

Ministry of Health, Labour and Welfare
Office of Chemical Safety / Pharmaceutical and Food Safety Bureau

Committee on Sick House Syndrome: Indoor Air Pollution
Progress Report No.1
- Summary on the discussions from the 1st to 3rd meetings -

26 June 2000

1. Guideline values and sampling/analytical methods

Scientific discussion leading to establishment of the guideline values for indoor air concentration of toluene, xylene and p-dichlorobenzene and standard sampling/analytical methods of indoor air pollutants (formaldehyde and other Volatile Organic Chemicals (VOCs)) are summarized. The guideline value for indoor air concentration of formaldehyde, which was established at the committee on comfortable and healthy houses in 1997, is also described in this report.

(1) Summary on guideline values for indoor air concentrations

The guideline values for indoor air concentration mean that, given the current available scientific knowledge, no adverse health effects would be caused in humans with the lifetime exposure of the chemical at the level any more than the value. These values may be revised in the future, as necessary, depending on further available knowledge and/or progress in international assessment works based on such scientific knowledge.

The committee first selected three chemicals (toluene, xylene and p-dichlorobenzene) because the indoor air pollution monitoring study conducted by Ministry of Health and Welfare (MHW) had revealed that some of houses subject to the study had been highly polluted with these three chemicals.

The guideline values for indoor air concentration of these three pollutants were set up based on chronic toxicity via a long-term exposure, while that of formaldehyde was given as a 30-minute average value, based on toxicity via a short-term exposure.

It is hoped that the setting of the guideline values will promote mitigation in indoor air pollution, as a result, ensure comfortable and healthy indoor environment.

Ministry of Health, Labour and Welfare

Office of Chemical Safety / Pharmaceutical and Food Safety Bureau

VOCs	Toxicity endpoint	Guideline value for indoor air concentration *
Formaldehyde	Nose, throat irritation in humans	100 $\mu\text{g}/\text{m}^3$ (0.08ppm)
Toluene	Effects on CNS * * -behavior functions, and development/reproduction in humans	260 $\mu\text{g}/\text{m}^3$ (0.07ppm)
Xylene	Altered development of CNS * * in offspring whose mother rat exposed during its pregnancy period	870 $\mu\text{g}/\text{m}^3$ (0.20ppm)
p-Dichlorobenzene	Liver/kidney effects in beagles dogs	240 $\mu\text{g}/\text{m}^3$ (0.04ppm)

* At 25 degree Celsius

* * central nervous system

(2) Summary on sampling/analytical methods

Indoor air pollutants subject to the analysis

Formaldehyde, and other VOCs such as toluene, o-,p-,m-xylene and p-dichlorobenzene.

Sampling methods

Indoor air sampling for pollutants in a newly built house should be undertaken for about half an hour under the condition where a room has been closed up for more than 5 hours following a 30-minute ventilation, so that indoor air concentration of VOCs can be measured ($\mu\text{g}/\text{m}^3$) at possible maximum level. It is therefore recommended that sampling be conducted around 2⁰⁰-3⁰⁰ p.m. when indoor air concentration of VOCs probably gets to the highest in a day.

In a residential house, indoor air sampling for pollutants should be undertaken for 24 hours so that a whole-day exposure to indoor air pollutants in a usual residential condition can be estimated ($\mu\text{g}/\text{m}^3$).

Sampling should be undertaken in three areas, including a living room, a bedroom and the outside. The indoor air concentrations in either of a living room or a bedroom whichever is higher should be used for an assessment.

Analytical methods

The sampling and analysis procedure for formaldehyde involves collection from air onto cartridges coated with 2,4-dinitrophenylhydrazine (DNPH) and subsequent analysis by

Ministry of Health, Labour and Welfare
Office of Chemical Safety / Pharmaceutical and Food Safety Bureau

high performance/pressure liquid chromatography (HPLC) with detection by ultraviolet absorption. (DNPH-solvent tube/solvent extraction/HPLC) The sampling and analysis procedure for VOCs involves collection from air onto sorbent tubes or stainless sampler (canister) and subsequent analysis by gas chromatography with MS. (sorbent tube/solvent extraction/GC-MS; sorbent tube/thermal desorption/GC-MS; or stainless sampler/thermal desorption/GC-MS)

Others

Other possible analytical methods may be alternatively used for sampling/analysis as long as they are as equally or more accurate. A simple and comprehensive analytical method may be used for a screening purpose, but it should be ensured that underestimating the chemical pollution be avoided. Final assessment on measured concentrations should be made by the standard methods mentioned above.

2. Indoors air environments subject to the guideline

Any indoor air environment should be subject to the guideline. The committee will pursue exploration of the guideline into non-residential indoor environment. However, the guideline should take into consideration office buildings, hospitals/medical institutions, schools/educational institutions, governmental offices, vehicles and other facilities, where humans can stay for a certain period.

As for plants and other facilities, where particular chemical sources exist, their indoor environments should be separately approached.

3. Priorities for setting up guideline values beyond this report

Not only will the committee continue to proceed with setting up guideline values for other individual VOCs, but also develop methods to provide the value for Total Volatile Organic Compounds (TVOC) as a complementary indicator.

For the selection of VOCs subject to the guideline, the following criteria should be considered:

- (1) Indoor air pollutants for which guideline values are given in other international/governmental guidelines, such as the WHO Indoor Air Quality Guideline

Ministry of Health, Labour and Welfare*Office of Chemical Safety / Pharmaceutical and Food Safety Bureau*

- (2) Indoor air pollutants for which the indoor air concentration and the ratio of the indoor air concentration to the outdoor air concentration (I/O) are high and for which the ratio of the personal exposure concentration to the indoor air concentration (P/I) is not much greater than 1, according to the indoor air pollution monitoring conducted by MHW, etc.

e.g., the indoor air pollution monitoring conducted by MHW in 1998 (unit: $\mu\text{g}/\text{m}^3$)

VOC	Ave. indoor air concentration	Max. indoor air concentration	I/O ratio	P/I ratio
Toluene	98.3	3389.8	4.6	1.1
p-dichlorobenzene	123.3	2246.9	25.1	1.4
m-,p-xylene	24.3	424.8	5.6	0.9
o-xylene	10.0	144.4	4.5	1.0
Ethylbenzene	22.5	501.9	4.6	0.9
Benzene	7.2	433.6	2.2	1.0
Styrene	4.9	132.6	25.1	1.1
Trichlorethylene	2.4	104.7	2.1	0.8
Tetrachlorethylene	1.9	43.4	2.9	1.0
Tetrachlorcarbon	1.5	18.5	1.5	0.9
Chloroform	1.0	12.8	2.6	1.6

- (3) Indoor air pollutants about which lots of public comments have complained:
e.g., TVOC, compounds relating to the VOCs for which the guideline values have already been set (e.g., ethyl benzene contaminated in xylene)
- (4) Indoor air pollutants for which other foreign governments provided a new regulation:
e.g., chlorpyrifos

In addition to (1) - (4), the following issues should also be taken into consideration for exploring TVOC value:

- (5) Indoor air pollutants that have similar usage as the four VOCs (solvent, adhesive and insecticide) and that are commonly in use:
e.g., plastic (phthalic ester, etc.), termicide (chlorpyrifos, etc.)

Ministry of Health, Labour and Welfare

Office of Chemical Safety / Pharmaceutical and Food Safety Bureau

- (6) Indoor air pollutants that have similar structures as the four VOCs (aldehydes and ketones, aromatic hydrocarbons, and halocarbons) or that belong to other common structure groups:
e.g., alkanes, terpenes, esters, alcohol

Considering the criteria (1) - (6) comprehensively, the committee decided:

- to set up the guideline value for other four pollutants including ethylbenzene, styrene, phthalic ester and chlorpyrifos;
- to develop methodology to provide the TVOC value as a complementary indicator;
- to further explore the scope of the guideline

4. Priorities with a view to analytical methods beyond this report

The committee decided that:

- an inventory on available analytical methods according to their purposes, such as screening and evaluation based on the guideline values, should be developed to meet needs of users; these analytical methods should be validated;
- a manual for analysis of indoor air pollutants and for consulting should be developed to assist consulting staff and operators at local public health centers/health institutes and to improve consulting and operating services.

5. Others

The following measures will be taken to promote and expand healthy indoor air environment policies:

- to work with other ministries and research institutions concerned in a co-operative manner for sharing information;
- to establish the methodology to secure the validity of analysis;

Ministry of Health, Labour and Welfare

Office of Chemical Safety / Pharmaceutical and Food Safety Bureau

- to further explore the methodology to assess the measured values, or how to interpret individual measured values with multiple background factors in relation to the guideline values;

- others.

Ministry of Health, Labour and Welfare
Office of Chemical Safety / Pharmaceutical and Food Safety Bureau

[Glossary]

Terminology related to Sick House Syndrome (Indoor Air Pollution)

The following terms may be the most frequently used with a view to indoor air pollution. The terminology will be expanded for better understanding of this issue.

Sick House/ Sick House Syndrome/Sick Building Syndrome

It is reported that lots of residents experience multiple adverse health effects due to indoor air pollution by chemicals in newly 'tightly' built/rebuilt houses/buildings, where building materials release chemicals. The term 'Sick House Syndrome' is used to describe the conditions in which their complaints vary greatly and where the cause of the symptoms and the mechanism of action are still unknown.

Chemical Sensitivity Syndrome

Both of the reports from the committee on comfortable and healthy houses (Jan.1999) and the research on chemical sensitivity syndrome (conducted by Satoshi ISHIKAWA, in 1996) provided the following suggestion:

Chemical Sensitivity Syndrome is used to describe the situations where, once individuals get sensitized via initial exposure to certain amount of chemicals or repeated exposures to small amount of chemicals, some also get sensitized to very small amount of similar chemicals. Further research is needed because the causal relationship between chemicals and symptoms, and the mechanism of action are still unclear.

Total Volatile Organic Compounds (TVOC)

The reports from the committee on comfortable and healthy houses (Jan.1999) provided the following interpretation:

The term 'TVOC' refers to total concentrations of multiple indoor air pollutants. Ideally, guideline values for indoor air concentrations should be set for each individual VOC (Volatile Organic Compound) to directly assess health effects caused by each compound. However, it is quite hard to make health assessment on each of more than 100 VOCs in a certain short term. Furthermore, alternative new compounds, with which regulated existing compounds will have been replaced, might have another health effects. Therefore, it is rather important to use the TVOC as a complementary indicator to decrease indoor pollution level in total and achieve more healthy indoor air

Ministry of Health, Labour and Welfare
Office of Chemical Safety / Pharmaceutical and Food Safety Bureau

environment.

Ministry of Health, Labour and Welfare
Office of Chemical Safety / Pharmaceutical and Food Safety Bureau

Appendix

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