BEST PRACTICE NO. 54

VENTING STEAM:
THE LARGEST ENERGY LOSS IN STEAM SYSTEMS

1. OVERVIEW

With today's competitive international market, all plants need to reduce operating costs, and lowering energy consumption can have a positive impact on the bottom line. A plant's steam and condensate systems cannot afford to vent any utility steam, blowthrough steam, or flash steam to the atmosphere. An additional benefit of not venting steam is a significant reduction in emissions in the boiler operation.

Figure 1: Example of Steam Plant Operation: No Steam Venting

Any steam venting from the steam and condensate system is the top reason for lost energy in today's steam systems. Can this objective be accomplished? Yes. Many plants have accomplished the goal of not venting steam, and they were rewarded with a high steam system thermal-cycle efficiency.

Of course, lowering energy costs also makes the plant more profitable and better able to compete in today's international market.

2. WHY DO PLANTS VENT STEAM TO THE ATMOSPHERE?

There are several reasons that plants vent steam to the atmosphere. However, with modifications using today's technology, steam and condensate systems do not need to vent steam.

2.1. Improper or No Steam Balancing of the Steam System

The steam balance is always the first necessary part in any steam system optimization and management program. The valuable knowledge gained from a steam balance can help plant engineers use the steam system in the most efficient way, and this knowledge also provides essential insight that can support efforts to increase the steam system's thermal-cycle efficiency. The perfect steam balance has no energy losses from steam venting, excessive low-pressure steam venting, flash steam venting, condensate loss, and so on.

However, a high percentage of plants do not have a steam balance program, which typically leads to the following results:

- flash steam being vented;
- utility steam being vented to meet the process steam demands;
- blowthrough steam vented from the following:
  - process blowthrough,
  - bypass valves opened, and
  - steam trap station failures; and
- low-pressure nonutilized steam.

Ideally, every plant should strive to achieve the highest steam thermal-cycle efficiency possible. The steam balance provides the information needed to achieve this goal.

The optimal steam balance system ensures that the end users (steam processes) can achieve the correct volume of energy at the correct steam pressure/temperature with the required steam quality.

Table 1. Example of Steam Venting Costs	
Steam cost per 1,000 lbs.	$3.75
Steam pressure	125
Steam loss (pph)	12,784
Cost/hr.	$47.94
Days/yr.	350
Cost/yr.	$402,726.00
CO_2 emissions/yr.	14,995
NO_x	11,783

Figure 2: Example of an Unbalanced Steam System

2.2. Flash Steam Vented to the Atmosphere

A typical steam system will incorporate an atmospheric condensate receiver that allows the flash steam to vent to the atmosphere. There are systems such as modulating process steam systems where the condensate system needs to operate at zero pressure; therefore, the flash steam is required to be consumed or vented. Unfortunately, a large number of plants vent the flash, which is a substantial energy loss.

Table 2. Example of Flash Steam Venting Costs	
Steam cost per 1,000 lbs.	$6.21
Steam pressure	175
Steam loss (pph)	3,196
Cost/hr.	$19.85
Days/yr.	350
Cost/yr.	$166,728.00
CO_2 emissions/yr.	3,748,839
NO_x	2,947

Figure 3: Flash Steam Venting

A small amount of flash steam being vented to the atmosphere has a significant energy loss ($26,220.00 per year).

Table 3. Example of Flash Steam Venting Costs	
Steam cost per 1,000 lbs.	$6.11
Steam pressure	24
Steam loss (pph)	510
Cost/hr.	$3.12
Days/yr.	350
Cost/yr.	$26,220.00
CO_2 emissions/yr.	587,794
NO_x	462

Table 4. Example of Energy Losses From a Small Steam Trap Station Population	
Steam cost per 1,000 lbs.	$8.45
Steam pressure	100
Steam loss (pph)	2,125
Cost/hr.	$11.69
Days/yr.	350
Cost/yr.	$98,204.00
CO_2 emissions/yr.	2,486
NO_x	1,945

Figure 4: Flash Steam Venting to the Atmosphere

2.3. Blowthrough Steam

Blowthrough steam is generated in two primary ways. Process blowthrough steam is required for a limited number of processes to ensure proper condensate drainage. However, bypass valves around components that allow steam to freely flow into the condensate header, largely as the result of steam trap station failures, are totally unacceptable for steam system operations.

The lack of a proactive steam trap station management program allows failed steam traps to leak or blow steam into the condensate header. Eventually, this steam has to be vented to the atmosphere at the condensate collection tank system.

All of these items are easily correctable.


Figure 5: Blowthrough Steam

2.4. Unbalanced Steam Header Pressure

Steam header balancing can be a struggle, given that process steam demands frequently change to meet production requirements.

Unbalanced header pressure can be caused by instantaneous process changes, steam turbine operation, and uncontrolled pressure-reduction stations.

Unfortunately, an easy way to stabilize the steam header pressures is to vent steam to the atmosphere to reduce or eliminate overpressurized operations.

Table 5. Example of the Cost of Steam Venting From an Unbalanced Steam Header

Steam cost per 1,000 lbs.	$4.90
Steam pressure	40
Steam loss (pph)	2,111
Cost/hr.	$10.36
Days/yr.	350
Cost/yr.	$87,050.00
CO_2 emissions/yr.	2,403,212
NO_x	1,822

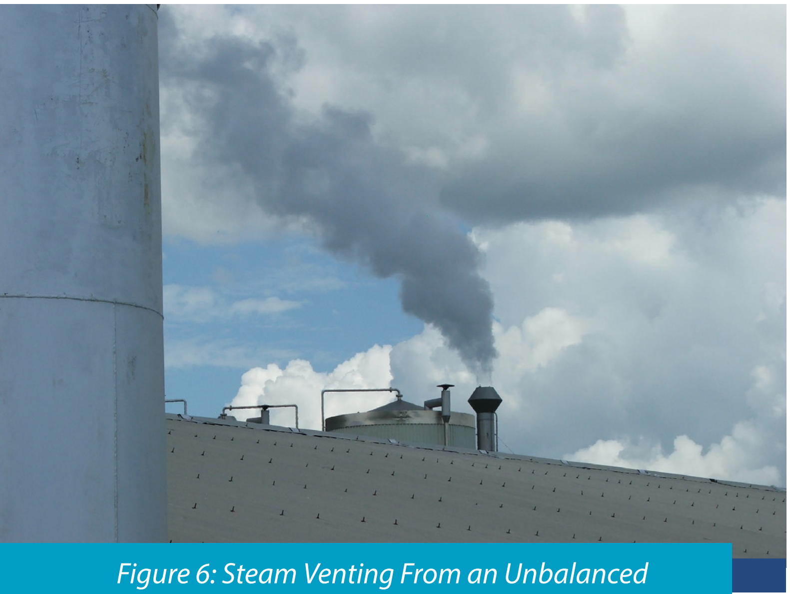

Figure 6: Steam Venting From an Unbalanced Steam Header

2.5. Deaerator Noncondensable Vent

In a steam deaerator, steam serves as the scrubbing agent to reduce the partial pressures of the gases being removed.

With the scrubbing action occurring, the deaerator must vent the noncondensable gases to the atmosphere. The only acceptable steam venting from a steam system operation is the deaerator venting noncondensable gases along with a very small percentage of steam.

With the high cost of steam today, the deaerator vent must be investigated to ensure that excessive steam venting does not occur. All deaerators need to have dissolved oxygen testing conducted at least every three months, and noncondensable venting must be adjusted accordingly to achieve maximum performance.

Table 6. Example of Energy Costs for an Aggressively Overventing Deaerator Vent

Steam cost per 1,000 lbs.	$5.45
Steam pressure	8
Steam loss (pph)	292
Cost/hr.	$1.51
Days/yr.	350
Cost/yr.	$14,494.00
CO_2 emissions/yr.	332,920
NO_x	262

Figure 7: Deaerator Venting

3. CONCLUSION

Tomorrow would be a good day to start following the road map to prevent any steam from venting to the atmosphere.

Figure 8: Plant Operation: No Steam Venting