

APPENDIX II

VINYL CHLORIDE CHRONOLOGY

While it had been recognized for decades that exposure to high concentrations of vinyl chloride monomer (VCM) might cause liver and kidney injuries, the U.S. chemical industry was not aware of any cancer-related potential of VCM until May 1970.

From the time polyvinyl chloride (PVC) -- the principal product of VCM -- was first produced in this country in the 1930s, the major worker hazard concern with VCM was believed to be flammability and explosions. Controls were designed to cover these.

The Manufacturing Chemists Association's (MCA) Chemical Safety Data Sheet on vinyl chloride, published in 1954, stated, "Aside from the risk of fire or explosion, vinyl chloride presents no other very serious problem in general handling. The presently accepted maximum allowable concentration is 500 parts per million (recommended by the American Conference of Governmental Industrial Hygienists -- ACGIH -- later in 1962) . . . In concentrations well above 500 ppm, vinyl chloride acts as a mild general anesthetic."

In 1961, The Dow Chemical Company reported that long-term (4½ to 6 months at what would correspond to normal working hours) VCM exposures of animals to down to 100 ppm VCM resulted in slight liver injuries, and recommended working exposure levels be reduced to 50 ppm.

This recommendation for worker exposure was not accepted by ACGIH. In 1962, on the basis of work done at Yale University, from which the authors concluded that 500 ppm offered an adequate safety margin for human exposure to VCM, ACGIH published 500 ppm as the recommended standard.

In 1971, the Occupational Safety and Health Administration (OSHA) established 500 ppm VCM as a national standard. This changed in April 1974 when OSHA, following voluntary disclosure by The B. F. Goodrich Company of liver cancer deaths possibly

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related to vinyl chloride exposure, set a temporary emergency standard at 50 ppm. Then, on May 10, citing the findings of an MCA-administered study that showed liver cancer in mice at 50 ppm, OSHA proposed a "no detectable" standard, as previously recommended by the National Institute of Occupational Safety and Health (NIOSH).

The following is a brief chronology of vinyl chloride activities, relating to worker health. It is based on MCA records and input from U.S. producers of VCM and/or PVC.

January 1967

Because of reports of finger abnormalities in the early 1960s, MCA arranged for a study at the University of Michigan on acroosteolysis -- softening of finger tip bones -- among VCM/PVC workers, particularly those who cleaned polymerization kettles. Study covered clinical, epidemiological and industrial hygiene aspects.

August 1968

Research by The Dow Chemical Company showed slight alteration in liver function in workers industrially exposed to concentrations of up to 300 ppm VCM.

February 1970

Findings of the MCA acroosteolysis study were submitted for scientific publication. They appeared in the "Archives of Environmental Health," published by the American Medical Association in January 1971. The authors were unable to pinpoint the cause of this disease and recommended animal studies by undertaken to develop an experimental model. They also recommended a worker exposure limit of 50 ppm VCM.

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May 1970

At the 10th International Cancer Congress, Houston, Texas, Dr. P. L. Viola, of the Regina Elena Institute for Cancer Research, Rome, Italy, reported 30,000 ppm VCM exposures at four-hours-a-day, five-days-a-week for a year, caused cancers of the skin, lung and bones of rats. He concluded that "no implications to human pathology can be extrapolated from the experimental model reported in this paper." He exposed these animals in an attempt to develop an experimental model for acroosteolysis.

August 1970

ACGIH considered a reduction of the worker exposure limit to 200 ppm VCM, but did not publish it as a recommendation until August 1972.

September 11, 1970

In spite of Dr. Viola's study and his conclusions of no human implications, MCA's long-standing Occupational Health Committee (OHC) considered the need for additional VCM research.

October 27, 1970

At the suggestions of the OHC, MCA wrote to a number of laboratories regarding the conducting of toxicological studies on laboratory animals with VCM.

April 12, 1971

MCA invited Dr. Viola to visit with the OHC and discuss his findings.

May 5-6, 1971

Dr. Viola came and discussed his work to date and referred to other European studies in progress. He stated the vinyl chloride used in his tests was impure. He reported tentative observation of tumors in the ears of rats exposed to 5000 ppm VCM, but gave his opinion that 2500 ppm would not produce this effect. He stated that he would not be concerned about workers exposed to less than 500 ppm VCM.

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May 6, 1971

MCA's OHC recommended U.S. VCM/PVC producers sponsor animal exposure and epidemiological research on VCM carcinogenicity (cancer-causing) to be administered by MCA.

May 1971

MCA acted on Dr. Viola's statement that other studies were being conducted in Europe and attempted, unsuccessfully, by correspondence and direct visits of a U.S. company representative, to learn of them.

July 7, 1971

MCA corresponded with medical contacts of member companies, alerting them to potential occupational health problems with VCM and asked them about interest in supporting related research.

November 5, 1971

MCA received a letter from Dr. Viola confirming observation of tumors in rats at 5000 ppm VCM (and perhaps less) and made some suggestions for further animal studies.

November 16, 1971

At a vinyl chloride meeting arranged by MCA in Washington for interested U.S. company representatives, a European representative of Solvay et Cie reported that he was aware of further studies just beginning in Europe. He said it was too soon to expect any data, and that he was not free to describe the source of his information nor the location of the studies. He said the exposure concentrations ranged from 20,000 ppm to 50 ppm and that groups of 25 male and 25 female rats were being exposed. He expressed concern about the purity of the vinyl chloride used in Dr. Viola's original study, since it was reported to contain one to three percent of impurities. The representative stated that Dr. Viola had observed a 10 to 15 percent incidence of ear tumors in rats exposed to 5000 ppm of vinyl chloride. Suggestions for epidemiological and animal exposure studies to be administered by MCA, on behalf of interested companies, were discussed at this meeting.

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March 30, 1972

Seventeen U.S. companies had agreed to financially support VCM studies.

April 1972

MCA's Chemical Safety Data Sheet on vinyl chloride was revised to state: "Recent research studies reported from Italy indicate that repeated, long-term high level exposure of rats to vinyl chloride monomer vapor can result in the development of malignant tumors. However, many years of industrial experience with human exposures to concentrations frequently far above current standards have not demonstrated any carcinogenicity to humans."

April-June 1972

To enable the MCA program to be designed so as to yield data of optimum significance, overtures were made by MCA to establish technical liaison with the new European research mentioned at the November 16, 1971, meeting in Washington.

January 17, 1973

The U.S. VCM/PVC industry technical delegation visited the European sponsors and Dr. Maltoni's facilities to learn in more detail about his experimental procedures and results.

January 30, 1973

At an MCA meeting of participating company technical representatives, a brief oral progress report on Dr. Maltoni's work was presented by those who had visited him. It was reported that, in experiments with rats, in addition to tumors of the ear canal, tumors of the kidney and liver were observed at concentrations as low as 500 and 250 ppm VCM, but not at 50 ppm nor in the controls. The European work was observed to be of high quality, similar to that which would be done in U.S. laboratories. At this meeting, it was decided by the U.S. group of participating companies to initiate an epidemiological study of VCM/PVC workers, recognized earlier as an important complement to animal testing, but most usefully carried out with the benefit of the animal research background.

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February 1, 1973

Having benefited from the European study indications in setting the protocol for the MCA research program, MCA signed a contract with Industrial BIO-TEST Laboratories, Inc., to conduct animal exposure studies. Subsequently, a press release was issued announcing, on behalf of participating companies, animal inhalation studies with VCM that would expose rats, mice and hamsters to VCM concentration of 2500, 200 and 50 ppm for one year, with the animals to be kept on observation for an additional year. By contractual stipulation, the study results would be made public.

March 1973

MCA and participating companies initiated steps to present the details of VCM-related research to the appropriate U.S. government agency.

June 15, 1973

Following up on the proposal, four MCA representatives visited European group executives in Brussels. They were given assurance of the European companies' willingness to release their data -- although still incomplete -- to the U.S. government, and agreement to participate in its presentation. The European companies requested time to prepare the information for prior release to their respective governments, also. A presentation to the National Institute of Occupational Safety and Health (NIOSH) was planned for the week of July 16.

June 27, 1973

An MCA press release announced an epidemiological survey, to be conducted by Tabershaw-Cooper Associates, Inc., to document the health experience of present and former employees who worked with VCM. Again, by contractual stipulation, the results would be made public.

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July 11, 1973

Three U.S. industry representatives reported to the MCA group the results of the Brussels visit on June 15. The European information then discussed included epidemiological data which indicated no increase in gross mortality from cancer and no increase in cancer morbidity or incidence of cancer among workers exposed to VCM.

July 17, 1973

A presentation was made to NIOSH. A summary of the published toxicity data on vinyl chloride, along with a description of the industry and full details of the studies contracted under MCA administration were presented by MCA representatives, with expressed interest in taking advantage of any suggestions NIOSH might offer. A representative of the European group (a physician), reporting on the European studies, said that tumors had been observed in rats down to 250 ppm, but that an epidemiological survey had indicated no increase in gross mortality from cancer and no increase in cancer morbidity or incidence of cancer among workers exposed to VCM.

Summer-Fall 1973

Companies involved in the Tabershaw-Cooper survey assembled their personnel records and death certificates of employees having had vinyl chloride exposure.

November 28, 1973

A further progress report of Dr. Maltoni's studies was given to MCA by a European group representative. Results confirmed earlier observation of malignant tumors in rats at 10,000, 6000, 2500, 500 and 250 ppm VCM, but not at 50 ppm.

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January 23, 1974	The B. F. Goodrich Company announced that Kentucky health officials and NIOSH had been notified of the company's investigation of whether cancer deaths of three workers in PVC operations in its Louisville, Kentucky, plant were related to occupational causes.
January 29, 1974	Goodrich reported, in a press release, that the death of another former employee had been tentatively identified as due to angiosarcoma of the liver.
February 1, 1974	MCA proposed to the European group that they make arrangements for Dr. Maltoni to come to the OSHA hearings on vinyl chloride, February 15.
February 6, 1974	MCA issued a press release announcing that it had stopped circulation of its Chemical Safety Data Sheet on vinyl chloride, because of the Goodrich reports -- now questioning the validity of the Data Sheet statement noting that carcinogenicity to humans had not been observed.
February 15, 1974	Goodrich reported the death of a fifth employee due to liver angiosarcoma.
February 15, 1974	MCA and Dr. Maltoni presented separate statements at OSHA hearings on vinyl chloride, giving background on work done to date.
February 21, 1974	Union Carbide Corporation notified NIOSH of the death of a PVC worker from liver angiosarcoma.
March 1, 1974	The Goodyear Tire & Rubber Company, in a press release, announced a vinyl chloride worker fatality resulting from angiosarcoma of the liver.
March 6, 1974	Goodrich reported cases of liver angiosarcoma in two living employees.

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March 22, 1974	Goodyear, in another press release, announced two more worker fatalities from liver angiosarcoma.
April 5, 1974	OSHA published an Emergency Temporary Standard which provided for proper respiratory protection for workers exposed to above 50 ppm of VCM.
April 9, 1974	Industrial BIO-TEST Laboratories phoned MCA and reported that preliminary findings in the animal exposure study showed angiosarcoma was produced in mice at 50 ppm VCM.
April 10, 1974	MCA reported these preliminary findings to OSHA, NIOSH and the Environmental Protection Agency (EPA) by phone.
April 15, 1974	MCA representatives and officials from OSHA, NIOSH and EPA met at Industrial BIO-TEST Laboratories, Inc., Northbrook, Illinois, to be briefed on the findings.
April 16, 1974	MCA issued a press release announcing preliminary indications that VCM exposure produced liver cancer in mice at several exposure levels, down to 50 ppm.
April 16, 1974	Firestone Plastics Company, Division of The Firestone Tire & Rubber Company, in a press release, announced an angiosarcoma death of a PVC plant employee.
May 7, 1974	In another press release, the results of the Tabershaw-Cooper survey were given. The survey showed that workers exposed to VCM have experienced overall death rates from cancer that are comparable to those experienced by other U.S. industrial populations, but less than in the general public. This is in spite of the now well-recognized risk of higher incidence of angiosarcoma of the liver among such workers. Also, there did appear to be suggestive dose-related increases in cancer incidence in respiratory tracts and the brain in longer-exposed workers.

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May 10, 1974

It was reported at the New York Academy of Sciences' meeting that The National Cancer Institute had diagnosed a liver angiosarcoma in a living Union Carbide employee. The company reported this case to NIOSH in March 1974 as a liver ailment.

June 25, 1974

OSHA hearings in response to the Proposed Permanent VCM Standard published May 10, 1974, began in Washington to receive facts and data regarding VCM.

October 5, 1974

OSHA published Permanent Standard for VCM which effectively required proper respiratory protection for workers exposed to VCM at levels exceeding 1 ppm, 8-hour Time Weighted Average (TWA), and 5 ppm ceiling averaged over a 15-minute period.