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Process Safety Beacon

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Mechanical Integrity

In August 2012, a pipe in a crude distillation unit (CDU) in a refinery in California ruptured, releasing hot, flammable hydrocarbon process fluid (Photo 1). The released material partially vaporized, forming a large vapor cloud that ignited. The pipe failed due to thinning caused by sulfidation corrosion, a common damage mechanism in refineries. Sulfidation corrosion failures are of great concern because of a comparatively high likelihood of catastrophic failure. This can happen because corrosion occurs at a relatively uniform rate over a broad area, so a pipe can get progressively thinner until it bursts, rather than a failure starting as a small leak at a pit, crack, or local thin area.

In November 2013, a fire erupted after a leak from a pipe containing vacuum residue at a CDU in a refinery in Brazil (Photo 2). The leakage occurred due to the rupture of a straight section of pipe in a pipe rack near the pre-flash tower of the CDU. The investigation determined that the pipe section was very thin (less than 1 mm). The specified material for this pipe section was an alloy steel, but the actual material was found to be carbon steel — the pipe section had been replaced during a maintenance shutdown in 1998, and the wrong material of construction was used.

In both of these incidents, the mechanical integrity management system was not successful at detecting and replacing deteriorated piping components before they failed. In the 2013 incident, the maintenance system did not ensure that the correct material of construction was used when the pipe was replaced. More-effective mechanical integrity and maintenance programs could have prevented both incidents.


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What Can You Do?

- Immediately report any leak that you discover, no matter how small, and follow up to make sure action is taken.
- If you are responding to what appears to be a small leak in a large pipe or vessel, consider the possibility that the "small" leak is actually caused by a large area of thin or weak metal that could suddenly become a large leak. Plan your response to ensure that people are protected should this happen.
- If you are replacing piping or other equipment, make sure that you use the correct material for all replacement parts. Follow the positive material identification (PMI) procedures at your facility and verify implementation in the field. Perform a 100% component inspection of what has been replaced during a turnaround before restarting.
- Frequent use of leak-repair clamps to externally stop process fluid leaks raises questions about the effectiveness of a mechanical integrity program. These devices are intended to provide a temporary repair while a process continues operating until a permanent repair can be made — perhaps during a plant shutdown. When such temporary repairs are implemented, follow your plant's management-of-change (MOC) procedures. Be sure that temporary repairs are managed so they can be included for permanent repair when planning the next shutdown.
- Understand and make sure that recommendations from your inspection group are implemented in a timely manner.
- An effective MOC system is vital to the success of any piping integrity management program. Your plant inspection group can anticipate changes in corrosion or other deterioration and change inspection schedules and procedures appropriately. Make sure your inspection group is involved in the approval process for changes that may affect the integrity of piping or other equipment.

"You get what you inspect, not what you expect!"

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