

Know

You Should



A Message from the American Concrete Pipe Association

Bulletin No. 142

HDPE Pipe Service Life Facts and Conclusions

The Plastics Pipe Institute (PPI) recently published information claiming that high-density polyethylene (HDPE) M294 pipe has a service life of 2,893 years at 5% deflection. The American Concrete Pipe Association finds this claim to be grossly irresponsible. How is such a prediction possible for a pipe material that has been in existence for less than 50 years? Let's look at some relevant facts that **YOU SHOULD KNOW**.

Fact – HDPE's strength is time dependent and decreases over time under applied load.

Fact - Allowable design stresses in the American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications are based on 50-year HDPE material property values. There are no values for designing HDPE pipe with a service life that exceeds 50 years.

Fact - The AASHTO values were derived from HDPE pipe manufactured with HDB (Hydrostatic Design Basis) rated resins. [Resins tested per American Society for Testing and Materials (ASTM) D2837 to ensure 50-year strength values.]

Fact - The AASHTO requirement for M294 pipe to use HDB-rated resins was eliminated in M294 in 1991 and in the AASHTO Standard Specifications (design) in 1996.

Conclusion –Even the use of 50-year long-term material properties is, at best, suspect under the circumstances. The cell classification for M294 pipe has been changed several times since 1991. Removal of requirements for pressure-rated resins and modifications to the testing for stress crack resistance have weakened cell classification requirements. Thus, it is reasonable to conclude that HDPE pipe manufactured today may have an even shorter service life than that produced 20 years ago.

Fact - There are no AASHTO accepted 100-year long-term material properties for M294 pipe.

Fact – The Florida Department of Transportation (FDOT) hired Dr. Grace Hsuan in 2003 to conduct research into stress crack resistance, oxidation resistance, and long-term material properties for M294 pipe.

Fact - Hsuan's paper Evaluate the Long-Term Stress Crack Resistance of Corrugated HDPE Pipes, (Plastics Pipes XIII, 2006), which stems from the FDOT research, along with the 2006 American Society of Civil Engineers paper, Establishing 100-Year Service Life for Corrugated HDPE Drainage Pipe written by PPI employee Mike Pluimer, are the bases of PPI's claim of a 2,893-year service life prediction at 5% deflection.

Fact – Hsuan's research reveals that the pipe liner exhibits a major susceptibility to stress cracking. Yet service life predictions based on the Hsuan research do not utilize liner cracking as the controlling factor to predict service life. With significant cracks in the liner, it is not rational to assume the pipe will maintain consistent hydraulic properties during its design life.

Fact – Past National Cooperative Highway Research Program (NCHRP) research and the FDOT research performed by Dr. Hsuan indicate that the existing test for antioxidants required for long-term service life in M294 is inadequate. Therefore, any HDPE pipe currently produced per M294 is subject to oxidation and material property breakdown prior to its design service life.

Fact – The FDOT Task Group that reviewed the research was split on its conclusion that the FDOT testing protocol would assure a 100-year service life.

Conclusion – Although it finalized its research on stress crack resistance and oxidation resistance, the FDOT never completed the material properties research for M294 pipe. However, the FDOT's initial tests indicated long-term strength and modulus values are actually lower than the values presently given for use in AASHTO Design. Despite its recent claims to the contrary, HDPE pipe may be getting weaker. Certainly it is not the miracle product its advertisements proclaim.

Summary – If PPI's service life claim is legitimate, a pipe with a 2,893-year service life installed today should last until the year 4900. Is this possible? The 2,893 years may apply to the "life" of a fragment of the material still surviving in a landfill but not the "service life" of a functioning pipeline – both structure and conduit.