

Basic Condition Monitoring of Water-based Metalworking Fluids

A typical metalworking fluid is a complex mixture of components and performance additives, carefully selected and blended to provide optimum performance in a given application.

The metalworking fluid is therefore a vital part of the manufacturing process and maintaining the fluid in good order will return benefits in product performance, manufacturing quality and reduced waste disposal costs.

Another aspect, often overlooked, is the impact the metalworking fluid can have on operator health.

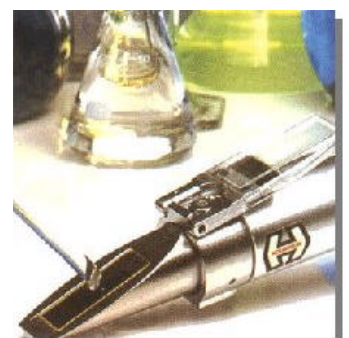
The HSE Good Practice Manual – Working Safely With Metalworking Fluids – provides extensive information on the known hazards to health caused by poor fluid management.

A regular regime of simple tests and record keeping can form the basis of a good fluid management programme, in accordance with HSE recommendations. A typical regime suitable for most water-based fluids would include:

- **Visual assessment & odour** – has the fluid changed from the 'usual' appearance and odour? Is there excessive surface oil or copious swarf/metal fines present, both of which can affect operator health? Observations would be followed up by other tests.
- Determination of **product concentration** – too high and operators could suffer skin irritations or dermatitis, too low and microbial inhibitors become ineffective, causing proliferation of bacteria or other bio-films.
- Measurement of **pH level** – this gives an indication of chemical activity relative to the product. A very high pH could present a risk of skin problems. Too low a pH could be due to microbial contamination and also lead to reduced corrosion protection.
- **Microbial Contamination** – bacterial contamination can lead to premature deterioration of the fluid including loss of stability and corrosion protection. Bio-films can blockages in filters and pipework. Note: Continual biocide treatment is not a substitute for good housekeeping practices.

Houghton plc offer the following guidelines to assist in the monitoring and management of typical water-based metalworking fluids including wash solutions.

Monitoring accessories eg; refractometers, pH papers, microbial diptslides, Coolant Management Charts and further information can be obtained via your Houghton Technical Representative.



TEST	PURPOSE	METHOD & FREQUENCY	CONTROL LIMITS	ACTION
Visual Assessment & Odour	Appearance and poor or unusual odour, etc. indicates obvious contamination problems eg; tramp oil, wrong fluid in system, heavy fines, microbial etc.	Daily	Compare against 'usual' fluid colour and odour.	<ul style="list-style-type: none"> Investigate changes. Monitor and treat as required Maintain surface oil and fines at minimum practicable levels. Refer to fluid supplier if necessary
Concentration	Maintains optimum tool-life, surface finish, corrosion protection, microbial inhibition. Also controls potential for operator skin problems.	1. Refractometer - weekly* 2. Titration - weekly* (mainly Wash fluids) * Increase testing frequency on problematic machines.	As indicated on fluid suppliers Product Data Sheets.	<ul style="list-style-type: none"> Add concentrated or dilution product via mixer unit as required. Ensure fluid contaminants are minimal to assist accurate measurement of product concentration.
pH Level	Monitors general 'health' of fluids. High pH level usually indicates contamination ie; by wash fluid. Low pH level usually indicates microbial contamination and/or low product concentration.	1. Dip-paper - weekly or 2. Meter - weekly	pH 8.5 - 9.6* * Unless specified otherwise.	<ul style="list-style-type: none"> >pH 9.6 = Re-test. If same result, refer to fluid supplier. pH 8.5 – 8.8 = Take action as indicated by other confirmatory tests eg; concentration, bacteria etc <pH 8.5 = Re-test. If same result, clean out system (with a system cleaner) and replace with fresh fill.
Microbe Levels	Indicates bacterial and/or fungal contamination.	Microbial Dipslide - weekly* * Frequency can be extended based on result trends.	1. Bacteria = if >10 ³ CFU/ml* 2. Fungal = if >10 CFU/ml * Coliforms per ml	Dose fluid with appropriate bactericide and/or fungicide as per suppliers instructions. DO NOT OVERDOSE !!

Metal Working Fluids – Do's and Don'ts

1. Mixing Fluids

Do's

- Use only freshly diluted fluid at concentrations recommended by your supplier.
- Add the fluid concentrate to the water slowly. Apply gentle agitation until a uniform solution is achieved. Never add water to the fluid concentrate.
- Use water of the correct hardness. Water that is too soft may result in foaming problems; water that is too hard may lead to scum formation. You may be able to adjust the hardness by using diluted fluids prepared with de-ionised water.
- Make use of proprietary dosing and mixing units.
- Take special care when handling concentrates to avoid waste through spills, etc.

Don'ts

- Mix excessive amounts of diluted fluids. This wastes concentrate and increases the amount of fluid requiring disposal.
- Use dirty or contaminated mixing vessels.
- Use contaminated water.
- Mix fluids in the machine tool.
- Use fluid beyond its recommended shelf life.

2. Topping Up Machines

Do's

- Maintain the correct level of fluid in the machine tool. Over filling or under filling may cause machine and fluid damage.
- Measure the fluid concentration and fill the machine accordingly
 - To replace water lost through evaporation, use diluted fluid.
 - To replace fluid lost through swarf drag-out, calculate how much fluid is needed to replenish the system and add fluid of the appropriate concentration.

Don'ts

- Mix different metalworking fluids (unless you have consulted your fluid supplier).
- Add water unless absolutely necessary.

3. Hygiene For Operators

Do's

- Wash hands and apply barrier cream.
- Use clean protective clothing and appropriate eye protection and safety shoes.
- Wash hands after work and apply skin conditioner.
- Make use of machine splashguards.
- Make use of mist extraction units.
- Keep floors clean.
- Follow advice given in product safety data sheets.
- Take special care to avoid exposure when handling concentrate.

Don'ts

- Consume food and drink with oily hands.
- Place oily rags in pockets or wipe hands with contaminated rags.

4. Keeping The Fluid Clean

Do's

- Adopt a regular cleaning and inspection policy.
- Keep fluid contact surfaces clean.
- Label all containers, vessels and pipework clearly.
- Deal with leaks of contamination lubricants, e.g. hydraulic and slideways oils, promptly.

Don'ts

- Allow foreign bodies and debris to fall into machines of fluid systems.
- Add clean fluid to a dirty machine.
- Prepare fluid dilutions in dirty mixing vessels.
- Return fluid spills to the machine sump
- Return swarf to the fluid system.
- Pour other wastes into the fluid system.
- All the machine to stand idle for long periods

5. Cleaning Out Machines

Do's

- Clean machines regularly or as dictated by your fluid management regime.
- Make use of good-quality machine cleaning fluids. These dislodge debris, emulsify any free oil and destroy any bacteria and fungi present. Cleaning fluids are typically added to the machine sump at 2 – 4% by volume and used together with the metalworking fluid for normal operations for 24 - 48 hours. The machine should then be emptied and hosed down with water before adding fresh fluid.
- Follow the recommendations for use of machine cleaning fluids.

- Remove the excessive layers of tramp oil before using the machine cleaning fluids.
- Take extra precautions when using the machine cleaning fluids because they have a higher biocide concentration and can cause skin irritation problems.

Don'ts

- Take short cuts during machine cleaning. Operators often do not appreciate the importance of cleaning and many line managers want to resume full production as quickly as possible.

6. Storing Fluids

Do's

- Store fluids under cover and in a bunded area.
- Avoid rain collecting in the container bunds.
- Use a stock rotation regime.
- Carry out a COSHH assessment for each metalworking fluid and make appropriate arrangements to prevent/control exposure.

Don'ts

- Use fluids that are past their expiry date.
- Expose fluids to temperatures below 5°C. This can cause some additives to separate out. The material can then be difficult to remix.
- Store water-based diluted fluids, because they will start to degrade.

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System Cleaning

All fluids benefit from periodic system cleaning, whether it is a bacteria infested coolant sump that needs sterilising, or a hydraulic oil system that only requires flushing through. However, with oil based products cleaning is desirable, but with water based coolants thorough cleaning is essential. The details outlined below demonstrate how the adoption of simple procedures can dramatically reduce coolant problems and ensure maximum sump life.

Water based coolants are very prone to attack by micro-organisms. These can cause product breakdown, which may result in foul odours. Production problems of reduced tool life, poor surface finish and corrosion, can also be caused by their presence. The reason for this is that metalworking coolants contain additives that are nutrients (food) to micro-organisms. These include emulsifiers, corrosion inhibitors, coupling agents and EP additives. Thus, when the micro-organisms consume portions of these it seriously affects the balance of the coolant stability. This can ultimately lead to complete splitting into oil and water based phases.

The success of any FLUIDCARE system involving coolants hinges upon the incorporation of an effective procedure for cleaning coolant sumps. The development of modern biocidal cleaners such as ABC Machine Cleaner, allows efficient cleaning to be carried out. Addition of ABC Machine Cleaner 24-48 hours prior to dumping a coolant allows both the biocide and detergent packages to combat the bacteria and dirt simultaneously. The product is carefully designed to allow production to continue uninterrupted whilst this occurs. Thus a complete cleaning regime can be devised to allow machine sumps to be cleaned out at regular intervals without any disruption of production demands. Below is an example of a typical procedure.

1. Add 2% ABC Machine Cleaner 24-48 hours prior to coolant dumping.
2. Circulate for 24-48 hours.
3. Empty coolant sump.
4. Remove debris physically.
5. Rinse with water.
6. Fill with fresh coolant, pre-mixed at the correct concentration.

NB. If machines are heavily contaminated, a further clean with a 2% solution of ABC Machine Cleaner can be carried out after stage 4.

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