TECHNICAL GUIDE

Oil mist

EN

Table of contents

SIEBEC SAS
ZAC Vence Ecoparc, 9 rue des platanes
38120 St Egrève, FRANCE

Tel : +33 4 76 26 12 09
contact@siebec.com

TECHNICAL GUIDE

Oil mist

I. Nature of cutting fluids and associated risks

I.1. Whole oil

Oils can be of mineral, synthetic or vegetable origin. They may contain varying degrees of carcinogenic polycyclic aromatic hydrocarbons (PAHs), which are present in the oil during refining or created by the high thermal stresses of machining.
These oils may also contain various additives, although the proportions are lower than in aqueous fluids.

I.2. Aqueous fluid

Aqueous fluids are essentially of 2 types: emulsions, which contain oil droplets in suspension, and solutions, which contain only soluble compounds. **In both cases, these fluids consist mainly of water (over 90%), but also of numerous additives that can be highly toxic.**

In addition to the compounds initially present in cutting fluids, there are compounds created over time by the degradation of the fluid, the appearance of micro-organisms or the presence of heavy metal particles due to abrasion.

I.3. Risks and nuisances

- **Skin diseases:** irritation, often due to the high pH or allergies caused by certain additives such as biocides or biocides or heavy metals.
- **Respiratory diseases :** Irritant or allergic pneumonitis, asthma.
- Several links have been established between certain cancers and cutting fluids, including: skin and laryngeal cancer (whole oils), oesophagus and stomach (aqueous fluids) ...
- The risks obviously depend on the concentrations involved and the time of exposure, so they need to be put into perspective.
- Formation of a greasy film on the floor and walls, creating a risk of falling.
- For more information, please refer to article ND2164 from INRS.

II. Aerosol creation mechanism

Fog or smoke, in both cases an aerosol, i.e. a droplet suspended in the air. The only distinction between these two terms is the size of the droplets. Very fine droplets smaller than a micron are referred to as smoke, while larger droplets are referred to as fog.

The term vapour, often used incorrectly, refers to a gaseous state and is therefore radically different from an aerosol.
There are many methods of capturing droplets, but in all cases, size has a direct influence on efficiency.
Small drops (smoke) will be more difficult to capture than large ones (fog).

Granulometry (droplet size distribution) is directly linked to the mechanism that produces the aerosol. These mechanisms are essentially of 3 types:

SIEBEC SAS
ZAC Vence Ecoparc, 9 rue des platanes
38120 St Egrève, FRANCE
Tel : +33 4 76 26 12 09
contact@siebec.com

• **Impaction :** The lubricant is sprayed by the rotating tool or part. The droplets are rather large (fog).

• **Pressure spraying :** The mist is not created when it comes into contact with the tool or workpiece, but when it is injected (micro-lubrication).

• **Thermal :** Fog is created by evaporation on contact with the tool, followed by condensation. This phenomenon often produces very fine fumes. This is the most problematic scenario, as these fumes are the most difficult to capture and the most toxic.

The devices we offer, fitted with HEPA filters, are capable of capturing the finest droplets (mist and fumes). However, the service life of finishing filters may vary from case to case.

III. Work environment regulations and recommendations

III.1. Regulations

There is no specific standard for working environments subject to oil mist. However, the French Labour Code does impose certain rules, including the following:
A room subject to the release of oil mist is considered to be **« Specific pollution premises » (Article R4222-3)**

Article R4222-12 : *Emissions in the form of gases, vapours, aerosols of solid or liquid particles, or substances that are unhealthy, annoying or dangerous to workers' health are eliminated [...].*

Failing that, they are captured as they are produced, as close as possible to their source of emission and as efficiently as possible [...].

If it is not technically possible to capture all the pollutants at their source, the residual pollutants are evacuated through the general ventilation of the room.

Article R4222-13 : *The capture and ventilation installations are designed in such a way that concentrations in the atmosphere are not dangerous at any point for the health and safety of workers and remain below the exposure limit values set in article R4412-149 [...].*
An automatic warning device signals any failure in the collection installations that is not directly detectable by the occupants of the premises.

All articles can be consulted on the Legifrance website.

The regulations are clear on one point: the employer must ensure that the atmosphere is not hazardous to workers' health at any point (**Article R4222-13**) but does not specify the limits that must not be exceeded, except for certain substances (**Article R4412-149**), which do not include cutting lubricants. However, lubricants themselves may contain substances covered by this list, such as benzene, PAHs, formaldehyde and amines ....

III.2. Recommendations

Although the regulations remain vague as to how to safeguard employee health, several bodies have issued recommendations. Ainsi, **INRS recommends not exceeding the NIOSH proposed value of 0.5mg/m3 for the inhalable fraction of the aerosol (particles smaller than 100µm).**

Please refer to INRS document ED972 for further details.

SIEBEC SAS
ZAC Vence Ecoparc, 9 rue des platanes
38120 St Egrève, FRANCE
Tel : +33 4 76 26 12 09
contact@siebec.com

IV. Technical solutions

IV.1. SIEBEC ATMOS™ : a recirculating oil mist purifier

The ATMOS™ is a recirculating oil mist scrubber. This means that the air drawn in is cleaned and then discharged back into the room where it is located. This operating principle has several major advantages over a centralised installation:

- The **flexibility**. Unlike a centralised installation, it is entirely possible to add equipment or move it at will if the production tools are reorganised. It is also possible to work with different cutting fluids depending on the machine.
- The fluid recovered by the ATMOS™ pre-filtration stage is reintroduced into the machine, **saving lubricant**.
- This technique causes virtually **no discharge into the environment**, unlike a centralised installation, whose filtration performance is generally much lower.
- The final advantage is the **energy saved on heating**, compared with venting outside the premises.
    - For example, with an indoor temperature of 20°C and an outdoor temperature of 0°C, a 1000m3/h (1 machine) exhausted to the outside represents a heating capacity of around 6000W.

On the other hand, a recirculation unit must offer a sufficient level of reliability to guarantee the cleanliness of the reintroduced air :

- The ATMOS™ is thus equipped with **HEPA H13 filters with a minimum efficiency of 99.95%**, even with droplets smaller than 1um in diameter. Depending on the concentration at the ATMOS™ inlet, the oil concentration obtained at the HEPA filter outlet is 100 to 1000 times lower than the value recommended by the INRS of 0.5mg/m3.
- **Cartridge clogging is monitored in real time** using pressure sensors. The ATMOS™ provides a visual display of the state of the filter.

While the HEPA filter alone is capable of removing almost all the oil contained in the air in an ATMOS™, it only recovers the finest droplets. In fact, the technical sophistication of the ATMOS™ does not lie in this filter, but in a patented multi-cyclone pre-filtration device, enabling 99% of the oil to be captured on its own. This pre-filtration, which requires no consumables, requires little maintenance and optimises the life of the HEPA filter.

SIEBEC ATMOS™ removes droplets of cutting fluid but does not dispense with general ventilation of workshops in compliance with regulations.

IV.2. Capture method

Labour law (**Article R4222-12**) requires pollutants to be captured as close as possible to the source in order to minimise contamination of the working environment. **There are two possible solutions.**

SIEBEC SAS
ZAC Vence Ecoparc, 9 rue des platanes
38120 St Egrève, FRANCE
Tel : +33 4 76 26 12 09
contact@siebec.com

IV.2.1. Wrap-around capture

This is the solution to adopt wherever possible. In this case, the source is enclosed in a hood. The INRS gives aeraulic recommendations to avoid pollutant dispersion as far as possible:

During machining, with the machine closed :

- In the case of a relatively tight cover, **the recommended negative pressure is around 20 Pa**.
- For large openings, **the recommended minimum speed is 0.2 m/s.**

By way of example, the following table gives an estimate of the maximum width that a square opening communicating with the outside of the machine could have, in order to maintain a negative pressure greater than 20Pa :

Flowrate	500 m^3/h	1000 m^3/h	1500 m^3/h
Opening size	220mm	315mm	385 mm

When the machine is opened :

The machine door opening phase remains the most significant source of pollution.
There are two possible solutions:

- Or **time the door to renew the air before opening.** This solution makes it possible to install a lower-flow model.
- Or **ensure sufficient sweeping of the machine**. The recommended minimum sweep speed is 0.2 m/s.

IV.2.2. Induction capture

When it is not possible to install a complete enclosure and the openings are still too large to guarantee the minimum sweeping speed, it is preferable to use a suitable extraction unit located as close as possible to the source of the pollutant.

V. Air quality control

Air quality control can only be carried out in accordance with regulations by an accredited body.

Siebec does, however, have measuring instruments for assessing air quality before and after the installation of a purifier. These measurements allow you to be sure that your installation complies with the recommendations and to provide an initial argument in the event of questions from the inspection bodies.

The instrument most commonly used is a diffusion laser photometer. It can be used to measure the concentration of particles (droplets or dust) instantaneously, or to take automatic readings over long periods.

SIEBEC SAS
ZAC Vence Ecoparc, 9 rue des platanes
38120 St Egrève, FRANCE
Tel : +33 4 76 26 12 09
contact@siebec.com