PROBLEMS ENCOUNTERED IN CLEANUP OF A PCB, DIBENZOFURAN AND DIOXIN CONTAMINATED OFFICE BUILDING

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ABSTRACT

The Binghamton State Office Building PCB transformer fire of February 5, 1981 with contamination of the building with PCBs and pyrolytic conversion products, including chlorinated dioxins and dibenzofurans, has become the prototypal incident of its kind. Nine years after the incident, after expenditure of almost 40 million dollars to clean a building, which cost 17 million dollars to build less than a decade previously, the building has not yet been cleaned to the criteria established by the New York State Health Department and an expert panel. Three problems are documented here: The chemicals penetrated the concrete in floors and walls, including new concrete laid over old after partial removal. There has been migration of chemicals through epoxy paint. The in-floor ducts, found in every floor and containing air handling systems and electrical and telephone wire, have proved difficult to clean, using detergent wipes followed by epoxy coating, in a fashion similar to wiping a clarinet.

INTRODUCTION

In February of 1981, an electrical panel fire caused overheating of a transformer containing PCBs and chlorinated benzene in an office building in Binghamton, New York. Because of an unusual venting of air from the basement transformer room where the 30 minute fire occurred, very extensive contamination of the building occurred with PCBs, dioxins, and dibenzofurans.

Because the incident was the first of its kind to be documented, it was not readily apparent how cleanup of the building should proceed. Steam detergent cleanup was used initially and some surfaces were painted over with epoxy paints to lower chemical levels and decrease human exposure. Much furniture and other material was removed from the building and taken to a toxic landfill.

The building, a modern office building, was completed in 1973 and occupied shortly thereafter. The cost of construction was 17 million dollars. There were two large PCB-containing transformers with a capacity of 1,100 gallons each. The transformer fluid was 65% Arochlor 1254 and 35% tri- and tetrachlorinated benzenes. Approximately 180 gallons of transformer fluid leaked out from a cracked porcelain bushing on the side of one transformer.

The building, which presents a learning experience, has taken longer than other PCB transformer fire contaminated buildings to clean. This is in part due to the extensive contamination with high levels of dioxins and dibenzofurans which were found in soot from the fire, and partly due to careful measurements which were made to ascertain that the building met guidelines for reoccupancy set by the New York State Health Department with an expert advisory panel. This paper reviews three cleanup problems, with references to recent findings from air and surfaces for the building.

TABLE I BINGHAMTON STATE OFFICE BUILDING REOCCUPANCY GUIDELINES	
AIR	
PCBs	1 microgram per cubic meter
2,3,7,8-TCDD Equivalents	14 micrograms per cubic meter (for renovation workers)
	10 picograms per cubic meter (for office workers)
SURFACES	
PCBs	100 micrograms per square meter
2,3,7,8-TCDD Equivalents	25 nanograms per square meter

FINDINGS

I. Concrete

IA. Concrete Floor

The concrete floor in the basement mechanical room where the transformers were was partially removed, to a depth of 0.75 inches over an area of approximately 100 square feet in 1985, and a 0.75 inch patch of new concrete was applied over this area.

Test results were taken in October 1989 of concrete cores from the floor. Results are shown in Table II for repeatedly cleaned, and also patched areas where concrete was removed and new concrete patched over. The area was painted with epoxy paint on four occasions between 1985 and 1989.

IB. Concrete Walls

The walls in the basement mechanical room were repeatedly cleaned with steam detergents and then coated with four coats of epoxy paint between 1985 and 1989. The results are shown in Table III.

II. In-floor duct system

There is a series of metal ducts embedded horizontally in concrete in each floor throughout the building. These serve as air handling systems (air ducts) or for holding electrical and telephone wiring (communication ducts). These were found to be chemically contaminated and in need of cleaning or removal. Levels of PCBs, as high as 4,340 micrograms per square meter of Arochlor 1254, were found. Since the ducts were imbedded in concrete, cleaning was elected. The ducts were reached by cutting access holes in the bottom of the ducts. They were then cleaned by hand with detergent (Triton-X 100) soaked cloths. The ducts were coated with an epoxy resin (LinSet D sealant) by pulling a sponge coated with epoxy through the ducts. The results of late 1989 duct PCB and PCDD/F TEQs sampling after cleaning and sealing are shown on Table IV.

III. Epoxy sealant or paint

The failure of the sealant used to block PCB and PCDD/F penetration was documented best in the basement mechanical room in the data described above. Toledo Edison had similar findings in 1989 for PCB penetration of epoxy painted concrete. The sealant was used also for walls and stairs elsewhere in the building. Current data is not available at this time concerning penetration of epoxy resin in these locations.

CONCLUSIONS AND DISCUSSION

The difficulty in cleaning the most contaminated concrete after removal of 0.75 inch of floor and replacement with new concrete which was penetrated by PCBs and dioxins and dibenzofurans is documented in this paper. In addition, the inability of sealants to seal these chemicals is also documented. Despite repeated detergent cleaning of the concrete, and also use of an epoxy sealant, portions of the extensive ducts remain partially contaminated with PCBs and dioxins and dibenzofurans.

TABLE II

CORES OF CONCRETE FLOOR IN THE BASEMENT MECHANICAL ROOM OF THE BINGHAMTON STATE OFFICE BUILDING[1,2]

Sample ID	Location	PCB[3]	2378-TCDD equivalents[4]
C2A	Core Top-0.25" -E of AC -1 10' N of S wall	53000	714.361
C2B	Core 0.25-0.75" -E of AC -1 10' N of S wall	2700	20.221
C2D	Core 1.25-1.75" -E of AC -1 10' N of S wall	<50	3.173
C2F	Core 2.25-2.75" -E of AC -1 10' N of S wall	<50	3.677
C3A	Core Top-0.25" -12' N of S wall & 10' W of E wall	23000	303.387
C3B	Core 0.25-0.75" -12' N of S wall & 10' W of E wall	1000	9.898
C3D	Core 1.25-1.75" -12' N of S wall & 10' W of E wall	<50	2.910
C3F	Core 2.25-2.75" -12' N of S wall & 10' W of E wall	<50	2.756
C4A	Core Top-0.25" -transformer site in patch	3000	34.227
C4B	Core 0.25-0.75" -transformer site in patch	3900	10.682
C4D	Core 1.25-1.75" -transformer site in patch	<50	5.172
C4F	Core 2.25-2.75" -transformer site in patch	<50	2.832

1 Samples were collected on October 10, 1989. An aliquot of each sample was extracted with benzene and the extract split for PCB and PCDD/F analysis.

2 FROM: New York State Dept. of Health Report, Feb. 1990; summary of test results from Basement Mechanical Room.

3 PCB concentrations are micrograms per kilogram (ug/kg or ppb).

4 2378-TCDD equivalents are nanograms per kilogram (ng/kg or ppt).

TABLE III
SECTIONS OF CONCRETE BLOCK WALLS AND CORES IN WALLS OF THE BASEMENT MECHANICAL ROOM OF THE BINGHAMTON STATE OFFICE BUILDING [1,2]

Sample ID	Location	PCB[3]	2378-TCDD equivalents[4]
WB1A	Block wall behind comm room at floor	< 50	8.092
WB1B	Block wall behind comm room at floor	5500	1196.835
WB2A	Block wall behind elevator shaft at floor	48000	2040.603
WB2B	Block wall behind elevator shaft at floor	< 50	18.535
WB3A	Block wall behind comm room at ceiling	70000	26076.817
WB3B		3800	452.587
WB5A	Block wall behind elevator shaft at ceiling	340000	108385.647
WB5B		880	251.822
WB6A	Block wall behind stairwell 4' above floor	7000	1099.415
WB6B		< 50	61.134
C8A	Plaster wall -S wall W of AC-1 2' from floor	1300	210.117
C8B	Wire mesh under plaster -S wall W of AC-1 2' from floor	630	3.740
WB9	Sheetrock wall near transformer site -4' above door	1500	49.137

1 Sections marked 'A' are the surface 0.5" of block, and sections marked 'B' are the next 0.5" below the surface. Samples were collected on October 10, 1989. An aliquot of each sample was extracted with benzene and the extract split for PCB and PCDD/F analysis.

2 FROM: New York State Dept. of Health Report, Feb. 1990; summary of test results from Basement Mechanical Room.

3 PCB concentrations are micrograms per kilogram (ug/kg or ppb).

4 2378-TCDD equivalents are nanograms per kilogram (ng/kg or ppt).

TABLE IV
RESULTS OF SURFACE WIPE SAMPLES FOR PCBs AND PCDD/PCDFs IN DUCTS IN THE FIRST FLOOR (BASEMENT CEILING) OF THE BINGHAMTON STATE OFFICE BUILDING

2378-TCDD equivalents (ng/m^2)	Total PCB (ug/m^2)	Sample description
	19.4	Air duct - mechanical room transformer site
104[2]		Air duct - mechanical room transformer site[2]
	132	Com duct - mechanical room transformer site
760[2]		Com Duct - mechanical room transformer site[2]
26.6[3]	188	Air duct - mechanical room 20' N of transformer site
30.6	244	Com duct - mechanical room 20' N of transformer site
14.7	48.0	Air duct - mechanical room 20' S of transformer site
106	22.9	Com duct - mechanical room 20' S of transformer site
149	6.92	Air duct - mechanical room W of AC-1
13.5	10.8	Com duct - mechanical room W of AC-1
	10.6	Air duct - center DOT storage room
	10.8	Com duct - center DOT storage room
151	72.8	Average - mechanical room
124	54.5	Average - overall

1 Samples were collected July 17 (PCBs) and July 26 (PCDD/PCDFs), 1989, except as noted, above the basement locations described.

2 Sample collected September 10, 1988 and previously reported (NYSDOH, 1989).

3 Not corrected for extraction and analyte enrichment efficiencies. Accuracy is probably within a factor of two.