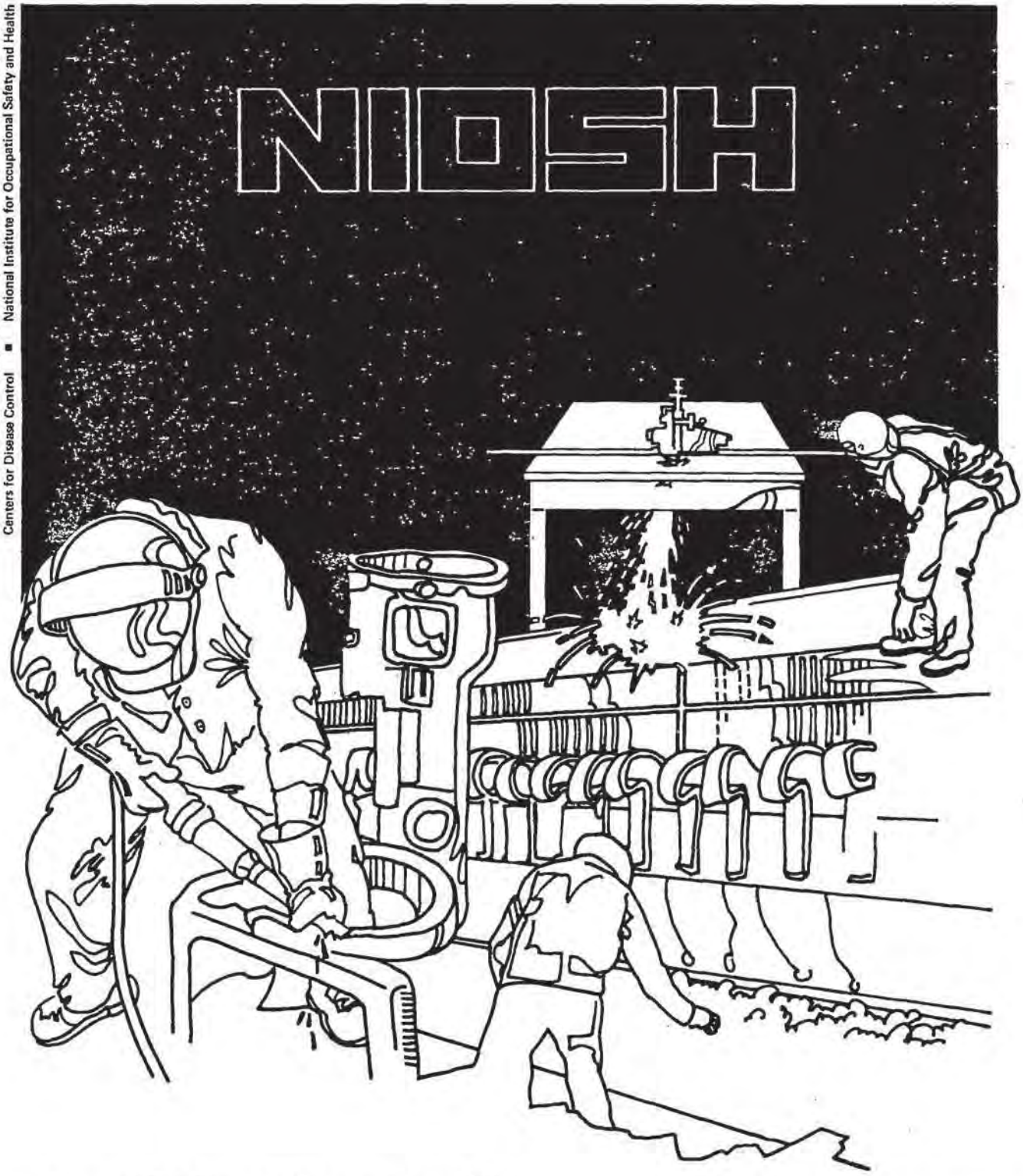
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health



Health Hazard Evaluation Report

HETA 81-016-942
IOWA BEEF PROCESSORS, INC.
DAKOTA CITY, NEBRASKA

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

HETA 81-016-942
August 1981
Iowa Beef Processors, Inc.
Dakota City, Nebraska

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I. SUMMARY

On October 6, 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request from the United Food and Commercial Workers Union to evaluate employee reports of upper respiratory irritation in the kill and carcass preparation room at Iowa Beef Processors, Inc., Dakota City, Nebraska.

Environmental and medical surveys were conducted on December 15-17, 1980. The environmental evaluation consisted of personal breathing zone and area air samples for chlorine, hydrogen chloride, phosphates, and other substances, a review of chemical and water usage, and observation of production operations. Health effects were evaluated by administration of a directed questionnaire to 67 employees. This questionnaire elicited information on smoking history, allergic history, job history, and symptoms such as headache, nausea, eye and upper respiratory irritation, chest pain, and sneezing.

The company chlorinates its water prior to use. The environmental data show employee long-term time-weighted average exposures to air chlorine levels of from 0.1 to 0.4 parts of chlorine per million parts of air (ppm). These levels of chlorine are below the Occupational Safety and Health Administration (OSHA) standard of 1 ppm for an 8-hour time-weighted average exposure. All samples were below the OSHA standard of 5 ppm for hydrochloric acid (maximum of 0.6 ppm). All exposures for these compounds were below the standard for a mixture of compounds which produce similar symptoms. Other chemicals evaluated were well below the appropriate environmental standards.

The questionnaire survey revealed the frequent occurrence of eye irritation, nasal irritation, cough, and sneezing. Thirty-eight (57%) of the 67 workers interviewed had experienced at least three of these four symptoms during the preceding two weeks. These symptoms were most likely to occur in workers exposed to hot water and in those working in the northern part of the room. Both groups receive chlorine exposures which current knowledge suggests are compatible with the symptoms reported.

On the basis of data obtained during this investigation, NIOSH determined that a hazard from exposure to chlorine in the air was present at the time of the survey and had probably been present on a sporadic basis in previous months. Exposure to hydrogen chloride and phosphates did not present a health hazard. Recommendations to reduce chlorine exposure have been incorporated into this report.

KEYWORDS: SIC 2011 Meat Packing Plants - chlorine, phosphoric acid, carbon monoxide, oxides of nitrogen, ozone, hydrogen sulfide, xylene, toluene.

II. INTRODUCTION

On October 6, 1980, NIOSH received a request from Local 222, United Food and Commercial Workers, for a health hazard evaluation at Iowa Beef Processors, Inc., Dakota City, Nebraska, to evaluate reports of upper respiratory irritation among employees in the kill and carcass preparation room. Medical and environmental surveys were conducted on December 15-17, 1980.

III. BACKGROUND

The kill and carcass preparation room is approximately 180 feet wide, 200 feet long, and 35 feet high. There are approximately 200 employees working in the area (about 100 per shift on both the day and evening shifts). There are a few employees on the third shift for clean-up.

An assembly line carries the beef carcasses from the slaughter (knocking) area, located in the southwest corner in the room, to the skinning area, located along the southern part of the room. Gutting takes place along a long table roughly in the center of the room. From there the assembly line carries the carcasses to the trimming area and then a washing area, both of which are north of the gut table.

Some of the processes require large amounts of water, which the company obtains from wells. Since the water is treated with phosphates and chlorine prior to use, employees are potentially exposed to chlorine, hydrochloric acid, and to phosphoric acid.

IV. METHODS

A. Environmental

Environmental surveys were conducted on December 16-17, 1980. Personal breathing zone and area air samples were obtained and analyzed for chlorine, hydrochloric acid, and phosphoric acid. Collection media flowrates and analytical methods for hydrochloric acid and phosphoric acid are presented in Volumes I through VI, "NIOSH Manual of Analytical Methods".(1) Impinger samples were obtained at a flowrate of 1 liter per minute (LPM) using a solution of 0.1 percent sulfamic acid. These were analyzed for chlorine using the Occupational Safety and Health Administration (OSHA) Draft Method No. VI-15. Drager long-term detector tube samples for chlorine were obtained at a flowrate of 20 cubic centimeters of air per minute. Drager short-term detector tube samples for chlorine were obtained at various times to check on possible excursions over the NIOSH recommended ceiling level. Separate bulk water samples were obtained at 10 different locations of the water system for analysis of chlorine and phosphoric acid. A 10-milliliter aliquot of the bulk water sample was mixed with a 10-milliliter aliquot of a 0.1 percent solution of sulfamic acid and analyzed for chlorine.

Short-term detector tube and/or long-term charcoal tube samples were obtained for carbon monoxide, oxides of nitrogen, ozone, hydrogen sulfide, and organic compounds such as toluene and xylene.

B. Medical

A directed questionnaire was administered to 67 (33%) of the 200 employees who work in the kill room. Workers were not chosen randomly, but an attempt was made to obtain a representative sample of workers from both shifts and from a variety of areas and job categories. The questionnaire elicited demographic information, smoking history, allergic history, occupational history, and symptoms experienced within the preceding two weeks, including headache, nausea, lightheadedness, burning eyes, cough, wheezing, chest pain, nasal congestion, sore throat, and sneezing.

For purposes of analysis, employees were divided into categories that depended more on the area in which they worked than on their specific job. Thus, the "highwash" category includes both highwash workers and scalers, who work near the highwash area. Similarly, "head area" includes brain savers, who work very near that area, and "gut table" includes two workers at the nearby pluck table.

V. EVALUATION CRITERIA

A. Environmental Standards

To assess the concentrations of air contaminants found in the place of employment, three sources of standards were used, as follows: (1) NIOSH criteria for recommended standards for occupational exposure to substances (Criteria Documents); (2) recommended and proposed Threshold Limit Values (TLV's) and their supporting documentation as set forth by the American Conference of Governmental Industrial Hygienists (ACGIH), as of 1979; and (3) occupational health standards as promulgated by the U. S. Department of Labor (29 CFR 1910.1000).

The current criteria are as follows:

Substance	NIOSH Recommended Standards	ACGIH TLV+	OSHA Standard+
Chlorine	0.5 ppm ceiling for a 15 minute sample	1 ppm*	1 ppm*
Hydrochloric Acid	--++	5 ppm	5 ppm
Phosphoric Acid	--	1 mg/m3**	1 mg/m3**

*ppm--parts of substance per million parts of air
**mg/m3--milligrams of substance per cubic meter of air
+8-hour Time-Weighted Average
++--no criteria established

Unless otherwise noted, the above values are based upon 8-hour time-weighted averages. In the case of a mixture of air contaminants which produce the same health effects, such as chlorine and hydrochloric acid, the overall effects are considered additive and an equivalent exposure is calculated as follows:

$$Em = C_1/L_1 + C_2/L_2 + \ldots + C_n/L_n$$

Where

Em is the equivalent exposure for the mixture,
C is the concentration for a particular contaminant,
L is the environmental standard for that contaminant.

The value of Em should not exceed 1.

B. Toxicology

Symptoms reported with chlorine exposure include eye and mucous membrane irritation, cough, and headache. Very severe exposures have resulted in fever, shortness of breath, and pulmonary edema, sometimes resulting in death. Victims of the more severe exposures may have suffered a chronic effect on their pulmonary function, but most people exposed to chlorine appear to recover completely upon removal from exposure.(2,3)

Mucous membrane irritation from chlorine exposure has usually been reported in the literature only at levels above 1 ppm.(4) However, reactions to chlorine have been documented at air concentrations below 0.5 ppm. In a study in which human volunteers were exposed to known concentrations of chlorine, Rupp and Henschler found that "subjective irritations of nose and throat...are quite obvious with chlorine at 0.1 ppm," and that "beyond 0.1 ppm the stay of all test subjects was felt to be uncomfortable." Subjects did not remain in the room longer than 50 minutes.(5) Another study using volunteers reports that exposure to chlorine at 1 ppm became unbearable after 20 minutes. This latter study found symptoms of upper respiratory irritation (nasal irritation, throat irritation, and cough) at air levels of 0.1 ppm.(3)

Hydrogen Chloride is also an irritant of the eyes and mucous membranes and can cause dermatitis and burns. However, it is considerably less irritating than chlorine at similar concentrations.(2)

Phosphoric acid is an irritant of mucous membranes and skin. Unacclimated workers have noted mild symptoms at air levels as low as 3.6 mg/m^3. Acclimated workers tolerate substantially higher levels. Hence, the OSHA standard of 1 mg/m^3 is below the concentration producing symptoms in unacclimated workers and well below the level producing symptoms in acclimated workers.(2,6)

VI. Results

A. Environmental

The main emphasis in the environmental survey was on the portion of the room north of the gut table, since that is the area where large volumes of water are used, and from which most complaints seemed to emanate. This area included the gut table, paunch-tripe, high wash, and trim and saw. The results of long and short-term samples indicate that employees were exposed, on a long-term approximately full-shift basis, to chlorine air levels of from 0.1 to 0.4 parts of chlorine per million parts of air (ppm)(Tables I and II). The short-term detector tubes, which have an accuracy of ±25-30%, were obtained at various locations during two hours of each 8-hour shift. Hence, levels of chlorine could have exceeded the NIOSH recommended ceiling level of 0.5 ppm over 15 minutes during those periods when short-term samples were not obtained.

All personal and area air samples for hydrochloric acid were well below the OSHA standard of 5 ppm for hydrochloric acid (Table III). The maximum result was 0.6 ppm. All exposures for chlorine and hydrochloric acid were less than 85% of the environmental standard of 1 for a mixture of compounds which produce the same symptoms.

Results of area air samples for phosphoric acid were all 2% or less of the environmental standard of 1.0 mg/m^3 (Table IV).

Results of short-term detector tube and/or long-term charcoal tube samples for carbon monoxide, oxides of nitrogen, ozone, hydrogen sulfide, and organic compounds such as toluene and xylene, were all far below the appropriate environmental standards, and are therefore not discussed further.

An evaluation was made of the water system. Water is obtained from wells through an aerator into a 200,000 gallon retention tank. The water is then treated with a polyphosphate compound and chlorine, filtered through horizontal pressure filters (sand filters), and stored in large tanks prior to use. The carcass wash uses 350 gallons per minute, which is around 12.5% of the total water used. The water is at 600 psi and a temperature of 90-105°F. The tripe wash uses about 130 gallons per minute and the gut table around 90 gallons per minute. There are several sterilizers in the kill room for sterilizing the knives and other equipment. The water in the sterilizer is maintained at 180-190°F. The company tries to maintain the chlorine level at 0.2 to 0.3 ppm and the phosphate level at 1 ppm. The company has an in-line chlorine monitor which shows, on a continuous basis, the chlorine level at one location only. An operator checks the concentration of chlorine once an hour, and some samples of water are obtained during the day and evening shifts for analysis of chlorine and

phosphorus. The in-line monitor was twice checked by NIOSH and indicated a level of around 0.2 ppm. Ten bulk water samples were obtained from different locations in the facility and analyzed for chlorine; they varied from 1 to 9 ppm, with an average of 5.8 ppm (Table V). These levels are considerably higher than the 0.2 ppm target of the company. The supervisor of the water treatment facility said that the average daily use of chlorine is 200 pounds for the treatment of 3.5 million gallons of water. This would result in a concentration of 6.8 ppm of chlorine in water, assuming that the above figures for chlorine use are correct. A concentration of 6.8 ppm agrees closely with the results which NIOSH obtained.

Ten bulk water samples were also analyzed for phosphoric acid (Table VI). Eight of the 10 samples were in fairly good agreement with the company's target level of 1 ppm (mean--0.84 ppm).

A ventilation survey was made in several areas. There were gusts of air of 400 feet per minute (fpm) around the gut table on the pluck table side and 50 fpm in the paunch area. The air flow around the gut table was turbulent, probably because of the overhead fans. There was little flow of air in the head chain area. The carcass wash was enclosed and was provided with ventilation from a 14-inch duct with an estimated flow rate of 6,800 fpm. There were four openings of 1.5 square feet each at the bottom of the carcass wash near the floor. Air flowed at several hundred feet per minute out of three of these openings into the general work area. Air flowed from the work area into the carcass wash through the other opening. There were no flexible doors provided for the head wash facility.

B. Medical

Figure 1 (following Table VI) is a graphic display of reports of irritative symptoms listed on the OSHA log of illnesses and injuries (Form 200). This demonstrates both the duration and intermittency of the problem.

Table VII lists the number of employees interviewed in each category as a percentage of the total employment for that category. Of the 67 employees interviewed, 40 worked on the first shift and 27 worked on the second shift.

Table VIII summarizes the symptoms which employees had been experiencing during the two weeks preceeding the survey. Knockers and shacklers were furthest removed from the area which had, apparently, been generating the most reports of illness. Significance tests, using the Fisher's Exact Test, were performed for each job category and each symptom, using the knockers and shacklers as a comparison, or control, group. Workers at the gut table, high wash, and scaling had the most symptoms when compared to knockers and shacklers, followed by workers in the trimming and tripe areas.

From the "total" row, it can be seen that the symptoms most frequently reported were cough, sneezing, nasal irritation, and eye irritation. To further analyze the data from the questionnaire, employees with these symptoms were compared with those who did not suffer from them. For this purpose, a "case" of irritation was defined as a greater than usual frequency, during the two weeks preceding the survey, of any three of the following symptoms:

1.) Eye irritation
2.) Nasal irritation
3.) Sneezing
4.) Cough

Of the 67 employees interviewed, 38 (57%) met this case definition. The percentage of employees interviewed in each area who met the case definition is called the attack rate for that area. These attack rates are listed in Table IX. Also listed in this table are the mean and range for air chlorine levels determined during this survey for the jobs in these areas.

In Table X cases and non-cases are compared for several characteristics. There was no significant difference between cases and non-cases for age, length of service at the company, or smoking. There was also no difference for shift worked. The mean latency, that is, the time required after the start of work for symptoms to develop, was 4 hours for affected workers.

Affected workers (cases) were significantly more likely to use hot water than were non-cases ($p=0.0053$, Fisher's Exact Test). Cases were also far more likely than non-cases to work at the gut table or further north in the kill room ($p=0.00019$, Fisher's Exact Test).

Table XI shows that employees at the gut table, highwash, and tripe wash were noting irritative symptoms during this survey. This data would tend to underestimate the problem since many employees note symptoms only very late in the shift and, therefore, may have been interviewed prior to the onset of symptoms.

VII. DISCUSSION

The data of Tables VII and VIII suggests that the workers at high wash, tripe wash, gut table, and trimming and sawing have reported an unusually high frequency of eye and upper respiratory irritation. Workers in the head and brainsaving area were also affected, but the skinning line was less involved, and knockers and shacklers were unaffected.

The company obtains water from wells, and then treats it with phosphate compounds and with chlorine. Of those areas surveyed the highest use of water is in the gut table area, and in the high wash and paunch-tripe areas, which are north of the gut table. The average concentrations of chlorine in these areas were 0.2 ppm, 0.3 ppm, and 0.2 ppm, respectively (Table IX). The average concentration of chlorine in the trim area, where little water is used, was 0.1 ppm. Thus, there is a correlation between the use of water in an area and the air concentration of chlorine. In Table X use of hot water and working at or north of the gut table are both implicated as risk factors. Both of these factors are associated with increased risk of exposure to chlorine. Heated water releases more of its chlorine into the air than does cold water, and the vast majority of water used in the kill room is used at or north of the gut table. The automatic carcass wash, located along the north wall, since it sprays large amounts of heated water, might be expected to produce considerable quantities of chlorine. The results of the environmental sampling suggest that it does.

The typical affected employee noted onset, about 4 hours after the start of the shift, of eye irritation, followed by nasal irritation, sneezing, and a non-productive cough, in that order. Symptoms were often worse after leaving work, frequently lasting through the night. Allergens can cause such symptoms, but rarely affect such a high percentage of those exposed. The extrinsic alveolidites, such as farmer's lung, which are usually caused by fungi, also produce respiratory symptoms, but in these cough, rather than nasal congestion and sneezing, is the primary symptom. The employees' symptoms are most suggestive of a toxic inhalation exposure. While the possibilities for such an exposure are very limited in the kill room, the results of the environmental sampling suggest that significant amounts of chlorine were present in the air north of the gut table. Based on the literature cited in the toxicology section above, the amounts of chlorine found in this survey are consistent with the symptoms reported, especially since workers are exposed to these levels far longer than were participants in the experimental studies.

In summary, the type of symptoms reported is in accord with chlorine exposure, and the employees most affected work in areas with chlorine levels consistent with these symptoms. Hence, chlorine released from water is their most likely cause. This investigation supports the findings in volunteer exposure studies that have found significant symptoms at exposure levels below 0.5 ppm.

VIII. RECOMMENDATIONS

1.) A thorough evaluation should be made of the ventilation system and air flow patterns in the kill room. An attempt should also be made to use the ceiling and overhead fans more effectively.

2.) A thorough evaluation should be made of the water and chlorination facilities and of water use in the various operations. Appropriate changes should be made in the chlorination methods to ensure that the concentrations found in the water are not excessive, and that they are accurately measured.

3.) The company should monitor carefully for the future occurrence of symptoms consistent with chlorine exposure. This could be done by reviewing the OSHA Form 200 and by regularly asking the local union about reports of illness. Outbreaks of symptoms could be correlated with such factors as water and chlorine use and results of air sampling.

IX. REFERENCES

1.) NIOSH, U.S. Department of Health and Human Services. NIOSH Manual of Analytical Methods, Volume I-VI. DHEW (NIOSH) Publication No. 77-157 A-F. Washington: U.S. Government Printing Office, 1977.

2.) Proctor NH, and Hughes J. Chemical Hazards in the Workplace. Philadelphia: Lippincott, 1978.

3.) NIOSH, U.S. Department of Health and Human Services: Criteria for a Recommended Standard: Occupational Exposure to Chlorine. NIOSH 76-170. Washington: U.S. Government Printing Office, 1976.

4.) National Research Council, Committee on Medical and Biological Effects of Environmental Pollutants. Chlorine and Hydrogen Chloride. Washington: National Academy of Sciences, 1976

5.) Rupp H and Henschler D. Effects of Low Chlorine and Bromine Concentrations on Man. Int. Arch. Gewerbepathol 23: 79-90, 1967.

6.) American Conference of Governmental Industrial Hygienists. Threshold Limit Values of Chemical Substances and Physical Agents in the Workroom Environment, 1979.

X. AUTHORSHIP AND ACKNOWLEDGENTS

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XI. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH, Publications Office, at the Cincinnati address.

Copies of this report have been sent to:

1.) Iowa Beef Processors, Inc.
2.) Local 222, United Food and Commercial Workers Union
3.) NIOSH Region VII
4.) Department of Health - Nebraska
5.) OSHA - Region VII

For the purpose of informing affected employees, a copy of this report shall be posted in a prominent place accessible to the employees for a period of 30 calendar days.

Table I
Results of Impinger Samples for Chlorine (Cl_2)
Iowa Beef Processors, Inc., Dakota City, Nebraska
HETA 81-016

Date	Job Category or Location	Time	Chlorine Concentration ppm*
12/16/80	High Wash Area	1555-2127	0.4
12/17/80	High Wash Area	0629-1446	0.3
12/17/80	South Side Carcass Wash	0750-1500	0.3
12/16/80	Scaler Helper	0647-1440	0.1
12/17/80	Dump Paunch Operator	0620-1443	0.3
12/17/80	Paunch Cut Area	0745-1535	0.2
12/16/80	Paunch-Tripe Area	1535-2132	0.2
12/16/80	Paunch-Tripe Operator	0654-1404	0.2
12/16/80	Gut Table North Area	1550-2132	0.2
12/16/80	Gut Table Operator	0652-1358	0.2
12/17/80	Gut Table Operator	0634-1440	0.1
12/16/80	Low Trim Operator	0636-1420	0.1
12/16/80	Trim Rail Area	1545-2130	0.1

*ppm = parts of chlorine per million parts of air
NIOSH Recommended Standard = 0.5 ppm ceiling for 15 minute sample
OSHA Standard = 1 ppm for 8-hour Time-Weighted Average

Table II
Long-Term Detector Tube Samples for Chlorine
Iowa Beef Processors, Inc., Dakota City, Nebraska
HETA 81-016

Date	Job Category or Location	Time	Chlorine Concentration ppm*
12/17/80	Area Sample - Carcass Wash by Ladder	0755-1450	0.4
12/17/80	Area Sample - Carcass Wash	0753-1450	0.3
12/17/80	High Wash Operator	0630-1446	0.3
12/17/80	High Wash Area	1550-2127	0.2
12/17/80	Area Sample - Paunch-Tripe	0745-1435	0.2
12/16/80	Tripe Wash - Paunch	0739-1420	0.1
12/17/80	Paunch Dump Operator	0615-1440	0.1
12/17/80	Gut Table Operator	0710-1430	0.2
12/16/80	Gut Table Operator North Side	0707-1410	0.1
12/16/80	Gut Table Operator	0713-1115	0.1
12/16/80	Area Sample - Paunch-Tripe	1535-2132	0.1

*ppm = parts of chlorine per million parts of air

NIOSH Recommended Standard = 0.5 ppm ceiling for 15-minute sample
OSHA Standard = 1.0 ppm for 8-hour Time-Weighted Average

Table III
Silica Gel Samples for Hydrochloric Acid (HCl)
Iowa Beef Processors, Inc., Dakota City, Nebrasksa
HETA 81-016
December 16, 1980

Job Category or Location	Time	Hydrochloric Acid Concentration (ppm)*
High Wash Area	1540-2127	0.2
High Shroud Operator	0749-1224	0.2
Paunch-Tripe Area (Near Hot Water)	1535-2132	0.6
Stand Pipe (Condemned Area)	1537-2133	0.2
Tail Washer Operator	0815-1221	0.2
Pluck Table Operator	0802-1216	0.2
Sweet Bread Operator	0743-1220	0.1
North Gut Table Area	1539-2132	0.2
High Trim Operator	0756-1222	0.2
Trim Rail Area	1535-2130	0.3

*ppm = parts of hydrochloric acid per million parts of air

ACGIH Threshold Limit Value = 5 ppm for 8-hour Time-Weighted Average for hydrochloric acid

Table IV
Air Samples for Phosphoric Acid (H_3PO_4)
Iowa Beef Processors, Inc., Dakota City Nebraska
HETA 81-016
December 17, 1980

Location	Time	Phosphoric Acid Concentration (mg/m3)*
Paunch Cut Area	0745-1535	0.02
Stand on East Side of Condemned Area	0802-1531	0.01
Hightrim Area South of Carcass Wash	0758-1535	0.02
Carcass Wash Area	0750-1530	0.01

*ppm = milligrams of phosphoric acid per million parts of air.

OSHA Standard = 1.0 mg/m^3 for phosphoric acid for an 8-hour Time-Weighted Average.

Table V
Chlorine Concentrations in Bulk Water Samples
Iowa Beef Processors, Inc., Dakota City, Nebraska
HETA 81-016
December 17, 1980

Job Description and/or Location	Chlorine Concentration ug/g or ppm*
Grub Rail Sterilizer	2
Wash Cabinet - East Side (Carcass Wash)	1
Wash Cabinet - West Side (Carcass Wash)	4
Hot Water Sample - South of Paunch Chute (Gut Table)	4
Cold Water Sample - Hose Drop Over Chute (Gut Table)	7
Water from Hose Over Cone - Tripe Area	8
After Chlorination and Before Filters	9
After Filters and Before the Reservoir	8
After Reservoir	8
Processing Return Line to Reservoir	7

*ug/g = micrograms of chlorine per gram of water; ppm = parts of chlorine per million parts of water.

No environmental standards have been established for bulk water samples. The target concentration of the company is 0.2 ppm.

Table VI
Bulk Water Samples for Phosphoric Acid (H_3PO_4)
Iowa Beef Processors, Inc., Dakota City, Nebraska
HETA 81-016
December 17, 1980

Location	Phosphoric Acid Concentration (ug/g or ppm)*	pH**
Grub Rail - Sterilizer	(Void)	8.3
Wash Cabinet - Carcass Wash (East Side)	16	7.1
Wash Cabinet - Carcass Wash (West Side)	2.2	7.6
Hot Water Off Hose - Gut Table (South of Paunch Chute)	0.9	7.6
Off Hose Drop Over Chute from Gut Table	0.5	7.6
Hose Over Cone in Tripe Area	1.0	7.6
After Chlorination and Before Filters	0.5	7.4
After Filters and Before the Reservoir	0.3	7.6
After Reservoir	0.3	7.6
Processing Return Line to Reservoir	1.0	7.8

*ug/g = micrograms of phosphoric acid per gram of water; ppm = parts of phosphoric acid per million parts of water.

**pH = the negative logarithm of the effective hydrogen concentration ranging from 0 - 14; 7 represents neutrality.

No standards are established for bulk water samples. The company target is 1.0 ppm.

Table VII
Employees Interviewed
Iowa Beef Processors, Inc. Dakota City, Nebraska
HETA 81-016
December 1980

Area	Number interviewed/total
High Wash	7/10 (70%)
Knocking and Shackling	10/15 (67%)
Trim and Saw	11/18 (61%)
Gut Table	16/28 (57%)
Paunch-Tripe	3/10 (30%)
Skinning Line	13/50 (26%)
Head Table	5/30 (17%)
Other	2/39 (5%)
Total	67/200 (34%)

Table VIII
Percentage of Workers Noting Symptoms
During Preceding Two Weeks
Iowa Beef Processors, Inc., Dakota City, Nebraska
HETA 81-016
December 1980

Area	Head-ache	Eye Irrit.	Cough	Chest Pain	Nasal Irrit.	Throat Irrit.	Sneezing
Knock & Shackle (10)	0	20	0	0	0	0	0
Skinning (13)	15[a]	23[a]	38[b]	0[a]	31[a]	8[a]	46[b]
Gut Table (16)	38[b]	69[b]	88[e]	25[a]	81[e]	38[b]	75[d]
Trim-Saw (11)	9[a]	73[b]	73[d]	18[a]	64[c]	18[a]	73[b]
Highwash (7)	43[a]	71[a]	100[e]	43[a]	100[e]	29[a]	100[e]
Paunch-Tripe (3)	0[a]	100[a]	100[c]	100[c]	100[c]	67[b]	67[b]
Head Table (5)	60[b]	60[a]	60[b]	20[a]	60[b]	80[c]	80[c]
Total (67)[f]	22	52	60	19	57	25	60

[a]Not significant, p>0.05, Fisher's Exact Test
[b]p-value 0.01-0.05, " " "
[c]p-value 0.001-0.01, " " "
[d]p-value 0.0001-0.001, " " "
[e]p-value <0.0001, " " "

[f]Two employees in other job categories included in final total.

Table IX
Attack Rates by Area
Iowa Beef Processors, Inc., Dakota City, Nebraska
HETA 81-016
December 1980

Area	Cases/Total	Attack Rate	Mean Chlorine Air Level (Range)
High Wash	7/7	100%	0.3 ppm (0.1-0.4)
Paunch-Tripe	3/3	100%	0.2 ppm (0.1-0.2)
Gut Table	13/16	81%	0.2 ppm (0.1-0.2)
Trimming	8/11	73%	0.1 ppm (0.1)
Head Table	3/5	60%	---
Skinning	4/13	31%	---
Knocking	0/10	0%	---

Table X
Comparison of Cases and Non-Cases
Iowa Beef Processors, Inc., Dakota City, Nebraska
HETA 81-016
December 1980

	Cases	Non-cases	Significance
	N=38	N=29	
Mean age (years)	32	30	NS[1]
Mean seniority (years)	5	7	NS
Smokers	23 (61%)	14 (48%)	NS
Use hot water	19 (50%)	5 (17%)	p=0.0053[2]
Work at gut table or further north	28 (74%)	8 (28%)	p=0.00019[2]

[1]not significant, p>0.05, Fisher's Exact Test

[2]Fisher's Exact Test

Table XI
Percentage of Workers Noting Symptoms
On Day of Survey
Iowa Beef Processors, Inc., Dakota City, Nebraska
HETA 81-016
December 1980

Area	Eye Irrit.	Cough	Nasal Irrit.	Throat	Sneezing
Knocking (10)	0	10	0	0	0
Skinning (13)	0	0	8	0	0
Gut Table (15)	53[a]	67[b]	53[a]	67[a]	53[a]
Highwash (8)	38	25	75[b]	0	25
Head (5)	20	0	20	40	0
Trim (11)	9	0	18	0	0
Paunch-Tripe (2)	0	100[c]	100[c]	0	50

[a] $p<0.001$ Fisher's Exact Test
[b] $p<0.01$ " " "
[c] $p<0.05$ " " "

One employee normally assigned to gut table was on highwash during this survey. One employee normally at tripe wash was on other work on this day.

Figure 1
Irritative Symptoms Noted on OSHA 200
Iowa Beef Processors, Inc., Dakota City, Nebraska
HETA 81-016