AIRING OUT POLLUTIONS

T Follin
BARAB, Sweden

ABSTRACT

In Stockholm the indoor air in a group of multistorey, newly constructed, buildings was contaminated due to destruction of carpet glue on damp concrete with high pH level. In the same houses SBS symptoms was common.

In order to reduce the SBS-symptoms, airing out (baking out) the contaminants from the concrete was done after removing the carpets.(1), (2), (3), (4). Measurings showed that the VOC concentration in the indoor air was dependent on indoor air temperature and on surface temperature on the emitting floor, that the emissions from the floor rose when baking out and that there was no correlation betwen odour strength and VOC concentration. A half year after the baking out period a questionaire survey showed the same result as in undamaged houses. The sick buildings was cured.

INTRODUKTION

In 10 residential buildings, 160 apartments, in Stockholm, SBS symptoms occurred. The main reason for the symptoms was contamination of the indoor air due to destruction of carpet glue as a result of a high humidity level and a high pH level in the concrete when gluing the carpets.

When this kind of destruction occurs, 2-ethylhexanol and n-butanol are produced and found in the indoor air.

High concentrations of 2-ethylhexanol was found in the room air in various apartments. We decided that in apartments with a concentration higher than 10 ng/l in the room air retrofits had to be done.

Finding a relationship betwen the concentration of 2-ethylhexanol in the room air and the odour intensity under the carpet failed. The odour intensity under the carpet was judged in a scale from 0 to 5. In some of the apartments VOC-samples were taken in the room air at the same time. Retrofits based on the odour intensity under the carpets were inappropriate as the resulting concentration of 2-ethylhexanol in the room air varied widely.

As a result of the failure of the odour investigation it was decided to do VOC sampling in the room air in all apartments in order to decide where retrofits should be done. In the different flats in the houses the concentration varied widely.

In the advice on cures we recommended retrofits in flats where the 2-etylhexanol concentration ecceeded 10 ng/l in the room air (at normal ventilation). The method recomended was to take the carpets and the remaining glue away and air out the contamination still remaining in the concrete. We already knew (1) that most of the contamination occurs in the upper concrete surface and that high temperature supports the airing out (baking out) (2).

In order to predict how long time the baking out period had to be it was nessesary to follow the decline of emissions from the concrete surface during the baking out period. The target for the emission had to be set at a level low enough for the resulting concentration in the room air after a new carpet was laid not to exceed 10 ng/l.

METHODS

Sampling in the concrete slabs

In order to compare the concentrations of 2-ethylhexanol between different houses and different depths, concrete samples Ø100 mm were drilled out and examined. (4)

Baking out time

A piece of the vinyl carpet was removed and the emissions of 2-ethylhexanol from the concrete were measured with the Field and Laboratory Emission Cell (FLEC) (3).

The rest of the carpet was removed and all remaining glue was taken away. The following day the emissions from the concrete were measured with the FLEC again and after that every third day for two weeks.

During those two weeks the room was heated to 35°C. At the same time it was well ventilated.

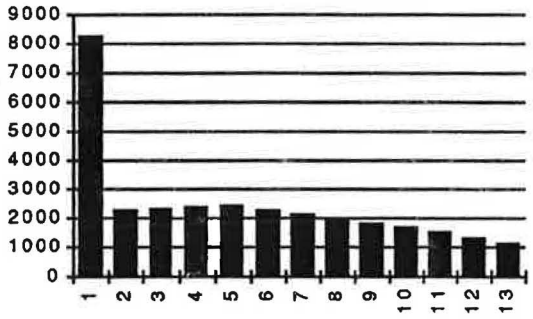

Fig 1. Emissions of 2-ethylhexanol (ng/l) from the concrete surface during the two weeks of baking out.

Removal of the carpet and the glue made the emissions drop to 1/4 in one day. After that the emissions increased slightly due to the high temperature and started to decline after less than one week.

We calculated the airing/baking out time needed in every apartment. (4)

In three apartments the room air concentrations had been so high that the results were questioned (67, 89 and 86 ng/l). Instead of calculations, that would result in very long baking out times new samples were taken. The result was 80, 180 and 220 ng/l. Instead of the lower concentrations we had hoped for the concentrations were much higher in the second sampling. The reason to the big differences was sunshine on the floors during the second sampling.

Due to those results the calculated baking out times were questioned. (4)

Emission measurments with FLEC equipment

The new theory was that the conditions in the different concrete slabs might be nearly the same (the same degree of destruction) and that the differences in concentration of 2-ethylhexanol in the room air was dependent more on differences in temperature in the concrete then in differences in the degree of destruction. In order to get control over the real situation in the concrete slabs during the baking out time measurments with the FLEC equipment were made in some apartments during the baking out time.

The initial concentrations were not the same in the different floors as we had believed but the differences were not as big as in the samples taken from the air. In most cases the concentration in the concrete was already below the limit some day after the flooring materials had been taken away.

VOC-sampling in the air

2 L air was pumped trough steel tubes containing Tenax absorbent indoors and outdoors. (4).

Half a year after the cures was done new VOC samples showed that loose layed PVC carpets still emitted much 2-etylhexanol, so much that the room air concentration was over the target level in most of those apartments. In apartments with linoleum carpets some values was to high depending on lack of surfase coating on the carpet (wax or polish), it was far too open for diffusion of vapours from the concrete. Of about the same reason some of the apartement where wooden floors had been choosen had too high values too. There was a significant difference betwen the concentration of 2-etylhexanol in the room air in apartments with PVC flooring and those with other kind of floorings. The concentration in the apartments with PVC floorings was higher, due to initial emissions that continued longer time than calculated.

RESULTS

The final control measurings in the room air was done during the fall ´96, half a year after curing, in order to avoid hot sunny days and to avoid the initial emissions from the new carpets.

The control measurings showed that the the airing/baking out had been successful. The target level (10 ng/l) had been reashed eccept in some apartements. In those apartments other reasons to much 2-etylhexanol in the room air was found: bad ventilation, initial emission, floorings more open for diffusion than calculated.

At the same time as the control measurings were done a questionnaire survey (5) were done. The result of this survey shows a success. The result was about the same as in the referens houses used when creating the questionnaire (houses without known IAQ problems=normal houses).

DISCUSSION

During the work we learned:
* The concentration of VOC in the room air is dependent on the temperature on the room surfaces, not only on ventilation rate.

* There is no relation betwen odour under a carpet and measured VOC:s in the room air produced for the same reason.

* Most of the contaminants due to destruction of carpet glue dissapear at the same time as the remaining glue is taken away.

* It is not the 2-ethylhexanol who causes the SBS-symptoms.

* Compound(s) produced due to destruction of water based carpet glue causes SBS-symptoms.

* We have got one more prove on that it is possible to cure sick buildings.

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