PLAINTIFF'S EXHIBIT

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DOW CHEMICAL U.S.A.

TEXAS DIVISION
FREEPORT, TEXAS 77541

ENVIRONMENTAL HEALTH REPORT

FILE NO. A50-1950

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AUTHOR E. P. Whatley
E. A. Engeling

CHECKED George H Flores

DATE July 24, 1980

EVALUATION OF EXPOSURES TO CHLORINE (Cl_2) AND ASBESTOS

CHLORINE VI
A-5000

Summary

A survey was conducted from November, 1979-January, 1980 to determine employee exposures to chlorine and asbestos.

All employee exposures were within acceptable levels.

Future monitoring emphasis should be placed on short term or peak exposures to employees while performing those job procedures with the highest potentials for exposure.

Employees should be informed of the results of this survey and the informing documented.

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bbs

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INTRODUCTION

A survey was conducted November, 1979 - January, 1980 to determine employee exposures to chlorine (Cl_2) and asbestos at Chlorine VI, A-5000.

PROCESS AND JOB DESCRIPTIONS

Chlorine is produced electrolytically from sodium chloride brine in asbestos drawn diaphragm cells. By-products are hydrogen and 8-10% sodium hydroxide (cell effluent). The chlorine is cooled to condense and remove water, and is further dried by bubbling through concentrated sulfuric acid. The dry chlorine is then compressed and liquefied, stored in spheres, and piped to Dow user plants or to Chlorine V for shipment to outside customers. The electrolytic cells are fabricated and repaired on site, but the asbestos drawing is done by the Cell Services Department. Brief summaries of the job duties of Chlorine VI employees follow:

Superintendent and Engineers - most of their time is spent in the A-5024 office, with 15-25% in the cell area, brine and liquefaction plants.

Shift Foreman - generally spend 75% of their time outside in all three plants.

Production Foreman - spends an average of 50% of his working time outside in the three plant areas, balance in office.

Maintenance Foreman - usually outside in plant areas 60% of time.

Cell Repair Foreman - work in the A-5022 shop except during turn-arounds, at which time virtually all of their time is spent in the cell areas. Turn-arounds usually occur every 1-2 months.

Control A Operators - operate the board in the control room, and are seldom outside unless problems in the plant develop.

Control B Operators - work in the liquefaction plant, generally spending 50% of the shift out in the plant. Also responsible for collecting quality control samples of concentrated sulfuric acid (completely slickered plus respiratory protection).

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PROCESS AND JOB DESCRIPTIONS (continued)

Control C Operators - "Cell Operators" who spend the majority of their time in the cell areas. Collect & analyze chlorine and cell effluent samples, as well as brine as it comes into the block from Chlorine I. Also pulp cells with wet asbestos slurry from the Cell Services Department.

Control C Operators - Brine Plant - much time is spent outside collecting grab samples of brine and carb liquor (sodium carbonate). Also responsible for waste water treatment in that area.

Class 1 & Class 2 - Cell Repair - erect and dismantle cells in cell areas. Clean & rebuild cells in the cell repair shop(disassemble, remove graphite, scrape off putty, wash down, and replace graphite & putty(cathodes are further cleaned at cathode cleaning facility at Dow Oyster Creek).

Class 2 Unloader- unloads asbestos slurry, sulfur dioxide, sulfuric acid (98%), and sodium thiosulfate tank trucks. Checks cell effluent (sodium hydroxide), chlorine, and carb liquor (sodium carbonate) pipelines for leaks, and cleans & greases chlorine & cell effluent valves. Also runs a diesel engine and changes air conditioning filters in A-5024. Generally spends 60-70% of his workday outside in various areas of the plant.

Sr. Assistant Chemist, Class B - collects chlorine sample from CDC (cooling, drying & compression) area; spends majority of time analyzing chlorine, brine & sulfuric acid samples.

METHODOLOGY

Personnel chlorine and asbestos samples were collected by E. A. Engeling of Chlorine VI. Bendix BDX44 Super Sampler pumps were used to collect chlorine samples on 5 gram charcoal tubes, and asbestos on Millipore® filters (MAWG 037AO, Millipore Corp., Bedford, Mass.). The samples were collected by drawing a measured volume of air (approx. 1.5 liters per minute) through a Millipore filter together with a charcoal tube in line for six hours. The Bendix pumps were calibrated before and after use with a calibrated Gilmont rotameter, S/N B3895. Sampling was conducted while employees performed routine job duties.

Analyses for chlorine were performed by Analytical Services, B-2406 by extraction of the charcoal with sodium hydroxide and potentiometric titration for total chloride ion content. The chloride content was doubled to obtain the total chlorine content. Analyses for asbestos were performed by Analytical Services, B-1225, using optical microscopy.

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EVALUATION CRITERIA

Permissible exposure limits (PEL's) are concentrations of airborne substances to which nearly all employees may be repeatedly exposed throughout a working lifetime without adverse effect. These levels are based on industrial experience, and on experimental human and animal toxicological studies. Permissible exposure levels do not represent fine lines between safe and dangerous exposures. As the name indicates, they are to be used by Industrial Hygienists as guides for plant design and for evaluating occupational exposures. PEL's for gases and vapors are usually expressed on a molar volume basis as parts contaminant per million parts of air (ppm); for dusts, mists, aerosols and fumes, they are usually expressed as milligram or microgram of contaminant per cubic meter of air (mg/m^3 and ug/m^3, respectively). For asbestos fibers, PEL's are expressed as asbestos fibers per cubic centimeter of air. An asbestos fiber is defined as a particle greater than or equal to 5 microns in length.

Most PEL's are time-weighted average concentrations for 8-12 hour work days and 40 hour work weeks. For many substances, higher Short Term Exposure Limits (STEL's) are allowed for periods up to 15 minutes, provided that there are no more than four excursions per day with at least 60 minutes between exposure periods. Ceiling PEL's are designated for some substances, in which cases short term exposures to higher levels are not permitted.

The PEL's for chlorine and asbestos are as follows:

	8 Hour Average	STEL
Chlorine	1 ppm ceiling	
Asbestos	2 fibers/cc air	10 fibers/cc air

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RESULTS AND DISCUSSION

Chlorine VI employee exposures to chlorine and asbestos are summarized by job classification in Table I; individual employee exposures are shown in Appendix A. Contractor Maintenance employee exposures are summarized in Table II, and are shown individually in Appendix B.

All employee exposures to both chlorine and asbestos were within allowed exposure levels.

Average employee exposures to chlorine by job classification were 30% or less of the allowed exposure limit, with the highest average exposures being those of the Control C Operators. However, actual employee exposures ranged as high as 70% of the allowed exposure limit; in these cases employees may have received short term or peak exposures in excess of the allowed 1 ppm. Average employee exposures to asbestos were less than 1 % of the allowed exposure limit.

CONCLUSIONS AND RECOMMENDATIONS

Employee exposures to chlorine and asbestos at Chlorine VI are well within acceptable levels.

Future monitoring for chlorine and asbestos should be conducted with emphasis on short term or peak exposures during those job procedures with the highest potentials for exposure.

Employees should be informed of the results of this survey, the consequences of overexposure to chlorine and asbestos (attached), methods of exposure control, and the care and use of protective equipment. This informing process should be documented.

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TABLE I

EMPLOYEE EXPOSURES TO CHLORINE AND ASBESTOS
(8 HOUR AVERAGES)
CHLORINE 6

JOB CLASSIFICATION	CHLORINE (PPM) AVERAGE	CHLORINE (PPM) RANGE	ASBESTOS (FIBERS/CC) AVERAGE	ASBESTOS (FIBERS/CC) RANGE	NO. SAMPLES
Superintendent & Engineers	.11	.04 - .23	.009	.003 - .015	7
Production Foremen	.08	.06 - .09	.010	.007 - .012	2
Foremen	.14	.04 - .26	.012	.007 - .017	5
Shift Foremen	.13	.01 - .35	.006	.004 - .008	5
Instrument	.20	.07 - .24	.008	.003 - .012	4
Matl. & Production Clerks	.08	.07 - .09	.005	.003 - .007	2
Maintenance (machinists, welders, pipefitters)	.06	.04 - .09	.012	.009 - .013	5
Control A Operator	.12	.03 - .23	.007	.003 - .013	9
Control B Operator (Liquefaction Plant)	.20	.04 - .36	.007	.002 - .013	4
Control C Operator (Cell Operators)	.30	.13 - .70	.007	.003 - .014	9
Control C Operator (Brine Plant)	.11	.05 - .22	.008	.006 - .009	3
Class 1 & Class 2 Operators (Cell Repair)	.13	.04 - .45	.012	.002 - .017	26
Class 2 Operator (Unloader)	.27	--	.016	--	1
Sr. Asst. Chemist Class B	.12	--	.008	--	1
Allowed Exposure Level	1 ppm Ceiling		2 fibers/CC Air		

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TABLE II

CONTRACTOR EMPLOYEE EXPOSURES TO CHLORINE AND ASBESTOS
(8 HOUR AVERAGES)
CHLORINE 6

JOB CLASSIFICATION	EMPLOYER	CHLORINE (PPM) AVERAGE	CHLORINE (PPM) RANGE	ASBESTOS (FIBERS/CC) AVERAGE	ASBESTOS (FIBERS/CC) RANGE	NO. SAMPLES
Foreman	U.S. Contractor	.13	--	.012	--	1
Pipefitter	U.S. Contractor	.06	.03-.07	.011	.006-.016	6
Carpenter & Pipefitter	U.S. Contractor	.09	--	.012	--	1
Welder	U.S. Contractor	.16	--	--*	--	1
Fiberglass work	U.S. Contractor	.09	--	--*	--	1
Electrician Foreman	Gulf States	.07	--	.016	--	1
Electrician	Gulf States	.09	.06-.11	.013	.002-.020	6
Machinist	McGill Maintenance	.16	.11-.20	.003	.002-.004	2
Janitor	Ramirez	.15	--	.008	--	1
Allowed exposure level		1 ppm (ceiling		2 fibers/cc air		

* Filters were too dirty to obtain asbestos fiber counts

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APPENDIX B

CONTRACTOR MAINTENANCE EMPLOYEE EXPOSURES TO CHLORINE AND ASBESTOS
(8 HOUR AVERAGES)
CHLORINE 6

EMPLOYEE	EMPLOYEE NO.	EMPLOYER	DATE	Cl_2 (PPM)	ASBESTOS (FIBERS/CC AIR)
Foreman					
	7370	U.S. Cont.	1-3-80	0.13	.012
Pipefitter					
	8846	"	1-3-80	0.06	.006
	3735	"	12-31-79	0.06	.011
	3801	"	1-4-80	0.05	.011
	9791	"	12-31-79	0.03	.007
	4656	"	12-31-79	0.06	.016
	4208	"	1-4-80	0.07	.014
Welder					
	7995	"	1-4-80	0.16	too dirty to count
Carpenter & Pipefitter					
	15783	"	1-3-80	0.09	.012
Fiberglsss Work					
	17840	"	1-3-80	0.09	too dirty to count
Electrical Foreman					
	171	Gulf States	1-9-80	0.07	.016
Electrician					
	850	"	1-9-80	0.15	.011
	3597	"	1-7-80	0.10	.016
	428	"	1-7-80	0.07	.012
	3367	"	1-9-80	0.07	.015
	3494	"	1-7-80	0.11	.020
	533	"	1-7-80	0.06	.002
Machinist					
	145	McGill Maint.	1-4-80	0.11	.004
	049	"	1-10-80	0.20	.002
Janitor					
	014	Ramirez	1-10-80	0.15	.008

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NOTE: Filters "too dirty to count" represent normal welding or glass fiber work - no asbestos handling involved.

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APPENDIX A (continued)

EMPLOYEE	MASTER NO.	DATE	Cl_2 (PPM)	ASBESTOS FIBERS/CC AIR
Class 2 Operator(cont.)				
	130801	12-19-79	0.04	.015
	142123	12-13-79	0.05	.009
	142130	12-13-79	0.05	.014
	141622	12-13-79	0.06	.017
	138397	12-14-79	0.05	.017
	133775	12-3-79	0.27	.016
	139063	11-29-79	0.17	.011
	138305	12-14-79	0.10	.007
	138517	11-30-79	0.19	.017
	138449	12-7-79	0.08	.015
	139188	12-20-79	0.21	.002
	142128	12-13-79	0.04	.014
	137390	12-14-79	0.09	.015
	131677	12-6-79	0.44	.012
	139765	12-21-79	0.05	.016
	138473	12-6-79	0.25	.012
	138825	11-29-79	0.15	.012
	142124	12-7-79	0.04	.013
	136236	12-20-79	0.07	.011
Sr. Asst. Chemist Class B				
	107860	1-10-80	0.12	.008
	142168	12-27-79	0.02	.014

NOTE: Filters "too dirty to count" represent normal welding work -- no asbestos handling involved.

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APPENDIX A (continued)

EMPLOYEE	MASTER NO.	DATE	Cl_2(PPM)	ASBESTOS FIBERS/CC AIR
Welder				
	117055	1-2-80	0.07	too dirty to count
Control A Operator				
	115435	12-3-79	0.22	.006
	134071	11-28-79	0.16	.005
	116142	11-26-79	0.11	.005
	142033	12-27-79	0.05	.013
	141582	12-28-79	0.03	too dirty to count.
Control A Operator				
	130122	12-4-79	0.18	.010
	110304	12-11-79	0.06	.009
	113814	12-17-79	0.07	.003
	115122	11-27-79	0.23	.006
Control B Operator				
	134880	11-28-79	0.36	.013
	137377	12-5-79	0.27	.002
	138177	12-12-79	0.04	.006
	136698	11-26-79	0.14	.006
Control C. Operator				
	138003	11-26-79	0.19	.004
	142129	1-2-80	0.13	.004
	139770	12-4-79	0.34	.006
	138835	12-17-79	0.21	.008
	138866	11-27-79	0.36	.003
	136251	12-4-79	0.25	.005
	133621	12-11-79	0.06	.008
	137301	12-4-79	0.70	.006
	141492	12-20-79	0.31	.010
	131902	12-28-79	0.05	.009
	134864	12-4-79	0.25	.014
	135085	12-5-79	0.22	.006
Class 1 Operator				
	136252	12-7-79	0.06	.013
Class 2 Operator				
	139655	12-20-79	0.05	.014
	138181	11-30-79	0.06	.017
	142126	11-30-79	0.18	.016
	138985	12-7-79	0.10	.012
	132824	12-14-79	0.08	.011
	137632	12-14-79	0.08	.016
	142421	12-7-79	0.06	.008
	135143	12-6-79	0.45	.016
	139239	12-13-79	0.04	.015
	140712	12-6-79	0.27	.007
	139240	11-29-79	0.15	.005

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APPENDIX A

EMPLOYEE EXPOSURES TO CHLORINE AND ASBESTOS
(8 HOUR AVERAGES)
CHLORINE 6

EMPLOYEE	MASTER NO.	DATE	Cl_2 (PPM)	ASBESTOS FIBERS/CC AIR
Prod. Supt.				
	132154	12-12-79	0.07	.006
Sr. Prod. Engineer				
	138154	12-11-79	0.14	.008
	506930	12-17-79	0.06	.014
	138898	12-3-79	0.23	.015
Prod. Engineer				
	138576	12-12-79	0.05	.007
Engineer				
	141912	12-3-79	0.22	.003
	142251	12-17-79	0.04	.007
Prod. Foreman				
	131719	12-12-79	0.09	.007
	113835	12-19-79	0.06	.012
Foreman				
	132330	12-19-79	0.04	.009
	137945	12-19-79	0.06	.007
	104582	12-21-79	0.11	.017
	115399	12-3-79	0.26	.008
	134255	12-19-79	0.24	.017
Rotating Shift Foreman				
	119051	12-21-79	0.01	.004
	137536	12-12-79	0.07	.005
	119459	12-27-79	0.16	.004
	135208	12-28-79	0.35	.008
	134962	1-9-80	0.07	.007
Instrument Technologist				
	133521	12-5-79	0.24	.011
Instrument Technician				
	140002	12-17-79	0.07	.003
	131433	12-5-79	0.24	.005
Inst. Trainee				
	140342	12-5-79	0.26	.012
Material Control Clerk				
	100744	12-20-79	0.07	.007
Prod. Clerk				
	132572	12-11-79	0.09	.003
Machinist				
	136674	12-27-79	0.04	.013
Pipefitter				
	131795	1-2-80	0.05	.011
	134847	12-21-79	0.05	.013
	132878	12-28-79	0.09	.009

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ASBESTOS/BRICKMASONS A+B ✓
ASBESTOS/CARPENTERS A+E ✓
ASBESTOS/INSULATORS
ASBESTOS/SALVAGE

I. TESTING SCHEDULE

A. Audiograms - Annually if the 8-hour equivalent for noise exposure is greater than 85 decibels for 8 hours.

B. AM Blood Work (to include CBC, UA, liver and renal function tests) - annually.

C. Stools for Occult Blood over age 40 - annually.

D. Chest x-ray, expirogram, respiratory symptomology history - annually.

E. Sputum cytology over age 40 or with greater than 10 years potential exposure - annually.

F. Core Exam - Every 2 years.

G. Hands on physical examination every 2 years over 40 years of age and every 4 years under 40 years of age.

II. JUSTIFICATION FOR DEVIATION FROM THE CORE EXAM

A. Audiograms - Conforms with Dow guideline for hearing conservation.

B. Annual AM Blood Work and stools for occult blood - Dictated by tradition.

C. Annual chest x-ray, expirogram, and respiratory history - Dictated by the Asbestos Standard published in the Federal Register, Volume 40, No. 197, on Thursday, October 9, 1975.

D. Annual Sputum Cytology - Dictated by tradition and the Asbestos Standard. (The Standard states age 45, but traditionally it has been offered to those over age 40.)

E. Physical Exam - Dictated by tradition.
To deviate from this tradition would probably have a detrimental impact on participation and attitude toward our periodic health surveillance program.

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CKB/ske
10-16-80

PROTOCOL FOR HEALTH SURVEILLANCE OF THE PLANT A & B CARPENTERS

PROBLEM

1. These individuals are potentially exposed to asbestos and thus are covered by the Asbestos Standard published in the Federal Register, Volume 40, No. 197, on Thursday, October 9, 1975.

2. The Dow guideline for hearing conservation states that audiograms are to be done annually if the 8-hour equivalent for noise exposure is greater than 85 decibels. According to the noise survey dated February 19, 1981, there is potential for exposure to noise in excess of 85 decibels.

METHOD

1. Add an annual health history, expirogram, and chest x-ray for all individuals who work with asbestos in addition to the Core examination every two years to comply with the Standard. Also, add a physical examination based on age. Those over 40 years of age will be examined every two years and those under 40 will be examined every four years. This is to look for additional signs of possible disease or cancer.

2. Add an annual audiogram.

INTERPRETATION OF RESULTS

The history and all tests will be evaluated individually for each employee. The group will be analyzed for trends or changes in symptoms or signs of respiratory disease, if these exist. The audiograms will be analyzed for trends to facilitate hearing conservation.

DISSEMINATION OF RESULTS

The results of all tests will be individually communicated to each employee in writing. Any significant abnormalities will be discussed with supervision and a representative of Environmental Health Services. There will be no further dissemination or publication of the results without a separate approved protocol.

C. K. Browdy M.D.

C. K. Browdy, M.D.
Sr. Industrial Physician

W. A. Fishbeck, M.D.
Medical Director

J. R. Venable, M.D.
U. S. Area Medical Director

CKB/ske
2-16-82

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