

Independent Study Sings the Praises of PVC Water Pipe

By Craig Fisher
Association Engineer

Where at Uni-Bell have never been shy about singing the praises of PVC water pipe. However, in this article, we will step aside and let an AWWA Research Foundation (AWWARF) study do the singing for us. The study, entitled "Evaluation of Polyvinyl Chloride (PVC) Pipe Performance," documents PVC's exceptional track record in the water industry. This article will provide some background on the study, outline the approach, and review the findings.

Background

As you are well aware, AWWARF has been instrumental in generating quality research on a number of topics of interest to you, the water supply professional. One topic you have told AWWARF that you wanted investigated is PVC water pipe performance. As a result, AWWARF contacted various research facilities early in 1991 and requested research proposals on the subject. The Research Foundation awarded the \$133,000 project to Utah State University (USU). That should come as no surprise. With USU's thirty-five (plus) years of pipe research experience, it has earned its long-standing reputation as the premiere site for pipe research, regardless of pipe type.

The members of the USU research team may sound familiar to you as a result of their past contributions to the engineering community. Dr.

Al Moser was the Principal Investigator for the research team. Co-Principal Investigators were Doctor Reynold Watkins, Doctor Roland Jeppson, and Doctor Ronald Canfield, Ph.D. Candidate Ken Kellogg served as the Research Assistant.

Approach

The first phase of the research may best be described as assembling and analyzing the collective knowledge of many individuals. The means to be used to tap this collective knowledge was, of course, a questionnaire. Crafting the perfect questionnaire involves eliminating any source of bias while eliciting thoughtful and meaningful responses. (Those surveyed should be thankful that academics recognize the bias of nonresponse, which is reduced by limiting the questionnaire's length.) But we will not bore you with Questionnaire Design 101. Suffice it to say, the eight-page questionnaire was worded carefully to eliminate bias and to solicit concise responses. Most important to the validity, only actual users of PVC could input on PVC experi-

ence questions.

The questions themselves addressed important issues in design, installation, operation and long term maintenance; asked for responses from a

population.

In September of 1991, the four hundred utilities, firms and agencies were contacted. Of those contacted, 228 utilities and 56 engineering firms and government agencies agreed to participate. 162 utilities and 29 engineering firms and government agencies actually returned the questionnaires, which represents a terrific response rate. The research team then compiled the data from the questionnaires and analyzed the results. These results were discussed with AWWARF's project advisory committee. Together they formed the

focus for the second phase of the project. This involved resurveying selected utilities to obtain more detailed information. It also involved collecting pipe samples from utilities for testing. Both of these subjects will be discussed below in greater detail.

Survey Results

In a nutshell, you like PVC water pipe - a lot. On the top of your list of reasons was the pipe's hydraulic performance, both new and after years of service. Can your other pipe

products say the same? When the research team asked you on the utility questionnaire, "Have you ever experienced any noticeable increase in frictional losses caused by excessive material buildup on the interior wall of the PVC water pipe?" 116 of you said no, and none of you said yes.

The second item on your Why-I-Like-PVC-Pipe list is longevity. The product scored extraordinarily well in the longevity categories: corrosion resistance, life expectancy, and durability. PVC simply does not corrode or deteriorate over time, which is one solid reason to use the pipe.

Engineers like numbers, so we certainly will not hold them back from you. Question 17 of the Utility Questionnaire asked, "Based on past performance in your pressurized water system, for each listed design consideration, rate the following types of pipe from 1 to 5. (1 being poor and 5 being excellent)." The pipe materials considered were Steel, Ductile Iron, Reinforced Concrete, Polyvinyl Chloride, Cast Iron, and Abestos Cement. Let's see how you rated PVC.

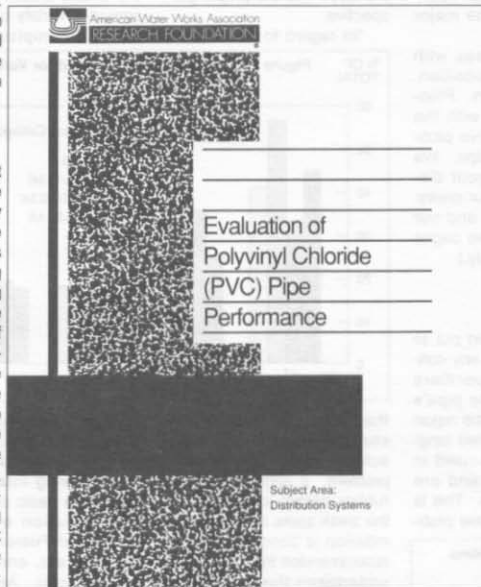
(a) **Economics:** best total value considering initial cost, installation, maintenance and life - 3.8

(b) **Installation:** ease of handling, care required in installing, availability of fittings and adaptors - 4.0

(c) **Hydraulic Characteristics:** small frictional head loss and conservation of energy, etc. - 4.5

(d) **Surge and Water Hammer problems and control thereof - 3.4**

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range of personnel - designers to maintenance foremen; and requested background information on the water system.

Questionnaires were delivered to water utilities, engineering firms, and government agencies. But how many and which ones? Here is where Dr. Canfield's services as a statistician came in handy. Four hundred candidates representing a broad range of users and specifiers throughout the United States were chosen, which provided a proper and valid sample

Ductile Iron/Why A New Standard?

By Dave Eckstein
Deputy Executive Director

As I travel the United States, many of you have two questions about iron pipe: (1) What does the revised AWWA standard really say? and, (2) What are people saying about pressure class ductile iron?

Canadian water suppliers have almost unanimously said "No" to ductile iron and "Yes" to PVC. (Vancouver being a notable exception). Our Canadian constituent, therefore, may choose to skip to another

article but are welcome to continue reading for sheer curiosity's sake if they wish.

What does the standard really say? We just look at the standard itself: ANSI/AWWA C151/A21.51-91, "American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids", is the standard in question. This first item to jump out to most is that this is not really a "new" standard. It carries a 1991 designation. The iron industry has curiously shied away from the fanfare typically accompanying a new or updated AWWA

standard. The attitude appears to be much more a "wait and see" or perhaps "use only as required."

From C151, "III, Major Revisions. Major revisions made in this edition of ANSI/AWWA C151/A21.51 include incorporating a pressure class designation for ductile-iron pipe and adding 60" and 64" (1500 mm and 1600 mm) sizes...previous standard thickness classes of ductile-iron pipe have been designated as special classes..."

The old thickness classes (50, 51, 52, 53, 54, etc.)

are now "special classes" and the norm is now a "pressure class" designation.

The huge success of AWWA C905, "Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 inches through 36 inches," would certainly promote a reaction from iron. In essence, the thinking was that the iron industry would introduce Class 49, 48, etc. in larger diameters.

Understandably, the marketing folks don't think much of introducing a new "lower" classification like Class 49. A good deal of current iron users don't think much of Class 50 and

51 due to tapping problems and, of course, corrosion in general. It was predictable to see a "new" classification system. What was completely unpredictable was which products were included in the pressure class designation and which were deleted.

Table 1 (see page 5) compares 8", 12", and 24" diameter pipes.

Basically, the larger diameter scenario was accurate. In 24" pressure classes 350, 300, 250 and 200 are marginally like getting a Class 52, 51, 50 and 49 respectively. Class 53 and larger, however, have been deleted. At 30" a pressure Class 150 or

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(e) **Maintenance:** relatively free from breaks, ease of repairs, nondeterioration with age, etc. - 3.9

(f) **Life Expectancy:** longevity, resistance to internal & external attack, etc. - 4.1

In all but one category, PVC ranked either first or second. (Incidentally, no piping product was able to sweep every category with either a first or a second place ranking.)

From those of you who haven't yet experienced the excellence of PVC we sometimes hear, "Yah, but what about tapping?" or "That PVC may be okay now, but wait awhile. It'll get brittle. And then - WATCH OUT!" or "Notice they ducked the permeation question altogether." AWWARF and USU did not skirt any of these issues in the report, and neither will we in this article. The greatest contribution this report may make will be to give you the facts from users and docu-

problem is rarely difficult to find. The report states that the most common cause of tapping problems is just plain tapping too fast. Other culprits cited were dull cutters (or the wrong cutter) and improper saddles. One other interesting statistic is that 4 percent of the utilities reported 71 percent of the major tapping problems.

The report agrees with the Association's position. The key is education. Properly trained crews with the right tools do not have problems tapping PVC pipe. We have two tools at your disposal for training your crews: our Tapping Video and our Tapping Guide. (See pages 11 and 12 respectively.)

Longevity

The report should put to rest once and for all any concerns users and specifiers may have about the pipe's longevity. To quote the report again: "Material-related long-term problems reported in PVC pipe are few and are decreasing with time. This is an indication that these prob-

lem is consistent with previous studies on the aging of PVC."

Permeation

Another concern non-users have shared with AWWARF was that of permeation. This study should put the issue into the proper perspective.

"In regard to permeation,

Testing

Research efforts were not limited to questionnaires alone. The team asked for pipe samples and got them. Sixteen utilities provided sixty samples. The samples were obtained from utilities across the United States and represented a variety of manufacturers. Samples received

Locating

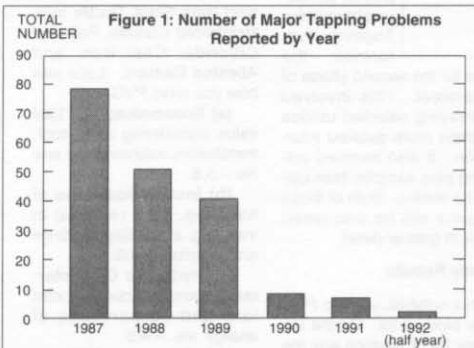
We feel we would be negligent if we did not tell you both the good news and the bad news. Your major concern with PVC pipe, if you had one, was locating. The feedback is important and we are listening. Work on locating non-metallic pipe is underway.

Conclusion

Research such as this provides invaluable information to the users and specifiers of PVC pipe, as well as to non-users. It shows that PVC water pipe's popularity across the United States and Canada has not been an accident and has been a result of a well engineered product that is very suitable for this end use. We commend USU and AWWARF for their efforts.

Editor's Note: To order your own copy of this report call or write AWWA Customer Service Department, 6666 West Quincy Ave., Denver, CO 80235, (800) 926-7337.

Ask for Evaluation of Polyvinyl Chloride (PVC) Pipe Performance Report # 90644



mentation you need to silence these rumors.

Tapping

As Figure 1 shows, utilities are having fewer and fewer problems with tapping PVC pipe as they are becoming more and more familiar with the proper tools and procedures. To quote the report, "Tapping problems associated with PVC are decreasing with time as utilities gain more experience in tapping."

The utilities that did report tapping problems were resurveyed for more detailed information. Eighty percent who had said they had major problems said they felt they have solved their tapping problems when resurveyed. They also said they have "not had any failures in the last year or two of the survey period."

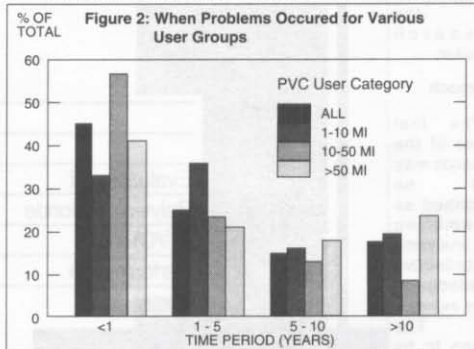
The source of a tapping

problem is not a result of aging."

We would like to tell you that PVC water pipe is an absolutely fool-proof product that will never experience any problems. We can not make that claim, nor can any other piping product. We can say this, if you do have a problem, your system will most likely be under contractor warranty, because "Almost 50 percent of [the] problems reported with PVC pipe occur in the first year after installation."

Figure 2 graphs the occurrence of problems as a function of time. As the graph shows and as the report states:

"It is evident that the problem rate is decreasing with time. If the pipe material were degrading as it aged, one would expect just the opposite trend in the data (i.e., the problem rate would increase with time). This find-



the utilities included in this study reported very little actual experience with this problem. It appears that the rubber gasket joints may be the weak spots as far as permeation is concerned. It is recommended that a study be undertaken that will obtain data on actual field experience combined with data from laboratory tests to better understand the importance of proper joint design to help minimize permeation."

The report goes on to say that "For future studies, it is recommended that utilities keep better records on problems they experience with any type of pipe. Accurate records will be particularly important for any future studies dealing with permeation."

We agree with the research team. The gasket is the weak spot. That is why AWWA requires all gasketed piping standards to have a permeation warning statement. When using gasketed joints, with PVC or Ductile Iron or Steel or what have you, the prudent engineer should consider permeation whenever he or she encounters a contaminated area.

On the brighter side, utilities infrequently encountered the problem. Only seven out of 162 (4%) utilities surveyed claimed to have any permeation problems whatsoever. The figure was originally 11 out of 162 (7%). But the "subsequent follow-up found that one of the 11 had problems with polybutylene, not PVC; two had only heard of problems in other utilities; and one utility had problems with low-head irrigation pipe."

were manufactured by ten different companies. The pipe samples were subjected to the following three tests to determine basic composition and extrusion quality: (1) Degree of Fusion Test, (2) Impact Test, and (3) Filler Content Tests. As a result of the testing, the report finds that "PVC pipe being installed in 1992 appeared to be of high quality."

Fisher Joins Uni-Bell

The Uni-Bell PVC Pipe Association has named **Craig A. Fisher** to the position of Association Engineer.

"Craig's primary responsibility is to strengthen Uni-Bell's position as the source of technical information to the PVC pipe industry," said Deputy Executive Director Dave Eckstein.

Craig graduated from the University of Texas with a Bachelor of Civil Engineering and a Master of Business Administration. He is a member of the American Water Works Association and the American Society for Testing and Materials.

As Association Engineer, Craig is responsible for writing technical articles, responding to inquiries,



conducting seminars, and representing Uni-Bell at professional meetings.