

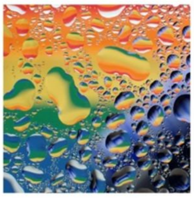

Condition Assessment of Sewage Rising Mains

Sewer rising mains are a critical asset in a sewer network and are viewed by their operators as a high risk and high consequence assets.

Failure can have significant environmental and operational impacts requiring costly reactive solutions with extensive tankering needed in smaller mains and over-pumping in mains typically greater than 300 mm to maintain the flows. Recently reported incidents of rising main failure have seen costs of over £1M in over-pumping costs alone.

Although companies have invested large sums in assessing the condition of their critical gravity sewer network, to date there has been little condition assessment work carried out on the rising main stock. This is principally due to the significant difficulties in undertaking accurate inspection either by using standard CCTV inspection or using non-destructive testing (NDT) methods.

To undertake a CCTV inspection of a rising main, the main needs to be removed from service and drained down to enable access to the pipe with resultant over-pumping or tankering costs. CCTV inspection will also not provide the required level of information to make an accurate determination of the remaining asset life as no measurement of pipe wall thickness is possible. Identification of areas of localised corrosion or ragging plugged in small holes may be possible, but will only provide an indication of likely failure.

NDT inspection of metallic pipes using ultrasonics or electro-magnetic devices can be used to provide a measurement of the remaining pipe wall thickness to allow calculation of the rate of corrosion and therefore an estimate of remaining asset life.

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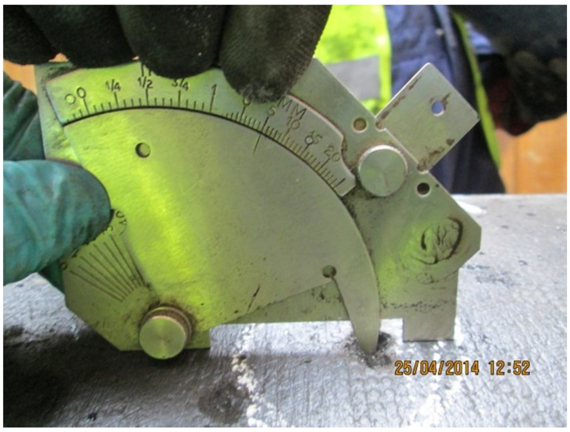
NDT inspection is carried out externally at selected locations along the length of the main where the pipe is exposed and cleaned over a 2 m section. Physical measurement of any external corrosion pits and the measured pipe wall thickness provide a calculated rate of corrosion based on the pipe age.



These locations are selected where there is an increased likelihood that external corrosion may occur such as changes in soil type or the proximity to a watercourse. The NDT results only provide the operator with a snapshot of the rising mains condition at those locations and assume that the corrosion is a linear process with a constant rate of corrosion over time.

Rising main operators have been reliant on the failure history of their rising main assets to indicate which mains may require replacement in the short to medium term and have used condition assessment investigation to determine the extent of any required pipe replacement. This has left companies responding on a reactive basis and unable to strategically plan their asset replacement programmes over the course of several AMP periods.

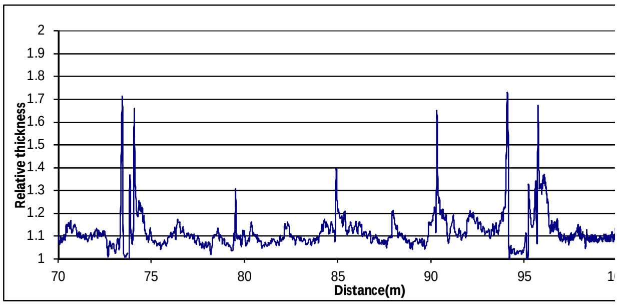
This has provided the driver for water companies to fund research into the development of new inspection techniques to provide them with a tool to determine asset condition without needing to remove the main from service or to excavate with the subsequent expensive enabling works.

An initial literature review conducted by WRc identified the use of sophisticated condition assessment tools in the oil and gas industry but these were seen to be prohibitively expensive and technically too advanced for the pipe materials encountered in the water industry. The first study identified 7 potential techniques to explore and these included acoustic surveys, CCTV inspection in live mains, the use of tracer gas, electrical conductivity, measurement of gross metal loss and the use of a remote field eddy current to detect leakage or pipe deterioration.

Use of acoustic techniques was found to be ineffectual in rising mains, unlike water mains, due to the lower operating pressures and the tendency of rising mains to self-seal with debris removing the ability to hear leaks. Tracer gas was also seen as unlikely to succeed due to the difficulties of tracing a gas escape over a long distance and the likely large volume of gas required. Visual inspection was trialled using sonar, infra-red and CCTV systems in a live main to identify the ragging plugs that appear in a main prior to failure. However the turbidity of the flow and the entrained debris meant visual interpretation was extremely difficult. Remote field eddy current devices operated in North America were reviewed and thought promising for metallic rising mains but the high cost of mobilisation prevented any live UK trials. However the trials of the conductivity and gross metal loss techniques utilising the WRC Sahara system as a mode of delivery were found to have a practical application in a live rising main inspection.

Gross Metal Loss (GML) uses 2 different frequencies transmitted from the Sahara sensor head in the live rising main to identify changes in the speed of the received signal ratio at a receiver on the surface indicating any relative changes in the pipe wall thickness.

Case Study: 100 mm Ductile Iron Rising Main



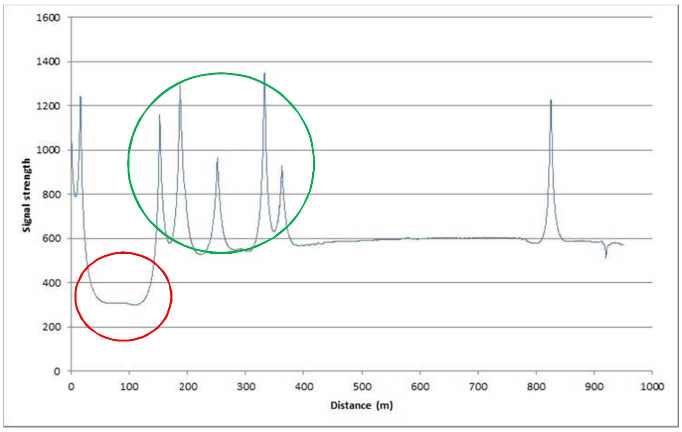
This case study results show:

- Regularly spaced pipe joints (79 m, 85 m, 91 m etc.)
- The location of two repairs (73 m and 95 m) – made using PE pipe so very low signal.
- Thinning of the rising main at 73 m (immediately up stream of the repair).
- General variation in pipe wall thickness – thickest between 90 and 94 m.

Work is on-going with WRc to further develop the GML tool to enable absolute thickness measurements to be completed. Other improvements in the systems resolution and sensitivity to detect smaller more localised defects and their circumferential position to be determined are being explored. The speed of survey also requires improvement to enable greater distances to be inspected.

By using the insulating properties of a plastic rising main pipe the electrical conductivity technique was developed to identify conductive pathways caused by a metallic fitting or a leak in the plastic main. The Sahara sensor head passes a small current into the main and the point of escape is monitoring to track the position of the leak or fitting on the rising main.

Case Study: 200 mm PVC Rising Main Inspection



The graph alongside shows the result from a survey of a live PVC rising main. The survey covered the full 950m length of the pipeline. The peaks (circled in green) correspond to metallic fittings and short sections of pipe used to repair previous bursts. The section circled in red had been replaced using HPPE pipe shortly before the inspection. The difference in the signal strength between the pipe types is clearly seen. The peaks at either end of the new section correspond to the metal fittings used to couple the replacement section of pipe to the original pipe.