Health Hazards

Vinyl-Chloride Risks Were Known by Many Before First Deaths

Hindsight Shows Weakness In Firms' Systems Aimed At Protecting Workers

The Tip of a Large Iceberg

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A few weeks before Christmas in 1948, Earl Parks, then 26 years old, signed on as a helper-trainee at the large B. F. Goodrich Co. plastics factory in Louisville, Ky. The plant had been making polyvinyl-chloride plastic from vinyl-chloride gas since before the war, using a process developed by Goodrich in 1937.

It was a growing industry that Mr. Parks joined. Polyvinyl chloride—dubbed PVC for short—had found special, but limited, applications in the war years, especially as a fireproof coating for electric wiring in fighter planes and ships. But in the late 1940s, so-called vinyl consumer products, made from PVC, began coming into vogue; and by the time the 1950s were under way polyvinyl-chloride products such as containers, phonograph records and curtains were staples in American households.

The basic Goodrich process, still in use today, pipes vinyl-chloride gas into large reactor vessels; there, the gas is agitated together with a liquid and catalysts. The process causes polymerization, a linking together of the molecules of the gas (a monomer) into the long chains that give PVC (a polymer) its strength and other desired characteristics.

This is the first of two stories concerning implications of the discovery that vinyl chloride can cause cancer.

The First Years

In his first years with Goodrich, it was Earl Park's job to crawl inside the reactors after each batch of PVC was drained off and to chip away that portion of the polymer that had congealed. During the hour-long task, repeated several times in the course of an eight-hour shift, Mr. Parks and other workers who performed the same function would unavoidably inhale the heavy, sweet-smelling fumes of vinyl-chloride gas that had escaped polymerization.

As the 1950s went by and the 1960s began, Earl Parks was working his way up to the job of foreman, a post that he had attained by the time that ill health forced his early retirement in the late 1960s. In the years that he had worked with Goodrich, the PVC industry flourished as thousands of new uses were discovered for the polymer.

On March 3, 1973, at the age of 50, Earl Parks died of angiosarcoma of the liver, a type of cancer that is invariably fatal. His death attracted scant public attention at the time, but today the significance of Mr. Park's illness is unquestionable and shattering in its implications. For Earl Parks came to be one more statistic in turning a hypothesis into a reality: Vinyl chloride can cause cancer.

Deadly Statistics

The link between angiosarcoma and vinyl chloride is further buttressed by other deadly statistics. Seven of Mr. Park's fellow workers at the Goodrich plant also contracted the disease, and five have died. In all, there have been 16 documented angiosarcoma cases in the U.S. in recent years, all of them linked to vinyl chloride. In addition, 10 other cases have been reported in Europe.

While the total number of cases is small, the industry has been shaken to its roots. The disease now is known to work insidiously, slowly, during decades of exposure, the implications being that the cases thus far are quite likely only the tip of an iceberg. Nine companies, with 14 plants and 940 employes, currently produce vinyl chloride monomer from ethylene, a petrochemical. The monomer, in turn, is used by 21 companies operating 36 major plants and employing 5,000 workers, to make more than five billion pounds of PVC annually. (World-wide production is some 18 billion pounds annually.)

Even the five billion pounds of PVC annually produced in this country isn't enough to meet the domestic demand for the plastic into which PVC is formed. From 3,000 to 4,000 processors, employing an estimated 700,000 workers, fabricate the plastic into a wide variety of products ranging from vinyl floor tiles to shower curtains. According to a study done for the Society of the Plastics Industry by Arthur D. Little Inc., as many as 2.2 million jobs depend on polyvinyl-chloride plastic. If PVC were banned, the study says, the annual loss to industry in sales and production would be some $65 billion to $90 billion. (The Manufacturing Chemists Association estimates the wholesale annual value of all PVC products is $3 billion.)

Emergency Decree

At the moment, no one believes the industry will suddenly come to a screeching halt. However, after the first human cases of vinyl chloride-induced angiosarcoma were disclosed, the Labor Department's Occupational Safety and Health Administration imposed a temporary emergency standard for PVC factories; thenceforth, OSHA decreed, the permissible level of vinyl chloride in the air of such factories would be 50 parts per million. That level was far below the industry standard, in effect for years, of 500 parts per million.

OSHA's emergency decree was made last May. Since then, animal research found that tumors develop at 50 parts per million. Yesterday, OSHA issued a new permanent standard requiring employers after Jan. 1, 1975, to reduce exposure to one part per million in factory air, averaged over eight hours, and five parts per million averaged over any period no longer than 15 minutes. (See story on page 22.) While considerably more stringent than the emergency decree, the new permanent standard—particularly with its five-parts-per-million provision and its allowance of averaging—nevertheless falls short of the "no detectable" limit advocated by unions, many medical experts and such groups as the National Institute for Occupational Safety and Health, and the American Chemical Society. This no-detectable limit would have constant, not average, adherance to one-part-per-million levels. Therefore, it seems certain that the argument won't abate.

As the controversy continues, it is revealing to examine how the link between vinyl chloride and cancer was established. If nothing else, such an examination points out the grave weaknesses of the present system—or lack thereof—of protecting workers and others from industrial hazards.

The judgment is made in hindsight, but the history of vinyl chloride shows that evidence of its toxicity was often ignored. What's more, the chemical companies knew, but kept secret for at least six months, the fact that Italian researchers had shown that rats develop tumors, including angiosarcoma, when exposed to low levels of vinyl chloride monomer. European companies, which paid for the animal research, knew of these research findings for more than a year before the first human cases were reported but didn't reduce the exposure of their workers to vinyl chloride.

But Dr. Irving J. Selikoff, an expert on environmental carcinogens, or cancer-causing agents, claims that blame shouldn't be placed at industry's door alone. "We're all a bit responsible," he says. "None of us did our homework." Culpability, he says, should be shared by scientists, government agencies and labor unions.

The case of Earl Parks is illustrative. Mr. Parks first came to the attention of Goodrich medical people in 1964, when the company, concerned about the known liver toxicity of ethylene dichloride (a chemical from which vinyl chloride is made) tested the liver function of workers in the Louisville plant.

Mr. Parks's readings were abnormal. Nevertheless, he continued to work at the same job. In October 1964, however, he was hospitalized with what was initially diagnosed as a bleeding ulcer. Doctors treated the "ulcer" without surgery, and Mr. Parks was released.

He was readmitted to the hospital the following May, and the decision was made to operate. But when the operation was begun, surgeons, instead of finding an ulcer, found instead that Mr. Parks's problem resulted from severe liver damage, which had caused blood to back up in the portal vein leading into the liver. The surgeons corrected the vein problem with a shunt and took a sample of liver tissue for analysis. The analysis showed that the liver had been damaged by exposure to "chemicals." Cancer wasn't mentioned.

(According to testimony at OSHA's hearings on vinyl chloride, held last June and July, Mr. Parks received a total of almost $6,000 in workman's compensation from Goodrich before he died, but only after Goodrich protested that his illness couldn't have resulted from exposure to the chemical.)

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It was an alert Louisville doctor who first made the connection between angiosarcoma and vinyl chloride. Dr. John L. Creech, who for years has treated workers sent to him by Goodrich on a fee-per-patient basis, had followed Earl Parks's case for some time, even though he wasn't treating Mr. Parks. Dr. Creech says he had been concerned about an abnormally high number of Goodrich workers who had liver disease. When he heard that Mr. Parks had died, he recalls, he asked to see the autopsy report.

It was in August 1973 that Dr. Creech learned that Mr. Parks had died the previous March of angiosarcoma of the liver. The doctor says he then realized that something was seriously wrong, since another Goodrich PVC worker, a private patient of Dr. Creech, had succumbed to the same type of cancer in 1971. Dr. Creech says he knew that liver angiosarcoma is exceedingly rare and that two cases among such a small plant population was abnormal. (In fact, medical men estimate that fewer than 30 cases occur each year in the U.S., striking only one in 900,000 persons.)

Dr. Creech met with Goodrich's occupational health director, Dr. Maurice N. Johnson, who subsequently decided to ask Tabershaw-Cooper Associates Inc., a Berkeley, Calif., epidemiological-studies concern, to do a survey of Goodrich death records. But the study was hardly needed; on Dec. 19, a third PVC worker at the Louisville plant died at the age of 58; he had been at the plant for 28 years.

On Jan. 23 of this year, Goodrich officials met in Washington with officials of the National Institute for Occupational Safety and Health and informed them of the three angiosarcoma deaths. The following day, Kentucky occupational-health officials also were informed and Goodrich made its first public announcement.

Almost since its first commercial introduction, there have been reports that vinyl chloride is toxic above certain levels. Indeed, during World War II, vinyl chloride was rejected as a surgical anesthetic because animals developed heart irritation when exposed to it. In 1949, Russian scientists reported "hepatitis-like changes" in the livers of 25% of the workers in a small PVC plant.

Then, in the late 1950s, research toxicologists at Dow Chemical Co. showed that animals exposed to as few as 100 parts per million of vinyl chloride (or 100 molecules of vinyl chloride in every one million molecules of air) developed slight liver damage. Based on its research, Dow began a program in the 1960s to reduce the level of vinyl chloride monomer in the air of its plants to below 50 parts per million.

Dow published its results in 1961. But the rest of the industry chose to rely on a Yale University study that recommended 500 parts per million as a safe level. This same level had been recommended by the Manufacturing Chemists Association since 1954, was affirmed in 1962 by the American Conference of Governmental Industrial Hygienists and was given the force of law by OSHA in 1971. However, evidence at the OSHA hearings indicates that this level was regularly exceeded until this year in many plants. (The hygienists' group didn't recommend lowering the level to 200 parts per million until 1972, four years after Dow concluded from further tests that repeated exposure by workers to vinyl-chloride monomer at an average of 300 parts per million or above for a working lifetime could cause changes in the liver.)

During the 1960s, there were reports of a disease called acroosteolysis among vinyl-chloride workers. The disease consists of skin lesions and changes in the blood vessels, leading to degeneration of the bones at the tips of the fingers and toes in those exposed to high levels of the monomer. (Emissions of vinyl chloride are generally lower at plants where the monomer, or gas, is made, since the process is less complex, and there is less chance for leaks than at the polymerization plants; none of the reported angiosarcoma cases in this country has occurred among workers making vinyl-chloride monomer, and only one of the 10 deaths in Europe was in a monomer plant.)

In early 1967, the Manufacturing Chemists Association arranged with the University of Michigan to study acroosteolysis among vinyl-chloride workers, particularly those who cleaned the reactor vessels and others who were exposed to large concentrations of vinyl chloride in the air. The Michigan scientists reported in 1970 that although they couldn't pinpoint vinyl chloride as the cause of the disease, worker exposure to the monomer should be cut to 50 parts per million or below.

Other than Dow, which had already instituted reductions in air levels of the monomer, the rest of the industry in the U.S. ignored the recommendation. Nor was there any significant reaction to findings by European industry that animals developed adverse effects from vinyl chloride. This was at least partly because the Europeans downgraded the importance of some of their findings. For example, Prof. Pier Luigi Viola, a medical director employed in Italy by Solvay & Cie., the Belgian chemicals company, found bone changes in rats exposed to air levels of 30,000 parts per million of vinyl chloride; even more important, he found that vinyl chloride at that level caused malignant tumors in the ear canals, lungs and bones of rats.

Prof. Viola reported his findings before an international cancer congress in Houston in 1970. It was the first reported link between cancer and vinyl chloride. But the professor expressed doubt about the purity of the vinyl-chloride gas he had used and stated that the rat cancer findings, because they occurred at such high levels of the monomer, had no human implications.

(Prof. Viola subsequently found tumors in rats exposed to 500 parts per million; but this fact wasn't revealed until well after the first human angiosarcoma cases were revealed.)

Based on Prof. Viola's early cancer findings in rats, Montedison S.p.A., the huge Italian chemicals company, in 1970 asked Cesare Maltoni, a respected researcher at the Institute of Oncology in Bologna, Italy, to do more extensive animal studies. By October 1972, Prof. Maltoni says, he had found that 250 parts per million of vinyl chloride produced tumors in rats in three parts of the body: the ear canals, kidneys and the liver. The liver tumors included angiosarcoma. The professor immediately informed his sponsors.

The Europeans offered their information to the Manufacturing Chemists Association in the U.S., but only if the Americans guaranteed confidentiality. With great reluctance, the association says, it finally agreed to the secrecy condition "because of the vital importance of learning of any indications from the European research . . . without the delays which could have resulted from duplication of effort."

On Jan. 30, 1973, a year before the first human angiosarcoma cases were reported by B. F. Goodrich, the MCA finally got the Maltoni data. For five months, the secrecy restrictions were such that government agencies, PVC workers exposed to vinyl chloride and even company doctors were kept in the dark. Then, in the late spring, the Europeans agreed that the chemists' association could pass the information on to the U.S. National Institute for Occupational Safety and Health, the Labor Department agency that monitors worker safety. On July 17, 1973, representatives of the association and the agency met.

There is some dispute as to what transpired at the meeting. The Labor Department agency claims it wasn't given the full story; the chemists' association claims that the agency misunderstood the findings. But one thing is certain: The agency, and OSHA, made no move to change the standard of 500 parts per million and didn't do so until after the human angiosarcoma cases were announced. In Europe, by contrast, Great Britain had lowered the maximum level to 200 parts per million following the cases of acroosteolysis in the '60s; and West Germany had set a level of 100 parts per million in 1970, based on Dow's 1961 results with animals. According to New Scientist, the British science journal, "No other section of the U.S. or European industry followed Dow's lead. The reasons for this international confusion are obscure."

This all changed quickly, of course, once the first human cases of angiosarcoma were reported by Goodrich. Indeed, the swiftness with which new research has been carried out since Jan. 23 is perhaps without precedent in the world of medicine and science.

Much of this recent research is concerned with studies of the incidence of disease of all types among vinyl-chloride workers. Thus far, some studies show that workers exposed to high levels of vinyl chloride show greater than expected incidences not only of angiosarcoma but certain other cancers as well. The ramifications of these findings for the future of the industry and its workers remain to be seen. However, for the veteran PVC workers, whatever changes the findings produce will be useless in counteracting the insidious effects of working day after day, year after year, in what now is generally viewed as a contaminated atmosphere.