Successful Trunk Main Correlations

By Andrew Clark

Introduction

The Gutermann Aquascan™ (Trunk Main) correlator recently provided a series of high performance correlations in trials performed in Sydney, Australia. Sydney Water provided a 1.2km of 600mm OD steel trunk main for a series of tests to be performed to evaluate the performance. The testing was administered by Veolia Water and Sydney Water with on-site assistance provided by ADS Environmental.

The performance of both accelerometers and hydrophones was tested during this trial. The installation of accelerometers is far easier and always the preferred option when tappings are not available. To deploy an accelerometer sensor, you need access to the pipeline, so a magnetic connection can be made. To use hydraphones, a tapping must be made in the main so that the sensor can make contact with the water column.

You can see on the map in Figure 1 that when a sensor is deployed at position "A", it will be right next to one of Sydney's busiest highway's generating a large amount of low frequency background noise. There is a strong possibility that this background noise can drown out the sound of the leak and make correlating impossible during busy traffic periods. If this is the case the trials may have to be performed at night. The pin hole leak was simulated at point "B" by placing a cap over the valve with a small hole of approximately 1mm diameter drilled into the cap. The scour valve was used as a leak simulation at point "D", to create a 1L/S leak it was opened about 2 turns and to create 0.3L/S it was opened half a turn.

Measurement 1 is a simulated leak on a 600mm OD steel pipe over a distance of 746m and the leak is simulated by activating a scour valve to generate a 1L/S leak. Hydraphones were used

> "*The Aquascan™ successfully locates leaks at distances over 1 km in Australia - the land of long pipes.*"
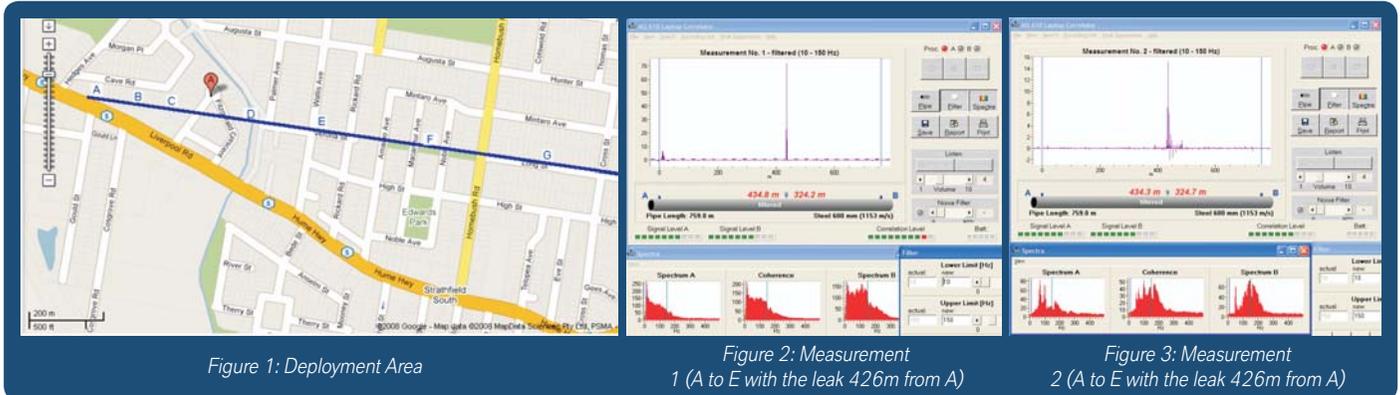
Figure 1: Deployment Area

Figure 2: Measurement
1 (A to E with the leak 426m from A)

Figure 3: Measurement
2 (A to E with the leak 426m from A)

in this correlation and the high quality correlation peak instantly identified the position of the leak to be 428.3m from sensor A and 317.7m from Sensor B. The correlator latched to this peak after about 15 seconds, providing an almost instant result. The actual scour position is 426m from sensor A and 310 from sensor B. The exact distance measurement is yet to be confirmed, the sketch indicates a distance of 736m, however the distance entered into the correlator was 746m, an error of 10m.

Measurement 2 is a simulated leak on a 600mm OD steel pipe over a distance of 746m and the leak is simulated by activating a scour valve to generate a 1L/S leak. Accelerometer sensors were used in this correlation and the high quality correlation peak instantly identified the position of the leak to be 428.3m from sensor A and 317.7m from Sensor B. The actual scour position is 426m from sensor A and 310 from sensor B. The difference between the correlations in Measurement 1 and Measurement 2 is that measurement 1 uses Hydraphone sensors and Measurement 2 uses accelerometer sensors.

A tapping on the main is required to use hydraphones as they actually measure the sound and pressure wave in the water column, where as the accelerometer sensors make a magnetic connection to the pipe wall to detect the leak noise travelling along the pipe wall. With the resounding success of measurement 1 and measurement 2, the distance was extended to 1226m and the size of the leak was reduced to 0.3L/S. Measurement 3 shows the correlation with hydraphones and Measurement 4 with accelerometers. The

leak was instantly found with the hydraphones in measurement 3 and a very high quality leak peak accurately plotted the position of the leak. This leak is simulated with a sluice valve at 0.3L/S.

Measurement 4 shows the leak position correlated using the accelerometer sensors. Filters had to be applied to improve the shape of the peak indicating the leak position and the peak is far less dominant than the correlation with the hydraphones. The accelerometers picked up a significantly wider range of noises and these background noises are drowning out the sound of the leak. The fact that sensor A was right next to "Liverpool Road", one of Sydney's busiest roads, would have increased the amount of background noise. If this correlation was performed at night with less traffic noise, I would expect a much higher quality peak. ☞ **www.gutermann.net.au**

To test the equipment to extreme limits a new leak simulation was trialled which had a tapping on the 600mm OD steel main with a plastic hose leaking 5L/S. This was not detected by the hydraphones or accelerometer sensors over the 1226m length. Measurement 5 shows the poor quality correlation about 50m from the actual leak position, this measurement was performed with hydraphones.

Sensor B was then relocated to make the total distance 220m with a pin hole leak about 1mm diameter releasing about 8ltrs/min. The successful result to this correlation is shown in Measurement 6, a little filtering was performed during the correlation to find the leak within about 30 seconds. The leak
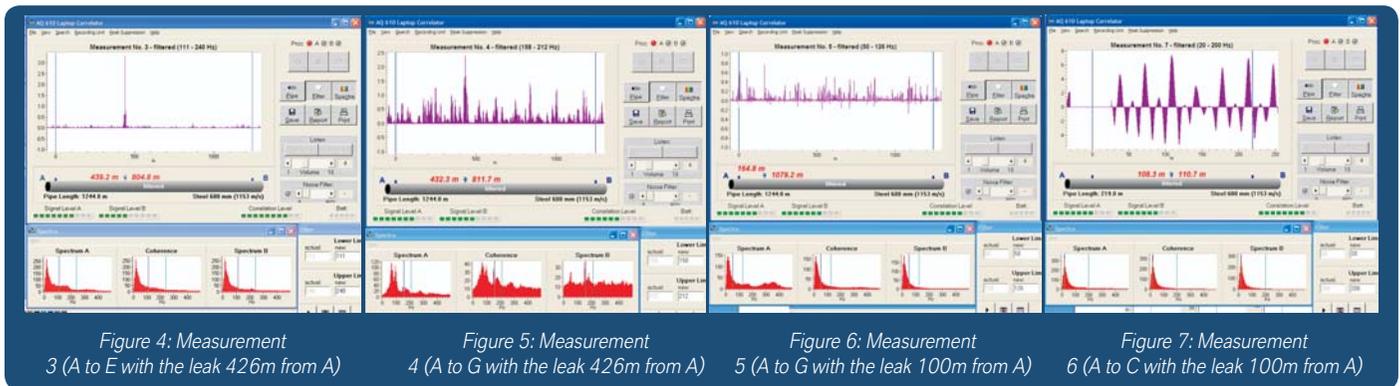

Figure 4: Measurement
3 (A to E with the leak 426m from A)

Figure 5: Measurement
4 (A to G with the leak 426m from A)

Figure 6: Measurement
5 (A to G with the leak 100m from A)

Figure 7: Measurement
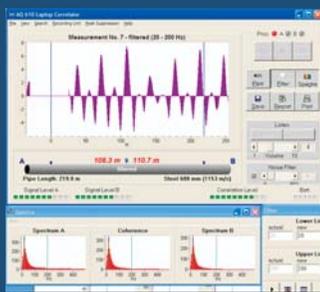6 (A to C with the leak 100m from A)

Figure 8: Measurement 7 (A to C with the leak 100m from A)

Figure 9:

a) Correlating from A to E with hydrophones - instant, high quality peak accurately indicating leak position. This is the same correlation as Measurement 1. Leak position is 426m from A.

b) Correlating from A to E with accelerometers - instant, high quality peak accurately indicating leak position. This is the same correlation as Measurement 2. Leak position is 426m from A.

c) Correlating from A to G with hydrophones and leak reduced - good quality peak accurately indicating leak position after filter applied. This is the same correlation as Measurement 3. Leak position is 426m from A.
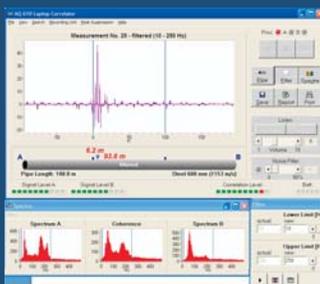

Figure 10

position indicated of 100.1m from sensor A and 113.9m from sensor B is believed to be accurate to 100mm.

Measurement 7 shows the same leak correlation with hydraphones. The hydraphones picked up the extreme traffic noise close to sensor A and it wasn't until we applied the "peak suppression" mode to suppress this peak that we unmasked a reasonably accurate correlation with a low quality peak indicating the leak position 5 meters from the leak. Hydraphones are tuned to lower frequencies than accelerometers, so they favour the low frequency traffic noise over the high frequency pinhole leak. The Peak that had to be surpressed is believed to be an actual leak very close to sensor "A". Initially it was believed to be the traffic noise but after investigation with an Aquascope 3 acoustic leak detection kit it looks likely to be a real leak.

The leak at B was turned off and more correlations were measured the results gave us a leak between 4 to 6m from Sensor A in the direction of B see correlation below.

The main was then probed and an Aquascope 3 was used to listen where the correlation indicated the leak. Sure enough a leak could be heard. Conformation of the leak will be achieved on excavation.

The correlation was reduced in length and Sensor B was moved to location B where the leak was originally created. A correlation was made and the result of 6m from Sensor A is shown below. This was suspected to be a possible out of bracket correlation due to its close proximity to the Sensor but with the conformation of the Aquascope 3 this all points towards a leak.

Conclusion

The trunk main correlator successfully located the leaks on the scour valve at 1L/S and 0.3L/S over distances of 746m and 1226m with both accelerometer and hydrophone sensors during the day.

It was found that Hydrophones performed better with the Scour Valve simulated leak and the Accelerometers performed better with the simulated pinhole leak. It was also found that the traffic noise provided greater interference to the hydrophones than the accelerometer sensors. These findings are to be expected, as hydrophones operate in very low frequencies, including the frequency range of traffic noise and accelerometer sensors work across a much broader range of frequencies incorporating the higher frequency of a pinhole leak.

Both accelerometer and hydrophones were effective at finding the simulated sluice valve leaks over distances of 1226m, however improvements in technology are required to find the pinhole leaks. I believe the correlator would have found these pinhole leaks at night when the busy traffic noise was reduced.

Leak noise correlators provide a location for the leak that is usually accurate to within 2m. Different joints and variations in the pipe manufacturing process will always cause a small variation in the velocity used to calculate the leak position and the result will always be more accurate when the leak is closer to the centre. Once the leak is located with the trunk main correlator, it should be pin pointed with an Aquascope 3 ground microphone or electronic listening stick. The ground microphone will perform better on low frequency leaks and the electronic listening stick will perform better on high frequency leaks. Follow the path of the pipe taking acoustic readings 10m either side of the leak location at 750mm intervals to identify the position with the loudest noise level, which is likely to be the exact position of the leak.

It was interesting to find that the Gutermann standard Aquascan 610 Correlator was also capable of accurately locating a number of these leaks including the correlation over 1226m, proving yet again why many people believe this to be the best correlator in the world.

About the Author

Andrew Clark is currently the Asia Pacific Regional Manager for Gutermann and has been involved in the training and supply of a wide range of pipe location and water leak detection equipments to the water industry for over 8 years. He has travelled extensively throughout the Asian region and is familiar with the extreme conditions many leakage operators face in busy cities with very low pressures. Prior to this role in Australia, he was based in Malaysia and England working in the oil and gas industry. Gutermann designs and manufactures data acquisition and leak location equipment for the world's water industry.

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