

accelerated air velocity. Only in these cases are measurements potentially useful.

The irritant effect of MMMFs, which is occasionally the subject of debate, is linked to fibres larger than the WHO variety and only occurs if mineral-wool insulating materials have not been installed properly or the cladding has become damaged over time and there are visible fibrous dust deposits. According to Walker et al. [23], there are no health-related grounds for removing old MMMF insulating materials that have been properly installed.

Asbestos fibre dust poses much more of a hazard. If it is suspected that asbestos fibres have been released in the building in question, further investigation must be carried out using the customary procedures, as described at length in [24] for example. If necessary, a refurbishment plan must be drawn up in line with the requirements of the Asbestos Directive [21].

Tobacco smoke in indoor workplaces

Tobacco smoke in indoor air is classified as carcinogenic for humans. By law, employees are entitled to a smoke-free workplace. Section 5 (1) of the Arbeitsstättenverordnung (Ordinance on Workplaces) [25] states:

“Employers must take the measures necessary to ensure effective workplace protection for non-smoking employees against the health hazards of tobacco smoke.”

There are various ways of complying with the legal requirement to protect non-smokers. The most effective is to impose a universal ban on smoking throughout the building concerned. Once such a ban is in place, there is no longer any need to include tobacco smoke when investigating sources of air pollution.

The German statutory accident insurance institutions published a report in 2011 on the topic of tobacco smoke pollution in workplaces, including an in-depth review of exposure situations in indoor workplaces [26].

12.4.7 Phthalates

Phthalates continue to be manufactured on a large scale. Around 1 million tonnes are currently produced every year in Western Europe, roughly 90% of which is used for plasticising in polyvinyl chloride (PVC) production [27]. Indoor applications include plastic floor coverings, additives including additives in building materials such as concrete, coatings or sealants and in condensers, wallpapers and textiles. As phthalates can be used as solubilising agents, they can also be found in paints, varnishes, adhesives, cosmetics and personal care products.

Unusually high levels of butanol and/or 2-ethylhexanol detected in the VOC analysis can be an indication of increased phthalate concentrations since they can be released from dibutyl phthalate (DBP) and di(2-ethylhexyl)phthalate (DEHP) plasticisers by means of hydrolysis.

Usually DEHP dominates indoors and has been found at concentrations around the low $\mu\text{g}/\text{m}^3$ mark in the air in homes

examined in a number of studies [27]. The total phthalate content usually detected in house dust can be up to 1,000 mg/kg though this increasingly includes longer-chain phthalate substitutes, e.g. diisononyl phthalate, in addition to the main component, DEHP [28].

Due to their hormonal properties and toxicity to reproduction, phthalate plasticisers in dust in nurseries can be a particular problem. The average phthalate level in such dust is more than three times higher than that of dust in homes [29]. The main sources are furnishings made of soft PVC – for instance, PVC floors, vinyl wallpaper, gym mats, plastic tablecloths or imitation leather upholstery. By contrast, there has long been a ban, for example, on the use of phthalates in children’s toys, which used to be common.

The UBA has recommended nurseries not to buy soft PVC products so as to reduce phthalate levels. Instead, nurseries and parents should opt for products that do not contain any of the plasticisers listed as being “of high concern” [30]. Retailers and distributors must provide consumers with the relevant information on request. Parents and nurseries should take advantage of this right. The UBA has drawn up a template letter for contacting retailers to find out more [31].

12.4.8 Insecticides

Although insecticides, i.e. products for insect pest control, are primarily used in agriculture and forestry, they are also used extensively indoors for the following purposes:

- to preserve wood and protect fabric (e.g. permethrin in wool carpets);
- to provide mosquito protection (electric vaporisers and sprays);
- to protect plants against pests;
- to treat parasitic skin diseases in humans and animals; and
- to eliminate pests (e.g. cockroaches, silverfish) by means of decontamination.

The following categories of substance currently play a role in indoor applications:

- Pyrethroids

Pyrethroids serve as active ingredients in more than half of the insecticides used indoors. They go by various names, including permethrin, cypermethrin, cyfluthrin, deltamethrin, allethrin and tetramethrin. Recently, there has been much debate about their effect on human beings. The target organ for pyrethroids is the nervous system – both in insects and in warm-blooded animals. Incorrect handling can cause acute poisoning in humans but there is also some debate as to the possibility of the substances penetrating the skin. The chronic neurotoxic potential is deemed to be low. Unlike the natural product pyrethrum, pyrethroids are extremely persistent by virtue of their absorption capacity, low vapour pressure and