Emissions During Replacement of PCB Containing Sealants- a Case Study.

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Introduction

Sealants are often used on the following outside locations on buildings; around concrete slabs, and doors, close to window frames and the wall or as isolation joints. Before restrictions were made for the open use of PCB, the sealants was commonly produced of Thiokol® plasticised with PCB (up to 35 %). When outdoor sealants are exposed to sun, wind and rain the PCB is emitted to the environment. Elevated levels of PCB have been found in a gradient from the wall of houses with this kind of sealants as well as in the ambient air outside these houses.

In Sweden sealants containing more than 500 ppm PCB are being replaced due to a voluntary agreement. In the process of replacing these sealants there is a need for developing methods and techniques following the best available techniques. A case study was performed during replacement on a seven stores apartment house in Stockholm during 1999. The study was made to judge the size of emissions of PCB during the replacement to the ambient air and ground. The facade was also cleaned with high-pressure water, which implies emissions of PCB to the combined sewage system.

Removal of old sealants

Two of the house facades were covered with light concrete slabs. The other two sides were covered with ordinary concrete slabs with imbedded pebbles. All visible sealants around the light concrete were cut out with a knife as this material was soft and did not need further cleaning. No emission to air was expected during this work and consequently this was not studied.

From around the concrete slabs, sealants were cut out with a high frequent oscillating knife. The lengths of sealants in this part were 600 m. Afterwards the edges of the concrete were cleaned from residuals of sealants with an angle grinder. About 1-2 mm of concrete was cut of from the concrete brink that holds a major part of migrated PCB. A high efficiency vacuum cleaner was attached to the tool. The outflow of air passed a filter and an additional microfilter. In order to protect the ground, plastic film covered the soil out to a distance of 2 meters from the building during the replacement work.

Sampling

The air outflow from the vacuum cleaner was sampled with a high-volume sampler during one-hour periods. The sampler, which has been described previously[1] consist of a glass fiber filter for

the collection of particles and polyurethane foam plugs for the collection of PCB vapours. Sample volumes were between 43 and 50 m^3.

The soil samples were taken at different distances from the house before the replacement of the sealants started. To study the deposition to soil during the process, pots containing uncontaminated soil were dug into the ground at the original sampling sites. These were left there during the whole procedure and analysed afterwards.

Drippings from the sprayed wall were collected in cleaned glass bottles using a metal gutter for studying the emissions in the cleaning water. The samples were centrifuged before analysis, and as the water phase was shown to contain less than 1% of the PCB, only the solid material was analysed.

Analysis

The following extraction techniques, using decachlorobiphenyl as an internal standard, were used for the different matrices:

- The sealant samples were cut to 1x1x1 mm pieces and extracted three times in n-hexane in an ultrasonic bath.
- The air filter and polyurethane adsorbent samples were Soxhlet extracted separately with acetone. The adsorbent plugs were cut in two pieces to investigate if there were any break through of PCB.
- The soil samples were extracted with a mixture of acetone and n-hexane (1:1) three times in an ultrasonic bath.
- The water samples were centrifuged and the water phase and the pellet were extracted separately. The pellet was shown to contain less than one percent of the PCB and consequently only the water phases were analysed.

All extracts were treated with concentrated sulphuric acid before analysis and concentrated/diluted to an appropriate volume before gas chromatographic analysis. A gas chromatograph with electron capture detector was used for all determinations. The resulting chromatogram was compared to those of commercial PCB mixtures, and the quantitative analysis was based on one peak representing each of the different mixtures.

Results and discussions

The PCB found in the sealants was a mixture of products containing 48 and 54 % (e.g. Aroclor

Table 1. Results of the PCB analyses.

Sample	Remark	PCB concentration
Sealants		8 – 16 % w/w
Air after vacuum cleaner	Gas phase	43 - 76 microg/m^3
Air after vacuum cleaner	Particulate phase	4 - 17 microg/m^3
Air about 20 m from vacuum cleaner	Gas phase	0.71 microg/m^3
Air about 20 m from vacuum cleaner	Particulate phase	0.46 microg/m^3
Soil before action	Upper 10 mm	48 – 120 microg/kg ww
Soil, deposition during action	Upper 10 mm	90 – 2500 microg/kg dw
Water from high pressure washing	Particulates	94 – 850 microg/L

1248 and Aroclor 1254), respectively. The concentrations varied from 8 to 16% (Table 1), with a mean at 13%. The built in stock of PCB was calculated to approximately 70 kg. This can be compared with the different activities generating emissions of PCB.

The exhaust air from the vacuum cleaner contains high PCB concentrations. The lower levels in the particulates indicate a rather high efficiency of the filters used in this equipment. Also at some distance the levels are much higher than in background air in Stockholm, which normally is in the sub-ng/m^3 range. The measured levels correspond to a release of 0.6 – 1.3 g PCB.

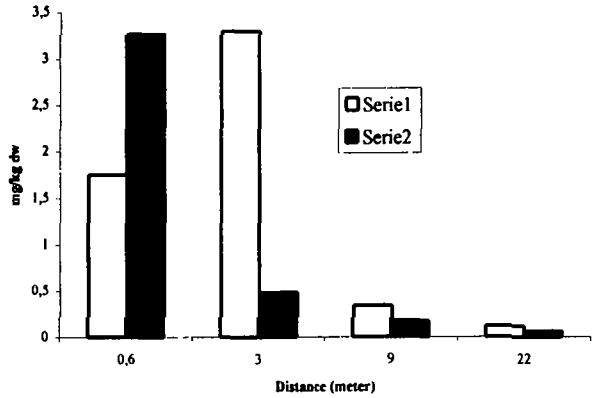

Figure 1. Concentration of PCB in soil samples from two transects out from the restored house. The samples were introduced just before the replacement of the sealants, so the results represent the deposition during the action.

The PCB concentrations in the soil before the sealant replacement are of the same order of magnitude as have been seen in earlier studies of houses containing these sealants[2]. The Swedish guidance value for PCB in soil in populated areas is, calculated on seven congeners, 20 microg PCB/kg dw. This corresponds to 60 – 100 microg sumPCB/kg dw, and several of the concentrations measured before the replacement exceeds this value. The deposition of PCB during the replacement operation gives a substantial contribution to the earlier high values. The very high depositions are, however, appearing close to the house, as shown in Figure 1. The high variation between the two double samples close to the house probably represents different amounts of fragments in the samples. A plastic sheet during the operation covered the innermost sample (0.6 m). Part of the PCB in soil may come from the washing water.

Cleaning of the facade with high-pressure water generates small particles, which flows down to the combined sewer. The measured concentrations correspond to a total emission of about 2 – 20 g PCB.

A PCB budget for the replacement of sealants was estimated (Figure 2) and the fraction of PCB emitted during the replacement was found to be less than 0.03 % of the total amount.

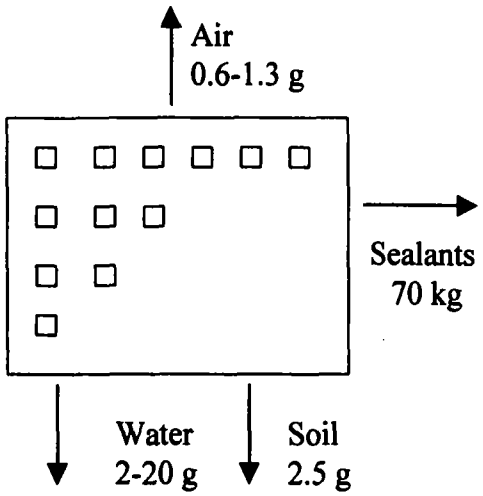

Figure 2. PCB budget for the replacement of the PCB containing sealants in the studied house.

Acknowledgements
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