Auto Trim Plant
polyvinyl chloride parts

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

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 73-123-298

CAMPBELL PLASTICS, INC.
SCHENECTADY, NEW YORK

JUNE 1976

I. TOXICITY DETERMINATION

It has been determined that the smoke and fumes evolved from work with hot polyvinyl chloride (PVC) are causing a minor toxic irritation of workers eyes, nose and throat. About 40% of the workers have experienced this problem by history. The throat irritation is confined to persons working directly with the hot PVC. Further, one worker's chronic respiratory problem appears to be worsened by exposure to the smoke and fumes. This determination is based primarily on worker interviews with very limited review of past medical records.

Two workers appeared to be hypersensitive to work with hot PVC products, one to the fumes and smoke, one to skin contact. Adequate corrective measures have been taken.

There has been a toxic exposure to organic solvents as shown by skin changes in workers using solvents in the Aluminum Priming line without adequate protection. By history there had also been toxic levels of solvent vapor as shown by central nervous system symptoms of lightheadedness. This has been corrected by covering the solvent baths.

There does not appear to be a toxic exposure to vinyl chloride monomer as air samples collected in the compounding and extrusion operations by the Occupational Safety and Health Administration (OSHA) were below levels detectable by the NIOSH recommended methods of sampling and analysis.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are available upon request from the Division of Technical Services, Information Resources and Dissemination Section, NIOSH, Robert A. Taft Laboratories, 4676 Columbia Parkway, Cincinnati, Ohio 45226. Copies have been sent to:

a) Campbell Plastics, Inc., Schenectady, New York
b) Authorized Representative of Employees
c) U.S. Department of Labor - Region II
d) NIOSH - Region II

For the purpose of informing the approximately 175 "affected employees" the employer will promptly "post" the Determination Report in a prominent place(s) for a period of 30 calendar days 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), authorized 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 regarding exposure by inhalation of smoke, fumes and vapor from work with polyvinyl chloride, toluene, and methyl ethyl ketone, and also skin contact with these same agents.

IV. HEALTH HAZARD EVALUATION

A. Plant Process

The building, dating from World War II, is long, has a high ceiling and few internal partitions. The building was converted to its current use 14 years prior to this study with production starting about 13 years prior to this study. Space is more than adequate for the level of current operation. The major activity is fabricating polyvinyl chloride trim parts for several models of automobile. The majority of these involve bonding plastic to metal. Additionally there is an operation which plastic coats cloth for the shoe industry. Other jobs utilizing polyvinyl chloride are also done and some mylar plastic is utilized.

The Compounding Department is responsible for producing the colored plastic from granular PVC and the appropriate plasticizers, stabilizers and pigments; for running this through the first melt; and producing solid pellets for use in the next step of the operations. They are also responsible for the recycling of any salvagable scrap.

In the initial mixing operation granular PVC is added to a large mixing vat. Normally this is accomplished by dumping bags of the material into a hopper which is then raised and dumped into the top of the vat. Once in the vat the other ingredients are added by pipe, and the resulting mixture is transferred to a cone mixer where it is tumbled for further mixing. Filling is from the top with a tap at the bottom for removal.

The dry mixture is next run through an extrusion machine which produces spaghetti-like cords which are cooled in a water bath and then run through a chopper to make pellets. The pellets are then either stored for future use, or transferred to the Extrusion Department. The salvage operation utilized a big chopper. Ear protection is required of the person operating the chopper. The man on days who runs the cone mixer is supplied a dust type full face mask, but others who draw off mixture on other shifts do not use masks.

The Compounding Department is primarily a first shift operation although it does operate during the other shifts at a reduced level.

The Extrusion Department takes the PVC pellets which have been suitably formulated and colored and runs them through a second extrusion, this time through a die to produce the desired shape. At this time the PVC is bonded to metal or mylar strips if this is desired. This part of the department's activity runs full staff all three shifts.

Additionally, the Extrusion Department includes the cloth coating operation, the Zimmer machine, on the day shift, and the aluminum priming operation on the first and second shift. The aluminum priming line operator is also responsible for running the "Puff Strap" machine a few times a month that it is run.

The Extrusion operators are exposed to a small amount of fumes coming off the hot plastic as it runs into a cooling bath. As the machines are fairly closely spaced, generally ventilation is less effective than in other areas of the plant.

The Zimmer machine runs a fabric over heated rollers to melt the PVC into the fabric. Considerable fume is produced in the process, much of which is captured by an overhead hood. However, from time to time the operator must lean over the machine to clean accumulated plastic from the rollers.

The aluminum priming operation runs a strip of aluminum through several solvent baths and then through an oven to prepare it for bonding to plastic. Until the time of the first NIOSH visit the solvent trays were uncovered with appreciable solvent loss. At NIOSH's suggestion covers were fashioned

for the solvent trays with decreased loss of solvent by evaporation. The Puff Strap operation reportedly produces considerable fumes. There is a hood over the Puff Strap Oven. As this process is performed only a few times monthly, the NIOSH investigators did not have the opportunity to see it in operation.

The bulk of the workers are in the Assembly Department. They take the extruded PVC and cut it, join it and bond it to metal forms as required. The only process which was specifically identified as causing problems was the "sealing" operation in which two ends of PVC strips are pressed against a hot metal plate and then pushed together allowing them to weld together as they cool. This procedure produces a plume of smoke. During the course of this study small exhaust fans were installed near the "knife edges" to suck the smoke away from the operator and exhaust it into the general room air.

The Assembly Department operates two shifts, the second shift being only about half the size of the first shift.

The Aftermarket Department prepares special orders such as painting stripes on ribbons of plastic, slitting films and ribbons and other such operations. Exposures involve solvents, noise and some dust from the cutters.

In addition to the Production Departments there is a Maintenance and Machine Shop operation which is not actually a part of this study.

The workers are all members of the same union. Advancement is primarily within the specific department with the entry level being a light or heavy laborer with progression to operator status. It is not uncommon for a worker to rotate through several departments while still in the labor category.

The plant does not have a medical staff. There is a first aid room and several of the supervisors and workers have had first aid training. Steps are being taken to organize this better to assure coverage of all shifts. One of the workers who had had some experience in first aid is in charge of the first aid room. Problems of more than a first aid matter are referred to a private physician.

B. Evaluation Design

1. Preliminary Survey

On October 17, 1973, an initial visit at the plant was conducted by David Burton, Sanitary Engineer, Western Area Occupational Health Laboratory. A walk-through survey was conducted and non-directed medical questionnaires

were administered for a number of workers from the Compounding, Extrusion, Assembly and Aftermarket Departments. Bulk samples were taken of powder, liquid and cloth from the Zimmer machine for percent cadmium, barium and asbestos content. No asbestos was found in the cloth which was composed of spun cotton; less than 1% cadmium and less than 5% barium was found in the bulk powder and liquid. All levels were judged not to present a potential health problem.

2. Medical Evaluation

Medical evaluation was done on visits of February 5-6, 1974 and April 2-3, 1974, in which workers from the several departments were interviewed and readily verifiable physical findings were checked.

Following a review of information available at the plant on those workers who had quit after long service, retired or died, an attempt was made to follow-up on one worker who terminated for health reasons at a younger age than could be reasonably expected. Follow-up was unsuccessful.

On a repeat visit of May 9, 1975, the medical history on one worker was investigated in depth.

3. Environmental Follow-up

Based upon new information related to the development of cancer of the liver by some workers exposed to vinyl chloride monomer since the origin of the request for this evaluation, an investigation to define environmental levels of vinyl chloride was conducted. On December 4, 1974, OSHA, Department of Labor, took eight samples for vinyl chloride in the plant. Based upon their results, NIOSH deemed it unnecessary to repeat this work.

C. Evaluation Methods

1. Environmental

Vinyl Chloride Monomer: Personal breathing zone air samples were collected on activated charcoal contained in glass sampling tubes. Analysis was accomplished according to NIOSH P&CAM #178 (desorption with carbon disulfide: gas chromatography).[1]

2. Medical

After an initial walk-through survey and conference with management and labor representatives, a sampling of first shift workers from the Compounding, Extrusion, Assembly and Aftermarket Departments were interviewed. A few workers from the second and third shift were also included. On the second visit an effort was made to see workers who were said to have medical problems.

Table I characterizes the workers seen by department and shift. Table II characterizes the workers seen by age, sex and length of service. After obtaining identifying data and a job history, the worker was first asked non-directed questions regarding work related health problems in himself and other workers. This was followed by a non-directed question regarding other health problems, questioning regarding smoking history, possible off-job exposures and a system review. Readily verifiable physical findings were checked. A copy of the interview form is included as Appendix A.

On the final visit the one worker in question was interviewed with specific attention to variations in response to different formulations of PVC. Permission was obtained and the worker's private physicians were contacted for further information.

D. Evaluation Criteria

Medical evaluation was based on symptoms as reported by the workers. The tabulation is divided into those giving a positive response to the question "Do you have any health problems you feel might be related to your work?" - the "non-directed question"; and those giving a positive response to all of the questioning. The non-directed questioning gives some indication of the problems the workers have noticed. The total questioning helps indicate the full extent of the problems so identified. Where statistical comparisons were made a chi-square test was used utilizing a 95% confidence level.

Exposures to hydrogen chloride and other products of heat decomposed chlorinated organic matter (such as PVC) would be expected to be irritating to eyes, nose and throat and possibly the bronchi and lungs as well.

Exposure to organic solvent vapor can cause varying degrees of anesthsia, with minimal levels causing headaches, and greater exposure causing light-headedness, "drunkenness" and even unconsciousness. Additionally, they may have a somewhat disagreeable odor and be irritating to eyes, nose and throat. Skin contact with the solvents, particularly on a prolonged or repeated basis may remove the natural oil from the skin causing dryness and cracking.

Vinyl Chloride Monomer: Vinyl chloride is considered a carcinogenic agent. It is an etiologic agent in the development of angiosarcoma of the liver (a rare form of liver cancer). As stated in NIOSH's Recommended Standard for Occupational Exposure to Vinyl Chloride,[2] "there is probably no threshold for carcinogenesis although it is possible that with very low concentrations, the latency period might be extended beyond the life expectancy." In view of these considerations and NIOSH's inability to define a safe exposure level the concept of a threshold limit for vinyl chloride gas in the atmosphere is rejected. As a result, the NIOSH Recommended Standard for Occupational Exposure to Vinyl Chloride states that exposure to vinyl chloride monomer should not exceed levels that are detectable by the recommended methods of sampling and analysis.

The cancer has a 20 year + latency period between first exposure and when it is found. Further, screening tests, in all cases, have not proved helpful in the early identification of individuals at risk. Liver cancer has not been linked to work with the polyvinyl chloride alone. Exposure to vinyl chloride at sufficient concentrations can cause anesthesia and altered liver function.

If any free vinyl chloride were to be found, it would be expected to be in the Compounding Department where the raw polyvinyl chloride is handled and where it is initially melted. Trace concentrations of free vinyl chloride monomer have been found in initial mixing and in extrusion procedures in NIOSH studies at other plants utilizing polyvinyl chloride resin.[3,4,5,6,7]

The exact constituents of the smoke from heat decomposed polyvinyl chloride are not well identified. Studies in the meat wrapping industry[8,9,10] on the pyrolysis products of polyvinyl chloride film suggest that the smoke is primarily plasticizers with only minimal amounts of hydrogen chloride and other decomposition products of the polyvinyl chloride. It further seems unlikely that any free vinly chloride is released from the thermal decomposition of polyvinyl chloride as the plastic decomposes by losing hydrogen chloride and not by depolymerization.[11]

E. Evaluation Results and Discussion

1. Environmental

Eight personal breathing zone samples for vinyl chloride monomer were collected on PVC mixer, tumbler and extruder operators in December, 1974. All samples were collected and analyzed according to NIOSH recommended methods;[1] all results were less than 0.25 ppm, the NIOSH limit of detection for vinyl chloride according to this procedure. The existing OSHA standard for vinyl chloride is 1.0 ppm measured as an 8-hour time weighted average concentration.

2. Medical

Review of information available at the plant on those workers who had quit after long service, retired or died showed only two known deaths. The two deceased had died of apparently non-job related heart attacks while still employed. Of the rest, one ex-worker was from a section of the plant not under study; two retired at a normal retirement age; and one terminated for health reasons at a younger age than could be reasonably expected.

On the second visit in looking at workers thought to have medical problems, 15 out of 26 were seen. All had apparently non-job related medical complaints (compared to only 50% of those seen on the first medical visit). The proportions reporting apparently job-related problems was similar on the two visits. Because apparently job-related complaints appeared similar and apparently

non-job-related problems had led to identification of the workers seen on the second visit, all workers interviewed except one from outside the study area were included in the analysis of results.

Table III summarizes the reported symptoms. As can be seen these are primarily irritant in nature. Only two statistically significant correlations could be made. (1) Workers with hot PVC had a greater incidence of throat irritation and dryness than did workers who did not work with hot PVC (35% on total questioning). This difference is significant at the 0.037 level (96.3%) using the chi-square test. When only the non-directed question was considered the difference was only 29% to 0% which would be significant at the 0.08 level (92% level). This suggests that this represents a real difference and is not just an artifact created by directed questioning. (2) On directed questioning on-the-job headaches were confined to the women (35% to 0%). Again this was significant at the 0.037 level, but unlike the throat irritation there was no suggestion of a significant difference in the response to the non-directed question.

No significant associations of symptoms with smoking habits was found.

For the group as a whole on non-directed questioning 59% complained of some job-related symptomatology. On total questioning this rose to 88% with 41% having some manner of skin irritation, 38% nasal irritation and 31% eye irritation. Throat irritation was only 19% in the group as a whole.

The correlation between throat irritation and working with hot PVC, and the general level of job related symptomatology primarily of an irritative nature indicate that there is a problem with this relatively minor toxic effect.

Although the particular constituents of the smoke have not been identified, from studies in the meat wrapping industry it would appear that the smoke is primarily plasticizers with only minimal amounts of hydrogen chloride and other decomposition products of the polyvinyl chloride.[8,9,10] It further seems unlikely that any free vinyl chloride is released since polyvinyl chloride decomposes by losing hydrogen chloride rather than by depolymerization.[11]

Certain specific problems need comment although they cannot be considered characteristic of the work force as a whole. Two of the sealers have had problems other than irritation with the smoke generated in the sealing process. One of the workers had to move to another job because the smoke from the sealing operation made this workers nose drip and face break out. Since the move this worker has not had this problem. Another of the workers has developed an asthma-like condition in the last five years. Control has been achieved with medication. In addition to the respiratory complaints, this worker developed a condensate on eye glasses which require periodic removal and cleaning during the shift. Unfortunately, the exact relationship between work and symptomatology is unclear as there is a history of fairly heavy smoking and of childhood pneumonia. The employee's work does aggravate this problem.

The aluminum primers have had trouble with their hands drying and the skin breaking down. One relieved this by using creams and gloves. The other showed signs of defatting and fissuring of the hands. This worker was advised to use gloves at the time of our visit. There were also complaints of lightheadedness developing over shift before the solvent baths were covered.

One of the workers in the Assembly section has had problems with hands breaking out from handling the plastic. This has been solved by wearing gloves. This did not involve handling hot PVC.

F. Conclusions

The general atmosphere, particularly near work with hot PVC, caused a minor acute toxic effect of throat irritation and dryness, and probably eye and nose irritation as well. One worker with a chronic respiratory problem is apparently aggrevated by the fumes.

There appear to be at least two workers who may have developed an allergic type reaction to the PVC products, probably to the additives rather than the PVC itself: one had a dermal and mucosal reaction to the sealing operation smoke; and one has a dermal reaction on handling warm plastic.

The workers who work with solvents on the aluminum priming line showed more or less dermal and central nervous system effects in inverse proportion to their appreciation of proper methods of using solvents. Exposure to vinyl chloride monomer is not a problem as levels found were insignificant.

Since the initial contact with this plant some of the solvent exposure has been greatly improved by covering the baths. The worst fume exposure (that of the sealers) has been corrected by exhausting the fumes from the operator's breathing zone.

The problem of general ventilation has not been resolved. The plant atmosphere was generally worse during the mid-winter visit since the blowers were off and the windows closed in an effort to save heat.

V. RECOMMENDATIONS

1. The exhaust ventilation of the sealing machines seems to have answered a very specific irritant problem. It is not clear exactly what effect this will have on the general atmosphere, but should be no worse than before as the smoke was discharging into the general atmosphere before the installation of the fans. The only objection to this solution would be if the fumes appeared to be particularly hazardous, requiring either outside venting or complete containment. This does not seem to be the case.

2. Workers should be instructed in the proper methods of handling solvents; where appropriate protective creams and gloves should be utilized.

VI. REFERENCES

1. NIOSH Manual of Analytical Methods; USDHEW, CDC, NIOSH - 1974, Pub. No. 75-121.

2. NIOSH Recommended Standard for Occupational Exposure to Vinyl Chloride, May 1974.

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10. Jaeger, R.J.; Hites, R.A. "Pyrolytic Evaporation of the Plasticizer from Polyvinyl Chloride Meat Wrapping Film," Bulletin of Environmental Contamination and Toxicology 11:45-48 (1974).

11. Encyclopedia of Polymer Science and Technology: Plastics, Rubber, Fibers. Interscience Publishers, New York, 1968, Vol. 14, p. 386.

VII. AUTHORSHIP AND ACKNOWLEDGEMENT

Report Prepared By: Theodore W. Thoburn, M.D.
Medical Officer
Medical Section, HETAB

Consultant: Jerome P. Flesch
Acting Chief
Hazard Evaluation & Technical Assistance Branch

Originating Office: Jerome P. Flesch
Hazard Evaluation & Technical Assistance Branch

Acknowledgements: David J. Burton
Western Area Occupational Health Laboratory
Salt Lake City, Utah

Occupational Safety and Health Administration
U.S. Department of Labor
Albany, New York

TABLE I

Campbell Plastics, Inc.
Schenectady, N.Y.
April, 1974

CHARACTERIZATION OF SAMPLE IN RELATION TO WORK FORCE

Department	Shift	Total on Duty	Sample		
			Total Seen	Male	Female
Compounding	Day	6	4	4	0
	2nd	2	0	0	0
	3rd	2	2	2	0
Extrusion	Day	18	9	7	2
(Includes Aluminum Priming)		1	1	1	0
(Includes Zimmer Machine)		2	2	2	0
	2nd	16	2	1	1
(Includes Aluminum Priming)		1	1	1	0
	3rd	15	0	0	0
Assembly and Aftermarket	Day	80	15	1	14
	2nd	35	0	0	0
Totals		174	32	15	17
	Day	104	28		
	2nd	53	2		
	3rd	17	2		
Machine Shop	Day		1		
			33		

TABLE II

Campbell Plastics, Inc.
Schenectady, N.Y.
April, 1974

CHARACTERIZATION OF SAMPLE BY AGE, SEX, LENGTH OF EMPLOYMENT AND DEPARTMENT

Department	Sex	Age Average	Age Median	Age Range	Length of Employment Average	Length of Employment Median	Length of Employment Range	Total Number
Compounding	Male	28.8	32	18-36	5.8	8	4m-12y *	5
Extrusion	Male	38.1	30	25-57	6.5	8	5m-12y	9
	Female	41.6	34	32-59	8.5	9	6y-10.5y	3
	TOTAL	38.2	33	25-59	7.0	8	5m-12y	12
Assembly	Male	55	55	55	9.5	9.5	9.5	1
	Female	47.3	47	19-68	6.6	7.5	5m-10y	11
	TOTAL	47.9	49	19-68	6.9	7.5	5m-10y	12
Aftermarket	Female	47.3	44	40-58	9.0	9	8y-10y	3
TOTAL	Male	36.1	32	18-57	6.5	8	4m-12y	15
	Female	46.3	46	19-68	7.4	8	5m-10.5y	17
	TOTAL	41.5	44	18-68	7.0	8	4m-12y	32
Machine Shop	Male	62	62	62	14	14	14y	1
								33

* m - months
y - years

TABLE III

Campbell Plastics, Inc.
Schenectady, N.Y.
April, 1974

SYMPTOMATOLOGY REPORTED ON NON-DIRECTED AND TOTAL QUESTIONING

Symptoms	TOTALS			
	Non-Directed Questions	%	All Questions	%
Skin Irritation	4	13	13	41
Eye Irritation	5	16	10	31
Nasal Irritation or Stuffiness	7	22	12	38
Throat Irritation or Dryness	5	16	6	19
Cough (Reportedly Job-related)	2	6	6	19
Asthma (Reportedly Job-;elated)	0	0	1	3
Nausea or Bad Odors	4	13	6	19
Headaches (Reportedly Job-related)	2	6	6	19
Noise	3	9	7	22
Other (Reportedly Job-related)	3	9	6	19
Total with Reportedly Job-related Symptoms	19	59	28	88
Total with No Job-related Symptoms	13	41	4	13
Total with Non-Job-related Symptoms	-	-	23	72
Total with no Complaints	-	-	1	3
TOTAL SEEN	32			

APPENDIX A

HAZARD EVALUATION
MEDICAL QUESTIONNAIRE

RHHE NO._____

(CONFIDENTIAL)

DATE_____

I. IDENTIFICATION

Name_____
First Middle Last

Address_____City_____

Telephone____ - _____ Social Security_____/_____/_____

Age_____ Sex - Male___ Female___ Race_____

Job Title_____Location_____Shift_____

Length of employment with this company?_____

Length of time in present job?_____

Past Job History (Question from present to past)

COMPANY	JOB	FROM	TO	REMARKS

II. HEALTH PROBLEMS

1. Do you have any health problems you feel might be related to your work? If you do, what are they and when do they bother you? How long have they bothered you? Do you have any idea what is causing the problem?

_____

_____

_____

_____

APPENDIX A

2. Are there any health problems related to your work which may not affect you, yourself, but are bothering your fellow workers? Why do you think you have been spared?

_____

_____

_____

3. Do you have any other health problems? If so, what are they, when do they bother you, how long have you had them, and what are you doing about them? Do you take any medicine regularly? What about aspirin or other "Over-the-counter" medicines?

_____

_____

_____

III. PERSONAL HABITS

1. Do you smoke?_____. If so, how old were you when you started to smoke regularly?_____. How much do you smoke now (pkg/day,_____, cigars/day_____, pipefuls/day_____).

Is this typical of your past smoking habits, or did you used to smoke more or less, or smoke (non) filters? If you do not smoke now, did you ever smoke regularly in the past? How much and when?

_____

_____

2. Do you do projects off the job which might expose you to dusts or solvents? Are you involved in a hobby? a do-it-yourself project? a garden or insecticides? mechanical work on cars?

_____

_____

APPENDIX A

IV. SYSTEM REVIEW

Symptoms - When, How Long, First Attack, Rx.

EYES

EARS

NOSE OR THROAT

COUGH

SHORTNESS OF BREATH

OTHER RESPIRATORY COMPLAINTS

SKIN IRRITATION

HEADACHE

HEART PROBLEMS

HYPERTENSION

G.I. COMPLAINTS

G.U. COMPLAINTS

ARTHRITIS & MUSCULAR SKELETAL

NEUROLOGICAL COMPLAINTS

V. FINDINGS:

Interviewer_____