REDUCING THE MOISTURE CONTENT IN A CONCRETE PREFAB CONSTRUCTION HELPS TO IMPROVE REPORTED SENSORY-IRRITATION SYMPTOMS

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In a health care center erected in 1981 several sensory-irritation symptoms were reported. A combined medical and technical step-by-step investigation indicated technical shortcomings in the building. With the use of self-administrated questionnaires before, during and after relevant technical alterations, an obvious reduction of the building related symptoms were documented. The results from chemical and moisture measurements will be presented and discussed.

INTRODUCTION

In a middle size Swedish town a health care center was erected in 1981 on watery ground.
For the local people this place, in the wintertime, was used as an excellent skating ground.
Soon the health care personnel complained on "sick building symptoms" such as sensory-irritation from the upper airways and skin, and general symptoms such as fatigue and mild headache and bad odour. Upon leaving the building, they experienced a clear relief of these symptoms.

METHODS

After several years of minor technical alterations without successful outcome a group of technicians, representatives of the local staff and a physician from the Department of Occupational Medicine in Örebro, was formed.

A step-by-step investigation with unbiased and thorough penetration of existing ground conditions, construction, building material and installation, was initiated.

The medical survey consisted of an examination of all dental health care personnel and others who consulted examination. A self-administrated questionnaire on symptoms related to the indoor climate was used before, during and after technical alterations. Here the results from two different occasions, January 1987 (n=48) and February 1989 (n=46), will be presented.

The moisture content of the slab was measured in predrilled holes using a calibrated Rh-meter. The holes were drilled to 30, 60, 90, 120, 150 and 180 mm depth, respectively. The moisture content of the slab and the air in the holes were allowed to come to equilibrium for at least 48 hours prior to measurement. After the measurement the holes were sealed using a plastic plug and tape.

Organic compounds were trapped on Tenax by active pumping (approx. 200 ml/min) for about 30 minutes. The Tenax tubes were then thermally desorped to a gas chromatographic/mass spectrometric system.

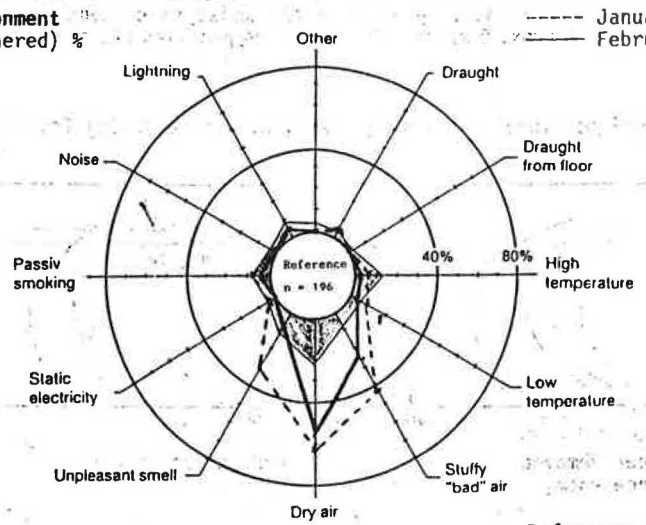
RESULTS AND DISCUSSION

Medical investigation:

In figure 1 there is a clear reduction of complaints concerning the work environment between January 1987 and February 1988.
As illustrated by figure 2 an obvious reduction of the symptoms related to the indoor climate was achieved. This is true in particular for sensory-irriation symptoms and general symptoms. In fact the symptoms are reduced to a level close to or better than the reference group. The small increase in skin symptoms is probably due to an unusual cold winter 1988 (-25°C).

Fig. 1

Work environment
(often bothered) %

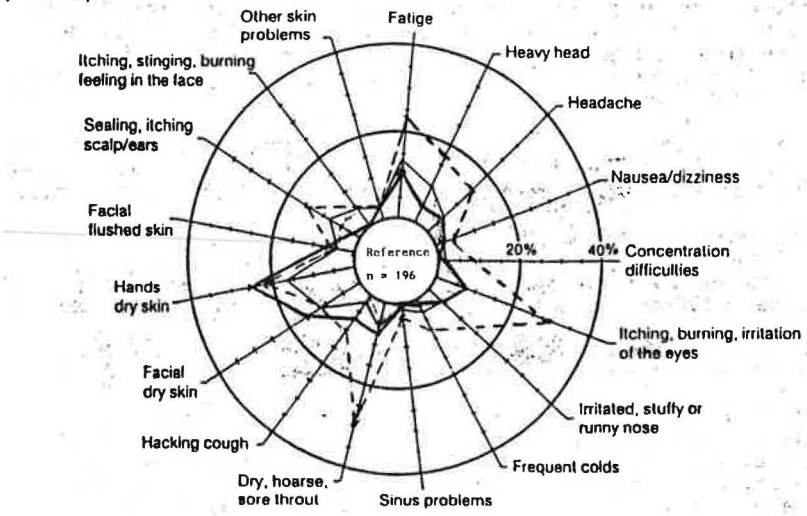


Reference group.

The shaded area represents complaints as reported from n=196 persons in healthy buildings.

Fig. 2

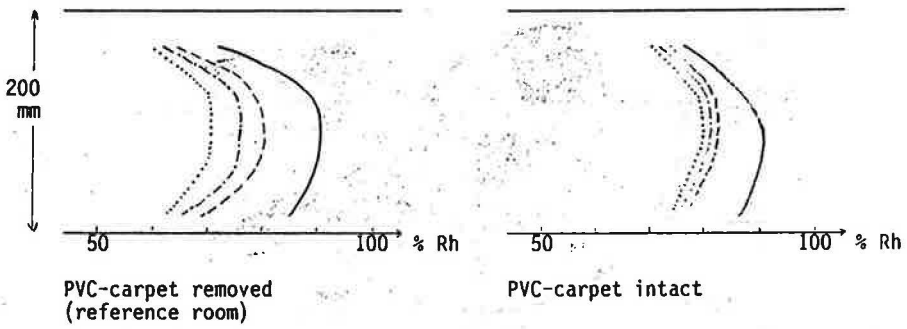
Symptoms
(yes, often) %



Technical investigation

As a premier attempt to reduce the moisture content of the slab, dried heated air was flushed under the slab. The floor was kept intact. In one room, however, we removed parts of the PVC-carpet. This room was used as a reference when studying the moisture reduction rate. We studied the moisture content by intermittent measurements over approx. 9 months. The moisture profiles are presented in figure 3.

Fig. 3 Typical moisture profiles in the slab. Active drying from below.



The left-hand drawings represents the moisture conditions when the carpet is removed and the right-hand when the floor covering (PVC-carpet) is kept on. It is obvious from the figure that it is impossible, in reasonable time, to dry the slab with heated dry air from below. It can also be seen that the drying from both upper and under sides gives a good result.

Thus the PVC-carpet was removed and the slab was dried from the upper side by using active dehumidifiers in each room. The self-levelling screed is sensitive to high moisture contents and higher values than 75 % Rh leads to ammonia emission.

The time needed to reach 70 % from the initial 90 % varies due to the thickness of the slab and to a minor extent to the weather conditions. In the case presented here we reached 70 % within 2-4 weeks. After the successful reduction of moisture and change of PVC-carpets no complaints about bad odour have been reported.

In the end of 1989 we made a check of the content of chemical compounds in some rooms where we originally have had high concentrations of chemical substances. Based on Tenax sampling we found 140 µg/m³ in one room and 90 µg/m³ in another, figures 4 and 5. The compounds found by mass spectrometric analysis were aliphatic hydrocarbons in the range C9-C12 probably from a white spirit fraction, some aromatics such as toluene and xylenes and finally some glycol - ethers from water based paints. The concentrations found are on a level where we normally have no complaints or symptoms related to the indoor climate.

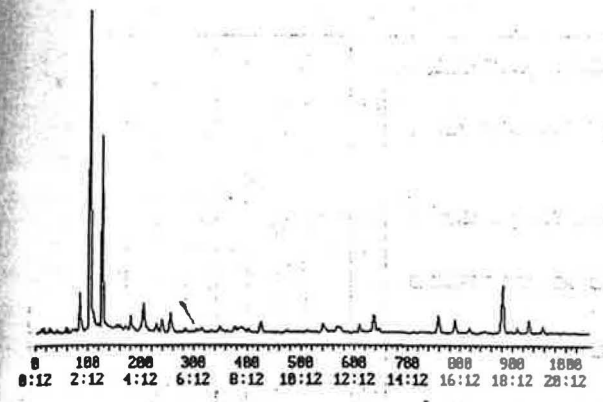


Fig. 4 Concentration of organic compounds in a medical examination room (90 µg/m³)

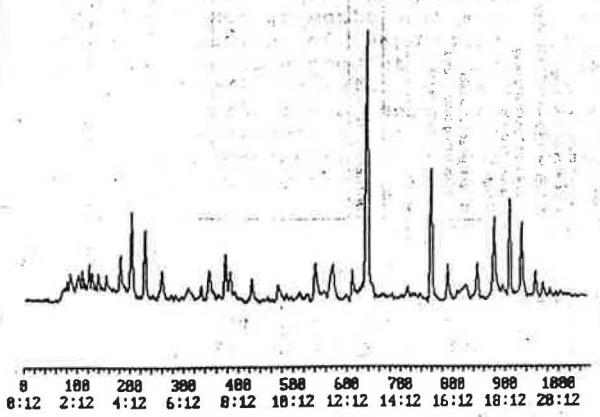


Fig. 5 Concentration of organic compounds in a dental treatment room (140 µg/m³)

CONCLUSIONS

Sensory-irritation symptoms and complaints originating from exposure to chemicals from a humid slab construction can be reduced by active drying and minor changes of materials.
Questionnaires provide an excellent low-cost method to evaluate symptoms and complaints before and after technical measures.
A latter version of the indoor climate questionnaire (MM 040 EA) is available in English, figure 6.

REFERENCES

Andersson K, Fagerlund I, Bodin L, Ydreborg B. Questionnaire as an Instrument when Evaluating Indoor Climate. Healthy Buildings' 88, vol 3, p 139-145.

Fig. 6

INDOOR CLIMATE

MM 040 EA

Work environment

ENGLISH VERSION

Name

Date

Company/institution

Number

Occupation

Department

User

Group

Filled in by investigator

This questionnaire concerns your indoor climate and possible symptoms you may be experiencing.

BACKGROUND FACTORS

Year of birth 19 ___

Sex male ☐ female ☐

Do you smoke? Yes ☐ No ☐

Occupation .....

How long have you been in your present place of work? ___ years

WORK ENVIRONMENT

Have you been bothered during the last three months by any of the following factors at your work place?

	Yes, often (every week)	Yes, sometimes	No, never
Draught	☐	☐	☐
Room temperature too high	☐	☐	☐
Varying room temperature	☐	☐	☐
Room temperature too low	☐	☐	☐
Stuffy "bad" air	☐	☐	☐
Dry air	☐	☐	☐
Unpleasant odour	☐	☐	☐
Static electricity, often causing shocks	☐	☐	☐
Passive smoking	☐	☐	☐
Noise	☐	☐	☐
Light that is dim or causes glare and/or reflections	☐	☐	☐
Dust and dirt	☐	☐	☐

WORK CONDITIONS

	Yes, often	Yes, sometimes	No, seldom	No, never
Do you regard your work as interesting and stimulating?	☐	☐	☐	☐
Do you have too much work to do?	☐	☐	☐	☐
Do you have any opportunity to influence your working conditions?	☐	☐	☐	☐
Do your fellow-workers help you with problems you may have in your work?	☐	☐	☐	☐

Environment unit, Dept. Occ. Med., Örebro, test version 881016/KA/BY ©

Andersson K, Fagerlund I, Bodin L, Ydreborg B.
Questionnaire as an instrument when evaluating Indoor Climate.
Healthy Buildings' 88, vol 3, p 139-145

Translator: Cheryl Sunesborn

PAST/PRESENT DISEASES/SYMPTOMS

MM 040 EA Page 2

	Yes	No
Have you ever had asthmatic problems?	☐	☐
Have you ever suffered from hayfever?	☐	☐
Have you ever suffered from eczema?	☐	☐
Does anybody else in your family suffer from allergies (e.g. asthma, hayfever, eczema?)	☐	☐

PRESENT SYMPTOMS

During the last 3 months have you had any of the following symptoms?

	Yes, often (every week)	Yes, sometimes	No, never	If YES: Do you believe that it is due to your work environment? Yes	If YES: Do you believe that it is due to your work environment? No
Fatigue	☐	☐	☐	☐	☐
Feeling heavy-headed	☐	☐	☐	☐	☐
Headache	☐	☐	☐	☐	☐
Nausea/dizziness	☐	☐	☐	☐	☐
Difficulties concentrating	☐	☐	☐	☐	☐
Itching, burning or irritation of the eyes	☐	☐	☐	☐	☐
Irritated, stuffy or runny nose	☐	☐	☐	☐	☐
Hoarse, dry throat	☐	☐	☐	☐	☐
Cough	☐	☐	☐	☐	☐
Dry or flushed facial skin	☐	☐	☐	☐	☐
Scaling/itching scalp or ears	☐	☐	☐	☐	☐
Hands dry, itching, red skin	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐

FURTHER COMMENTS

THANK YOU!