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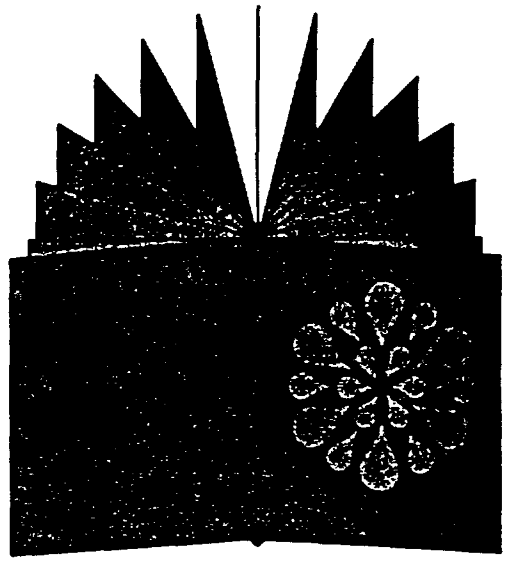

BIBLIOGRAPHIES
ON THE WATER SUPPLY INDUSTRY

ASBESTOS CEMENT PIPE

1983

Technical Library
American Water Works Association

"Asbestos in MWDSC Supplies," McGuire, M.J.; Cohen, R.S, AWWA Research Foundation Research News, p 11, August 1982. Originally reported in The Occurrence of Asbestos Fibers in Source Water Supplies Available to Metropolitan, MWDSC Water Quality Branch Laboratory Report, October 1980.

This article discusses the presence of asbestos fibers in the water supply of the Metropolitan Water District of Southern California (MWDSC). Colorado River water contains few asbestos fibers. However, State Project water (SPW) contains high fiber counts due to erosion of serpentine minerals in the watershed. MWDSC filtration plants eliminate 74 to 100 percent of the fibers, producing finished water counts varying from below detection limit to 19 million fibers per liter (MFL).

"Asbestos-Cement Pipe Investigations," Logsdon, G.S.; Millette, J.R., AWWA Research Foundation Water Quality Research News, p 6-7, February 1982.

The Drinking Water Research Division of the U.S. EPA conducts and sponsors outside research on the condition of asbestos-cement (A-C) water mains, including the methods which bind the asbestos fibers to the pipe wall and prevent deterioration. Laboratory investigations and practical findings from preventive measures studies in Greenwood, South Carolina, Weston, Wisconsin, and Bellevue, Washington are documented. Tests used in these studies included pipe tapping, applications of zinc orthophosphate and iron to the A-C pipe, and the use of recirculating tanks fabricated of polyethylene rather than stainless steel. Rockwell "L" scale and the Durometer hardness tests disclosed that hardness testing may offer an inexpensive route to assessing the state of the inner pipe wall. This paper was presented at the AWWA 1981 Water Quality Technology Conference.

"Nonaggressive Water in A/C Pipe," Kanarek, M.S.; Conforti, P.M.; Jackson, L.A., AWWA Research Foundation Water Quality Research News, p 8-9, November 1981. Originally reported in Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe, Environmental Science and Technology, Vol. 15, August 1981, p. 923.

This study compared drinking water samples collected from treatment plant effluents in the San Francisco area before and after passing through asbestos/cement (A/C) pipes. Chrysotile asbestos fiber counts rose in non-aggressive and moderately-aggressive drinking water after passing through the A/C pipes.

"Corrosion of Asbestos-Cement Pipe," Schock, M.R.; Logsdon, G.S.; Clark, P.J., AWWA Research Foundation Water Quality Research News, p 3-4, September 1981. Originally reported in Evaluation and Control of Asbestos-Cement Pipe Corrosion, EPA 600/D-81-067, February 1981.

The Drinking Water Research Division of the U.S. Environmental Protection Agency has supported field evaluations, on-site tests, and pilot-plant tests for the purpose of investigating asbestos-cement (A/C) pipe corrosion. The following methods and instruments have been utilized: the Aggressive Index coupled with computer-assisted calculation, the standard optical microscope, scanning and transmission electron microscopy, and energy-dispersive x-ray spectroscopy.

"Asbestos Ingestion by a Baboon," Patel-Manlik, K.J., AWWA Research Foundation Water Quality Research News, p 10, August 1981. Originally reported in Distribution of Orally Administered Chrysotile Asbestos in Newborn Baboon Body, EPA-600/1-80-022, May 1980.

Results of a study in which chrysotile asbestos fibers were orally administered to a newborn baboon are highlighted. After nine days, fibers had migrated through the gut wall into and between other organs of the body. The highest concentration of chrysotile fibers was found in the kidney cortex.

"Confluence -- AC Pipe Retains Strength in Corrosive Water Environment," Journal American Water Works Association, p 111, April 1982.

An ongoing quality assurance program shows that nearly all asbestos-cement water distribution pipes still exceed structural requirements for new pipe even after many years' use. The data collected substantiate the ability of AC pipe to convey moderately to highly aggressive water over a long period of time with little or no apparent loss of strength.

"News of the Field -- Evidence Points Away From Link Between Asbestos Ingestion and Cancer," Journal American Water Works Association, p 54, May 1982.

Based on data obtained through animal experiments, occupational exposure, and epidemiology, British scientists Robert Murray and Kevin Browne have concluded that little evidence exists to establish an association between asbestos fibers and excess mortality from gastrointestinal tumors. The bases for their conclusion and several related studies are outlined.

"Asbestos Content of Canadian Waters," Meranger, J.C., AWWA Research Foundation Water Quality Research News, p 13-15, January 1981.

Analyses were performed on 55 percent of Canada's drinking water using the U.S. Environmental Protection Agency's interim carbon-coated "Nucleopore" technique, considered a reliable procedure for testing asbestos fiber concentrations. Chrysotile asbestos constituted the major asbestos type prevalent in Canadian potable supplies. Filtration was found to efficiently remove asbestos fibers from the water.

"News of the Field -- Minnesota Study Finds No Link Between Ingested Asbestos and Cancer," AWWA Journal American Water Works Association, p 49-50, March 1982.

Interim results of an epidemiology study conducted by the Minnesota Department of Health recently reported no link between the ingestion of asbestos fibers in Duluth drinking water and incidence of cancer. The completed portion of the ongoing EPA-funded study compared Duluth cancer rates during the period 1969-1971 with rates in Minneapolis and St. Paul. Other comparisons revealed that cancer rates for a later period declined in Duluth, which is affected by the tailings of a nearby mining operation.

"Asbestos Analysis Case History: Surface Water Supplies in Southern California," McGuire, Michael J.; Bowers, A. Eugene; Bowers, Daniel A., Journal American Water Works Association, p 470-478, September 1982.

In 1974, analyses for asbestos fibers were conducted on a one-time basis at the surface water supply reservoirs of the Metropolitan Water District of Southern California. Although no asbestos fibers were found at that time, a further analysis in 1980 detected the presence of asbestos in the water supply that originates in Northern California. This paper presents the data from the initial and follow-up surveys (1980-1981) and identifies potential sources of the asbestos fibers, which include high background counts from erosion of serpentine minerals in the aqueduct watershed. Based on these studies, a program was initiated to remove asbestos-contaminated sediments from the bottom of the aqueduct.

"Analyzing Asbestos Fibers in Water by Means of Transmission Electron Microscopy," Boatman, Edwin S., Journal American Water Works Association, p 533-536, October 1982.

Data that have been gathered over the past eight years indicate that a method involving Transmission Electron Microscopy (TEM) is the most appropriate of the micro-scopic methods used to detect and identify asbestos fibers in drinking water. The authors discuss the following: sample collection; sample preparation; identification of fibers; fiber counting; laboratory facilities and equipment necessary for analyzing asbestos fibers; and possible sources of error in the analysis.

"Vinyl Lined Asbestos Cement Pipe Problems - Operator Aspects," Gardner, Robert L., Journal of the New England Water Works Association, p 220-223, September 1981.

During April 1980, the water departments of South Burlington, Shelburne, and Williston, Vermont were faced with the potential problem of trichloroethylene (TCE) leaching into water supplies from the lining of asbestos cement pipe. This article describes the interaction which took place between utility personnel and members of the news media in keeping the public informed of the situation. Some important guidelines when dealing with such occurrences are given.

"Asbestos Analysis Case History: Surface Water Supplies in Southern California," Bowers, A. Eugene; McGuire, Michael J.; Bowers, Daniel A., Proceedings AWWA Water Quality Technology Conference (9th 1981); Seattle, WA; December 6-9, 1981; Paper No. 3A-3, p 169-189.

This paper presents the data of surveys for asbestos fibers in the water supply of the Metropolitan Water District of Southern California. The authors identify potential sources and introduce possible control procedures to reduce the exposure of Metropolitan's consumers to chrysotile asbestos fibers. The emphasis of the paper is on planning the surveys, coordination of the contract laboratories, and evaluation of the inherently imprecise data from different sources. Quality assurance procedures were designed into the intensive sampling program to assure reliable data. A program was initiated to optimize the removal of asbestos fibers in Metropolitan's filtration plants.

"Asbestos-Cement Pipe at Greenwood, South Carolina," Grubb, Clarence E., AWWA Research Foundation Water Quality Research News, p 9-10, June 1981. Originally reported in Field Test of Corrosion Control to Protect Asbestos-Cement Pipe.

Concerned by the aggressive water distributed through its asbestos-cement (A/C) pipes, Greenwood, South Carolina began injecting zinc orthophosphate into the effluent just ahead of the clearwell at each of its two treatment plants. The zinc application protectively coats the A/C pipe and substantially decreases the asbestos fiber count in the water.

"Vinyl Lined Asbestos Cement Pipe Problems - Health Aspects," Anderson, Paul T., New England Water Works Association Journal of the New England Water Works Association, p 217-219, September 1981.

The presence of tetrachloroethylene in public water supplies using vinyl lined asbestos cement pipe first came to the attention of Massachusetts authorities in 1980. Consequently, arrangements were made to sample 94 water systems to determine the effect of pipe age, detention time, flushing, and corrosion control chemical feed practices. The following treatments were tried with varying levels of success: aeration; dilution; steam cleaning and sand blasting; cement lining; flushing; bleeding; carbon filtration; boiling; pH adjustment; polyphosphate addition; superchlorination; and replacement of pipe.

"Vinyl-Lined A/C Pipe: The Manufacturer's Perspective," McCallie, S. Wyatt, Proceedings AWWA 1981 Annual Conference - Another Century of Better Water Quality and Service; St. Louis, MO; June 7-11, 1981; Paper No. 7-5b, p 315-320.

In April 1980, a major cancer scare was precipitated in New England when tetrachloroethylene (perchlorethylene) was discovered in several dead ends of drinking water systems where vinyl-lined asbestos-cement pipe was used. This paper describes how vinyl-lined pipe was developed and how it was discovered to be a source of PERC. Current evidence on whether PERC is a health hazard is discussed. Health authorities must develop expertise and restraint to handle such emotional health issues.

"The Behavior of Asbestos-Cement Pipe Under Various Water Quality Conditions: Part 2, Theoretical Considerations," Schock, Michael R.; S. Buelow, Ralph W., Journal American Water Works Association, p 636-651, December 1981.

A water chemical model involving the complexion and solubility equilibria of calcium, magnesium, zinc, iron, manganese, silica, chloride, orthosphosphate, and carbonate has been developed and applied to laboratory pipe-loop-coupon and field data on asbestos-cement pipe. Calculation of the saturation states of the relevant solids enables preparation of graphic guides for the prediction of dosage levels for in-situ pipe coating by zinc compounds as well as protection afforded by coatings formed by natural inhibitory constituents of the water. Environmental impacts of zinc treatment, aggressiveness index, and A-C pipe coupon tests are discussed.

"Use of Vinyl-Lined Asbestos-Cement Pipe - A Case History," Woodhull, Richard S., Proceedings AWWA 1981 Annual Conference - Another Century of Better Water Quality and Service; St. Louis, MO; June 7-11, 1981; Paper No. 7-5a, p 313-314.

A total of 146 Connecticut water utilities use asbestos-cement pipe, and seven of these were found to have pipe with a vinyl lining. Tetrachloroethylene was leaching at an unacceptable rate in five systems. Operation of bleeders on selected dead ends has successfully reduced the TCE to less than the 20 u/L level being allowed in Connecticut.

"The Relationship Between Asbestos and Turbidity in Raw Water," Severson, Richard K.; Harvey, James; Polissar, Lincoln, Journal American Water Works Association, p 223-224, April 1981.

In an effort to study the relationship between waterborne asbestos and cancer, thirty-five raw water samples from a watershed area were analyzed for turbidity and asbestos levels. This paper establishes a significant correlation between turbidity and asbestos levels, possibly providing a means by which historical levels of asbestos and exposure to it could be ascertained.

"Removal of Naturally Occurring Asbestos Fibers From Seattle's Cascade Mountain Water Source," Kirmeyer, Gregory J.; Logsdon, Gary S.; Courchene, John E.; Jones, Roy R., Proceedings AWWA 1979 Annual Conference - Our Job, All The Water You Need; San Francisco, CA; June 24-29, 1979; Paper No. 25-6, p 903-927.

In 1975, the U.S. Environmental Protection Agency (EPA) discovered naturally occurring asbestos fibers in the Tolt River, a 100 million gallon per day (MGD) source of water supply for the City of Seattle. Two types of fibers were detected - amphibole and chrysotile. These fibers are in the sub-micron size range and are thought to have opposite surface charges. Although earlier research had been conducted on amphibole fiber removal from Lake Superior, little was known about methods of removal for chrysotile. To reduce lead time should fiber removal become necessary, the Seattle Water Department obtained research funding from EPA to develop methods of removal for these contaminants.

"Laboratory Techniques for Determining Corrosivity of Water to Asbestos-Cement Pipe," Buelow, Ralph W., Proceedings AWWA Water Quality Technology Conference (7th, 1979) - Advances in Laboratory Techniques for Quality Control; Philadelphia, PA; December 9-12, 1979; Paper No. 4A-4, p 239-246.

Asbestos cement pipe deteriorates when certain aggressive water quality conditions exist and asbestos fibers are loosened and can be released into the water. A/C pipe resistance to chemical attack has been evaluated by use of an index comprised of the pH, alkalinity, and calcium factors in water. Iron, manganese, zinc, and silica are substances found in water that can protect A/C pipe.

"The Behavior of Asbestos-Cement Pipe Under Various Water Quality Conditions: A Progress Report," Buelow, Ralph W.; Millette, James R.; McFarren, Earl F.; Symons, James M., Journal American Water Works Association, p 91-102, February 1980.

Asbestos-cement pipe has had a reputation for resisting attack by aggressive waters that cause corrosion of metal pipe materials. The results of this study suggest that asbestos-cement pipe behaves much like other piping materials, except PVC, that are commonly used for potable water distribution. If aggressive water conditions exist, the pipe will corrode and deteriorate; if aggressive water conditions do not exist, the pipe will not corrode and deteriorate.

"Studies of Asbestos Removal by Direct Filtration of a Lake Superior Water," Peterson, David L.; Schleppenbach, Frank X.; Zaudtke, Terry M., Journal American Water Works Association, p 155-161, March 1980.

A filtration research program conducted at Duluth, Minnesota included pilot and full-scale plant studies to investigate the effectiveness of anionic polymers, the use of pH adjustment to reduce alum feed rate, the effects of various rapid mix velocity gradients on particulate removal, alternate fluoride chemical feed points, and the operational impact of exceptionally high turbidities experienced as a result of storms on Lake Superior.

"Asbestos Analytical Technique," Millette, J.R.; Rosenthal, M.T.; Feldman, R.S., Proceedings AWWA Water Quality Technology Conference (8th, 1980) - Advances in Laboratory Techniques for Quality Control; Miami Beach, FL; December 7-10, 1980; Paper No. 3A-2, p 173-188.

A variety of methods and procedures have been developed for asbestos measurement. The transmission electron microscope (TEM), the scanning electron microscope (SEM), optical microscopy, sampling, laboratory analysis, and standardization are discussed. Biological and mineral fibers coated with iron and other materials present the greatest problems in identifying chrysotile in drinking water.

"Improved Electron Microscopic Methods for Measuring Asbestos in Water," Anderson, C.H., Proceedings AWWA Water Quality Technology Conference (6th, 1978) - New Laboratory Tools for Quality Control in Water Treatment and Distribution; Louisville, KY; December 3-6, 1978; Paper No. 2A-4, 14 p.

This paper describes experimental work carried out over the past several years that has led to improvements in the measurement of asbestos content of water.

"Public Health Aspects of Asbestos Fibers in Drinking Water," Cooper, Robert C.; Cooper, W. Clark, Journal American Water Works Association, p 338-340, June 1978.

A brief review of several aspects of the presence of asbestos fibers in drinking water is presented. The health effects, especially possible carcinogenicity, are examined.

"Asbestos Fiber Removal," Hunsinger, R.B.; Logsdon, G.S., AWWA Research Foundation Water Quality Research News, p 2-4, May 1980, No. Eight. Originally reported in Environmental Science and Technology, March 1980, p 333; EPA Report, December 1979, 146 p.

Various methods of asbestos fiber removal are reviewed. Transmission electron microscope, bacteriological tests, residual chlorine determination, turbidimeters, coagulation, granular media, nephelometric turbidity unit (ntu), pH, chemical feed, rapid filtration rate, alkalinity, chrysotile fibers, backwashing, air binding, diatomaceous earth (DE), monitoring, amphibole fibers, analysis, X-ray diffraction, and calibration are discussed. Waters investigated were at Duluth, Minnesota; Seattle, Washington; Philadelphia, Pennsylvania; Chicago, Illinois; and the San Francisco Bay area in California.

"Is Chrysotile Asbestos Released From Asbestos-Cement Pipe Into Drinking Water?" Hallenbeck, William H.; Chen, Edwin H.; Hesse, Carolyn S.; Patel-Mandlik, Kusum; Wolff, Arthur H., Journal American Water Works Association, p 97-102, February 1978.

To investigate the possibility that asbestos cement pipe does release asbestos as a contaminant in drinking water, a study was made of water samples from fifteen public water-supply systems before and after their flow through asbestos cement pipes of various ages, lengths, and diameters. Calculation of fiber and mass concentrations, detection limits for fiber counts, and calculation of saturation and aggressiveness indices are discussed.

"The Duluth Experience - Asbestos, Water, and the Public," Peterson, David L., Journal American Water Works Association, p 24-28, January 1978.

In 1973, the EPA discovered high levels of asbestos-like particles in the Duluth, Minnesota finished drinking water. The abundance of these amosite asbestos particles was attributed to the dumping of tailings from a taconite-iron-ore beneficiation plant into a trench in Lake Superior. Health risks associated with inhalation of asbestos fibers caused great public uproar which prompted the city to seek ways to eliminate the particles from the water supply.

"Exposure to Asbestos Fibers in Water Distribution Systems," Craun, Gunther F.; Millette, James R.; Woodhull, Richard S.; Lauippi, Richard, Proceedings AWWA 97th Annual Conference - Water and the Environment; Anaheim, CA; May 8-13, 1977; Paper No. 7-4, 13 p.

A study of the asbestos-cement pipe distribution systems in Connecticut water supplies was performed as background for an epidemiology investigation designed to determine whether there were differences in cancer experience between population groups exposed to asbestos-cement pipe distribution systems and those exposed to distribution systems of other materials. The preliminary findings of the epidemiology study did not show any excess in cancer incidence.

"Committee Report — Use of Asbestos in Water Utility Construction," AWWA Committee on Use of Asbestos in Water Utility Construction, Journal American Water Works Association, p 217-219, April 1978.

Working with asbestos cement pipe can be a risk free job under most circumstances, if good work practices are followed. Recommended work practices are outlined in detail. Health effects and OSHA standards are discussed.

"Investigation of Turbidity, Asbestos Fibers and Particle Counting Techniques as Indices of Water Treatability of a Cascade Mountain Water," Watkins, Jack, Jr.; Ryder, Robert A.; Persich, William A., Proceedings AWWA 1978 Annual Conference - What Price Water; Atlantic City, NJ; June 25-30, 1978; Paper No. 33-3, 38 p.

Water treatment pilot plant research conducted in 1977 on the Everett, Washington, surface supply utilized particle counting and asbestos fiber counting techniques in evaluating unit process performance. Good correlations between turbidity, particle count, and asbestos fiber data demonstrate the importance of these counts in water treatment plant design and in monitoring process operational behavior.

"Work Practice for Asbestos-Cement Pipe; AWWA Manual M16," AWWA Committee on Use of Asbestos in Water, 24 p, 1978. Originally reported in Recommended Work Practices for A/C Pipe, A/C Pipe Producers Association, 1977.

AWWA Manual M16 describes recommended work practices for shipping, receiving, handling, assembling, disassembling, cutting, machining, hole cutting, and "dry" and "wet" tapping when using asbestos-cement pipe. Care of equipment, waste disposal, and several non-recommended work practices are covered as well.

"Removal of Asbestiform Fibers by Water Filtration," Logsdon, Gary S.; Symons, James M., Journal American Water Works Association, p 499-506, September 1977.

Results of pilot plant research in an EPA-US Army Corps of Engineers study of asbestiform fiber removal and recommendations. Equipment, analytical methods, raw water quality, turbidity, fiber count, amphibole mass, fiber size, chrysotile fibers, granular filtration, diatomite filtration, surface change, rapid detection methods, research, and effluent monitoring are discussed.

"An Electron Microscope Study of Asbestiform Fiber Concentrations in Rio Grande Valley Water Supplies," Oliver, Timothy; Murr, L.E., Journal American Water Works Association, p 428-431, August 1977.

No evidence of asbestiform fiber attributable to asbestos cement (A-C) pipe could be found for water systems in New Mexico. Testing procedures are described.

"Analysis of Particulate Contaminants in Water," Stewart, Ian M., Proceedings AWWA 95th Annual Conference, Research - Key to Quality Water Service in the 80's; Minneapolis, MN; June 8-13, 1975; Paper No. 28-d, 12 p.

> Available techniques for small particle identification are reviewed, including light microscopical analysis, electron microprobe analysis, x-ray diffraction analysis and use of the ion sputtering mass spectrometer. The scanning electron microscope and transmission electron microscopes (TEM) are evaluated in terms of small particle analysis. Discussed in some detail are some problems of obtaining valid data on asbestos in water supplies.

"Asbestos-Cement Transmission Pipe," Bryant, Robert S., Proceedings AWWA 95th Annual Conference - Research-Key to Quality Water Service in the 80's; Minneapolis, MN; June 8-13, 1975; Paper No. 11-3c, 2 p.

> AWWA specification C402-75 recognizes a new type of pipe for economical transmission of water by the utilization of time tested features and materials with history of over 70 years of use. Asbestos-cement transmission pipe has been developed on a different approach from the previous type of asbestos-cement pipe in that a wide range of pressure classes are available in diameters considered as above the size of distribution pipelines and in the transmission pipe sizes.

"Asbestos Analysis by Electron Microscope," McFarren, Earl F.; Millette, James R.; Lishka, Raymond J., Proceedings AWWA Water Quality Technology Conference (2nd, 1974); Dallas, TX; December 2-3, 1974; Paper No. XIV, 11 p.

> Optical microscopy is useless for detecting asbestos in most water supplies because the size of the fibers usually found are too small to be visible. Electron microscopy is useful in counting and sizing the fibers, provided electron diffraction or energy dispersive x-ray fluorescence or both are used to identify the fibers. Electron diffraction will classify the fiber as being either chrysotile, amphibole, or nonasbestos.

"Direct Filtration of Lake Superior Water for Asbestiform-Solids Removal," Robinson, J.H.; Schmidt, O.J.; Stukenberg, J.R.; Jacob, K.M.; Bollier, G.H., Proceedings AWWA 95th Annual Conference - Research-Key to Quality Water Service in the 80's; Minneapolis, MN; June 8-13, 1975; Paper No. 10-2a, 22p.

> Direct filtration has been investigated as a means of removing asbestiform fibers from the Duluth, MN water supply (Lake Superior). Filtration processes investigated included granular filtration, pressure diatomaceous earth filtration, and vacuum diatomaceous earth filtration. Filter bed design, filtration rate, coagulant and polyelectrolyte type and dosage, as well as a method of flash-fixing were examined. Amphibole asbestiform-fiber removals routinely greater than 95 percent were accomplished. Maximum fiber removal generally occured when filtered water turbidities of 0.1 Ftu or less were attained. A brief economic analysis is also presented.

"Determining of Asbestos by Optical Microscopy," McFarren, Earl F. Proceedings AWWA Water Quality Technology Conference (1st, 1973); Cincinnati, OH; December 3-4, 1973; Paper No. XIV, 5 p.

> It may be possible to determine the total number of asbestos-like fibers present in water by phase contrast microscopy, and then determine by dispersion staining the percentage that are asbestos.

"Health Effects and Prevalence of Asbestos Fibers in Drinking Water," McCabe, L.J.; Millette, J.R., Proceedings AWWA 1979 Annual Conference - Our Job, All The Water You Need; San Francisco, CA; June 24-29, 1979; Paper No. 29-6, p 1079-1093.

> In 1974 the Research Foundations Committee concluded that "no firm evidence" shows that proper use of asbestos-cement pipe poses a hazard to health by reason of ingestion of asbestos fibers." We now know that there is much improper use of asbestos-cement pipe because in many situations the fibers come off the pipe into the drinking water. There is also evidence that the ingestion of asbestos fibers is a health hazard. The fibers released from pipe may be a greater hazard than fibers from geologic erosion because of the greater length.

"Current Capability and Needs in Particle Counting and Identification -- The Variances in Analysis by Several Laboratories," Anderson, Charles H., Proceedings AWWA 95th Annual Conference, Research - Key to Quality Water Service in the 80's; Minneapolis, MN; June 8-13, 1975; Paper No. 28-c, 8 p.

> The potential health hazard associated with the ingestion of asbestos fibers necessitates that improved methodology for determining their presence in water be developed. This paper compares results obtained by several laboratories and suggests reasons for the observed discrepancies. The paper also outlines EPA research activity on asbestos measurement methodology.

"Diatomite Filters for Asbestiform Fiber Removal from Water," Baumann, E. Robert, Proceedings AWWA 95th Annual Conference - Research-Key to Quality Water Service in the 80's; Minneapolis, MN; June 8-13, 1975; Paper No. 10-2c, 45 p.

> In 1974, a five month pilot-plant study was conducted for removal of asbestos fibers from Lake Superior water at Duluth. This paper reports the results from operation of pilot vacuum and pressure diatomite filters and describes the optimization of plant design for a 30 mgd plant to be operated to produce 20 mgd of filtered water. Optimization data were provided by the pilot-plant operations. The plant was designed to provide a filtered water turbidity of 0.05-0.1 Jtu and over 95 percent removal of amphibole fibers.

"OSHA's Effects on AC Pipe Installation - Water Utility Responsibility," Greaves, R.W., Proceedings AWWA 1978 Annual Conference What Price Water - Atlantic City, NJ; June 25-30, 1978; Paper No. 16b-2c, 2 p.

> This paper states that there is no risk of asbestos from drinking water carried in A.C. pipe, nor in loading, and installation of A.C. pipe. Any risk comes from the various forms of machining or trimming that is occasionally required. Asbestos is bound into cement to form A.C. pipe and can only present a risk when disturbed.

"Letters to the Editor - Asbestos," Plumlee, Lawrence A., Journal American Water Works Association, p 30, 32, October 1975.

The author takes issue with a conclusion reached regarding a decrease in gastrointestinal cancer cited in the article entitled "Asbestos in Potable Water Supplies" which appeared in the September 1974 JAWWA. The author, a doctor, finds these conclusions errroneous and suggests that the decreasing rate is not caused by the switch from cement to asbestos pipe but from other factors such as decrease in the consumption of smoked meats, or the banning of food additives found to be carcinogenic.

"Asbestos in Potable-Water Supplies," Olson, Harold L., Journal American Water Works Association, p 515-518, September 1974.

Asbestos-cement pipe was developed in Italy approximately sixty years ago and its use rapidly spread around the world. The causes of the rapid acceptance are as follows: the pipe is resistant to corrosion, asbestos-cement pipe has a high enough strength to withstand high external forces, asbestos-cement pipe has contributed to high water quality, it is light weight and easy to install and has a permanently smooth wall so pumping costs are low. Asbestos fiber is dangerous when inhaled but there is no evidence that asbestos from pipe endangers the health of humans.

"Asbestos in Drinking Water," Kay, G. H., Journal American Water Works Association, p 513-514, September 1974.

The discovery of asbestos in drinking water in Ontario led to a study of the the water. In August 1972 the collection of water samples began in 22 cities in Ontario. After testing the results were delivered to the Ontario Ministry of the Environment. The results showed that there is asbestos in all surface waters of all inhabited areas of Ontario, and was probably there for some time but has just now been detected. The Ministry of Health has indicated that at the present time the levels of asbestos present is no danger to the public's health.

"C603-78 AWWA Standard for Installation of Asbestos-Cement Pressure Pipe," vi, 10 p, 1978.

This standard was first made in January 1964 with the latest revision occurring January 1978. Also provided is a history of the standard, information regarding use of the standard, and major revisions. This standard covers the installation of water pipelines of asbestos-cement pressure pipe with fittings and appurtenances of asbestos-cement, cast iron, other materials, or combinations of any of these. Included are sections on the following: definitions, references, material acceptance, storage, and handling, general and detailed work to be performed including alignment and grade, excavation and preparation of trench, laying of pipe, jointing of pipe to valves, hydrants and fittings, setting of hydrants, valves and fittings, leakage, backfilling procedure before tests and after tests, and disinfection.

"C402-75, AWWA Standard for Asbestos-Cement Transmission Pipe, 18 in. Through 42 in., for Water and Other Liquids," AWWA Standards Committee on Asbestos-Cement Pressure Pipe, Journal American Water Works Association, p 462-467, August 1975.

AWWA Standard C402-75 presents guidelines for the physical and chemical requirements, design, workmanship and finish, inspection, testing, rejection, marking, and delivery of asbestos-cement transmission pipe, 18 inches through 42 inches, for water and other liquids. Specific topics covered include composition, pipe classification, diameters, lengths, couplings, joints, wall thickness, imperfections, physical test requirements, tests for uncombined calcium hydroxide, and test records.

"C403-78 AWWA Standard Practice for the Selection of Asbestos-Cement Transmission and Feeder Main Pipe, Sizes 18 In. through 42 In.," vi, 36 p, appendices, 1978.

This standard was made in January 1978 and ANSI approved July 1978. Also provided is a history of the standard, and a discussion of transmission and feeder main pipe and surge pressure. This standard has been prepared so that design engineers may quickly determine the correct strength classification of asbestos-cement transmission pipe to use under various combinations of internal pressure (static, operating and surge) and external load (earth and superimposed live loads). Combined loading curves depicting the relationship between hydrostatic loading and the external loading capabilities are included to expedite selection of the correct pipe strength classification. The pipe strength classifications of 30, 35, 40, 45, 50, 60, 70, 80, and 90 refer to similarly numbered classifications found in AWWA C402. Detailed coverage of installation of asbestos-cement pipe can be found in AWWA C603. Included are sections on the following: general information, general design including strength and design factors, combined loading theory, three edged bearing load; external loads, earth loads and superimposed loads; hydrostatic pressure, operating pressure and surge pressure; pipe selection, combined loading curves, safety factors, use of selection charts for economical surge pressure analysis, frictional power requirements and a friction loss head chart.

"C402-77 AWWA Standard for Asbestos Cement Transmission Pipe, 18 In. through 43 In., for Water and Other Liquids," ix, 10 p, 1977.

This standard was made in January 1953 with the latest revision approved January 1977. It was ANSI approved November 1977. Also included is a history of the standard, information on use of the standard, and major revisions. This standard covers nine pressure classifications of Type I and Type II asbestos cement pipe, 18 - 42 in. in diameter, for water and other liquids to be laid underground in public or private rights-of-way. The transmission pipe to be used in pipe systems having relatively predictable flows and few appurtenances, which permit reasonable hydraulic analyses, including those for surge pressures. Included are sections on the following: general information, definitions, affadavit of compliance, materials specifications of composition, physical and chemical requirements, design pipe classification, pipe diameters and length, couplings, joints, wall thickness, inspection, physical test requirements, retests and basis for rejection, test for uncombined calcium hydroxide, test records, marking and delivery, and preparation for shipment.

"C401-77 AWWA Standard Practice for the Selection of Asbestos Cement Distribution Pipe, 4 In. Through 16 In., for Water and Other Liquids," iv, 20 p, appendix, 1977.

This standard was first approved January 1964 with the latest revision approved May 1977. It was ANSI approved January 1978. A history of the standard and the major revisions are also discussed. This standard has been prepared so that design engineers can quickly determine the correct class of asbestos cement pipe to use under various combinations of internal pressure and external loading. Curves are included to expedite the correct selection of pipe. Detailed analyses of the various structural factors affecting pipe design and selection are treated under separate headings. Pipe pressure class designations of 100, 150, and 200 refer to similarly numbered classes in AWWA C400, and coverage of installation can be found in AWWA C603. Included are sections on the following: references; pipe design and selection including strength and design factors, combined loading theory, three edge loads, and a number of selection curves.

"C400-80 AWWA Standard for Asbestos Cement Distribution Pipe, 4 In. through 16 In. (100 mm through 400 mm) NPS, for Water and Other Liquids," vii, 12 p, appendix, 1980.

This standard was made in May 1953 with the latest revision approved June 1980. It was ANSI approved in February 1981. Also provided is a history of the standard, information on use of the standard, the major revisions and metric information. This standard covers three pressure classes of Type I and Type II asbestos cement pipe, 4-16 in. (100 mm to 400 mm) in diameter for water and other liquids intended to be private rights-of-way. The pipe is to be used in pipe systems having relatively unpredictable flows and many appurtenances that do not permit reasonable hydraulic analyses, including that for surge pressure. Pressure class designations of class 100, class 150, and class 200 are the same used in AWWA C401. Included are sections on the following: general information, definitions, references, affadavit of compliance, materials specifications of composition, physical and chemical requirements, design, pipe classes, pipe diameters, pipe lengths, couplings, joints and wall thickness, workmanship and finish including imperfections, inspection, physical test requirements, retests and basis for rejection, test for uncombined calcium hydroxide, and test records, marking and delivery, and preparation for delivery. The appendix includes information and a table on fittings ends designed for use with asbestos cement pressure pipe.