

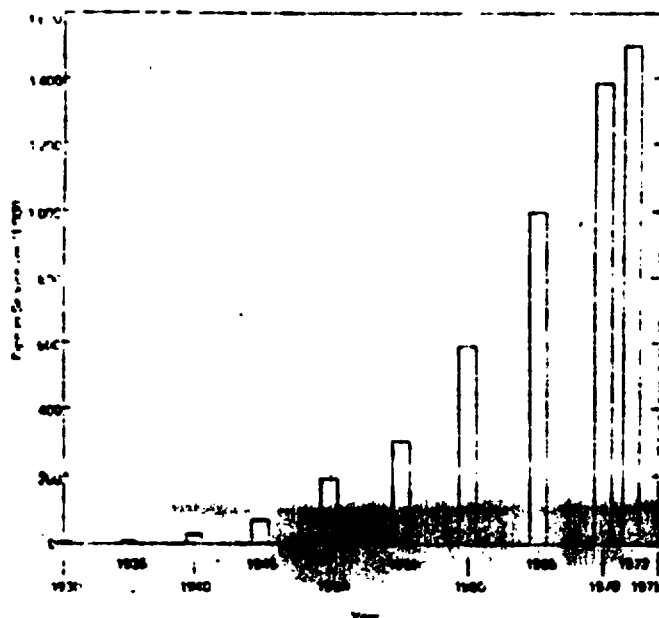
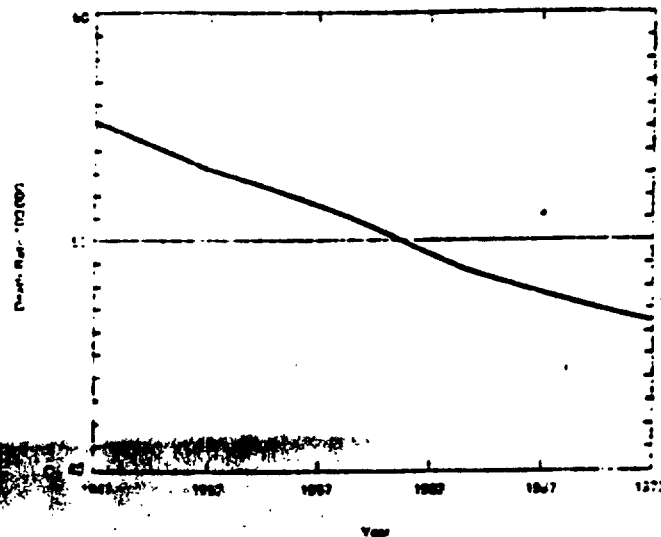


Fig. 1. Asbestos-Cement Pipe in Use Worldwide



Source: National Office of Vital Statistics

Fig. 2. Death Rate in US From Cancer of Digestive Organs

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Asbestos in Potable Water Supplies

Harold L. Olson

A paper presented at the Conf. of State San. Engrs. on May 7, 1973, by Harold L. Olson (Active Member, AWWA), market mgr., Public Water Pipe Div., Johns-Manville Sales Corp., Denver, Colo.

Tests made in various parts of the world indicate that present levels of asbestos in drinking water are not harmful to consumers and may, in fact, be economically beneficial.

Asbestos-cement pipe was developed in Italy approximately sixty years ago. Corrosion in lines of seacoast towns in Italy motivated a search for a corrosion-resistant pipe. In the years 1906-1913, an Italian company, Società Anonima Fieranit Pietra Artificiale di Genova, Italy, combined asbestos fibers with cement to produce a reinforced pipe that would take the high pressure necessary to pump salt water up into the city of Genova for its street flushing system. From this early origin

the acceptance of asbestos-cement spread rapidly through Europe and the rest of the world.

Widespread Use of Asbestos-Cement Pipe

By 1958 there were 40 000 mi of asbestos-cement pipe in the ground. There are now an estimated 1.5 million mi of asbestos-cement in service, of which more than 200 000 mi are in the US (see Fig. 1).

Causes for this worldwide acceptance and rapid growth follow:

1. Asbestos-cement pipe is resistant to corrosion, both internally and externally. This resistance has been demonstrated in tests run by the US Bu. of Standards on buried samples and by the US Bu. of Mines through tests conducted using corrosive mine-drainage water.

2. Asbestos-cement pipe has high enough strength to withstand the high internal forces imposed by water-hammer and shock earth loads from earthquakes.

3. Asbestos-cement pipe has contributed to high water quality. Manufacturers of the pipe have pioneered the concept of rubber ring joints—joints containing no jute that offers a focal point for bacterial growth. Asbestos-cement pipe does not rust and cause discoloration of the water.

4. Asbestos-cement pipe is light in weight and easy for the contractor to install. These qualities result in lower installation costs.

5. Asbestos-cement pipe has a permanently smooth interior wall so pumping costs are low.

Is Environmental Asbestos Dangerous?

Asbestos fibers have been recognized as a health hazard when inhaled in significant amounts into the lungs over pro-

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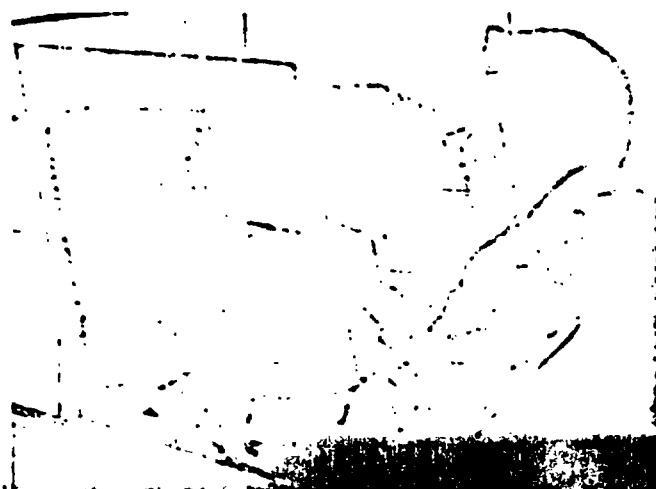


Fig. 3. Counting Asbestos Fibers on Electron Microscope

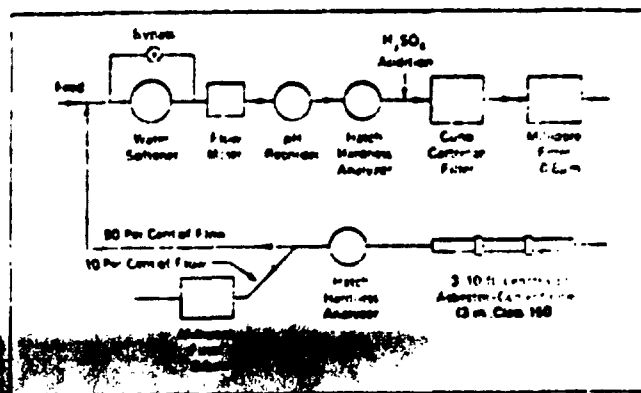


Fig. 4. Diagram of Experimental Loop System for Checking Asbestos Pickup From Asbestos-Cement Pipe

longed periods of time. Much work has been and is being done to clean up the atmosphere in occupational areas where asbestos is being used. Threshold limits for airborne asbestos have been established. It is interesting to note, however, that where asbestos fibers have been determined to be a factor, lung cancer has occurred only in workers who smoke regularly.

In late 1967 the USPHS was asked to look into the question of a potential health hazard from asbestos fibers in water supply, especially as it might be related to the risk of gastrointestinal (GI) cancer.

USPHS officials discussed the matter with two prominent medical authorities in the field of asbestos and health. They are George W. Wright, chairman of the scientific advisory committee of the Inst. for Occupational and Environ. Health and then head of the Med. Res. Dept., St. Luke's Hospital, Cleveland; and Irving J. Selikoff, prof. and chairman, Div. of Environ. Medicine, Mount Sinai School of Medicine, New York City.

Dr. Wright stated

To my knowledge, there have been no reports in medical literature of a relationship between gastrointestinal (GI) cancer and the drinking of water supplied through an asbestos-cement-pipe water system. There is no evidence that the ingestion of one, or a hundred, or a thousand asbestos fibers on one or more instances is related to gastrointestinal cancer.

Dr. Selikoff's view is that

There is no evidence at all at this time that the presumably very low-level exposure by ingestion which might occur by intake of water supplied through asbestos-cement pipe has resulted in a recognized health hazard.

These two opinions supported the position of the USPHS

that there is low probability of any health hazard associated with the use of asbestos-cement pipe (see Fig. 2).

Johns-Manville research assumed the task of further evaluating this situation. At that time, the J-M research facility was located at Finnerde, N. J., and employed more than 300 scientists and technicians with 30 assigned to research in the pipe division.

The research project was conducted along these lines:

1. Review of all available published literature and statistics.
2. Development of techniques to measure the amount of fiber in water. Levels of asbestos in water are so low that existing techniques to measure asbestos fibers in air samples detect asbestos in water.
3. Use of a new technique that employed an electron microscope. Water samples were measured for source waters, waters taken from distribution systems where asbestos-cement pipe was used extensively, and a special asbestos-cement pipe loop system constructed at the research facility which the quality of water could be varied to see if asbestos pickup changed with the different types of water.
4. A long-term study of two cities, undertaken to check asbestos in water samples over an extended period of time.

Animal Experiments

Published literature reveals that animal experiments had been conducted in which laboratory test animals had been either exposed to airborne asbestos or fed asbestos dust directly.

Inhalation. Animal experiments with airborne asbestos produced no GI cancer. Laboratory-test animals were used extensively in cancer research to study their reactions to various



Fig. 5. Overall View of Test System

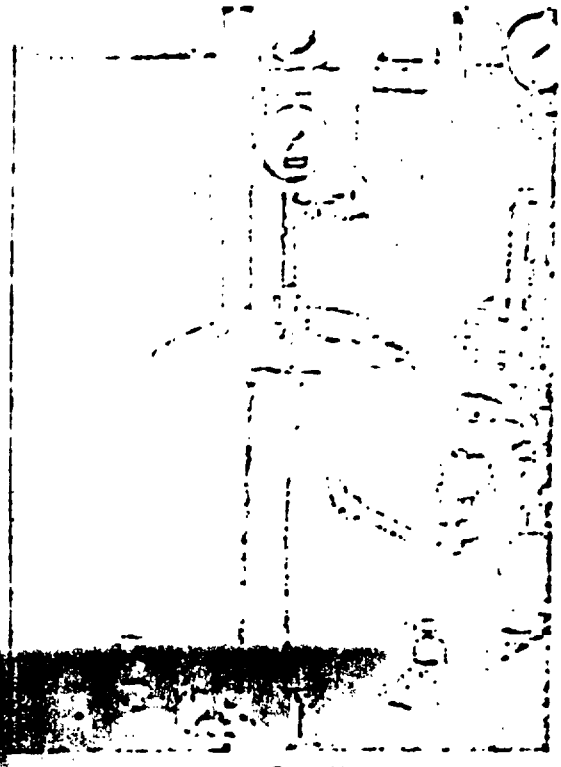


Fig. 6. Millipore Filter Housing

substances that are suspected of having some relationship to cancer in humans.

Tests of this nature, using asbestos dust in heavy concentrations in inhalation chambers, had been conducted on mice for as long as two years and on dogs for more than four years. The amount of fiber inhaled and swallowed by these experimental animals was 10 to 100 times that of the human exposure.

Dr. Wright pointed out that in inhalation experiments, the food, especially of the small animals, was covered by the settled-out asbestos fibers in the experimental chambers.

Inhalation experiments of this type have been conducted for many years in many laboratories without a single report of GI cancer. Dr. Arthur Vorwald and associates at the Saranac Lab. of the Trudeau Fdn. have issued two reports covering more than twenty years of investigation.

Dr. J. C. Wagner has conducted similar animal inhalation experiments in South Africa and in Britain. Neither Vorwald nor Wagner noted GI cancer in any animal.

In addition experiments conducted by Dr. Selikoff on hamsters generally support the dog- and mice-test findings.

"Yet," Dr. Selikoff commented, "the exposure to ingested asbestos in this experimental work was very much larger indeed than might be anticipated in water obtained from asbestos-cement pipes."

Direct feeding. Direct feeding of asbestos dust to experimental animals has failed to produce GI cancer.

In 1968, two British investigators, Brown and O'Flynn, reported an experiment in which hamsters were fed asbestos dust and approximately 100 mg of asbestos dust was ingested. The results of the experiment showed that the hamsters did not develop GI cancer.

sorption of asbestos fibers."

Statistics for Humans

USPHS records show that the incidence of GI cancer in the US has been declining steadily during a period in which asbestos-cement pipe sales have been increasing.

The level of asbestos in water-source samples transported through asbestos-cement pipe is very low. OSHA standards for occupational exposure calls for examination of airborne samples by an optical microscope 450x. Only asbestos fibers more than 5 μ m in length were given consideration. None of the water samples checked from either source water or water from asbestos-cement pipe showed any asbestos when examined with optical microscopes. Asbestos fibers were so thin and short that they could be seen only through the use of an electron microscope at a magnification of 4,000.

A procedure for checking the asbestos content of water samples by use of an electron microscope (Fig. 3) was developed and is described in Johns-Manville research reports E404-37 and 404-67.

Using this newly developed technique, researchers conducted a study of the waters from nine cities using asbestos-cement pipe for periods ranging from eight to seventeen years. Asbestos content of the water at the source to these city water systems was determined. Asbestos content was also checked at a point in the distribution system after the water had flowed through asbestos-cement pipes.

All source waters that were checked contained some asbestos fiber, the amount varying between 1 μ g/gal and 5 μ g/gal. After flowing through asbestos-cement pipe, the fiber content was 1 μ g/gal to 6 μ g/gal.

An experimental loop system of asbestos-cement pipe was

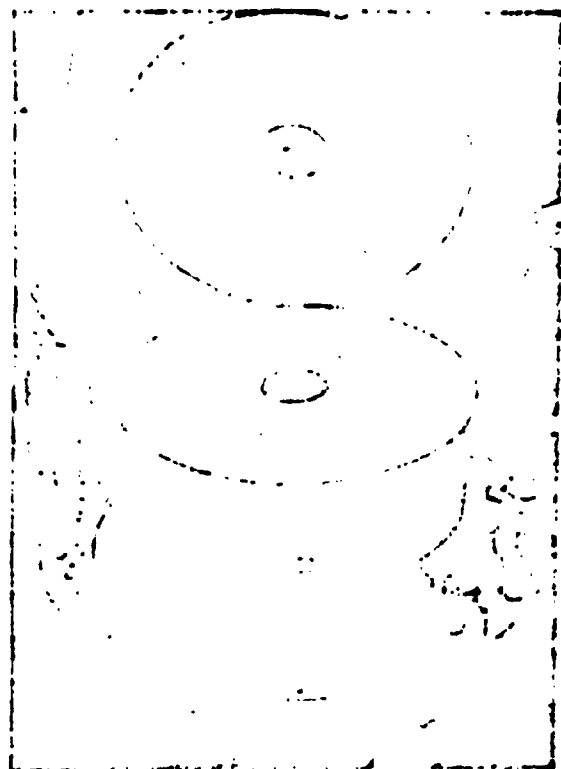


Fig. 7. Inside of Malvern Filter

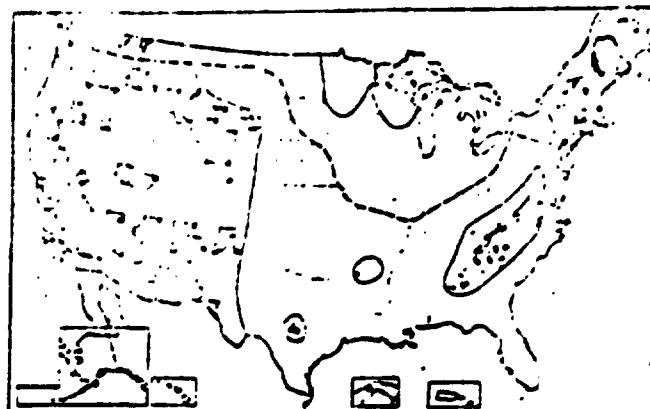


Fig. 8. Locations in US of Asbestos Sources
Gray areas are countries where amphibole asbestos fibers have been reported. Solid black areas are countries where amphibole or serpentinite rock, or both have been reported. (Where amphiboles and serpentinite are found in a country, it is solid black.) Solid lines surround those areas where amphibole rocks might exist. The dashed line shows lowest limit of glacial activity. Rocks not native to the area can be found north of this line.

constructed at the Johns-Manville Res. Ctr. The physical properties of water flowing through the system could be varied, and the asbestos pickup as a function of type of water could be determined.

This experiment is described in detail in J-M Res. Rpt. 1425-T-1360. Figure 4 shows the diagram of this loop system, and Fig. 5-7 show the filters that were employed in obtaining samples for examination with the electron microscope.

Long-term studies at Malvern, Pa. and Glendale, Ariz. were made; the results of the investigation of samples taken over an extended period of time at these two cities are contained in J-M Res. Rpt. 404-79. (See Appendix D, Part 2, September JOURNAL.)

Conclusions

1. The incidence of GI cancer has decreased within a period of time in which asbestos-cement sales have been increasing. This does not mean that the use of asbestos-cement pipe will decrease the chance of developing GI cancer; it does suggest, however, that GI cancer is not caused by using asbestos-cement pipe.

2. Pickup of asbestos in water that flows through asbestos-cement pipe is very small, and, frequently, many source waters contain more asbestos fiber than does water that flows from asbestos-cement pipes.

3. Under conditions in which the maximum asbestos-fiber content in water was observed, the total amount of asbestos that would be inhaled by a person during a 70-year life span in water would be less than 100 mg.

In Oct. 1972 a meeting was held at Lyon, France, under the auspices of the Intl. Agency for Res. on Cancer. This meeting was attended by scientists from all over the world actively in-

volved in the general field of the biological effects of asbestos.

At the conclusion of the seminar, with regard to evidence of increased cancer risk from asbestos fibers, some of the scientists stated that the amount of information developed to date on the subject of asbestos in potable water is quite extensive, and experts in this field have stated that there is no indication that waters conveyed in asbestos-cement pipes constitute any health hazard.

The AWWA Research Foundation may set as one goal the development of a maximum level of asbestos fiber content in water supplies. Judging from available data one may assume that most water supplies have some asbestos in them. Asbestos in source waters comes from the contact between water and serpentinite rock containing asbestos fibers. Figure 8 shows locations where asbestos-bearing rock can be found in the US.

Water flowing through asbestos-cement pipe does not increase the level of fiber content significantly. Asbestos in water is at a noncritical level, if, indeed, there is a critical level.

There is little evidence to support the belief that human life is shortened by drinking water that flows through asbestos-cement pipe, but there are data to support the position that one benefits by having a dependable water system that brings him water of the good quality at a reasonable cost.

The benefit to the consumer in using asbestos-cement pipe is supposedly that of a lower water bill every month. If this were achieved at the expense of a lower life expectancy, it would not be a good bargain for the consumer.

The material Johns-Manville has gathered and which has been presented in this article leads one to the conclusion that the consumer does benefit from the purchase of asbestos-cement water pipe.

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