TELEMETRY CUTS THE COST OF LEAK DETECTION

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Abstract
A medium-sized water utility in southwest Germany has installed innovative technology that permanently monitors the network and alerts the central office as soon as a leak appears. The average run-time of a leak event has been reduced to one-and-a-half days, thus enabling reduction of water losses to lower levels than ever before. In addition to this, the effort and cost of localisation has been reduced by 98%, with all analysis being performed in the office.

Introduction
Albstadt is a town located in southwest Germany, about 80km south of Stuttgart. Albstadtwerke is the utility network distribution provider in this region, supplying potable water, natural gas and electricity. In addition to managing and maintaining the local distribution assets in Albstadt, Albstadtwerke operates and maintains two more potable water distribution networks, seven natural gas distribution networks and an electricity supply.

Albstadtwerke is efficiently run with 80 employees for the entire operation and construction of its networks and facilities. It has been a corporate policy for many years to continuously evaluate current methodologies and introduce new innovative methods in leak detection and trenchless pipe installation.

The Challenge
Figure 1 shows a picture of the Albstadt region, which is spread across three valleys and has a height variation of 400m. This geographical landscape creates a number of operational challenges, including:

• A large number of different pressure zones;
• Long sections of trunk main; and
• Long distances for maintenance staff to drive to reach the extremities of the network.

Approximately 50% of the water supply comes from our raw water catchment and is processed in several stages at our water plant to produce high-quality drinking water. The other 50% is purchased from a total of three suppliers. We are about 80km away from the Lake of Constance, which is one of the biggest lakes in Europe.

Our current Non-Revenue Water is 20% (600,000 cubic metres), which has increased from 10% five years ago. The increase in the NRW percentage is due to a 50% reduction in total consumption; our water loss has remained constant.

The ground is limestone, which means that almost no leak is visible on the surface as there is always good drainage. We have had massive leaks of 25L/S disappear underground (Figure 2). Our first investigation was in the Braunhartsberg reservoir zone. This zone consists of 52km of pipework with a mixture of cast iron, UPVC and ductile iron, and it contains most of the factors that make leak detection difficult.

Water Loss Innovations
Our first strategy to improve network efficiency was to install a flow meter on the reservoir outflow and have the data sent to our office on a daily basis with alarms to advise us if there was an increase in minimum night flow (MNF). This is shown in Figure 3.

Figure 1. The Albstadt region in Germany.

Figure 2. Typical limestone ground.

Figure 3. Flow meter installation.
Leak detection was performed by sending a team out in a van to deploy noise loggers with radio communication and then download the data in a drive-through survey the following day to localise the leak position and use a ground microphone and correlator to pinpoint the leak. We have been using this equipment for many years and we have found that only loggers with radio communication could be used efficiently. The loggers are mounted directly on the pipeline with a magnetic connection to provide a good sound recording. It would often take this two-man crew five to ten days to find the leak in this large zone, driving an hour each way every day.

The next strategy made to improve efficiency was to install additional flow meters within the zone to localise the leak position to a smaller area within the zone, and reduce the amount of time spent searching for the leak. We were not measuring or analysing total flow into sub-zones, we were just looking at significant changes in daily water flows to localise the leak positions.

Our Next Improvement — the Optimal Solution?

With the previously identified systems, we were able to achieve good results. However, there was always still a certain amount of effort to carry the measured data to the office for any detailed analysis and then send a crew to pinpoint the leak before the leak is repaired. Because of our geographical situation, a lot of time was wasted driving back and forth to the office to analyse the data and then back to the field to pin-point the leak. Therefore, we decided to introduce a system that transmits the data every day to the decision maker at the office to reduce the response time and travelling time.

Communication reliability. We found the communication to be very good, without the need to install an antenna close to the surface. Batteries lifetime: We operate in a temperature range from –30°C in winter to +30°C in the summer. In 12 months of operating the Zonescan, there have been no problems.

Assessment

Noise loggers have been deployed magnetically on a hydrant and correlating noise logger deployed on the water tower.

Figure 4. Installation pictures of the noise logger, radio repeater and GPRS data collection unit.

Figure 5. Braunhartsberg pressure zone in Zonescan net software.

Noise loggers have been deployed magnetically on a hydrant.
The Monitoring Platform

The data is hosted on the Gutermann webserver and accessible via log-in to the Zonescan net software. There is mapping, amplitude distribution graphs, frequency spectrum and correlation data in this software platform. Figure 5 shows a map in the Zonescan net software; the green, orange and red dots are the loggers. They are colour-coded green for no leak, orange for possible leak and red for probable leak. The fuzzy orange dot is a correlated leak position.

It is also possible to show the loggers in a satellite picture; this provides better orientation. When this particular leak appeared it was identified with correlations from over 15 logger combinations and we repaired the leak in record time, it started on February 9 and was repaired on February 10.

We can identify mechanical noises, which reduces the amount of time wasted searching for noises that are not leaks.

Figure 6 (top) is the correlation graph and shows the location of noise on the pipeline to identify the leak position with the big peak, which is 22.9 metres from logger 1 and 63.6 metres from logger 2.

Figure 6 (bottom) shows the frequency spectrum of the noise detected. False alarms can be created from low frequency noises in the 50 to 150Hz range, while leaks are usually at a higher frequency.

All of this analysis is performed in the office before any employee goes out to the site.

A leak can be seen in Figure 7; the correlation provided by the Zonescan system was less than half-a-metre from the actual position.

Conclusions

With this technology we have been able to continue to maintain our MNF to 0.4L/S, with an average run-time of a leak event being 1.5 days, enabling us to reduce our water losses to lower levels than ever before. In addition to this we have reduced the effort and cost of localisation by 98%.

With very good maps of the pipeline network the Zonescan produces a precise location of the leak. Considering the excavation cost is €3,000, we still confirm the leak position with a ground microphone before digging.

We had no communication problems during a particularly cold winter, with a thick layer of snow on the ground.

We found small leaks that our experienced leakage team would not have discovered, and the leak hunters tell me they can hear the worms cough!

The Author

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This edited version has been prepared by Andrew Clark, who is International sales and marketing director for Gutermann, a company specialising in intelligent leakage management.

Since the paper was presented at the Global Leakage Summi, Albstadtwerke has started installing the equipment over the whole of their network.