PLANT ENGINEERING

COMPRESSED AIR

BEST PRACTICES: Steam and condensate leaks

Steam and condensate leaks cost industrial plants millions of dollars in lost energy, while increasing emissions, creating safety hazards, and lowering the reliability of plant operations.

BY KELLY PAFFEL, SWAGELOK COMPANY DECEMBER 15, 2010

Steam and condensate leaks cost industrial plants millions of dollars in lost energy, while increasing emissions, creating safety hazards, and lowering the reliability of plant operations.

Steam leaks result in the loss of both latent and sensible energy. While plant personnel would be well advised to pay attention to all utility losses, greater attention should be paid to the costs and problems associated with losses related to steam.

Steam leaks result in higher energy losses than comparable compressed air leaks, as shown in the following example:

At 100 psig and a 1/8 in. leak and calculating a $10 per 1,000 lb of steam, the cost is $3,591.

For compressed air, at 100 psig and a 1/8-in. leak at $0.05 per kWh, the cost is $2,095.

Leaks in the steam and condensate system can contribute to significant energy losses – as great as 19% of the overall energy consumption – in a plant's operations. In fact, due to the high cost of these energy losses, the correction of steam and condensate leaks offers very lucrative paybacks. The greatest benefit of a proactive steam and condensate leakage correction program is that most leaks can be corrected without expending capital.

Steam leak causes

The number one cause of steam and condensate leaks is the use of threaded pipe connections in a steam and condensate system. Pipe threads are prone to fail with the expansion and contraction of the steam and condensate during system startup, operation, and shutdown. Using different types of materials on the threaded connection to prevent leakage has limited success.

Solution: Use other connection methods in the steam and condensate system, such as welded connections or tube-type connections.

- Packing on Standard Type Valves

Without a proactive maintenance program, standard packing on steam isolation valves will fail and leak steam during operation.

Solution: Use other types of valves that have corrected the sealing problems encountered in steam and condensate. Commonly used valves include ball valves and butterfly valves (in some applications).

- Carbonic Acid

The carbonic acid found in most systems will attack the components of a steam and condensate system. The carbonic acid deterioration will be noticeable at the thinnest part of the pipe, which is the threaded connection.

Solution: Use other connection methods in the steam and condensate system, such as welded connections or tube-type connections that will resist the carbonic acid or CO_2 corrosion. In the condensate system, use stainless steel to provide maintenance-free operation.

- Water Hammer

The water hammer in the steam and condensate system can produce pipe connection failures that result in system leaks.

Solution: Water hammer should not occur in the steam and condensate system. If water hammer exists, the issue must be resolved. Causes and solutions require a separate article to be addressed adequately.

Steam leak losses

Steam flow through a leak can be calculated using an orifice equation, which is based on the diameter of the leak, pressure at the inlet of the orifice, and pressure at the outlet (atmosphere).

Steam Flow = f (orifice diameter, inlet pressure, atmospheric pressure)

The following leak characteristics have historically been seen in steam and condensate systems:

- The leak path is not a perfect orifice.
- Determining the diameter of the passage is difficult because the leak is not a perfect circle.
- Inlet pressure may not be measured and may have to be calculated based on flows and pressure drops.

See BEST PRACTICES: How much do steam leaks cost?

It is recommended that plant personnel be trained with different tools to help visually determine the steam leak diameter from a safe distance. To determine steam leak volume by plume length is extremely difficult and not very accurate.

Measuring inlet pressure (P1) is also important. Inlet pressure is determined by the steam system operating pressure. If the pressure is unknown and the steam is saturated vs. superheated, then the task of determining P1 is accomplished easily by using infrared temperature measurement devices. Saturated steam at a given temperature directly correlates to saturated steam pressure.

– Kelly Paffel is Technical Manager at Swagelok Energy Advisors, Inc. Contact him at Kelly.Paffel@swagelok.com and (239) 289-3667. For more information about Swagelok Energy Advisors, visit www.swagelokenergy.com.

Roadmap for steam leaks

1. Correct all steam leaks in the plant.
2. Reduce or eliminate threaded connections.
3. Eliminate any water hammer issues.
4. Review steam valve selection process.
5. Review material selection for condensate systems.

Return to BEST PRACTICES: Finding the way forward

Related Articles

- *BEST PRACTICES: How much do steam leaks cost?*


Real-time vibration monitor warns of fault condition

RELATED CONTENT

Compressed air in the pulp, paper and board industry

SAKU VANHALA

Consider modular reed valves for reciprocating compressors

HEINZ P. BLOCH

Top 5 Plant Engineering articles Sept. 27- Oct. 3, 2021

KEAGAN GAY

How to select a dust collection system

GWENDY WYMAN

Implement load sharing in a multiple compressor installation

CHRISTOPHER NACRELLI

Improving the triple bottom line through compressed air leak detection and remediation

ROB MILNER

Compressed air in the pulp, paper and board industry

SAKU VANHALA

Consider modular reed valves for reciprocating compressors

HEINZ P. BLOCH

Top 5 Plant Engineering articles Sept. 27- Oct. 3, 2021

KEAGAN GAY

How to select a dust collection system

GWENDY WYMAN

Implement load sharing in a multiple compressor installation

CHRISTOPHER NACRELLI