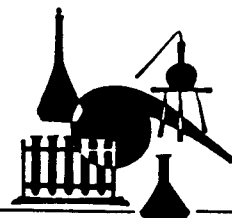


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CHEMICAL SAFETY ENGINEERING REPORT
AND OPINION

RE: JOHN PETERSON V. UNION CARBIDE

"Occupational Exposure to Dangerous Materials
(e.g. Polyvinyl Chloride Resin Dust,
Free Vinyl Chloride Monomer Gas, and
Heat Sealer Fumes)"

Place of Exposure: Amboy Terminaling Company (ATC)
Perth Amboy, New Jersey

Period of Exposure: 1967 - 1986

Type of Injury: Cancer of Larynx

Prepared By

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July 20, 1989

RNW 1130

Re: Peterson v. Union Carbide

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Re: Peterson v. Union Carbide

I. BACKGROUND

This writer was first informed about the matter of John Peterson v. Union Carbide at a conference meeting with Mr. Alfred Levinson on April 20, 1989.

A. NATURE of the ASSIGNMENT

The writer was engaged to:

- (1) Review all pertinent file materials on John Peterson's work and non-work history with the view of identifying his exposure to any dangerous materials;
- (2) Research the available literature on those materials which were found to be dangerous in Mr. Peterson's exposure history and most probably responsible for his injuries;
- (3) Evaluate the technically feasible ways that could and should have been, but were not, used before the fact to prevent Mr. Peterson's apriori exposures;
- (4) Express opinions on the parties responsible for both the apriori exposures and ways not used for avoiding the exposures.

and

B. MATERIALS REVIEWED

In arriving at the writer's opinions, the following file and cognate materials were reviewed:

(1) Interrogatories and Admissions

- (a) Request for Admissions by Maliko et als for Union Carbide
- (b) Interrogatories by Maliko et als for Union Carbide, including Supplemental Interrogatories
- (c) Interrogatories by Peterson for Union Carbide

(2) Deposition Transcripts

- (a) John Peterson
- (b) Shirley Mae Peterson
- (c) R.N. Wheeler, Jr.
- (d) E.K. Borch
- (e) N.H. Brown, Jr.
- (f) D.P. Romaine
- (g) Dr. B.W. Carnow
- (h) Dr. S.S. Epstein

(3) Reports

- (a) Dr. B. Davidson, July 31, 1975
- (b) R.N. Wheeler, Jr.,

- (c) Dr. Fred Gollob, report numbers
G.A.S. 36417, 35274, 35085---35091, 35097,
34575, 34557, 34144, 33760, 33549, 32712,
32590A, 32588, 32455, 32407, 32289, 31848,
31591, 31594, 31119, 30999, 30895, and
30895A.
- (d) A. R. Goodman, Sept. 1978, (Re: Neighborhood
Pollution)
- (e) Dr. C. A. Dernehl, M.D.,
- (f) Drs. B. W. Carnow's and S.S. Epstein's
reports on Arthur Schaffer, Henry Wilkinson,
Henry Mazanowski, and Eugene Maliko.
- (g) Epidemiological Study of Vinyl Chloride
Workers, by Equitable Environmental Health,
Inc., Jan. 1978.
- (h) James H. Jones, Draft Report on VCM Exposure
for Workers, Jan. 1978. NIOSH Contract CDC-
99-74-50
- (i) Drs. J.K. Wagoner and Peter Infante, 1978
review paper on VCM-PVC Carcinogenic and
Toxicologic Effects. (Nov. 15, 1978
correspondence to Dr. S. Epstein).

(4) Various Union Carbide/ATC Correspondences

- (a) Romaine to Wheeler and Wheeler to Romaine,
dated 5/8/75 and 5/19/75, respectively
- (b) Romaine to all employees, dated 5/1/75
- (c) Borch to Archer, 1/30/76
- (d) Bell to internal list, dated 1/13/76
- ? —(e) Novak to Archer, dated 3/4/76
- (f) Borch to All Employees dated 12/5/74
- (g) Borch to Yacullo and Romaine, dated 11/12/74
- (h) Borch to All Employees, dated 12/2/74

- (i) Krusman to Union Carbide, Bound Brook, dated 2/13/75
- (j) Borch to All Supervisors, dated 3/26/75
- (k) Borch to All Employees, dated 3/25/75
- (l) Romaine to All Supervisors, dated 3/26/75
- (m) Bell to Distribution List, dated 3/25/75
- (n) Romaine to Distribution List (includes John Peterson) dated 3/24/75
- (o) Romaine to Borch, dated 4/7/75
- (p) Romaine to all Supervisors, dated 4/4/75
- (q) Notice to John Peterson of his Wed. 9:00 A.M. physical examination, dated 6/6/75
- (r) Wheeler to Romaine, dated 5/3/76
- (s) Borch to All Supervisors and Shop Stewards, dated 5/31/74
- (t) Romaine to Borch, dated 12/23/75
- (u) Romaine to All Supervisors, dated 3/10/76

(5) Various Standards and Government Documents

- (a) EPA-National Emission Standards for Hazardous Air Pollutants - Part II, Dec. 24, 1975
- (b) MCA-Chemical Safety Data Sheet SD-56 for VCM, 4/1/77
- (c) EPA - Assessment Report on VCM and PVC, Dec. 1975, EPA-600/6-75-004.
- (d) OSHA Act of 1970

(6) Engineering Controls

- (a) Vinyl Chloride and PVC Manufacture, Process and Environmental Aspects, Marshall Sittig, Noyes Data Corp., 1978
- (b) CEP, Vol. 71, No. 0, Sept. 1975 (Series of Articles on VCM Emission Control)
- (c) A.I.H.A.J., (38), 12/77, article by K.S. Schaulitz, et als
- (d) OSHA, 29 CFR Part 1910, Respiratory Protection, 7/20/85

II. John Peterson's Occupational Exposure History

A. 1946 -1967, Not at ATC

From testimony in John Peterson's deposition, it was learned that during the interval 1946-1967, he worked for various periods of time for a variety of employers. Mr. Peterson indicated that none of these jobs involved exposure to any toxic chemicals. His only health problem during the 1946-1967 work period was a hand infection while employed at Rheem Manufacturing Company. Mr. Peterson also indicated that the quality of the air in his work areas while at General Motors and Rheem was "very good" and "pretty clear", respectively.

B. 1967-1986, at ATC

Mr. Peterson took full-time employment with ATC as a maintenance mechanic from 1967-1973. From 1973 until 1986, the year when the ATC plant closed, Mr. Peterson was a full-time maintenance supervisor. For about a year following his employment with ATC, Mr. Peterson worked part time for the Bermuda Agency, which took over the inoperative ATC plant in 1986. Mr. Peterson stopped smoking cigarettes in 1966. In 1987, Mr. Peterson took full time employment with Summit Associates as a mechanic.

Mr. Peterson indicated in his deposition statements that during his first six years of employment at ATC he worked all shifts in a variety of jobs as a maintenance and repairs mechanic that included assignments as an electrician, a plumber, a welder, a carpenter and a mason. Nearly every day during the 1967-1973 period, Mr. Peterson indicated that he worked in-and-around the PVC resin and other resin packaging rooms, which areas included, but not limited to, the Tilting Frame ensembles, pit and upper levels of the Bagging Conveyer Lines, Heat Sealer Machines, and Palletizing room. Mr. Peterson also stated in his deposition that as a maintenance supervisor from 1973 to 1986 he had to inspect and supervise on a nearly daily basis various maintenance and repair projects associated with the PVC resin and other resin packaging areas.

In Mr. Peterson's deposition statements he described the atmosphere in his primary work areas as "very dusty" and the air quality was "terrible". He indicated that the burning sensation in his throat occurred when he worked in-and-around the PVC packaging lines and nowhere else at the ATC plant. Mr. Wheeler in his report and deposition indicated that during the period 1966-1986, Union Carbide shipped three kinds of PVC resins (i.e., Suspension, Bulk, and Solution), polystyrene resins, polyethylene resins, and bisphenol A prills to ATC. These were the principal materials that were handled at ATC and encountered by Mr. Peterson. Each individual material as received and handled at ATC created fugitive dust particles, in process, of varying sizes, aerodynamic characteristics, and quantity. Additionally, each type of resin, in process, at ATC generated fugitive chemical fumes as a result of residual free species and monomer levels in the resins and/or thermal decomposition (e.g. thermal decomposition of fugitive PVC dust particles in-and-around welding and heat sealing machinery).

From Mr. Wheeler's statements and this writer's independent engineering assessment, it can be concluded within the "four-corners" of scientific certainty that the totality of the subject resins, in process and in Mr. Peterson's breathing zones, did at least emit to varying degrees gaseous vinyl chloride monomer, acetone, isopropanol, styrene monomer, ethylene, phenol, and vinyl acetate. Additionally, the thermal decomposition of fugitive PVC resin dust in-and-around welding and heat sealing machinery produced respirable fumes of hydrogen chloride gas and some gaseous benzene and a cacophony of lesser amounts of different hydrocarbon compounds. Welding operations in and of themselves probably produced respirable oxides of nitrogen, ozone, and oxides of zinc, chromium and cadmium.

The potpourri of respirable chemical fumes probably acted synergistically in the throat and respiratory tract of Mr. Peterson in the sense that the fumes were both corrosive to human tissue and served as tissue defatting agents. Consequently, the surfaces of the affected tissue areas during Mr. Peterson's continual exposure periods were thus conditioned for enhanced sorption of all chemicals that were inhaled and/or ingested, including free vinyl chloride monomer in the gaseous state and as absorbed or complexed on the PVC dust particles.

From Mr. Peterson's deposition and the report of Mr. A.R. Goodman, fugitive PVC and other resin dust particles were all over the ATC plant and particles were even contaminating the neighborhood homes and environs. Mr. Peterson indicated that excess PVC resin from the bags on the conveyer units would overflow and lay underneath the belts, sometimes accumulating as high as a "foot-and-a-half off the floor". The excess PVC resin dust would contaminate the functioning components of the conveyer bagging and heat sealing systems, requiring his daily maintenance work to keep the system operating. Mr. Peterson stated in his deposition that while working in the PVC packaging room, he would at times be "covered in it" and "you laid in that stuff". Also, he indicated that PVC dust would get into his mouth and on his clothes. The dust would also get into his eyes and ears. Mr. Peterson repeatedly stated throughout his deposition that the fumes from the PVC heat sealing machine were the worst, causing him to experience burning sensations in the throat. Even the PVC dust in his mouth and throat would cause him to "cough".

C. Epilogue

John Peterson's occupational exposure history at ATC from 1967-1986, while replete with a variety of persistent and dangerous chemical fumes and resin dust particles, showed that his exposures to in process PVC resins (including entrapped RVCM, fugitive VCM, and thermal decomposition fumes from the heat sealer plate) were most prevalent and most intimate during the period of 1967-1974. From the totality of reports, deposition transcripts and correspondences reviewed, it is presumed by this writer that most probably a major co-chemical culprit in causing Mr. Peterson's throat cancer was generic VCM in either, or both, the resin bound RVCM and/or fugitive VCM forms. Furthermore, Mr. Peterson's PVC resin exposures, and for that matter all of his ATC exposures, were in improperly ventilated rooms and without the benefit of ATC-enforced wearing of approved respiratory gear at all times, even after 4/1/76.

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III. Cognate Literature on PVC-VCM

A. Genesis of VCM-PVC as a Chemical Material

The literature on the evolution of VCM-PVC as a chemical material is quite extensive. Cognate reviews have been previously documented in the 7/31/75 report of this writer and in the report of R.N. Wheeler. The 1978 book by Marshall Sittig gives a comprehensive review of worldwide VCM and PVC manufacturing and environmental aspects. The literature showed that Union Carbide has been a world leader in VCM-PVC technology since at least 1933 and including the present time.

B. Emergence of the Worldwide VCM-PVC Toxicity Problem Related to Occupational Exposure

The literature on the emergence of the VCM-PVC toxicity problem resulting from occupational and animal research exposures is quite extensive. Cognate reviews have been previously documented in the 7/3/75 report of this writer and in the reports of R.N. Wheeler, J.K. Wagoner, J.H. Jones, Equitable Environmental Health, Inc., and in the treatise by Marshall Sittig (loc cit).

In the late 1950's and throughout the 1960's, Union Carbide via R.N. Wheeler and probably other co-workers, were aware of the growing literature on potential and actual VCM-PVC toxicity related to occupational exposure. In the 1970's, and particularly through the published works of Viola in 1970 and later by Maltoni in 1974, Union Carbide was aware that VCM produces cancer in animals. In 1974, Union Carbide was also aware from the B.F. Goodrich announcement in the Wall Street Journal that a link was found between liver cancer and occupational VCM exposure. R.N. Wheeler in his deposition implied that Union Carbide by 1966 had a "presumed connection" understanding that acroosteolysis among PVC reactor cleaners was occupationally related to VCM exposure. In the period 1955-1974, Union Carbide and Armstrong Cork knew, and became concerned about the fact, that flammable mixtures of VCM existed in some of the storage silos (Wheeler Dep., p. 94). Since the lower explosive limit for VCM in air is 3.6 percent, this translates into 36,000 ppm of fugitive VCM for fresh PVC resin in storage. By 1969, Union Carbide had developed its own analytical method to determine VCM in the atmosphere at the 50 ppm level.

IV. Engineering Controls for Avoidance of Chemical Exposures in John Peterson's ATC Workplace

A. Prologue

The focus of analysis and opinions at this juncture in the report have centered on John Peterson's VCM-PVC and heat sealer fume exposures at ATC. In this section of the report, attention is directed towards technically feasible safety engineering modalities, known to the VCM-PVC industry prior to

1967, and beyond, that could and should have been used on a timely basis by Union Carbide at ATC in order to have avoided the subject exposures.

For a long time, it has been, and is, an absolute canon of the chemical process industries to design and implement processes that are both economical (i.e. energy and materials efficient), and safe (i.e. accident and exposure prevention for people, property, and the environment). According to statements in R.N. Wheeler's depositions, Union Carbide had a "general directive to minimize exposure to any materials". It was this principle of safety engineering that was inadequately applied at ATC during the critical 1967-1974 exposure period. Union Carbide-ATC failed to achieve a proper minimum in the subject exposures to VCM-PVC because a timely combination of (a) Press Design Changes, (b) Environmental Controls, and (c) Warnings was not used.

B. Process Design Changes

According to statements made by R.N. Wheeler, and E.K. Borch in their depositions, it was determined that the source of the RVCN problem at ATC was effectively resolved in 1974-1975 by the Union Carbide resin producing plants using advanced process engineering control devices (e.g., the RVCN count for the suspension resin was reduced from 860 ppm to less than 100 ppm). By 1974-75, this process design change for reducing the RVCN levels in resins shipped to, and handled at, ATC translated into reduced fugitive VCM concentrations in John Peterson's 1974-75, and beyond, exposure environments, probably to average values less than the OSHA action level of 0.5 ppm.

This result appeared to be substantiated for the PVC bagging area as reported in the various Gollob reports. However, it should be kept in mind that the Gollob analyses in 1974-75 did not include the measurement of other co-pollutants, as for example respirable toxic fumes from the heat sealer machine (i.e., HCl, benzene, etc.) and ingested PVC resin dust containing entrapped, but still elutable and dangerous, RVCN.

Prior to the advanced process engineering changes noted above, John Peterson's 1967-1974 ATC exposures to VCM gas probably exceeded the 1974 OSHA action level of 0.5 ppm to a significant degree (i.e., order of magnitude or greater). The reasons for this are a combination of the following factors: to wit,

The mathematical simulation and modeling of VCM exposure on p. 48 of R.N. Wheeler's report failed to account for

- (1) effects of extra fixed-point VCM emissions from accumulated PVC spills in-and-around the bagging conveyor system.
- (2) effects of assuming a perfectly mixed control volume in the calculations when it is probable that the actual room ventilation was imperfect and VCM's vapor density is 2.2 times that of air (i.e., finite VCM dispersion plume).
- (3) extra fixed-point VCM emissions from the thermally activated fugitive PVC dust which encounters the hot heat sealer plate.

- (4) VCM contaminated make-up air for the bagging room ventilation stemming from fugitive PVC resin dust outside the bagging building.

The point of the above arguments is that in order for John Peterson to have experienced the estimated 0.98 ppm of VCM exposure in his breathing zone in the bagging room, as estimated by R.N. Wheeler on p. 48 of his report, the breathing zone would have been artificially enlarged to include, all at once, the entire volume of the bagging room. This was not the case because the actual fixed-point VCM emissions extended in space and time to include restricted dispersion zones where nearfield forced ventilation was essentially nonexistent or ineffective.

C. Environmental Controls

Environmental controls involve the use of near-and-far field forced ventilation and respiratory protective gear safety modalities. These standard safety devices must be properly implemented in the event that process design changes cannot eliminate the potential exposure hazard. From the preponderance of background evidence, Union Carbide - ATC, certainly before 1974, knew or should have known that they had a potential RVCN occupational exposure problem in the PVC resins as shipped to, and handled at, ATC. Consequently, during John Peterson's most critical exposure period (i.e., 1967-1974), ATC failed to provide proper near-and-far field forced ventilation devices in the subject bagging room areas, knowing that PVC resin producer plant design changes had not yet materialized to eliminate the VCM exposure hazard. Notwithstanding, was the related exposure problem associated with fumes generated by the heat sealer plate, which in-and-of itself required near-and-far field ventilation at all times.

Consequently, Union Carbide and ATC, knowing that both producer plant design changes and near-and-far field ventilation safety modalities were not yet properly in place at ATC for the period of 1967-1974, still had recourse to another safety management plan. This plan was to mandate the 100% wearing of Scott Air Packs (or equivalent self-contained respiratory gear) for workers in-and-around the subject PVC bagging room areas. This safety device was well known to Union Carbide and ATC prior to 1967.

Had John Peterson been forced to wear a Scott Air Plack (or equivalent gear), however uncomfortable to wear, at all times during his critical 1967-1974 exposure period, and beyond, he would not have experienced, as he did, respiratory and ingestion exposure to VCM, PVC-VCM, heat sealer fumes, and all other fugitive airborne chemicals. In other words, when all else fails, a principle of safety engineering dictates that proper respiratory protective gear does "minimize exposure".

From the deposition transcripts of N.H. Brown and D.P. Romaine, ATC did not pay, but should have paid, proper safety management attention to the above principle. For example, "It was optional", referring to N.H. Brown's statement about dust masks, which masks are not approved for chemical vapor exposures; and D.P. Romaine's statements "The only reason that we used respirators was because of the standard" and "We did have on hand Scott Air Packs". The management at ATC, as expressed in E.K. Borch's 12/5/74 correspondence to all employees, also knew ATC had a basic "housekeeping" resin dust exposure problem; to wit, "The main thing we can do to help ourselves immediately is to make sure that housekeeping in the packing bays is immaculate, etc.". From Mr. Peterson's deposition testimony, the "housekeeping" and chemical exposure problems were brought to the attention of ATC on numerous occasions during the 1967-1974 period.

D. Warnings and Instructions

Although John Peterson knew during his critical exposure period that he was working with PVC, he did not know, and could not have foreseen, that PVC resin dust in his breathing zone contained potentially dangerous, even suspect cancer causing, chemicals like VCM. The deposition testimony indicated that there were no warnings and instructions posted or distributed anywhere at John Peterson's ATC workplace during the 1967-1974 period concerning the dangers of inhaling or exposing oneself to PVC resin dust and heat sealer fumes. And there were no warnings or instructions posted or distributed at the points of risk during the 1967-1974 subject exposure period alerting workers, like John PETERSON, about the absolute necessity to wear Scott Air Packs (or equivalent gear) in-and-around the PVC bagging room areas at all times.

V. Responsible Party

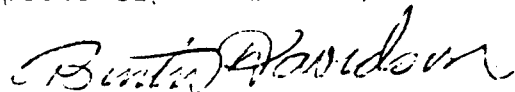
John Peterson's exposures at ATC to VCM and PVC resins and related fumes from the hot heat sealer plate essentially stopped on or about 1981 because PVC bagging operations were terminated at that time. Although the control of VCM exposure from 1975-1981, at ATC was in basic compliance with OSHA regulations, there were still other co-causing exposures not controlled or measured (e.g. ingested PVC-RVCM resin dust and inhaled fumes from the heat sealer plate). The subject exposure period from 1967-1974 was most critical since the potential for serious toxic emissions of all types was greatest due to a lack of proper implementation of all three types of basic engineering safety control modalities (i.e., Process design changes, Environmental controls, and Warnings and instructions) on the part of Union Carbide at ATC.

Because of Union Carbide's unique technical expertise and extensive manufacturing experiences with PVC resins prior to 1967, they had numerous opportunities to diagnose and envision the major potential health hazards associated with downstream occupational exposure situations of the type experienced at ATC from 1967-1974, and beyond. Union Carbide not only could and should have issued effective PVC resin health hazard warnings and specialized handling instructions to ATC prior to 1967, but they could and should have also mandated the "non-optional" use of Scott Air Pack respirators (or equivalent gear) for all PVC bagging room workers and supervisors. Consequently, Union Carbide and their business surrogate ATC were co-responsible for the subject toxic exposures. A safety engineering interpretation of the cognate medical literature leads this writer to also conclude that the subject exposures were probably responsible for John Peterson's cancerous condition.

John Peterson was not responsible for his exposures since he did not manufacture the subject PVC resins, design or abuse the PVC processing machinery at ATC, nor have the expert knowledge and benefits of warnings on how, when and where to detect and avoid the hazards.

This writer reserves the right to modify this report upon receipt and review of additional, relevant materials.

Respectfully submitted,



DR. BURTON Z. DAVIDSON, Ph.D., P.E.