ROSEN's Ultrasonic Crack Detection in Demanding Pipeline Environments

Ultrasonic crack-detection represents a reliable and recognized inspection technology for the detection of probably the most severe feature class in pipelines of all diameters. In contrast to laboratory conditions, the pipeline environment generates a complex combination of circumstances that influence the performance of the applied measurement system and pigging technology. In particular cases these can be as significant as increased temperature levels above 50°C, high pressures exceeding 100 bars and medium types (e.g. heavy crude oil) with inherently high damping and temperature dependent damping characteristic. Furthermore, the measurement setup of ultrasonic crack-detection leads to additional dimensional constraints to the general design approach of these in-line inspection (ILI) tools.

The application of electro-magnetic acoustic transducers (EMAT) and ultrasonic crack detection tools represent the principal approaches for detecting cracks. As EMAT ILI tools are not reliant on a liquid coupling medium, both gas and liquid pipelines can be inspected without any limitations. However, due to the complex mechanical construction, this technology is limited to larger diameter pipes. For that reason an ultrasonic crack-detection tool for the detection of circumferential cracks in low diameter pipes with demanding pipeline conditions was developed.

Tools for ultrasonic wall thickness measurement were initially developed for 6" pipelines. This tool design proved excellent data quality during approximately 100 ILI surveys. In addition to the inspection of the pipe body, the long seam and girth weld were evaluated with reasonable data quality. Experience with the ultrasonic wall thickness, led them to conclude that the ultrasonic crack-detection tool would perform even better as the weld is inspected with an axial offset due to the sensor inclination. This approach would allow for higher quality in detecting circumferential flaws close to the girth weld.

For the case of ultrasonic crack detection the angle between pipe wall and incident ultrasonic beam has to be kept as constant as possible. Typical limits are approx. ± 1.5° in order to ensure that the signal reflected from cracks can be properly detected. If the sensors are attached to the tool body a misalignment between the inclined ultrasonic beam relative to the inside pipe wall is created if the tool remains not within the centre line of the pipe. The tool was built and developed with special consideration of demanding pipeline conditions, such as pressure exceeding 100 bars, medium temperatures of up to 70°C and minimum passage ID of less than 120 mm.

The tool is optimized for detecting circumferential cracks in the influencing region of the girth weld. The tool body design was chosen, i.e. that the ultrasonic crack detection probes are attached to the central tool body, to reduce the influence of the welds on run behaviour. This enables excellent signal quality for crack detection of flaws parallel to and close to the girth weld.

In 2010 the ultrasonic crack detection tool (RoCD·UT) successfully inspected seven heavy wall pipelines with OD 8.0" and a wall thickness of 33 - 37 mm.

Figure 1: ROSEN ultrasonic crack detection tool RoCD·UT

Figure 2: A crack that was found after dig-up work