Application Note

HIGH TEMPERATURE CORROSION MAPPING OF IN-SERVICE HEAT EXCHANGERS WITH ULTRASONIC SCANNING SOLUTION

Chemical processing units are employed everyday for fluid management and heat transfer operations in oil, gas and chemical plants worldwide. These include, but are not limited to, increasing the viscosity of crude oil for the refining process, providing steam to power generator turbines, and maintaining the temperature of hydraulic and transformer oil and lube in pump and compressor seals. A heat exchanger's peak performance is crucial for efficient productivity from the industrial assets that depend on these systems. Non-Intrusive Inspection (NII) and Non-Destructive Testing (NDT) actions help support their safe fitness-for-service (FSS).

The harsh environmental conditions that heat exchangers operate under introduce certain damage mechanisms naturally. Cracks or wall thinning result from the heated side expanding while the cooled side contracts from opposite heat transfer activity. Corrosion is one of the most common degradations that occur in heat exchangers given the presence of corrosive fluids and tensile stress encouraging surface pitting and other local flaws.

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THE CHALLENGE

Hard-to-access and high temperature environments make heat exchanger spot checks difficult and unreliable.

2

THE SOLUTION

A remotely operated ultrasonic scanner provides corrosion mapping of in-service assets.

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THE BENEFITS

Human and environmental risk is minimized, and a comprehensive report is available for clients to make important business decisions.

The Challenge

Extensive piping running throughout chemical processing units can sometimes present a challenge for close monitoring of these defects due to limited accessibility. Where access is feasible, NDT technicians will perform spot readings. Working in a typically high temperature environment not only impacts inspection quality and Probability of Detection (PoD), it also creates safety concerns with potential explosion risks due to wall loss. Engineers responsible for risk-based inspection programs do not receive a comprehensive picture of a heat exchanger's actual condition with this manual assessment but taking the asset offline is also counterproductive.

The Solution

Ultrasonic Testing (UT) has proven to be an effective method for corrosion mapping, and the Silverwing RMS 2 offers a remote-controlled scanner solution that removes operators from hazardous areas. The RMS ultrasonic corrosion mapping solution features an extended umbilical and robust components capable of operating on surface temperatures up to 200 degrees Celsius (392 degrees Fahrenheit). The remote access scanner has a narrow water column so that water is recycled before boiling at the test surface making sure the ultrasound propagates in the test subject.

An in-service heat exchanger inspection was conducted using standard RMS water column probes with 25- and 75-millimeter probe holders. The inlet end of the unit was between two and three meters in diameter with a nominal thickness of 35 millimeters. The distance between the flanges was approximately 810 millimeters.

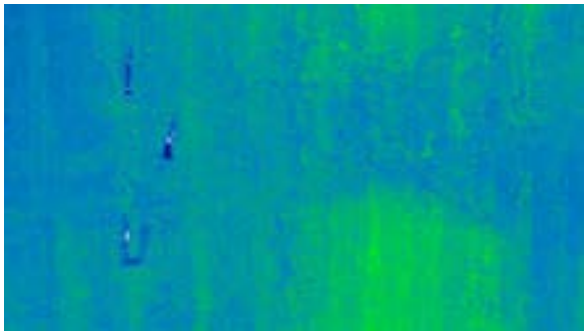
The RMS 2 successfully provided reasonable A-Scan echoes and a corresponding C-Scan for an easily understood corrosion map of the heat exchanger inlet end. This was achieved by slowing the scanner speed to 300 millimeters per second, allowing the water column to stabilize. A variety of scans with different resolutions were performed with virtually same results. The several dark blue areas in the C-Scan image relate to the weld of internal supports scattering the sound and thus reducing the amplitude of the reflected signal. In order to maintain an acceptable water seal, the probe holder required a high tension. Several scans were conducted over a three-hour period with a maximum duration of the RMS 2 on the surface for 30 minutes. It is recommended to allow the system to cool down for five minutes between each 30-minute interval. Because the RMS 2 is sealed, the water supply can be used to further cool the wheels and scanner body as needed.

RMS 2 in action

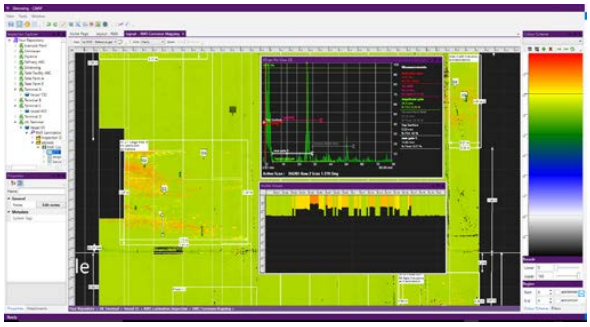
Elevated surface temperature

The Benefits

The robotic RMS 2 provides objective, digital data for heat exchanger wall thickness measurements and FFS, while reducing both human and environmental risk. It enables engineers to provide asset owners with precise and consistent data that accurately determines remaining life assessment and optimizes maintenance or repair scheduling.



C-scan dark blue areas correspond to internal support welds



CMAP: Inspection analysis and reporting software

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