Advanced Engineering Solutions Limited

Case Study - Failure of Ductile Iron Sewer Rising Main

Problem

Three failure occurred in close proximity on a 700mm diameter ductile iron sewer rising main, the third failed pipe section was delivered to AESL for failure investigation. A fracture along top dead centre ran the majority of the length of the pipe spool (Fig 1), this was reported to be the same type of fracture as on the first two failures.

A section of the pipe wall was removed for detailed inspection. Deep corrosion pitting was identified along the line of the fracture on the internal surface. This line of corrosion was observed to be extremely localised (approx. 30mm wide) and ran in a straight line along top dead centre of the main. This pipe section was grit blasted to remove any corrosion product and allow accurate measurement of the depth of corrosion. (Fig 2)

Fig 1 - External pipe surface along line of fracture

Fig 2 - Close up of line of internal corrosion post grit blasting

Inspection of the socket from the adjacent pipe spool confirmed that the line of corrosion continued on the adjacent pipe spool suggesting that the pipe wall corrosion occurred after the main was laid.

Following AESL's identification of the corrosion pattern, AESL were tasked with determining the extent of this corrosion pattern along the length of the pipeline.

Solution

The inspection process targeted the identification of the observed corrosion pattern and used three inspection techniques at selected locations along the length of the pipeline. Each of the inspection methods was used externally over the pipe surface at the selected locations.

- A pattern of 120 ultrasonic spot readings (A scan) were taken over the full circumference of the pipe section, to determine general pipe wall thickness and allowing variations in wall thickness to be identified.

- The AESL magnetic flux leakage (MFL) inspection tool was used to identify patterns of internal and external pitting defects over the full circumference of the pipe section.

- Inspection using a B scan ultrasonic technique was used to provide a cross sectional ultrasonic wall thickness data over crown of the pipe to investigate the geometry of this internal corrosion pattern.

The inspection method was testing on the failed pipe spool to ensure clear results were achievable (Fig 3). The line of pitting defects were clearly visible at 0º on the MFL data and B-scan ultrasonic data showed a wall thickness reduction from 9.5mm to 4.17mm.

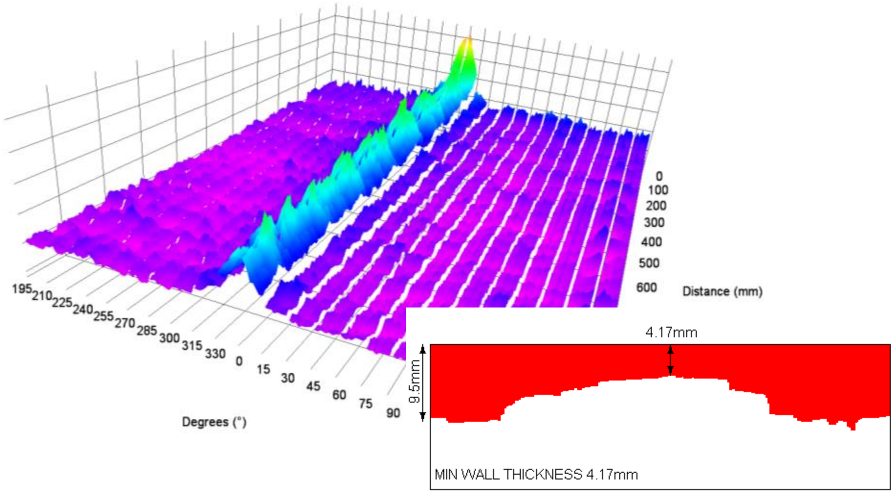

Fig 3 - MFL inspection and B' Scan Ultrasonic results on fractured pipe showing significant localised wall thickness loss at 0º (crown of pipe)

Inspection locations on the live pipeline were located along the rising main each location representing a section of the pipelines length. Fig 4 shows the results of the inspection closest to the failure, 250 metres up stream. The MFL data clearly shows that the pattern of wall thinning at 0º exists at this location, however the magnitude of the response is much smaller. B-scan results measured a minimum wall thickness of 9.1mm on a general wall thickness of 10.7mm.

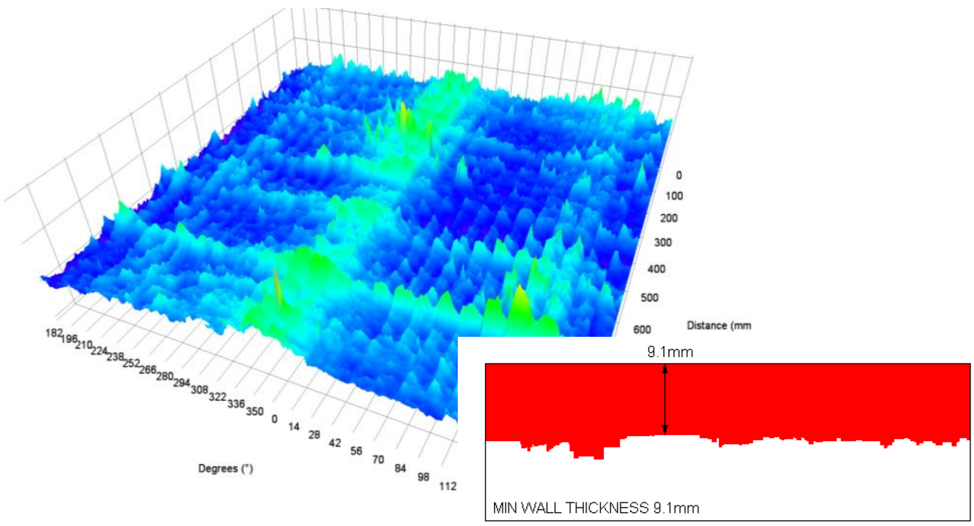

Fig 4 - MFL inspection and B Scan Ultrasonic Inspection showing wall thickness loss 250metres upstream of the failure

Conclusion

The pattern of corrosion that had caused the failure was evident at other locations on the pipeline, but to a much lesser extent. However given the short time over which the corrosion had developed, the remaining life of each section effected was severely limited.

The customer was able to use the inspection results and life prediction to plan a remediation stratergy, focusing first on the the sections most effected by the pattern of corrosion .