# Inspector gadgets save the sewers

Before embarking on a trenchless technology project for the repair of sewage pipelines, it's essential to have a clear idea of the level of deterioration before taking the next step. CCTV, and laser and sonar profiling provide a good picture of what lies ahead. **BY FRANCES RINGWOOD**

It's often been noted that the majority of South Africa's underground pipe network is between 40 and 50 years old, and that this is the time when it's most advisable to replace or repair pipes. Trenchless technologies (TT) offer a range of repair options that are often more environmentally friendly and quieter than open-dig methods, while being far less expensive than replacing large sections of pipe.

However, before embarking on any pipe repair project, it's critical that the municipal engineer or his representative consulting engineer evaluates the condition of a given pipeline. This will ultimately assist proactive municipalities to manage their assets in a cost-effective, and environmentally and socially conscientious manner.

According to Alastair Goyns, owner of Pipeline Installation and Professional Engineering Services, "The use of reliable, affordable CCTV inspection systems to inspect gravity pipelines and capture a visual representation of their internal condition has probably been the major driving force behind the development of trenchless rehabilitation techniques."

Engineer physically assessing the level of encrustation within a pipe *(Source: Aecom)*

The reason for this is that the internal state of a pipeline cannot be ignored. Pressurised pipes usually have ways of letting the public know when a leak has occurred. Gravity-fed sewer systems are not as straightforward. When an outfall sewer leaks, contaminated wastewater may enter the water table or seep into local rivers. It's unhygienic and it's clearly more desirable that faulty pipes or broken joins are repaired in order to ensure environmental and community health and hygiene.

"In the worst cases, sinkholes may appear. These are costly to repair and in these cases it's too late to apply TT repair techniques," comments Mike King, past president of the South African Society of Trenchless Technology and current technical specialist in municipal engineering at SMEC South Africa.

## Inspecting pipes

King goes on to say that proactive pipe rehabilitation entails inspecting pipes that are expected to show deterioration. "Pipes don't last forever – although some do last an extremely long time, provided correct installation and appropriate procedures are followed by good, qualified engineers and contractors. Once a CCTV camera is inside a pipe, it will then collect diagnostic information measured against a five-point rating tool, to determine whether a repair intervention is necessary," explains King.

In the most severe cases, data collected will indicate that a pipe may be at risk of imminent collapse; in slightly less severe cases, the pipe condition may indicate that it is likely to deteriorate further. In these cases, using trenchless repair methods is advisable.

A trenchless project in progress after a pipeline was determined to be in need of repair in Cape Town *(Source: Gustav Diedericks, Aecom)*

Other scenarios will show pipes need further inspection in, say, five or ten years, that there is only minimal deterioration, or that the pipe is still in good condition.

"Once the decision has been made to rescue a pipe that is severely deteriorated or facing imminent collapse, the pipe can be effectively rehabilitated using trenchless methods – it can be reinstated as a valuable asset to the municipality," says King.

## Camera operation

In the case of smaller-diameter pipes, CCTV inspection is relatively easy. Inspections can be performed at night, when flow rates are minimal or absent. Large-diameter pipes, on the other hand, require considerably more sophisticated inspection methods because they are subject to continuous flows.

"In these cases, the municipal or consulting engineer carrying out the inspection may want to mount a CCTV camera on to a small pontoon or boat. For large-diameter pipe inspection, it's often advised to incorporate laser and sonar capability to provide a 360-degree view of how the pipe looks from the inside," says King.

"The laser projects a ring of light around the top of the pipe and the camera picks up whether the ring is broken or deformed. If the image presents a perfect ring, the pipe is okay. Sonar works in much the same way, except it's capable of showing the pipe's profile below the water line. In addition to being able to detect slippages between the joins, corrosion and section alignment issues, sonar can also detect debris or silt at the bottom of the pipe," he adds.

What's useful about silt detection is that it indicates if a pipe needs cleaning prior to undertaking rehabilitation services. If the pipe cleaning contractor knows the extent of the silting, it will greatly assist them to come up with a realistic cost estimate, rather than having to provide a guess-based invoice and then haggling over prices after the fact.

**"The use of reliable, affordable CCTV inspection systems has probably been the major driving force behind the development of trenchless rehabilitation techniques."**

After the CCTV or CCTV-combined sonar and radar analysis has been completed, the municipal or consulting engineer in charge will produce a report detailing what defects were encountered, according to specific engineering coding manuals. The codes will indicate a range of different defects, including cracks, abrasion or imminent collapse.

Once the report has been compiled, it will be assessed to determine the condition of the pipes, as well as looking at where environmental factors like groundwater seepage need to be considered in taking the decision to repair a pipe.

However, a CCTV diagnostic on its own is not enough, and it's also important that a physical assessment of the pipe be carried out in order to look at other factors, such

Engineers will often mount CCTV cameras and any additional equipment they need on to a little remote-controlled car, which they operate from the surface *(Source: San Invest)*

as pipe thickness, acidity and whether pipe loading has remained the same since the product was initially specified.

## Physical inspection

Henk Aartsma, principal engineer at Bigen Africa, explains how to approach physical inspections intelligently and what processes are involved. "Obviously, with physical inspections, safety must come first. You can't just send a man down a pipe with a torch and ask him how it looks," says Aartsma.

"A quick way to determine what a pipeline was originally made of is to look at the intervals between the pipe joins using a CCTV device; because different materials are manufactured in different lengths, this provides a reasonably accurate picture of the original material," he adds.

Encrustation can make it difficult to tell very much about the condition of the original pipe material. In cases of extreme encrustation, a screwdriver or other flat-ended tool can be used to find out about the real condition of the pipe. "Once you look beneath the surface, you'll see that build-up is like a cancer. I've seen a pipe originally built out of fibre-cement that had become as thin as paper," says Aartsma.

For determining a pipe diameter, Aartsma says the easiest way is to go to where pipes abut a manhole structure. This will also reveal the pipe's wall thickness, as well as its class in terms of loading capacity.

"Sometimes, additional loading capacity is imposed on pipes and it's advisable to do some reverse engineering to determine if the pipe is handling loads it was originally designed for. For this purpose, I usually go back and look at old design catalogues to determine external strength characteristics. Then, you look at whether a road was built on top of the pipe in the intervening years and take into account additional loading from traffic above ground. From there, it's possible to determine what amount of loading is still available to the pipe in order for it to retain its structural integrity."

**A laser projects a ring of light around the top of the pipe and the camera picks up whether the ring is broken or deformed. If the image presents a perfect ring, the pipe is okay**

Aartsma also recommends using litmus paper to perform a simple pH test on the moisture of pipe walls. Extreme discolouration will indicate a sulfuric acid attack. "For a more detailed investigation, we drill for a few core samples, which will also provide us with an indication of wall thickness, corrosion and encrustation," says Aartsma.

## Trenchless options

Once the full condition assessment is completed, the time comes to make a decision as to what – if any – remediation steps need to be taken to protect the long-term value and integrity of the pipe.

"For these decisions about the most suitable method for repairing a pipe – taking into account the capacity, water tightness, durability and structural needs of the pipe – there are a number of TT options available in South Africa," says Goyns.

He adds that these methods for sewer repairs include:

- Sliplining: This involves the insertion of a smaller-diameter pipe into a larger-diameter host pipe. This method will reduce the inside diameter of a pipe, but it is efficient.
- Cured-in-place pipe (CIPP): CIPP involves the insertion of a resin-impregnated soft liner. The liner is then expanded and cured using heat or ultraviolet light. This method does not reduce the host pipe's diameter but it can be tricky if there are sharp changes in the pipe profile, which may place stress on the liner.
- Spiral-wound lining: This involves feeding a continuous, unplasticised polyvinyl chloride or high-density polyethylene profiled strip into a mandrel placed to form a continuous spirally wound pipe. This method only slightly reduces the diameter of the host pipe and is useful for large-diameter pipes where it is important that flow reduction is minimal.

"For reticulation and collector sewers, another technique that can be included is pipe-cracking, which enhances the sewer's capacity. Other technologies that can be used are CIPP patch, repair and grouting for sealing joints," says Goyns.

The latter methods are more suitable for pipelines subjected to isolated damage and other unique scenarios.

## Recommendation

Trenchless experts agree that proper diagnostics are an essential tool for determining when to repair a pipeline, as they provide a sound method for balancing cost, environmental performance and the immediacy of need.

Where sewerage pipelines are allowed to deteriorate without regular inspection, the results can be disastrous, eventuating in contamination of nearby surface water, sinkholes that put human lives and property at risk, and – at the very least – the unnecessary loss of a municipal asset.

CCTV, radar and sonar technologies have been indispensable in the rise of trenchless repair methodologies. Nevertheless, physical assessments continue to play a critical role in the decision-making process of how best to manage the long-term life of pipes. 3S

# No-Dig: 2018's ours

The Southern African Society for Trenchless Technology (SASTT) has secured its bid to host the prestigious International No-Dig Conference and Exhibition.


Sam Efrat, president, SASTT, has dedicated the society's successful bid to former honorary director Joop van Wamelen, who sadly passed away earlier this year

"I recently had the honor of representing SASTT at the International Society for Trenchless Technology's (ISTT) 33rd annual International No-Dig Conference and Exhibition. The event was held on 28 to 30 September 2015 at the WOW Convention Center in Istanbul, Turkey, and was jointly hosted by the Turkish Society for Infrastructure and Trenchless Technology," explains Efrat.

"As is customary, the ISTT board of directors held its AGM on 27 September 2015 – the day before the start of the conference. Of the 27 ISTT-affiliated member societies worldwide, 22 attended the ISTT board meeting, including SASTT. One of the main items on the agenda was the selection of the society to host the 2018 No-Dig Conference," he adds.

## Tough competition

In a hotly contested bidding process, presentations were made by the Finnish Society, bidding for Helsinki, the Romanian Society, bidding for Bucharest, and SASTT, bidding for Cape Town.

"I am extremely pleased to announce that the ISTT board selected SASTT to host the 2018 International No-Dig Conference and Exhibition in Cape Town," says Efrat.

This is indeed a huge honour as well as a great opportunity for South Africa. The conference and exhibition will see a large number of both local and international delegates and exhibitors attending the event.

"It will be a great opportunity to unite government and the engineering industry in finding common ground and the most applicable solutions to rehabilitating our leaking water pipes and solving and managing our current water shortages," adds Efrat.

## Leading up to 2018

In 2016, the ISTT will be joining with the China Society of Geology – Trenchless Technology Committee to host the 2016 No-Dig Beijing.

In 2017, the ISTT will join with the Colombian Institute for Subterranean Infrastructure Technologies and Techniques in hosting the 2017 International No-Dig.

Leading up to the 2018 event, SASTT will undertake several smaller conferences in all major centres each year to create awareness and promote the use of trenchless technology, which can offer sustainable job creation as well as provide cost-efficient pipe rehabilitation and installation methods. 3S