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Kevin Thibault, P.E.
Assistant Secretary for Engineering and Operations
Florida Department of Transportation
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Re: FDOT Standard for HDPE Pipe Service Life Determination

Dear Mr. Thibault,

As you are likely aware, on April 18, 2007 the FDOT issued the final report of the Technical Review Group (TRG) on HDPE Corrugated Pipe (HDPE CP) entitled "Research Synthesis and Recommendations for Corrugated High Density Polyethylene Pipes." This report was based on the several meetings of the TRG dedicated to a review of the adequacy of proposed FDOT specification for HDPE CP 100-year service life (FDOT Section 948), based on the report of Drs. Hsuan, Y.G., and McGrath T.J. [1]. We, Drs. A. Chudnovsky and S. Stivala, were asked to serve as members of FDOT's TRG.

As members of the TRG, we have raised numerous critical questions and concerns related to a) unreasonably long extrapolation of a relatively short-term test data, and b) test methodology for chemical degradation, with no resolution in the TRG. In most cases, the topics were pushed aside with a comment by the facilitator that "more work is welcomed in research synthesis and direction." We find the specification inadequate and we question the scientific basis of the testing.

Unfortunately, the conclusions of the TRG report essentially ignored these important questions and concerns, and failed to recommend any changes to the FDOT testing protocol that would have resulted in a more scientifically-defensible specification. In addition, we believe that the TRG report presents our comments on the subject in a capricious manner. It is our concern that the FDOT may be proceeding with a high-density polyethylene (HDPE) pipe service life testing specification that is fundamentally wrong and thus would mislead the industry.

The following is an example of use of misleading information from the report [1] contained in an article posted on July 31, 2007 on CENews.com by Michael Pluimer, the technical and engineering manager for the Plastics Pipe Institute, entitled "How long will corrugated HDPE pipe last?." Below we quote from that article.

"Drexel University researchers, led by Grace Hsuan, Ph.D., have developed a new test protocol for corrugated HDPE pipe, utilizing the Rate Process Method, The results were published and presented at the recent international Plastics Pipes XIII conference, held in Washington DC.

According to Hsuan's data, the pipe tested far surpassed the 100-year service requirement in the harsh environmental conditions of Florida. The results were dramatic enough to remove any doubt about the 100-year issue and re-set the baseline much higher for corrugated HDPE pipe.

Highlights of the data include the following:

- *Service life of 572 years at 7.5 percent deflection (675 psi material stress in the pipe wall);*
- *Service life of 949 years at 6 percent deflection (600 psi material stress in the pipe wall);*
- *Service life of 2,893 years at 5 percent deflection (500 psi material stress in the pipe wall)."* [End of quote.]

Indeed, the results are "dramatic" enough to require that their validity be examined. In that respect we have two fundamental concerns:

1) The duration of the accelerated testing that allowed one to extrapolate the data for hundreds and even thousands years of HDPE CP service life was less than a year of testing of coupons cut from the pipes (see ref. [1]).

2) The assumptions (limitations) built into the "Rate Process Method" that was the basis of such an incredible extrapolation of relatively short tests results are:

> Assumption 1: During the time interval of extrapolation (hundreds and thousands of years in this case), **the material properties remain the same** as they are during the time of testing (less than one year);
>
> Assumption 2: There are **no new mechanisms of failure** take place over the time of the extrapolated service life other than those observed during the accelerated testing.

There is no basis to believe that the fundamental assumptions 1 and 2 are valid for HDPE for hundreds and thousands of years, since it is well known that HDPE over time experiences physical aging and chemical degradation. For what HDPE CP service life the aging should be taken into consideration depends on molecular architecture, additives and morphology of the HDPE, as well as on the service conditions. There is no question in our mind that HDPE aging should be taken into consideration, when 100-years service life is promised, not to mention 500 hundred or even thousands of years.

One should also keep in mind that the Rate Process Method is an empirical method, justified by past experience. It has never been validated for HDPE for more than an extrapolation of ~ 20 times. Claims of hundreds and thousands years of HDPE CP service life based on less than one year of testing (hundreds and thousands times extrapolation!) are irresponsible speculation.

The above limitations of Rate Process Method have not been mentioned anywhere in either [1], TRG Report from April 18, 2007, or FDOT Section 948. Our critique of the specification was ignored. Simply put, we do not believe the FDoT's test requirements will demonstrate a 100 year service life for HDPE drain pipe.

In the event that another state is considering the adoption of the FDOT requirements for Class II HDPE pipe (100-year service life per Section 948), it would be misleading if our concern expressed in this letter is not made available to that state.

We would welcome an opportunity to explain more fully our position on this matter to you and other interested parties. Please feel free to contact us by email or phone.

[1]. Hsuan, Y.G., and McGrath report T.J., "Protocol for Predicting Long-term Service of Corrugated High Density Polyethylene Pipes", Final Report to Florida Department of Transportation, July 29, 2005.

Sincerely,

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