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HEALTH HAZARD EVALUATION REPORT 71-25-20
HAZARD EVALUATION SERVICES BRANCH
DIVISION OF TECHNICAL SERVICES

Establishment: Aerosol Techniques, Inc.
Danville, Illinois

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45202

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HEALTH HAZARD EVALUATION REPORT 71-25
AEROSOL TECHNIQUES, INC.
DANVILLE, ILLINOIS

SEPTEMBER 1972

SUMMARY DETERMINATION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by 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 National Institute for Occupational Safety and Health (NIOSH) received such a request from an authorized representative of employees to evaluate the potential health hazard associated with adding specific ingredients to cans and pressurizing these cans to produce a typical aerosol can for sale to the public. The specific ingredients which were added to the can involve the processing of a carburetor and choke spray cleaner which contains primarily diacetone alcohol, xylene, and perchloroethylene. These aerosol cans are filled and capped at Aerosol Techniques, Inc., Continental Filling Division, 800 South Gilbert Street, Danville, Illinois. There are about 14 employees (day and swing shifts only) involved in the above operations during any one campaign involving the carburetor and choke cleaner operations. These operations involve a two or three times a year production schedule involving a minimum of two days to a maximum of three days production requirements.

Based on information obtained during a preliminary survey, the potential hazards to which workers might be exposed were considered to be (1) solvent vapors containing various amounts of perchloroethylene, diacetone alcohol, and xylene which may also contain a small amount of benzene contaminants; and (2) noise levels in various operations such as the loading of empty cans on conveyor lines.

The ingredients of the carburetor and choke cleaner are known to produce irritation of the skin and mucous membranes of the body and to cause central nervous symptom effects such as headaches, dizziness, and feelings of light-headedness among others. In this regard, workers not wearing respirators did admit to such symptoms, particularly after a can had been crushed or when spray was grossly evident from the filter or gasser operations inside the Gas House.

An environmental survey was conducted on May 11-12, 1972. The results show that outside of the Gas House #3 no airborne concentrations individually or combined exceeded the established standards (Federal Register, Part II, §1910.93, Table G-1, Individual Standards and Part II, §1910.93 (d)(2)(i) - Combined Standards) promulgated by the U.S. Department of Labor to prevent toxic effects characteristic of such substances. However, the results of the environmental survey inside the Gas House show that "individual standards" were exceeded in some operations for perchloroethylene and diacetone alcohol. "Combined standards" were exceeded by as much as 4.8 times in the gasser operation, and 3.0 in the valve dropper area.

Sound levels of 93-102 dBA measured in a few operations, particularly the loading of empty cans on conveyor lines, exceeded the standard (90 dBA) for noise exposure (Federal Register, Part II, §1910.95, Table G-16). Exposure to excessive noise levels can produce permanent hearing loss in man. The use of air jets on the conveyor line also produces excessive noise levels to about 105 dBA although little employee exposure was noted at the time of the survey.

It is our determination that a hazard to the health of unprotected workers exists from exposures to the chemical substances investigated inside Gas House #3. This is based on multiple exposure concentration of substances found in the working environment at the time of this survey and a history of symptomatology obtained from employee interviews. In addition, a potential hazard to employees exists from exposure to noise. Recommendations in areas of concern have been made to management to obviate the observed and potential hazards to the approximately thirty affected employees.

Copies of this Summary Determination as well as the Full Report of the evaluation are available from the Hazard Evaluation Services Branch, NIOSH, Cincinnati, Ohio 45202. Copies of both have been sent to:

- a) Aerosol Techniques, Inc., Danville, Illinois
- b) Authorized Representative of Employees
- c) U.S. Department of Labor - Region V

For purposes of informing "affected employees," the employer will either (1) "post" the Summary Determination in a prominent place near where affected employees work or (2) provide a copy of the determination to each affected employee.

I. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by 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 National Institute for Occupational Safety and Health (NIOSH) received such a request from an authorized representative of employees of the Aerosol Techniques, Inc., Continental Filling Division, 800 South Gilbert Street, Danville, Illinois. This company's main operation consists of adding specific ingredients to cans and pressurizing these cans to produce an aerosol can. The company is involved in processing aerosol cans containing the whole gamut of household, industrial, and outdoor products. The company receives all raw materials and only processes or fills the cans with the specific products and caps the can in an assembly type operation. The carburetor and choke cleaner is introduced into cans inside the Gas House #3, a 12 foot by 60 foot room within the plant itself, containing several windows and also having ventilation holes near the union of the wall and floor. Empty, topless aerosol cans are brought into the Gas House by a conveyor belt. The cans are filled with the ingredients and then a valve-spray nozzle cap is introduced into the can and crimped; propellant is added, and the can is finally pressurized. The cans then leave the Gas House for leak testing and further processing such as quality control.

The specific hazard evaluation was directed to a specific carburetor and choke spray cleaner product which contains the following ingredients: perchloroethylene, xylene, and diacetone alcohol. The gasses used to pressurize the cans are isobutane and propane. The product is processed about three times each year which involves campaigns of two shifts per day for a period of two to three days. There are about six or seven employees working inside the Gas House per shift; four are continuously exposed to the vapors.

II. BACKGROUND HAZARD INFORMATION

A. Standards

The Occupational Health Standards as promulgated by the U.S. Department of Labor (Title 29, Code of Federal Regulations, Chapter XVII, Part 1910, Subpart 1910.93, entitled "Air Contaminants") applicable to substances of this evaluation are as follows:

OCCUPATIONAL SAFETY AND HEALTH STANDARDS
 SUBPART G - OCCUPATIONAL HEALTH AND ENVIRONMENTAL CONTROL
 (Code of Federal Regulation, Title 29, Chapter XVII, Part 1910)

Substance	p.p.m. ^a	mg/M ³ b
Diacetone Alcohol	50	240
Xylene	100	435

^a - Parts of vapor or gas per million parts of contaminated air by volume at 25°C and 760mm Hg pressure.

^b - Approximate milligrams of compound per cubic meter of air.

Material	8-hour time weighted average	Acceptable ceiling concentration	Acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift	
			Concentration	Maximum duration

Benzene
 (10 ppm is about 32 mg/M³)
 (Z37.4-1969)---10 p.p.m.-----25 p.p.m.-----50 p.p.m.-----10 minutes

Perchloroethylene (tetrachloroethylene)
 (100 p.p.m. is about 670 mg/M³)
 (Z37.2-1967)---100 p.p.m.--200 p.p.m.--300 p.p.m.--5 minutes in any 3 hours

Although the primary ingredients of the product being evaluated were perchloroethylene, diacetone alcohol, and xylene, benzene was also included as it is a contaminant of xylene.

B. Toxic Effects

Perchloroethylene: There have been relatively few instances of serious illness or death as a result of exposure to this substance. The most important effects of vapor inhalation are narcosis or anesthesia and primary irritation of the eyes, nose, and skin. In common with other chlorinated solvents, over exposure to perchloroethylene may sensitize the heart, predisposing it to the development of serious or even fatal rhythm disturbances. Furthermore, persons with definite liver, renal, cardiac or neurologic disease should not be placed at work where there may be substantial repeated exposures. The anesthetic effects of the chemical begin at concentration of about 200 ppm and manifests itself as loss of good judgment, and mental acuity and, as concentrations increase, feelings of light-headedness, dizziness, and lack of coordination may be noticed. The chemical may cause irritation of the skin and mucous membranes by prolonged or repeated contact. The maximum exposure to perchloroethylene is 200 parts per million and it is believed that the standard of 100 parts per million will prevent serious narcotic effects.

Xylene: The main hazard with xylene is that of the profound narcotic effect produced when it is taken into the body. In addition, chronic exposure to xylene will produce irritation to the eyes, and a flaky dermatitis. Furthermore, nasal and bronchial irritation may result. The standard for xylene is 100 parts per million which is the maximum allowable concentration not to be exceeded in an 8-hour day. It is noted in discussions of the effects of xylene on the human body that one should be more concerned with the impurities of xylene, mainly benzene, in considering the toxic effects of solutions of xylene.

Diacetone Alcohol: This substance is used as a lacquer and as a solvent. It is a primary irritant of mucosal membranes and will manifest itself as eye irritation, nose and throat irritation. The standard for this substance is 50 parts per million and symptoms of mucosal irritation are noted at 100 parts per million. Work based largely on animal experiments indicates that diacetone alcohol may be two times as toxic systemically as acetone, and may cause injury to kidneys, liver, and the blood.

III. HEALTH HAZARD EVALUATION

A. Initial Visit - Observational Survey

An initial hazard evaluation survey of the Aerosol Techniques, Inc., Plant was made on December 16, 1971 by NIOSH representatives, Mr. Raymond L. Hervin and Mr. Raymond L. Ruhe. The function of the National Institute for Occupational Safety and Health and its relation to Section 20(a)(6) of the Occupational Safety and Health Act and the purpose of the visit was explained to Mr. [†]

Director of Manufacturing; Mr. [†] Director of Industrial Relations; and Mr. [†] Plant Engineer. The National Surveillance Network Part I questionnaire was completed with their assistance. The company employs about 349 employees of which 296 are normally in the work areas as opposed to administrative office work areas. The company works day and swing shifts only for the five days of the week. Twenty-five per cent of the employees are male. An authorized representative of employees accompanied us on the trip.

To briefly describe the process, empty aerosol cans enter Gas House #3 on a conveyor belt and arrive at the filling machine which automatically fills eight cans in less than one minute. The operator working this machine is called a filler operator. After the cans have been filled with the ingredients, valve spray nozzle caps are introduced into the cans by two workers who are called valve droppers. The nozzles or valves are pressed into the cans and a vacuum is set in each can by a machine called a vacuum crimper. In a separate machine, the propellant is introduced and the cans leave the Gas House. The worker who is responsible for the vacuum and propellant machine is called a Gasser Operator. The filled cans leave the Gas House on an assembly line for quality control measures such as leak testing and weighing.

There are four workers who are always in the Gas House, and include one filler operator, two valve droppers, and a gasser operator. Normally these workers do not wear respirators but are only required to wear safety goggles. During a shift there are other workers who occasionally enter the Gas House. One or two maintenance personnel may be repairing a piece of equipment, or quality control workers may be pulling a certain number of cans off the line for inspection. In addition, the supervisor normally enters the Gas House several times a shift. It should be noted that respirators have not been a requirement for employees inside the Gas House prior to the visit,

although management had recently purchased respirators with cartridges for organic vapors. Management felt that the respirators would be utilized whenever processing the carburetor and choke cleaner product. Respirators worn by the four employees who are always in the Gas House during the subsequent environmental surveys while processing of the carburetor and choke cleaner product. However, the other employees who have occasion to be in the Gas House were not required to wear a respirator.

A critique of the initial visit was made with management of Aerosol Techniques, Inc. As a result of this initial visit it was determined that environmental measurements and a medical evaluation of employees were necessary to complete the evaluation.

B. Medical Evaluation

A total of 21 workers were interviewed and examined on March 1, 1972 by Steven K. Shama, M.D., NIOSH physician. Seven workers were presently exposed to the carburetor and choke cleaning product and 14 had past exposures in October 1971. Respirators were not required in previously during the processing of the subject product were exposed to the total environment. Ten workers who worked without respirators noted symptoms which included eye and nose irritation, coughing, shortness of breath, and central nervous system symptoms of headaches, light-headedness, dizziness, giddiness, and nausea. The remaining four people who wore respirators denied any significant complaints referable to the ingredients of the subject product. It should be noted that many workers who did admit to symptoms noted that the symptoms were considerably worse after a can had ruptured and the vapors and odors were readily apparent throughout the Gas House.

The seven workers interviewed who were currently exposed to the subject product had only a few hours of exposure. None of them admitted to symptoms referable to the ingredients of the product. All workers working continually in the Gas House were wearing goggles and respirators. However, an occasional worker who would have to do some periodic inspection in the Gas House may enter the Gas House without a respirator. Appropriate respirators and safety goggles eliminate symptoms referable to the carburetor and choke cleaner product.

C. Environmental Survey

On March 1-2, 1972, a follow-up survey was conducted by Mr. Raymond L. Hervin and Mr. Raymond L. Ruhe to determine environmental exposures of employees in Gas House #3 during the processing of the carburetor and choke cleaner product. The environmental exposures involved perchloroethylene, xylene, diacetone alcohol, and benzene being a minor contaminant of xylene. The results of this survey were not considered valid by the surveyors and a follow-up environmental survey was accomplished May 11-12, 1972. The following are results from the latter survey as the previous results were invalid.

A total of 30 breathing zone samples, 42 general area samples, and three blank samples were collected and analyzed for the contaminants of concern during all hours of two day shifts. Air was drawn through a charcoal tube at a rate of one liter per minute (lpm) for a period of about ten minutes per sample for the breathing zone samples. Air was drawn through the charcoal tube at one lpm for an average of about 25 minutes for the general area samples. Sampling was accomplished throughout both day shifts at various times and the average of the breathing zone and general area samples should simulate an 8-hour time weighted average. The general area room sampling devices were located in a specific location in the work environment to obtain a general air sample of the operation involved (filler, valve droppers, and gasser). The breathing zone samples were hand-held to obtain air from the actual breathing zone of the employee and is representative of breathing zone air. The sample air flow was maintained by the use of an MSA Model G, Battery-Operated Pump.

1. Environmental Survey Results

a. General Information

The 75 air samples were analyzed by the Division of Laboratories and Criteria Development, NIOSH, Cincinnati, Ohio, and approximately 400 determinations were accomplished to evaluate the working environment in and around Gas House #3. A summary of the sample results for perchloroethylene, benzene, diacetone alcohol, and xylene in mg/M³ (milligrams of compound per cubic meter of air sampled) are shown in Tables I, II, III, and IV (attached). The minimum detectable amounts, from an analytical standpoint, are about 1/20th of the appropriate health standard for each of the compounds involved in this evaluation.

In evaluating Table I through IV, it should be noted that the vast majority of the measured concentrations of the air samples for each of the compounds did not exceed the individual established standards for the substances evaluated. Some individual samples exceeded the standards for perchloroethylene and diacetone alcohol. Three samples of perchloroethylene exceeded the maximum detectable limit and are therefore minimum values only. However, when two or more hazardous substances are present such as in this evaluation, their combined effects, rather than that of either individually, must be considered. Hence, in the absence of information to the contrary, the effects of the different hazards must be considered as additive, that is, if the sum of the following fractions:

$$E_m = \frac{C_1(\text{Conc. Benzene})}{L_1(\text{Std. Benzene})} + \frac{C_2(\text{Conc. Per.})}{L_2(\text{Std. Per.})} + \frac{C_3(\text{Conc. Xy.})}{L_3(\text{Std. Xy.})} + \frac{C_4(\text{Conc. D.A.})}{L_4(\text{Std. D.A.})}$$

exceeds unity (1), then the TLV of the mixture should be considered as being exceeded. C/1, C/2, C/3, and C/4 are the observed concentrations of benzene, perchloroethylene, xylene, and diacetone alcohol respectively, and the L/1, L/2, L/3, and L/4 are the health standards for the compounds. E_m is the sum total and should not exceed 1. Table V discusses this matter in more detail. In evaluating Tables I through IV, it is noted that E_m was greater than unity for the majority of breathing zone samples and all occur inside Gas House #3. The following discusses the sample results in more detail.

b. Filler Operations

There were a total of nine samples taken in the breathing zone of the filler operators. Of these samples, eight exceeded unity and the E_m varied from 0.76 to 2.94. The average E_m equaled 1.82. There were nine general area air samples of which three exceeded unity and the E_m varied from 0.70 to greater than 1.60 with an average E_m of 1.47. There was one sample in which the charcoal tube was overloaded with perchloroethylene and hence the value is a minimum value. Please refer to Table I for specific details concerning sample results for the filler operations.

c. Valve Dropper Operations

There were a total of 12 samples taken in the breathing zone of the valve droppers. Six samples were over an E_m of one with the samples varying from an E_m of .33 to 3.03. The average E_m for the breathing zone of the employees was 1.01. There were ten general area air samples taken in the vicinity of the valve droppers. The E_m varied from 0.28 to 1.62 with an average E_m of .77. Please refer to Table II for additional details concerning sample results for valve dropping operations.

d. Gasser Operations

There were a total of nine air samples taken in the vicinity of the breathing zone of the gasser operators. Of the total of nine, five were over an E_m of 1. The E_m varied from 0.39 to 3.15 with an average E_m of 1.26. There were a total of ten general area air samples taken in the vicinity of the filler of which six were over an E_m of 1. The E_m varied from 0.31 to greater than 4.81. Two samples were overloaded and hence, the results were a greater than 1.41 and greater than 4.81. The average E_m is 1.38. Please refer to Table III for specific details concerning sample results.

e. Operations Outside of Gas House #3

There were several samples taken outside the Gas House in order to evaluate the environment, although it was felt prior to sampling that concentrations would not exceed any health standards. There were six samples taken on top of the water bath--conveyor line which is utilized for leak testing of the aerosol cans. Of the six general area air samples taken, none exceeded an E_m of 1. The E_m varied from 0.02 to 0.17 with an average E_m of 0.08. There were also six general area air samples taken in the vicinity of the general inspection-quality control-packaging line by the conveyor line and none exceeded an E_m of 1. The E_m varied from 0.06 to 0.26 with an average E_m of 0.15.

f. General Discussion of Air Sample Results

The results of the environmental survey outside of Gas House #3 show that no airborne concentrations individually or combined (E_m) exceeded the established standards (Federal Register, Part II, §1910.93, Table G-1--Individual Standards and Part II, §1910.93 (d)(2)(i)--Combined Standards) promulgated by the U.S. Department of Labor to prevent toxic effects characteristic of such substances. However, the results of the environmental survey inside of the Gas House #3 show that many airborne concentrations individually, and particularly if combined, significantly exceeded established standards referenced above.

The average combined E_m for the breathing zones of the filler, valve dropper, and gasser operators were 1.82, 1.01, and 1.26 respectively, and simulates the time-weighted combined average for these operations. Although one individual sample result for

perchloroethylene approached the "five minutes in any three hours" health standard of 300 ppm or 2010 mg/M³, the sample results did not show such a standard being exceeded. However, it is felt that such a "2010 mg/M³ in five minutes" health standard was probably exceeded on at least a few occasions when cans were ruptured in the vacuum and/or propellant machines which are operated by the gasser operator. The liquid sprays in the general area of these machines when a can is ruptured did in fact spray a few individuals such as the gasser and maintenance man. On one occasion, an employee was sprayed in the face and had to thoroughly wash his face. It was also noted that ruptured cans were placed in grocery type carts for temporary storage inside and outside the Gas House. This practice of storing ruptured cans is a source of fumes. The carts are replaced when around 50% filled with ruptured cans.

The above results in items b, c, and d were obtained in Gas House #3 during the processing of the carburetor and choke cleaner product. It is noted that most of the samples had significant amounts of isobutane and propane which is utilized as the propellant in the aerosol cans. The filler operation involves the addition of the propellant. It was not possible to quantitatively analyze for these components. However, it should be noted that in "TLV's of Airborne Contaminants and Physical Agents with Intended Changes adopted by ACGIH for 1971" published by the American Conference of Governmental Industrial Hygienists, these compounds are considered as simple asphyxiants or "inert" gasses and vapors. A Threshold Limit Value (TLV) may not be recommended for each simple asphyxiant because the limiting factor is available oxygen which should be a minimal oxygen content of 18% by volume under normal atmospheric pressure. Atmospheres deficient in oxygen do not provide adequate warning and most simple asphyxiants are odorless. Propane and isobutane also present an explosion hazard. In this regard, it should be noted that the exhaust air from the Gas House is monitored with explosionometers.

g. Noise Measurements

Some areas of high noise level were observed during the survey. It has been determined that "substances" as presently defined in Section 20(a)(6) of the Act do not include physical agents. However, for completeness of our overall responsibilities of acknowledging any occupational hazards encountered during an evaluation of a place of employment, noise levels were measured and reported.

The standards for Occupational Noise Exposures as published in the Federal Register, Part II, §1910.95, Table G-16 are shown in Table VI-A. Sound levels were measured with a General Radio Company Permissible Sound Level Meter, Type 1565-b in dBA with a slow response. Sound level readings were taken in the hearing zone of employees at the start of the conveyor line during the loading of empty cans on the conveyor platform line. These readings varied from 92 to 102 dBA. The standard (using formula from footnote from Table VI-A) was exceeded for the employee loading the empty produces excessive noise levels to about 105 dBA, although very little employee exposure was noted at this location at the time of the survey. All of the above areas were outside of the Gas House. Noise measurements inside the Gas House did not show any exposure of personnel which exceeded the appropriate standard. Table VI-A is a summary of noise levels at various locations. Exposure to excessive noise levels can produce permanent hearing loss in man. There is no known surgical treatment for this type of injury. Hearing loss due to noise is insidious and generally requires an exposure over a period of years for damage to occur.

h. Ventilation Measurements

The Gas House has make-up supply ventilation as well as its own separate exhaust system. The Gas House is a small concrete block structure with a roof and is maintained on a negative pressure to the general building atmosphere. The Gas House (12 feet by 60 feet by 12 feet high) is a small building within a larger building. The systems were specifically designed to have the air come from the building into the Gas House and exhausted at the floor level via six openings in the wall at the floor level. Please refer to Table VII for ventilation measurement results. The results show good ventilation for confining the fumes to the Gas House. The exhaust air is monitored for potential explosion hazards. The current ventilation capacity inside Gas House #3 appears satisfactory but is somewhat ineffective due to no local exhaust on the conveyor line and other operational considerations.

i. Contacts During Environmental Survey

The same contacts were made during the medical and environmental survey as during the initial visit. _____ was the authorized representative of employees at the time of the environmental survey.

IV. RECOMMENDATIONS

Based on multiple exposure concentrations exceeding appropriate health standards and a history of past symptomology obtained from employee interviews, it is our determination that a health hazard exists from exposures of personnel to the chemical substances investigated. In addition, a potential hazard to employees exists from exposure to noise. The following recommendations are submitted to management to obviate observed and potential hazards and to provide a desirable working environmental for all personnel.

1. Employees with definite liver, renal, cardiac, or neurologic disease should not be placed in work areas where a hazard of major acute exposure exists or where there may be substantial repeated exposures.

2. The company should solicit services of a private ventilation firm or consultant or in-house services, if such expertise is available, to determine specific needs and institute controls for an effective separate exhaust system which could enclose most of the operations including the filler and gasser operations inside the Gas House. It is felt that such an enclosed system, with its separate exhaust system from the filler to the gasser, or other appropriate solutions to the problem are available. The present room ventilation capacity appears satisfactory but is somewhat ineffective due to lack of local exhaust on the conveyor line and other operational considerations such as enclosures.

3. All employees, without exception, should be required to wear Bureau of Mines approved organic vapor respirators and cartridges plus appropriate safety goggles when working inside the Gas House during processing of the carburetor and choke cleaning product. The employees should be instructed on the proper use of the respirators (e.g., fit, cleanliness, etc.) and to change the cartridge when the worker smells solvent vapors coming through the cartridge. The use of respirators should continue during the processing of the subject product until appropriate modifications to ventilation system are made and air concentrations are less than appropriate health standards.

4. The accumulation of ruptured but partially filled cans in an open container (grocery cart) should be discontinued. A tight container which will prevent volatile materials from becoming airborne should be provided for the temporary storage of such cans inside and outside of the Gas House until final disposition is made on such cans. Good housekeeping practices should be continued and maintained as a routine work procedure.

5. Periodic checks should be made of the operations to assure that appropriate health standards are not exceeded and to institute appropriate engineering and/or administration controls if the standards are exceeded.

6. Engineering controls should be instituted to reduce excessive noise exposure levels to the existing standard of 90 dBA or below. If this is not possible, protective devices should be worn. A hearing conservation program including periodic audiometric testing is recommended for workers exposed in high noise areas.

7. It is noted that the above summary and recommendations of the evaluation are related to Gas House #3 and the carburetor and choke cleaner product processed at the time of the survey and that the product is processed only a few times a year. Although this evaluation covered only one product, there are many other products processed throughout the year. Some of these products (e.g., dog repellants, ant and roach killer, flying insect killer, etc.) such as insecticides or pesticides may also present a potential hazard to employees. Hence, the implementation of the above recommendations in one of the Gas Houses and the confining the processing of such potentially hazardous materials in an adequately ventilated conveyor line inside a Gas House may preclude exposure of personnel to other potential health hazards. In either event, it is necessary to provide for periodic checks (recommendation 5 above) of airborne levels during the processing of such materials which may present a potential hazard and to take appropriate action if health standards are exceeded.

TABLE I
 AIR SAMPLE RESULTS ON FILLER OPERATIONS
 (Concentration of subject compound in mg/M³ - milligrams of compound per cubic meter of air)

Sample No.	Em*	Benzene	$\frac{C_1}{L_1}$	Perchloroethylene	$\frac{C_2}{L_2}$	Xylene	$\frac{C_3}{L_3}$	Diacetone Alcohol	$\frac{C_4}{L_4}$
		mg/M ³		mg/M ³		mg/M ³		mg/M ³	
<u>Breathing Zone Air Samples - Filler Operators</u>									
2	2.02	3.3	.10	708.5	1.05	140.1	.32	132.7	.55
15	2.94	ND	-	928.0	1.4	204.0	.47	265.	1.07
27	1.34	ND	-	581.5	.94	32.4	.07	80.1	.33
33	.76	1.02	.03	128.3	.19	41.6	.10	106.4	.44
35	2.03	ND	-	611.6	.92	156.9	.36	180.6	.75
43	1.59	ND	-	469.4	.70	126.0	.29	145.	.60
53	2.14	ND	-	644.9	.96	176.2	.41	184.7	.77
57	1.79	ND	-	556.9	.83	146.2	.34	149.7	.62
65	1.79	ND	-	561.7	.84	140.9	.32	151.9	.63
<u>General Area Air Samples</u>									
7*	>1.60	4.0	.12	>511.4	>.76	123.3	.28	105.	.44
14	.99	ND	-	304.2	.45	84.3	.19	84.3	.35
17	1.52	ND	-	529.0	.79	118.0	.27	111.	.46
26	1.27	ND	-	581.5	.87	32.4	.07	80.1	.33
32	.83	ND	-	269.0	.40	69.0	.16	65.2	.27

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*Em = $\frac{C_1}{L_1} + \frac{C_2}{L_2} + \frac{C_3}{L_3} + \frac{C_4}{L_4}$; if Em is >1, then the standard is exceeded--see Table V for explanation.

TABLE I (cont'd)
 AIR SAMPLE RESULTS ON FILLER OPERATIONS
 (Concentration of subject compound in mg/M³ - milligrams of compound per cubic meter of air)

Sample No.	E _m *	Benzene		Perchloroethylene		Xylene		Diacetone Alcohol	
		mg/M ³	$\frac{C_1}{L_1}$	mg/M ³	$\frac{C_2}{L_2}$	mg/M ³	$\frac{C_3}{L_3}$	mg/M ³	$\frac{C_4}{L_4}$
40	.88	ND	-	269.0	.40	75.0	.17	75.0	.31
47	.08	ND	-	33.0	.05	2.0	.01	6.0	.02
56	.77	ND	-	201.3	.30	54.8	.13	82.1	.34
61	.70	ND	-	211.28	.31	59.4	.14	61.	.25
68	.86	ND	-	271.3	.41	66.6	.15	71.1	.30

NOTE: Sample 47 is not considered valid as little or no air passed through charcoal tube.

*E_m = $\frac{C_1}{L_1} + \frac{C_2}{L_2} + \frac{C_3}{L_3} + \frac{C_4}{L_4}$; if E_m is >1, then the standard is exceeded--see Table V for explanation.

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TABLE II
 AIR SAMPLE RESULTS ON VALVE DROPPER OPERATIONS
 (Concentration of subject compound in mg/M³ - milligrams of compound per cubic meter of air).

Sample No.	Em*	Benzene	$\frac{C_1}{L_1}$	Perchloroethylene	$\frac{C_2}{L_2}$	Xylene	$\frac{C_3}{L_3}$	Diacetone Alcohol	$\frac{C_4}{L_4}$
		mg/M ³		mg/M ³		mg/M ³		mg/M ³	
<u>Breathing Zone Air Samples - Valve Droppers</u>									
3	1.20	1.0	.03	400.6	.60	94.2	.22	83.9	.35
4	1.07	0.9	.03	104.2	.16	126.5	.29	140.9	.59
10	1.45	ND	-	442.3	.66	107.1	.25	128.9	.54
18	3.03	ND	-	1014.9	1.5	232.8	.53	251.	1.0
23	1.13	ND	-	313.0	.47	85.0	.20	110.	.46
28	1.40	ND	-	427.7	.64	108.6	.25	122.6	.51
37	.47	ND	-	160.4	.24	40.8	.09	34.1	.14
38A	.58	1.2	.04	173	.26	68	.16	30	.12
50	.38	.55	.02	116.8	.17	37.5	.09	23.3	.10
64	.33	ND	-	118.3	.18	30.3	.07	18.5	.08
52	.49	ND	-	192.0	.29	46.5	.11	20.8	.09
69	.59	ND	-	185.3	.28	54.5	.13	44.4	.18
<u>General Area Air Samples</u>									
6	.71	2.2	.07	220.8	.33	53.0	.12	45.4	.19
13	.61	ND	-	205.0	.31	46.0	.11	45.	.19

*Em = $\frac{C_1}{L_1} + \frac{C_2}{L_2} + \frac{C_3}{L_3} + \frac{C_4}{L_4}$; if Em is > 1, then the standard is exceeded--see Table V for explanation.

TABLE II (cont'd)
 AIR SAMPLE RESULTS ON VALVE DROPPER OPERATIONS
 (Concentration of subject compound in mg/M³ - milligrams of compound per cubic meter of air)

Sample No.	E _m *	Benzene		Perchloroethylene		Xylene		Diacetone Alcohol	
		mg/M ³	$\frac{C_1}{L_1}$	mg/M ³	$\frac{C_2}{L_2}$	mg/M ³	$\frac{C_3}{L_3}$	mg/M ³	$\frac{C_4}{L_4}$
19	1.62	2.44	.08	515.4	.77	114.4	.26	123.1	.51
24	1.18	ND	-	362.3	.54	86.9	.20	105.	.44
34	.94	0.65	.02	251.1	.38	71.2	.16	91.3	.38
39	.73	1.9	.06	202.4	.30	59.1	.14	54.7	.23
46	.78	ND	-	207.8	.31	60.0	.14	79.6	.33
55	.45	0.6	.02	133.1	.20	38.5	.09	33.2	.14
59	.28	ND	-	90.3	.13	23.4	.05	24.9	.10
67	.37	ND	-	124.3	.19	31.4	.07	25.7	.11

*E_m = $\frac{C_1}{L_1} + \frac{C_2}{L_2} + \frac{C_3}{L_3} + \frac{C_4}{L_4}$; if E_m is >1, then the standard is exceeded--see Table V for explanation.

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TABLE III
 AIR SAMPLE RESULTS ON GASSER OPERATIONS
 (Concentration of subject compound in mg/M³ - milligrams of compound per cubic meter of air)

Sample No.	E _m *	Benzene mg/M ³	$\frac{C_1}{L_1}$	Perchloroethylene mg/M ³	$\frac{C_2}{L_2}$	Xylene mg/M ³	$\frac{C_3}{L_3}$	Diacetone Alcohol mg/M ³	$\frac{C_4}{L_4}$
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Breathing Zone Personal Air Samples - Gasser Operators

1	1.44	1.4	.04	358.0	.53	101.0	.23	154.4	.64
11	3.15	6.7	.21	962.3	1.4	237.1	.54	243.	1.0
22	1.33	ND	-	300.0	.45	103.0	.24	154.	.64
33A	1.89	ND	-	614.7	.92	151.2	.35	148.3	.62
36	.45	1.08	.03	120.6	.18	35.0	.08	38.5	.16
44	1.60	ND	-	489.3	.73	122.8	.28	142.	.59
51	.39	ND	-	110.0	.16	27.0	.06	39.9	.17
58	.39	0.5	.02	118.3	.18	34.7	.08	27.4	.11
70	.67	ND	-	198.0	.30	51.0	.12	59.8	.25

General Area Samples

5	>1.41	2.2	.07	>344.5	>.51	100.4	.23	144.	.60
12	1.52	ND	-	721.8	1.1	56.9	.13	69.8	.29
16	>4.81	1.5	.05	>1247.7	>1.9	417.9	.96	457.	1.9
25	1.47	ND	-	367.0	.55	107.0	.25	160	.67
31	1.59	1.6	.05	411.9	.62	117.7	.27	155.5	.65

*E_m = $\frac{C_1}{L_1} + \frac{C_2}{L_2} + \frac{C_3}{L_3} + \frac{C_4}{L_4}$; if E_m is >1, then the standard is exceeded--see Table V for explanation.

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TABLE III (cont'd)
 AIR SAMPLE RESULTS ON GASSER OPERATIONS
 (Concentration of subject compound in mg/M³ - milligrams of compound per cubic meter of air)

Sample No.	<u>E_m</u> *	<u>Benzene</u>		<u>Perchloroethylene</u>		<u>Xylene</u>		<u>Diacetone Alcohol</u>	
		mg/M ³	$\frac{C_1}{L_1}$	mg/M ³	$\frac{C_2}{L_2}$	mg/M ³	$\frac{C_3}{L_3}$	mg/M ³	$\frac{C_4}{L_4}$
38	1.04	3.07	.10	239.1	.36	72.5	.17	98.6	.41
45	.89	0.6	.02	258.8	.39	69.1	.16	77.	.32
54	.36	ND	-	112.7	.17	34.6	.08	26.0	.11
60	.31	0.2	.01	107.6	.16	31.3	.07	16.0	.07
66	.38	0.1	.00	30.5	.19	38.6	.09	23.1	.10

*E_m = $\frac{C_1}{L_1} + \frac{C_2}{L_2} + \frac{C_3}{L_3} + \frac{C_4}{L_4}$; if E_m is >1, then the standard is exceeded--see Table V for explanation.

TABLE IV
 AIR SAMPLE RESULTS ON MISCELLANEOUS-GENERAL AREA SAMPLES-OUTSIDE OF GAS HOUSE
 (Concentration of subject compound in mg/M³ - milligrams of compound per cubic meter of air)

Sample No.	Em*	Benzene mg/M ³	$\frac{C_1}{L_1}$	Perchloroethylene mg/M ³	$\frac{C_2}{L_2}$	Xylene mg/M ³	$\frac{C_3}{L_3}$	Diacetone Alcohol mg/M ³	$\frac{C_4}{L_4}$
<u>Top of Water Bath - Conveyor Line</u>									
8	.05	ND	-	15.4	.02	6.7	.02	2.0	.01
20	.10	ND	-	36.9	.06	14.0	.03	3.6	.01
29	.06	ND	-	17.0	.03	7.9	.02	3.2	.01
41	.06	.01	-	21.3	.03	10.1	.02	1.6	.01
49	.02	ND	-	9.0	.01	2.0	.00	2.0	.01
63	.17	ND	-	55.1	.08	23.4	.05	8.9	.04
<u>General Inspection/Conveyor Line</u>									
9	.13	2.74	.09	12.4	.02	3.1	.01	1.4	.01
21	.06	ND	-	21.0	.03	3.0	.01	4.0	.02
30	.17	4.2	.13	15.1	.02	3.4	.01	2.5	.01
42	.26	7.17	.22	11.30	.02	3.7	.01	2.2	.01
48	.17	4.24	.13	14.4	.02	3.6	.01	2.7	.01
62	.12	1.0	.03	26.7	.04	9.9	.02	6.0	.03
<u>Blank Samples</u>									
1	-	ND	-	0.1	-	0.3	-	ND	-

*Em = $\frac{C_1}{L_1} + \frac{C_2}{L_2} + \frac{C_3}{L_3} + \frac{C_4}{L_4}$; if Em is >1, then the standard is exceeded--see Table V for explanation.

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TABLE IV (cont'd)
 AIR SAMPLE RESULTS ON MISCELLANEOUS---GENERAL AREA SAMPLES--OUTSIDE OF THE GAS HOUSE
 (Concentration of subject compound in mg/M³ - milligrams of compound per cubic meter of air)

Sample No.	E _m *	Benzene		Perchloroethylene		Xylene		Diacetone Alcohol	
		mg/M ³	$\frac{C_1}{L_1}$	mg/M ³	$\frac{C_2}{L_2}$	mg/M ³	$\frac{C_3}{L_3}$	mg/M ³	$\frac{C_4}{L_4}$
2	-	ND	-	0.2	-	1.6	-	4.4	-
3	-	ND	-	ND	-	0.2	-	ND	-

*E_m = $\frac{C_1}{L_1} + \frac{C_2}{L_2} + \frac{C_3}{L_3} + \frac{C_4}{L_4}$; if E_m is >1, then the standard is exceeded--see Table V for explanation.

TABLE V

OCCUPATIONAL SAFETY AND HEALTH STANDARDS
SUBPART G - OCCUPATIONAL HEALTH AND ENVIRONMENTAL CONTROL
(Code of Federal Regulations, Title 29, Chapter XVII, Part 1910)

PART 1910 -- OCCUPATIONAL SAFETY AND HEALTH STANDARDS

1910.93 AIR CONTAMINANTS

Part B(2)(i) In case of a mixture of air contaminants an employer shall compute the equivalent exposure as follows:

$$Em = \frac{C_1}{L_1} + \frac{C_2}{L_2} + \dots + \frac{C_n}{L_n}$$

Where:

Em is the equivalent exposure for the mixture.

C is the concentration of a particular contaminant,

L is the exposure limit for that contaminant, from table G-1, G-2, or G-3.

The value of Em shall not exceed unity (1).

(ii) To illustrate the formula prescribed in subdivision (i) of this subparagraph, consider the following exposures:

Material	Actual concentration of 8-hour exposure	8-hour time weighted average exposure limit
Acetone (Table G-1)	500 ppm	1,000 ppm
2-Butanone (Table G-1)	45 ppm	200 ppm
Toluene (Table G-2)	40ppm	200 ppm

Substituting in the formula, we have:

$$Em = \frac{500}{1,000} + \frac{45}{200} + \frac{40}{200}$$

$$Em = 0.500 + 0.225 + 0.200$$

$$Em = 0.925$$

Since Em is less than unity (1), the exposure combination is within acceptable limits.

TABLE VI-A
PERMISSIBLE NOISE EXPOSURES*

<u>Duration Per Day, Hours</u>	<u>Sound Level dBA Slow Response</u>
8	90
6	92
4	95
3	97
2	100
1-1/2	102
1	105
1/2	110
1/4 or Less	115 Ceiling Value

*When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions: $C_1/T_1 + C_2/T_2 + C_n/T_n$ exceeds unity, then the mixed exposure should be considered to exceed the limit value. C_n indicates the total time of exposure at a specified noise level, and T_n indicates the total time of exposure permitted at that level.

Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

TABLE VI-B
SUMMARY NOISE MEASUREMENTS

LOCATION	SOUND LEVEL dBA	MAXIMUM DAILY EXPOSURE HOURS
<u>Conveyor Line Outside Gas House</u>		
Loading Empty Cans on Conveyor System	Min 92 Max 102	6- 1-1/2
Conveyor Belt After Cans Are Filled	86	NA
Air Jet When Cans Come Out of Water Bath	95	4
Drying Air Jet on Conveyor Line	105	1
3 Feet From Drying Air Jet on Conveyor Line	95	4
End of Conveyor Line Where Several Employees Work	87	NA
Miscellaneous Operations as Packing and Stacking	86	NA
General Area	84	NA
<u>Conveyor Line Inside Gas House</u>		
Gasser Operator	84	NA
Valve Droppers	80	NA
Filler Operator	88	NA

NA means not applicable as there are no established maximum daily exposure hours at the dBA sound level found.

TABLE VII

SUMMARY OF VENTILATION MEASUREMENTS MADE INSIDE GAS HOUSE NO. 3

LOCATION	FACE VELOCITY feet per minute (fpm)
Front Floor Exhaust Vent (17" x 19")	800
Middle Floor Exhaust Vent (17" x 19")	800
Rear Floor Exhaust Vent (17" x 19")	800
Average Face Velocity Outside Floor Intake Vents which Provide Make-Up Air for Gas House	400
Average Velocity in Doorway with Door Opened Near Valve Dropper	270
Average Velocity in Doorway with Door Opened Opposite Valve Dropper	330
Average Velocity in Doorway with Door Opened Near Filler Operator	290
Average Velocity in Doorway with Door Opened Opposite Filler Operator	320