CAN AN EASILY RECOGNISED ODOUR “MASK” THE PERCEPTION OF IRRITATING SUBSTANCES IN INDOOR AIR? – A CASE REPORT

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ABSTRACT

Sixty percent of pupils and personnel in a secondary school reported unpleasant odours, which they attributed to gases from the waste system. The was verified by the technical investigation which also found signs of breakdown products from the floor, including ammonia, 2-ethyl hexanol and n-butanol. However, the prevalences of eye, nose and throat irritations reported by pupils and school personnel were surprisingly low. In a nearby school having the same type of problems, the prevalence of symptoms from the mucous membranes was high. A strong but easily recognised and familiar odour seems to “mask” the diffuse stimulus pattern of specific volatile organic compounds in low concentrations which are thought to irritate the mucous membranes.

INTRODUCTION

In a questionnaire survey including 27 schools in Stockholm, one school differed from the others because of a high frequency of complaints about unpleasant odours among both pupils and school personnel (60% stated that they often were disturbed), but few symptoms from the upper airways. From comments in the questionnaires, it was obvious that gases were emitted from the waste system. An inspection verified this but also found signs of evident chemical breakdown of compounds in the floor. In a nearby school having no problems with the waste system, but the same type of construction and moisture problems, the prevalence of mucous membrane irritations was high.

The school was built in 1979 and had a self-levelling layer of compounds containing casein covering the concrete floor. It is well known that, in a alkaline environment with high humidity, the casein decomposes to ammonia and amines and the plasticizers in the PVC carpet break down, forming 2-ethyl hexanol [1]. An investigation was performed, including technical measurements of ammonia and VOCs, especially 2-ethyl hexanol and n-butanol.

RESULTS

Questionnaire survey
The results of the questionnaire survey are presented in Figure 1 which shows similar complaints patterns in pupils (n=248, 13-15 years of age) and school personnel (n=30). The prevalence of symptoms differ, but both pupils and school personnel report few symptoms from the mucous membranes and similar to those seen in healthy buildings [2]. Pupils normally report a higher prevalence of general symptoms, especially concentration difficulties, than adults do, which is evident in this study.
Technical measurements
Volatile organic compounds were sampled on Tenax tubes and analysed with a gas chromatograph having a mass-selective detector. Samples were taken from the space between the concrete and the PVC-carpet and from the indoor air. The emissions were very high under the carpet (TVOC >30 000 µg/m³, 2-ethyl hexanol >1 100 µg/m³, n-butanol >5 000 µg/m³) and were also high when half of the carpet was removed (TVOC 1 520 µg/m³, 2-ethyl hexanol >120 µg/m³, n-butanol >390 µg/m³), but lower in a room where the carpet was untouched (TVOC 310 µg/m³, 2-ethyl hexanol 7 µg/m³, n-butanol 10 µg/m³). Eight samples of the self-levelling compound were analysed and all contained proteins (casein). Measurements of ammonia under the carpet showed concentrations between 10 and 200 ppm, indicating massive decomposition of the casein.

Figure 1. The perceived indoor climate and symptoms (based on standardised questionnaires (MM 040 NA and MM 060 NA) among pupils (n=248, thin line) and school personnel (n=30, thick line) in the study school. The shadowed areas represent the references for healthy buildings [2].

DISCUSSION
A serious moisture problem causing emissions of ammonia and typical VOCs was discovered. These situations are commonly associated with irritation of the mucous membranes, although low concentrations are mostly measured in the indoor air, which was also the case in the nearby school. This may be explained by the extreme homogenisation of the indoor climate in modern buildings, causing sensory confusion and strain on the system when trying to interpret the diffuse signals from these environments [3]. On the other hand, it is sufficient with a single sniff to distinguish the characteristic odour of one air sample from another, probably because the olfactory system can perform a “pattern analysis” and make use of image comparison based on earlier experiences. In this case, the odours from the waste gases were perceived as very unpleasant, but also easily interpreted and recognised from earlier experiences. The odours were probably strong enough to “mask” the emissions from the water-damaged floor and avoid the development of mucous membrane irritations from the eyes, nose and throat found in the neighbouring school.
REFERENCES