- CNC (computer numerical control) machining
Additional Resources

- North Carolina Waste Reduction Resource Center, Waste Reduction for Metal Machining
  [http://wrrc.p2pays.org/industry/metalmach.htm](http://wrrc.p2pays.org/industry/metalmach.htm)

- Cutting Fluid Management for Small Machining Operations: A Practical Pollution Prevention Guide, Iowa Waste Reduction Center, University of Northern Iowa, 1996

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Next Steps: Assess Cutting & Stamping Operations & Implement a FMP!

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