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PLAINTIFF'S EXHIBIT

DOW-652

OYSTER CREEK DIVISION
POST OFFICE BOX 88
FREEPORT, TEXAS 77541

INDUSTRIAL HYGIENE REPORT

REPORT NO. OYC IH-2-1

TITLE

EVALUATION OF THE CHLORINE AND
ASBESTOS EXPOSURES OF PERSONNEL
IN THE CHLORINE PRODUCTION AREA
AT THE OYSTER CREEK DIVISION

FILE NO. OCD-2-1

DATE May 11, 1976

AUTHOR G. R. Gantt

CHECKED

DATE Sept. 20, 1976

SUMMARY

The chlorine and asbestos exposures of the personnel working in the chlorine production area were surveyed and found to be well within both the existing and proposed exposure standards. This report gives additional conclusions and recommendations as well as the actual survey information.

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AN OPERATING UNIT OF THE DOW CHEMICAL COMPANY

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PROBLEMS

This study was undertaken to evaluate the exposure of Unit II personnel to asbestos fibers and chlorine.

CONCLUSIONS AND RECOMMENDATIONS

A. Asbestos

1. Atmospheric concentrations of asbestos fibers were found to be well below the maximum allowable concentration of 2 fibers/cc (TWA) for all operations sampled.
2. The use of disposable coveralls and respirators is good practice and should be continued.
3. A method of asbestos handling and pulping, which eliminates the practice of leaving open bags of asbestos on the cell covers, should be devised.
4. There is too much loose asbestos on the cell covers. This fiber has been wet and probably does not represent a health hazard, but a way should be found to eliminate it.
5. The transfer of bagged asbestos from the warehouse to the cell area is an operation where the potential for overexposure exists. The use of asbestos in polyethylene lined bags seems to have reduced the possibility of overexposure and the use of this type bag should be continued.
6. Training programs on the hazards of and proper handling techniques for asbestos appear to be very good.

B. Chlorine

1. Atmospheric concentrations of chlorine were found to be below the maximum allowable concentrations (TWA of 1ppm) for all areas.

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2. The highest concentrations of chlorine were found in the secondary chlorine compressor area.
3. No suitable method for determining the peak exposure to chlorine has been found. Unit II personnel have been advised to use respiratory protection at the first odor of chlorine.

PROCESS

Unit II produces chlorine and sodium hydroxide by the electrolysis of sodium chloride brine. The electrolysis is carried out in Dow diaphragm cells which utilize an asbestos on wire screen diaphragm to separate the anode and cathode compartments. During the operation of those cells, holes may develop in the asbestos portion of the diaphragm. Such holes are undesirable since they affect both the performance and longevity of the cells. To plug these holes, a slurry of asbestos in water is added to the anode compartment of the cell. This procedure is known as "pulping" and involves the following steps:

- a. A bag of asbestos is carried from the cell area storage location to the top of the cell to be pulped.
- b. The bag is opened and the dry asbestos is wet with a hose.
- c. The asbestos is dumped from the bag into a large plastic basket where it is slurried with water.
- d. The slurry is added to the cell through a large funnel.
- e. The area is washed thoroughly with a hose.

The major portion of the asbestos is stored in a warehouse which is some distance from the cell area. It is moved to a temporary storage location in the cell area by use of a forklift. This temporary storage area will hold about a week's supply of asbestos.

The chlorine which is produced in the cell area is collected under a slight vacuum. It is dried and goes through successive stages of compression and cooling until the pressure reaches a level at which the chlorine can be readily transported.

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DISCUSSION

Two job classifications were under study during the course of this study. The cell control technician (operator) is responsible for the day to day operation of the electrolytic cells. He generally works a straight day schedule. During the course of this work he is on top of or around the cells for several hours a day. He may handle asbestos every day, but the amount of time spent moving asbestos bags and pulping seldom exceeds thirty minutes and is frequently much less. All technicians who handle asbestos wear disposable coveralls and mouth bit respirators while doing so. The short lengths of time during which asbestos is actually handled gives an actual TWA exposure of far less than the concentrations given for pulping operations in Table I of the Data Section.

The chlorine technician is responsible for the operation of the chlorine cooling, drying and compression areas. During the day, he may also assist the cell control technicians. He works a rotating schedule (shift) and at night he is responsible for the operation of the cells.

The asbestos sampling covered only the cell control technicians. They were considered to be the most frequently exposed group because they handle asbestos almost every day. The chlorine survey included both job classifications and all chlorine manufacturing areas.

Overexposure to asbestos fibers can cause asbestosis (a disabling injury in which scar tissue forms in the lungs) and has been implicated in the formation of tumors of the chest cavity. The currently recommended maximum exposure is 2 fibers/cc for an eight-hour time weighted average (TWA).

Chlorine overexposure can be divided into two categories. An acute overexposure, such as could occur during a gas release, can lead to possible lung damage and death. A chronic overexposure can lead to irritation of the respiratory system producing a condition which has been referred to as a "chlorine cold". The maximum allowable concentrations are a TWA of 1 ppm and a ceiling level of 3 ppm. At any concentrations above the ceiling level, respiratory protection should be used.

SAMPLING AND ANALYSIS

A. Asbestos

The samples being reported were collected during June, 1975 and January, 1976. Breathing zone samples

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were collected in the warehouse area and the cell area while asbestos was being handled. Technicians also wore personnel monitors while performing those portions of their jobs which did not require the handling of asbestos. These samples were collected to insure that there was no contamination of the work area from the adjoining temporary storage area. Area samples were collected in the storage areas to insure that levels there were not excessive.

Samples were collected on a Millipore 37 mm filter cassette having an exposed area of 855 sq. mm. A Bendix Micronair or MSA Model S sampling pump set to a flow rate of 1.7 to 2.0 l/min. was used to pull air through the cassette. Flow rates were measured with an American Meter Division Model 115 Dry Test Meter. The fiber counts were obtained by the Microscopy Section of the Texas Division Central Laboratory.

B. Chlorine

The chlorine samples were collected on a bed of activated charcoal contained in a Pyrex drying tube. The sampled air was pulled through the charcoal bed with a Bendix Micronair or MSA Model S sampling pump set to a flow rate of 2 - 2.3 l/min. Flow rates were measured in the same manner as those for asbestos sampling. All chlorine samples were of the area type rather than personnel monitors. The decision to monitor in this fashion was made for the following reasons:

1. Having a personnel monitor with a glass sampling tube was considered unsafe.
2. While a personnel monitor gives information about exposure levels it does not provide information about the location(s) where the exposure actually occurred.

For any type of job where there is a considerable amount of movement from place to place this is a necessary piece of information.

The measurement of the chlorine levels is based on the catalytic properties of the charcoal bed which converts chlorine to chloride ion. The chloride ion is extracted from the charcoal and titrated with silver nitrate. The titrations of these samples were performed by the Texas Division Central Laboratory using a coulometric method of end point detection.

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PRESENTATION OF DATA

Table I presents all the areas sampled and the results of these analysis. Also included is additional information such as total amount of air sampled and total fiber counts.

Table II presents information about the chlorine sampling and results of the analysis of these samples. Table III shows how the information from Table II is used to determine a composite average concentration for various areas of the chlorine manufacturing facility. Table IV is a compilation of actual time spent in each area which, when combined with the composite average concentrations, leads to the TWA exposure listed.

Figure I is an overview of the chlorine manufacturing facilities and areas surveyed. The circled letters represent the areas described in Table III.

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TABLE I - ASBESTOS SAMPLING LOCATIONS AND RESULTS

JOB/LOCATION	ml. AIR	FIBERS COUNTED PER SQUARE	TOTAL FIBERS COUNTED	FIBERS/cc	TYPE OF SAMPLE
1. Loading asbestos bags on forklift in warehouse and unloading in cell area.	5040	12	1140	0.23	Personal
2. Pulping Cells	18530	30	2850	0.15	Personal
3. Pulping Cells	17060	17	1615	0.10	Personal
4. Pulping Cells	16600	46	4370	0.26	Personal
5. Near asbestos storage in cell area.	19500	7	665	0.03	Area
6. Daily job procedure with no handling of asbestos.	418000	11	1045	0.01	Personal
7. West side of asbestos warehouse with doors closed and no recent disturbance of asbestos bags.	25200	8	760	0.03	Area
8. Daily job procedure with no handling of asbestos.	215000	91	8645	0.04	Personal
9. Daily job procedure with no handling of asbestos.	215000	97	9215	0.04	Personal
10. Pulping Cells	15000	12	1140	0.08	Personal
11. Pulping Cells	34200	2	190	0.01	Personal
12. Pulping Cells	15750	12	1140	0.07	Personal

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TABLE II - CHLORINE SAMPLING LOCATIONS AND RESULTS

LOCATION	AIR PUMPED IN l.	TOTAL ug OF Cl ⁻ FOUND	CHLORINE CONC. IN ppm.
1. Cell covers - Series I	792	385	0.17
2. Cell covers - Series 3	702	151	0.07
3. Cell covers - Series 4	828	743	0.31
4. Cell covers - Series 6	720	491	0.23
5. Cell covers - Series 5	736	568	0.27
6. Cell covers - Series 7	640	518	0.28
7. Ground level between Series 5 and 8	805	342	0.15
8. Ground level between Series 1 and 4	700	526	0.26
9. South end of Series 8	817	835	0.35
10. Chlorine Scrubber Deck	840	29	0.01
11. Near Chlorinated water pump	1058	533	0.17
12. North Side - Sump 1	920	771	0.29
13. Between C-202 A/B (secondary chlorine compressor)	810	743	0.32
14. Between C-203 A/B (secondary chlorine compressor)	780	2177	0.96
15. North Side of Terry Turbine (primary compressor deck)	897	1143	0.44
16. South Side of Terry Turbine (primary compressor deck)	840	108	0.05
17. South Side of T-202 (drying tower)	966	121	0.04
18. Between C-203 A/B (secondary chlorine compressors)	870	1183	0.47
19. Cell Lab	1000	90	0.03

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TABLE III - CHLORINE CONCENTRATIONS BY AREAS

<u>AREA</u>	<u>LOCATION FROM TABLE II</u>	<u>CHLORINE CONCENTRATION (COMPOSITE AVERAGE)</u>
A. Cell Covers	1 through 6	0.22
B. Ground level around cells	7 through 9	0.25
C. Cell Lab	19	0.03
D. Chlorine Drying Cooling and Compression	11 through 18	0.34
E. Inside Main Building	-----	0

TABLE IV - CHLORINE EXPOSURE LEVELS

JOB ASSIGNMENT	TIME IN HOURS		TIME IN HOURS		TIME IN HOURS		*TWA EXPOSURE ppm
	AREA A	AREA B	AREA C	AREA D	AREA E	AREA F	
Cell Control Technician	3	2	1.5	0			0.15
Chlorine Technician First Schedule (days)	1	1	0.75	2.3			0.16
Chlorine Technicians Second and Third Schedules (midnights and evenings)	1.5	1.5	0.75	2			0.18

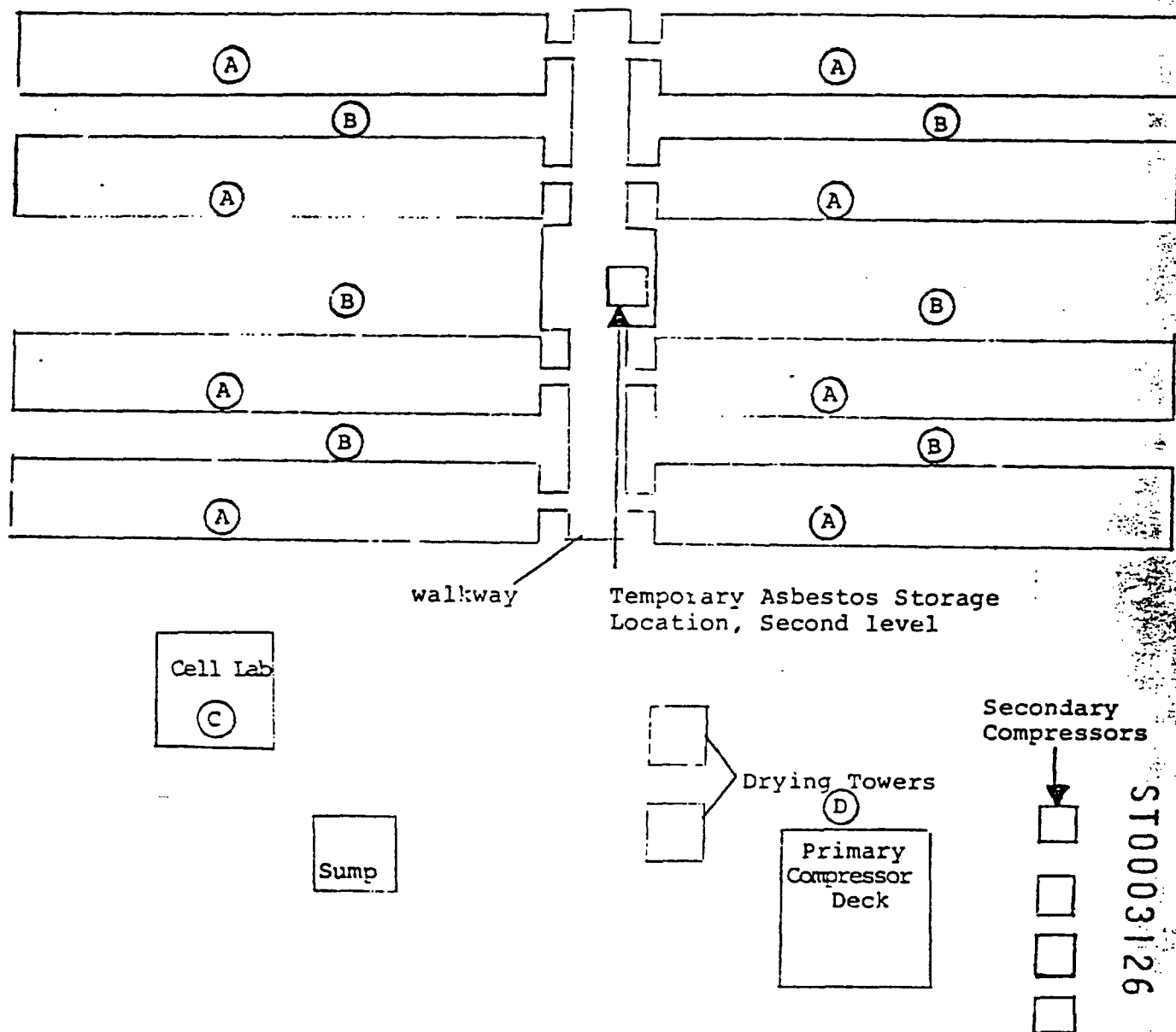
* Using chlorine concentration from Table III.

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FIGURE I - CHLORINE MANUFACTURING AREA



Not drawn to scale
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Main Building, Shop, Offices, Etc.

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2. The highest concentrations of chlorine were found in the secondary chlorine compressor area.
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PROCESS

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10. Pulping Cells	15000	12	1140	0.08	Personal
11. Pulping Cells	34200	2	190	0.01	Personal
12. Pulping Cells	15750	12	1140	0.07	Personal

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TABLE II - CHLORINE SAMPLING LOCATIONS AND RESULTS

<u>LOCATION</u>		<u>AIR PUMPED IN l.</u>	<u>TOTAL ug OF Cl⁻ FOUND</u>	<u>CHLORINE CONC. IN ppm.</u>
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17.	South Side of T-202 (drying tower)	966	121	0.04
18.	Between C-203 A/B (secondary chlorine compressors)	870	1183	0.47
19.	Cell Lab	1000	90	0.03

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TABLE III - CHLORINE CONCENTRATIONS BY AREAS

<u>AREA</u>	<u>LOCATION FROM TABLE II</u>	<u>CHLORINE CONCENTRATION (COMPOSITE AVERAGE), ppm.</u>
A. Cell Covers	1 through 6	0.22
B. Ground level around cells	7 through 9	0.25
C. Cell Lab	19	0.03
D. Chlorine Drying Cooling and Compression	11 through 18	0.34
E. Inside Main Building	-----	0

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TABLE IV - CHLORINE EXPOSURE LEVELS

JOB ASSIGNMENT	TIME IN HOURS		TIME IN HOURS		TIME IN HOURS		*TWA EXPOSURE ppm
	AREA A	AREA B	AREA C	AREA D	AREA D	AREA D	
Cell Control Technician	3	2	1.5	0			0.15
Chlorine Technician First Schedule (days)	1	1	0.75	2.3			0.16
Chlorine Technicians Second and Third Schedules (midnights and evenings)	1.5	1.5	0.75	2			0.18

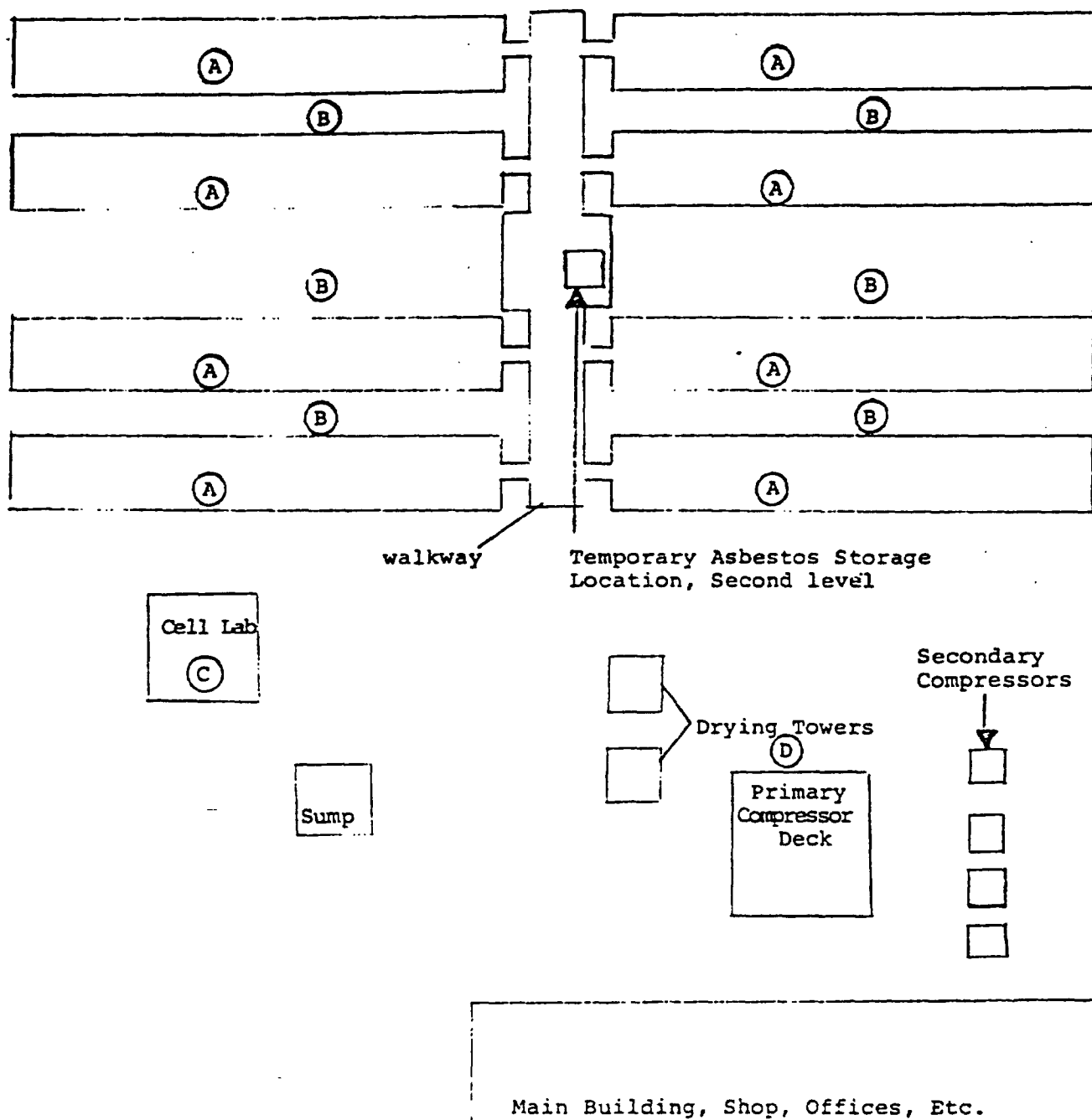
* Using chlorine concentration from Table III.

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FIGURE I - CHLORINE MANUFACTURING AREA



Not drawn to scale
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