Fumigation with formaldehyde

1. Introduction
In certain circumstances it will be necessary to fumigate MSCs and on occasion rooms for purposes of decontamination.

The fumigant commonly used is formaldehyde; however this is an extremely toxic compound, which has a Maximum Exposure Limit [MEL] of 2ppm. At the end of the process the formaldehyde vapour must be vented to atmosphere to reduce the concentration as low as practicable below the MEL. This can present difficulties, particularly where recirculating MSCs are used.

The University has evaluated the risks associated with the fumigation process and compared these with the risks presented by the materials which have been handled within the microbiological safety cabinets. As a result of this assessment, Schools are advised to only fumigate cabinets in the following circumstances:

- Before any maintenance work on the cabinet where the engineer needs to access potentially contaminated parts. E.g.:
  - when HEPA filters are to be changed
  - before carrying out filter penetration tests,
  - when access to the internal fans is required.
This would not include routine servicing of the MSC and KI OPF tests, except in circumstances shown below.

- Before any maintenance or testing is carried out on MSCs used in association with any Class 3 BA/GMO or any Class 2 organisms where the risk of exposure cannot be adequately managed by surface decontamination.

- Cabinets in which there has been a major spillage of viable material where inaccessible surfaces may have become contaminated. This should be carried out at the time of the incident or as early as possible after the incident has occurred.

- Where there are any significant changes to the nature of the work carried out. [e.g. use of a significantly different pathogen]

2. Hazard associated with formaldehyde
2.1. Toxic properties
Formaldehyde is a highly toxic substance, corrosive and a severe irritant. It has been shown to cause cancer in animals.

It has a MEL of 2ppm which is a short-term exposure limit [STEL] and an odour threshold of 1ppm which is very close to the MEL. It is mandatory to ensure that the MEL is never exceeded and that exposure is kept below as low as practicable below the MEL. It should be noted that some individuals are not able to detect its presence, even at levels around or above the MEL and therefore may not be aware that they are being exposed, unless an appropriate monitoring device is used.
2.2. **Physical Properties**
Formaldehyde is explosive at 7.75% in dry air. Above 60°C explosive air-vapour mixtures can be formed, unless the atmosphere is humid. Because it penetrates poorly in very dry conditions, for both safety and efficacy the conditions should be humid and warm [above 65% relative humidity and above 20°C].

In order to achieve this, a proprietary fumigation kettle must be used to produce the required vapour.

2.3. **Chemical Interaction**
Under certain conditions formaldehyde can react with hypochlorite and other chlorine containing chemicals such as Chloros to form bis-(chloromethyl)-ether which is a known lung carcinogen. Chlorine containing compounds must therefore be removed from rooms and cabinets before fumigation.

3. **CONTROL MEASURES TO REDUCE RISK.**
The first principal of control is to remove the hazard or substitute with something less harmful. Currently the alternative to fumigation is vaporised hydrogen peroxide which is less toxic but should only be used in strictly defined circumstances where its efficacy can be demonstrated. The University is currently investigating these systems and will evaluate them and may issue further guidance in due course. In the meantime formaldehyde remains the preferred fumigant.

Fumigation with formaldehyde must be carried out in accordance with a written protocol; however the exact methodology will need to be determined by Schools/departments to reflect local situations and circumstances.

When drawing up fumigation protocols Schools/departments must incorporate the following general principles and the cabinet manufacturer's instructions.

- The procedure must only be carried out by suitably trained and authorised personnel. This is a task for experienced technical staff and must not be undertaken by students.
- Sufficient warning signs must be displayed to ensure there is no inadvertent exposure to vapour.
- Where possible rooms should be locked to prevent entry.
- Remove sources of chlorine from room/MSC
- Exposure to liquid formaldehyde during preparation should be kept to a minimum. When priming fumigation kettles the exact amount of formaldehyde should be dispensed into a small plastic universal container within a fume cupboard and then transferred to the MSC kettle.
- In the case of room fumigation, the controls should be operable from outside.
- Use only proprietary fumigation kettles.
• Ensure the integrity of seals around MSC ‘night blinds’ and on any exhaust ducting. If necessary by the use of duct tape.

• Ideally cabinets should be vented via the roof, in which case Estates Officers must be informed in advance. Where it is necessary to vent via a window then care must be taken to ensure that vapour cannot re-enter into another area to impinge on passers-by.

• Suitable respiratory protective equipment [full-face respirator] must be available for use in the event of emergency/inadvertent release. [E.g. Arco Filtermax 2 with an ABE 2 or ABEK 2 filter]. Staff must be trained in its correct use and the filter must be changed in accordance with manufacturer's instructions.

• A formaldehyde meter must be available and used to check that levels are below the MEL. Checks should be made at frequent intervals, as it has been known that levels can fall below the MEL and then build up again over time. The Safety Office has a formaldehyde meter which can be booked out on loan.

4. **Recommended concentrations and contact times**
Sufficient formaldehyde should be vaporised to produce an airborne concentration of at least 50mg/m³ for a minimum of 6 hours. Use of excessive amounts can result in polymer deposition and may cause filter blockage in the MSC.

Formaldehyde can be generated by:

• Heating equal volumes of formalin solution and water [Bear in mind that formalin solution is 36% in water]
• Depolymerisation of paraformaldehyde by heating, providing adequate humidity is available.

5. **REFERENCES:**
This Appendix has been drawn up with reference to BS EN 12469:2000