

## PRACTICAL RESEARCH BRIEFS

### In-Vehicle Pollution: Is Commuting Linked to SBS Symptoms?

Is it possible that vehicle emissions during a long commute contribute to an individual's response to building conditions? This is an unexplored area, but the possibility arises with a recent report on the buildup of pollutants within vehicles under certain road conditions.

Surveys of building occupants often include questions about the respondents' health status and allergy history, but none, or few, explore the conditions under which different respondents get to work each day.

This at least raises the possibility that adverse pollution conditions during the commute may sensitize some individuals to react more vigorously to conditions within the building.

The report by Paul Jeffries and others from Earth Resources Research of London, UK, uses a number of studies from various countries and finds that in-vehicle levels of such pollutants as benzene, other hydrocarbons, carbon monoxide (CO), and nitrogen dioxide (NO<sub>2</sub>) are substantially higher inside automobiles than they are in the air 50 to 100 meters from the road.

Ventilation didn't substantially change the in-vehicle pollutant levels, primarily because the concentration immediately outside the vehicle creates what the authors call a "tunnel" of pollution, with the concentration highest on the road itself and decreasing rapidly with the distance from the center of the road.

Jeffries and the other authors, rather than focusing on the absolute level of pollutants, concentrated on the relative pollution load between the in-vehicle levels and those levels found in the ambient air.

#### Volatile Organic Compounds

Various volatile organic compounds (VOCs) come from automobile exhaust, through uncombusted or partly combusted fuel, and by evaporation from the engine or fuel tank during vehicle operation. However, the in-vehicle levels of VOCs, including benzene, range from 2 to 18 times higher than levels found at the roadside. This would mean that drivers on long commutes would endure benzene levels higher than those who walk or take public transportation.

One study cited by the authors found in-vehicle benzene levels to be twice as high as those for urban cyclists and pedestrians and four to seven times as high as in the home.

Running the air conditioner seemed to lower pollution levels, but the levels increased with the heater or the fan on. Opening windows didn't seem to have any effect.

#### Carbon Monoxide

CO levels within cars averaged from 8 to 14 parts per million (ppm), although they sometimes peaked at 60 ppm or higher. The authors point out that for nonsmokers, commuting may constitute their single greatest exposure to CO — about 25% of their total intake. Interior CO levels rise in slow or heavy traffic, as could be expected.

#### Nitrogen Dioxide

NO<sub>2</sub> levels proved to be more of a problem, the study reports. Although absolute levels were lower, the effective exposure was greater with regard to ambient levels and health guidelines.

The greatest concentrations of NO<sub>2</sub> seemed to be the opposite of other pollutants — higher on roads outside the city and lower in urban areas. Also, the levels were greater in the afternoon than in the morning, most likely because NO<sub>2</sub> concentration depends on background levels and on the availability of ozone, which increases as the day progresses.

Factors that affected the pollution concentrations in many of the studies cited included time of day, traffic density, and atmospheric conditions. For all pollutants, except NO<sub>2</sub>, concentrations are usually highest during the morning rush hour, when traffic is heaviest.

Another factor is the ratio of gasoline-driven vehicles to diesel vehicles. This means that the truck-to-car ratio is important, and that conditions will differ in some areas, such as the UK, where buses and taxis are diesel-powered.

One interesting note is that the NO<sub>2</sub> levels in the US, where catalytic converters are required, were comparable to those in areas where the devices are not widely used. This suggests that pollution control devices alone may not be enough.

## Conclusions

The findings suggest no obvious link to building-related health problems or reactions, nor do the authors make any such connection. However, this is due more to the lack of any studies correlating the two than to proof of the contrary.

One perplexing aspect of sick building syndrome is why some occupants develop symptoms and others who work in the same conditions do not. It's possible that exposure to increased pollution levels during a lengthy commute could explain

some of the variation, although the effect of that on building operation policies is uncertain.

It might mean nothing more than that ventilation procedures may have to account for the fact that some people arrive in the building already compromised from exposure to CO and VOCs.

While further research would show what correlation, if any, exists, the link can't be ruled out without some study of the issue.

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## Can't Rule Out Cat and Dust Mite Allergens in Office Problems

Many IAQ professionals consider dust mites and cat allergens to be problems in residential rather than commercial settings, and most pay little attention to the potential roles these allergens play in sick building syndrome. However, one group of researchers has found that we may need to rethink this approach.

The main concern with both mites and allergens is that they elicit allergic responses and asthmatic attacks in many susceptible individuals. However, the more hospitable conditions for mites in homes and the general lack of cats in office buildings have made both the subject of less concern in nonresidential settings.

Ling-Ling Hung, a microbiologist with the US Public Health Service in Philadelphia, Pennsylvania, USA, and a group of other researchers recently reported their findings that stemmed from a study of five large office buildings in the mid-Atlantic region of the US. The team reported the research at ASHRAE's IAQ '92 symposium in San Francisco, California, USA, in late October.

The researchers found that dust mite allergens were at generally low levels, although moderate to high levels turned up in some office carpets and chairs in several of the buildings. Cat dander allergens, however, were at high levels in all buildings. Most high readings occurred at the locations of employees who had cats at home, and researchers theorize that the employees carried the allergens into the office on their clothing.

### The Research Project

Researchers focused on five office buildings — two in Philadelphia and three in Washington, DC, USA. They selected 10 carpet and 5 chair

dust samples from each building. For the carpet samples, they vacuumed a two-square-meter area for three minutes with a filtration device. They also vacuumed the entire surface of selected chairs for three minutes.

The team then analyzed the dust for the two dust mite species most commonly associated with allergic reactions — *Dermatophagoides pteronyssinus* (Der p-I) and *Dermatophagoides farinae* (Der f-I). The "I" designation refers to the group I allergens, which are associated with mite feces and are carried on particles greater than 10 µm in diameter. Because of their large size, the allergen particles don't usually remain airborne and may cause reactions in some individuals only when the dust in the room is disturbed.

Researchers also looked for the major cat dander allergen, Fel d-I, usually found on particles less than 2.5 µm in diameter. These tend to remain airborne longer — sometimes for several hours — and many susceptible individuals may experience a reaction even in an undisturbed room. Also, previous studies have shown that reactions can occur even in places where there are no resident cats.

### Allergen Risk Levels

For Der p-I and Der f-I, levels less than 2 µg/g of dust — or 100 mites per gram of dust — are considered low and present little risk. Between 2 and 10 µg/g of dust, a moderate risk exists for sensitization and bronchial hyperactivity. Above 10 µg/g of dust, the risk is high for acute asthmatic attacks in mite-allergic individuals.

Of 75 samples taken, 10 locations showed mite allergen levels in the moderate range, and only 1