You Should Know

American Concrete Pipe Association

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A Case In Point

Reinforced concrete pipe has a proven performance history. It has provided, and continues to provide, a reliable structure for the conveyance of effluent in a variety of conditions.

HDPE pipe has a proven performance history as well. It has proven to be insufficient to handle the design and installation requirements that most owners, engineers, and contractors have come to expect from concrete pipe. Time and again individuals who have specified and installed HDPE pipe have come back and inspected the pipe later only to find the installation not meeting expectations. What happens then? Who pays for the repair or replacement of the pipe and the social costs involved?

The case of *Ridge Line, Inc. vs. Advanced Drainage Systems, Inc. (ADS)* in the U.S. District Court of West Virginia is a good example of what the limitations are for HDPE drainage pipe, and how problems resulting from these limitations are addressed when brought to the attention of the HDPE pipe manufacturer. When the pipe starts to fail, several questions arise, including:

- Can you believe the research claims made by the producer?
- Is the producer's profile wall design sufficient to avoid any localized failures of the pipe?
- Is the quality of the material in the pipe sufficient?
- Whose fault is it?

Ridge Line chose to use ADS pipe on the Southridge Centre development in Charleston, WV.

Six years after installation the 48-inch HDPE pipe was found to be collapsing. The pipe was relined with a 36-inch pipe with grout between the two pipe walls. This resulted in insufficient drainage capacity for the site. Consequently, another pipe must now be installed to compensate for the lost capacity. The developer, Ridge Line, brought suit against ADS, who brought in by way of Third-Party Complaint, both Green Valley Bridge, Inc. (contractor) and Triad Engineering, Inc.

The height of fill above the pipe ranged from 17 feet to 35 feet. The ADS product sheet, dated 1995, states that the pipe "has been tested to soil pressures equal to 180 ft. of fill", and lists a maximum cover of 60 feet. In this case, the "soil pressures equal to 180 ft of fill" was derived from testing in a soil cell. Many prominent buried pipe researchers have questioned the results from this soil cell test, believing it does not accurately reflect actual field conditions. Dr. Glenn Hazen from Ohio University was deposed in support of ADS. When he was asked, *"Do you believe that there are special installation methods or precautions that need to be taken with the installation of HDPE pipe that does not need to be taken in connection with the installation of concrete, aluminum, or steel pipe of similar styles for similar uses?"* Dr. Hazen replied, *"Yes"*. This question was followed by, *"Can you list for me what you think the special installation methods and precautions are?"* He responded, *"I think that backfill is much more critical for high-density polyethylene pipes. I don't think it is as critical for concrete."*

An assessment of the pipeline failure was performed for Ridge Line by Dr. Ernest Selig. Dr. Selig is a Professor Emeritus at the University of Massachusetts in the Department of Civil and Environmental Engineering and has performed a vast amount of research on buried pipes, including HDPE drainage pipe. He is also former Chairman of Transportation Research Board Committee A2K04 on Soil-Structure Interaction.

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Dr. Selig wrote in his assessment: *"Both ductile tearing and slow crack growth brittle cracking were prominent, accompanied by folding over of the damaged portions of the pipe wall. "É .the cracking potential is increased by using a polyethylene material with low crack resistance and by tendency for distortion of the wall profile under loading. The cracking and distortion greatly increase the buckling potential. Furthermore, the polymer material used in the manufacture of this pipe is susceptible to cracking over time. In my opinion the combination of the pipe profile design and the pipe material is the cause of the failure."* In his deposition, when Dr. Glenn Hazen of Ohio University, testifying for ADS, was asked, *"Are you aware that there have been any manufacturing changes in the pipe of this type from 1995 to the present by anyone?"* He responded, *"What happens in the manufacture of pipe is usually things change from month to month."*

The second key issue in this case was the pipe's potential for cracking. In his assessment, Dr. Selig stated: *"Also the tensile stress required to cause failure in the form of cracks in the pipe wall is time-dependent. The lower the tensile stress, the longer the time to failure. The plastic may stretch a lot before failure (termed ductile) or it may deform very little (termed brittle)."* In the proceedings of the court case, ADS repeatedly stated how a sample of the resin taken from the failed pipe easily passed the current slow-crack growth requirement within AASHTO M 294. Perhaps this is more an indication that the slow-crack growth testing requirements for the product need to be improved, and not that the pipe itself is sound and reliable.

In seeking to avoid its own liability for its failed product, ADS alleged, "...any failure of the pipe *was the result of poor construction practices and a failure to adhere to the applicable requirements of ADS and ASTM."* With a pipe product made from a material that has questionable attributes, it is interesting that ADS claimed, *"The key to the performance of any flexible conduit, like ADS's HDPE pipe, is the installation, which is a specific, fact by fact, case by case, issue."* Apparently ADS refused to even consider that pipe material might be the problem. Another ADS response was, *"Among other things, the pictures of ADS's pipe show that the pipe deflected more than 5%. For a pipe to have such deflection, the surrounding soil would have to compress an equal amount, which means that there was not adequate soil compaction by the contractor."* 5% deflection is an important service limit for this product. While one may often hear an HDPE salesman say that the deflection limit should be somewhere in the area of 7.5 to 10%, when it comes down to the performance of an actual installation, 5% is where they draw the line.

The case of *Ridge Line, Inc. vs. Advanced Drainage Systems, Inc.* brings to light many of the problems that can be associated with using HDPE drainage pipe. Unfortunately, this is not an isolated incident. In response to a request made during the case ADS supplied the names of fourteen similar claims or lawsuits for the period between 1996 and August 2001.

Certainly proper installation is an important requirement for all buried pipes. However, when consistent pipe problems occur because of a pipe's sensitivity to installation, then it really must be considered a material/product problem. An explanation of failure given by Dr. Ernest Selig for the pipe in the case of *Ridge Line, Inc. vs. Advanced Drainage Systems,Inc.* is as follows. *"Because of the profile wall shape, the load on the pipe from the fill caused high tensile stress concentrations which, together with stress crack sensitive polyethylene, resulted in the initiation of cracks. These cracks continued to grow over time. Local buckling developed in the profile including tubular members with or without the presence of cracks. The buckling would have initiated additional cracks. As the process progressed, tearing and folding of the wall components developed. The presence of cracks in the profile along with buckling would have caused pipe failure to occur at a much lower fill height than would be predicted by the crack analysis and local buckling models alone."*

Does this sound like an installation problem?

For a copy of "A Case in Point for Choosing Concrete Pipe" *(Ridge Line, Inc., vs. Advanced Drainage Systems, Inc.)* request ACPA Dispatch, Vol. 1 No. 3 from any ACPA member or download a copy from www.concretepipe.org.