Increase savings and efficiency using high reliable Steam Vent and Drain Solutions

Introduction

Just because it's "been that way" for a long time, don't assume it's right. In many cases steam systems were designed long before there was any concern about energy efficiency. The design of steam systems and equipments change because of variety of problems in the field – either something didn't fit, got changed or there was a better idea. All these factors and more are reasons to expect that steam piping systems could be improved when the objective is better function and energy efficiency.

Steam Vent and Drain

High Pressure Vent and Drain lines in the Steam System are no exception. Steam Flowing at a very high velocity (50-80 m/s, depending on Pressure Drop), has a huge deteriorating effect on the valves that are used for vent and drain. It has a capability to erode the valve internals within an extremely short period of time. Refer Figure 1 for the impact that a high pressure drop application can cause to various valve components.

Figure 1. Erosion of valve components due to very high pressure drop

When the valve trim components get damaged, they start to leak the process fluid to its downstream. In case of a steam vent and drain application, if the trim components erode then it will result in continuous leak of steam into atmosphere that not only results in valuable steam loss but also pose a hazard to the operating personnel nearby.

Lets consider a high pressure Steam Drain Application Scenario:

The Steam Leak through a 1/2 in. Drain Valve (full open) will have following effects:	
Steam Pressure (barg)	100
Steam Loss (kg/hr)	7,330
Enthalpy (btu/lb)	557
Steam Loss/year (kg/hr)	53,959,700
Estimated Energy Loss (mmbtu/yr)	79,830
Estimated Emissions, (lbs of CO_2/year)	4,236,750
Estimated Chemical Usage ($/Yr)	8,740
Estimated Water Consumption (m3/yr)	53,960
Estimated Loss ($10/500 kg of steam)	$594,800

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A failed open 1/2 in. 1500# Steam Drain valve, if undetected, can cause monetary loss of over $500K in addition to the following impact.

Huge Water Consumption | Safety Hazard | High Power Consumption | Low System Efficiency | Huge consumption of Chemicals for water treatment | Environment Hazard | Plant Integrity

One of the biggest hazards of any steam system is the risk of injury to employees. HP steam leaks are typically invisible to the human eye but are very noisy. High pressure (HP) steam can cause severe burns to plant personnel or even fatalities. Catastrophic failure of HP steam pipes (photo) can cause personnel injury through hearing damage, burns/scalds, shrapnel wounds and asbestos exposure (if old insulation contains asbestos). On a national scale, slips and falls account for an estimated $70 billion in workers' compensation and medical bills, according to the Centers for Disease Control and Prevention.

How can steam vent and Drain valves impact the efficiency of Steam Systems?

Generally, Boiler users face following problems for high pressure steam vent and drains:

- **High failure rate owing to high differential pressure**

  High Differential Pressure will cause permanent damage to the internals (plug and orifice) due to wiredrawing.
  During such occurrence the valve can never reseat and will leak continuously resulting in huge steam loss causing monetary loss and safety hazard.

- **Low flow handling capability for the same size**

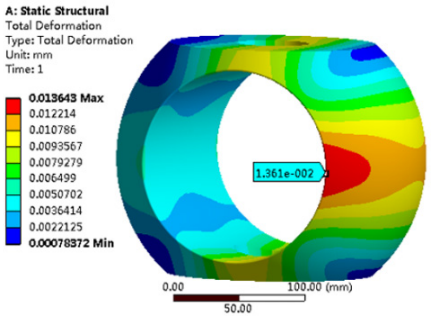
  Valves having insufficient flow handling capability can prevent discharge resulting in over pressurization of the system, which can cause safety hazards.

- **Multiple potential leak points**

  Valves with pressurized body/bonnet design can have multiple leak points, through which steam will leak over a very short period. A Bonnetless valve will reduce a pressurized component in the valve resulting in minimal leak points.

- **High stress concentration due to the design of the valves**

  A Valve with a very high stress concentration is likely to fail at a very faster rate as compared to the one with low stress concentration.



- **High maintenance requirements**

  High Pressure Steam Vent and Drain applications have valves with welded connections and generally will be insulated. Regular failure will cause excessive maintenance costs and man hours.

- **High inventory costs**

  Valves with high stress concentrations will fail quickly and hence huge inventory is required to ensure the availability of components for quick turnaround.

- **Absence of in-line repairability**

  As the high pressure steam vent and drain valves are generally with welded connection and insulated, absence of in-line repairability function will require to remove valve from pipeline for replacement of the trim components or repairing.
  This will have high manhours cost due to replacement, welding, insulation and cladding.

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Can any valve be used for Steam Vent and Drain?

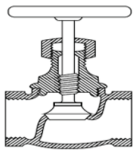

Figure (a)

For High Pressure Steam Vent and Drain application, valves are required to meet conditions of ANSI/ASME B31.1-1986 paras. 122.1.7(c) and 122.2.

- Ordinary Globe/Ball/Gate Valves have very high stress concentrations owingto the globe design, specifically in an application that calls for pressure class of over 1500#.

Result: During opening of the high pressure vent and drain valve, the level of stress will be very high as the steam will escape the system at an extremely high velocity that will cause for quick erosion on the area with high stress concentration.
This will result in quick and frequent failure of the valves.

- A conventional metal seated valve will have face contact seating. It is the case wherein the face of valve plug will rest on the face of orifice as per the Figure (b).

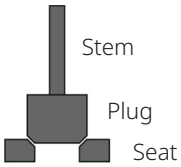

Figure (b)

Result: Most of the metal seated valves give sealing by the metal to metal contacts. Due to cavitation, flashing, erosion, or unidentified causes, the gap will be produced between the plug and seating. Such a gap or scratches will causes leaking and free movement of plug and stem. Lapping is performed to even the plug and seat surfaces. For Steam Application with such high pressure class, generally valves will be welded and insulated. Regular maintenance and lapping will require removing valve from the system, perform maintenance, weld the valve back and insulate the same, which results in huge manhours and cost.

How to Optimize System Efficiency and Conserve Energy through effective vent and drain solutions?

I. Regular maintenance: Vent and Drain valves bear the impact of huge pressure drops, regular maintenance of the valves will ensure optimum performance.

II. Proper valve sizing: Ensure that the steam vents and drains valves are correctly sized for the specific equipment and system they serve. Oversized or undersized valves can lead to inefficiencies.

III. Continuous monitoring: Implement continuous monitoring of steam vent and drain valve performance, using sensors and automation systems to detect issues in real-time.

IV. Regular training: Train operators and maintenance staff on best practices for steam vent and drain valve management, including proper settings and troubleshooting.

V. Energy audits: Conduct regular energy audits to assess the overall efficiency of your steam system, including vent and drain valves. Identify areas for improvement and implement changes accordingly.

VI. Insulation: Properly insulate the steam valves to minimize heat loss and maintain steam temperature.

VII. Utilize advanced control systems: Implement advanced control systems and automation technologies to optimize the operation of steam vent and drain valves based on real-time demand and system conditions.

VIII. Energy recovery technologies: Investigate the use of energy recovery technologies to capture energy from vent and drain valves before they are discharged, thus conserving valuable heat.

IX. Benchmarking and best practices: Compare the performance of your steam vent and drain valve systems to industry benchmarks and adopt best practices for steam management.

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