ASSIST INFORMATION SHEET:

Recirculating fume cabinets

Recirculating fume cabinets are an alternative to built-in fume cupboards, which have the benefits of portability, initial low cost and easy installation due to the absence of external ducting. They operate by drawing air into the cabinet and exhausting the air through a filtration and absorption system that removes chemical fumes and vapours before being recirculated back into the laboratory. There are however numerous limitations with this system and as a result Science ASSIST does not recommend their use in school science laboratories.

A recirculating fume cabinet may have an advantage of lower installation costs, however it is important that prior to considering purchase that a risk assessment is conducted to determine its suitability for its intended use. In the event of an existing fume cabinet being already on site, regular risk assessments should be conducted to ensure that current and future work has safe work practices in place. This should include aspects such as identification of the types and quantities of the airborne contaminants; the matching of appropriate filters with substances used and produced as well as the operational requirements of user safety through monitoring and disposal of saturated filters.

Recirculating fume cabinets should comply with **AS/NZS 2243.9.2009 Safety in Laboratories Part 9: Recirculating fume cabinets**.

This Standard specifies safety requirements and gives recommendations for the design, manufacture, use and maintenance of recirculating fume cabinets, the test methods to determine their performance and explains the limitations of their use.

The Foreword of the above Standard states:

> *Recirculating fume cabinets rely on filtration or absorption to remove airborne contaminants released in the cabinet, so that the exhaust air may be safely discharged back into the laboratory atmosphere. Recirculating fume cabinets are suitable for light to moderate use with a limited range of substances. The range of substances for which each cabinet can be used is limited by the need for compatibility with the particular type of absorber or filter fitted to the cabinet.* [1]

Science ASSIST recommendations

Science ASSIST does **not recommend** the use of recirculating fume cabinets in school science laboratories due to the following points.

1. **The filters are not suited for a wide range of chemicals**: Schools have access to a wide range of chemicals that are used in a variety of reactions producing fumes and gases requiring the use of a fume cabinet. Filters play a crucial role and are specific for groups of chemicals and hence the filter selected must be compatible with **all substances to be used.**
2. **Environment**: The filtration system can be affected by temperature and humidity.

3. **Siting location:** Fume containment can be affected by airflow disturbances so careful consideration needs to be given to the location of the cabinet.
4. **Possibility of hazardous vapours recirculating in the work environment**: There is potential for chemical vapours trapped in the filter to be released into the work environment when filter saturation has been reached, either through continual use or in the event of a chemical spill.
5. **Monitoring exhaust**: A system for identifying when filter saturation has occurred needs to be implemented so that occupational exposure standards for hazardous chemicals are not exceeded. School science laboratories are not generally sufficiently equipped to fulfil the requirements of monitoring and maintenance of filters and exhaust air quality on a regular basis. There is a large reliance upon the performance of these tasks as well as costs associated with this continuous maintenance and monitoring program.
6. **Disposal of filter:** Filters should be discarded and replaced when nearing chemical saturation. Used filters are regarded as hazardous waste and safe handling procedures need to be put into place for handling and disposal.
7. **Safe Operating Procedure:** Systems of work should be implemented to ensure that a competent person assesses all of the above matters. The absence of this could create a false sense of safety in the use of a recirculating fume cabinet.

A built in fully ducted fume cupboard, whilst more expensive for an initial set up, is recommended for school science use.

Limitations of recirculating fume cabinets:

1. General limitations on the range and amounts of substances which can be absorbed.

- Recirculating fume cabinets should be used for small quantities of low hazard chemicals
- They are not recommended for use with highly toxic or flammable substances
- They are not recommended for certain quantities of corrosive fumes
- Consideration also needs to be given to the atmospheric conditions.

Clause 2.2 of AS/NZS 2243.9.2009, Limitations of use [2]

The recirculating fume cabinet shall not be used in the following circumstances (see also Clauses 6.2, 6.6.2.3 and 6.6.2.4 in AS/NZS 2240.9.2009*):*

(a) For work with organic solvents which are only physically absorbed on the absorber and the solvents—

(i) have boiling points less than 75°C; and

(ii) are evaporated in quantities of more than 50 mL per day.

NOTE: Fumes from these organic solvents can be insufficiently delayed on the filter unless chemisorption takes place, i.e. a chemical reaction between the absorbent and the solvent fume.

(b) Where more than 50mL of corrosive liquids are involved in a reaction or process that generates fumes.

(h) Where temperature and humidity extremes can affect filter operation. See Section 5 of AS/NZS 2240.9.2009[2]

2. Siting of the recirculating fume cabinet

- The recirculating fume cabinet should be positioned and used in a well ventilated laboratory, taking into consideration traffic flow, doorways and egress.

- Airflow disturbances can have an adverse effect on fume containment and may lead to leakage of fumes into its surroundings.
- The surrounding temperature and relative humidity should also be considered since they may affect the filter performance.
- If the cabinet is mobile and is moved it requires testing to ensure optimal safe performance.
- For further details see AS/NZS 2243.9.2009 Section 5 Siting and Commissioning

3. Poisoning and saturation of the filter

- Filters play a vital role in the safe operation of recirculating fume cabinets.
- Filters are not suitable for all substances.
- A risk assessment needs to be conducted to ensure that the filter is suitable for the chemicals being used and this should be reviewed on a regular basis
- The fitted or selected filter will only be compatible with the fumes of the group of chemicals it is designed for.
- Reactions that produce unknown or incompatible products should not be conducted in a recirculating fume cabinet.
- When changing a task where the chemical/s used are changed or there is an alteration in the quantity, volume or frequency of use of the chemical/s the filter must be checked to ensure compatibility and to avoid unexpected filter saturation.
- Filters will become saturated after continual use or in the event of a significant spillage. If breakthrough occurs, hazardous substances will be recirculated into the laboratory.
- It is difficult to estimate the lifespan of a filter
- It is recommended to dedicate these fume cabinets for fixed tasks.

Clause 6.2 of AS/NZS 2243.9.2009, General procedures[3]

Recirculating fume cabinets shall only be used for absorbing the fumes that the fitted filter is designed for, and not for carrying out reactions that produce unknown products.

High concentrations of fume entering the filter can saturate the absorber.

Clause 6.6.2.3 of AS/NZS 2243.9.2009, Saturation of the filter[4]

The filter material has a limited capacity to absorb fume. This will vary with the particular chemical compound used and any previous or simultaneous exposure to other chemicals. Consequently, it is difficult to accurately predict the working life of the filter. Early detection of fume break through or filter saturation can be determined by checking for fumes on the exhaust side of the filter.

Clause 6.6.2.4 of AS/NZS 2243.9.2009, Poisoning of the filter[5]

The absorption of small amounts of some chemicals can have disastrous effects on the capacity of the filter system for other fume

These effects are impossible to predict, so that great care should be shown in using the recirculating fume cabinet for a wide variety of tasks. Recirculating fume cabinets should be dedicated to fixed tasks.

4. Monitoring and disposal of filters:

- There are specific procedures and costs associated with filter monitoring, replacement and safe disposal.

- It is imperative to have systems in place for regular checking of filters for saturation and efficiency and also for monitoring air quality of the exhaust. This is clearly described in detail under **clause 6.6 of AS/NZS 2243.9.2009, Identifying Filter Saturation**
- Safe operating procedures should be in place for the safe handling, replacing and disposal of contaminated filters.
- Used filters should be handled and disposed of as hazardous waste.

References

[1,2,3,4,5] These excerpts are from AS/NZS 2243.9.2009 Safety in Laboratories Part 9: Recirculating fume cabinets reproduced with permission from SAI Global Ltd under Licence 1407-c117

Division of Occupational Health and Safety, Office of Research Services, Office of the Director, NIH. 2005. *Ductless fume cupboard review* National Institutes of Health website http://www.ors.od.nih.gov/sr/dohs/Documents/DOHS%20Ductless%20Fume%20Hoods%20Review_2007.pdf

'Fume cupboards, How to select', University College of London Safety Services website http://www.ucl.ac.uk/estates/safetynet/guidance/lev/select/types/fumecupboards/ (Accessed July 2015)

University of Reading 2014.*Safety code of practice 49: part 2, Fume cupboards: Selection, installation, maintenance and decommissioning,* University of Reading website https://www.reading.ac.uk/web/FILES/health-and-safety/CoP_49_Part_2_Fume_cupboards_selection_installation.pdf