Process Safety Beacon

This Issue Sponsored by ioMosaic
www.iomosaic.com

Messages for Manufacturing Personnel
http://www.aiche.org/CCPS/Publications/Beacon/index.aspx

February 2018

Contamination As a Contributing Factor

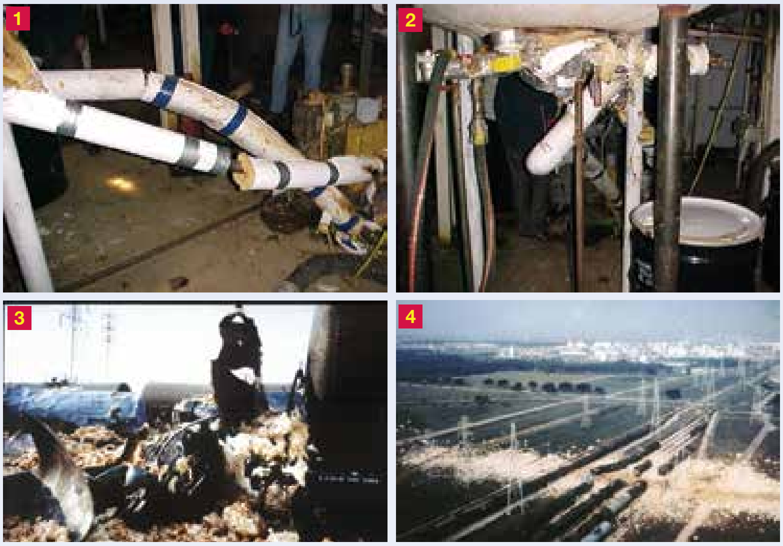
Most incidents have multiple causes. For each of these incidents, contamination was a contributing factor.

Incident 1. A closed valve isolated a pipe containing an organic residue from distillation processes and liquid from process vent systems. The pipe was steam-traced to keep the residue from solidifying. During a weekend shutdown, the pipe exploded (Images 1 and 2). No one was injured because the building was not occupied and damage was minimal.

The temperature control system on the steam-tracing system had failed, causing temperatures to rise. This alone should not have created the conditions for decomposition and explosion, but the residue had been contaminated with approximately 1% water. Water vapor from process vessels condensed in the vent system and drained into a residue tank. Lab tests confirmed that this amount of water reduced the decomposition temperature of the residue by about 100°C. The temperature due to the steam temperature control failure was high enough to initiate decomposition.

Incident 2. A railroad tank car containing crude methacrylic acid (MAA) was hot and venting material from its relief valve. The area was evacuated, and after some time, the railcar exploded, destroying the car and causing significant damage in the area (Images 3 and 4). Because people were evacuated, no injuries occurred.

Crude MAA contains strong mineral acids from the manufacturing process, which corrode stainless steel. The dissolved metal from corrosion increases the tendency of MAA to polymerize. Crude MAA is supposed to be stored in lined tank cars, but, in this incident, an unlined stainless steel tank car was used. In addition, the plant did not add the specified amount of polymerization inhibitor to the crude MAA. The inhibitor stabilizes MAA by stopping slow polymerization that can occur even in pure MAA. The metal contamination from corrosion of the tank car may have induced the polymerization, and the reduced inhibitor concentration diminished the stability of MAA, ultimately leading to the runaway polymerization and explosion.



1 2 3 4

Incident 1: Hendershot, D., *et al.*, "Connections: How a Pipe Failure Resulted in Resizing Vessel Emergency Relief Systems," *Process Safety Progress*, **22** (1), pp. 48–56 (2003).
Incident 2: Anderson, S., and R. Skloss, "More Bang for the Buck: Getting the Most from Accident Investigations," *Process Safety Progress*, **11** (3), pp. 151–156 (1992).

What can you do?

- When you check safety information for materials in your plant (*e.g.,* safety data sheets, operating procedures), pay attention to possible hazardous reactions, such as decomposition and polymerization, that may be related to contamination. Be aware of any specific contaminants of concern that are present in your plant.
- Know if any common contaminants — rust, water, heat-transfer fluids, lubricants, metals, and corrosion products from pipes and equipment — are a concern for your process.
- Recognize that even a small amount of contaminant can be enough to cause a dangerous reaction.
- Follow all procedures for avoiding contamination in your plant and equipment. Take care to verify the identity of materials before unloading them into storage tanks or other equipment.
- Ensure the correct material of construction for all components is used during maintenance activities.
- Confirm that containers being filled (*e.g.,* pails, drums, tank trucks, rail cars) are made of the correct material of construction.
- Ensure pipes, vessels, and portable containers are clean. Clean means free from deposits, residue, rust, or other contamination as defined by plant procedures for the specific service.

A small amount of contamination can cause a big problem!