High Temperature Ultrasonic Thickness Monitoring

Technology Innovation - Thick Film Sensors

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The ability to continuously monitor component thickness at high temperatures has many benefits in the power generation industry, as well as many other industries. Most significantly, it enables condition-based inspection and maintenance, as opposed to schedule-based, which assists plant management with optimizing operations and maintenance budgets and streamlining outage schedules. Furthermore, it can assist with the early identification of potential issues, which may be used to further optimize plant operations and provides ample time for contingency and repair planning.

Over the last several years, Structural Integrity has been working on the development of a real-time thickness monitoring technology that utilizes robust, unobtrusive, ultrasonic thick-film sensor technology that is enabling continuous operation at temperatures up to 800°F. Figure 1 shows a

FIGURE 1. Photograph of an ultrasonic thick-film array for monitoring wall-thickness over a critical area of a component.

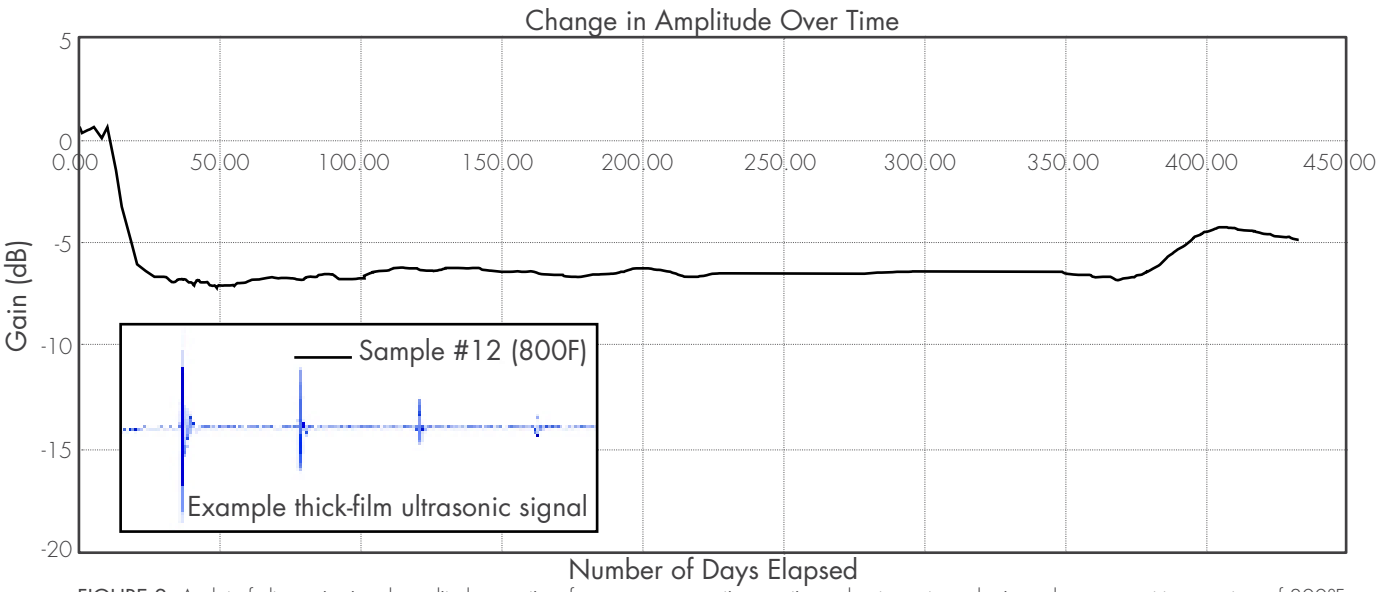

FIGURE 2. A plot of ultrasonic signal amplitude over time for a sensor operating continuously at an atmospheric and component temperature of 800°F.

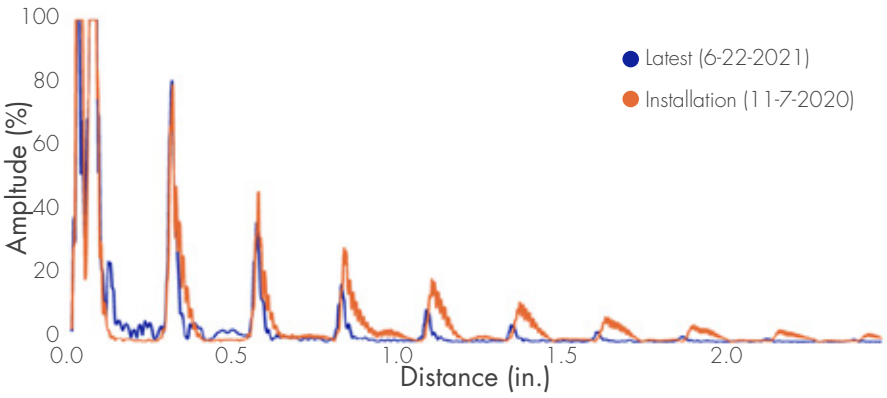

FIGURE 3. Ultrasonic waveforms acquired approximately 8 months apart showing 0.005 inches of wall loss at the sensor location over this period.

photograph of an installed ultrasonic thick-film array, illustrating the low-profile, surface-conforming nature of the sensor technology. The current version of this sensor technology has been demonstrated to operate continuously for over two years at temperatures up to 800°F, as seen in the plot in Figure 2.

In addition to significant laboratory testing, the installation, performance, and longevity of Structural Integrity's thick-film ultrasonic sensor technology has been demonstrated in actual operating power plant conditions, as seen in the photograph in Figure 4, where the sensors have been installed on multiple high-temperature piping components that are susceptible to

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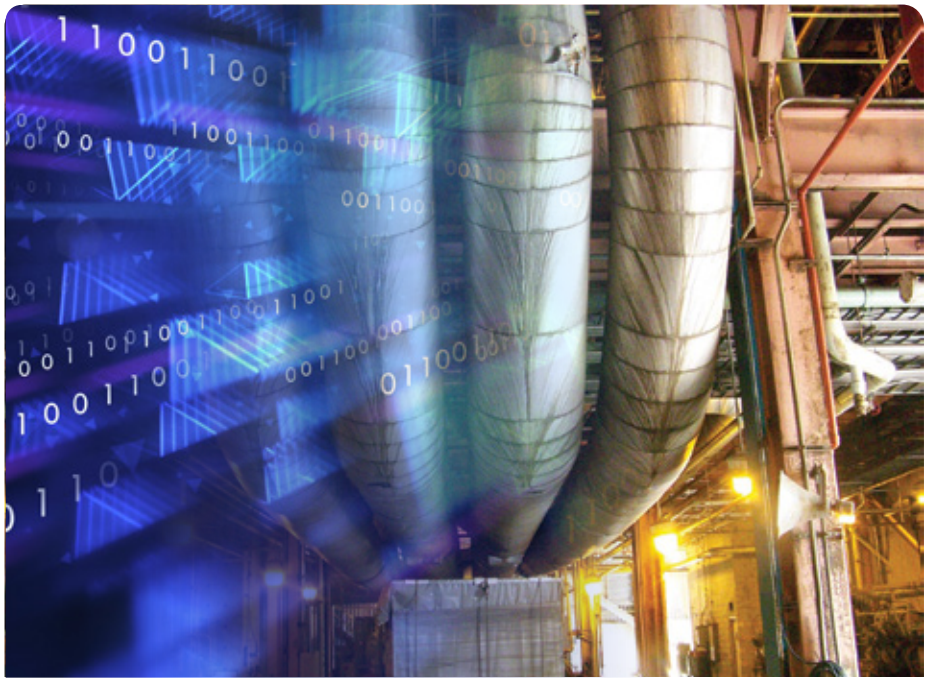

FIGURE 4. Photograph showing Structural Integrity's thick-film ultrasonic sensor technology installed on two high-temperature piping elbows that are susceptible to thinning from erosion.

wall thinning from erosion. In this application, the sensors are fabricated directly on the external surface of the pipe, covered with a protective coating, and then covered with the original piping insulation. Following installation, data can either be collected and transferred automatically using an installed data acquisition instrument, or a connection panel can be installed that permits users to periodically acquire data using a traditional off-the-shelf ultrasonic instrument.

Figure 3 shows two sets of ultrasonic data that were acquired approximately eight months apart at an operating power plant. The first data set was acquired at the time of sensor installation and the second data set was acquired after approximately eight months of typical cycling, with temperatures reaching up to ~500°F. Based on the observed change in the time-of-flight between the multiple backwall echoes observed in the signals, it is possible to determine that there has been approximately 0.005 inches of wall loss over the 8-month period. Accurately quantifying such as small loss in wall thickness can often provide meaningful insight into plant operations and processes, can provide an early indication of possible issues, and is only possible when using installed sensors.

Other potential applications of Structural Integrity's ultrasonic thick-film sensor technology include the following:

- Real-time thickness monitoring
  - Flow Accelerated Corrosion (FAC)
  - Erosion / Corrosion
- Crack Monitoring
  - Real-time PAUT
  - Full Matrix Capture
  - Critical Area Monitoring
- Other Applications
  - Bolt Monitoring
  - Guided Wave Monitoring

In addition to novel sensor technologies to generate data, Structural Integrity offers customizable asset integrity management solutions, such as PlantTrack™ , for storing and managing critical data. Many of these solutions are able to connect with plant historians to gather additional data that feed our engineering-based analytical algorithms, which assist in converting data into actionable information regarding plant assets. These algorithms are based on decades of engineering consulting and assessment experience in the power generation industry.

Reach out to one of our NDE experts to learn more about SI's cutting-edge thick-film UT technology.

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