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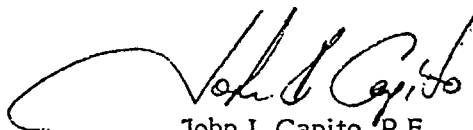
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LEGAL DEPARTMENT

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Attached is a paper entitled, "Use of Vinyl-Lined Asbestos-Cement Pipe -A Case History," by Richard S. Woodhull which will be presented at the AWWA Annual Conference in St. Louis. As previously arranged, we are sending you this paper so that you may prepare your written comments and return them to us by May 27. Your comments will be published in the Proceedings and will be sent to Mr. Woodhull for his review.

If you have any questions, please do not hesitate to contact me.


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VINYL-LINED A/C PIPE:
THE MANUFACTURER'S PERSPECTIVE

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In April 1980, a major cancer scare was precipitated in New England when tetrachloroethylene (perchloroethylene or "PERC") was discovered in several dead ends of drinking water systems where vinyl-lined asbestos-cement pipe was used. This paper will describe briefly how vinyl-lined pipe was developed and how it was discovered to be a source of PERC. The author will then discuss the current evidence on whether PERC is a health hazard, and at the end will have a recommendation regarding emotional health issues affecting drinking water.

Development of Vinyl-Lined A/C Pipe

In the late 1960's, Providence, Rhode Island was using A/C pipe to replace iron pipes in dead ends because of a buildup of iron concentrations from corrosion. All finished cement products, including A/C pipe or the cement lining in ductile iron pipe, contain trace amounts of unreacted lime (calcium carbonate), and in contact with highly aggressive waters, the unreacted lime can dissolve into the water. To prevent a buildup of alkalinity from unlined A/C pipe in the dead ends, Providence requested the technical assistance of Johns-Manville, and a seal coating appeared to be the most effective solution. Initial attempts to use standard asphaltic linings resulted in complaints about an oily taste and odor in the dead end situations.

J-M then developed a vinyl lining. This plastic was and is approved by the Food and Drug Administration for contact with food and water and is used in milk cartons. The vinyl comes in a powdered form, and before it could be sprayed on the inside of the pipes, it had to be converted into a liquid. This was accomplished by dissolving the vinyl in PERC.

PERC was chosen as the solvent because of its extremely wide use with no evidence of low-level toxicity. PERC had even been tested and used as a prescription drug at high doses for thousands of people without any reported long-term effects.¹

The company tested the new lining and found that almost all of the PERC evaporated after a short period of air drying. At the time, the only standard applicable to seal coats was AWWA C104 for cast iron pipe. This standard required that no taste and odor be imparted to the water. The vinyl lining passed that test. Standard C104 was later modified to limit organics to 50 parts per million in a standpipe test. Tested against this quantitative standard, vinyl-lined pipe passed by a safety factor exceeding two hundred.²

In late 1968, J-M wrote Providence explaining how the lining was made and identifying PERC as the solvent. Providence ran its own tests on the vinyl lining and also found it acceptable. Thereafter, the corrosion resistance of the pipe and its freedom from taste and odor problems resulted in its wide acceptance throughout New England.

Discovery of PERC Release

In 1976, the Newport Water Department was looking for trihalomethanes in conjunction with EPA as part of the National Organics Monitoring Survey. During the survey, PERC, which is not a trihalomethane, was found in concentrations around 1,200 ppb or less. In May 1977, EPA wrote to Rhode Island that an acceptable short-term exposure limit could be computed at 23,700 ppb based on occupational inhalation exposure data for PERC.³ Thus, there was no alarm over the levels of PERC being found, but there was concern as to where it might be coming from since it could indicate source water contamination or the presence of cross-connections. In a long, slow process unaccompanied by any form of alarm or public notification, the search eliminated various possibilities and in January 1980 finally focused on newly installed vinyl-lined pipe.

In February 1980, EPA generated a Suggested No Adverse Response Level or SNARL of 20 parts per billion for long-term exposure to PERC.⁴ This limit was not based on a cancer theory, but the SNARL document did state that PERC was a carcinogen.

In April 1980, PERC was discovered in a water system in Connecticut, and a press conference was called by the Health Department. The media perceived a serious health hazard from the presence of a "carcinogen" in excess of an EPA "safety" level. The resulting media crisis exploded throughout New England in an episode reminiscent of the Great Cranberry Scare of the late 1950's.

The Health Effects of PERC

The public concern for PERC was generated almost totally by its labeling as a carcinogen. EPA and other health department personnel were constantly citing a 1977 study by the National Cancer Institute showing that PERC had caused liver cancer in mice. There was no mention that the special strain of mice used in the study was known to have a high rate of spontaneous liver cancer and was selected for its unusual sensitivity to liver cancer. There were few reports that the same test had found that PERC did not cause cancer in rats, and that in other studies PERC had not caused cancer in rabbits, guinea pigs, monkeys or other strains of mice and rats.

There was also no mention of the serious scientific doubt about the validity of extrapolating liver cancer test results from mice to man. Outside its Office of Drinking Water, EPA had issued in January, 1980 a health assessment document on PERC stating:

Indeed, the relevance of liver cancer induction in the mouse as a predictor of carcinogenic potential in man is unquestionably one of the most controversial issues in cancer research. ... Recent discovery of a high incidence of spontaneous liver tumors in untreated B6C3F1 mice which live longer than bioassay lifetimes, indicates factors other than the test chemical may influence the incidence of hepatomas in mice. A mechanism may be responsible for the effect in mice exposed to high levels of chemical which is less likely to occur in man exposed at low levels.⁵

Just what is the opinion of the scientific community on PERC as a carcinogen?

- World Health Organization, International Agency for Research on Cancer: "There is limited evidence that tetrachloroethylene is carcinogenic in mice."⁶
- National Academy of Sciences: In its 1980 book, Drinking Water and Health, NAS established SNARLs of 172,000 ppb (24-hour) and 24,500 ppb (7-day) based on non-carcinogenic toxicity and using a safety factor of 100. NAS declined to generate a long-term SNARL based on a carcinogenic theory noting that "it is unclear whether TCE is a carcinogen." NAS commented on the 1977 NCI study: "The findings of this study should be interpreted with caution, recognizing the limitations of the experimental design"⁷

- National Cancer Institute: Responding to criticism of the experimental design of the 1977 study, NCI is redoing it.
- EPA's Science Advisory Board: Composed of independent scientists from outside the agency, this Board in September 1980 refused to agree with EPA that there was substantial evidence that PERC is a carcinogen.⁸
- Toxicology and Applied Pharmacology: In September 1980, this peer-reviewed journal published a study showing that in the special strain of mice, PERC does not affect the genetic DNA material of liver cells but in massive doses is metabolized into another chemical that injures liver tissues. This results in roughly doubling the aging of the mice livers, which are already predisposed to spontaneous cancer. Rats metabolize the PERC far less than mice, and humans metabolize even less than rats. The report concluded: "Thus, levels of perchloroethylene which do not induce organ toxicity are not likely to pose a carcinogenic risk to man."⁹
- Occupational Safety & Health Administration: OSHA does not regulate PERC as a human carcinogen, and permits daily exposures to PERC equivalent to 804,000 ppb in drinking water.¹⁰

Amidst all of the controversy over whether PERC is a carcinogen at all, several very uncontroversial facts were ignored:

- If PERC is a carcinogen at all, it is at most an extremely weak one.
- If there is any risk from drinking minute quantities of PERC, that risk is immeasurably small.
- There is no assurance that the risks of taking "remedial steps" are lower than the risks of not taking them. For example, the risk of dying in an automobile accident from driving three miles round trip to pick up a supply of bottled water is known to be about one in a billion.¹¹ This is ten times more risk than EPA hypothesizes from drinking one's daily supply of water at 100 ppb of PERC.⁴ A loving and concerned parent might ask a child to bicycle over to

a neighbor's to pick up a bottle of water. Every 53 feet of that trip would expose the child to a real risk of immediate death equal to EPA's hypothesized risk of drinking two liters of water containing 1,000 ppb of PERC.^{11, 4} Risks from remedial measures such as shifting to untreated well water could be several orders of magnitude higher than from the PERC.

Recommendation

The people of New England were told that a crisis existed but were given no information or data to evaluate their response. Faced with a barrage of intemperate headlines and overreaching media analysis, they resorted to a host of self-help remedial measures such as buying bottled water, installing charcoal filters, boiling water, shifting to untested and untreated wells, and even paying to have service lines replaced. All of these actions were costly and most of them exposed people to risks far more certain than those hypothesized for PERC.

There will be other emotional health issues identified with drinking water from time to time. Witness the current debate on the connection between the use of chlorine and cancer. When these issues involve immeasurably small and largely hypothetical risks, they will not lend themselves to analysis based on a simplistic notion of prudence. All of the alternatives will also involve risks, hopefully small and hopefully hypothetical as well, and the alternatives will always be more expensive.

In dealing with emotional but small, hypothetical risks, those of us associated with the safety of drinking water - suppliers, utilities, health authorities and others - must develop the expertise to understand the degree of the potential risks relative to the alternatives. More importantly, the public looks almost exclusively to health authorities for guidance on health issues and the public gets that guidance through the news media. Therefore, health authorities must develop the expertise and the restraint to give to the media and the consuming public enlightened and balanced information that makes possible unemotional and truly prudent decisions about risks, alternatives and costs. If we have learned that from the PERC issue, then it will not have been a lesson in vain.

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10. The 8-hr. OSHA time-weighted-average standard of 100 ppm by volume in air results in daily blood-stream absorption of 1,608 mg PERC per day assuming that the lungs absorb 30% of inhaled PERC, a breathing rate of one cubic meter per hour, and an air conversion factor of 6.7 mg per cubic meter per ppm of PERC. Assuming a drinking

rate of two liters per day and 100% absorption of ingested PERC, water concentrations of 804,000 ug/l (ppb) would cause bloodstream absorption of 1,608 mg/day. This figure is not intended as the basis for a drinking water standard.

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