INDUSTRIAL HYGIENE SURVEY OF THE

Polychlorinated Biphenyl Filled Transformer Production Operation Westinghouse Electric Corporation Sharon, Pennsylvania

SURVEY DATE

January 5-6, 1977

SURVEY CONDUCTED BY

Al Gudeman
Mark Jones

REPORT WRITTEN BY

Mark Jones

DATE OF REPORT

July 25, 1977

Industrywide Studies Branch
Division of Surveillance, Hazard Evaluations and Field Studies
National Institute for Occupational Safety and Health
Center for Disease Control
Cincinnati, Ohio

PLACE VISITED:	Westinghouse Electric Corporation Transformer Division 469 Sharpsville Avenue Sharon, Pennsylvania 16146
DATE OF VISIT:	January 5-6, 1977
PERSONS MAKING VISIT:	Al Gudeman - NIOSH Mark Jones - NIOSH
PERSONS CONTACTED:	Thomas Leen Personnel Services Manager George Laverty Safety Supervisor John Adams Corporate Industrial Hygienist
PURPOSE:	To conduct an industrial hygiene survey of the polychlorinated biphenyl filled transformer production area.

INTRODUCTION

Recent literature has linked possible carcinogenic effects with exposure to polychlorinated biphenyls. Since this literature is incomplete, the Division of Surveillance, Hazard Evaluations and Field Studies of the National Institute for Occupational Safety and Health has underway an "industrywide" study of industries using polychlorinated biphenyls.

As a result of the walk-through survey conducted by Mark Jones at the Westinghouse facility in Sharon, Pennsylvania on October 27, 1976, it was decided to conduct an indepth survey of the PCB-filled transformer production area. This survey was conducted by Al Gudeman and Mark Jones on January 5 and 6, 1977.

During the visit, approximately 26 air samples were taken for evaluation of polychlorinated biphenyls exposures. In addition, air samples also were taken to evaluate exposures to the solvents that were used.

DESCRIPTION OF FACILITY

The plant which is a subsidiary of the Westinghouse Electric Corporation was built in 1923. The main products are different types of transformers (mineral oil filled, polychlorinated biphenyls filled, dry type and instrument).

Production of polychlorinated biphenyls-filled transformers began in 1938. Production of this type of transformer represents only a small percentage (less than 1%) of the total number of transformers produced.

The total work population at the plant is approximately 3100 employees of which approximately 2300 are hourly employees. The union at this plant is the International Union of Electrical Workers, Local #617.

Approximately 20 employees are involved in the operations where polychlorinated biphenyls are present.

MEDICAL, INDUSTRIAL HYGIENE AND SAFETY PROGRAMS

The Westinghouse Electric Corporation has a Corporate Medical Services Administrator located in Pittsburgh, Pennsylvania. A local physician, Dr. Tong Ham is hired part-time and is on call 24 hours a day. There are two licensed nurses at the plant during the day shift and one on both the evening and night shifts.

Pre-employment physical examinations are given to all employees and periodic physical examinations are given annually to part of the employees. These examinations include chest x-rays, hearing tests, visual acuity, pulmonary function, urine tests and electrocardiograms.

Industrial hygiene and safety at the plant are handled by the Safety Supervisor, George Laverty. The safety supervisor periodically collects both area and personal air samples and the Corporate Office conducts on the average one industrial hygiene survey a year at the plant. The plant had not collected any air samples for polychlorinated biphenyls prior to the NIOSH visits.

Personal protective programs presently in force at the plant include safety glasses, safety shoes, protective clothing and respirators (only in certain areas of the plant). The plant provides a facility for taking showers and changing clothing.

DESCRIPTION OF THE PROCESS

Many types of transformers are manufactured at these plants; however, this survey involved only the operation in which polychlorinated biphenyls-filled (Aroclor 1242) tranformers are manufactured.

First coils of metal (e.g. copper, aluminum) are wound and placed within a magnetic core, which in turn is placed in a metal case. The container is sealed by welding the top. The transformer is then filled with mineral oil and tested. When the transformer has passed all the tests the mineral oil is pumped out of the transformer and Inerteen (Westinghouse's name for PCB) is pumped into the transformer while it is in an enclosed chamber or on the floor near the chamber. Some of the larger transformers which are already painted are filled directly from the storage tank on the railroad spur outside of the building. The cover is then rebolted and the transformer cleaned manually with a solvent. The transformer is now painted and prepared for shipment to the customer.

All materials and waste which may be contaminated with polychlorinated biphenyls are sent to the Chemetron Company in 55-gallon drums for disposal.

INSPECTION OF THE PLANT

Potential Health Hazards

Potential health hazards observed during this survey were as follows:

Hazard	Location	# of Workers With Exposure
1) Polychlorinated Biphenyls	Filling of transformer; Storage tanks	20
2) Solvents	Welding Department Painting Department	**
3) Welding fumes	Welding Department	**

**There are a number of painting departments and welding stations in the plant and this survey only involved one area of the plant.

Some employees working in operations using polychlorinated biphenyls have developed dermatitis problems. These people were referred to a physician and if necessary, assigned to new jobs.

Ventilation

Local exhaust ventilation is used in the paint spray booths. Following the filling operation, the chamber is maintained under a vacuum for at least one hour before the transformers are removed. The only other ventilation in the area consists of a few small windows near the roof that may be open.

SURVEY PROCEDURES

General

Air samples were collected in this plant for evaluating exposure to polychlorinated biphenyls, methyl ethyl ketone, toluene, benzene, xylene, butyl acetate and ethyl acetate. The following paragraphs describe the methods used to collect and analyze the air samples.

Polychlorinated Biphenyls

Both personal and area air samples were collected in the polychlorinated biphenyls-filled transformer manufacturing area. Sipin SP1 pumps were used to collect the air samples in tubes containing a magnesium silicate absorbent called florosil. The tubes have a 100 mg primary section and a 50 mg backup section. Samples were collected from four to eight hours at a flow rate of approximately 200 cc/min. The polychlorinated biphenyls were desorbed from the florosil with benzene and analyzed by using a gas chromatograph with an electron capture detector.

Benzene, Butyl Acetate, Ethyl Acetate, Methyl Ethyl Ketone, Toluene, and Xylene

Personal air samples were collected for the different solvents which might be present in the polychlorinated biphenyls-filled transformer manufacturing area. Sipin SP1 pumps were used to collect the air samples on tubes containing an activated coconut charcoal absorbent. The tubes have a 100 mg primary section and a 50 mg back-up section. The samples were collected from 4 to 5 hours at a flow rate of approximately 200 cc/min. The solvents were desorbed with carbon disulfide and analyzed with a gas chromatograph equipped with a flame ionization detector.

RESULTS AND DISCUSSION

Polychlorinated Biphenyls

The results of the area and personal air samples are given in Table I and the job descriptions corresponding to the job titles are in Appendix A.

Twenty personal and 6 area air samples were collected for analysis for polychlorinated biphenyls (Aroclor 1242). The personal air samples ranged from a concentration of 9.5 $\mu g/m^3$ to 69.7 $\mu g/m^3$ while the area air samples ranged from 28.4 $\mu g/m^3$ to 56.7 $\mu g/m^3$.

Benzene, Butyl Acetate, Ethyl Acetate, Methyl Ethyl Ketone, Toluene and Xylene

Two personal air samples were collected for analysis for solvents which might be present. No concentration (limit of detection is 0.01 mg/tube) of benzene, butyl acetate, ethyl acetate, and methyl ethyl ketone were found. One sample had a xylene concentration of 0.17 ppm and a toluene concentration of 0.6 ppm. The other sample, which was saturated, had a toluene concentration of 77.7 ppm.

STANDARDS AND HEALTH EFFECTS

Polychlorinated Biphenyls

The current OSHA Standard and ACGIH TLV for chlorodiphenyl (42% chlorine) is 1000 $\mu g/m^3$ (1 mg/m^3).

The dermatological effect and systemic effect on the liver of polychlorinated biphenyls is well reported in the literature; however, recent literature has linked possible carcinogenic effects to polychlorinated biphenyls.[1,2,3] Therefore, this standard may not adequately protect the workers health.

Toluene

The current OSHA Standard for toluene is 200 ppm. However, the NIOSH recommended standard and ACGIH TLV is 100 ppm.

Some of the health effects due to toluene exposure reported in the literature are changes in muscular coordination, and reaction time, production of mental confusion, irritation of mucous membranes, and reversible liver damage.[4,5,6,7,8,9,10]

CONCLUSIONS AND RECOMMENDATIONS

Based on observations made during this survey and the results of the air samples, the following conclusions are drawn and recommendations for improvements made. The author realizes that this operation has been shutdown but if the operation should resume anytime in the future, these recommendations should be employed.

Table I

CONCENTRATIONS OF POLYCHLORINATED BIPHENYLS
(AROCLOR 1242) FOUND AT THE WESTINGHOUSE FACILITY
IN SHARON, PENNSYLVANIA ON JANUARY 5-6, 1977

PERSONAL AIR SAMPLES

Job Title	Date	Total Sampling Time (min.)	Volume (liters)	Concentration ($\mu g/m^3$)	TWA ($\mu g/m^3$)
Fit Test	1/6	--	61.6	15.6	
"	1/6	319	53.4	26.8	24.2
"	1/5	418	81.4	21.0	
"	1/5	419	40.5	25.4	
Group Leader	1/6	300	60.0	50.0	39.6
"	1/5	404	88.6	31.9	
Mounter	1/5	425	83.9	26.7	24.8
"	1/6	303	61.2	22.1	
Painter	1/5	406	81.8	18.9	20.8
"	1/6	246	59.5	24.0	
Fit for Ship	1/5	408	83.0	26.6	36.0
"	1/6	306	57.6	48.6	
Packer	1/5	407	79.4	20.7	
"	1/5	410	81.5	11.8	
"	1/5	413	73.3	13.1	15.3
"	1/6	304	56.9	14.9	
"	1/6	305	58.8	16.3	
Dismantler	1/5	299	33.0	69.7	69.7
Craneman	1/5	415	91.8	9.5	11.3
"	1/5	409	82.4	13.1	

AREA AIR SAMPLES

Area	Date	Total Sampling Time (min.)	Volume (liters)	Concentration ($\mu g/m^3$)	Average ($\mu g/m^3$)
Filling Chamber					
Left Side	1/5	385	72.8	56.7	
"	1/6	282	61.4	47.2	
Front	1/5	381	76.7	46.7	41.6
"	1/6	282	56.6	39.8	
Right Side	1/5	383	59.3	30.9	
"	1/6	283	55.2	28.4	

Table II

CONCENTRATIONS OF XYLENE AND TOLUENE FOUND AT THE
WESTINGHOUSE FACILITY IN SHARON, PENNSYLVANIA ON JANUARY 5-6, 1977

Job Title	Date	Total Sampling Time (min.)	Volume (liters)	Concentration Xylene (ppm)	Concentration Toluene (ppm)
Painter	1/6	248	67.6	0.17	0.6
Fit for Ship	1/6	305	68.7	0.01	77.7

**No detection (limit of detection 0.01 mg/tube)

1. Due to the possible carcinogenic effect of polychlorinated biphenyls in humans, all operations involving its use should be carried out in an enclosed room equipped with a negative ventilation system (except the filling operation which is located on the railroad spurs outdoors).

2. Local exhuast ventilation should be installed wherever employees are working around open transformers or vats filled with polychlorinated biphenyls.

3. All employees working directly with polychlorinated biphenyls (filling and topping operations) should wear protective clothing impervious to polychlorinated biphenyls (long sleeve overalls and gloves) and use NIOSH certified organic vapor respirators during the time these operations are performed. All usage of respirators must comply with the OSHA regulations for respirator programs (29 CFR 1910.134).

4. Any materials which become contaminated with polychlorinated biphenyls should immediately be disposed in sealed 55-gallon drums or other appropriate containers and sent to an appropriate disposal site.

5. NIOSH certified air supplied respirators should be available in case of spills or other emergencies.

Appendix A

JOB DESCRIPTIONS

Fit Test - Builds cabinet around the guts of the dry transformers (located near filling chamber).

Group Leader - Loads and unloads the PCBs filled transformers from the fill chamber and dry transformers from the oven.

Mounter - Makes all the electrical connections on the dry transformers (located near filling chamber).

Painter - Paints the transformers.

Fit for Ship - Prepares the transformer for painting and adds (topping off) any PCBs that might be needed to insure transformer is full.

Packer - Packs transformers and prepares them for shipping.

Craneman - Operates overhead crane which moves the transformers to the different areas of the operation.

Dismantler - Dismantles any transformer that needs repair or is being discarded.

REFERENCES

1. Urabe H: (Forward the fourth reports of study of "Yusho" and PCB) Fukuaka Acta Med 65 1-4, 1974 (Jap).

2. Kimbrough RD, Squire RH, Linder RE, Strandberg JD, Montaili RJ, Burso VW: Induction of Liver Tumers in Sherman Strain Female Rats by Polychlorinated Biphenyls - Aroclor 1260. J. National Cancer Institute 55:1453-59, 1975.

3. Kimbrough RD, Linder RE: Induction of Adenofibiosis and Hepatoma of the Liver in BALU/J Mice by Polychlorinated Biphenyls (Aroclor 1254) J. National Cancer Institute 53:547-52, 1974.

4. Oettingen WF, von Neal PA, Donahue DD: The Toxicity and Potential Dangers of Toluene - Preliminary report. JAMA 118: 579-84, 1942.

5. Oettingen WF, von Neal PA, Donahue DD, Svirbely JE, Baernstein HD, Monaco AR, Valaer PJ, Mitchell JL: The Toxicity and Potential Dangers of Toluene with Special Reference to its Maximal Permissible Concentration, Bulletin 279, Public Health Service, 1942, pp. 50.

6. Carpenter CP, Shaffer CB, Weil CS, Smyth HF, Jr.: Studies on the Inhalation of 1,3 - Butadiene with a Comparison of its Narcotic Effect with Benzol, Toluol, and Styrene, and a Note on the Elimination of Styrene by the Human, J. Ind. Hyg. Toxicol 26:69-78, 1944.

7. Ogata M, Tomokuni K, Tokatsuka Y: Urinary Excretions of Hippuric Acid and m- or p-Xylene as a Test of Exposure. Br. J. Ind. Med. 27:43-50, 1970.

8. Capellini A, Alessio L: (The Urinary Excretion of Hippuric Acid in Workers Exposed to Toluene) Med. Lavoro 62:196-201, 1971 (It).

9. O'Brien ET, Yeoman WB, Hobby JAE: Hepatorenal Damage from Toluene in a Glue Sniffer: Br. Med. J. 2:2930, 1971.

10. Greenburg L, Mayers MR, Heimann H, Moskowitz S: The Effects of Exposure to Toluene in Industry. JAMA 118:573-79, 1942.