

Vacuum Can Put a Dent in Your Process

February 2024



▲ A railcar collapsed after a steam-out process because it was not properly vented.

A process containing flammable materials was operating under vacuum. Suddenly, the vent line collapsed. Equipment can collapse when the internal pressure created by the vacuum is lower than the equipment's vacuum rating. Vacuum can be created inside equipment by:

- exposing equipment to a strong vacuum source, such as an eductor or vacuum pump, without adding a gas to control the pressure
- draining a tank without properly venting the headspace
- cooling a tank without venting it — this can even occur if a vessel vent is blocked and the ambient temperature decreases (*e.g.*, a sudden rain)
- steaming a vessel without venting it — the water vapor can condense and create a vacuum inside the equipment (as in the image above).

Why is creating vacuum a problem? Beyond the potential for vessel collapse, vacuum can cause other potentially unsafe conditions. Air can be drawn into the equipment; if the process contains flammable materials, an ignition or explosion could occur. Vacuum could also cause materials in the process to boil or foam unexpectedly. Certain pieces of equipment are also at risk of backflow since materials tend to flow toward lower pressure points in the process.

Did You Know?

- When a process operates at less than atmospheric pressure (vacuum), the process contains less air than at atmospheric pressure. If it operates near full vacuum (*i.e.*, 0 psia or 0 mmHg), there is little air in the process.
- Equipment rated for internal pressure may not be rated for vacuum. Pressure and vacuum ratings for equipment can be found on the equipment tag or the equipment data sheet.
- Vacuum control systems reduce the pressure by opening valves to a vacuum source. The pressure can be raised by adding a gas (usually inert) into the process.
- For boiling processes, lower pressure allows materials to boil at a lower temperature. This is often how high-boiling materials are separated.

What Can You Do?

- Understand how the vacuum systems work for your processes — both how the vacuum is created and how the pressure is controlled.
- Recognize that loss of vacuum in a flammable system could mean that air got into the process. Follow your unit's procedures to manage the upset.
- Do not block the vent of a tank without providing a venting path, such as a vacuum relief device.
- Don't steam-out equipment or pump material out of a tank or vessel without a venting path or other means of protection from vacuum.
- During hazard reviews, discuss all the possible causes of vacuum. Some consequences may be more than a quality problem — they could be an unsafe situation.

Do not let vacuum collapse your equipment!