Metalworking Fluids
The Whole Perspective

Brian K Hovik – Chemetall / BASF
About the Presenter

• BS in Manufacturing Engineering  1985

• MBA Technology Management  2005

• Boeing Company 29 years – Retired 2014

• Manufacturing Engineering background:
  • All aspects of manufacturing
  • Coolant and Lubricant involvement since 1990

• Coolant & Lubricant Focal for Boeing Co. over 20 years

• Chemetall US since 2014

• Member STLE since 1991
  • STLE Metalworking Fluids Steering Committee member
  • STLE Metalworking Fluids Education and Training Sub-Committee Chair

• Member SME since 1985
Perspective ?
What is your perspective?
Metalworking Fluid Players

- MWF Manufacturer or Raw Material Supplier
- MWF End User
- MWF Regulating Agencies
- MWF Waste Treatment and/or Haulers

All have a unique perspective
Goal of Presentation

- Educate each group about the other’s unique perspectives

- To help grow the industry together in harmony instead of as adversaries

- Understand that Metalworking fluids are an asset – not a necessary evil
Presentation Topics

• Key Concepts
• Metalworking Fluid (MWF) Basics
  • Definitions
  • Types
  • Functions
• The Formulator’s Perspective
  • MWF Formulations & Differentiators
  • REACH
  • Additives/Components
• The End User’s Perspective
  • The Perfect MWF
  • Cost Comparisons
  • MWF Selection Issues
  • Performance
• The Regulating Agencies’ Perspective
  • Regulation
  • Banned Chemicals
  • OSHA Waste Reduction Manual
• The Waste Treatment Perspective
  • Treatment Methods
• Summary
Key Concepts

• All players with regards to Metalworking Fluids have a perspective based on their position in the industry.

• Metalworking Fluids are costly and should be treated as an asset in increasing productivity.

• There will be continuous change in the Metalworking Fluid Industry due to improvements in formulations, pressure from regulatory agencies and world demand.

• Working together to solve issues will enhance productivity, reduce waste and create a safer working environment for the metalworking industry.
Metalworking Fluid Basics – Definitions

**Straight oil (neat or cutting oil):**
Not diluted with water, oil-based with additives

**Concentrate:**
Undiluted fluid prior to addition of water
Blend of mineral oils or organic oils and additives

**Emulsion:**
Oil dispersed within water using an emulsifier

**Working fluid:**
Concentrate diluted with water from concentrate
Straight (Neat) Oil Formulation

- Petroleum Oil 75 – 95%
- Boundary lubricants: 5 – 10%
- Extreme Pressure Additives: 0 – 20%
  - Chlorinated Paraffin, Sulfates
- Other additives possible
  - Metal deactivators
  - Anti-mist or anti-foam
- Excellent lubrication – poor cooling
Soluble Oil (Emulsifiable Oil)

- Petroleum Oil 40 – 70%
- Diluted with water to form emulsion (milky appearance)
- Light to Heavy Duty Machining
- Combines lubrication and cooling
- Used extensively in all forms of metal cutting/grinding
- Prone to biological activity and foaming
- Standardized waste treatment processes
- Most common type of MWF
Synthetics

- NO Petroleum Oil
- Diluted with water to form solution (clear or opaque)
- Light to Medium Machining
- Combines medium lubrication with cooling
- Used in all forms of metal cutting, especially grinding
- Prone to be harsh on equipment
- Specialized waste treatment processes
Semi-Synthetics

- Concentrate contains petroleum oil & water
- Diluted with water to form part solution & part emulsification working fluid (light milky color)
- Light to Heavy Machining
- Combines lubrication with cooling
- Used in all forms of metal cutting
- Formulated to be bio-stable
- Standard waste treatment processes
- Most rapidly growing fluid type
- Combines both lubricity of soluble oil with cleanliness of synthetics to form a unique working fluid
Differences in MWF

- Cooling Ability
  - Synthetic
  - Semi-Synthetic
  - Emulsified Oil
  - Straight Oil

- Lubricity
Metalworking Fluid Functions that Can impact Processes, Quality and Total Cost

- **Lubrication**
  - Lowers Friction and enhances tool life

- **Cooling**
  - Lowers temperature of workpiece and tool
  - Allows for better part tolerance

- **Chip Removal (adds liquidity to chip mass vs. dry)**
  - Keeps chips from being re-cut
  - Keeps dust and swarf from becoming airborne

- **Rust Protection**
  - Keeps machine tool from rusting (machines are mostly steel)
  - Keeps tools (mostly steel and/or steel holders) from rusting
  - Keeps parts from rusting and/or creating dielectric corrosion
MWF Formulator’s Perspective

• The formulator has many options but also many challenges
• Each formula may contain as many as 20 ingredients
• The change or omission of any of the ingredients can change the product
• Changes in Regulating Agencies regulations can reduce the available chemistry
• This is especially true with regards to anti-microbial pesticides
• Changes in availability and cost for raw materials can adversely affect the product
• Global impact such as REACH (Registration, Evaluation, Authorization and Restriction of Chemicals)
• Performance of the product can be degraded without certain chemistry
  • It’s like trying to write a novel using only the Hawaiian alphabet (only 13 letters)

A E I O U H K L M N P W '
• The Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) is an EU regulation released in December of 2006. **REACH Compliance** is designed to improve the protection of human health and the environment through better identification of the properties of chemical substances.

• The most significant impact of REACH is to mandate chemical manufacturers and importers to determine the hazardous properties of chemicals through testing of thousands of older industrial chemicals.

• These substances will then have to be registered with the European Chemicals Agency (ECHA). REACH compliance is essential to any business looking to sell their products in Europe, and is considered to be the strictest law regulating chemical substances.
Metalworking Fluid Additives/Components of Most Concentrates or Neat oils

- Reserve Alkalinity Boosters (Amines)
- Metal Deactivators (Mostly for non-ferrous applications)
- Extreme Pressure Additives (Cl, P, S)
- Biocides or Antimicrobial Pesticides
- Coupling Agents (Glycols, glycol ethers)
- Emulsifiers (Soaps, Sulfonate, Amides)
- Lubricity Additives (Fatty esters, Polymers)
- Defoamers
- Dyes or Smell-Covering Agents (Pine Oil, Almond Extract etc.)
- Anti-mist Additives
- Whetting Agents
- Corrosion Inhibitors (Mostly ferrous)
- Anti-Oxidants (Primarily Neat Oils)
MWF Formulator’s Perspective

Example: Cost to formulate one gallon of concentrate – Soluble Oil

- Group 2 Base Oil $ 5.45
- Reserve Alkalinity Booster $ 1.25
- Metal Deactivators $ .65
- Extreme Pressure Additive $ 1.54
- Biocide $ .85
- Coupling Agent $ .40
- Emulsifier $ 1.23
- Lubricity Additive $ 1.10
- Defoamer $ .74
- Dye $ .10
- Anti-mist Additive $ .40
- Whetting Agent $ .32
- Corrosion Inhibitor $ .64
- TOTAL COST $ 14.67

August 2016
MWF Formulator’s Perspective

Example: Cost of base oil increases 20%

- Group 2 Base Oil $6.54
- Reserve Alkalinity Booster $1.25
- Metal Deactivators $0.65
- Extreme Pressure Additive $1.54
- Biocide $0.85
- Coupling Agent $0.40
- Emulsifier $1.23
- Lubricity Additive $1.10
- Defoamer $0.74
- Dye $0.10
- Anti-mist Additive $0.40
- Whetting Agent $0.32
- Corrosion Inhibitor $0.64
- TOTAL COST $15.76

September 2016
### MWF Formulator’s Perspective

**Example: Raw material supplier (5) increases price by 10%**

<table>
<thead>
<tr>
<th>Material</th>
<th>Price</th>
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</thead>
<tbody>
<tr>
<td>Group 2 Base Oil</td>
<td>$ 6.54</td>
</tr>
<tr>
<td>Reserve Alkalinity Booster</td>
<td>$ 1.25</td>
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<tr>
<td>Metal Deactivators</td>
<td>$ 0.65</td>
</tr>
<tr>
<td>Extreme Pressure Additive</td>
<td>$ 1.54</td>
</tr>
<tr>
<td>Biocide</td>
<td>$ 0.85</td>
</tr>
<tr>
<td>Coupling Agent</td>
<td>$ 0.40</td>
</tr>
<tr>
<td>Emulsifier</td>
<td>$ 1.23</td>
</tr>
<tr>
<td>Lubricity Additive</td>
<td>$ 1.10</td>
</tr>
<tr>
<td>Defoamer</td>
<td>$ 0.74</td>
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<tr>
<td>Dye</td>
<td>$ 0.10</td>
</tr>
<tr>
<td>Anti-mist Additive</td>
<td>$ 0.40</td>
</tr>
<tr>
<td>Whetting Agent</td>
<td>$ 0.32</td>
</tr>
<tr>
<td>Corrosion Inhibitor</td>
<td>$ 0.64</td>
</tr>
<tr>
<td><strong>TOTAL COST</strong></td>
<td><strong>$ 16.16</strong></td>
</tr>
</tbody>
</table>

October 2016
MWF Formulator’s Perspective

**Example:** Raw material supplier discontinued emulsifier – acceptable replacement found that costs double

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Group 2 Base Oil</td>
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<tr>
<td>Reserve Alkalinity Booster</td>
<td>$1.25</td>
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<td>Extreme Pressure Additive</td>
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<td>Biocide</td>
<td>$0.85</td>
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<tr>
<td>Coupling Agent</td>
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</tr>
<tr>
<td>Emulsifier</td>
<td>$1.23</td>
</tr>
<tr>
<td>Lubricity Additive</td>
<td>$1.10</td>
</tr>
<tr>
<td>Defoamer</td>
<td>$0.74</td>
</tr>
<tr>
<td>Dye</td>
<td>$0.10</td>
</tr>
<tr>
<td>Anti-mist Additive</td>
<td>$0.40</td>
</tr>
<tr>
<td>Whetting Agent</td>
<td>$0.32</td>
</tr>
<tr>
<td>Corrosion Inhibitor</td>
<td>$0.64</td>
</tr>
<tr>
<td><strong>TOTAL COST</strong></td>
<td><strong>$17.39</strong></td>
</tr>
</tbody>
</table>

16% increase in 4 months

November 2016
MWF Formulator’s Perspective

• In a four month period, due to cost increases for raw materials (or replacement materials) the cost increased 16%

• Most of these changes are totally out of the hands of the formulator

• Explains why there are periodic price increases

• Most formulators only increase their price about half the increased cost to maintain the market at a level plane.

• Rarely do costs go down unless the formulator finds a less expensive raw material

• Regulation can also play a part in the cost – Elimination of raw materials

• Formulators are continuously faced with cost increases and reduced raw materials available on the market. It is a never-ending process of finding materials that will give the end-user the products they need for a reasonable cost.
End-User Perspective

End-User’s Coolant or Lubricant Wish List:

• Low or no VOC Content
• Clean Petroleum Content (Group 2 Base Oil)
• Extended Sump Stability
• No Biocides/Fungicides required (concentrate or tank side)
• No Secondary Amines
• High Detergency
• Low or no Foaming
• Extended tool life
• Easy maintenance (no special tools or equipment needed)
• Manageable overall cost
• Cost effective waste treatment and/or recycling
Manufacturing Costs Example A: 3 months of production

- Purchase Price of one drum **Soluble Oil Coolant** (initial) $1,200.00
- Cost of water to mix at 5% concentration $25.60
- Labor cost to mix 1100 gallons of coolant (with proportioner) $50.00
- Cost to **maintain** 5% concentration for 90 days (coolant) $1,200.00 < second barrel of coolant
- Cost of water to maintain 5% concentration for 90 days $25.60
- Defoamer $150.00
- Biocide $140.00
- Labor cost to periodically maintain concentration/stability $300.00
- Labor to remove coolant at end of useful life (90 days) $50.00
- Cost to waste-treat coolant (1100 gallons) $120.00
- Labor to waste-treat/transport waste oil (55 gallons) $100.00
- Transportation costs (initial coolant drums & waste oil) $350.00

Total Cost for 90 days use of 110 gallons of concentrate $3,711.20
End-User Perspective

Manufacturing Costs Example B: 3 months of production

- Purchase Price of one drum Semi-Synthetic Coolant (initial) $1,200.00
- Cost of water to mix at 5% concentration $ 25.60
- Labor cost to mix 1100 gallons of coolant (with proportioner) $ 50.00
- Cost to maintain 5% concentration for 90 days (coolant) $ 600.00 < second barrel of coolant
- Cost of water to maintain 5% concentration for 90 days $ 12.30
- Defoamer $ 0.00
- Biocide $ 65.00
- Labor cost to periodically maintain concentration/stability $ 75.00
- Labor to remove coolant at end of useful life (90 days) $ 0.00
- Cost to waste-treat coolant (1100 gallons) $ 0.00
- Labor to waste-treat/transport waste oil (55 gallons) $ 0.00
- Transportation costs (initial coolant drums & waste oil) $ 0.00

Total Cost for 90 days use of 81 gallons of concentrate $2,027.90

Coolant lasts 6 months

46% Less
End-User Perspective

Manufacturing Costs for one year of production:

Example A       $14,844.80
Example B       $  9,351.60  38% less
Metal Removal Fluid Selection Issues

- Sump Life
- Health & Safety
- Part Cleaning
- Waste Treatment
- Machinability
- Foaming
- Bio-Stability
- Purchase Cost
MWF Performance

• Metalworking Fluids must perform well in three major areas to be an aid to manufacturing and productivity:
  • Machinability
  • Sump Life
  • Drag Out (residue on chips)

• Other important performance characteristics:
  • Waste treatability
  • Employee Health and Safety
  • Cleanability
  • Environmental Impact
## Coolant Differences – Machinability - Titanium

<table>
<thead>
<tr>
<th>Coolant</th>
<th>Machinability Factor</th>
<th>Type</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEST NORMAL</td>
<td>1.0</td>
<td>2% Synthetic Test Base</td>
<td>2%</td>
</tr>
<tr>
<td>Semi-Synthetic C</td>
<td>1.44</td>
<td>Semi-Synthetic</td>
<td>5%</td>
</tr>
<tr>
<td>Semi Synthetic E</td>
<td>1.57</td>
<td>Semi-Synthetic</td>
<td>5%</td>
</tr>
<tr>
<td>Semi-Synthetic A</td>
<td>1.67</td>
<td>Semi-Synthetic</td>
<td>5%</td>
</tr>
<tr>
<td>Semi-Synthetic B</td>
<td>1.67</td>
<td>Semi-Synthetic</td>
<td>5%</td>
</tr>
<tr>
<td>Semi-synthetic D</td>
<td>1.67</td>
<td>Semi-Synthetic</td>
<td>5%</td>
</tr>
<tr>
<td>Semi-Synthetic F</td>
<td>1.96</td>
<td>Semi-Synthetic</td>
<td>5%</td>
</tr>
<tr>
<td>Soluble Oil A</td>
<td>2.06</td>
<td>Soluble Oil</td>
<td>5%</td>
</tr>
<tr>
<td>Synthetic C</td>
<td>2.07</td>
<td>Synthetic</td>
<td>10% *</td>
</tr>
<tr>
<td>Semi-Synthetic H</td>
<td>2.43</td>
<td>Semi-Synthetic</td>
<td>5%</td>
</tr>
<tr>
<td>Soluble Oil B</td>
<td>2.47</td>
<td>Soluble Oil</td>
<td>5%</td>
</tr>
<tr>
<td>Soluble Oil C</td>
<td>2.57</td>
<td>Soluble Oil</td>
<td>5%</td>
</tr>
<tr>
<td>Semi-Synthetic G</td>
<td>2.93</td>
<td>Semi-Synthetic</td>
<td>5%</td>
</tr>
<tr>
<td>Neat Oil A</td>
<td>3.82</td>
<td>Straight Oil</td>
<td>100%</td>
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</table>
## Coolant Differences – Sump Life

<table>
<thead>
<tr>
<th>Coolant</th>
<th>Sump Longevity Factor</th>
<th>Type</th>
<th>Concentration</th>
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</thead>
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<tr>
<td>TEST NORMAL</td>
<td>1.0</td>
<td>Synthetic</td>
<td>2%</td>
</tr>
<tr>
<td>Soluble Oil C</td>
<td>1.7</td>
<td>Soluble Oil</td>
<td>5%</td>
</tr>
<tr>
<td>Soluble Oil B</td>
<td>1.7</td>
<td>Soluble Oil</td>
<td>5%</td>
</tr>
<tr>
<td>Semi-Synthetic C</td>
<td>1.8</td>
<td>Semi-Synthetic</td>
<td>5%</td>
</tr>
<tr>
<td>Soluble Oil A</td>
<td>2.0</td>
<td>Soluble Oil</td>
<td>5%</td>
</tr>
<tr>
<td>Semi-Synthetic A</td>
<td>2.1</td>
<td>Semi-Synthetic</td>
<td>5%</td>
</tr>
<tr>
<td>Semi-Synthetic F</td>
<td>2.1</td>
<td>Semi-Synthetic</td>
<td>5%</td>
</tr>
<tr>
<td>Semi-Synthetic E</td>
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<td>5%</td>
</tr>
<tr>
<td>Semi-Synthetic B</td>
<td>2.2</td>
<td>Semi-Synthetic</td>
<td>5%</td>
</tr>
<tr>
<td>Synthetic A</td>
<td>2.2</td>
<td>Synthetic</td>
<td>10%*</td>
</tr>
<tr>
<td>Semi-Synthetic H</td>
<td>3.1</td>
<td>Semi-Synthetic</td>
<td>5%</td>
</tr>
<tr>
<td>Semi-Synthetic G</td>
<td>3.2</td>
<td>Semi-Synthetic</td>
<td>5%</td>
</tr>
</tbody>
</table>
Normal (rating of 1.0) is a control coolant
• 2% concentration of synthetic coolant (mainly rust inhibitor)

Machinability factor:
The expected tool life of standard tools beyond the normal control using standard tools, feed rates, metal removal rate, on the same CNC machine.
• A rating of 1.0 equals 26 passes

Sump longevity factor:
Amount of time the coolant lasts in the test sump before emitting a .003 reading of hydrogen sulfide with a Draeger tube system. (Hydrogen sulfide is the rotten egg smell)
• A rating of 1.0 equals 3.5 weeks
## Coolant Differences – Drag Out on Chips

Using Standard Coolant Drag-Out Test Process

<table>
<thead>
<tr>
<th>Coolant</th>
<th>Manufacturer</th>
<th>Coolant Type</th>
<th>Starting Chip Weight</th>
<th>Ending Chip Weight</th>
<th>Delta</th>
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<tbody>
<tr>
<td>Neat Oil A</td>
<td>A</td>
<td>Straight Oil</td>
<td>5875</td>
<td>6305</td>
<td>430</td>
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<tr>
<td>Neat Oil B</td>
<td>B</td>
<td>Straight Oil</td>
<td>5934</td>
<td>6341</td>
<td>407</td>
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<td>Soluble Oil A</td>
<td>B</td>
<td>Soluble Oil</td>
<td>5865</td>
<td>6172</td>
<td>307</td>
</tr>
<tr>
<td>Soluble Oil B</td>
<td>C</td>
<td>Soluble Oil</td>
<td>5922</td>
<td>6224</td>
<td>302</td>
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<tr>
<td>Soluble Oil C</td>
<td>B</td>
<td>Soluble Oil</td>
<td>5987</td>
<td>6264</td>
<td>277</td>
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<tr>
<td>Soluble Oil D</td>
<td>D</td>
<td>Soluble Oil</td>
<td>5794</td>
<td>6045</td>
<td>251</td>
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<td>Semi-Synthetic</td>
<td>5823</td>
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<td>K</td>
<td>Synthetic</td>
<td>5694</td>
<td>5792</td>
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## Coolant/Lubricant Comparison

<table>
<thead>
<tr>
<th>Coolant</th>
<th>Machinability</th>
<th>Sump Life</th>
<th>Drag Out</th>
<th>Cleaning</th>
<th>Toxicology</th>
<th>Waste Treatment</th>
<th>Foaming</th>
<th>Bio-Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neat Oil A</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>1</td>
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<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>1</td>
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<tr>
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<td>2</td>
<td>3</td>
<td>4</td>
<td>4</td>
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<td>3</td>
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<td>3</td>
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<tr>
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Coolants/Lubricants scored 1 – 5 based on performance. 5 is best
## Coolant/Lubricant Comparison  4’s and 5’s

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Coolants/Lubricants scored 1 – 5 based on performance. 5 is best
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Sorted based on total score
Regulating Agency Perspective

• The goal and challenge for regulating agencies is to protect the people, environment and workers from hazards related to industrial manufacturing.

• They must balance the risks involved with chemicals and practices to protect and preserve our natural resources along with the impact to our industry.

“If…a chemical substance or mixture…presents or will present an unreasonable risk of injury to health or the environment, the Administrator shall by rule apply…requirements…to the extent necessary to protect adequately against such risk using the least burdensome requirements.”
TSCA Sec. 6(a) 15 U.S.C. 2605
Regulating Agency Perspective

In the United States and Canada the four main agencies that regulate MWF’s are:

- EPA – Environmental Protection Agency
- OSHA – Occupational Safety and Health Administration
- NIOSH – The National Institute for Occupational Safety and Health
- OSH – Canadian Centre for Occupational Health and Safety

In addition, many states, counties and cities have implemented regional requirements and/or regulations.

For Example:  Washington State - WISHA – Washington Industrial Safety & Health Act
  DOSH – Division of Occupational Safety and Health
  King County - DPH – Department of Public Health
  Seattle - SDPH – Seattle Department of Public Health

Metalworking Fluid End Users & Suppliers must potentially adhere to 7 different agencies
Businesses and Industries that come into contact with MWFs are all impacted by various regulations:

<table>
<thead>
<tr>
<th>Regulation</th>
<th>Raw Material Suppliers</th>
<th>MWF Formulators</th>
<th>MWF Transporters</th>
<th>MWF Distributors</th>
<th>MWF End-Users</th>
<th>MWF Waste Haulers</th>
<th>MWF Disposers</th>
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Chemicals Banned by EPA - TSCA

• Polychlorinated Biphenyls (PCBs) 1978
• Fully Halogenated Chlorofluoroalkanes (aerosol sprays) 1978
• Dioxin (about 75 chemicals of this class) 1980
• Asbestos 1989
• Hexavalent Chromium (Erin Brockovitch) carcinogen 1990

• Mixing Nitrites with: (metalworking fluids) 1984
  • Mixed mono and diamides of an organic acid
  • Triethanolamine salts of a substituted organic acid
  • Triethanolamine salt of tricarboxylic acid
  • Tricarboxylic acid
• Short Chained Chlorinated Paraffins 2004

• UNDER REVIEW
• Medium & Long Chain Chlorinated Paraffins
• Secondary Amines
• Formaldehyde and Acetaldehyde
Topics covered in Manual

- Health Effects
- Engineering and Work Practice Controls
- Personal Protective Equipment (PPE)
- Establishing a MWF Management Program
- Instituting An Exposure Monitoring Program
- Medical Monitoring of Exposed Employees

Waste Treatment Perspective

• Most oils and/or additives in MWFs will eventually be treated and/or separated from the water content.

• Many methods are used to accomplish this

• Some chemicals cannot be removed from water and are banned

• The end-user must comply with the EPA’s RCRA (Resource Conservation and Recovery Act)

• Many jurisdictions have discharge standards and regulations
Waste Treatment Perspective

- Sewer discharge standards restrict pH, “oil and grease”, solids, metals and other components. These standards vary from place to place but some typical effluent criteria are:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sewer Limit</th>
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<tr>
<td>COD (Chemical Oxygen Demand)</td>
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<tr>
<td>TSS (Total Suspended Solids)</td>
<td>250 ppm (max)</td>
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<tr>
<td>pH</td>
<td>6.0 – 9.0</td>
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<tr>
<td>Oil and Grease</td>
<td>10 – 100 ppm (max)</td>
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<tr>
<td>Metals</td>
<td>Varies</td>
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<tr>
<td>Other Inorganic compounds</td>
<td>Varies</td>
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</table>
Waste Treatment Perspective

Treatment Methods for metalworking fluids effluent:

• **Physical Treatment**
  • Evaporation is a standard method to remove the water from the mixed effluent. Either natural evaporation (which can take a long time) or elevated temperature evaporation (using a heater). Air discharge permits are required if using a heat evaporator.

  • Membrane Separation is another method of separating the solids and oils from the effluent. Ultra-filtration and Reverse Osmosis are common methods using a membrane (usually less than 2 microns).

• **Chemical Treatment**
  • Using inorganic chemicals like aluminum sulfate or ferric chloride to “break” the emulsion between the oil and water. Once separated the oil naturally floats to the surface for skimming.

• **Biological Treatment**
  • Using natural occurring bacteria to consume the oily residue of spent metalworking fluids is a common secondary or tertiary method of reducing the contaminates left over from a chemical treatment. NOTE: very smelly
Waste Treatment Perspective

- The End-user is almost always impacted by the cost of treating waste MWF
- Reducing the frequency and volume of MWF changes is critical to lowering cost and impact to the waste stream.
- Use products that last longer and still give acceptable performance
- Waste treatment costs will continue to rise
- Elimination of harmful chemistry makes the job of the waste-treatment easier
- Hundreds of waste treatment employees get sick or injured due to the toxicity
Market Trends:
U.S. metalworking fluids market volume, by product, 2012 - 2022 (Metric Tons)

(source – grandviewresearch.com)
Summary

- Each player in the Metalworking Fluids industry has a unique perspective.

- The MWF formulator is under constant pressure to produce products that enhance productivity for their customers. Regulations and changes in raw material availability will mean continuous change/improvement.

- Regulating agencies are continuously monitoring the industry and the products or ingredients used in Metalworking Fluids. Their goal is to minimize or eliminate chemistry that is harmful to the environment or health of workers and citizens.

- End users of Metalworking Fluids are continuously looking for products that will help them be more productive, lower costs and keep their workers and environment safe. Changes that are passed down from Raw Material manufacturers and in turn from Formulators can impact their productivity.

- Waste Treatment companies and facilities face a constant battle to treat the waste from industrial effluent, much that comes from spent MWF. Reducing the volume and complexity of chemistry that flows their way will go a long way in making our environment and citizens safe.

- Meaningful discussions amongst all four main players together has been fruitful in educating each about their unique situations and to help grow the industry together in harmony instead of as adversaries.

- Metalworking fluids are an asset. They enhance productivity and allow industry to provide products faster, cheaper and reduce waste.
Thank You

"Sometimes you need to look at Life from a different perspective."
References

- TLT Magazine STLE, February, 2016  EPA and Chlorinated Paraffins
- EPA Premanufacture Notification TSCA review of Medium Chain & Long Chain Chlorinated Paraffins
- Metalworking Fluids (MWFs) for Cutting and Grinding - Elsevier B.V  2016
- Selecting the Perfect Metalworking Fluid, Tribology and Lubrication Technology Mag. March, 2009