

Stephen L. Gauthier

Metalworking Fluids Consultant and Advisory for IUE/CWA

Introduction

End Users Perspective:

"Machinists, Operators and Employers"

Machinists are usually well aware of the safety hazards associated with operating machines. But less known, are the health hazards associated with the use of Metalworking Fluids (MWF) which are liquids used in the machining process for Cutting, Turning, Grinding, Boring, Drilling, Hobbing and Broaching etc. Their purpose is to provide lubricity in order to remove friction and control thermal-distortion by carrying away the heat, improving the machinability. At the same time they extend tool life, reduce power consumption and move metal chips.

Problem

Metalworking fluids may also contain other substances such as emulsifiers, stabilizers, corrosion inhibitors, biocides, fragrances and extreme pressure additives. These complex mixtures are very useful but can cause a variety of health problems such as; Dermatitis, Asthma, Hypersensitivity Pneumonitis (HP). Metalworking fluids also form a mist of small droplets that are suspended in the air and can be inhaled and ingested. When these fluids form into a mist during the machining process, they can be very irritating to the eyes, nose and throat. The larger droplets can pass into the nose and windpipe and can be swallowed. The smaller droplets can deposit in the lungs. The inhalation of Metalworking Fluids mist, vapors and smoke over time may cause Asthma, HP and evidence has suggested that in the long term they may lead to lung cancer. "Past hazard, current danger". The repeated exposures to these insoluble fluids may also cause sensitization. The Aerosolization of other contaminants that are present in the MWF sumps may pose a greater threat than the mineral oil itself, the adverse health affects are not currently being researched. Metalworking fluids are toxic and extremely hazardous and are exposed to an innumerable amount of people during the course of a single day. Minimal action is currently being taken to protect individual employees as well as our environment from these detrimental effects MWFs bring about.

Acute Health Hazards

are those whose effects occur immediately or soon after you come in contact with them.

Immediate → Many Years

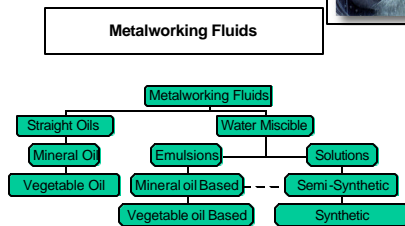
ACUTE

Immediate → Many Years
CHRONIC

Chronic Health Hazards

are those whose effects take years or decades to occur after many exposures.

Overview

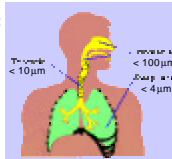


This Poster will provide insight and information about Oil Mist:

- Oil mist generation points
- Oil mist vapors
- Oil Mist residue on horizontal and vertical surfaces
- Oil mist entrainments
- Equipment design problems
- Lack of Fluid Management

Aerosolization and Atomization of:

- Mineral oil
- Bacteriological content
- Particulate matter
- Metal fines
- Grind swarf
- Vapors condense to form mist

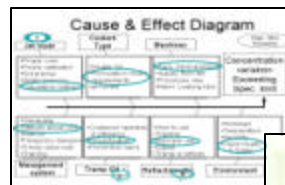


Inhalation:

Is the most common route of exposure for most health hazards. This includes breathing in dust, fumes, oil mist, metal particulate and vapors from solvents and various gases.

Methods

1. Analysis of 32 stand alone machines: turn, drill and mill
 - a. Observation
 - b. Data collection
2. Analysis of 160 samples from stand alone machines

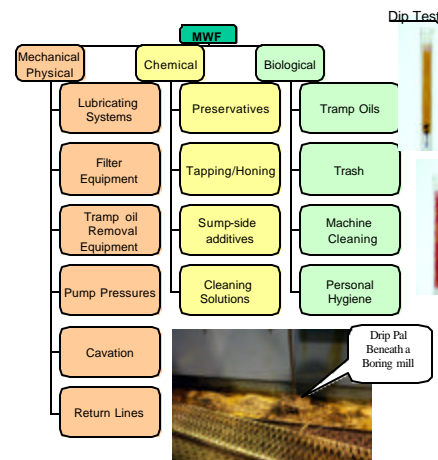


Basic MWF Tools



Results

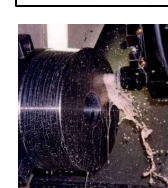
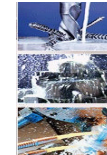
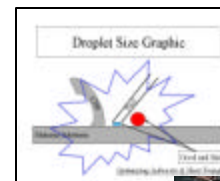
Influencing Factors



Dip Test



Drip Pal
Beneath a
Boring mill



How Does Mist Behave?
Most stays airborne

Particle size (µm)	Settling velocity (cm/s)
1000	0
100	0.0
10	0.000
1	0.00007
0.1	0.000002

Results – cont'd

Oil Mist Generation

Machine Tool

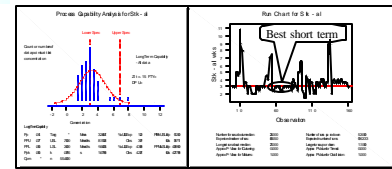
- machine controls
- + spindle RPM
- + wheel SPFM
- + lubrication cycles
- + enclosures/door opening

MWF delivery application

- flood, poured, sprayed
- pump pressure
- chip blasters
- nozzle size
- distance from part
- compressed air

MWF sumps/tanks

- Incorrectly sized (turn-over rate)
- temperature heat carry-off



Analysis of 32 stand alone machines:

- Conc. varied 2% -18% Make-up at 1.5% - 7%
- Tramp Oil min. 1% Max 10%

Analysis of 160 data points, stand alone machines:

- Machines 66% Tramp Oil 16% pH 18%

Conclusions

The evaluation has shown that, machine controls, tramp oil, MWF concentration, and sump side additives must be maintained to minimize the inhalation of mineral oil mist and the contaminants carried.

Adopting a Standard Operating Procedure will resolve many of the common every day problems and provide resources for other issues.

The competitive and proprietary nature of the MWF companies has prevented the open study for an accurate assessment. Also Non-Aqueous components (added Biocides) can become a fine aerosol entering the breathing zone as well.

References

- 1 BGI, Incorporated Aerosol Science and Technology Waltham Massachusetts
- 2 UAW Health and Safety Department (United Auto Workers)
- 3 Solutions Metalworking Fluids Awareness Training Consultant Salem New Hampshire