

The dusty path to sick buildings

There is growing evidence that indoor surface pollution is one of the causes of sick building syndrome and that ventilation and air conditioning can exacerbate the problem. Gary Raw of the BRE explains

INDOOR SURFACE pollution includes contaminants such as dust, fibres and micro-organisms, which are deposited on building surfaces and in office furnishings. It is not just settled dust: it consists of all those contaminants given off by the building's users, its contents and services. For example, people contribute micro-organisms, skin scales, debris from shoes and clothing, and the products of smoking, eating and drinking. Animals and plants are also a source of ISP. Building, furnishing and office materials can degrade, releasing particles or fibres; they can also store up dust and dirt, particularly organic material, and become inhabited by organisms such as fungi and dust mites. The pres-

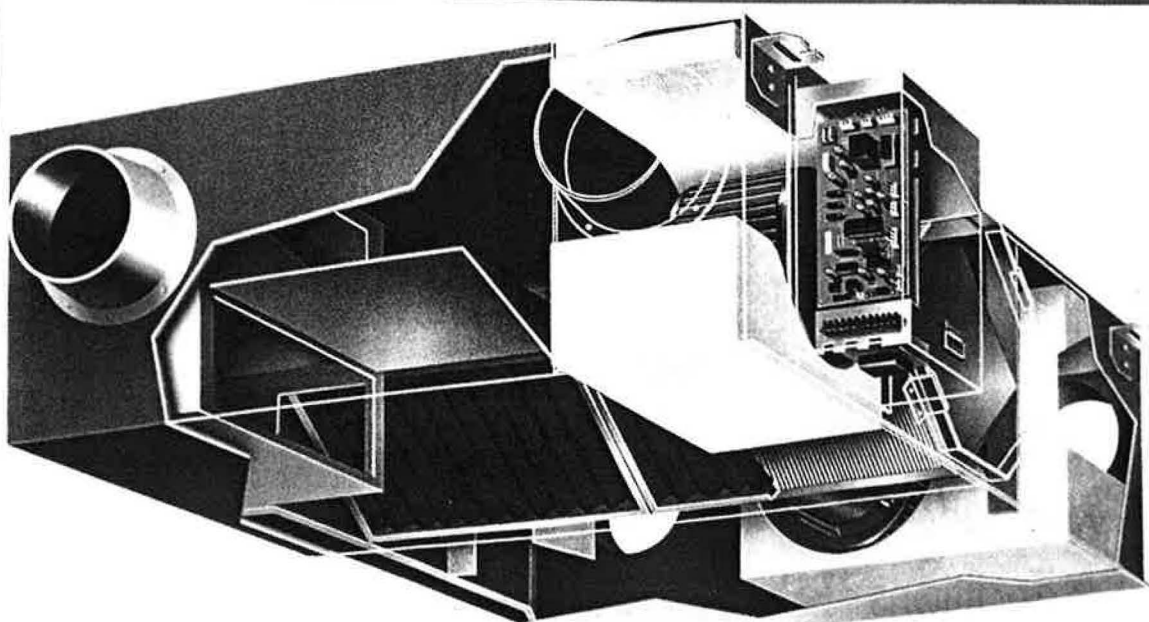
ence of particles can in turn increase the adverse effects on health of gaseous air pollutants.

POLLUTANTS

■ Ventilation systems can raise the level of ISP by providing insufficient filtration of outside or recirculation air, and by emitting pollutants from within the system (such as fibres from filters or duct lining, accumulated dust and micro-organisms). Air conditioning systems can also contribute to ISP by maintaining an indoor environment which is suitable for micro-organisms.

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► Air conditioning manufacturer Daikin claims to have improved the ability of its VRV systems to provide better quality air by refining the heat exchanger technology in its HRV heat reclaim unit and combining it with the ac system



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Paradoxically, SBS is most commonly reported in air-conditioned buildings, even though the filtration provided by the air-conditioning system should mean that levels of airborne particulates are lower than in naturally ventilated buildings. There are two reasons for this apparent contradiction. First, people at work create their own 'dust cloud' by stirring up settled dust, so much so that office workers can be exposed to dust levels which are four to five times higher than ambient airborne levels.

Second, there is more to ISP than potential air pollution, which has to be inhaled to be troublesome. ISP can also be transferred to the hands and thence to the face, or ingested with food or drink: These aspects of indoor pollution have hardly been explored at all in the context of SBS.

EVIDENCE

Recent studies have built up a considerable body of evidence for a relationship between ISP and SBS including 'the fleece factor': the area of carpet, curtains and other fabric divided by the volume of the space, and 'the shelf factor': the length of open shelving or filing divided by the volume of the space.

These two factors reflect possible sources of pollution, such as organic material and ISP. The occurrence of SBS symptoms was also correlated with a poor stan-

dard of office cleaning, and with the presence of macromolecular organic dust on the floor.

Research in the United States found a significant correlation between SBS and the level of deposited man-made mineral fibres: the level of airborne fibres did not have a significant effect on SBS. The presence of deposited fibres may be important in its own right, or - more likely - it may reflect the general level of cleaning and ISP.

A study in Britain found that the only environmental factor correlated with dissatisfaction with the office environment was deposited dust. There was no such correlation with temperature, humidity or CO2 levels, or with the presence of airborne dust, bacteria and fungi.

Two previous BRE studies have sought to identify the causal factors responsible for the correlation between the fleece and shelf factors, standards of office cleaning, and SBS. In the first study, cool shampooing was used with vacuum cleaning on carpets, chairs and other fabric surfaces. Hard surfaces (on furniture, window sills, and window blinds) were cleaned with wet cloths to remove dust. Paper files were vacuum cleaned to remove dust as thoroughly as possible, and vacuum cleaners were fitted with high-efficiency final filters. The second study investigated the effectiveness of a similar cleaning regime. The

“A body of evidence links SBS with indoor surface pollution”

only changes were that steam cleaning was substituted for cool shampooing, and there was no vacuuming of the paper files.

In both studies, after the office had been cleaned, people reported a large improvement (relative to a control group) in their SBS symptoms and in the working environment. The overall reduction in weekly SBS symptoms was greater in the second study. The cleaning methods used in this study reduced the prevalence of dust mites, particularly in chair covers. This raises the possibility that mites were responsible for the symptoms, but does not prove it conclusively.

TREATED

Apart from the direct evidence linking SBS and ISP, a number of other findings can be explained in terms of ISP.

* SBS can apparently be successfully treated by the removal of carpets.

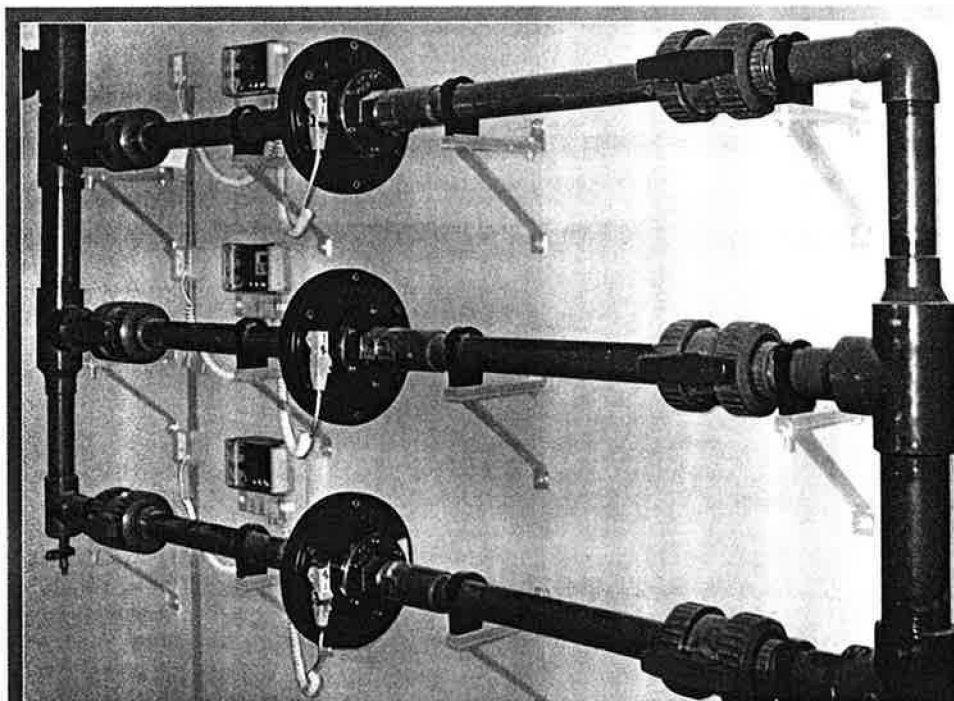
* SBS has been found to occur most frequently in:

a) older buildings, ie those built in the 1970s compared with those built in 1980s

b) public sector buildings, which, in general, were not maintained as well as buildings in the private sector, and

c) open-plan spaces which, by comparison with cellular offices, can make it more difficult to determine who is responsible for dirty surfaces, and hinder access for cleaning staff.

There has been limited success in linking SBS to ventilation rates and indoor pollutant levels. This makes sense in terms of ISP, because higher ventilation rates will have little effect on ISP. On the contrary, they could result in additional environmental prob-



Three Hydromag electromagnetic water conditioners were installed in this plant room to provide a barrier to the build-up of limescale on a continuous basis. The manufacturer claims that the system is designed to work non-stop and that it requires no maintenance.

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▲ The new stand at Preston North End Football Club bears that name of its most famous player, Tom Finney. As well as being a soccer legend, Mr Finney also founded a building services contracting company which was the one chosen, appropriately, to carry out the m&e services including Andrews water heaters and Chaffoteaux boilers to supply hygienic hot water.

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lems, such as draughts, increased transfer of contaminants from the ventilation system, and increased disturbance of settled dust in the building.

STUFFY

■ SBS is generally correlated with a perception that the air is hot, stuffy or dry. However, the sensation of dry air is not always due to low humidity: it can also be caused by dust and gaseous air pollutants.

There is a correlation between the operation of visual display units (VDUs) and SBS4, but the

precise reason has not yet been established. It may be that VDU work is correlated with a more direct causal factor: for example, the user may be restricted to a poor working environment for long periods. Alternatively, the screen may attract charged particles to the vicinity of the user's face.

Attempts to reduce SBS by air ionisation have had a mixture of positive and negative results. Ionisers can deposit dust out of the air, and their effect may depend on how much dust is in the air, what pollutants are adsorbed by the dust, and what cleaning is carried out to remove deposited dust.

The results of the study confirmed earlier findings on the benefits of reducing ISP. The reasons for these benefits are now also clearer: for example, treating chairs with liquid nitrogen significantly reduced symptoms, which strengthens the argument that dust mites are partly responsible for ill effects of SBS. The office cleaning treatment provided additional indirect evidence of the role of dust mites in SBS. It also confirmed that dust on papers and hard surfaces, as well as dust on soft furnishings, can produce SBS symp-

toms. A mixture of allergens in the dust, plus irritant or toxic effects, might account for these symptoms.

It is therefore of some concern that ISP has not been measured in many studies of SBS. Measurement of ambient air pollution, by human panels or by mechanical instruments, may not adequately reflect people's exposure to airborne pollution. This is true, not only of ISP, but also of other pollutants which have localised sources related to the activities of office users, eg correction fluids, glossy paper, photocopiers, etc.

DESIGN

■ Indoor air pollution has tended to be seen as a problem caused partly by ISP. This has led to errors in study design and associated measurements. Instead, it may be appropriate to think of ISP as a problem in its own right, which needs special measures to combat it. It is well understood that cleanliness of building services is important for health, but the cleanliness of offices also needs attention. ■

“The offices themselves must be clean not just the services”

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