PCB IN BUILDING SEALANT IS INFLUENCING PCB LEVELS IN BLOOD OF RESIDENTS

Niklas Johansson[1,2], Annika Hanberg[2], Håkan Wingfors[3] and Mats Tysklind[3]

[1]Swedish Environmental Protection Agency, SE-106 48 Stockholm, Sweden
[2]Institute of Environmental Medicine, Karolinska Institutet, P.O. Box 210, SE-171 77 Stockholm, Sweden
[3]Environmental Chemistry, Umeå University, SE-901 87 Umeå, Sweden

Introduction

PCBs were used in different kinds of building material in many countries during the fifties to the early seventies. In Sweden this occurred during the period 1956 - 1972. The most important of these building materials were presumably sealants used between concrete blocks and around windows and doors on the outside of the building. The total amount of PCB that has been used for this purpose in Sweden has been estimated to 70-190 tons[1]. The PCB concentration in such sealants has today been found to be from a few percent up to around thirty percent but considerably lower concentrations have also been found, probably as a result of contamination. It has not been possible to determine the original PCB content in the current sealants. It was long anticipated that PCB would stay in the sealant and in the buildings as long as the sealant was not removed. However, later investigations have shown that PCB could escape from the buildings into the environment and that it also could be found in indoor air[2-6]. The toxicological significance of the latter finding is uncertain. Tentative calculations indicate that the exposure via indoor air could contribute significantly to the total exposure.

Different measures have since long been taken in order to decrease the release of PCB into the environment, mainly from different kinds of electrical equipment. These measures have resulted in decreasing PCB levels in biota, including man, in most of the industrialised world.

In order to remove the remaining PCB in Swedish buildings, the Eco-cycle Council of the Building Sector has launched a programme that comprises inventories, development of environmentally sound methods and removal and destruction of the current sealants. Therefore they have produced instructions for the screening procedure (which buildings should be investigated, how sampling should be performed etc.) in order to get reliable information for the further efforts. The sealant and other PCB-contaminated material generated during the process will eventually be destroyed in a hazardous waste incineration plant. The dismounting process has caused some harassment among the people living in the current buildings, as it has not been possible to answer the entitled question: “Have we been living in a poisonous building?” This study has been performed in order to generate information that would facilitate the possibilities to answer that question.

Methods and Materials

A residential area, built in the early seventies, was identified in Solna, north of Stockholm, Sweden. The area was chosen as contained buildings with as well as without PCB containing sealants, thereby suitable for comparative studies. The buildings in the area are materially identical and so is the social structure. The primary use of PCB containing sealant in the current area was for tightening between balconies and outer wall. As a number of these balconies later had been furnished with windows, the balcony doors had been kept open during part of the year, which led to that these sealants materially often became a part of the indoor environment.

The indoor air concentration of PCB in these buildings was determined with passive samplers and it was found that the levels of PCB in buildings containing PCB sealant could be up to two orders of magnitude higher compared to similar buildings without such sealants[6].

Sampling

Blood samples (3 x 10 ml) were drawn from 36 individuals (men and women) that participated in the study on a voluntary basis. Twenty-one persons had lived in flats in buildings containing PCB sealant for at least five years, whereas the remaining 15 persons lived in flats in the corresponding control building mentioned above. The blood samples were drawn at a medical health care centre close to the current buildings. In connection to the blood sampling, each volunteer filled in a comprehensive questionnaire on dietary habits, profession, former resident, hobbies, age, sex, number of children, accumulated breast feeding time etc. During the time the volunteers answered the questionnaire, they had assistance from one nurse with special training. The questionnaires and the blood samples were coded at the medical health care centre and the blood samples were stored for a short period (week) before they were sent to the laboratory, Environmental Chemistry at Umeå University.

Analytical procedure

Denaturated samples of approximately 30 g were applied to a Hydromatrix column and extracted with isopropanol-hexane[8]. Twelve ^{13}C-labeled PCBs used as internal standards were added prior to the extraction. The solvent was removed and the lipid content was determined gravimetrically. The extracts were purified in a multilayer silica column (KOH-silica + H_2SO_4–silica). Prior to the final evaporation of solvents, two ^{13}C-labeled PCBs used as recovery standards were added. Sample analysis was performed by using HRGC-LRMS with a 30 m DB5 GC-column attached directly to a MD800 MS instrument.

Results and Discussion

Using the above-mentioned technique, it was possible to detect some 30 different PCB congeners. Among these some 15 could be quantified in all samples, whereas congeners as 101, 110, 141, 157, 174, 177, 172/192, 189, 201, 196/203, 206 and 209 could be quantified in a limited number of samples. Among the congeners that could be identified in all samples elevated levels were found in samples from individuals living in the “PCB flats” (Figure 1, Table 1). Most congeners were only slightly elevated (1.2 to 3.2 times) but the two low-chlorinated congeners 28 and 66 were detected at several times higher levels (30 and 9 times).

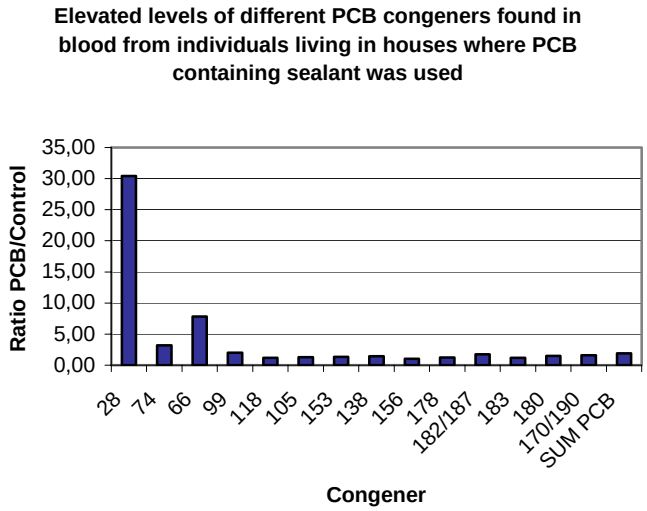

Figure 1: Relative elevation of PCB levels in blood in individuals from "PCB flats" related to levels from control flats.

Table 1. Median PCB concentrations of the congeners most frequently found in blood from individuals living in buildings with and without PCB-containing sealant.

PCB congener	Median concentration in blood (ng/g fat)		p
	Control flats	"PCB flats"	
28	2.92	88.91	<0.001
74	5.75	18.48	<0.001
66	1.21	9.50	<0.001
99	3.20	6.48	0.007
118	8.00	9.59	0.235
105	1.75	2.29	0.083
153	57.97	76.69	0.352
138	42.24	61.75	0.386
156	6.75	7.02	0.898
178	2.76	3.48	0.521
182/187	10.35	18.05	0.078
183	5.63	6.76	0.336
180	56.75	85.08	0.142
170/190	25.29	39.82	0.096
SUM PCB [30]	**225.92**	**434.07**	**0.005**

The elevation of the levels of the low-chlorinated PCBs is illustrated in Figure 1. It could be interesting to note that, despite a large inter-individual variation, the median concentration was found to be elevated for all of the major PCB congeners in blood from individuals that had lived in “PCB flats” The statistical evaluation of the same data is presented in Table 1 and it should be noted that reliable difference between the two groups is not only recorded for PCB 28, 74, 66 and 99 but also for total PCB based on some 30 different congeners.

The toxicological significance of this finding still remains to be elucidated.

Acknowledgements
This study was financed by the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning, the Swedish Environmental Protection Agency, the National Board of Health and Welfare and the City of Stockholm. We would also thank the residents in the buildings of this study and also Barbro Lorentzon at the municipal housing company.

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