1. On occasions it will be necessary to decontaminate laboratories, animal containment facilities and safety cabinets by fumigation when, for example, there has been a spillage of infectious material or when servicing or maintenance work is to be carried out. Fumigation should always be a planned exercise with appropriate controls in place and with information and warnings provided for those who need to know. Fumigation operations should only be carried out by named, trained personnel working to an agreed plan and using a method that is known to be effective in the circumstances of use.

2. Whilst fumigation is an important component of the procedure used to treat spillages in containment level 3 or 4 facilities, it should be noted that it is primarily a way of inactivating small deposits of infective agent that may, for example, be generated as consequence of the splashes and aerosols that occur during a spillage. However, since fumigant will not penetrate throughout the entire volume of a large spillage, fumigation should not be seen as a way of satisfactorily inactivating the bulk of liquid within the main spill itself. Thus fumigation should be undertaken alongside measures to treat the main spill with an appropriate disinfectant. For example a logical sequence would be to evacuate the laboratory, then fumigate, then disinfect the bulk spillage and remove all debris and then possibly fumigate again, if this was felt to be necessary. In cases where the infective agent is transmissible by the airborne route, such a procedure would be likely to necessitate the use of respiratory protective equipment during the process of disinfecting the spillage.

3. Formaldehyde vapour has been known for many years as a highly effective biocidal agent. It is the fumigant most commonly used in laboratories. There is more than one way of generating formaldehyde but the usual source is formalin which is readily available as a 40% solution of formaldehyde vapour in water. When heat is applied, a large quantity of the vapour is generated. (See endnotes 1 and 2.)

4. For formaldehyde to act to maximum effect, it must be able to penetrate (hence pre-cleaning is helpful if it can be done without jeopardising safety) and, it must be able to dissolve at adequate concentrations in the film of moisture in the immediate vicinity of the organisms to be inactivated. Water vapour generated in the process of dispersing formaldehyde provides the essential optimum level of relative humidity (i.e. greater than 35% but less than 80%). Too much formaldehyde results in the deposition of sticky deposits of paraformaldehyde.

5. Normally microbiological safety cabinets should be fumigated before filters are changed or any maintenance work is carried out which involves gaining access to the interior of the cabinet (for example air ducts). In addition cabinets may be fumigated following a small spillage. However, in the event of a large spillage consideration should be given to the fumigation of the whole room. Fumigant should be generated with the night door securely sealed and the non-return valve left closed. Passive migration of the fumigant through the filter can occur but an alternative is to leave the valve open and the fan running for 10 to 15 seconds to ensure penetration of the filter medium. The valve should then be closed and the fan switched off while the remainder of the fumigant is left to disperse within the cabinet. After at least six hours, or preferably overnight, the fumigant should be exhausted to atmosphere by switching on the fan and allowing air from the room to enter the cabinet (for example through a large bunghole in the night door). Before venting the formaldehyde in this way, it is essential to ensure that no-one is in the vicinity of the exhaust outlet and that the exhaust air does not enter nearby windows or ventilation air intakes.

6. If filters are to be changed after fumigation, the discarded filter unit should be bagged and autoclaved before disposal. There are special difficulties if the cabinet is used with the agents causing transmissible spongiform encephalopathies as they are resistant to inactivation by formalin. More detailed advice on the fumigation of safety cabinets is given in Part 4 of British Standard 5726:1992

Fumigation of rooms
7. Where a room in a laboratory or animal containment unit is to be fumigated the area should be checked to ensure that it is securely sealed so as not to allow the escape of fumigant to other parts of the building. Suspended ceilings can present a special difficulty as there may be a void above connecting with other rooms nearby. Careful thought also needs to be given to fumigation of any duct work.

8. It should be noted that any hydrochloric acid and chlorinated disinfectants should, if possible, be removed from the room before fumigating with formaldehyde. This is to prevent the possibility of forming bis (chloromethyl) ether which may be carcinogenic. In high containment facilities, care must be taken where double ended dunk tanks are present.

9. A test of the effectiveness of the fumigation may be carried out by placing spore strips/discs carrying Bacillus subtilis var. globigii (filter paper inoculated with a suspension of the organism) at various points in the room to test penetration of the fumigant. Similarly, a standardised spore suspension may be painted onto small marked areas on surfaces which are later swabbed to recover any surviving organisms.

10. Exposure to the residual effect of the fumigant after generation should be for at least six hours or preferably overnight. Fumigant may be extracted from the area by the air handling system but only when that is a total loss system with no possibility of formaldehyde vapour being conducted to other areas. More commonly, use is made of a microbiological safety cabinet or a fume cupboard as a means of extraction if one is situated within the area under treatment and if it exhausts to atmosphere. In all cases the plant or equipment extracting the air should be operated by an external switch so as to avoid entering the room. For instance, it should be possible to switch microbiological safety cabinets on and off from outside the room thereby the relative humidity created, the volume of the space to be fumigated, the surface area exposed in that space and the presence of absorbent materials such as cardboard boxes. At temperatures below 18°C formaldehyde fumigation is less effective. Below 9°C, formaldehyde sublimes and is less easy to vaporise.

11. After the fumigant has been evacuated in this way, there should be a thorough check of the level of residual vapour before anyone enters. This may be done most conveniently by, for example, sampling the air through a small port fitted in the door for this purpose. Meters and other assay devices are available to indicate the concentration of formaldehyde vapour remaining in the air. (See endnote 1.)

12. A number of factors affect the efficiency of fumigation. The ratio of formalin to water used and thereby the relative humidity created, the volume of the space to be fumigated, the surface area exposed in that space and the presence of absorbent materials such as cardboard boxes. At temperatures below 18°C formaldehyde fumigation is less effective. Below 9°C, formaldehyde sublimes and is less easy to vaporise.

13. Personnel should not enter an area when a major spillage of micro-organisms has taken place as there may be a great risk of exposure to infection by organisms that may remain suspended in the air for some time. Moreover, personnel should not enter an area when the fumigant has been generated except in a dire emergency when full breathing apparatus which provides air from an independent source must be worn. Only those trained in the use of breathing apparatus should use it. Respirators are not appropriate for use in the concentrations of formaldehyde vapour achieved when carrying out these procedures.

14. The legal requirement that the room should be sealable for fumigation should be interpreted as meaning that the only area which should need to be sealed up, in order to undertake a fumigation, should be the door. It should not be necessary to enter the room in order to seal up gaps in the integrity of the laboratory prior to fumigation.

15. In case of difficulty, HSE's Biological Agents Unit (Magdalen House, Stanley Precinct, Bootle, Merseyside L20 3QZ) is able to provide advice on fumigation.

Notes

1. Formaldehyde is a Schedule 1 chemical under the COSHH Regulations and has a Maximum Exposure Limit (MEL) of 2 ppm or 2.5 mg m⁻³.

2. Formaldehyde vapour is explosive at 7.75% in dry air. Its ignition point is 430°C.