FUCHS Industrial Lubricants

Coolant Management Guide

LUBRICANTS.
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YOUR **PERFECT** PRODUCT **PARTNER**

The continuous monitoring of coolants is essential to ensure that their performance and quality are maintained. Effective monitoring can help to increase machine and fluid life, while improving manufacturing efficiency and maximising profitability as well as improving safety. However, monitoring the condition of your fluids needn't be complicated or expensive.

Although companies with large lubrication systems will certainly benefit from implementing the FUCHS CPM, CENT systems and FLUIDS LIVE, our web based monitoring service (see the Technical Services Brochure for further information), those with smaller systems can use tools, such as refractometers, pH sticks and coolant management charts.

There are various monitoring techniques that can be used to measure a range of factors. Some of these tests may have to be done in a laboratory, but others are relatively easy and inexpensive to complete. This brief guide gives a few pointers on setting up and operating effective condition-based analysis techniques for coolants.

THE **FUCHS GROUP**

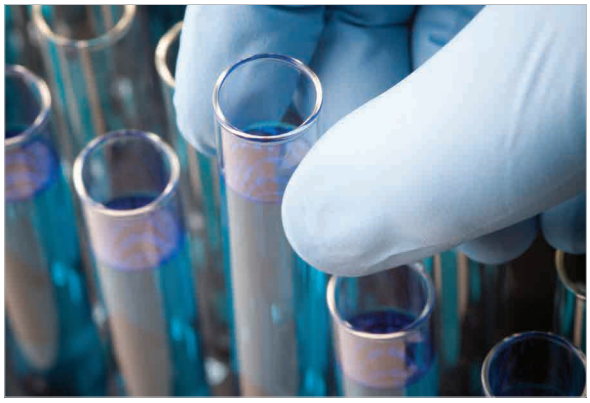
FUCHS is the world's largest independent lubricant manufacturer. The Group comprises of 49 operating companies with 33 production plants worldwide.

In addition to products developed for industry in the UK, we have access to more than 2,500 industrial FUCHS products from within the Group. Customers can make use of FUCHS' technical expertise and product availability on a global scale, providing access to international fluid technology.

UK GROUP PROFILE

The headquarters of the UK subsidiary is located at our modern, highly automated production plant in Stoke-on-Trent. Our UK manufacturing site carries all the necessary approvals required including AS 9100, ISO 9001, ISO 14001, ISO/TS 16949 and OHSAS 18001.

FUCHS is a full line supplier of lubricants and provides customers with local manufacturing, first-class logistics and specialist technical support.



RESEARCH & **DEVELOPMENT**

The FUCHS Group has a very strong focus on R&D with more than 400 chemists, engineers and specialists in more than 40 laboratories worldwide. Our labs are extremely well equipped and audited to the highest levels, having state-of-the-art equipment and highly trained staff with extensive technology and application knowledge.

Regular dialogue with OEMs, other industry bodies and component suppliers maintains technical advantages. Our continued investment ensures that we are at the forefront of lubricant technology.

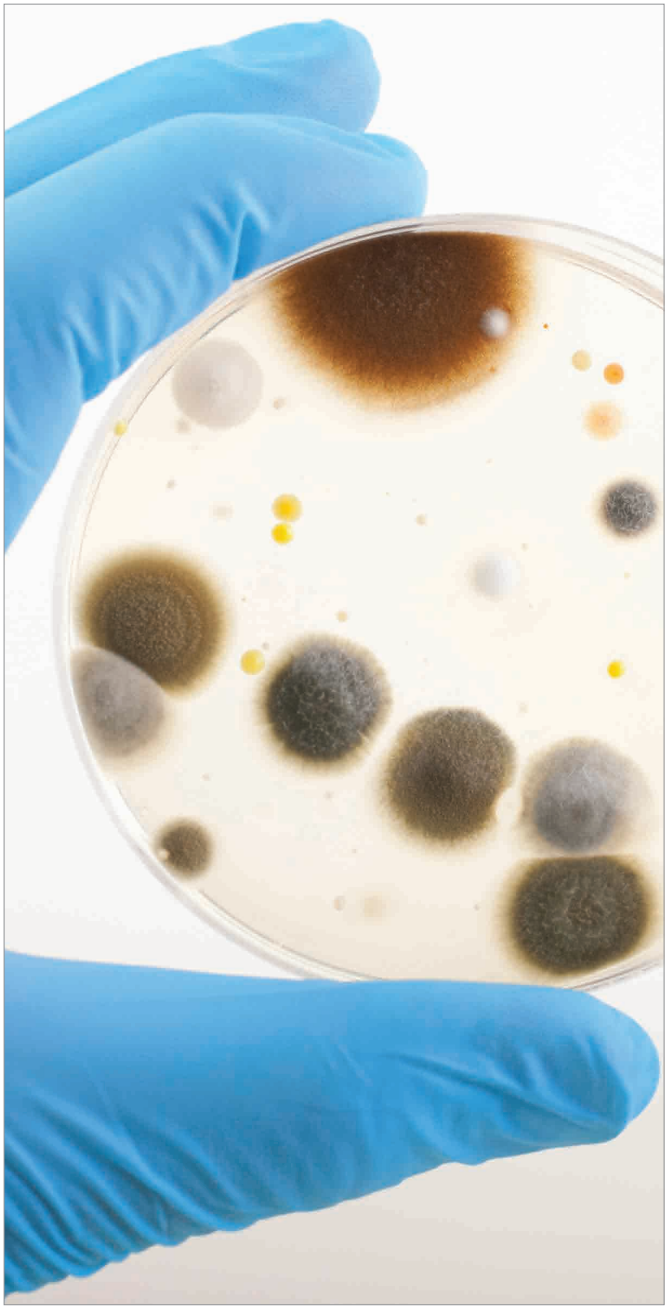
TECHNICAL **SUPPORT**

With our industry leading experience in lubrication and chemical processes, FUCHS is able to provide customers with unparalleled products and services through focused engineering, administrative and technical support. Our business support solutions include a UK based customer service team, local customer account managers, as well as experienced technical engineers and product specialists.

Every lubrication recommendation schedule and review we complete is utterly unique, dedicated to the exact need of the operation and chosen with the aim of extending service life and to optimise operational efficiency.

COOLANT **MANAGEMENT**

Compared to other types of lubricants, coolants need extra care and attention to ensure they're kept in good condition. Dirt and contaminants can have a detrimental effect on the effectiveness of the coolant, therefore good housekeeping practises, effective coolant management and high standards of hygiene are essential.



BACTERIA AND **MICRO-ORGANISMS**

One of the most significant causes of reduced fluid quality and life is microbial contamination. Water based coolants offer bacteria an abundant water supply and if not well maintained and controlled, can support microbial growth. Micro-organisms can enter coolant systems in a variety of ways including through tramp oil, organic matter (e.g. food), the water used to mix emulsion and metal fines. A large presence of bacteria can degrade the technical performance of water miscible cutting fluids as they create an acidic environment causing the coolant to separate, reducing its lubricity.

Bacterially spoiled emulsions can be detected by emulsion instability or splitting, offensive odours after machine shut down, increased corrosion or rusting, change in coolant colour, drop in pH levels or presence of scum clogging lines or filters.

Solution There is no way of preventing bacteria entering the coolant system, however levels can be kept to a manageable level by avoiding creating a favourable habitat for them to multiply. To help minimise the effect of bacteria, ensure good coolant management practices are in place, including keeping the correct fluid concentration, removing tramp oil, ensuring coolant is kept clean by removing swarf. Scheduled clean outs as required are essential to limit bacteria growth and prolong service life.

Coolant care is very important and preferable to post treatment with biocides. Post treatment of cooling systems which are out of control should be minimised as this may lead to releasing endotoxins which have been linked to respiratory disorders.

FUCHS personnel can advise on the safe use of biocides which should only be considered for use when other control measures have failed. Extensive use of biocides can increase the risk of skin irritation and their use must be carefully controlled using correct PPE and safety measures. Biocides should be used at the manufacturers recommended dose to avoid potential for resistant strains if under dosed.

WATER QUALITY AND HARDNESS

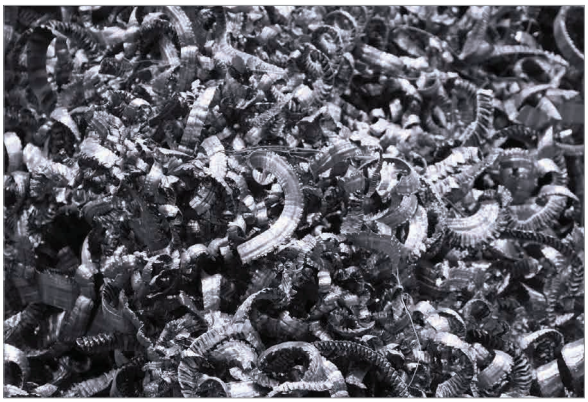
A soluble emulsion may contain 85-98% water, which is why poor water quality can affect the performance of the fluid; the purer the water quality, the longer the life of the coolant. Water hardness varies from very soft (0-20ppm) which increases the risk of foaming, to a very hard 400ppm and above which can cause severe problems in the mixing and stability of the fluid.

Solution Where the water quality is generally poor, water softeners, de-ionisation and reverse osmosis systems can be used to achieve a greater quality of water. Water can also be a major source of microbial contamination and therefore fresh drinking water quality is preferred when available.

TRAMP OIL

Tramp oil, is unwanted, lube oil which has seeped or leaked into the coolant system, which is the single biggest coolant contamination problem. Tramp oil floats on top of water based emulsions, as it has a lower specific gravity than water. This effectively seals off the surface of the sump from air, causing the system to degrade as a result of oxygen deprivation. Anaerobic strains of bacteria, which do not require oxygen to survive, are encouraged to rapidly multiply in these conditions releasing putrid smelling Hydrogen Sulphide. Left untreated, tramp oil can cause quicker fluid degradation, increased corrosion, unstable emulsions and become a health hazard to workers.

Solution Regular circulation of the fluid can prevent tramp oil formation and bacterial growth. Any tramp oil can be separated and removed using skimmers, tramp oil separators or centrifuges. To eliminate mineral oil leakages into the coolant system, ensure machines are regularly cleaned, maintained and monitored to detect any leakages in hoses or seals or defective parts replaced.
Well managed systems should have less than 2% tramp oil.



SWARF

Swarf fines should be removed from the sump on a regular basis. This assists in reducing the risk of corrosion and the removal of swarf also increases the available sump capacity for the coolant. Removal of fines helps reduce the static zone which can become contaminated. It is important to filter the coolant to maintain a good surface finish, cutting performance and to prevent damage to the machines.
Removal of fines also helps to reduce the abrasive nature on the skin caused by these sharp particulates.

Solution Excess swarf should be separated and removed from the fluid, using filtration units or vacuums, as often as possible and before the machine tool is shut down for a period of time (i.e. between shifts, overnight or prior to the weekend).
Well managed coolant samples typically contain less than 100ppm/mg per litre of fines.

COOLANT MONITORING

MONITORING COOLANT **CONCENTRATION**

- Concentration control is of paramount importance and care should always be taken to maintain the recommended dilution rates.
- When the correct concentration is used, end users can save up to 50% on coolant costs, as well as helping to lower bacteria populations and prevent skin problems.
- The concentration recommended for any water miscible metalworking fluid is set, by the manufacturer, at a level that gives maximum performance (EG: 5% = 5 parts of water miscible metalworking fluid concentrate to be mixed with 95 parts of water).
- It is essential that a coolant's strength is checked on a regular basis - daily checks are recommended.
- Monitoring concentration can be easily carried out by shop floor personnel by using a refractometer.

MIXING OF **WATER MISCIBLE METALWORKING FLUIDS**

- Use a mixing system with a clean container to prepare water miscible coolants.
- Avoid mixing the fluids in the sump of the machine tool.
- Automatic mixing systems are available which greatly assist in mixing the coolants. These can be set up to dose accuractly the desired mix strength to the machine tool.

REFRACTOMETERS

- A refractometer is a tool that measures the 'refractive index' of a solution; i.e. the volume of oil and water that makes up the coolant.
- Refractometers are a quick and convenient way of monitoring coolant concentration.
- The refractometer should always be wiped clean between testing different emulsions.

CALIBRATION

- Lift the Perspex flap and wipe the glass prism clean.
- Place several drops of clean water onto the glass surface and close the cover.
- Look into the refractometer and use the focus ring to create a clear image so that the scale comes into focus in the eye piece.
- Adjust the small screw on the top of the refractometer until the line between the white and blue areas meet at 0 on the scale.
- The refractometer is now 'zeroed'.
- Wipe the water off the prism.

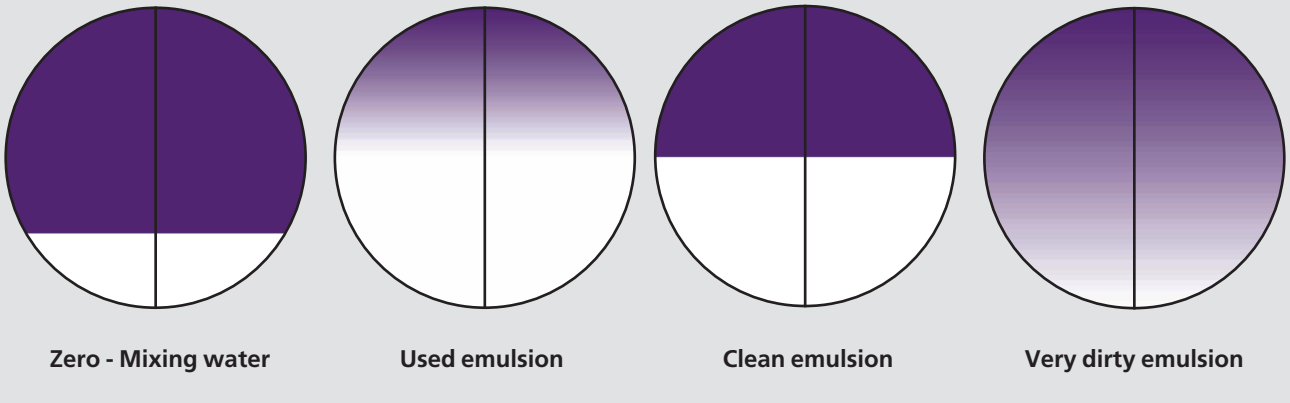
REFRACTOMETER

MEASUREMENT

- Place several drops of coolant on the glass surface and close the cover (the coolant is best taken from the delivery jets.
- Care needs to be taken to exclude any oil that is floating on the surface of the coolant, as this will lead to a better reading on the instrument).
- Look into the refractometer and note the reading on the scale (the reading is taken where the line between the blue and white area cut the scale).
- The actual concentration of the emulsion is obtained by multiplying the scale reading by the factor for the coolant in use.
- Each product has its own refractometer correction factor, which should always be used when calculating emulsion concentration to ensure accuracy.
- To calculate concentration: Refractometer Reading x Correction Factor = Actual Concentration.
- The correction factor is normally quoted on data sheets.

REFRACTOMETER READINGS

- New or very clean coolant will give a crisp clear reading.
- After some time in use, the reading tends to become more obscure and a diffused area of colour is seen.
- When the coolant is very dirty and contains a high level of tramp oil, often no reading can be obtained.
- This view can also be obtained with good coolant and indicates contamination of the glass slide and Perspex cover with oil, dirt or grease.
- Cleaning of the glass slide and Perspex cover with soft, non-scratching materials is essential if reliable, repeatable results are to be obtained.



Refractometer views

MONITORING
BACTERIA LEVELS

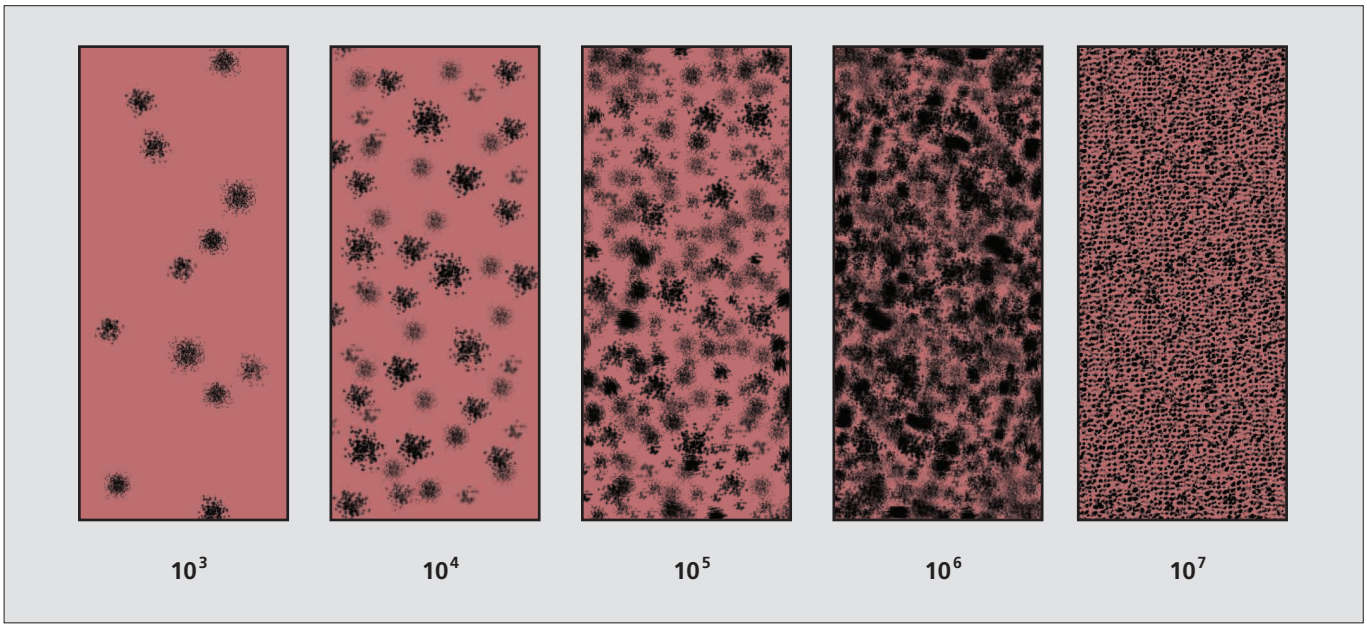
Levels of bacterial contamination should be checked on a regular basis. A large presence of bacteria can degrade the technical performance properties of soluble oil emulsions, as well as increasing the risk of health problems. Monitoring should be used to confirm your high standard of bacterial control, as well as indicating increased levels of bacteria at an early stage. Measurement can be done using dip slides; a quick and inexpensive way of allowing you to maintain low levels of bacteria and take action if necessary.

DIP SLIDES

- A dip slide consists of a plastic carrier coated with a sterile culture medium, which is dipped into the liquid to be tested.
- It is then incubated to allow microbial growth and the resulting colonies are estimated by reference to a chart on which the density of the resulting colonies is compared to indicate the level of bacterial contamination.
- Results are expressed in terms of Colony-Forming Units per Millilitre of fluid (CFU/ml).

USING A DIP SLIDE

- Loosen the cap on the tube and remove the dip slide from the container, taking care not to touch the surface.
- Immerse the dip slide into the emulsion being tested - it is essential to ensure that both sides of the slide come into contact with the emulsion.
- Enter machine ID and emulsion ID on the container and send the dip slide to a laboratory for incubation (@ 30°C for 48 hours) and interpretation.
- Dip slide samples should be taken carefully avoiding tramp oil contamination.
- Used dip slides should be disposed of safely in accordance with dip slide manufacturers instructions.



Dip slide comparisons

EFFECTIVE MONITORING

BACTERIA LEVEL **GUIDELINES**

The following values indicate what can be regarded as 'good', 'reasonable' and 'poor' levels of bacterial contamination, and what action should be taken.

- **Good Level = <10^3 CFU/ml**
  Bacteria are being maintained at low levels. No further action is required.
- **Reasonable Level = 10^3 to 10^6 CFU/ml**
  Review control measures to ensure levels of bacteria remain manageable. Risk assessment should specify action to be taken. Biocides and or cleaning may be indicated. If biocides are used, expert advice should be obtained, and the concentration of biocides should be monitored.
- **Poor Level = > 10^6 CFU/ml**
  Immediate action should be taken in line with the risk assessment. Normally at very high levels, draining and cleaning should take place.

THE **pH SCALE**

- This is a scale by which the acidity or alkalinity of a solution is measured.
- The scale goes from one to fourteen, with 7 being the neutral point (e.g. distilled water).
- A higher pH (alkali) value indicates that incorrect materials may have been put into the machine tool sump and that there could be an excessive amount of biocide or machine cleaner within the system or the coolant concentration could be high. This can result in skin irritation and corrosion.
- A lower pH (acid) value can indicate high levels of bacterial activity. This can result in emulsion instability and gummy deposits.

MONITORING pH LEVELS

- pH levels should be checked at least weekly.
- This is important as a change in the coolant's pH value indicates a change within the coolant itself.
- There are various methods that can be used to measure pH but the easiest, on-site method is to use pH strips.

USING pH STRIPS

- Dip the pH stick into the sample of emulsion.
- Wait 30 seconds.
- Compare the colours on the stick with those on the scale on the box, which will indicate the pH value.

MONITORING **ESSENTIALS**

Here is a list of things to bear in mind when monitoring:

- Draw up a strategy of things to be tested, frequencies and methods.
- Make sure that monitoring is done on a regular basis.
- Visual monitoring is simple but extremely important - staff should be vigilant in looking for signs of contamination and changes in the fluid's appearance and odour.
- Monitor fines debris counts on routinely tested sample points.
- Collect and analyse samples from a representative number of machines that are not on routine oil analysis, specifically for fines debris and bacteria.
- Make sure that the equipment used to capture and contain the sample is absolutely clean .
- If you are taking multiple samples from different systems, take care not to cross-contaminate one fluid sample with another.
- Always ensure that fluid systems are not under pressure when taking samples.
- Charts are an easy way to record results and the results can easily be interpreted into graphs - you can then see trends and changes instantly.
- Keep records of all tests for several years, as this will help to create benchmarks for monitoring.
- Make sure that results are acted upon.
- Follow-up any recommendations and record their effect.
- Coolant systems should be regularly checked for evidence of fungal growth. This often occurs in head spaces and above the coolant level in the tanks. In case of susspected fungal presence contact your technical support person for advice on removal and treatment.
- For further help and advice contact FUCHS.

COOLANTS AND YOUR **HEALTH**

Coolants contain a complex mixture of several potentially hazardous chemicals. Substances such as emulsifiers, stabilisers, corrosion inhibitors, biocides, fragrances and extreme pressure additives can all contribute to ill health. The HSE has highlighted the increased risk of health problems due to contaminated fluid which has not been properly maintained and controlled.

It is important for manufacturers to be aware of their legal duty of care regarding the protection of the work force from the health risks associated with using metalworking fluids. The primary aim of the Control of Substances Hazardous to Health (COSHH) regulations is to protect workers from the adverse health effects of hazardous substances, such as coolants, at work. Under these regulations, manufacturers are legally required to carry out regular and sufficient risk assessments to examine what, in the workplace, could cause harm to people and assess whether sufficient precautions have been taken to prevent harm. The regulations require exposure to metalworking fluids to be adequately controlled and reduced to a minimum; all non-essential exposure must be prevented.

EMPLOYERS SHOULD:

- Assess the risks to workers' health and decide what precautions are required
- Prevent exposure to metalworking fluids or, if not practical, ensure exposure is adequately controlled and minimised
- Monitor exposure and carry out any necessary health surveillance
- Refer anyone suspected of a work related illness to an occupational health professional
- Ensure safety and control measures are regularly checked and maintained and that all procedures are being observed
- Provide workers with sufficient information, training and instruction in the use of control measures and PPE equipment required.

EMPLOYEES SHOULD:

- Co-operate with employers and follow all training and instruction given
- Make full use of any control measures and PPE
- Report any defective equipment
- Attend and participate in health surveillance programmes where necessary
- Maintain fluid management procedures and contamination control measures.

REDUCING INHALATION

Oil mists and vapours are generated when fast moving machinery vaporises the coolant into the atmosphere. Oil mists and vapours are highly pervasive substances; once airborne, they can remain in the air for lengthy periods before sticking to surfaces, walls and floors.

Mist, vapour, smoke and fumes often contain respiratory 'sensitisers', substances that can trigger an allergic reaction in the respiratory system when inhaled, potentially causing respiratory illnesses such as asthma.

COOLANT **CONTROL**

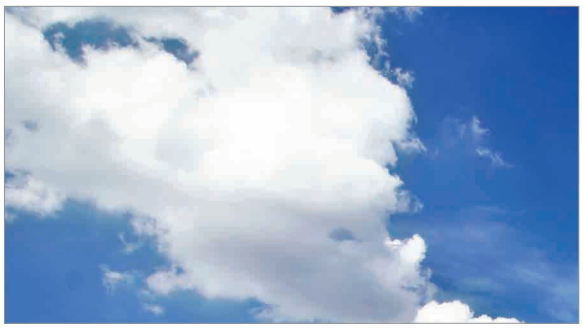
To reduce the effects of inhalation, the coolant's volume and rate of flow to the tool should be controlled to minimise the production of mist or vapour by preventing unnecessary spray and splashing. The fluid should be applied at the lowest possible pressure and directed at the tool/ work piece interface; coolant should never flow over unprotected hands. Delivery should be automatically stopped or diverted when not in use. These measures will also optimise fluid usage and help reduce costs.

VENTILATION

Adequate ventilation, extraction and air filtration systems, such as Local Exhaust Ventilation (LEV), are also effective in minimising the risk of exposure to oil mists and vapours as they prevent the accumulation and recirculation of airborne contaminants. Improving natural ventilation, such as opening doors or windows, can help towards lowering vapour levels.

SPLASH **GUARDS**

Splash guards and enclosures can help protect workers from accidental splashes and will reduce the extent to which the fluid contaminates surrounding surfaces. However, even if machines are completely covered, operators can still be exposed to the fluid once the cabinet door is opened. Using a time delay on doors will allow mists and vapours to be removed by ventilation. All control measures should be regularly checked, tested and defective equipment replaced.



USE OF **COMPRESSED AIR**

It has been shown in studies that the practice of using compressed air to remove coolant and swarf from machined components leads to increased risk of the fluid being aerosolized and deposited onto clothes and the operators skin. Wherever possible, avoid the use of compressed air and use alternative methods to clean components. Carefully consider the risk, if you must use compressed air use a low pressure and adopt suitable controls to protect your health.

PROTECTION
FOR SKIN

Coolants can come into contact with the skin, particularly the hands and forearms, throughout all stages of the manufacturing process. Coolants have the potential to cause skin irritation and other contaminants in the fluid can increase the risk of developing skin problems, which is why it is vital to have good coolant management controls in place. The sharp edges of swarf, filings and other foreign matter suspended in the fluid can cause abrasions and cuts leading to further irritation of the skin.

PERSONAL **PROTECTIVE** EQUIPMENT

PPE is designed to minimise contact with coolants and can be effective in protecting workers from skin irritation. However, PPE should only be used as a last defence as contact with the coolant can still occur when PPE is being used by touching the outside, or contaminating the inside, of clothing when putting on or removing. All PPE should be used in accordance with risk assesments and regularly examined for any tears or holes, cleaned, tested and replaced.

Users should be aware of the increased risk of finger entrapment in moving parts when wearing gloves. Suitable gloves should be used.

HYGIENE

Good personal hygiene is vital for reducing the risk of developing dermatitis. A pre-work barrier cream such as FUCHS Velvetone Hand Care Protect should be used in conjunction with PPE and applied before commencing work, after washing hands and every 24 hours to provide an additional layer of protection between the skin and contaminants. Oily rags should not be used to clean hands; hands, forearms and any other body part that may have come into contact with metalworking fluids should be regularly washed with soap and hot water. A reconditioning after-work cream such as FUCHS Velvetone Hand Care Conditioning should be applied after finishing work to help replace and restore the skin's natural oils.

Further information guidance and advice on working safely with Metalworking fluids can be found on the Health and Safety Executive Web Site : www.hse.gov.uk/metalworking/index.htm

For advice on the safe disposal of metalworking fluids please refer to the UKLA PERA Best Practice Guide: www.ukla.org.uk/publications or contact FUCHS technical experts, Tel: +44 (0) 1782 203 878.

Check the web links regularly to ensure the latest advice is followed.

providing coolant solutions complemented by excellent technical support and advice...

FUCHS

LUBRICANTS.
TECHNOLOGY.
PEOPLE.

UKLA METALWORKING FLUID PRODUCT STEWARDSHIP
An active member

YOUR COOLANT MANAGEMENT **PARTNER**

An effective coolant management schedule should be the cornerstone of any initiative geared towards improved production efficiency or reducing exposure to metalworking fluids. FUCHS has developed a unique and flexible Chemical Process Management (CPM) programme that can be customised to serve your specific needs.

CPM is a complete lubricant supply package that enables the customer to achieve maximum savings and efficiencies in lubricant usage, whilst maintaining and improving levels of production. The CPM programme can assist customers in identifying potential risks and planning effective measures of prevention and control. FUCHS provides expert support in all areas of fluid supply, distribution, monitoring, maintenance, assessment and disposal. Full technical support is provided by a dedicated team of production fluid specialists, with access to extensive laboratory facilities, incorporated into regular site visits.

As part of our CPM package we offer customers our CENT condition monitoring service. CENT is a state of the art production management tool that indicates the condition of the fluid and equipment by measuring wear trends, additive levels and sources of contamination. Clear and precise feedback is given to the customer in a regular, accurate and detailed report that highlights status indicators in graphical trend format.

Our CPM programmes have been successfully operating for many years; we have a proven track record in helping companies to develop more efficient and productive working practices.

As part of our CPM programme you can benefit from:

- Waste management and equipment
- Fluid condition monitoring (CENT)
- Lubrication surveys and schedules
- Environmental compliance assistance
- Rationalisation programmes
- Training on coolant best practice
- Materials and maintenance management
- Data management and reporting systems
- Stock maintenance and management
- Assistance with health and safety compliance
- Fluids Live web based recording and reporting tool

Our FUCHS team will be happy to provide more information on these, plus the many more benefits the CPM programme can offer you.

FLUIDS LIVE: WEB BASED MANAGEMENT SERVICE

Fluids Live is an easy to navigate, web based, recording, tracking and reporting tool with integrated KPI measurements; to give maintenance and production engineers immediate and remote access to the current condition of fluids in use. Fluids Live is an on-line platform, offering software free centralised management of data, resulting in no investment requirement from users.

- Information can be updated in as little as 2 hours from the time of collection of data giving users all of the information from which to make informed decisions on maintenance scheduling, production planning and other operational activities.
- All data collated and stored remains confidential and provides customers with a history of fluid usage, condition and concentration.
- Proactive use of the data will allow for better inventory control, reduced and simplified waste management activity and accurate analysis of fluid consumption by machine, cell or process.
- The data allows users to plan maintenance strategies more effectively and help reduce fluid usage expenditure.
- Each data reporting system is designed and developed by the FUCHS team to the bespoke requirements of the user.

Reporting data is broken down to the necessary levels, from company-wide to a specific machine, illustrating consumption against point of application. Fluids Live allows management teams to act accordingly based on the data produced.

Standard weekly reporting: Shows consumption broken down to the required level. Allows reason to be inputted, e.g. leak, normal consumption, cleanout. This clearly illustrates the reasons behind consumption figures, providing more information for management teams.

Exceptions reporting: Highlights high consumption. Ensures leaks do not go unnoticed, providing the opportunity for quick reaction thus reducing consumption costs.

Consumption reporting: Illustrates product usage at any level, from department to an individual machine.

Automated scheduling: Allows management to schedule workload and edit as required – with no limit to the amount of schedules able to be planned.

Data capture: Capture data easily via handheld units. Data available to management as soon as synchronisation is complete. Alternative manual data entry option is available.

Innovative lubricants need experienced application engineers

Every lubricant change should be preceded by expert consultation on the application in question. Only then can the best lubricant system be selected. We will be happy to advise on the right lubricant for each application and also the range of support services we can offer.

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