VENTILATION AND ENVIRONMENTAL TOBACCO SMOKE

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Introduction

Environmental tobacco smoke (ETS) is harmful to health. It contains over 4,700 chemical compounds, some of which have been shown to be highly toxic. Some compounds are carcinogenic and some are mutagenic (change genetic material of cells). Heart disease caused by ETS may be of even greater concern than the well-known lung cancer effects (Source: US EPA, US ASHRAE Handbook of Fundamentals, 2005).

ETS can be removed from indoor air only by removing the source. Separation of smokers from non-smokers in the same room (or even adjoining rooms) may reduce, but will not eliminate, non-smokers' exposure to ETS. This is because pollutants in ETS readily disperse throughout a space, collect on surfaces, continue to off-gas for a lengthy period (perhaps 2 years), and the gaseous components of ETS are able to pass through porous materials. It is therefore important to appreciate that ETS comprises not only the particulates, which readily cause irritation of mucous membranes, but also gas phase compounds which are readily transmitted to the brain via nasal passages and the bloodstream when inhaled.

Ventilation standards that exist set down outdoor air rates that should satisfy normal occupant needs for comfort. Ventilation standards do not address occupant needs for health as it is assumed that pollutants within an occupied space (kitchen vapours, industrial fumes) will be removed at source. The twin criteria of health and comfort should not be confused.

Although a moderate level of smoking was socially acceptable a generation ago, and ventilation standards of the day reflected this attitude, such is not now the case. The change in standards as a result of scientific and medical data about ETS is best exemplified by the words in the Foreword to the 2004 edition of the US ASHRAE Ventilation Standard 62.1 that state, "The Minimum Ventilation Rate is revised to apply only to non-smoking spaces by deleting smoking lounges from the list of occupancy categories". The Australian standard AS 1668.2 -2002 highlights the dangers of ETS and avoids addressing the health effects by assuming that no level of smoking is satisfactory. This standard seeks to set requirements for the comfort effects (acceptable level of smell) of ETS, not its health effects.

Where researchers have sought to establish a ventilation rate that would reduce the respirable particulate levels (such as in a smoking environment) down to a level at or below sensory perception, it has been found that an air circulation rate of 3,800 litres of outdoor air per second per person is necessary. This rate per person is so high it almost certainly is unrealistic.

(For comparison, a ventilation rate of, say, 7 to 10 L/s is normal for an office building). In one ASHRAE study the researchers concluded, “There is evidence that acceptable air quality cannot be achieved where smoking is permitted”.

Pollution Control Technologies

Conventional engineering approaches to pollutant removal also provide for a range of technologies able to collect pollutants and, effectively, lower the ventilation rate otherwise required.

These techniques include:

. Air cleaning. Filters of various types trap airborne particulates on surfaces within the filter. Such devices only handle the air actually passing through the filter and are not located near the source of ETS pollution. They generally handle only the solid or liquid particulates, and gaseous compounds pass through. While filters able to handle some gases have been developed these are technically complex, handle only gases of certain types (high or low molecular weight), have the disturbing characteristic that they unload the gases back into the airstream upon saturation being approached, are costly, and very large in size. No standards have yet been developed, wordwide, for the performance of gas phase filters and information is mainly only that presented in vendor claims. Nonetheless gas phase filters find application in specific industrial applications such as at airports (to handle hydrocarbons such as benzene, paraffins or other targeted chemicals – not the wide range of gases present in ETS).

. Displacement ventilation. Air is supplied at floor level rather than at the ceiling as is the conventional approach. These systems are newly developed, have found application overseas and in a few Australian buildings, but are substantially unproven in use even when compared with other approaches aimed at providing air conditioning within a non-smoking environment. Their use for the smoking environment is not proven in use. Questions of floor cleaning and the off-gassing that continues from cigarette butts or ash at the floor grilles would need to be addressed. Again, because the gases within ETS are of varying weights it could not be expected that the gases, and small particulates, would follow a predetermined air path towards the ceiling but would rather, it would seem, follow paths according to random air and molecular movements which include lodgement against building and person surfaces so continuing to off-gas. An investigation into the use of this approach, conducted by the ACGIH, concluded that displacement ventilation showed promise but no real data was presented and so the technique is unproven.

. Particulate agglomeration techniques. In this approach the small particulates within ETS are electrically agglomerated to form larger dust particulates able to follow predetermined air paths and eventually to settle within the filtration equipment in air handling plant. These devices have been used in

conventional air conditioning applications and at some casinos. They are a form of filter associated with air handling plant (generally located in a plant room) and are incapable of addressing the pollutants actually present near the occupants of a room.

. Air curtains. These devices find their well-known application in protecting thermally treated environments such as at open doorways to cold rooms or large stores. They are also used in industrial applications such as to provide a curtain across a tank containing acid so that fumes are trapped before being collected with an appropriate exhaust system. It is conceivable to make use of this technology to produce a curtain of air across a croupier's breathing zone. However the practicalities of such an arrangement would be very challenging and, because large air volumes are necessary, it is unlikely the space would exist to install such ventilation plant. Further, the arrangement would be fixed in position and could not reasonably cater for the general movement of croupiers around a table. Certainly it would not help other staff who may be in the area (serving drinks perhaps) from exposure to the ETS produced at tables.

General

A number of devices have been promoted to handle ETS within occupancies such as restaurants. They include use of ionisers, UV light, HEPA filters, and other techniques. Unfortunately the claimed collection efficiencies of these devices, which are manufactured only to a low standard, are seldom realised in practice. Certainly there are no standards that could provide a level of independence to the claims of the manufacturers. As an example, HEPA (High Efficiency Particulate Air) filters are normally used at hospital operating theatres and industrial clean rooms where very high standards of cleanliness, room negative/positive pressure isolations, use of air locks, and special personal clothing are normal. A gambling casino could not aspire to such levels of fastidious spotlessness.

Further, the ongoing need for monitoring (which would have to be continuous) and high-level maintenance to ensure proper operation of equipment would be a special need well above that normally expected in commercial applications.

At a more generalised level, there is the variability of pollutant generation rate. It is obvious that a group of smokers around a table are unlikely to follow preconceived assumptions of proportion of smokers to non-smokers. This is generally taken as around 25% but would, surely, be much higher at these tables. Even assuming effectiveness of the air handling devices, assumptions of this nature are needed to be able to carry out calculations. With a high pollutant generation rate, the surrounds would be heavily polluted no matter what equipment is installed at the (remote) plant room.

Conclusions

1. Ventilation can only dilute or partially displace pollutants; occupational exposure limits are based on the “as low as reasonably practicable” principle. There are no exposure limits set for ETS as the consensus is that any exposure is harmful.

2. Barrier techniques such as air curtains may assist in reducing exposure of croupiers to ETS but diffusion of pollutant molecules always occurs and the general movement of patrons at a table would be likely to upset any air balances established beforehand.

3. Devices that arrest particulates (solids and liquids) do not stop the transmission of gases. ETS comprises many harmful gases as well as having irritating properties caused by particulates.

4. Special air movement arrangements for the transfer of conditioned air from supply grilles at a room toward the exhaust grilles are unlikely to be accomplished all the time as compared with, say, a cleanroom application in which there are no people movements nor door openings to upset air currents.

5. Filters for gases are dependent on the molecular size of the target chemical compounds. With the wide range of chemicals within ETS, these devices can be only partially effective. They find their main use at industrial applications for which the target pollutant gas compound properties are known.

6. While devices do exist to improve indoor air quality in commercial environments, this is largely related to the sensation of comfort. Such devices are imperfect in their ability to address the health effects caused by indoor pollutants.

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. ASHRAE – American Society of Heating, Refrigerating and Air-conditioning Engineers.

. ACGIH – American Conference of Governmental Industrial Hygienists