REPORT ON ASBESTOS/CEMENT PIPE USE IN THE CITY OF PHOENIX, ARIZONA

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IN THE

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Introduction

The City of Phoenix, Water and Sewers Department, is the sixth of ten systems studied under the Municipal Analysis Program of the A/C Pipe Producers Association. In this detailed site visit, similar in nature and scope to the other nine, the objective was to obtain as much operating data on A/C pipe as possible in order to build a comprehensive data base. The broad functional categories covered by this fact-finding mission are as follows:

- Institutional
- Operational
  - Specification, Decisionmaking and Procurement
  - Installation and Testing
  - Operation and Maintenance
  - Repair and Replacement
  - Detection and Prevention
- Financial

Efforts were made to obtain detailed information in each of these categories. However, Phoenix had records of a much poorer quality than any water system visited. Information obtained is discussed herein.

Background on the Phoenix Site Visit

The two-day site visit was conducted on February 3-4. The most memorable feature of the visit is the degree of functional splits in responsibility coupled with the disparate locations of key entities.

Much of the two days was spent with Lyle Orr, Superintendent of the Water Distribution Division. Orr is a nice fellow, but fits into the mold of most Phoenix officials interviewed. Phoenix city officials, similar to those in San Diego, are concerned primarily with growth. Their water department is intertwined closely with other city functions and appears somewhat disorganized.

The Director of the Water and Sewers Department is Max T. Palmer. He has been Director for about five years, having succeeded the outspoken Art Vondrick in 1978. A/C pipe has been purchased for only those five years; Vondrick would not allow A/C to be bought.

The Assistant Director in charge of water operations is Philip W. Slagel. There are two main divisions on the water side, production and distribution, the latter headed up by Orr. As can be seen in the organization chart on page 4, the Engineering Division, directed by Raby, reports to the Director.

Phoenix is growing rapidly; the population equivalent served increased by 2 percent to 996,339 during the fiscal year ending June 30, 1982. The population equivalent (3.6 X service connections) increased 40 percent during the ten-year period 1972-81. The total number of service connections has increased correspondingly, from 271,048 in 1980 to 276,761. Over the same ten-year period, the number of service connections increased by an average of 8737. This rapid growth rate exceeds even that of Houston and El Paso.

Phoenix actually encourages growth, fearing that it will become "landlocked." Since 1972, Phoenix has annexed a number of private and public water systems in the surrounding area. During that period, the service area has increased for 282 to 331 square miles. One result of this rapid growth is that the distribution system is a hodge-podge of materials and hydraulicly undersized lines.

Phoenix's water supply is obtained primarily from a series of high level reservoirs, most of which were constructed around 1911 by the Bureau of Reclamation. Water also is obtained from the Salt and Verde Rivers as well as more than 100 deep wells in Deer Valley, Paradise Valley, and the Salt River Valley. To augment current treatment capabilities, Phoenix will construct a new water treatment facility in the near future. This construction is in anticipation of continued growth and getting a portion of the water from the controversial Central Arizona Project.

Water usage is a big issue in the entire state. The per capital usage in Phoenix is more than 235 gallons per day while usage in Tuscon is about half that amount. Governor Babbitt has repeatedly chided Phoenix's high usage in state newspapers. City officials say they would like to encourage conservation, but do not know how; this is a cavalier and untrue statement given the absurdly low rate of $0.37 per 1000 gallons charged to residential customers. Average daily production of the water system in 1981 was 234 mgd.

The Transmission and Distribution System

The Phoenix Transmission and Distribution System consists of 4270 miles of pipe as of May, 1981. Main sizes range from "2 inches and less" to 108 inches in diameter. Phoenix does not keep records of its system with respect to types of construction materials. Lyle Orr noted that about 10 percent of the system (420 miles approximately) is gray cast iron. Most of the cast iron is located in the downtown area. Almost all new development installations are A/C.

Both Orr and Raby estimate the amount of A/C pipe in the system to be approximately 3300 miles. This estimate would seem to be extremely high since most A/C installations have occurred in the past half dozen years. Some A/C pipe also has been inherited from acquisitions. Phoenix acquired Consolidated Water Company recently (as a result of condemnation proceedings) and in the process inherited a 20-inch A/C main.

Whereas the actual amount of A/C in the system is questionable, the amount of pipe added to the system in 1981 is known:

Size (inches)	Amount (feet)
4	14,400
6	293,000
8	171,000
12	51,000
Total	529,400

This amounts to about 100 miles of new pipe, 98 percent of which is said to be A/C. Thus, Phoenix appears to be the second largest user of A/C pipe, ranking second only to Houston.

Phoenix purchases and installs A/C primarily in the 6-12 inch sizes. However, they recently replaced a mile of 16-inch pipe on Sweetwater Avenue. The competition between the steel cylinder suppliers and the A/C suppliers was intense. The A/C people were successful, meaning that future jobs in this size--can result in A/C installations. For 16-inch and larger mains, the choice of material normally is mortar lined steel cylinder.

There is no discernible trend in pipe purchases. A/C is clearly the chcice of developers and, due to the rapid growth, this represents the most important portion of the market. The city itself purchases both ductile iron and A/C for repairs and replacement. Orr decides on the pipe material for these jobs. More often than not, the decision depends on "what is available in storage."

illustration of how decisions are made. The Ameron people argued A/C pipe was not a good choice in that large diameter. It was the first time Ameron--marketing mortar lined steel cylinder--had competed with A/C. The A/C people simply wanted to have their product included in the contract specifications, knowing the contractor would base his decision on cost. A/C was included in the specs and subsequently won the job.

There is no consumer constraint on decisionmaking. Furthermore, city officials are satisfied from a health standpoint that A/C is all right to use.

Although no one stated definitely why A/C is purchased, it appears to be a combination of soil conditions, price and ease of installation. The former director favored gray cast iron and did not like A/C. In addition, he did not want to buy Japanese pipe; therefore, the city bought no A/C at all.

Design Considerations

Class 150 pipe is purchased except in short sections. Tom Wasbotten, the city's hydraulic engineer, stated he does not feel load is a primary consideration, even under city streets. Class 150 has plenty of strength for the 3-4 feet of cover used. Normal design practice calls for 150 psi plus 60 psi of surge. Class 200 pipe is purchased in MOA's, the reasoning being that since wall thickness is reduced through machining, additional beam strength is needed.

Aggressive soils are somewhat of a factor. The soils pose a problem only when they get wet. Since Phoenix gets only about 7 inches of rainfall, this is not a significant problem. Phoenix also has expansive soils which cause the city to take special precautions in backfilling. Wasbotten feels distribution lines are extremely vulnerable to unknown sources of water. Given the dry condition, an unknown source of water results in severe settling and shearing actions.

Ductile iron is used under downtown city streets. A/C also is replaced with ductile iron whenever a storm drain or sanitary sewer crosses under the water main. In relatively inaccessible river or canal areas, the tendency is to use ductile iron because of its additional strength.

Service pressure in the system is 75-80 psi. In some areas, it is as high as 100-110 psi.

Another design consideration is hydraulic capacity. In some main replacement jobs, the city installs a 12-inch line parallel to an existing line. They may also install a 16-inch line parallel to an existing 6-inch main in a high density area.

As is the case in other cities, Phoenix is receiving bargain bids from contractors these days because of the depressed state of the economy.

Operation and Maintenance

Phoenix does not keep good records of main breaks. Orr believes they have about 2000 leaks or breaks per year on mains plus 5000 service leaks. Most breaks are thought to be caused by contractors, resulting from negligence. One inspector in the field engineering department stated "breaks are not due to lack of structural integrity of A/C, but rather due to our own negligence." The predominant type of break experienced in A/C is shear; this could be due to the fact that Phoenix pours concrete under some A/C joints. Occasionaly they place concrete on top of A/C in an attempt to keep the sewer line separate.

An inspection of leak report card files in the engineering department revealed most breaks occur in 1½-, 2-, and 3-inch galvanized, 6- and 12-inch cast iron. Of more than 60 recent (1981) leak report cards inspected, only 5 showed A/C breaks. Therefore, one can state with some degree of certainty that A/C breaks account for less than 10 percent of the annual total.

The Distribution Superintendent is not familiar with the aggressiveness index. The annual distribution system chemical analysis shows average values for pH of 7.8, total alkalinity of 106, and hardness 158. From these figure, an AI of 11.87 can be calculated. Since hardness ranges from 72-450 mg/l and alkalinity ranges from 82-254 mg/l, it is unlikely that the aggressiveness index ever dips below 11.

Repair and Replacement

Repairs

The total repair budget for main leaks and service leaks is $1.396 million. The main break portion of this budget is $531,000. Given the fact that there are approximately 2000 main breaks per year, an average cost per break of $2650 can be derived. Costs obtained in other cities have ranged from $700 to $5000. City officials estimate that it cost about $57.25 per hour to put a 4 person repair crew in the field.

Most repairs are made by application of either a leak clamp or a flex coupling. Phoenix also is the only city which does not have a strict policy of making A/C repairs with A/C pipe. Ductile iron and A/C are used interchangeably. Preference is given to DI in rocky areas. In the downtown area, either can be used.

operating budget including debt service is $30.5 million. The capital expenditure appropriation is $19.4 million.

Both revenue and general obligation bonds are used to fund long term debt. The water system currently has revenue bonds outstanding; the 1981-82 budget from this fund is $13.6 million.

Comparative bid data obtained have little value with regard to A/C pipe since the last actual purchase was in 1977. Average costs of the latest ductile iron and A/C purchases are shown below:

Material/Size	Average Cost
6" A/C	$2.32
8" A/C	3.36
6" DI	5.58
8" DI	7.22
12" DI	9.91

Conclusions

Phoenix appears to be the second largest user of A/C pipe in the country, having installed an average of just over 100 miles/year during the period 1978-81. The City itself has not purchased A/C since 1977; all purchases have been made either by developers or City contractors.

A/C's competition in Phoenix is ductile iron and not PVC. In fact, the City people are "scared of plastic"; this fear results from cracking problems experienced with polybutylene and polyethylene service lines. A/C has virtually the entire replacement market in the 4-12 inch size range and recently expanded into the 16 inch size.

A/C pipe use is relatively new in Phoenix and would appear to have its best years still to come. Any slow down in sales can be attributed largely to lack of housing starts and the overall state of the economy.

The challenge to the A/C industry is how to attack the fragmented management structure in the City. Unlike other cities visited in which key decisionmakers were few or at least concentrated, the number of decisionmakers in Phoenix is spread over two departments and four divisions.

Phoenix is a valuable account and a solid one. If there is a trend in pipe use, it is toward increased A/C use. The Water and Sewer Department can use a lot of technical assistance. They are not as advanced as San Antonio, EBMUD, or Pueblo. The industry by providing some technical assistance in the near term could secure this account for the foreseeable future.

Specification No. 6
Asbestos Cement Water Distribution Pipe
Revised May, 1980

6. The owner will reserve the right to make spot checks and tests for materials supplied to confirm that material received meet the standards. Failure of those tests would call for the removal of material from the project and all costs for testing and removal will be at the contractor's expense.

7. The uncombined calcium hydroxide shall not exceed 1%. Notarized test certificates of compliance to 1% or less of calcium hydroxide will be required.

   This uncombined calcium hydroxide (free lime) test, testing procedure, and sample selection shall be done in accordance with Appendix of AWWA C-400, latest revision.

8. Rubber rings used to seal the joints of asbestos cement pipe shall comform to the requirements of the latest revisions of ASTM-D-1869 (Rubber Rings for Asbestos Cement Pipe). The rings shall be compounded of synthetic rubber of the non-oil resistant type with physical properties as given in Table I. Natural rubber rings or neoprene rings will not be permitted.

   The rubber ring manufacturer shall submit, in triplicate, certified tests results, showing that the physical properties of the rubber rings comply with the physical requirements of Table I, ASTM-D-1869, latest revision.

9. All pipe and couplings shall be prepared for shipment and shipped as recommended by the manufacturer.