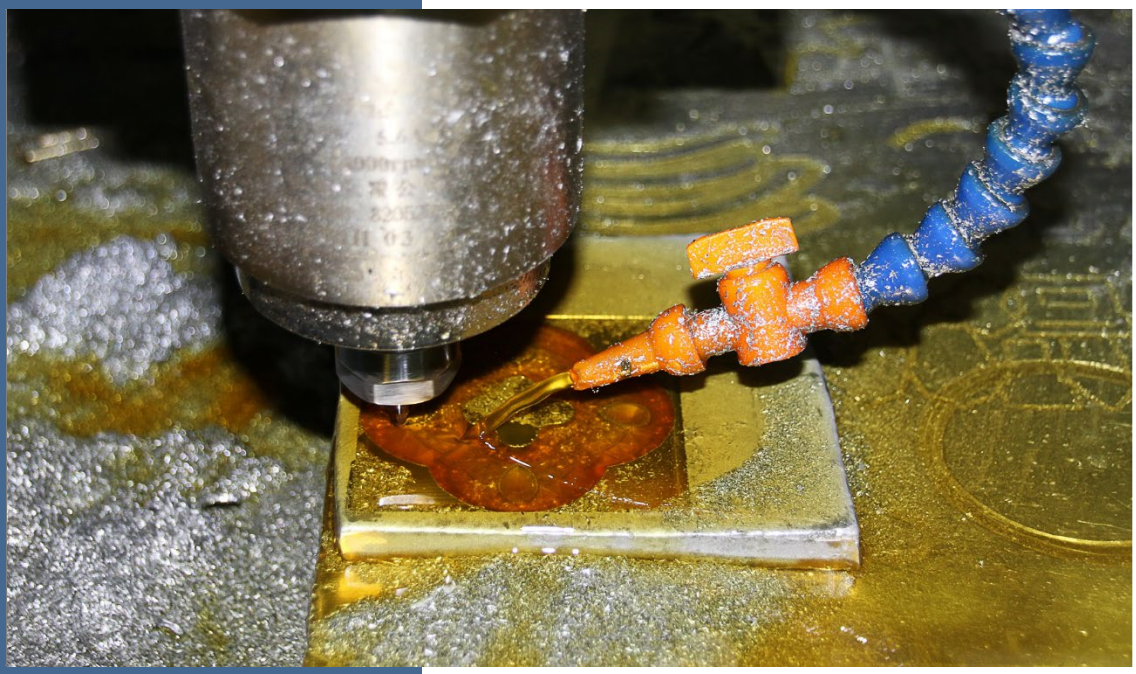

Pollution Prevention Practices for Metalworking Fluids

Hazardous Waste and Toxics Reduction Program

Washington State Department of Ecology

Olympia, Washington

November 2021, Publication 21-04-006

DEPARTMENT OF ECOLOGY
State of Washington

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Related Information

- Publication 96-414: Evaporation: Treatment Specific Guidance[1]
- Publication 20-04-010: Counting Dangerous Waste Under the Dangerous Waste Regulations[2]
- Publication 20-04-041: Focus on: Domestic Sewage Exclusion[3]

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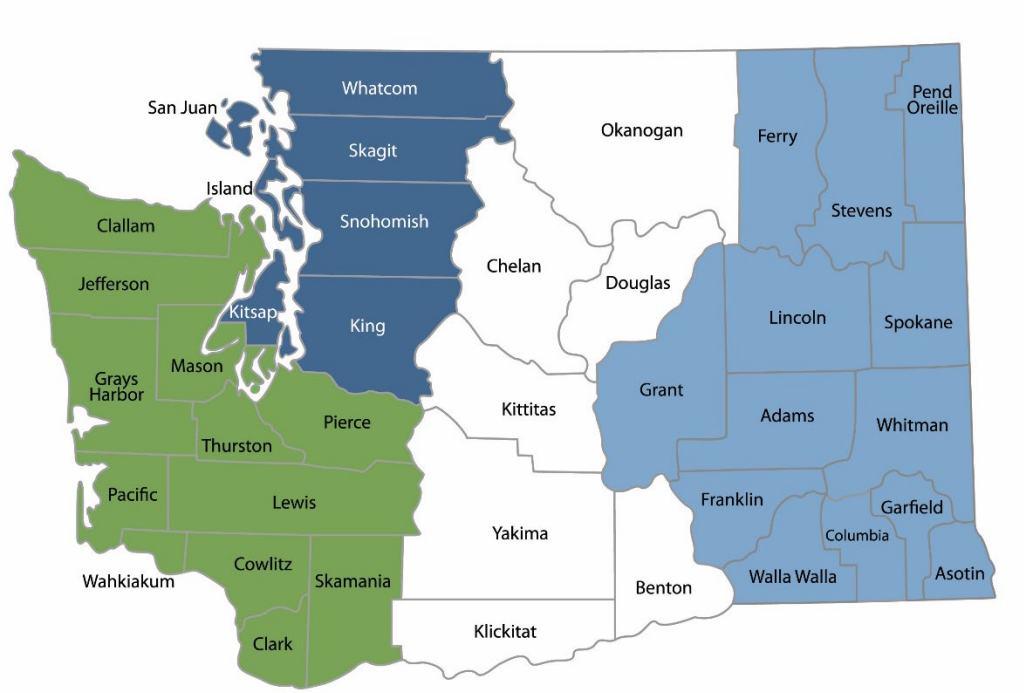
[1] https://apps.ecology.wa.gov/publications/summarypages/96414.html
[2] https://apps.ecology.wa.gov/publications/SummaryPages/2004010.html
[3] https://apps.ecology.wa.gov/publications/SummaryPages/2004041.html
[4] https://ecology.wa.gov/contact
[5] http://ecology.wa.gov/accessibility

Department of Ecology's Regional Offices

Map of Counties Served



Southwest Region 360-407-6300	Northwest Region 206-594-0000	Central Region 509-575-2490	Eastern Region 509-329-3400

Region	Counties served	Mailing Address	Phone
Southwest	Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Mason, Lewis, Pacific, Pierce, Skamania, Thurston, Wahkiakum	PO Box 47775 Olympia, WA 98504	360-407-6300
Northwest	Island, King, Kitsap, San Juan, Skagit, Snohomish, Whatcom	PO Box 330316 Shoreline, WA 98133	206-594-0000
Central	Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, Yakima	1250 W Alder St Union Gap, WA 98903	509-575-2490
Eastern	Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman	4601 N Monroe Spokane, WA 99205	509-329-3400
Headquarters	Across Washington	PO Box 46700 Olympia, WA 98504	360-407-6000

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DEPARTMENT OF
ECOLOGY
State of Washington

Table of Contents

Introduction

This guide explains how to reduce waste, prevent pollution, and manage spent metalworking fluids (MWFs) as required by the Department of Ecology.

This guide doesn't replace state or federal regulations for managing or disposing of MWFs. You're responsible for determining if any of your wastes designate as a dangerous waste. Learn more about designation on our designate your waste webpage.[7]

Pollution prevention (P2) is any practice that reduces, eliminates, or prevents pollution at its source.

If you have questions about designation, pollution prevention, or other dangerous waste topics, please contact your regional office.[8]

[6] https://ecology.wa.gov/Designation
[7] https://ecology.wa.gov/Designation
[8] https://ecology.wa.gov/contact

Selecting and Using Metalworking Fluids

There are four types of MWFs typically used at a large scale in industrial processes. Table 1 shows the fluid type, composition, advantages, and disadvantages of various MWFs.

Table 1: Types of metalworking fluids.

Fluid Type	Composition	Advantages	Disadvantages
Straight oils	Consist of: • Solvent-refined or hydro-treated petroleum oil. • Other oils of animal or vegetable origin.	• Resistant to biological degradation. • Good rust protection. • Very little maintenance required.	• Higher cost. • Difficult to clean. • Fire and health hazards.
Water-soluble oils	Contain about 50–90% water, with refined base oil and emulsifiers to mix the oil and water. Other additives commonly found in soluble oils are biocides, soaps, softening agents, and rust inhibitors.	• Good cooling capacity and lubricity.	• Require tramp oil removal. • Need a maintenance program to minimize bacterial growth.
Semi-synthetic fluids	Contain small amounts of refined base oil that are: • Micro-emulsified (5–20%). • Water. • A solution of additives. These fluids tend to be similar to water-soluble oils.	• Good cooling capacity. • Average lubricity. • Longer sump life.	• Difficult to treat. • May emulsify tramp oil. • High foaming potential. • Need a maintenance program to minimize bacterial growth.
Synthetic fluids	Aqueous (water-based) solutions that do not contain refined oil. Similar additives as seen in semi-synthetic fluids.	• Excellent cooling properties. • Longer sump life. • Good rust protection. • Clear fluid allows work piece to be visible.	• Poor lubrication. • Difficult to treat.

Metalworking fluids sometimes have high-pressure additives in them, such as chlorine, sulfur, and phosphorus compounds. These additives are sometimes referred to as extreme pressure (EP) fluids. The most common type of EP fluids are halogenated organic compounds (e.g., chlorinated paraffins).

Halogenated EP fluids have the advantage of performing well, extending the life of the product, and resisting microbial growth, but you shouldn't use them unless they're critical to your operation—they generate dangerous waste when spent. Although facilities also use sulfur and phosphorus compounds as EP additives, they're a food source for microbes that can lead to maintenance issues, and sulfur can stain metals.

If you use any fluids with these compounds, recycle and reuse them as much as possible.

P2 practices to select and use MWFs

There are many variables to consider when you select MWFs to fit your specific requirements. The following practices can limit unnecessary wastes and extend the life of your MWFs.

Use the highest quality MWF possible

High-quality MWF products will last longer, be easier to recycle, and perform better within your process.

Use an MWF that can be disposed of as used oil or that's not dangerous waste when spent

You can find a list of MWFs we've indicated will likely not generate dangerous waste when spent (see Appendix B. Metalworking Fluids Selection by Score).

Separate tramp oil

Thoroughly separate your tramp oil[9] from the MWF before you skim and remove the oil. This will reduce the amount of MWF waste generated.

Look at the compatibility of way oils and MWFs

Way oils and MWFs that separate easily help with treatment and recycling. Use a way oil that doesn't cause foaming problems or weaken the separation characteristics. High-grade way oils typically separate easily from MWF and contain few or no sulfur compounds (sulfur is a food source for bacteria).

[9] Tramp oil is most commonly made up of way oil (the lubrication used for the sliding parts of the machine) and hydraulic oils that fall into or are carried into the metalworking fluid.

Use chlorine-free MWFs

Chlorine typically causes MWF waste to designate as dangerous, which means you must follow stringent management requirements and pay higher disposal costs.

Use distilled or deionized water

Distilled or deionized water contains little to no minerals compared to other types of water. Use it to prevent mineral buildup and reduce contamination of MWF. This will extend the life of the product and equipment.

Limit the number of MWFs

Use the smallest number of different MWFs as possible to simplify your product use and management. This can allow you to consolidate similar and compatible MWF waste and avoid needing to segregate to different storage containers.

Monitor MWF concentration

Some MWF products are mixed with water to achieve better performance. Keep the MWF and water mixture in the manufacturer's suggested range. This helps prevent gumming, sticking, or smearing from excess concentrate.

Two common ways to measure fluid concentration are:

- **Refractrometry:** Assessing the mixture's composition by measuring the refractive index.
- **Titration:** Slowly adding a reagent to the mixture to neutralize it and measuring the target constituents of concern. This is a common laboratory practice.

Monitor pH

A drop in pH could mean there is a high microbe count in the fluid or a buildup of impurities. Monitor your pH at least monthly to ensure you meet manufacturer specifications (MWFs are typically alkaline). This helps control bug growth, reduce foaming, and minimize fluid separation.

Keep a log of monitoring data

Keep a log of fluid characteristics (such as pH and concentration) to help identify trends, solve problems, and keep the fluid in the proper condition.

Maintaining MWFs

Contaminated and spoiled fluids are the largest source of machining operation waste.

A written **MWF maintenance plan** limits waste generation, ensures fluids are not prematurely contaminated and spoiled, and helps extend your fluid's life by optimizing fluid performance and reducing oily wastewater volume, fluid concentrate, and disposal costs.

Include the elements in Table 2 in your MWF maintenance plan. Use your plan to educate employees about proper MWF management.

Table 2: Key elements of an MWF maintenance plan.

Maintenance Plan Element	Directions
Operator responsibilities	List necessary tasks and responsibilities for the operator to implement a successful maintenance plan.
Monitoring and fluid testing	Explain how to monitor fluids to anticipate problems. Physical characteristics such as product concentration, pH, fluid odor, color, and texture are good indicators of fluid degradation. **Example 1: Product concentration.** Measure product concentration by using a refractometer or by titration. **Example 2: pH.** Measure the pH of the fluid with litmus paper or a pH meter. If the pH of sump fluid falls below 8.5, it loses efficiency, is prone to rusting, and significantly increases in biological activity.
Data tracking system	Include a log of observations and test data.
Sump fluid change-out criteria	Establish change-out criteria to reduce unnecessary MWF fluid disposal. Create a standard for fluid reuse. **Examples:** odor, appearance (milky appearance is normal), length of use, pH (8.4–9.4 is normal), or residue or film left on parts.
Change-out procedures	Document how to handle and process the fluid through your recycling system.
Sump cleaning	Explain how to remove biological growth in the sump to reduce health risks and improve fluid life. **Examples:** steam clean or use a disinfectant solution.
Chip removal	Document chip removal frequency and procedure. This reduces the habitat for biological organisms in your sumps.

P2 practices to include in your MWF maintenance plan

Inspect daily

Conduct daily inspections of each machine to identify problems early and make repairs quickly. This contributes to less downtime and less fluid waste.

Add biocide if needed

If other methods don't work, a biocide or fungicide can help extend the life of water-based MWFs. Use these additives sparingly and only as a last resort as some biocides contain chlorinated compounds. Test spent fluids that contain biocides to determine if they are a dangerous waste.

Keep MWF cool

Keep MWF cool to slow the growth of microbes in the sumps and fluid areas.

Wash hands to reduce bacteria

Machinists frequently come in contact with MWFs and humans are a primary source of bacteria. Wash hands regularly to reduce the spread of bacteria.

Train operators

Limit MWF maintenance to one person or team that's trained and knowledgeable about fluid maintenance. This will reduce fluid property variances and coolant overuse.

Managing Spent MWFs

To manage dangerous waste properly, you must determine your **generator category**.

For help determining your generator category, visit our generator category webpage[10] or contact your regional Ecology office.[11]

Spent MWF containing chlorinated compounds

Spent MWF containing halogenated organic compounds must be managed as dangerous waste. You may **only** manage these spent MWFs as used oil if they meet all these criteria:

- They meet the definition of used oil.[12]
- They are sent to be re-refined into lubricant product (not fuel) as part of a tolling agreement.

You must manage spent MWFs as dangerous waste fuel if they designate as dangerous waste and are sent to be burned.[13] You must not burn spent chlorinated MWFs in improper combustion units as this can generate dioxins.

Note that the terms **chlorinated paraffins** and **chlorinated alkanes** are used interchangeably on safety data sheets.

Two parts of a safety data sheet (SDS) may contain information about chlorinated compounds. Please note that all SDSs are not always in the same format.

- Find Section 3 (composition/information on ingredients) of the SDS.
    - Look through the ingredients list for **Cl**, **chloro**, **chlorine**, or **chlorinated**. If it contains any of these, the MWF contains chlorinated compounds.
- If you don't find chlorinated compounds in Section 3 of the SDS, look in Section 10 (stability and reactivity data).
    - Find the line items titled **hazardous decomposition products** or **by-products**.
    - Look for any chlorinated compounds in the list, such as **hydrochloric acid (HCl)** or **oxides of chlorine**.

[10] https://ecology.wa.gov/GeneratorCategory
[11] https://ecology.wa.gov/contact
[12] Used oil means any oil that has been refined from crude oil, or any synthetic oil, that has been used and as a result of such use is contaminated by physical or chemical impurities. See full definition in WAC 173-303-040: https://apps.leg.wa.gov/WAC/default.aspx?cite=173-303-040.
[13] This falls under WAC 173-303-510: http://apps.leg.wa.gov/wac/default.aspx?cite=173-303-510.

Managing spent MWFs as used oil

If your spent MWF meets the definition of used oil and doesn't contain chlorinated compounds, you can manage it under WAC 173-303-515.[14] See Step 1: Determine if spent MWF can be defined as used oil in the Disposing of Spent MWF Waste section below for details.

If you manage your spent MWF as used oil:

- Manage it in a way that doesn't threaten human health or the environment. You're liable for used oil mismanagement and must report spills that threaten human health or the environment.
- Recycle of it properly. For example, using used oil as dust abatement or to control weeds is illegal.
- Keep containers closed except when adding or removing contents.
- Don't open, handle, manage, or store containers in a way that could cause the container to leak or rupture.

Managing spent MWF when it cannot be managed as used oil

Sometimes you cannot manage spent MWFs as used oil and instead must manage it as dangerous waste. Typically, you cannot manage MWFs as used oil if they contain chlorinated compounds. For guidance on how to manage spent MWF waste, see the Disposing of Spent MWF section below.

In some cases, halogenated MWF waste may not meet the definition of persistence as provided in WAC 173-303-040.[15] Please see our designation webpage[16] for further information.

[14] https://apps.leg.wa.gov/wac/default.aspx?cite=173-303-515
[15] https://app.leg.wa.gov/wac/default.aspx?cite=173-303-040
[16] https://ecology.wa.gov/Designation

Recycling Spent MWFs

A good fluid recycling system:

- Extends the useful life of MWFs.
- Improves product quality.
- Reduces the amount of new fluids purchased.
- Reduces disposal costs for spent fluids.
- Reduces downtime for machine clean outs and recharges.

Recycling systems remove contaminants such as tramp oil, dirt, and bacteria. They also readjust the fluid concentration before it's returned to an individual sump. There are two types of recycling systems: central recycling systems and individual recycling systems.

Central recycling systems (including portable systems)

These types of systems treat large volumes of fluid at once.

Central recycling systems

Commonly known as a cutting oil recycling system, a central recycling system is a large reservoir that supplies fluid to several individual machines. A major advantage of a centralized system is that contaminants can be controlled at one location.

- This makes many different systems on each machine unnecessary.
- This reduces time monitoring and maintaining the fluids.

With proper fluid controls and management techniques, fluid in a central system can typically last one to three years (or even longer).

Portable recycling systems

Portable recycling systems are a cost-effective alternative to centralized recycling systems.

This system pumps fluid from an individual sump into a portable unit that removes contaminant and returns the fluid to the sump. Then the portable system can be moved to the next machine.

If the fluid from each machine is treated according to a prescribed maintenance schedule, you may not need to monitor fluid every day.

Table 3: Contaminant removal equipment used in central recycling systems.

Equipment	Separates Oil?	Removes Dirt and Metal Chips?	Reduces Bacterial Growth?
Settling or dragout	No	Yes	No
Flotation	Yes	Yes	No
Positive filter: gravity	No	Yes	No
Positive filter: pressure	No	Yes	No
Positive filter: vacuum	No	Yes	No
Centrifuge	Yes	Yes	No
Oil skimmer	Yes	No	No
Coalescer	Yes	Yes	No
Pasteurization	No	No	Yes

Individual recycling systems

Individual recycling systems tend to control only one type of contaminant. For example, a milling machine might only have a skimmer to remove excess tramp oil.

The benefits of using individual systems are:

- Low capital costs.
- Ability to focus on one problem for a given machine.

Common individual machine recycling systems

Table 4: Attributes of media-based individual machine recycling systems.

Media-based Systems	Separates Oil?	Removes Dirt and Metal Chips?	Reduces Bacterial Growth?
Filtration	No	Yes	No
Pressure	No	Yes	No
Vacuum	No	Yes	No
Gravity	No	Yes	No

Table 5: Attributes of natural force individual machine recycling systems.

Natural Force Systems	Separates Oil?	Removes Dirt and Metal Chips?	Reduces Bacterial Growth?
Settling or gravity	No	Yes	No
Coalescers	Yes	Yes	No
Flotation or aeration	Yes	No	No

Table 6: Attributes of mechanical separation individual machine recycling systems.

Mechanical Separation Systems	Separates Oil?	Removes Dirt and Metal Chips?	Reduces Bacterial Growth?
Centrifuges	Yes	Yes	No

Table 7: Attributes of other individual machine recycling systems.

Other	Separates Oil?	Removes Dirt and Metal Chips?	Reduces Bacterial Growth?
Pasteurization	No	No	Yes
Ozonation	No	No	Yes

Common recycling components and considerations

Table 8: Common recycling equipment and their considerations.

Equipment	Description	Considerations
Settling or dragout	A simple gravity or settling tank that often adequately removes particles in many MWF systems. The tank is able to remove metal shavings and other settled solids if you add an automatic bar, rake device, or conveyer belt system.	Advantages: • No media replacement or disposal is required. Disadvantages: • Clarity is dependent on retention time and chip weight. • Not effective with aluminum chips or swarf, which tend to float.

Equipment	Description	Considerations
Flotation or aeration	A device that uses aeration to float solids and tramp oil to the surface.	Advantages: • No media replacement or disposal required. • Works on fine particles. Disadvantages: • Requires plenty of floor space. • Increases use of plant-compressed air.
Gravity filters	A filter that relies on gravity. The MWF's weight provides enough force to penetrate the filter medium. The most common gravity filters are made from cloth, paper, organics, polymer, or wire screens.	Advantages: • Low cost. • Easy to operate. Disadvantages: • Requires plenty of floor space. • Increases your media disposal.
Pressure filters	A device with two horizontal compartments: a movable top and stationary bottom. During operation, air pressure seals the two compartments together. The filter medium is a nylon belt that may or may not be coated with a disposable material.	Advantages: • Removes small particles efficiently. • Handles large volumes within minimal floor space. Disadvantages: • Prematurely plugs filters if tramp oil isn't removed first.
Vacuum filters	A common positive filter system driven by a vacuum. Fluid is pulled through a permanent roll or cylinder by the vacuum.	Advantages: • Low capital costs. • Efficient filtration. • No media replacement or disposal required. Disadvantages: • Requires plenty of floor space.

Equipment	Description	Considerations
Centrifuge	A rotating bowl that uses centrifugal force to separate oil, water, and solids. • Low-speed centrifuges remove suspended solids from most liquids. • High-speed units remove tramp oils and solids. The goal is to separate free tramp oil and loosely emulsified oil (such as mechanically emulsified oil). Chip wringers separate chips from cutting fluids by alternating high- and low-speed cycles.	Advantages: • High throughput rate (about 2 gallons per minute). • Good suspended solid and tramp oil separation. Disadvantages: • Solids and grease require frequent cleaning. • Product components can separate.
Coalescer	A device that removes tramp oil by using the oil's attraction to polypropylene media (or oil-loving materials).	Advantages: • Applicable to either central or portable systems. Disadvantages: • Not effective for removing water-miscible hydraulic oils or emulsified lubricating oils.
Pasteurization	A heating process that improves separation of solids and reduces biological growth.	Advantages: • Successfully controls microbial growth under certain conditions. Disadvantages: • Can reduce a fluid's lubricity and corrosion inhibition properties.
Filtration	A process in which fluid passes through a disposable filter to remove solid particles.	Advantages: • Enhances part finish, tool life, bacteria control, and lubricity properties. • Works best when used with central recycling systems or portable recycling units. Disadvantages: • Units on individual machines tend to be labor intensive.

Equipment	Description	Considerations
Oil skimmers	Devices that skim tramp oil from fluid reservoirs in machine sumps. The most common are belt and disk skimmers. For individual systems, a settling tank and skimmers will remove coarse particles and tramp oil.	Advantages: • Relatively inexpensive. • Often provides sufficient clean lubricant ready for reuse. Disadvantages: • Equipment maintenance can be labor intensive.
Ozonation	A process in which contaminated fluid is treated with ozone to control microbial growth.	Advantages: • Doesn't reduce fluid's lubricity. • Doesn't reduce corrosion inhibition properties. Disadvantages: • Equipment maintenance can be labor intensive. • Increased equipment footprint.

You may use portable and individual recycling systems in combination with other recycling methods. Examples include:

- A settling tank used alongside skimmers and aeration devices. This equipment can remove coarse particles by settling fine particles and skimming tramp oil for removal.
- A high-efficiency sump cleaner that removes fluids and solids from sumps. The fluid passes through a central batch recycling unit using a coalescer, pasteurization, and filtration technique, and then is returned to the sump. Other central batch combinations include:
    - Skimmers, filtration, and ozonators.
    - Skimmers and coalescers.
    - Skimmers and fluid concentration adjusters.
- A portable unit equipped with a skimmer and ozonator to treat individual sumps.
- A portable unit equipped with a coalescer, filter, and fluid concentration adjuster.
- A portable sump cleaner to transfer used fluid to a three-stage separation tank.
    - Settle out particulate.
    - Skim off tramp oil.
    - Use **portable sump cleaner** to return treated fluid to individual sumps.
- Portable units that act only as filtration units.
- A settling tank, ozonation or aeration, tramp oil skimmer, and a filter.

P2 practices for recycling systems

Skim tramp oil

Skimmers come in several different types including rope, belt, and disk skimmers. They remove the oil that makes its way into the MWF and floats on the surface of the fluid.

Oil removal helps keep the fluid aerated with dissolved oxygen and reduces the food source for microorganisms.

Aerate or ozonate the MWF to keep the dissolved oxygen level up

Aerate the MWF or use an ozone generator to bubble oxygen through the fluid. This will keep the anaerobic microbe count low.

Dissolved oxygen in the water prevents anaerobic bacterial growth. MWF treated with dissolved ozone reduces the microbe count because ozone is highly toxic to microbes and kills them.

Use central recycling systems

Central recycling systems treat large volumes of fluid at once. Small-wheeled versions (about the size of a large shopping cart) are available. A good recycling system includes a settling tank, oil skimmer, coalescer, and aeration device.

Recycling of Spent MWFs

If your MWF is no longer usable, you must evaluate and recycle of it properly. Follow the steps described below. See a visual summary of them in the spent metalworking fluid disposal flowchart.

Step 1: Determine if spent MWF can be defined as used oil

Used oil is any oil refined from crude oil—or any synthetic oil—that's been used and, as a result, is contaminated by physical or chemical impurities.[17]

Not all MWFs are formulated from crude oil or synthetic oil, in which case they don't meet the definition of used oil.

Step 2: Determine if spent MWF is formulated with persistent chlorinated compounds

Use generator knowledge (such as SDS information) and/or testing to determine if the MWF is made with chlorinated compounds. This group of MWFs cannot be burned for energy recovery under the used oil management standards (WAC 173-303-515).[18] See the spent MWF containing chlorinated compounds section for details.

If you don't know if the spent MWF is formulated with persistent chlorinated compounds, ask the manufacturer's tech support if it contains chlorinated parrafins or alkanes, or send a sample to a laboratory to test for chlorinated compounds. Keep a written record of the following at your facility:

- Name and telephone number of the person performing the test.
- Sampling date.
- Equipment calibration date.

All written test records should be kept on site for five years.

Step 3: Determine if spent MWF was mixed with any other waste stream

Spent MWF mixed with any other waste stream cannot qualify as used oil under the used oil management standards (WAC 173-303-515).[18]

You can avoid the problems associated with mixed waste streams by restricting container access and by training employees to keep waste streams separate and to properly label containers.

[17] See full definition in WAC 173-303-040: https://apps.leg.wa.gov/WAC/default.aspx?cite=173-303-040.
[18] https://app.leg.wa.gov/WAC/default.aspx?cite=173-303-515

If spent MWF is mixed with another waste stream (such as mop water or antifreeze), you must designate the resulting mixture to determine if it's a dangerous waste. Use process knowledge and SDSs to develop a complete list of chemicals in the mixture. You might also need to send a sample to a lab to test for lead, cadmium, chromium, selenium, total halogens, and any other suspected contaminants.

Step 4: Determine if MWF is derived from animal or vegetable oils

Spent MWFs that contain animal or vegetable oils don't meet the definition of used oil[19] and are subject to designation under the dangerous waste regulations.[20]

Step 5: Determine if MWF has more than 1,000 ppm total halogens

MWFs that define as used oil and also contain more than 1,000 ppm total halogens are presumed to be mixed with chlorinated hazardous waste listed in WAC 173-303-9903 and 173-303-9904. You may **rebut the presumption**[21] by demonstrating the MWF doesn't contain significant concentrations of listed chlorinated constituents due to mixing. A significant concentration of a single listed chlorinated constituent mixed with used oil is 100 ppm.

Rebutting the presumption requires meeting these criteria:

- Collect a representative sample of the MWF containing more than 1,000 ppm total halogens and send to a laboratory.
    - If test results show a concentration of 100 ppm of a single listed hazardous constituent, then the entire mixture will designate as a listed dangerous waste.
    - If the test results show each listed hazardous constituent mixed with used oil has a concentration less than 100 ppm, then the presumption that it designates as a dangerous waste is rebutted and it can be managed as used oil.
- The source of the halogens is the MWF itself. A safety data sheet (SDS) can show this.
- You don't use products that introduce chemicals listed in WAC 173-303-9903[22] and -9904[23] into the MWF.
- You manage other waste streams to prevent mixing.

[19] The definition of used oil excludes animal and vegetable oils (e.g., lard, canola, etc.)
[20] https://apps.leg.wa.gov/wac/default.aspx?cite=173-303
[21] This is a term used in the dangerous waste regulations. Halogenated dangerous waste constituents are listed in WAC 173-303-9903 and -9904.
[22] https://apps.leg.wa.gov/wac/default.aspx?cite=173-303-9903
[23] https://apps.leg.wa.gov/wac/default.aspx?cite=173-303-9904

Determine if spent MWF has more than 10,000 ppm total halogens

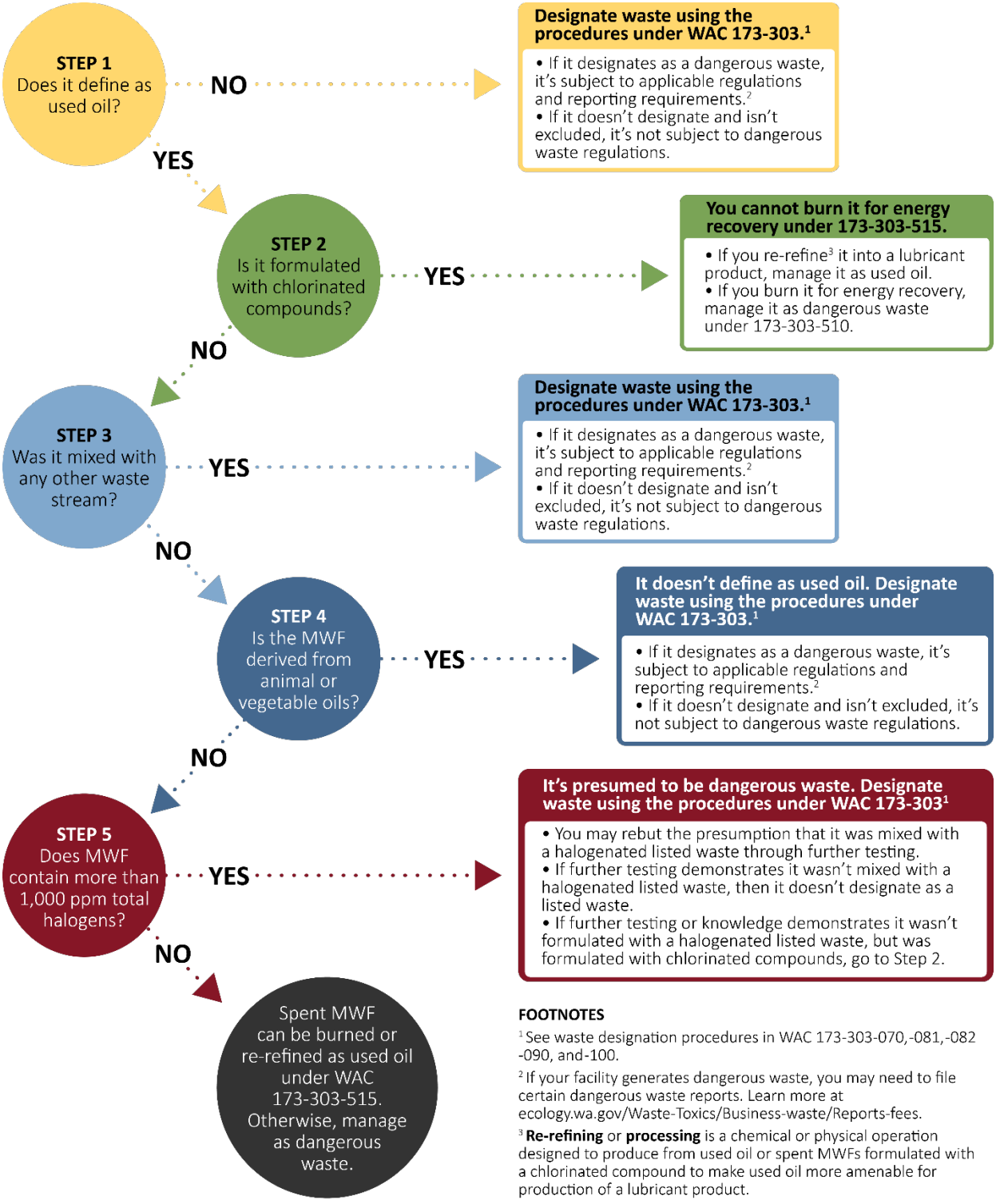
MWF waste with more than 10,000 ppm total halogens designates as extremely hazardous waste (EHW) under WAC 173-303-100.[24] MWF designating as an EHW is subject to all applicable requirements of the Dangerous Waste Regulations.

Water-soluble MWFs typically contain less than 10,000 ppm total halogens unless they are evaporated or mixed with other halogenated waste streams (e.g., chlorinated compounds). See the evaporating spent MWFs section for more information about evaporation.

[24] https://apps.leg.wa.gov/wac/default.aspx?cite=173-303-100

Spent metalworking fluid disposal flowchart

A visual summary of steps 1–5.



FOOTNOTES

[1] See waste designation procedures in WAC 173-303-070,-081,-082 -090, and-100.

[2] If your facility generates dangerous waste, you may need to file certain dangerous waste reports. Learn more at ecology.wa.gov/Waste-Toxics/Business-waste/Reports-fees.

[3] **Re-refining** or **processing** is a chemical or physical operation designed to produce from used oil or spent MWFs formulated with a chlorinated compound to make used oil more amenable for production of a lubricant product.

Evaporating Spent MWFs

If you generate spent water-based MWF, you may wish to reduce waste volume and disposal costs by evaporating water from this waste stream. Water-based MWFs include soluble, synthetic, or semi-synthetic fluids (but not straight oils). Water-based fluids usually contain non-volatile substances and therefore can typically be evaporated.

Don't exceed air quality standards when building and operating an evaporator as poor air quality can cause health concerns and potential worker or neighbor complaints, and may draw undesired regulatory attention. Evaporation of anything other than water could be discharge of dangerous waste to the environment.

You must follow all of these conditions when using an evaporator unit that's designed to remove water from non-volatile wastes:

- Only evaporate aqueous (water-based) wastes containing non-volatile organic substances, such as water-based MWF, rinse water, and water-based coolants.
- Don't evaporate volatile organic solutions, such as solvents, paints, oils, or aqueous wastes containing straight oil MWF.
- Don't evaporate to dryness. Soluble spent MWF is typically 95 percent water and 5 percent additives (oil, surfactants, etc.). If you evaporate to dryness, the emulsion portion will also be evaporated and may emit toxic air pollutants. Excessive evaporation also forms a baked-on residue that is very difficult to clean.
- Designate and dispose of remaining sludge properly. The concentrated sludge commonly designates as dangerous waste.
- Use secondary containment around the evaporator to catch spills.

Please note that this is a form of waste treatment and is subject to dangerous waste regulations. To avoid needing to obtain a Treatment, Storage, and Disposal (TSD) permit, you must follow Treatment by Generator regulations.

Evaporation example

Alpha Company needs to dispose 100 gallons of spent soluble machine coolant. The spent coolant contains:

- 5% tramp oil (5 gallons).
- 5% emulsified napthenic oil, chlorinated paraffins, and metals (5 gallons).
- 90% water (90 gallons).

They place the spent coolant into an oil-water separator to remove the 5 gallons of tramp oil. Then they place the remaining 5 gallons of emulsified compounds and 90 gallons of water into an evaporator. They should only evaporate 95% of the total amount of water. In other words, the company must leave 5% of the water in the evaporator (about 4.5 gallons). Otherwise, compounds will volatilize, creating toxic air pollution.

Alpha Company removes 9.5 gallons (5 gallons emulsified compounds and 4.5 gallons water), designates it, and disposes of it properly.

Evaporation equipment maintenance

"Clean" the solution as much as possible before evaporation. This will minimize toxic air pollutant evaporation and prevent the evaporator and associated piping from corroding. Evaporation of anything other than water could be discharge of dangerous waste to the environment.

For spent MWF, this means you should use an oil-water separator before evaporation. Skim oil from the oil-water separator and collect it for disposal. Note: oil-water separators do not remove emulsified additives from MWFs.

At the end of the evaporation process, remove and dispose of the concentrated emulsion properly.

- **Service the evaporator at regular intervals and keep a service log.** Make one person responsible for keeping the log current and performing work as required.
- **Carefully regulate the operating temperature of the evaporator.** Use the lowest temperature possible to avoid vaporizing toxic air pollutants. Water in soluble MWF boils at 212 degrees Fahrenheit at sea level and at slightly lower temperatures at higher elevations. Set and "lock" temperature controls at or below 212 degrees Fahrenheit, as appropriate.
- **Make sure the evaporator has emergency temperature and water level shutoffs.** To prevent a potential fire at your facility, set the emergency high temperature shutoff to no more than 230 degrees Farenheit and the low-level water shutoff at five percent of capacity.
- **Properly size mist eliminators.** High velocity airflows create water droplets that suspend metals and other toxic air pollutants in the exhaust air stream. Suspended pollutants will be carried out of the stack unless they're trapped by a mist eliminator. Ask your vendor to make sure your evaporator has a properly sized mist eliminator.

Air pollution control authorities[25] regulate evaporation processes that emit toxic air pollutants. Some toxic air pollutants that might be found in spent MWFs include:

- Cadmium compounds
- Lead compounds
- Aluminum
- Borates
- Chromium (II, III, VI, and metal)
- Iron oxide fume (Fe2O3)
- Copper
- Tin
- Oil mist (mineral)
- Iron salts
- Selenium
- Zinc

[25] https://ecology.wa.gov/Air-Climate/Air-quality/Business-industry-requirements

Currently, there is no toxic air pollutant minimum that will exempt you from regulatory review.

We explain how to evaporate spent MWF that designates as dangerous waste in our Evaporation: Treatment Specific Guidance focus sheet.[26] Treatment by generator requirements include:

- **Following rules for managing dangerous waste.** For example, containers used to hold dangerous waste must have secondary containment and be labeled "Dangerous Waste" and "Toxic." Refer to our manage your waste webpage[27] for more information.
- **Counting the spent MWF towards your generator category before and after it's placed in the evaporator.** You must log the pounds of dangerous waste you evaporate. Refer to our Counting Dangerous Waste Under the Dangerous Waste Regulations publication[28] for guidance on the counting rules.

[26] https://apps.ecology.wa.gov/publications/summarypages/96414.html
[27] https://ecology.wa.gov/Waste-Toxics/Business-waste/Manage-your-waste
[28] https://apps.ecology.wa.gov/publications/SummaryPages/2004010.html

Finding a MWF That Isn't Dangerous Waste

Metalworking Fluid Selection by Score

We have no control over how Washington businesses manage their metalworking fluids. For this reason, you are responsible for designating your spent metalworking fluid as required by WAC 173-303. Machine shop managers often want to switch to a MWF that doesn't need to be managed as dangerous waste. We developed a list of alternative MWFs that you can likely manage as used oil when it is spent, provided you follow all required best management practices.

The list, called the Metalworking Fluid Selection by Score, will not tell you which MWF will work best in your specific machining application. Only you can determine if an MWF will satisfy the alternative assessment (AA) considerations of your shop, such as cooling, lubricating, cost, expected life, odor, and recyclability. All MWFs on the Metalworking Fluid Selection by score list are used by machine shops in Washington state, so your competitors have done a preliminary AA for you. For additional help, consult technical specification sheets or the product manufacturer. Try an alternative MWF on a bench scale at first.

Figure 1 shows a partial version of the Metalworking Fluid Selection by Score alternative list. See the complete list in Appendix B. Metalworking Fluid Selection by Score.

Metalworking Fluid Name	Unused Product Disposal Status	% Toxic Substances	% Unknown Substances	% Preferred Substances
Blaser Synergy 735[44]	Not used oil, not DW	0	0.6	99.4
Goodson SGC-10 (SDS: FG-550)[44]	Used oil	0	1.3	98.7
Blaser Blasocut 4000 STRONG[44]	DW WP01, WP02	0	1.5	98.5
Blaser Vasco 7000[44]	Not used oil, not DW	0	2.0	98.0
Qualichem Xtreme Cut 250C[44]	Used oil	0	2.3	97.7
Blaser Blasocut 935 SW[44]	Not used oil, not DW	0	3.2	96.8

Figure 1: Part of Metalworking Fluid Selection by Score list. See full version in Appendix B.

How the Metalworking Fluid Selection by Score is organized

The first table in the Metalworking Fluid Selection by Score lists water-based MWFs. The second table lists straight oils.

Every MWF on the list has been scored and ranked for its safety based on the amount of toxic ingredients manufactured into the virgin product. The list is sorted from the lowest toxic

ingredient weight percentages at the top (which are apparently safest) to highest weight percentages of toxic ingredients at the bottom (which are best to avoid).

You may notice that several MWFs apparently have zero percent toxic substances. In these cases, the MWFs with the lowest weight percentage of unknown substances move to the top of the list. You want the lowest weight percentage of unknown chemicals in your MWF as possible because unknown substances are potentially toxic.

List disposal status

The Metalworking Fluid by Score shows the unused products' spent MWF's disposal status in any one of four categories:

- Used oil.
- Dangerous waste (DW).
- Not yet determined.
- Not used oil, not DW.

Unused product MWFs were assigned the disposal status **not yet determined** if manufacturer technical support didn't provide enough information to designate under the regulations.

MWFs were assigned **not used oil, not DW** if they didn't meet the definition of used oil. You must fully designate them under the regulations **after they're spent**[29] before you can conclude they're not dangerous waste. The unused product appeared not to be DW, but you must make sure the spent waste is not DW.

MWFs composed of vegetable or animal oils cannot be managed as used oil. Some MWFs include tall oil, a vegetable oil derivative, in their formulation. Such MWFs are identified on the alternatives list as **not used oil.**

It's possible that a spent MWF made from a vegetable oil that must be considered **not used oil, not DW** could end up dangerous waste when spent. You'd need to designate and possibly test to determine the disposal status. You're responsible for determining the disposal status of your spent MWF waste.

The unused products disposal status listed in the score can save you time and money finding a MWF that doesn't need to be managed as dangerous waste. See Appendix B. Metalworking Fluid Selection by Score for more details.

Metalworking fluid chemical safety evaluations

To create the score, a chemical hazard assessment (CHA) was performed on every MWF ingredient known to Ecology at the time by an independent company, Scivera LLC. We used the CHA results to assign each ingredient into one of three categories: toxic, preferred, or unknown. The weight percentage of all three categories (toxic, preferred, and unknown) adds up to 100% for each MWF. See our Toxics Evolution Metalworking Fluids Project Report[30] for more information.

[29] In accordance with WAC 173-303.

[30] https://apps.ecology.wa.gov/publications/SummaryPages/2104025.html

It is difficult to evaluate the disposal and safety of a MWF because manufacturers don't list all of the ingredients on safety data sheets. Most manufacturers are not willing to reveal proprietary ingredients (even with a signed non-disclosure agreement) in order to protect their market share and prevent product piracy.

As you review the list, remember that **percent unknown** doesn't mean safer. In all likelihood, it means **not adequately tested**, and therefore not required to be listed on the SDS. For this reason, and the fact that MWF chemical composition changes over time with use, we can only conclude that some MWFs are "apparently safer" than others.

Sump and Trench Maintenance

Sumps and trenches are a secondary containment measure typically incorporated into industrial processes that use MWFs.

Periodically clean out your sumps and trenches. This ensures safe management and helps keep them free of solid matter that can restrict fluid flow. Solid materials provide excellent areas for microbe growth, which may clog up MWF lines. Disinfect sumps and trenches with non-chlorine bleach or alcohol when you remove fluid. If you skip the disinfecting step, new fluid will be contaminated as soon as you add it to the sump.

P2 practices for maintaining sumps and trenches

Cover sumps

Many microbes that contaminate fluids are airborne. Covering the MWF sumps keeps out airborne microorganisms, along with dust, cigarette butts, food, and other materials.

Leave machine MWF pumps on during downtime

While the machine is not in operation, leave the MWF circulating through the machine to help aerate the fluid and keep it from becoming stagnant.

Circulate sump fluid

Use a small pump to circulate sump fluid. This prevents the water from becoming stagnant and microbes from growing in the fluid. Keep the sump size small to give the fluid a greater flow-through rate.

Chip Management

Metal chips are one of the two main waste streams metal fabricating facilities generate.

Recycling chips

Recycling is the standard industry practice for managing waste metal chips. Most metal fabricating facilities find this makes economic sense when generating large volumes of waste metal.

The key pollution prevention issue in recycling metal chips is separating MWFs from the chips. This separation simultaneously:

- **Reduces fluid purchasing.** The more fluid you recover, the more fluid you recycle and reuse, reducing the amount of fluid you need to purchase.
- **Reduces potential contamination.** Most metal recyclers require that chips are well-drained before pick up. By separating fluids from the chips, you reduce the potential stormwater contamination when the chips are stored outside, or during loading and transportation.

There are multiple methods for draining fluid from chips. We recommend one that allows the fluid to drain from the metal chip before it begins to evaporate. This prevents chemical residues that may contaminate stormwater from drying on the chips.

Here are three ways to drain fluid from your chips:

- **Manually shut off the chip conveyor for a period of time.** This allows the fluids to drain back into the machine sump.
- **Use a centrifuge and chip wringer to drain chips.** At low revolutions per minute, you can also use a centrifuge to separate tramp oils from MWFs.
- **Use a more passive chip draining system: drums with screens on top set at the end of the conveyor belt.** The fluid-coated chip falls off the conveyor belt onto the screen. Over time, the fluid drains through the screen. Then you can transport the dry chips to waste chip storage containers and recycle the collected fluids.

Facilities normally separate their chips by metal type to get the highest price from their metal recycling company. Metal recyclers may also offer a higher price if the chips are compressed into a briquette with a briquetting machine. If you're thinking about investing in one, consider the price of the machine, the price offered for briquettes versus loose chips, and the volume of chips you generate.

Storing chips

If you have room, we recommend storing waste chips indoors. If stored outdoors, they may contaminate stormwater due to contact with the MWF residue on the waste chips. Depending on the fluid you use, the residue may contain toxic/regulated metals, oils, or chlorinated paraffins.

If you do need to store your chips outside, follow these precautions to avoid stormwater contamination:

- **Drain fluid completely before placing chips in storage containers.** Any fluid or fluid residue may contaminate stormwater.
- **Cover outside chip storage containers.** This will protect clean rainwater from contamination due to residue on the chips.
- **Place chip storage containers on a concrete or asphalt surface.** This prevents spills and leaks to the bare ground. We also recommend installing a perimeter berm or curb to reduce the possibility of contaminating soils.
- **Continue draining fluids, if necessary.** If you need to store chips before they're completely drained, be sure your storage containers allow drainage. Many facilities tilt the waste chip dumpster towards one end so excess fluids can drain through an opening into a residue container.
- **Check often for leaks.** Be sure that outside storage and residue containers don't have any cracks or holes.
- **Monitor and maintain containers on a regular basis.** Empty storage or residue containers and don't allow them to overflow.

P2 practices for chip management

Use chip filters

Filters prevent the chips and grit created in the machining process from contaminating the MWF sump. The high amount of surface area created by the chips provides an excellent area for microbe growth. Filtering helps lower the bacteria count.

Drain metal chips to recover fluid

Drain metal chips by placing them in a perforated container with a catch basin and reuse the collected MWF.

Manually shut off the chip conveyor for a period of time, allowing the fluids to drain back into the machine sump. This process creates higher quality chips for recycling.

Use a chip wringer or centrifuge to recover even more fluid from the chips.

Recycle the metal chips

Many metal recyclers will take chips, but may require them to be free of oil and separated by metal type. If you compress the chips into briquettes using a briquetting machine, your recycler may pay a higher price for them.

Spills and General Maintenance

Mop water disposal

Your floor mop water may designate as a dangerous waste if it's used to clean up spilled or leaked MWFs, hydraulic oils, or tapping fluids. This is especially true if the cleaned or spilled fluids contain chlorinated paraffins. Your mop water may also designate as a dangerous waste depending on the chemical makeup of your cleaning agents and solvents.

Designate your mop water to determine if it's dangerous waste. Common dangerous waste constituents to test for include lead, cadmium, chromium, and selenium. Zinc-bearing metals (e.g., brass) and zinc-plated parts often contain lead. If the MWF or hydraulic oil contains chlorinated paraffins, test the mop water for total halogens.

Mop water disposal options depend on whether or not it is dangerous waste. You must manage mop water as dangerous waste if it exhibits dangerous waste characteristics (e.g., ignitable, reactive, corrosive, toxic).

You may be able to prevent your mop water from designating as dangerous waste by following these suggestions:

- Don't use mop water to clean up solvent or oily spills.
- Don't mix normal mop water with water that's used to clean up spilled solvent or chlorinated fluids and oils.
- Prevent leaks by properly maintaining equipment.

Mop water that's NOT dangerous waste:

- May be discharged to a sewer system if it doesn't exceed the sewer district's limits for oil and grease. Contact your local sewer district for discharge approval.
- Must not be discharged to storm drains, dry wells, or septic systems. Know where your drains lead before using them.
- Should not be mixed with spent MWF. See Step 3: Determine if spent MWF was mixed with any other waste stream.

Mop water that IS dangerous waste:

- Must be managed as dangerous waste. Management requirements depend on your generator category. For information about management requirements, visit our manage your waste webpage.[31]
- Must not be mixed with any other non-dangerous wastes. If it is, the entire waste stream becomes dangerous waste and must be managed as such.

[31] https://ecology.wa.gov/Waste-Toxics/Business-waste/Manage-your-waste

- May be shipped off site by small quantity generators to a permitted treatment, storage, or disposal (TSD) facility, local moderate risk waste facility, or other permitted solid waste facility.[32]
- Must meet some conditions to be discharged to a sewer system under the domestic sewage exclusion, including:
    - The local sewer district must be able to treat it.
    - You must obtain an appropriate permit issued by Ecology or your local sewer district before discharge.[33]

If you use the domestic sewage exclusion, you can exclude the mop water from the dangerous waste counting requirements (unless you treat or accumulate it before discharge).

If the publicly owned treatment works can't treat the waste, you cannot use the domestic sewage exclusion. You may wish to consider using treatment by generator options (such as evaporation) to reduce the volume of waste.

See our domestic sewage exclusion[34] publication for more information.

Absorbent waste disposal

The same constituents that can cause mop water to become dangerous waste can also cause floor absorbent to become dangerous waste. These constituents include lead, chrome, selenium, zinc, copper, chlorinated paraffins, solvents, etc. Designate according to the Dangerous Waste Regulations (WAC 173-303-070[35] through -100[36]).

Many facilities use absorbents to clean up wastes that are managed as used oil, such as way oils and spent MWF. This doesn't mean these contaminated absorbents may then also be managed as used oil. Our current used oil policy states:

> Materials that are not dangerous waste and that contain or are otherwise contaminated with used oil in recoverable quantities can be managed as used oil.

Under normal conditions, spent absorbents used to clean up oil spills don't contain recoverable quantities; therefore, you can't manage them as used oil. Instead, you must follow the designation process to determine if the waste absorbent is dangerous waste. Disposal options for waste absorbents depend on whether or not they are dangerous waste.

[32] Under WAC 173-303-070 (8)(b)(iii): http://apps.leg.wa.gov/wac/default.aspx?cite=173-303-070.
[33] Under WAC 173-303-071(3)(a): http://apps.leg.wa.gov/wac/default.aspx?cite=173-303-071.
[34] https://apps.ecology.wa.gov/publications/SummaryPages/2004041.html
[35] https://apps.leg.wa.gov/wac/default.aspx?cite=173-303-070
[36] http://apps.leg.wa.gov/wac/default.aspx?cite=173-303-100

Follow these practices to reduce your absorbent use or prevent your absorbents from designating as dangerous waste:

- Use catch basins or spill pans in place of pads.
- Vacuum spills.
- Use rags or absorbents that can be wrung out and laundered for reuse.
- Reuse, recycle, or properly dispose of recovered liquids.

Waste absorbents that are NOT dangerous waste:

- May be disposed of in a dumpster if your local landfill or solid waste hauler approves. Use enough absorbent to soak up all the liquid.

Waste absorbents that ARE dangerous waste:

- Must be managed as dangerous waste.

Small quantity generators may ship water absorbents that are dangerous waste to a permitted TSD facility, local moderate risk waste facility, or other permitted solid waste facility (WAC 173-303-171(1)(e)).[37]

P2 practices for spills and general maintenance

Fix leaking seals and gaskets

This keeps the fluid where it belongs, instead of on the floor or all over the machine and operator. Even small leaks can waste a surprising amount of fluid over time.

Use pumps, spigots, and funnels

Using pumps, spigots, and funnels when transferring MWF reduces the amount of lost fluid and lowers the risk of spilling fluid.

Reuse absorbent pads

Use absorbent pads that can be wrung out and reused. This will reduce the amount of absorbent material you discard as dangerous waste and lower your handling costs. Fewer purchases of fresh absorbent pads will also save money.

Another option is to dedicate a mop to only clean up oily spills.

[37] http://apps.leg.wa.gov/wac/default.aspx?cite=173-303-071

Stormwater Regulations

Our regulations require most industrial facilities to have a stormwater permit.[38] If you need a stormwater permit and don't apply for one, you could be subject to legal action.

- If you discharge stormwater to surface water or into a storm sewer that leads to surface water, you must apply for a stormwater permit.
- If all of your stormwater discharges to the ground or a combined storm or sanitary sewer, you don't need a permit.

The permit requires industrial facilities to develop a Stormwater Pollution Prevention Plan. The plan should identify existing and potential sources of stormwater pollution, and describe how you will reduce or eliminate that pollution. Additional specific planning requirements are detailed in the permit.

Contact your nearest Ecology regional office[39] if you aren't sure if you need a stormwater permit or if you have questions about current practices and possible stormwater impacts at your facility.

[38] https://ecology.wa.gov/MS4
[39] https://ecology.wa.gov/contact

Appendix A. Health Concerns

While machinists, machinery mechanics, metalworkers, and other machine operators and setters have the greatest contact with MWFs, workers performing assembly operations can also be exposed if MWFs remain on the machined product. Workers can be exposed to MWFs through skin contact, inhalation (breathing in), or ingesting (swallowing) particles, mists, and aerosols.

Although changes in MWF formulations have resulted in safer products, MWFs can still contain substances that are harmful to your health. The most commonly observed illnesses associated with MWF use are:

- **Skin problems.** Skin contact with MWFs is very common because MWFs are often applied to the machine tool in large volumes. Workers' skin can be covered with mist or spray while machining, or by handling parts and tools covered with residual fluid. MWF-soaked rags and clothing can also prolong the length of time that the MWF is in contact with the skin. MWFs have been shown to cause numerous skin problems, ranging from dermatitis due to irritation or allergy (very common) to skin cancer (relatively rare).
- **Lung disease.** Inhaling the aerosols, particles, and mists generated by MWFs while machining is a common source of exposure. Several lung diseases are associated with inhaling MWFs including asthma, acute airway irritation, lipid pneumonia, chronic bronchitis, and possibly lung cancer. NIOSH[40] researchers suggest that machinists face an increased risk of asthma at concentrations below the current permissible exposure limits (PELs).

  Researchers are investigating agents, including microbes, in MWFs that may contribute to hypersensitivity pneumonitis. However, there is consensus that disease prevention efforts in general should be focused on eliminating MWF aerosol inhalation.[41]
- **Cancer.** Evidence suggests exposures to some MWFs can increase workers' risk for cancer of the skin, esophagus, stomach, pancreas, larynx, colon, rectum, and other organs. However, the link between MWF exposure and cancer is controversial, since the epidemiological studies were performed on workers who were exposed to MWFs as long as 20–30 years ago. Before the 1950s and 1960s, some MWFs contained relatively high concentrations of substances suspected to cause cancer (mostly polycyclic aromatic hydrocarbons and nitrosamines). Since then, industry actions have substantially reduced concentrations of these substances in MWFs. However, it's unclear whether these changes have eliminated the cancer risk because it's unknown if the cancer-causing substances are present in the MWFs themselves, or whether they are constituents of MWF additives or contaminants.

[40] http://www.cdc.gov/NIOSH/
[41] https://pubmed.ncbi.nlm.nih.gov/27473679/

Occupational standards that apply to MWFs

The two most important occupational standards that apply to MWFs are those for **particulates not otherwise regulated** and **oil mists**.

In Washington state, the PEL for total particulates is ten milligrams of total particulate per cubic meter of air (10 mg/m3), based on an 8-hour time-weighted average (TWA). This means that exposures to total particulates can legally exceed 10 mg/m3 at times, but only if concentrations are below 10 mg/m3 at other times, so that the average exposure for any 8-hour work shift is 10 mg/m3 or less.

The PEL for oil mists is an 8-hour TWA of 5 mg/m3. PELs also exist for certain additives and other MWF constituents.

The Department of Labor and Industries has done substantial work with health concerns in the metal fabrication industry through their Safety & Health Assessment & Research for Prevention (SHARP) Program.[42]

The Pacific Northwest Pollution Prevention Resource Center website[43] is another good source for information about metal fabrication.

[42] https://lni.wa.gov/safety-health/safety-research/about-sharp
[43] https://pprc.org/

Appendix B. Metalworking Fluid Selection by Score

Warning: Businesses in Washington state are ultimately responsible for the proper designation and disposal of the waste they generate. Improper use of the Metalworking Fluids by Score (using the score without understanding its underlying assumptions and limitations) does not change your disposal responsibilities. Do not use the list until you understand it.

Want help or an explanation on using the list? Contact a toxic reduction assistance provider[44] in your region.

Understanding disposal status

Businesses must know the **disposal status of their spent MWF** to properly manage and dispose of their spent MWF. The alternatives list shows the **unused product disposal status**. What is the difference between the two?

- Spent MWF has been used to depletion.
- Unused product is fresh out of the drum (diluted if water based).

Knowing the unused product disposal status can really help you pick an alternative MWF by screening out ones that are guaranteed to become dangerous waste (DW) when spent and identifying ones that will not be DW, **provided that you follow certain best management practices**. Businesses are ultimately responsible for proper designation and disposal of spent MWF because Ecology cannot control business management practices.

Metalworking Fluid Selection by Score alternatives list

See the most recent version of the list in our Metalworking Fluid Selection by Score publication.[45]

[44] https://ecology.wa.gov/ToxicsReductionTeam
[45] https://apps.ecology.wa.gov/publications/SummaryPages/2104041.html

Appendix C. Acronyms and Definitions

Acronyms and abbreviations

Table 9: Acronyms and abbreviations used throughout this guide.

Acronym or abbreviation	Definition
AA	Alternative assessment
CHA	Chemically hazard assessment
DW	Dangerous waste
Ecology	Department of Ecology
EHW	Extremely hazardous waste
EP	Extreme pressure
HCl	Hydrochloric acid
HOC	Halogenated organic compounds
Mg/m3	Cubic meter of air
MWFs	Metalworking fluids
P2	Pollution prevention
PELs	Permissible exposure limits
PPM	Parts per million
SDS	Safety data sheet
TSD	Treatment, storage, or disposal
TWA	Time-weighted average

Definitions

Table 10: Definitions of terms used throughout this guide.

Term	Definition
Biocide	A chemical additive used to kill organisms in MWFs. Biocides include bactericides and fungicides. Bactericides kill bacteria and fungicides kill fungus.
Chlorinated	A substance that contains chlorine.
Coalescer	Material that is oleophilic (attracts oil) with a large surface area. Tiny drops of suspended oil attach to the surface and when enough drops attach, the coalescer forms a clump that breaks away and floats to the surface.
Designation	A step-by-step process for determining if a waste is a dangerous waste and, if so, what kind it is.
Dioxins	A group of very toxic chemical compounds that share certain chemical structures and biological characteristics. Dioxins break down very slowly and studies have shown that exposure to dioxins at high enough levels may cause a number of adverse health effects, including cancer.
Emulsifier	A substance that allows two substances to mix without separating, such as water and oil.
Emulsion	A mixture of two or more liquids in which one liquid does not dissolve within the other, such as oil and water, but is dispersed evenly within the mixture.
Extra pressure additives	These additives are commonly composed of halogenated paraffins. The halogen in the compound interacts with the metalwork piece and adds extra lubrication for longer tool life.
Extremely hazardous waste	Dangerous wastes that persist in hazardous form for several years upon disposal (persistent) and may be concentrated by living organisms through the food chain (bioaccumulative).
Halogenated	A compound containing any one of the halogen series of elements. These are commonly chlorine, bromine, and iodine in MWFs.
Metalworking fluid	Fluid used in machining metal parts to cool and lubricate the tool pieces, thus prolonging the life of the tool.
Oil skimmers	Tools that remove tramp oil and debris from the surface of the MWF. They use a rotating disk, a moving belt, or a moving rope that dips into the tank, and attract the tramp oil to its surface. The tramp oil is then scraped off the disk, belt, or rope and placed into a container.
Paraffin	Long, straight carbon chain organic molecules with no cyclic or ring structures in their molecular makeup. They are primarily composed of carbon and hydrogen, and may have halogens attached for extra properties.

Term	Definition
Secondary containment	A method or structure used to contain unexpected releases, leaks, or spills of toxic or hazardous substances.
Semi-synthetic fluid	This fluid is the same as the **synthetic fluid**, but has a small amount of oil added (2–20%).
Soluble oil fluid	A concentrate of severely hydro-treated oils combined with large amounts of emulsifiers. This combination allows the fluid to mix with water into a solution.
Straight oil fluid	A fluid that consists of solvent-refined or hydro-treated petroleum oil, or other oils of animal or vegetable origin.
Sump	A tank that holds metalworking fluid.
Swarf	Fine chips or filings of stone, metal, or other material produced by a machining operation.
Synthetic fluid	A concentrate that's added to water to form an aqueous metalworking fluid. The concentrate doesn't contain crude oil, or oil of any other kind. This fluid is commonly made up of amines, nitrites, nitrates, phosphates, soaps, and glycol.
Tramp oil	Most commonly made up of way oil (the lubrication used for the sliding parts of the machine) and hydraulic oils that fall into or are carried into the metalworking fluid.
Way oil	A lubricating oil made and used specifically for machine tool ways (guiding surfaces on the bed of a machine).