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

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

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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 Supervisor - Air Pollution Mr. Bruce Eley Corporate Industrial Hygienist Mr. Virgil Brawley Supervisor - PCB Production Mr. John Peduzzi Supervisor - Incineration Mr. Julio Muñoz - Air Pollution Group Mr. Neil Sullivan - Air Pollution Group Mr. Frank Basile - Air Pollution Group Mr. Ed Newman - Air Pollution Group 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.

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,~~ and benzene derivatives, rubber chemicals (antioxidants, etc.), ~~activated~~ chlorine and phosphorous products are other products produced at the facility.

The facility began production of polychlorinated biphenyls around 1929. Production continued to grow until 1970 when Monsanto began restricting the sale of PCBs ~~for~~ to use in closed systems.

* Benzene is not manufactured at the Sauget Plant.

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. Certain employees are then required to take periodic physical examinations. Certain employees are required to take additional examinations and/or special tests. Industrial hygiene matters at the facility are handled by the Air Environmental Pollution 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 discharge from the area, which is monitored twice a week, and the collection of a few air samples (Appendix B).

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.

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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 ~~an iron~~ $FeCl_3$ 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 ~~which separates the different polychlorinated biphenyl isomers~~ 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

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biphenyls the properties desired by the customer. ~~To give the poly-chlorinated biphenyls better electrical properties a small amount of~~ Diatomaceous earth is used as an aid to filtration ~~added to the blend tanks once a week and then filtered out.~~

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

Ventilation

Since the operation is outdoors there is very little ventilation. 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 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 SP1 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) ~~cartridges~~ into ~~the reactors~~ 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.

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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 PCBa production area. Chlorine measurements were made using "Bendix Gastec Analyzer Tubes - Low Range (1-8 ppm)."

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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.

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 standard for chlorodiphenyl (42% of chlorine) of 1 mg/m^3. However, this standard is based upon skin irritation and recent literature has linked carcinogenic effects to polychlorinated biphenyls. 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 catalyst to the reactor only takes 3 minutes and is done once per shift the workers time weighted average is well below the current standard 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 ~~procedure of adding~~ material handled diatomaceous earth to the blend tank is done usually 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 ~~during the~~ while loading material addition of the catalyst to the reactor is below the Federal Standard, it would be good industrial hygiene practice to continue wearing 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 effects 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.

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Table I

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

Personal Air Samples

Job Title	Date	Total 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	Total 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

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Table II

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

Location	Date	Total 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

Appendix A

JOB DESCRIPTIONS

Premium Operator - Operates both the continuous and batch chlorinators. This includes keeping the chlorinators running, adding ~~the~~ iron chloride catalyst ~~once a shift~~ and drawing samples ~~off twice a shift~~.

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.

Appendix B

CONCENTRATION IN THE ATMOSPHERE IN THE
MANUFACTURING DEPARTMENT BATTERY LIMITS AS MEASURED 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