U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 76-107-373

PABST BREWING COMPANY
PEORIA, ILLINOIS

MARCH 1977

I. TOXICITY DETERMINATION

Exposures of employees to ethyl ether in the laboratory and Special Analysis Room at the Pabst Brewing Company were not found to be toxic under the conditions observed by NIOSH Hazard Evaluation personnel during the survey conducted October 12-14, 1976. This determination is based upon environmental sampling (which included personal and area air sampling), medical evaluation by interviews, observations of work practices, ventilation controls, and production levels. The work load at the time of the survey was considered to be normal as compared to the production data for the past six months.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Services, Information 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:

a. Pabst Brewing Company, Peoria, Illinois
b. Authorized Representative of Employees
c. U.S. Department of Labor - Region V
d. NIOSH - Region V

This report shall be posted in a prominent place(s) accessible to the workers for a period of 30 calendar days.

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 USC 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by an 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 National Institute for Occupational Safety and Health received such a request from an authorized representative of employees regarding exposure of workers to ethyl ether. The request stated that employees exposed to ether anhydrous experienced nausea, light headedness, and swelling of the inner ear. The process consisted of determining the fat content in corn using an extraction procedure employing ethyl ether. This process is conducted in a room separate from the main laboratory with the extraction apparatus contained in a hooded enclosure. The work force in the laboratory is comprised of approximately 20 production and supervisory personnel over 3 shifts, with 11 of the personnel working the day shift. The ether extraction is performed during the day shift.

IV. HEALTH HAZARD EVALUATION

A. Process Description

A five gram sample of crushed grain is placed in a porous thimble and clipped to an extraction apparatus. A beaker containing ethyl ether is aligned with the apparatus, surrounding the thimble. The ether is gently boiled for 3 hours; during this time the vapors rise from the boiling liquid, condenses, and drips back through the grain, extracting the corn fat. After 3 hours, the thimble containing the sample is cooled and replaced with a glass collection tube. Heat is again applied for 10 to 20 minutes to recover ether from the extract, leaving the corn fat as a residue in the beaker. The sample which was removed from the apparatus, is heated in an oven to dry the grain saturated with ether.

There are 14 hot-plate extraction apparatuses in the Special Analysis Room (SAR). When reviewing the work load for the past 6 months (April thru September), 48 percent of the time two or less extractions were ran per day, and 10 percent of the time 10 or more were done (14 being maximum). During our investigation there were two extractions on October 13 and ten on October 14. The extractions are done simultaneously by one technician assigned to the task.

All 14 hot-plate extraction apparatuses are enclosed under a continuous hood with a plexiglass front. Access to the apparatus is obtained from the bottom where there is approximately 2 feet of space between the bench and the start of the plexiglass enclosure. The oven used to dry the grain is contained in the confines of a laboratory hood in the SAR. A month prior to our investigation the grain samples were dried in the main laboratory with an oven not equipped with local exhaust. Also the plexiglass enclosure was recently added to the existing laboratory hood housing the extraction apparatus. Both of these improvements would result in a decrease of contaminant release into the working environment.

B. Evaluation Design and Methods

Environmental monitoring for ethyl ether was conducted using two methods: (1) a direct reading instrument to provide an instantaneous measurement of the existing contaminant concentration, and (2) personal and area sampling to determine the integrated average exposures over the work shift. The former method employed the J-W Model SS-P* meter which was calibrated in the laboratory for ethyl ether. The range of sensitivity used in the evaluation was 0 to 1000 ppm, with the scale divided in increments of 20 ppm. For the latter method, tubes containing activated charcoal collecting media were used with Sipin pumps. When taking a personal sample, the tube was positioned in the breathing zone of the employee with air being drawn through the collection media at a rate of 50 milliliters (ml) per minute. The analysis on all tubes was performed with carbon disulfide desorption and gas chromatography by the Utah Biomedical Test Laboratory.

Ventilation measurements were taken at the laboratory hoods in the Special Analysis Room using a Sierra thermolanemometer Model 440.

The medical apportionment consisted of administering a non-directed medical questionnaire. Nine employees were interviewed regarding their occupational history, symptoms experienced on the job, and aggravating or alleviating factors. All employees working in or near the Special Analysis Room during ether extractions were interviewed.

C. Evaluation Criteria

1. Toxic Effects

The toxicity of ethyl ether is low; its greatest hazards in industry being those of explosion and fire. It is absorbed readily through the lungs and intestinal tract following exposure, and rapidly excreted, almost quantitatively, by the lungs with small amounts being excreted in the urine, perspiration, and other body fluids[1]. Concentrations of ethyl ether as low as 200 ppm may cause irritation of the nose in some persons upon initial exposure.[2] It has been estimated that at a concentration of 400 ppm a man of average weight would absorb a maximum of 1.25g and the concentration in the blood would be 0.018g/liter.[3] This concentration in the blood is not associated with any signs of intoxication.[4]

Locally, ethyl ether is a mild irritant. Direct contact with the fluid causes moderate erythema of the skin, and inhalation of ether vapors results in increased bronchial secretion.[1]

*Mention of commercial names or products does not constitute endorsement by NIOSH.

Systemically, ethyl ether is a depressant of the central nervous system. Chronic exposure can cause loss of appetite, exhaustion, headache, sleepiness, dizziness, excitation, and psychic disturbances.[5] When present in the body in sufficiently high concentrations, it is capable of producing intoxication resembling that of alcohol, with signs of drowsiness, stupor, and unconsciousness.[1] Kidney injury has been listed as a result of acute intoxication but this has been open to question.[6]

2. Environmental Evaluation Criteria

Airborne exposure limits intended to protect the health of workers have been recommended or promulgated by various sources. These limits represent conditions under which it is believed that nearly all workers may be repeatedly exposed to a substance on an 8-hour per day, 40-hour per week basis without adverse effects. The criteria used in this investigation were taken from the following sources: (1) Threshold Limit Values (TLV's) and their supporting documentation as set forth by the American Conference of Governmental Industrial Hygienist (ACGIH) for 1976, and (2) Occupational health standards as promulgated by the U.S. Department of Labor (Federal Register, 29 CFR 1910, pp 507, January 1, 1976). Both of the aforementioned sources cite exposure limits of 400 ppm for the maximum permissible 8-hour average exposure to ethyl ether.

D. Evaluation Results

When interviewing the potentially exposed workers, it was found that three of the nine had symptoms which they believed might be attributed to ether exposure. The symptomatology included dizziness, nausia, occassional headaches, pains in the kidney area, and possibly aggravation of an existing eye and ear infection. The remaining six employees received less exposure to ether since their duties required less time to be spent in the Special Analysis Room. Table 1 summarizes the pertinent points of the employee interviews.

Environmental sampling did not disclose appreciable concentrations of ether (Table 2). All results for the personal and area samples were less than 1 ppm. Ether vapor was detected in the work environment only during the initial measurement of the liquid into the beaker, when the thimbles containing the spent grain were removed from the extraction apparatus, and when pouring recovered ether back into the storage bottle. Measurements with the direct reading instrument were less than 10 ppm of ether during these time intervals. Peak concentrations upto 1000 ppm were detected around the cork gaskets and pressure release valves on the extraction apparatus. However the vapors were released inside the plexiglass enclosure where they were properly exhausted.

Face velocity determinations for the laboratory hoods in the Special Analysis Room ranged from 10 to 50 linear feet per minute (fpm). Velocity measurements have been presented for various operating conditions observed to occur. Refer to Table 3 for a summary of the determinations.

E. Conclusions

Based on environmental sampling, it was concluded that the employees working in the main laboratory area and the Special Analysis Room were not exposed to harmful concentrations of ether vapor under the conditions observed during the investigation. The construction of a plexiglass enclosure to extend the area of the hood surrounding the extraction apparatus, and the drying of ether saturated grain in a laboratory hood would have decreased the potential exposure as compared to past practices.

V. RECOMMENDATIONS

The following recommendations are made to help ensure a safe and healthful work environment is maintained:

1. Provide uniform exhaust air distribution in hood.

2. Maintain a minimum face velocity of 50-100 linear feet per minute across the face of the hood.

3. Install a device to indicate the mechanical exhaust system in the hood is operating.

4. Maintain extractor apparatus (i.e. sealing gaskets) to prevent needless contamination.

5. Store excess quantities of ether in a safe and well ventilated area.

VI. REFERENCES

1. Manufacturing Chemists' Association: Chemical Safety Data Sheet SD-29, Ethyl Ether. Manufacturing Chemists' Association, Inc. Washington, D.C. (1965).

2. Nelson, K.W., J.F. Ege, Jr., M. Ross., L.E. Woodman, and L. Silverman: Sensory Response to Certain Industrial Solvent Vapors. J. Ind. Hyg. Toxicol 25: 282 (1943).

3. Henderson, Y., Haggard, H.W.: Noxious Gases, 2nd Ed., p. 195, Reinhold Publishing Corp., New York (1943).

4. American Conference of Governmental Industrial Hygienist: Documentation of Threshold Limit Values, 3rd Ed., Cincinnati, Ohio (1971).

5. Lehman, K.B. and F. Flury: Toxicology and Hygiene of Industrial Solvents p. 248, Williams and Wilkins Co., Baltimore, Md. (1943).

6. E. Browning, Toxicity of Industrial Organic Solvents. Chemical Publishing, New York, 1953. Cited by Patty, F.A. (Editor) Industrial Hygiene and Toxicology. Vol. II, 2nd Ed., p. 1659, Interscience Publishers, New York (1962).

VII. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared By:

James H. Price
Industrial Hygienist
Hazard Evaluations and Technical
Assistance Branch
Cincinnati, Ohio

Originating Office:

Jerome P. Flesch, Acting Chief
Hazard Evaluation and Technical
Assistance Branch
Cincinnati, Ohio

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G. Edward Burroughs
Industrial Hygienist
Hazard Evaluation and Technical
Assistance Branch
Cincinnati, Ohio

TABLE 1

Summary of Health Complaints Reported
at the Pabst Brewing Company, Peoria, Illinois

October 13-14, 1976

Case Number	Symptoms	Time Spent in Special Anaylsis Room Per Day
1	None	0
2	Dizzy spells when performing ether extractions. Has experienced pains around kidney area.	3-4 hours when assigned to ether extraction
3	None	0
4	None	Less than 5 minutes
5	None	5 minutes
6	None	10 minutes
7	Nausea and possible irritation to eye and ear infection	4 hours when performing ether extractions
8	Occasional headache	2 hours when performing ether extractions
9	Not particularly bothered by ether	

TABLE 2

Summary of Air Sampling for Ethyl Ether at
the Pabst Brewing Company, Peoria, Illinois

October 13-14, 1976

Date	Operation/Location	Sample Type	Sample Time	Concentration of Ethyl Ether (ppm)
10/13/76	SAR (Special Analysis Room)	A	08:40-16:00	<1
	Lab Technician - Laboratory	P	08:52-15:59	<1
	Lab Technician - Laboratory	P	08:54-14:59	<1
	Extraction Operator - SAR	P	08:58-15:59	<1
	Laboratory (Approximately 15' from SAR)	A	09:03-16:00	<1
	Laboratory (Approximately 45' from SAR)	A	09:06-16:00	<1
	Lab Technician - Laboratory	P	09:27-14:50	<1
	Lab Technician - Laboratory	P	09:35-14:30	<1
	Lab Technician - Laboratory	P	10:00-14:54	<1
10/14/76	Lab Technician - Laboratory	P	09:30-14:25	<1
	Extraction Operator - SAR	P	10:00-15:15	<1
	SAR	A	10:00-15:05	<1
	Laboratory (Approximately 15' from SAR)	A	10:00-15:05	<1
	Laboratory (Approximately 45' from SAR)	A	10:00-15:05	<1
10/13/76	SAR	D.R.	10:00	<10
	SAR	D.R.	11:00	<10
	SAR	D.R.	14:00	<10
10/14/76	SAR-Pouring ether	D.R.	10:30	<10
	SAR	D.R.	11:45	<10
	SAR	D.R.	11:50	<10*
	SAR	D.R.	12:55	<10
	SAR	D.R.	13:00	<10-20*
	SAR - Removing Thimble Containing Grain Sample	D.R.	13:40	<10
	SAR	D.R.	13:45	20-1000*
	SAR Ether Recovery Stage	D.R.	14:00	<10
	SAR	D.R.	14:05	10-30*
	SAR - Pouring Recovered Ether into Storage bottle	D.R.	14:40	<10

1976 TLV and OSHA Standard - 400 parts of ethyl ether per million parts of air by volume (400 ppm).
P - Personal sample collected in breathing zone of employee
A - Area sample
DR - Measurement taken with a direct reading instrument
*Concentration of ethyl ether escaping around the sealing gaskets and pressure release valves on the extraction apparatus.

NOTE: Sampling period for the personal and area samples included the full extraction process.

TABLE 3

Summary of Face Velocity Determinations for
Laboratory Hoods Used in the Special Analysis Room
at the Pabst Brewing Company, Peoria, Illinois

October 13, 1976

Location	Door to Room Open/Closed	Linear Feet Per Minute*
Ether Extraction Hood (Window Side)	Closed**	45
Ether Extraction Hood (Window Side)	Open	50
Ether Extraction Hood (Hood Side)	Closed**	45
Ether Extraction Hood (Hood Side)	Open	40
Oven Hood 1 (Hood Exhaust Turned Off)	Closed	10
Oven Hood 1 (Hood Exhaust Turned Off)	Open	20
Oven Hood 2 (Hood Exhaust Turned Off)	Closed	10
Oven Hood 2 (Hood Exhaust Turned Off)	Open	15
Oven Hood 1	Closed	15
Oven Hood 1	Open	40
Oven Hood 2	Closed	30
Oven Hood 2	Open	30

*Data have been rounded off to the nearest 5 linear feet per minute. A minimum of 9 readings (traverse points) were used to determine the individual averages.

** Poor air distribution across face of hood. At bench level the velocity dropped significantly.