

DR. BURTON Z. DAVIDSON, PH.D., P.E.
PROFESSIONAL ENGINEER (01)
CONSULTING CHEMICAL, SAFETY, AND SYSTEMS ENGINEER
5 HAMLET CT., SOMERSET, NEW JERSEY 08873 • (908) 846-7311 (Office)



Alfred A. Levinson
% Levinson, Axelrod, Wheaton
& Grayzel
Levinson Plaza
2 Lincoln Highway
P O Box 2905
Edison, NJ 08818-2905

December 4, 1992

RE: Lawrence Colby

Dear Mr. Levinson:

You have retained me to review and assess the file materials on Lawrence Colby and render a report on Colby's relative exposures to dangerous chemical materials in his work place, and elsewhere.

Additionally, I understand that you wish opinions on avoidance-of-exposures in those instances, if found, where and when exposures are dangerous. You have also requested an opinion on the connection between the carcinogenic chemical agents identified in the medical report of Dr. Rowland D. Goodman (10/22/92) and those in Colby's exposure history.

In arriving at my opinions, I have relied on, among other things, the following background materials:

- (1) My previous, cognate reports Maliko et als (7/31/75), Peterson (7/20/89), and Bernadine (3/20/90), including file materials associated with these reports.
- (2) Deposition transcript of Phyllis Colby, dated 9/25/91.
- (3) Plaintiff's answers to interrogatories propounded by the defendant.
- (4) Defendant's answers to initial and supplemental interrogatories propounded by the plaintiff, including exhibits.
- (5) Report of Dr. Rowland D. Goodman, dated 10/22/92.

For the purpose of this report, the following abbreviations are used:

AVCM - Atmospheric, local or near field, free gaseous vinyl chloride monomer (VCM).

UCC 075866

- PVCR - Polyvinyl Chloride Resin, a sand-like whitish particle.
- RVCM - Entrapped gaseous and/or dissolved (or absorbed) Residual VCM in a PVCR particle.
- PPMV - Parts per million parts by volume, applies to the measure of concentration for AVCM.
- PPMW - Parts per million parts by weight, applies to the measure of concentration for RVCM in PVCR.
- VCM - Generic vinyl chloride monomer, includes AVCM, RVCM, and PVCR species.

**RE: Colby's History of Inhalation - Ingestion
Exposure to Toxic Materials**

Other than Colby's cigarette smoking nothing else specifically surfaced as a possible inhalation exposure health hazard from sources outside of his workplace. It is noted that Colby was an inveterate beer drinker. Alcohol consumption, and more likely cigarette smoking, may well be linked to strong synergistic effects between these exposures in combination with occupational chemicals exposures in respect to the chemical risk of lung cancer. By inference, the case of AVCM-PVCR workers, (like Lawrence Colby) who smoked, may well be analogous to the correlations found for asbestos workers who smoked. There is no evidence that Colby was exposed to respirable asbestos particles in his workplace, or elsewhere, but he was definitely exposed to AVCM and PVCR at OTD, as discussed below.

Colby's occupational work history showed only one specific employment place and period where exposures to cancer causing chemicals (like AVCM and PVCR) existed. The exposures were at the Union Carbide OTD facility in Perth Amboy, New Jersey during the span from May 27, 1961 to June 20, 1967. Colby worked during this period as a supervisor and shop steward on the PVCR and other processing lines in the packing and assembly departments. His exposures to dangerous chemical materials were similar in kind and duration to those of his fellow OTD workers (e.g. Maliko, Schaffer, Wilkinson, Mezanowski, Peterson, and Bernadino).

Lawrence Colby, like his fellow OTD workers, was most probably exposed to respirable AVCM; leachable RVCM from PVCR particle fines that were imbibed via his mouth and nose; leachable RVCM from PVCR particle fines that were coated on his exposed skin (including particles captured in the eyes); and absorption of AVCM onto and into all exposed skin. Colby's AVCM occupational exposures were continual and prolonged over his six year employment at OTD.

UCC 075867

Colby

Page 3

DEcemer 4, 1992

Like his fellow OTD workers, Lawrence Colby was repeatedly doused with PVCR particle fines all over his body and clothing while in-and-around the PVCR bagging rooms. The fugitive PVCR particle fines emanated from numerous broken bags, in process, that spewed their contents into the air and onto machinery parts and the floor. The airborne suspension times for the spewed PVCR particle fines and the "clinging" power of the fines to Colby's clothing and body, and elsewhere in his workplace, were aided by the triboelectrostatic charge build-up on the particles as a result of their rough in-process handling. Colby would prolong and extend his PVCR exposures into his home at the end of each work day because he was always covered with the white PVCR dust.

The fugitive PVCR particle fines that were generated also impinged upon the heated surfaces of the heat sealing machines, which action produced thermal decomposition fumes from the affected PVCR particles fines. These fumes were toxic and they invaded Colby's breathing zones. The fumes were composed of, but not limited to, hydrogen chloride, AVCM, some vinyl acetate, a little benzene, and a cacophony of lesser amounts of different hydrocarbon compounds.

Also processed and handled at OTD in the subject time frame in addition to the PVCR (homo and co-polymers), were polyethylene resins and polystyrene resins. In these operations, workers, like Lawrence Colby, would be additionally exposed to respirable gaseous monomers of ethylene and styrene. The modes of exposure would be similar to those of AVCM from PVCR particle fines as well as bodily contacts from ingested and inhaled resin dust. The "clinging" of these resin dust particles to Colby's clothing and skin would prolong the total exposure onslaught. Should atmospheric ethylene, released from its polymer resin, encounter hydrogen chloride at or near a source of heat (e.g. in excess of around 300 degrees F at the PVCR heat sealing machines or welding machines), the potential to chemically produce some oxychlorination of the ethylene would exit. Further thermal activation of the reaction product (i.e. ethylene dichloride) would then generate AVCM and hydrogen chloride. The extra AVCM thus generated would add to Colby's total VCM exposure landscape.

AS previously opined in the Peterson incident, R.N. Wheeler's simulation of estimated AVCM exposures in the breathing zones of OTD workers in-and-around the PVCR bagging room, and elsewhere, was flawed. Wheeler's model, applied to Colby's VCM exposures, would be likewise flawed, lacking the concerns raised in my previous critique of his modeling approach. The relevant part of Wheeler's analysis, however, was that it demonstrated that the seed bed for AVCM exposure resides within the PVCR itself, as manufactured, shipped, and downstream processed (e.g. bagging operation, pelletizing step, etc.). It is interesting to note that Wheeler's mean steady-state value estimate of 0.98 ppm AVCM for suspension

UCC 075868

Colby
Page 4
December 4, 1992

resin bagging operations was virtually equal to the April 1975 OSHA PEL-TWA value of 1.0 ppmv. All this means, and it is relevant, is that Colby's probable AVCM exposures, corrected upwards for the flaws and omissions in Wheeler's analysis, were easily in excess of 1.0 ppmv(TWA). Hence, Colby's AVCM exposures were most probably in the dangerous category during the 1961 - 1967 period.

The scientific literature generally cautions users of PEL's in the study of occupational carcinogenesis to be conservative when a multiple of toxic agents, other than the culprit carcinogen, are concurrently present in the workplace exposure pool. In Colby's case, we should anticipate that his multiple exposures consisted of thermal decomposition fumes from heat activated PVCr, fugitive releases of styrene and ethylene monomers, and other such exposures (including resin additives and fumes from working with his "glue" recipes for the bagging operation) would produce synergistic effects. The idea is that these effects would facilitate the carcinogenic action of the VCM. This effectively translates into enhancing the risk of danger. That is lower AVCM concentrations, below the PEL for example, would more readily cause the cancerous condition over prolonged exposure periods. Included in the synergistic effects would be Colby's cigarette smoking exposures, too, as an added facilitation agent.

I have not yet reviewed the medical reports of O. Aroback (6/25/90) and S.S. Epstein (8/15/89). However, the medical report of R.A. Goodman (10/22/92) was reviewed. Dr. Goodman specifically identifies inhaled AVCM in Colby's OTD workplace as a prime causal factor in the development of the plaintiff's cancerous condition. The culprit inhalation AVCM referred to in Dr. Goodman's report is the same AVCM presented in my OTD process exposure scenario. Consequently, there is a credible connection between Colby's total occupational exposures to AVCM and leachable RVCM from PVCr and the cause of his cancerous condition.

**RE: Safety Engineering Controls for
Avoidance of AVCM-PVCr Exposures
in Colby's OTD Workplace**

Union Carbide Corporation (UCC) admits that they were aware of the RVCM phenomenon in processed PVCr in 1933 (Suppl. Interr. #80). Further, UCC admits that prior to 1961 (and for the period 1961 - 1967, too) not all of the RVCM in manufactured PVCr could be removed. In fact, UCC admits that shipments of PVCr to OTD prior to 1961 (and during the 1961 - 1967 period) did contain, for example, RVCM (Rider56) at concentrations varying from 200 - 1000 ppmw for Suspension PVCr (homopolymer) and 500 - 2000 ppmw for Suspension PVCr (copolymer). Colby was exposed to both of these forms of PVCr. Consequently, it was factually untrue that UCC

UCC 075869

never shipped VCM to OTD prior to 1961 and including the period 1961 - 1967 (Interr. #116). The shipped VCM to OTD was in the elutable form as RVCML UCC was also aware of the fact that thermal decomposition of PVCr produces hydrogen chloride and other toxic fumes(Rider #51).

UCC additionally admits that some of the shipped PVCr during Colby's exposure period (Rider #65) did indeed contain finite, although small, quantities of respirable (i.e. less than 10 microns in aerodynamic diameter) RVCML laddened dust particles. UCC was mute on the point that a fraction of PVCr, as vigorously handled at OTD, could be reduced in effective aerodynamic diameter to the 10 micron (or lower) sized particles due to in-process attrition effects. It was also admitted by UCC (Rider #65) that respirable PVCr particles (containing leachable RVCML), if trapped in the lung's alveoli, would give up their RVCML directly into the blood by absorption. From Colby's VCM exposure history, it was probable that this additional exposure mechanism was operative to some extent.

Other UCC admissions of relevance in setting the stage for opining on required UCC-OTD exposure avoidance safety modalities (and responsible party) for VCM are

- (1) UCC personnel met with OTD management, including some foremen, to discuss operational problems (Suppl. Interr. #55). (Hence, the close engineering business relationship and the reason to couple UCC with OTD as UCC-OTD).
 - (2) UCC had a general directive to minimize exposure to any materials (Ref. Wheeler's Dep.).
 - (3) UCC since around 1930 and continually thereafter did keep abreast of the scientific literature on the developing worldwide occupationally related AVCM-PVCr exposure problems (Suppl. Interr. #52).
- and (4) UCC admits in-house safety policies to use Scott Air-Paks, or similar self-contained breathing apparatus (SCBA), and cloth coveralls were worker's clothing could be dusted with PVCr. (Suppl. Interr. #51).

Prior to 1961 (and during Colby's 1961 - 1967 exposure period at OTD; and beyond), it was an absolute canon in the PVCr chemical process industries to design and operate processes and manufacture and distribute resin products that are economical, needed and profitable, environmentally sound, and safe. To achieve safety, and we mean for operators and users like Lawrence Colby and others,

UCC 075870

Colby
Page 6
December 4, 1992

essentially three mutually exclusive safety management engineering modalities are generally used. They are (1) process design changes to eliminate hazards; (2) near-and-far field forced ventilation to minimize exposure, including SCBA and protective clothing; and (3) network of hazards communications for workers like technical data sheets, warning labels and instructions, and process safety review sessions for workers.

In the subject incident, UCC's PVCR producing plants didn't achieve enhanced RVCM safety until 1974-75 for their suspension resins (i.e. In 1974-75 process design changes reduced the average RVCM content in PVCR by a factor of ten). As regards safety modality (1) above, the near-and-far field forced ventilation modalities in 1961 - 1967 at OTD were ineffective, undersized, and not calculated to protect positively against VCM exposures for workers.

At OTD in 1961 - 1967, Scott Air Paks were on-hand, but not required for PVCR workers. The OTD plant manager in 1961 - 1967 (N.H. Brown) admitted it was optional for PVCR workers, like Lawrence Colby, to wear nuisance dust face masks. However, these types of masks were totally ineffective in protecting users from respirable AVCM and toxic chemical fumes from thermally decomposed PVCR dust. Protective coveralls and related work clothing (e.g. gloves, head gear, etc.) were not provided by OTD.

In the safety category of hazards communications, OTD workers, like Lawrence Colby, were not warned about the specific health hazard dangers of being exposed to AVCM, PVCR, and heat sealer fumes in their workplaces. Conversely, however, Lawrence Colby early on did repeatedly warn H.R. Brown about the lack of basic "good practice" housekeeping in the PVCR bagging rooms and the associated resin dust and heat sealer fume problems. Colby was a member of Local 825 of the International Union of Operating Engineers.

RE: Responsible Party

Although Lawrence Colby knew he was being occupationally exposed to PVCR dust and heat sealer fumes, he nevertheless could not have discerned on his own the associated health hazard dangers of these exposures, lacking opportunity to review and digest adequate product warnings concerning the risks. And most importantly, Lawrence Colby could not have foreseen nor comprehended the RVCM and AVCM health hazard dangers in his exposure zones, also lacking specific product and workplace warnings. Part of warnings are interrelated instructions designed to inform users (like Lawrence Colby) on specific ways to avoid the

UCC 075871

health hazard dangers. For example, given the facts and conditions in 1961 - 1967 at OTD, a cost effective and feasible way for workers, like Colby, to have been positively protected against all VCM related exposures was to wear complete protective work clothing and SCBA (i.e. Scott Air Pak) at all times while bagging PVCR. The safety duty to know and enforce this required safety modality resided with UCC-OTD management, and nowhere else.

Consequently, and in conclusion, UCC because of their extensive manufacturing experiences with PVCR prior to 1961, expertise, and close business relationship with OTD, thus had numerous safety opportunities and duties to diagnose and envision the major potential health hazards in the workplace associated with downstream users, like Lawrence Colby, as regards occupational exposures to AVCM and RVCM containing PVC resins, in process.

Had UCC properly, and at an early stage, managed their safety duties in the subject incident, the following safety actions prior to 1961 and beyond could and should have taken place:

- (1) OTD would have been warned and instructed by UCC to cleanup their messy and improperly ventilated and designed PVCR bagging operations.
- (2) OTD would have been put on constructive safety notice by UCC that all PVCR workers, like Colby, must wear a SCBA and work clothing at all times in order to ensure positive protection against VCM exposures.
- and (3) OTD would have been able to appreciate the safety value of conducting adequate process hazards safety review sessions with workers, like Colby, regarding the dangers of VCM exposures. (Also, OTD would have been more responsive to the safety needs of the Local 825 PVCR workers).

In any event, UCC had a direct safety duty to Lawrence Colby, beyond the above, via product safety warning labels, placards, technical safety data sheets, and other such communications vehicles calculated to reach end-users at the point-of-risk (e.g. attention grabbing warning labels on the kraft packaging bags as used in the PVCR bagging rooms.).

From Dr. Goodman's report, my own engineering review of the cognate industrial hygiene literature, and the facts in this exposure incident, I opine that the PVCR as manufactured by UCC and shipped to, and used by, OTD during 1961 - 1967 was a defective product. The defects were of two generic types: (1) a relatively high RVCM content that was leachable and elutable and (2) no

UCC 075872

Page 8
Colby
December 4, 1992

safety health hazard warnings nor instructions on the product or associated with the product for the expressed safety of end-users, and others, like Colby. The defects were the cause of Lawrence Colby's VCM exposures and resultant cancerous condition. Notwithstanding was the contribution to the VCM exposures resulting from the defectively designed and managed PVCR bagging rooms at OTD.

I wish to reserve the right to modify this report upon receipt and review of any additional, relevant materials.

Respectfully submitted,



Dr. Burton Z. Davidson,
Ph.D., P.E.

UCC 075873