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Volatile Pollutants in Suburban and Industrial Air

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Several studies are concerned with the occurrence of volatile pollutants, as hydrocarbons, halogenated alkanes, alkenes and methanes, chlorophenols and benzene derivatives in the air of cities and industrial facilities (Lillian et al. 1975, Ohta et al. 1976, Bauer et al. 1981).

A continuous exposure to volatile pollutants results in a body burden of long duration depending on the storage in tissues with high lipid content. Knowledge of the toxicity of and long-term exposure of humans to volatile pollutants is still limited (IARC 1972, Davidson et al. 1982).

The myelotoxic and leucogenic effects of benzene (Gerner-Smidt & Friedrich 1978) has lead to its replacement in many countries with other organic solvents as toluene and xylene (Srbova et al. 1950, Timbrell & Mitchell 1977). Toluene is, however, cardiotoxic and gives rise to hepatomegaly and renal dysfunctions (Press & Done 1967). Toluene and xylene produced reversible histological changes in rat liver (Hudak et al. 1975). All three xylene isomers decreased the cytochrome P-450 concentration in rat lungs (Pyykkö 1984).

Several reports also show that volatile halocarbons are toxic (Chu et al. 1982). They are also carcinogenic, mutagenic and teratogenic (Simmon and Tardiff 1978, Davidson et al. 1982).

There are already threshold values for some volatile halocarbons in some European countries, but Finland is not yet in this position.

Because of the possible health significance of the organic constituents, the aim of this study has been to determine the occurrence and possible exposure to

volatile pollutants in suburban and industrial air compared to the countryside on the south-west coast of Finland.

MATERIAL AND METHODS

The actual samples consisted of particles from the suburban air of the city of Turku, industrial air from the medical industry preparing solutions and from air from the countryside in the Islands of Iniö at the south-west coast of Finland.

One hundred samples were gathered during different seasons in 1987 by using an adsorption apparatus (3M 3500, K-electronics, Finland). The samples were taken during clear days and monthly, at the middle of the day.

The hydrocarbons were eluted with n-pentane (0.5 ml) containing a known amount of 1-chlorohexane as an internal standard. After centrifugation, the pentane phase was analysed by gas chromatography-mass spectrometry (GC-MS) in a selected ion moditoring mode (Kroneld and Reunanen 1988).

Student's t-tests were used in this study, $p < 0.001$ (***) was considered statistically highly significant and N.S. no statistical significance.

RESULTS AND DISCUSSION

The results of the analyses are shown in Table 1.

No volatile pollutants at all could be found in control samples from the countryside. The

The industrial air contained statistically highly concentrations for trichloromethane, dichlorobromomethane, dibromochloromethane, 1,1,1-trichloroethene, toluene, tetrachloroethylene, meta- and ortho- and paraxylene compared to the suburbous air. The results for trichloroethylene were not significant and for ethylbenzene the concentrations were higher compared to the concentrations in the industrial air ($p < 0.001$).

The increased production and use of volatile pollutants explained why they could be analysed especially in the suburban air and in industry air almost all over the world. It could be mentioned that toluene concentration in Helsinki was registered to be 0.1 mg/m^3 and the traffic in Finland leads according to estimations to out-leads of 2100 ton benzene, 2900

Table 1. Occurrence of volatile pollutants in industrial air, suburban air and countryside air during a one year study in the southwest of Finland

	industrial air (mg/m³)	suburban air (ug/m³)	countryside air
$CHCl_3$	0.095±0.010***	0.063±0.012	N.D.
$CHBrCl_2$	0.048±0.005***	0.002±0.008	N.D.
$CHCl=CCl_2$	0.036±0.004 N.S	0.027±0.011 N.S	N.D.
CH_3CCl_3	0.870±0.130***	0.230±0.021	N.D.
toluene	0.840±0.022***	0.420±0.031	N.D.
$CHBr_2Cl$	0.210±0.011***	0.014±0.003	N.D.
$Cl_2C=CCl_2$	0.130±0.008***	0.083±0.011	N.D.
ethylbenzene	0.094±0.012	0.212±0.016***	N.D.
m,p-xylene	0.568±0.024***	0.392±0.025	N.D.
o-xylene	0.207±0.016***	0.143±0.010	N.D.

N.D. = not detectable, p values by comparing industrial and suburban air.

ton toluene and 3300 tons of xylene, meanwhile the direct out-come from the industry is only about 1000 tons yearly all together (Häsänen et al. 1981). The exposure level of trichloromethane has been calculated to be 20 mg/year from the air, meanwhile the latest annual world production being $300x10^3$ tons and with about 10 mg/m³ registrated in urban areas in the air (Edwards et al. 1982).

The treshold values for air were in some European countries for benzene 10 ug/m³ in suburban air, 1,5 mg/m³ in industrial air, 50 ug/m³ for trichloroethene in suburban air and 2 mg/m³ in industrial air.

As this study shows could volatile pollutants be analysed especially in suburban and industrial air. These substances are highly lipophilic and it is obvious that they accumulate in tissues.

Earlier works described the occurrence of volatile pollutants in water, food, tissues, solutions and especially the accumulation during medical treatment in patients during haemodialysis (Kroneld and Reunanen 1982).

According to our results and by comparing them to results from Europe, it is reasonable to suggest that

threshold values for the substances studied also should be considered for air in Finland.

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