INCREASING OFFSHORE GAS PRODUCTION THROUGH MORE EFFECTIVE PIPING EROSION MANAGEMENT

Corrosion and erosion monitoring applied to natural gas piping on an offshore platform helps manage sand erosion inside valves and pipes. Article by **John Bromley-Barratt and Benchaporn Patsorndiloklert** from Emerson Automation Solutions.

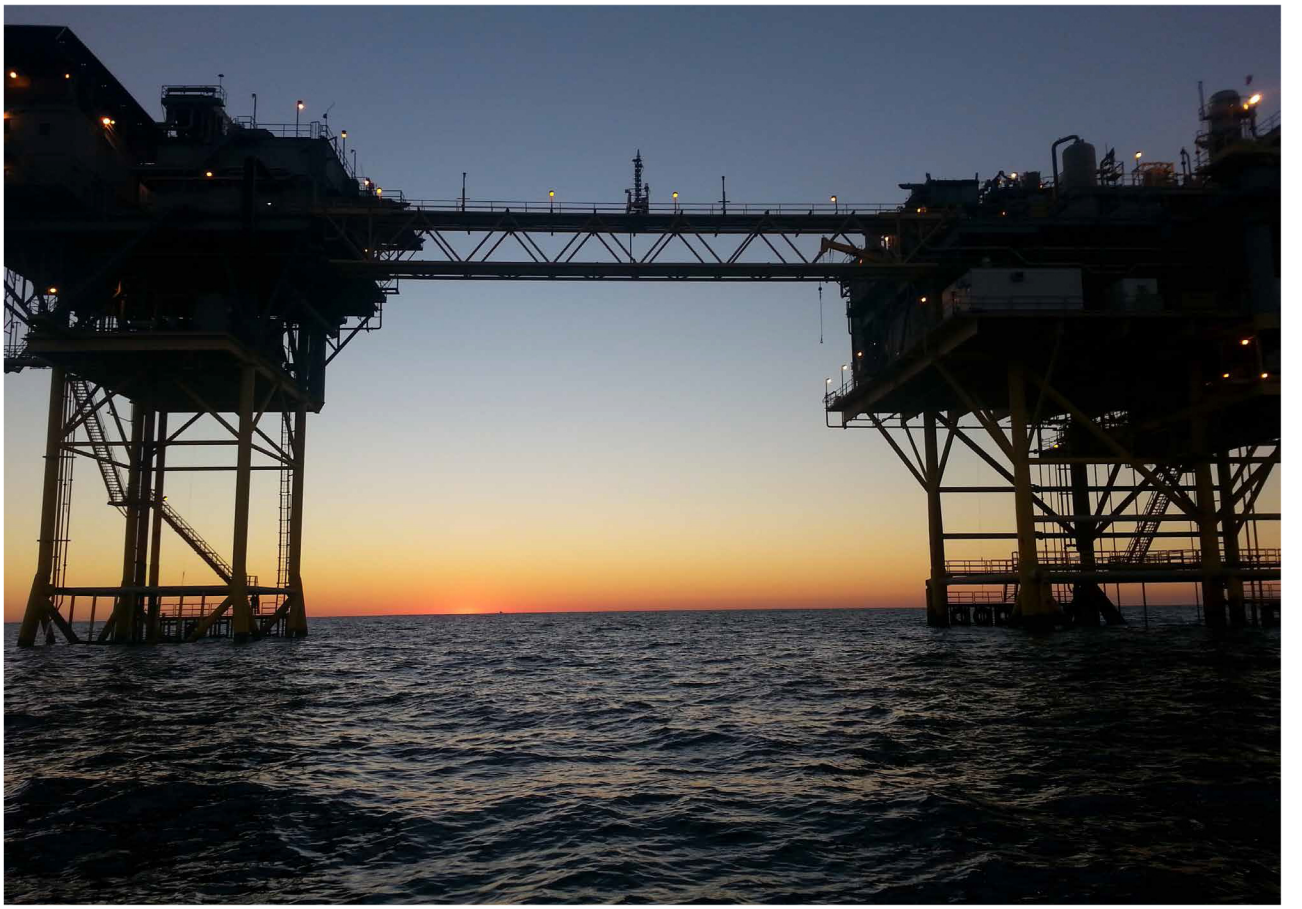
SANDBLASTING – shooting grains of sand in a compressed air stream is a very effective way to remove rust and paint from metal surfaces by the process of erosion. At natural gas wellheads, an equally effective, but highly undesirable, form of erosion can take place when the gas stream coming out of the well carries sand with it. These sand flows can erode the pipes, fittings, and valves from the inside out, resulting in high metal loss rates and short service life.

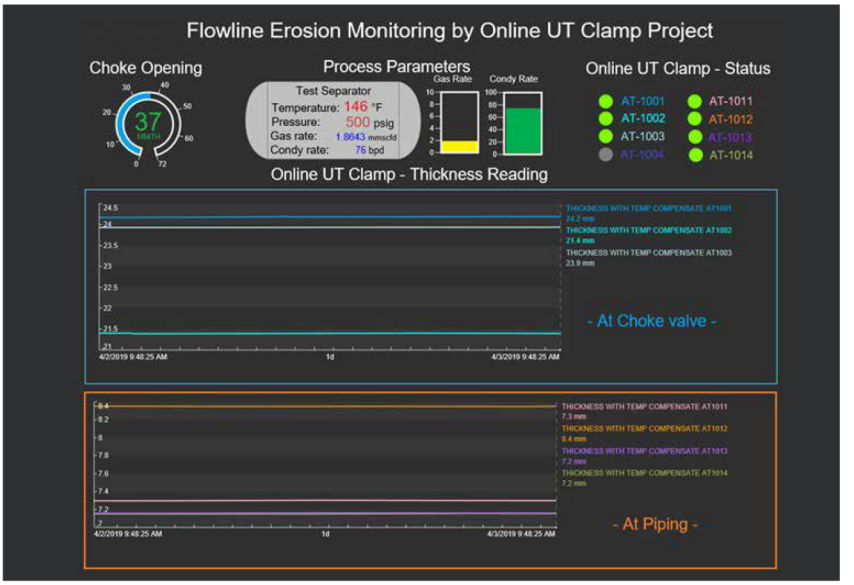
If such erosion remains undetected for an extended period of time, this can ultimately lead to a loss of containment. The amount of sand and particle size is variable and cannot be controlled or accurately predicted. The method used to determine the sand load in real time adding an acoustic detector to the relevant pipe section to listen for the characteristic sounds of sand entrained in the gas stream.

This gives a rough indication of what is going through the pipe but does not determine the amount of metal loss due to the abrasive grains. Unfortunately, there is only a loose correlation between sand load and erosion rates as the metal loss depends on numerous factors including local velocity, grain weight, size, shape, and so on.

The areas particularly vulnerable to erosion are where velocity changes, such as after the choke, and at elbows, where sand impacts the wall on the outside radius. Operators can use computational fluid dynamics to predict where erosion is most likely to happen, but such models do not provide real-time information on metal loss rates and generally have to be somewhat conservative due to the loose correlation between sand load, velocity, and metal loss. The only method operators have to control erosion is by the reduction of throughput to avoid high flow rates during times when acoustic sensors indicate higher sand loads. While this reduces the risk of erosion, it also reduces throughput and therefore production.

Maintenance engineers can try to determine the amount of actual metal loss using handheld ultrasonic thickness gauges, but these readings do not provide continuous measurements and will give no indication of when the erosion actually occurred. Additionally, on remote platforms, skilled personnel may not be available to carry out manual inspections on a regular basis.





Operators now have HMI graphics indicating thickness measurement trends correlated with the current choke opening and production rate. By watching the historical data, it is possible to see changes in thickness corresponding to sand content and gas velocity. (Photo: Emerson)

Platform operators understand the nature of sand erosion well enough to expect that it will happen and make allowances for an acceptable amount of metal loss before safety boundaries are crossed. The solution requires knowing just when erosion has happened and determining the maximum production rate that can be sustained without drastically shortening the equipment life.

Making this determination depends on having an accurate and continuous measurement of metal loss at vulnerable locations. One particular operator addressed this issue by installing eight Rosemount Wireless Permasense Corrosion and Erosion Monitoring sensors at strategic locations on valve bodies and piping. Since the sensors use a self-contained power module, they were installed with no wiring of any kind required for either signal or power. The monitoring locations selected represented areas where computation fluid dynamics models had indicated elevated risk of erosion.

These ultrasonic metal thickness sensors are permanently mounted and provide a wall thickness reading every 15 minutes. This data is sent to the control room and maintenance department via WirelessHART. Operators now have Human Machine

Interface (HMI) graphics in the control room indicating the wall thickness in real time at these critical locations, and thickness trends are correlated with the current choke valve settings and production rates.

By monitoring this data, it is possible to see changes in thickness corresponding to sand load and gas flow rate. The probes can deliver measurements to a repeatability of 10 µm, (the equivalent of 0.000394 inches), so it is possible to detect very small changes over time or to quickly identify if the metal loss rate exceeds acceptable limits. Using the data collected, it is also possible to identify changes in the rate of loss over time, giving insight into how varying conditions affect metal loss rate. This is a major improvement over data that has been manually collected from periodic inspections.

Using the unique combination of Rosemount Wireless Permasense Corrosion and Erosion Monitoring sensors and Roxar Acoustic Sand Detectors, operators can now see the effects of various operating conditions in real time, which has allowed them to characterise situations where metal loss is minimal, average, or severe. While it is still not possible to predict the amount of sand entrained in the natural gas, it is possible to determine when action must be taken to prevent excessive erosion.

Operators also know when flow can be increased beyond levels that were previously considered to be maximums. This digital transformation solution enables operators to know the condition of the flowline piping and optimize production at higher levels while predicting the remaining equipment life with a high degree of confidence. As a result of utilising this solution, the particular platform mentioned has realised a production increase of 50 BPD with no incremental risk of erosion in the flowline.