

The case for better corrosion monitoring in refineries

It's every engineer's nightmare – a ruptured pipe, a catastrophic failure. In June of 2019 a pipe failure in the hydrofluoric acid (HF) alkylation unit of the Philadelphia Energy Solutions refinery caused a disastrous series of explosions and fires, releasing over 5000 pounds of hydrofluoric acid into the atmosphere and launching multiple projectiles, one the size of a school bus.

Investigators from the U.S. Chemical Safety and Hazard Investigation Board (CSB) determined that the cause of the event was the rupture of pipe elbow that had corroded to just 0.012 inches, half the thickness of a credit card.



How could this happen?

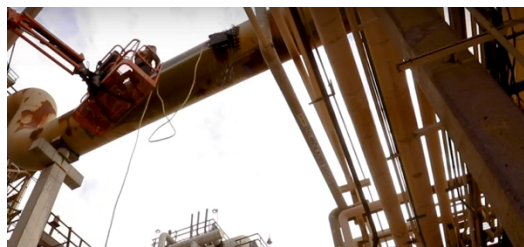
Acid corrosion is a known mechanism in HF alkylation units,¹ and the Philly refinery had a corrosion-monitoring program in place. They regularly conducted ultrasonic thickness measurements at designated locations as part of their standard inspection program. Recent monitoring didn't reveal excessive corrosion in the HF alkylation area around the rupture; wall thicknesses in nearby tube sections ranged from 0.229 to 0.345 inches, above the minimum thickness of 0.18 inches.

But not all pipes in the unit had the same composition. Back in 1973, when the unit was built, requirements for consistent corrosion-resistant piping weren't yet in place. Concentrations of nickel, chromium, and copper alloys in carbon steel tubes could vary from piece to piece. Tubes with higher concentrations of those metal alloys, in contact with hydrofluoric acid, corrode at a faster rate than tubes with lower percentages. Therefore, in any HF alkylation unit that's decades-old, spot measurements cannot prevent catastrophic failure; 100% of the components must be inspected.

More thorough piping inspections

The Philadelphia explosion has raised alarm bells about corrosion in HF alkylation units, and in refineries in general. After similar pipe ruptures due to thinning by corrosion occurred in 2009 and 2012, the CSB recommended that refinery operators inspect 100% of the components of piping systems. But it allowed operators leeway in inspections of some operating equipment, since comprehensive inspections are challenging, time-consuming and costly, especially in older plants. Most US refineries are between 50 and 120 years old, with the average age right about 40,² so outages for complete inspections of thousands of feet of pipe could cost the industry billions.

Industrial inspection robots can provide the solution, a way to conduct complete pipe monitoring that ensures safety but doesn't cripple plant operations with costly downtime. But not all robotic services are suited to the unique configuration of refineries. To address the sheer volume of piping, the cramped spaces and the need for thorough inspection, the choice of robotic services for inspection is critical. Gecko Robotics is uniquely equipped to address the challenge of refinery pipeline integrity.



Not all robotic inspection services are equal

- **Customized robots**

Gecko Robotics designs and builds their own robots. Their wall-climbing robots are built for refinery applications, and can enter pipe-racks and maneuver around obstacles. They can easily inspect 100% of the pipes for all types of corrosion in any oil or gas unit.

- **Cost-saving inspections**

Gecko Robotics robots can navigate sections in a fraction of the time of conventional inspections – up to 10x faster -- and faster than competitive services. This means even comprehensive piping inspections can be done with far less downtime and lower labor costs.

- **1000x more data**

Gecko robots collect up to 1000 times more data. With the Gecko Portal, you receive corrosion maps that give you a full picture of your asset. The maps provide the data to identify exactly where a replacement is required, where repairs will be sufficient, and where to focus future monitoring efforts. These pinpoint recommendations allow operators to confidently direct maintenance funds where they're most needed.

The Philadelphia Energy Services refinery has closed and the owners have filed for Chapter 11 bankruptcy, throwing 1100 workers out of a job. But the event could have been much worse -- fatalities, serious injury or more property damage. Thorough pipe inspection should be part of regular refinery maintenance and does not have to be prohibitively expensive. Gecko Robotics has the right equipment and expertise to improve refinery piping integrity management and plant safety.

¹ Inspectioneering. <https://inspectioneering.com/tag/hydrofluoric+acid>.

² <http://canaryusa.com/stresses-of-middle-age-for-todays-refineries/>