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Buried-pipe maintenance and rehabilitation: My view of the future

Contributed by Grant Whittle, Vice President, Ultraliner, Oxford, Alabama, USA

Most failures of buried clay pipes are related to poor construction practices, usually involving improper embedment. Following World War II, there was a huge construction boom and there were not nearly enough knowledgeable, well-trained construction workers. Much of the clay pipe installed during the fifties and sixties was cracked the day it was backfilled. The "as-constructed" extreme variability of the clay pipes from that era has made predictive maintenance essentially impossible. The joints on the old pipes have pretty much all failed since then, leading to the infiltration-erosion process causing uneven loads on the pipe thereby creating unpredictable rates of load-induced pipe fracturing.

It should, however, be noted that clay pipe has evolved over time. The current clay pipe uses the same quality joint gaskets as are used with PVC pipes, and they have more conservatively designed pipe walls that are highly unlikely to fail due to improper installation. Today's clay pipe is one of the most durable products on the market, albeit not always the most inexpensive.

Unfortunately, in the past, no-one recorded baseline-condition data "as-constructed" so it is hard to tell at what rate deterioration has occurred. Did fractures occur at the time of backfilling, or are they the result of an active deterioration process involving erosion of the bedding and backfill material? Given so many causes of failure, which occur at highly variable rates, achieving any semblance of accuracy in the projections of remaining design life will need a large sampling of data with multiple points (preferably including baseline-condition data), showing change in condition over time, correlated with as many field variables (soil type, burial depth, groundwater depth, rate of infiltration/soil erosion, etc) as practical.

There are two scientific methods of projecting remaining design life:

- a mechanistic model in which all possible variables are accounted for (or at least a valiant attempt to do so), so that the pipe behaviour over time can be accurately modelled, and
- a probabilistic model in which large volumes of data are analysed so that statistical trends emerge in the midst of incomplete data.

The problem with developing a complete mechanistic model for projecting pipe failure is that you'll spend large amounts of money collecting all of the data that influences the pipe deterioration (technology to see through the pipe and show voids, laser profiling of the exact geometry, soil sampling to determine the precise soil modulus and density, groundwater level testing taking into consideration 50 or 100 year flood levels, chemically active soils, pH of the water, etc).

It probably won't be affordable to routinely collect information about the soil on the other side of the pipe and the exact current geometry of the pipe for at least another decade. Sure we can do it now, but is it practical and affordable to create a mechanistic model dependent upon collecting so much, and such expensive field data? What good is such an accurate diagnosis if it costs more than the preventative cure? You may just as well go ahead and assume failure and spend a comparable amount rehabilitating the pipe in a preventative-maintenance model!

On the other hand, probabilistic models have accuracy problems. The many unknown variables create significant scatter in the data, preventing an accurate plot of the data points for projecting the behaviour. The only way to eliminate the scatter of the data is defining more variables at ever increasing costs, or to use a larger sampling of data. No single city, not even

the City of Atlanta, Georgia for instance, will ever have enough data to get a statistically valid predictive-maintenance projection.

So what can we do? A mechanistic model is too expensive at this stage to be immediately practical, and a probabilistic model seems improbable. Or is it?

Here's where the pipeline assessment and certification programme (PACP) of the National Association of Sewer Service Companies comes into the picture. When an agency uses PACP/Water Research Centre (WRc) standard codes, the collected data is compatible with most of the PACP/WRc data being collected across Europe, Asia, and North-America. While a single city's data may be an insufficient data pool to get a statistically valid projection, someday I hope to see the establishment of a central data warehouse for all PACP/WRc-compatible data.

And yes we are still trying to iron out the wrinkles of data-exchange capability and ensuring data integrity.

As the data pool increases in size, and as additional important variables are defined and added to the standard data pool, statistical trends will eventually emerge.

While, in the interim, researchers may develop their own preferred deterioration-projection models and predictive-maintenance models, such a central data warehouse can ultimately be used to benchmark the accuracy of such models.

We are not yet at the point where we can expect to do reliable projections regarding rates of deterioration and remaining design life. We are, however, rapidly headed in that direction. As our compatible data pool increases in size and in scope of information, analysable trends will develop and projection models will become amenable to scientific verification. We will ultimately get to the point of stating that at a certain confidence level, the least-cost predictive-maintenance schedule is to rehabilitate this pipe in a particular year.

Thus, we need to be working towards a scientifically-verifiable means of predictive modelling. At the same time, we must have predictive models that are actually affordable to implement. A central data warehouse of compatible data could be the key step in achieving this. Any agency can immediately adopt international coding standards i.e. PACP in North-America and the most recent version of WRc in the rest of the world, so that their data can someday be analysed with proven, benchmarked projection models. Without standard data, there can be no scientific basis for predictive modelling.

And as a post-script:

If we want to short-circuit this laborious process for future generations, all new projects need to have "as constructed" baseline condition data entered into our asset-inventory systems. In that way, 40 or 50 years from now, the engineers of the future can compare their current asset condition to the “as constructed” condition and get a more accurate projection of their predictive-maintenance needs.

Just as we have learned that the performance of some direct burial materials have proven easier to predict than others that suffered from greater construction variability, some rehabilitation alternatives are more consistent than others and will therefore be more predictable.

Ultimately, we will be able to adjust our design and our material selection processes for the lifecycle cost advantages of consistent and predictable materials.

Help! Our history is missing

by Joop van Wamelen

Since June of last year, I've been beavering away at the job of honorary director of SASTT. I had some catching-up to do, but eventually I could turn my attention to trying to tidy up the minute books containing the minutes of the annual general meetings and of the board meetings of SASTT, and collecting the annual reports by the presidents.

From the documents I "inherited" and out of my personal electronic files I could collect a set of minutes of the board dating from January 2000 to the present. I could not find any board minutes for the period before 2000.

I also assembled the minutes of the AGMs held in 1997, 1999, and from 2000 till now.

The AGM minutes from the inauguration of SASTT till 1996 and of 1998 are missing.

The constitution of SASTT requires that minute books must be kept - indefinitely, it would seem.

As regards the annual reports by the presidents, those were initially delivered verbally at the AGM. Only gradually did the good habit take hold to keep a written record of the annual reports. I have the annual reports for the years 1993, 1996, 2000, 2001 and 2004 - and a draft for 2005.

If any members, particularly those who have served on the board at any time, have any of the missing minutes or annual reports, they are requested to contact me, *groot asseblief*, to let me get copies, so that I can get the archives of SASTT up to scratch.

Workshop held in Cape Town

On 20 July 2006 a task team comprising SASTT members Jean-Louis Frey, Nigel Ireland, Mike King, Justin Spreckley and Mike Winfield, all of the Western Cape, held a workshop around the theme *Improving service delivery through proactive management of pipeline rehabilitation*.

Support was given by Glen Derman, Alaster Goyns and Johann Wessels who flew to Cape Town to participate in the event.

After the workshop had ended, 45 delegates returned questionnaires, all with very positive responses. Effectively, what most of them said about the various aspects of the workshop amounted to: "We want more!"

- They wanted more workshops - and a repeat of the one just held;
- they asked that such a workshop should be more technical;
- they wanted to learn about asset management; and
- half of them would join up if a Western Cape branch of SASTT would be established.

The task team did sterling work in giving publicity to the workshop. *Die Burger* carried a news article on it and IMESA asked for a contribution to its magazine.

And wait for it:

The workshop was sponsored by no less than sixteen organisations, with contributions ranging from R 500,00 to R 5000,00.

Good work, guys - and keep it up!

Any prospective members of the Western Cape branch of SASTT, are urged to contact Mike Winfield at:

Telephone 021 761 3474

E-mail: *mdw@martin-east.co.za*

Last (and late!) but not least: The SASTT board for 2006

You may well say: "About time to let us know!"

Well yes, but SASTT has not had a newsletter since the February 2006 number – and that preceded the AGM where the board was announced. Not having stories to fill a newsletter is a nagging problem. In 2005 we had a nice run of stories, all contributed by board members, but SASTT does not consist of the board only. Please, members, let's have your success stories, or even just photographs of matters trenchless.

But to get back to the board…

The composition of the board for 2006 has been on the SASTT website since April, but for those who don't browse, the elected board members are:

Craig Burnie, Vermeer Equipment Suppliers (Pty) Ltd, Vice-President
Glen Derman, Sight Lines Pipe Survey Services, President
Alaster Goyns, Pipes cc, Immediate Past President
Andries Lötz, Johannesburg Water (Pty) Ltd, Treasurer
Andy Pienaar, Insitu Pipelines cc
Joop van Wamelen, Secretary and honorary director
Johann Wessels, City of Tshwane.

The elected board members can also call on the following co-opted members for specialist help:

Paul le Roux, Goba Inc
Ian Venter, Petzetakis Africa (Pty) Ltd.