DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
ROBERT A. TAFT LABORATORIES
4676 COLUMBIA PARKWAY, CINCINNATI, OHIO 45226

May 10, 1977

Paul E. Heisler
Monsanto
Route 3
Sauget, Illinois 62201

Dear Mr. Heisler:

Enclosed is a copy of our final report of the industrial hygiene survey conducted at the W.G. Krummrich plant on July 21-22, 1976.

Copies of this report are being sent to the NIOSH Regional Office, OSHA Regional Office, Local #12, International Chemical Workers and the Illinois Department of Labor.

As previously mentioned, all investigative findings and reports are subject to mandatory disclosure, upon request, under the provisions of the Freedom of Information Act.

We appreciate the cooperation that you and your staff displayed during our visit. If you have any questions or desire clarification of this report, I can be reached by calling (513) 684-2876.

Sincerely,

Mark W. Jones

Mark W. Jones
Industrial Hygienist
Industrial Hygiene Section

enclosure
cc: J.T. Garrett
Dr. Craft
NIOSH Regional Office, Region V
OSHA Regional Office, Region V
International Chemical Workers, Local #12
Illinois Department of Labor
NIOSHTIC
B. Peterson

DSW 020369

STLCOPCB4008298

INDUSTRIAL HYGIENE SURVEY OF THE

Polychlorinated Biphenyl Production Operation
Monsanto Industrial Chemicals Company
Sauget, Illinois

SURVEY DATE

July 21-22, 1976

SURVEY CONDUCTED BY

Mark Jones
Janson Becker

REPORT WRITTEN BY

Mark Jones

DATE OF REPORT

May 6, 1977

Industrial Hygiene Section
Industrywide Studies Branch
Division of Surveillance, Hazard Evaluations and Field Studies
National Institute for Occupational Safety and Health
Cincinnati, Ohio

DSW 020370

STLCOPCB4008299

PLACE VISITED:	Monsanto Company W.G. Krummrich Sauget, Illinois
DATE OF VISIT:	July 21-22, 1976
PEOPLE CONTACTED:	Mr. Art Leisy Manufacturing Superintendent Mr. Paul Heisler Director, Safety and Environmental Control Mr. Bruce Eley Corporate Industrial Hygienist Mr. Virgil Brawley Supervisor - PCB Production Mr. John Peduzzi Supervisor - Incineration Mr. Julio Munoz Senior Technician, Environmental Control Mr. Neil Sullivan Technician, Environmental Control Mr. Frank Basile Senior Engineer, Environmental Control Mr. Ed Heumann Technician, Environmental Control Mr. Dale Rachel - Foreman, PCBs Production Mr. Tom Carrico - Foreman, PCBs Production
PERSONS MAKING VISIT:	Mark Jones Janson Becker
PURPOSE:	To conduct an industrial hygiene survey to determine the workers' level of exposure to chemicals present in the polychlorinated biphenyls production area at the Sauget, Illinois facility.

DSW 020371

INTRODUCTION

Recent literature has linked polychlorinated biphenyls with possible carcinogenic effects. Because 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. Since Monsanto is the sole producer of polychlorinated biphenyls in the United States, an industrial hygiene survey was conducted at their PCBs production area in Sauget, Illinois, on July 21-22, 1976. This survey was conducted by Janson Becker and Mark Jones.

During the visit, 18 air samples were collected for evaluation of polychlorinated biphenyls exposure. In addition, samples were collected for exposure to iron silica and chlorine.

DESCRIPTION OF THE FACILITY

The polychlorinated biphenyls production operation is one of many operations present at the Monsanto facility in Sauget, Illinois. Sulfuric acid, benzene derivatives, rubber chemicals (antioxidants, etc.), chlorine and phosphorous products are other products produced at the facility.

The facility began production of polychlorinated biphenyls around 1936. Production continued to grow until 1970 when Monsanto began restricting the sale of PCBs to use in closed systems.

The entire work force at the facility is approximately 1300 persons, with approximately 835 of these persons being hourly employees. Approximately 25 employees are involved with the production of PCBs. The union representing this group is the International Chemical Workers, Local #12.

MEDICAL, INDUSTRIAL HYGIENE AND SAFETY PROGRAMS

A dispensary is located at the plant. Nurses are present at the dispensary 24 hours a day and a physician is present during the day. All employees are required to take a pre-employment physical examination and annual physical examinations. Certain employees are required to take additional examinations and/or special tests.

Industrial hygiene matters at the facility are handled by the Environmental Control Group. The six people who are assigned to this group work in conjunction with the safety department. The only sampling that has been done for polychlorinated biphenyls is the waste water discharged from the area is sampled continuously and analyzed twice a week and the collection of a few air samples (Appendix B).

STLCOPCB4008301

Four people work in the safety department. Safety meetings are held every month and safety information is provided to the different work areas through safety committees. Personal protection programs used at the plant include safety shoes, safety glasses, hard hats, protective clothing and respirators (where needed).

Corporate industrial hygienists also give support to the industrial hygiene and safety programs.

DESCRIPTION OF PROCESS

Three products are made in the PCBs production area: Aroclor 1016, Aroclor 1242, and Aroclor 1254. Aroclor 1016 is used in capacitors and Aroclor 1242 and 1254 are used in transformers. The operation is outdoor and consists mainly of pipeline, reaction vessels, distillation columns and storage tanks. Even though the system is theoretically a closed system, samples are drawn off and leaks occur which give a potential for employee exposure.

Biphenyl is brought to the facility by tank car and pumped to storage tanks. The chlorine used for the operation comes by pipeline from another part of the plant. The chlorine and biphenyl are piped into a chlorinator in the presence of a catalyst and allowed to react. There are two separate groups of chlorinators, one group for producing Aroclor 1254 and the other for Aroclor 1242. The product from the Aroclor 1254 chlorinators goes through a purifying operation which includes a still, receiving tank and filtering system. From this operation the polychlorinated biphenyls go to the appropriate storage tank. The product from the Aroclor 1242 chlorinators goes to an intermediate storage tank and then either through a similar operation as the Aroclor 1254 or to a distillation column for producing Aroclor 1016. From here it goes to the storage tanks.

The mixing tanks are used to formulate the final product by the introduction of the appropriate additives needed to give the polychlorinated biphenyls the properties desired by the customer. Diatomaceous earth is used as an aid to filtration.

INSPECTION OF PLANT

Potential Health Hazards

Potential health hazards observed during this survey were as follows:

1. Polychlorinated biphenyls exposure
2. Chlorine exposure
3. Free silica exposure

STLCOPCB4008302

Ventilation

The polychlorinated biphenyls production operation is located outdoors. Local exhaust ventilation is used in two operations. The drumming operation is equipped with a hose which is placed near the opening of the 55 gallon drum while it is filled. Near the chlorinators is a work station where employees perform specific tests on samples drawn from the chlorinators. This work station has an exhaust fan and a hood over the area where the tests are performed.

Housekeeping

Housekeeping in the polychlorinated biphenyls production area was taken care of fairly well. The aisleways were kept clean and clear.

SURVEY PROCEDURES

General

Air samples were collected in the polychlorinated biphenyls production area for evaluating exposure to polychlorinated biphenyls, iron chloride, and chlorine. A bulk sample of the diatomaceous earth used was analyzed for free silica content. 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 production area. Sipin Spl pumps were used to collect the air samples on florosil tubes. The tubes contain a magnesium silicate absorbent called florosil and have a 100 mg primary section and a 50 mg backup section. Samples were collected for six to eight hours at a flow rate of approximately 200 cc/min. The polychlorinated biphenyls were desorbed from the florosil with hexane and analyzed by using a gas chromatograph with an electron capture detector.

Iron Chloride

Area air samples were collected for iron chloride while the employees poured the iron chloride (powder) into a vessel. MSA Model G pumps were used to collect the air samples on a 0.8 micrometer pore size mixed cellulose ester filter (37 mm in diameter). Samples were collected for the duration of the task which was approximately three minutes at a flow rate of 1.7 liters per minute. The samples were analyzed for iron by atomic absorption and are reported as such.

DSW 020374

STLCOPCB4008303

Free Silica

One bulk sample of the diatomaceous earth used was collected for analysis of free silica content. The per cent free silica was determined by x-ray diffraction.

Chlorine

Detector tubes were used to evaluate concentrations of chlorine in the PCBs production area. Chlorine measurements were made using "Bendix Gastec Analyzer Tubes - Low Range (1-8 ppm)".

RESULTS AND DISCUSSION

Polychlorinated Biphenyls

The results of the area and personal air samples are given in Table 1 and the job descriptions corresponding to the job titles are in Appendix A.

Eleven personal and seven area air samples were collected for analysis for polychlorinated biphenyls. The polychlorinated biphenyls being produced at the time of the survey were for Aroclor 1016 (42% chlorine). The personal air samples ranged from a concentration of 20 $\mu g/m^3$ to 86 $\mu g/m^3$ while the area air samples ranged from 16 $\mu g/m^3$ to 55 $\mu g/m^3$. These are all well below the current Federal Standard for chlorodiphenyl (42% of chlorine) of 1 mg/m^3. The dermatological effect and systemic effect on the liver resulting from polychlorinated biphenyls is well documented 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.

Iron Chloride

The results of the air samples are given in Table II. Two samples were collected for determining worker exposure to iron chloride. No iron could be detected on one of the samples, but the other sample had an iron concentration of 8.1 mg/m^3. Since this procedure of adding the iron chloride only takes an average of 3 minutes per shift, the workers time weighted average is well below the current recommended ACGIH TLV for iron salts of 1 mg/m^3 based upon soluble iron. The big difference in sample results was probably due to the differences in operating procedures observed each time the task was performed.

Free Silica

The bulk sample of diatomaceous earth was analyzed and determined to have a free silica content of 9.8%. Since the material is usually handled only once a week, the survey team was unable to observe this procedure.

Chlorine

No concentrations of chlorine were detected.

CONCLUSIONS AND RECOMMENDATIONS

Based on the observations made during this survey and the results of the air samples, the following conclusions are drawn and recommendations for improvements made:

1) Even though the concentration of iron chloride found while handling the material is below the ACGIH recommended TLV it would be good industrial hygiene practice to wear an approved respirator when this task is performed.

2) Since the diatomaceous earth contains 9.8% free silica, an approved dust respirator should be worn when the worker performs this task if this practice is not presently employed.

3) Because of the recent concern of the possible carcinogenic effect of polychlorinated biphenyls, engineering methods should be used to prevent employee exposure to polychlorinated biphenyls.

4) Emergency equipment (self-contained breathing apparatus) should be readily available in case of a chlorine leak.

is readily available - Scott Air Pack

Engr was used on air collectors - some he missed entirely! There are 4 sampling stations
1. Work station
1 Hood in Control Room
1 Hood at Exam Out.

DSW 020376

STLCOPCB4008305

Table I

CONCENTRATIONS OF POLYCHLORINATED BIPHENYL
(detected as Aroclor 1016) IN A FACILITY
MANUFACTURING POLYCHLORINATED BIPHENYLS

Personal Air Samples

Job Title	Date Sampled	Total Sampling Time (min.)	Volume (liters)	Concentration ($\mu g/m^3$)	TWA ($\mu g/m^3$)
Premium Operator	7/21	436	91.0	47	33
"	7/22	451	97.8	20	
Second Operator	7/21	432	80.0	46	44
"	7/22	448	95.3	43	
Column Operator	7/21		74.9	64	57*
"	7/22	446	85.7	51	
Still Operator	7/21	432	94.6	40	63
"	7/22	444	67.6	86	
Standard Operator	7/22	445	96.1	61	61
Distribution Operator	7/21	413	88.3	54	45
"	7/22	419	91.3	36	

Area Air Samples

Location	Date Sampled	Total Sampling Time (min.)	Volume (liters)	Concentration ($\mu g/m^3$)	Average ($\mu g/m^3$)
Drumming	7/21	418	89.1	45	48
"	7/22	418	87.6	51	
Temperature Testing	7/21	417	201.6	25	39
"	7/22	455	105.4	52	
Chlorinators	7/21	419	89.0	55	46
"	7/22	459	70.3	36	
Incinerator Burner	7/21	409	81.6	16	16

*Arithmetic Average

DSW 020377

Table II

CONCENTRATIONS OF IRON CHLORIDE
FOUND WHILE OPERATOR ADDED IT AS A CATALYST

Location	Date	Total Sampling Time (min.)	Volume (liters)	Concentration of Iron (mg/m^3)	Concentration of Iron Chloride (mg/m^3)
Near Reactor Lid	7/21	3	5.1	N.D.	--
"	7/22	3	5.1	8.1	18.4

DSW 020378

STLCOPCB4008307

Appendix A

JOB DESCRIPTIONS

Premium Operator - Operates both the continuous and batch chlorinators. This includes keeping the chlorinators running, adding iron chloride and drawing samples.

Second Operator - Loads the tank cars for shipment and takes care of the tank farm and blend tanks.

Standard Operator - In charge of making sure area is clean and does all the filling of the 55 gallon drums.

Column Operator - Operates the distillation column used to produce Aroclor 1016.

Still Operator - Operates both stills used in producing Arolcor 1254 and 1242.

Distribution Operator - Works in a different area of the plant and is in charge of operating the incinerator.

STLCOPCB4008308

Appendix B

CONCENTRATION IN THE ATMOSPHERE IN THE
MANUFACTURING DEPARTMENT BATTERY LIMITS AS MEASURE IN OCTOBER, 1975

Date	Location	mg/m^3
10/9/75	12 ft. operating level at batch chlorinator	0.022
10/9/75	12 ft. operating level at continuous chlorinator	0.012
10/13/75	12 ft. operating level at batch chlorinator	0.057
10/13/75	12 ft. operating level at continuous chlorinator	0.058
10/14/75	Ground floor operating level	0.006
10/16/75	Ground floor, scrubber discharge area	0.338

SOURCE: Monsanto

DSW 020380

STLCOPCB4008309

REFERENCES

1. Urabe H: (Foreward the fourth reports of study of "Yasho" and PCB) Fukuoka Acta Med 65:1-4, 1974 (Jap.).

2. Kimbrough, R.D., Squire, R.A., Londer, R.E., Strandberg, J.D., Montaili, R.J., Burso, V.W.: Induction of Liver Tumors in Sherman Strain Female Rats by Polychlorniated Biphenyl Aroclor 1260. J. National Cancer Institute 55:1453-59, 1975.

3. Kimbrough, R.D., Linder, R.E.: Industion of Adenofibrosis and hepatomas of the liver in BALV/J mice by polychlorinated biphenyls (Aroclor 1254) J. National Cancer Institute 53:547-52: 1974.

STLCOPCB4008310