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. 75-2-282

CLASSIC CHEMICAL COMPANY
CAMDEN, NEW JERSEY

APRIL 1976

I. TOXICITY DETERMINATION

It has been determined that, except for dermatological problems, no adverse health effects could be definitely attributed to the in-plant air concentrations of Weed-B-Gon® components measured during the evaluation conducted on September 25, 1975. The dermatological problems cannot be specifically linked to the components of the herbicide but may be caused by some of the other materials that are packaged.

Due to the short duration of production runs with no advance warning to NIOSH, a detailed pre-exposure medical examination could not be scheduled. This examination may have accentuated certain symptoms specific to the herbicide.

There is enough suspicion, particularly about the skin effects and hematopoeitic effects to strongly consider a thorough study of employees at Classic Chemical Company exposed to the herbicide evaluated and two other herbicidal preparations.

Information concerning environmental and medical results are contained in the body of the report.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are available upon request from NIOSH, Robert A. Taft Laboratories, 4676 Columbia Parkway, Cincinnati, Ohio 45226. Copies have been sent to:

a) Classic Chemical Company, Camden, New Jersey
b) Authorized Representative of Employees
c) U. S. Department of Labor - Region II
d) NIOSH - Regions II & III

For the purpose of informing the approximately 78 "affected employees," the employer shall promptly "post" the Determination Report for a period of 30 calendar days in a prominent place(s) near where exposed employees work.

III. 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 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 (NIOSH) received such a request from an authorized representative of employees regarding a herbicide which was reportedly causing numbness in the facial area. The toxicity of other herbicides which are formulated from time to time also was questioned.

IV. HEALTH HAZARD EVALUATION

A. Plant Process - Conditions of Use

Classic Chemical Company is a contractor formulating various chemicals for other companies on a contractual basis. The various compounds are formulated according to the customer's specification.

The operations consist of (1) can making and printing, (2) formulating, and (3) can filling and packaging. The health hazard evaluation request referred to the latter two operations. These operations are physically separated from the can making operation.

Three herbicides may be formulated. They consist of active ingredients, emulsifiers, and carriers.

B. Study Progress and Design

On March 26, 1975, an initial survey at the site was conducted by Walter Chrostek, NIOSH Industrial Hygienist. A walk-through survey was conducted during which non-directed medical questionnaires were completed for eleven (11) employees.

Due to the seasonal nature of the compounding work for these formulations, the contract was completed before an environmental-medical evaluation could be conducted at this time.

On September 24, 1975, the Industrial Hygienist, accompanied by Joseph Thomasino, M.D., Department of Environmental Health, University of Cincinnati, College of Medicine, Theodore Thoburn, M.D., and Robert Schutte of NIOSH, conducted a walk-through visit to acquaint themselves with the operations. The environmental-medical evaluation was conducted on September 25, 1975. During this evaluation, only one herbicide was being utilized (Weed-B-Gon®). The other two herbicides were not formulated and the company did not expect a contract for the other herbicides during the remainder of the year.

The herbicide was formulated in two mixing rooms 8x30x100 feet above the filling areas. The herbicide was compounded in large vats open to the general air and conveyed by pipes and hoses into the filling machines below. Two to three employees worked in each of these rooms daily. Ventilation consisted of doors and windows as well as several large wall fans approximately four feet in diameter located in each of the rooms.

The herbicide was packaged in two filling areas, Departments 59A and 59B. Both areas were rectangular rooms approximately 12x30x100 feet. These rooms each contained two lines for filling which consisted of a conveyer belt, a filling apparatus, a capping apparatus, and a stacking area for empty cans at one end and filled cans at the other. Five to twelve employees stood along the lines assisting with the operations, and two to three mechanics in each area would periodically adjust the machinery. At any one time during this particular production run, only one line in each department would be in operation and the other line would be idle. On both March 26 and September 24, 1975, only one line in one room was operating. Ventilation in each room consisted only of windows and doors.

Weed-B-Gon® consisted of butoxy propyl esters of 2,4-dichlorophenoxy acetic acid (2,4-D) (21.4% by weight), butoxy propyl esters of 2-2,4,5-trichlorophenoxypropionic acid (Silvex) (10.0% by weight), and 68.6% by weight of a mixture of methanol, aromatic hydrocarbons, alkyl sulfonate, alkyl aryl sulfonate, and Jet A fuel oil. It must be stressed that in addition to these substances in this herbicide, employees might also be exposed to a wide variety of other substances used in the many other products compounded and packaged at Classic Chemical Company, as "fillers" and "mixers" might be assigned to the herbicide line one day and some other line the following day where other materials are formulated and packaged.

Employees of filling Departments 59A and 59B rotate through the herbicide lines according to seniority, roughly on a one-day-in-two or one-day-in-three schedule. Production was eight hours a day, five days a week and had been ongoing for ten days prior to the survey. Two lines, one in each department, had been operating between September 15 and September 20; after September 22 one line had been operating. The total number of fillers and maintenance mechanics in both departments who had been involved at any time in the current run was approximately seventy.

In the mixing department two to three employees would rotate through the mixing areas concerned with the herbicide. Approximately nine employees had been involved in the mixing of herbicide during the current run. These mixers stand near the vats most of the working day. The 2,4-D, Silvex and Jet A fuel oil are conveyed to the vats in pipes outside the plant. The mixers connect pumps to drums of emulsifiers and then supervise the pumping of these substances into the vats and mixing operation as a whole.

In the filling departments an odor of hydrocarbons was noted and spilled herbicide was observed on the floor. As the automatic filling and capping machine sometimes malfunctions, the employees occasionally hand fill or cap a can and thus have some direct contact with herbicide.

In the mixing areas, an odor of hydrocarbons was present, especially about the mouths of the open vats; however, these areas were fairly clean.

Facilities

Employees in all departments were required to wear safety glasses and this rule was strictly observed. Similarly, break and rest areas were provided and rules against eating, drinking, or smoking outside these areas were also strictly observed. Mixers and maintenance men were provided with several changes of coveralls weekly and made use of shower and locker facilities provided them. Employees of the filling departments were not provided work clothes or these facilities. Some but not all of the "fillers" provided their own gloves, aprons, and safety shoes.

Medical Surveillance

Employees were not required to undergo a pre-employment physical examination. There was, however, periodic medical evaluation for employees of the mixing department. They were required to undergo annually a physical examination, urinalysis, and the performance of a complete blood count (CBC), Total Bilirubin, Direct Bilirubin and have a chest x-ray performed. No periodic evaluation was offered to other employees.

There is a small dispensary on the premises staffed by a registered nurse five days a week. Emergencies and other medical problems are referred to a local hospital emergency room or to an industrial clinic in Camden.

C. Evaluation Methods

1. Environmental

Atmospheric sampling was conducted for the atmospheric mist of herbicide utilizing midget impingers with ethylene glycol, (chromoquality), as the collection media and personal air sampling pumps, operating at approximately one liter per minute. These samples were analyzed by gas chromatography for 2,4-D, (propylene glycol butyl ether esters) and Silvex, (propylene glycol butyl ether esters).

Sampling was also simultaneously conducted for Jet A fuel oil. These samples were collected on charcoal tubes using personal air samples operating at 50 cubic centimeters per minute. These samples were analyzed for the components of Jet A fuel oil.

2. Medical

Employees of the mixing department and the filling departments 59A and 59B who voluntarily agreed to participate in the study formed the study population. Of these, six "mixers," fifteen "fillers," and one "mechanic," for a total of twenty-two workers, were included in the study. All of these workers had worked with the herbicide during the current production run. Of the twelve "fillers" and "mechanics" working on the production line on the day of the survey, eight were included in the sample.

Informed consent was obtained from all volunteers participating in the survey. The following procedures were performed on all participants:

a. Administration of a medical and occupational history which included specific questions concerning the renal, hepatic, central nervous, opthamological, and integumentary systems.

b. A brief physical examination focussing on the eyes, mucous membranes, abdomen, central nervous system (CNS), and skin.

c. Urinalysis of a freshly voided specimen for glucose, occult blood, ketones, urobolinogen, and protein.

d. Venous blood sample for hematocrit, hemoglobin, white cell count, differential and platelets, total protein, albumin, albumin/globulin (A/G) ratio, calcium, inorganic phosphorus, blood urea nitrogen (BUN), uric acid, total bilirubin, alkaline phosphatase, serum glutamic oxaloacetic transaminase (SGOT), serum glutamic pyruvic transaminase (SGPT), lactic dehydrogenase (LDH), and glucose.

D. Evaluation Criteria

1. Environmental

The Occupational Health Standard relevant to this evaluation as promulgated by the U.S. Department of Labor (29 CFR Part 1910.1000)[1] is as follows.

Substance	8-Hour Time Weighted Average
2,4-D	$10mg/M^3$

Although there is no permissible air concentration standard for Silvex, W. R. Mullinison of Dow Chemical Company,[2] states this compound belongs to the chlorophenoxy family of herbicides of which 2,4-D and 2,4,5-T are prominent members.

There is also no permissible air concentration standard for Jet fuel oil. Shell Oil Company in their "Material Safety Data Sheet"[3] proposes a standard of 100 parts of Jet fuel oil per million parts of air sampled.

2. Toxic Effects

The toxic effects of 2,4-D and Silvex include: CNS depression, eye irritation, primary irritant or allergic dermatitis, abdominal pain or tenderness, palpable liver, muscle weakness, incoordination, elevations of liver function tests, elevations of BUN and proteinuria.

-Normal Levels of Laboratory Tests*

Test	Normal Range
Total Protein	6.6-8.3g/100ml
Albumin	3.5-5.0g/100ml
A/G Ratio	1.0-2.2
Cholesterol	135-315mg/100ml
Total Bilirubin	Less than 1.5mg/100ml
SGOT	13-55 units
SGPT	12-53 units (males), 6-40 units (females)
LDH	63-155 units (males), 62-131 units (females)
BUN	8-26mg/100ml
Calcium	4.6-5.5 meq/liter
Uric Acid	4.0-8.5mg/100ml (males), 2.9-7.5 (females)
Alk. Phosphatase	35-148 units
Blood Glucose	70-110mg/100ml
Inor. PO_4	2.5-4.8mg/100ml
Hemoglobin	13-16g/100ml (males), 11-14g/100ml (females)
Hematocrit	40-48% (males), 39-47% (females)
White Blood Cell Count	5,000-10,000/cmm
% Lymphocytes	20-40%
% Polymorphonuclear Leukocytes (PMN)	35-70%

E. Results and Discussion

1. Environmental

Six (6) personal and general air samples were collected in ethylene glycol. These samples were analyzed by the gas chromatograph-electron capture method. Concentrations for 2,4-D ranged from non-detected to 0.021 milligram per cubic meter of air sampled. Silvex concentrations ranged from non-detected to 0.012 milligram per cubic meter of air. (See Table I.) Both of these levels are well below the evaluation criteria used for this evaluation.

* These are the normal values for adults as used by the Philadelphia Branch of Bio-Science Laboratories where the tests were run.

Air samples were also taken in the same locations utilizing charcoal tubes and were analyzed by gas chromatography. These samples showed five major and approximately ten minor peaks. One sample was analyzed by gas chromatograph - mass spectroscopy. The data system of the mass spectrometer has the ability to compare the spectra of unknowns to a library of spectra of substances. Benzene, toluene or xylene were not detected in the sample. The spectra of the five major peaks in the chromatogram were compared with the library of the mass spectrometer and tentative identifications were made. The possibilities for the components are listed below. In the case of two identifications for a component, the spectra of the substance listed first more closely matched the spectra of the unknown peak from the charcoal tube.

Peak No.	Tentative Identification
1	5-methyl decane 2,6,11-trimethyldodecane
2	n-nonane
3	n-decane 2,5-dimethyldecane
4	2,6-dimethylundecane n-undecane
5	2-propylheptanol 4-methylundecane

No quantitive amounts of these substances could be determined due to the lack of suitable laboratory standards.

Certain of these compounds are narcotic, irritants to the respiratory tract, or simple asphyxiants in high concentrations.(4)

2. Medical

In reviewing the histories and physical examinations of the 22 participants in the study, the following results were obtained. Only those effects directly attributable to known toxicities of the agents in question are discussed. See Table II for complete results.

Two employees complained of eye irritation. One employee reported that although eye irritation, watering, and burning had been present before working on the current production run, it had gotten worse during the run. On physical examination, no evidence of eye irritation in either employee could be found. Only one employee had any evidence of eye irritation on physical examination. This employee, a "filler" and "packer," had last worked with the herbicide ten days previously. Mild conjunctival irritation was noted but the employee gave a history of an upper respiratory tract infection which was present on the day of the survey. Rhinitis also was noted on physical examination.

Four employees complained of a variety of CNS symptoms. Two employees complained of dizziness, but not true vertigo, which existed prior to the run and may have been made worse during the run. Both were fillers who had worked with the herbicide during the past three to five days. One employee complained of a headache which was worsened during the run but had existed prior to the run. One employee complained of depression and crying spells but these symptoms, though worsened, had been ongoing for a long time and were attributed to emotional problems stemming fron non-work related problems. One employee, in addition to the dizziness noted above, was also the only employee to complain of numbness, tingling, and blurring of vision beginning during the run. No other CNS symptoms beginning or made worse during the production run were noted by any of the participants. On physical examination, only one participant had any neurological finding. This employee was found to have a questionably positive Rhomberg test to the right. This employee gave no history of CNS symptoms or problems. In all other employees, the Rhomberg and finger coordination tests were normal, no nystagmus was noted and all were well oriented and had normal gait.

Six participants in the study gave a history of skin rash during the production run. One of the participants described an area of pruritic small red macules of both arms. On physical examination, this employee was found to have a dry 3mm macular, erythematous lesion of the left volar forearm. Another employee gave a similar history for the hands and was found to have a lesion similar to that of the employee discussed above on the left index finger. A third employee complained of a pruritic scaly, erythematous lesion of the back. On physical examination, macular, 1-2mm lesions were noted. Three other employees complained of pruritic lesions of the back and arms but no lesions were noted.

No participants in the survey gave a history of symptoms referrable to the hepatic system per se. One employee gave a history of heartburn made worse during the production run. Two employees complained of mild nausea beginning during the production run. One employee demonstrated mild, localized tenderness of the right upper quadrant of the abdomen. This employee gave a two-year history of "colitis." Another employee demonstrated mild tenderness in the left lower quadrant and right lateral abdomen. This employee gave a history of cholelithiasis. A third employee demonstrated mild generalized tenderness and tenseness.

One employee, a "mixer," reported complaints of mild dysuria and burning sensation of the feet arising during the production run. One employee complained of frequent urination made worse while working with the herbicide. It was noted that he was on several anti-hypertensive medications at this time.

Several employees spontaneously related specific health problems to their work. Of the seven who did this, three had problems referrable to exposure to the herbicide. One employee complained of a rash noted above, another employee complained of a sore throat, and a third employee complained of mucous membrane irritation. No other positive findings were found in the histories of the participants.

Urine chemistries of all participants were within normal limits. Of the blood chemistries, no abnormalities of total protein, albumin, A/G ratio, cholesterol, total bilirubin, or SGOT were noted. Of the remaining liver function tests, the only elevations noted were in the SGPT, mildly elevated at 68 units in one employee and the LDH mildly elevated at 143 units in another employee. The BUN was elevated in only one participant at 62mg/100ml and the only abnormal calcium was also found with this employee decreased at 4.3meq/l. This worker had a long history of chronic renal disease secondary to protatic hypertrophy and obstruction. Three employees had slightly decreased hemoglobins. One employee with a long history of renal impairment was noted to have 12gms/100ml of hemoglobin. Two employees had had CBC's taken by the Classic Chemical Company in March, 1975. The hemoglobin level of one fell from 13.6g/100ml to 12.7g/100ml, while the level of the other rose from 11.7 to 12.3g/100ml. The hematocrits of two other employees were also slightly below normal. Two employees, though having normal hemoglobin levels, also showed slight reductions of hematocrit at 34% and 35% respectively. One of these employees gave a history of iron deficiency anemia for the past several months. Two anomalies of white blood cell count were noted. One

employee had a white count of 11,550/cmm with the normal being 5,000-10,000/cmm. The white count of this employee in March, 1975, was 4,100/cmm. The other participant had a slightly decreased white cell count at 4,900/cmm. This employee gave a history of several weeks of sore throat for which she had been treated with penicillin. Both of these employees had normal differential white blood cell counts but abnormal differentials were noted in three other employees. Their differentials all showed a slightly increased percentage of lymphocytes in the mid-40's (normal 20-40%). Table II indicates the number of workers who had a positive response to each item in the survey in which any positive finding of interest to this study was noted.

F. Conclusions

1. Environmental

Although exposures to the components of herbicide were not excessive in comparison to the environmental criteria used in this evaluation, during the time of the environmental evaluation, certain malfunctions and practices were noted during the initial walk-through survey which could contribute to excessive exposures. It was noted that at times the filling nozzle would not match up with the can spout resulting in most of the gallon of herbicide spilled on the floor. It was also noted that the filling nozzles would not completely shut off and would drip on the floor. A "filler" in the area would have his shoes saturated with the material.

2. Medical

In reviewing the results of the medical evaluation, no clearly defined health hazard emerges from this data. There is a suggestion of dermatitis, either primary irritant or allergic in nature to the herbicide, and this has been noted in the literature. Two employees had lesions possibly due to contact dermatitis in areas of exposure. Two participants demonstrated one mildly elevated liver function test, one with the SGPT and one with the LDH. Seven employees had decreased blood glucose levels and one had a mildly decreased inorganic phosphorus level as well. Three employees had mild anemias for which there is no clear explanation. One of these employees also demonstrated an elevated white cell count and three others had slight relative lymphocytoses for which no etiology can be offered.

Inasmuch as there is some evidence in the literature that 2,4-D and Silvex can cause some hepatic derangements in animals and possibly humans, the mild elevation of liver function tests in employees who do not use alcohol is somewhat disturbing. However, in the absence of an adequate control group due to time limitations, or any reliable estimate of the variability of the laboratory processing the tests and the multivariate nature of the exposures to the workers at Classic Chemical Company, the significance of these two liver function high elevations is not clear. Similarly, the unexplained mild anemias in three employees and the mild derangements of the white blood cell count and differential in four other employees is also somewhat disturbing. The decreased blood glucose levels and the decreased inorganic phosphorus level noted are changes which do not seem to have been attributed to any cause.

To clarify these findings, studies conducted well before a production run of these materials has begun, as well as during and after the run, employing an adequate control group and measuring the variability of the laboratory used to process the samples would be extremely helpful.

V. RECOMMENDATIONS

1. Gloves and coveralls should be used by all employees at Classic Chemical Company involved at the production of herbicides and similar substances. This will help prevent skin contact.

2. Improved work practices are recommended to prevent spills of herbicide and for quick and complete removal if spills occur. This will prevent prolonged inhalation and dust contact through the shoes of this material.

3. More frequent medical monitoring of all employees involved in the production of herbicides along the lines of the medical studies in this survey. "Fillers" and "mechanics," as well as "mixers," should have periodic medical evaluations, ideally at six-month intervals.

4. Those employees noted to have skin, liver function, hematopoeitic and other blood chemical anomalies for which no outside explanation can be found should be followed closely with repeat evaluations at frequent intervals until the cause of the anomalies can be determined and corrected, or the anomalies clear themselves.

5. Strong consideration should be given to a follow-up study as outlined above to improve the evaluation of this situation.

VI. REFERENCES

1. Federal Register, (29 CFR, Part 1910.1000).

2. Some Toxicological Aspects of Silvex, HG-125, W. R. Mullinison, Dow Chemical Company.

3. Material Safety and Data Sheets for Shell Heavy Solvent No. 1 and Shell Jet A, Shell Oil.

4. Dangerous Properties of Industrial Materials, Third Edition, N. Irving Sax.

5. Martin, H., Editor, Pesticide Manual of the British Crop Protection Council, Second Edition, England, 1971.

6. Gleason, M. N. et al., Clinical Toxicology of Commercial Products, Third Edition. The Williams & Wilkins Co., Baltimore, 1969.

7. Crafts, A. S., The Chemistry and Mode of Action of Herbicides. Interscience Publishers, New York, 1961.

8. Hamilton, A. and Hardy, L., Industrial Toxicology, Third Edition. Publishing Sciences Group, Inc., Acton, Mass., 1974.

9. Johnstone, R. T. and Miller, S. E., Occupational Diseases and Industrial Medicine. W. B. Saunders Co., Philadelphia, 1960.

10. Fairhall, L. T., Industrial Toxicology, Second Edition. Hafner Publishing Co., New York, 1969.

11. Thienes, C. H. and Haley, T. J., Clinical Toxicology, Fifth Edition. Lea & Febiger, Philadelphia, 1972.

12. Kimbrough, R. N., Chlorinated Hydrocarbon Herbicides: A Review. Arch. Environmental Health 25:125-31, August, 1972.

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TABLE I

Classic Chemical Company
Camden, New Jersey
Report No. 75-2

2,4-D and Silvex Air Concentrations
September 26, 1975

Location	Time (Min)	Air Concentrations mg/M^3*		Remarks
		2,4-D	Silvex	
Packaging Department				
Center 20-21 Line	7:35-15:54	0.003	0.002	General Air
Capper	7:45-15:45	0.003	0.002	Operator's Exposure
Can Feeding	8:22-15:51	0.003	0.002	Operator's Exposure
Can Filling	8:00-15:48	0.002	0.002	General Air
Production Worker	7:50-15:35	0.021	0.012	Operator's Exposure
C 3-5 Mixing Area				
Mixer	8:49-15:30	0.003	0.002	Operator's Exposure
Mixer's Desk	8:10-15:30	N.D.**	N.D.***	General Air

*mg/M^3 - denotes milligram of contaminant per cubic meter of air sampled.
**N.D. - denotes limit of detection, 0.4 microgram per sample.
***N.D. - denotes limit of detection, 0.3 microgram per sample.

TABLE II

Number of Workers with Positive Responses or Abnormalities

Symptom of Finding	Number	Percent	Notes
Total Number	22	100	6 Mixers, 4 Fillers, 3 Cappers, 8 Packers, 1 Mechanic
Symptoms			
Painful urination (Q9a)	1	5	
Frequent urination during day (Q9c)	1	5	
Frequent nausea or vomiting (Q9K)	2	9	
Heartburn or indigestion (Q10e)	1	5	
Skin rask (Q11)	6	27	2 had itching (Q9g)
Numbness or burning feet (Q9m)	1	5	
Other numbness or tingling (Q12d&j)	1	5	
Headaches (Q12c)	1	5	
Dizziness (Q12a)	2	9	
Depressed mood (Q12f&l)	1	5	
Blurred vision (Q13a)	1	5	
Eye irritation, burning and/or tearing (Q13b,c,d)	2	9	
No Symptoms	12	55	5 Mixers, 1 Filler, 6 Packers

TABLE II
(Continued)

Symptom of Finding	Number	Percent	Notes
Physical Findings			
Conjunctival irritation	1	5	Not related to symptoms
Abnormal chest sounds	1	5	
Abdominal tenderness	3	14	2 relate to symptoms of heartburn, indigestion, nausea or vomiting
Positive Rhomberg	1	5	
Skin rashes	3	14	
Skin or nail problems with feet	4	18	
Cuts	1	5	
Blood pressure elevation	4	18	1 severe
No physical findings related to this study	10	45	4 Mixers, 1 Filler, 2 Cappers, 3 Packers