

Metalworking fluids

Metalworking fluids (MWFs) are used in the cutting, machining, and grinding of metal parts to cool and lubricate tools and workpieces, wash away the removed metal, prolong tool life, and prevent corrosion of the workpiece being manufactured. In small operations, the fluid usually flows by gravity to an individual sump located near each machine where it is filtered and pumped to the point of operation. Fluid is sprayed, dripped or flooded over the tool and the workpiece. Larger operations often use a central system that provides fluid via piping to each machine; troughs in the floor return used fluid to a central reservoir.

The application of MWFs can create airborne mists when the fluid hits the rapidly spinning tools or parts, or when it hits a hot tool and is vaporized, cooled, and forms a mist. Uncontrolled, these small water droplets can become airborne and be inhaled by workers.

MWFs are generally divided into two categories: straight oils (neat oil, petroleum-based oil) and water based. Water based MWFs include soluble oils, semi-synthetics, and synthetics (the only MWF with no petroleum oil). In manufacturing today, the greatest demand is for the semi-synthetics.

Water-based MWFs may be formulated with up to 20 chemicals, including an emulsion of oil, water, and additives such as amines, esters, biocides (chemicals that kill mold and bacteria), corrosion inhibitors, emulsifiers, and anti-foaming agents. Many of the ingredients found in MWF are irritating to unprotected skin. Skin contact can occur not only when the machine is running but when an operator is setting it up, filling reservoirs, mounting or removing parts, changing cutting tools, or maintaining the machine.

Hazardous ingredients

Some MWFs may contain hidden hazards:

- Ethanolamines, including monoethanolamine, diethanolamine, and triethanolamine. Irritating to the skin, these chemicals may contribute to dermatitis and asthma in workers. Under certain operating conditions, they may convert to nitrosamines, which are known carcinogens.
- 1,3,5, tris(2-hydroxyethyl)-s-triazine and Tris(hydroxymethyl) nitromethane, biocides, will release formaldehyde (a carcinogen) when in contact with biological materials.
- IPBC short for 3-ido-2-propynyl-butylcarbamate, a fungicide that is toxic if inhaled.
- Boric acid, added as a rust inhibitor or a biocide, may damage fertility and the unborn child.
- Isothiazolinones, added as a biocide at low concentrations, are sensitizing substances and can cause allergies to the worker's skin or respiratory tract.
- Morpholines, used as biocides can cause possible skin sensitization.

MWF can become contaminated

During use, MWFs can be contaminated with substances from the manufacturing process including tramp oils, hydraulic fluids, and particulate matter.

Water-based metalworking fluids can also support microbial growth, including bacteria and fungi. Though the risk of direct infection of a worker is very small, exposure to these organisms or the endotoxins may produce illness or allergic sensitivity when inhaled or with skin contact.

What are the health hazards?

Workers exposed to MWFs may develop a variety of occupational illnesses. Respiratory conditions include hypersensitivity pneumonitis (HP), chronic bronchitis, impaired lung function, and asthma. Dermatologic exposures are most commonly associated with, but not limited to, allergic

and irritant dermatitis (skin rash). In addition, substantial evidence shows that past exposures to some metalworking fluids, no longer used today, were associated with increased risk of some types of cancer.

Can we measure the hazard?

Oil mist in air can be measured by an industrial hygienist who will compare levels to the National Institute for Occupational Safety and Health's recommended exposure limit (REL) of 0.4 milligrams per cubic meter (mg/m³) air (thoracic particulate mass) or 0.5 mg/m³ air (total particulate mass), as a time-weighted average concentration for exposures up to 10 hours a day, 40 hours a week. The REL is intended to prevent or reduce respiratory disorders.

How can exposures be prevented?

Substitution

Check the Safety Data Sheet (SDS) for the MWF used. If the SDS indicates it is a skin or respiratory sensitizer, or the MWF causes cancer or damages fertility, discontinue use and select a less hazardous MWF.

Engineering controls

Splash guards or enclosures should be installed around high-speed cutting machines to protect the operators.

A well designed and maintained local exhaust ventilation system to capture mist can eliminate most airborne hazards. Although best if professionally designed and installed, off-the-shelf mist collectors are also available. Commonly used systems are multi-stage fiberglass V-bag mist collectors and centrifugal-type collectors that use a rotating drum to spin out the oil. One type of system does not work on all types of MWF. Ventilation systems should be cleaned and tested periodically to ensure they work as designed.

Administrative procedures

Improvements in MWF maintenance and handling can also reduce exposure. Water-based MWF concentrations in the machine should be maintained at the dilution level recommended by the manufacturer. MWFs that are too "rich" are more irritating to the skin. MWFs that are too "lean," may be more susceptible to microbial growth. Coolants with heavy biological contamination or slime should be discarded and replaced as biocides can be used to prevent bacterial growth but cannot kill existing bacteria.

Many companies recycle oil with equipment designed to remove tramp oils by skimming the oil from the top of sump tanks. Sumps that smell or MWFs that show major changes in their physical characteristics, such as low pH or color changes, should be changed out.

Personal Protective Equipment

Workers should keep MWF off their skin. The type of PPE used should be based on a hazard assessment for the equipment and MWF used. Glove use may not be suitable for some operations, particularly if rotating machinery can snag gloves and cause injury. Maintenance personnel who handle concentrated coolants and/or biocides should also be evaluated.

Personal Hygiene

Workers should clean contaminated skin regularly with mild soap, clean water and soft towels. Scouring and harsh soaps should be avoided because they can scratch the skin and make it more susceptible to absorption of MWF.

Resources

1. Donaldson Torit, Mist Collection of Metalworking Fluids, How to Control, Contain, and Filter Coolant & Oil Mist, A Technical Reference Guide.