BEST PRACTICE NO. 59

INVENO ENGINEERING LLC

» STEAM SYSTEM ENGINEERING
FLASH STEAM RECOVERY FROM STEAM PROCESSES

1. STEAM APPLICATIONS FOR FLASH STEAM RECOVERY

Industrial plants are focused on steam system optimization to improve safety, increase production, enhance reliability, and reduce energy and emissions. Therefore, unnecessary steam venting from unused flash steam is the number one priority to improve steam system optimization.

Many steam processes will allow condensate to discharge into a pressurized condensate/flash recovery system, so plants need to take advantage of the tremendous opportunity for enhancing the steam system's thermal cycle efficiency.

Figure 1: Flash Steam Losses

1. Nonmodulating steam applications

2. High temperature process applications
  a. Typically, higher than 220°F

The above systems differ from a modulating steam system, which requires a gravity or zero-pressure condensate recovery system.

2. NONMODULATING STEAM PROCESSES FLASH STEAM UTILIZATION

Condensate/flash steam (two-phase flow) discharging from a nonmodulating steam process can be recovered in a flash tank and be used in a cascade flash steam system. A nonmodulating steam process means there is no modulating steam control valve that modulates steam flow to the process to maintain a temperature process or a steam application.

A process without a steam control valve will allow a constant differential pressure across the process condensate drain device, such as a condensate drain control valve or steam trap, as shown in **Figure 2**.

The two-phase flow (flash/condensate) from the steam process discharge can be directed into the pressurized flash tank for separation of the flash steam and condensate.

The purpose of the flash tank operation is to separate the flash steam and condensate, leaving no entrainment of condensate in the flash steam, or flash steam with a steam quality of 100%. The flash steam from the flash tank

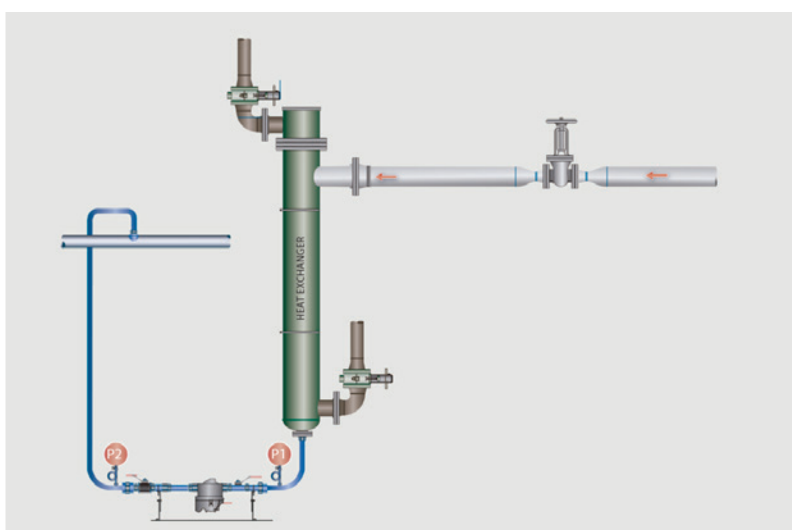

Figure 2: Nonmodulating Steam System

can then be delivered to a lower-pressure steam line for consumption by other processes or applications.

The system described above is referred to as a cascading flash steam system. See **Figure 3**. It is common for industrial plants to cascade the flash steam several times from high steam pressures to low steam pressures.

Here are some examples of nonmodulating steam processes or steam applications:

- steam tracing,
- drip leg steam traps,
- process heaters,
- reboilers,
- corrugators, and
- more.

The low-pressure steam system must have a higher steam demand than the amount of flash steam that is generated, thereby ensuring that the lower-pressure steam system does not become overpressurized.

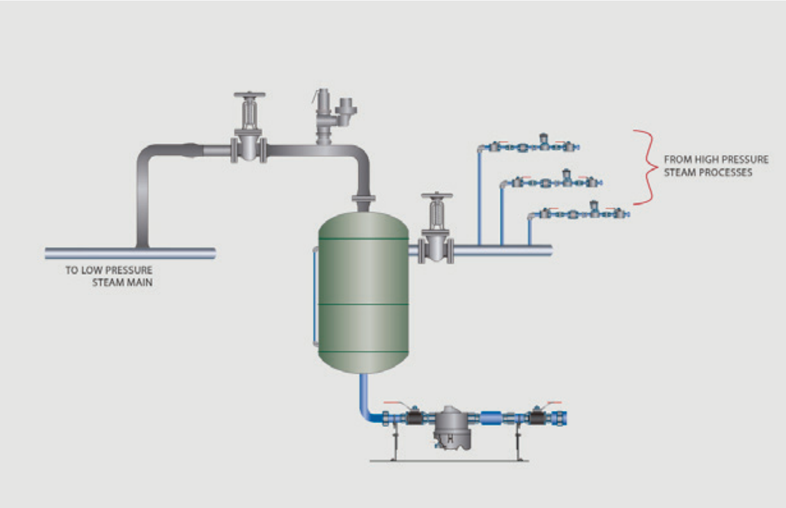

Figure 3: Cascade Flash Recovery System

Typically, a safety relief valve should always be installed on the top of the flash tank or lower steam line piping to preclude overpressurization in the steam system.

If the flash steam generated is less than the demand for the low-pressure steam, the flash system will need to include a pressure-reducing turbine or pressure-reducing valve, which will ensure that the low-pressure steam system maintains the correct operating pressure.

3. PROCESS APPLICATIONS WITH HIGH OUTLET TEMPERATURES

When the process application has an outlet temperature above 220°F, the steam control valve to the application will never reduce the steam pressure below the process outlet temperature.

Example:

- Process outlet temperature: 310°F
- Steam pressure @ 310°F: 90 psig

The steam pressure will not be lower than 90 psig; therefore, the condensate from the process can be discharged into a flash tank recovery system to be used in conjunction with a cascading system or thermocompressing system.

Here are some examples of high-temperature steam applications:

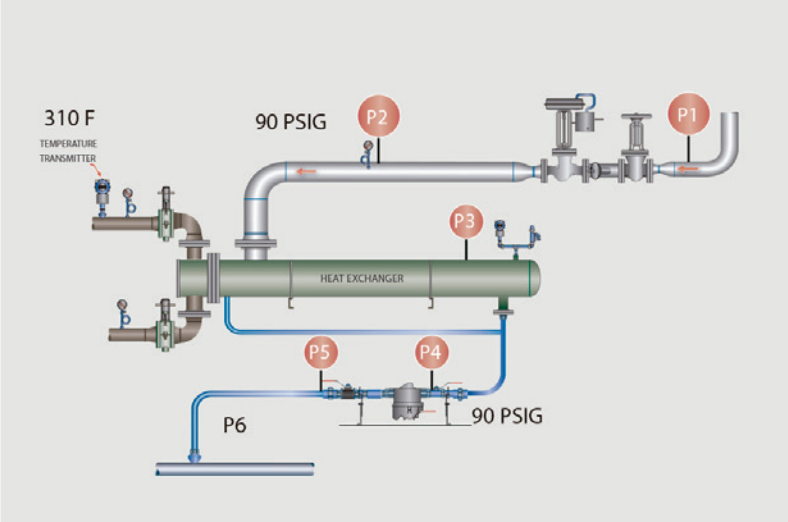

Figure 4: High Temperature Process

- wood product presses,
- tire presses,
- paper machines,
- metal processes,
- air heaters, and
- more.

4. FLASH STEAM RECOVERY DEVICES

4.1. Flash Tanks for Cascade Systems

A cascading system receives condensate and flash steam from the process applications that it directs into a flash tank. The flash tank separates the flash and condensate, which allows the flash steam to be directed into a lower-pressure steam system.

The benefits of using a flash tank include the following:

1. separation of condensate and flash steam,

2. delivery of the flash steam at low velocities into the low-pressure steam system to ensure no condensate recovery,

3. enough space to store a calculated amount of condensate and flash steam.

Please note: The release of energy or flash steam occurs in a condensate line that is properly sized for the flow rates.

Flash tanks can be mounted either vertically or horizontally, but the vertical arrangement shown in Figure 3 is the preferred method because it provides better separation of steam and condensate, resulting in the highest possible flash steam quality.

The most important dimension in the design of vertical flash tanks is the internal diameter, which must be large enough to ensure a low steam discharge velocity through the flash outlet nozzle to eliminate any possibility of condensate carryover. Outlet velocities from the flash tank should not exceed 3,000 feet per minute.

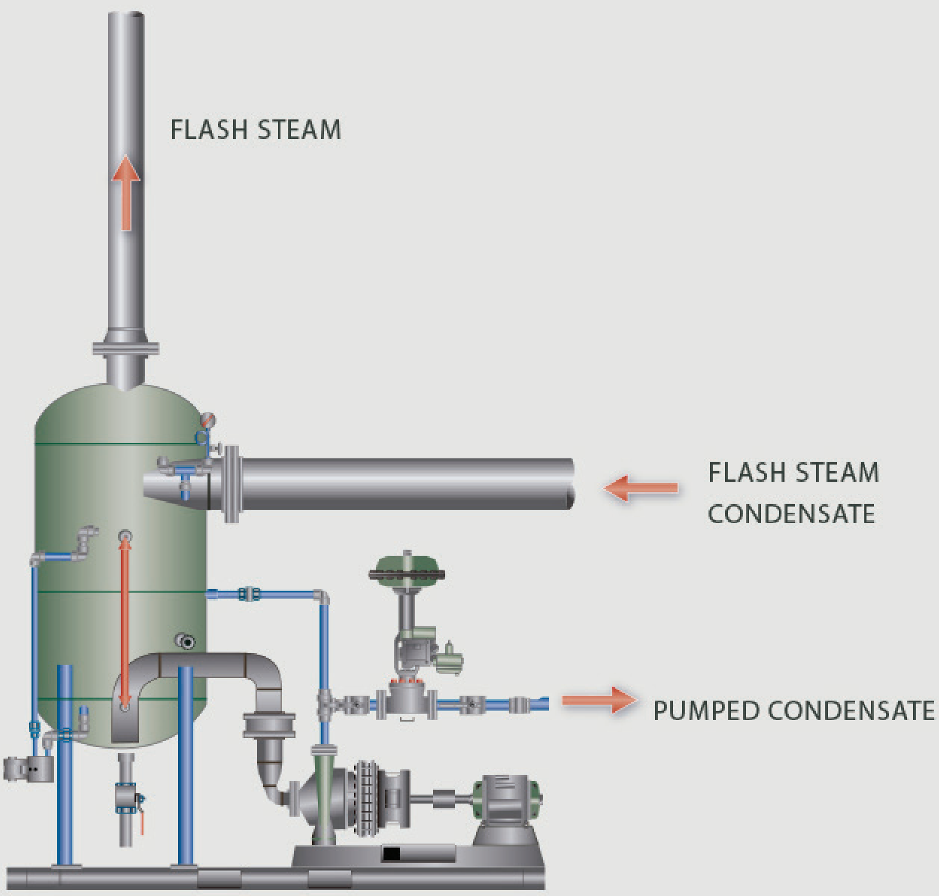

Figure 5: Flash Tank System

The condensate return line must be properly sized to ensure the flash steam is released in the condensate line before entering the flash tank; thus, the flash tank becomes a separation tank (flash and condensate). Unfortunately, a high percentage of condensate lines in industrial plant operations are not properly sized, so all flashing does not occur in the condensate line. In these cases, the flash tank must have additional area for the release of the flash steam.

Flash tanks are considered pressure vessels and must be constructed in accordance with ASME and local codes.

4.2. Thermocompressing

A large percentage of plants do not need low-pressure steam; therefore, a cascading steam system is not able to be implemented.

The alternative method is to recover the flash steam by incorporating a thermocompressing system.

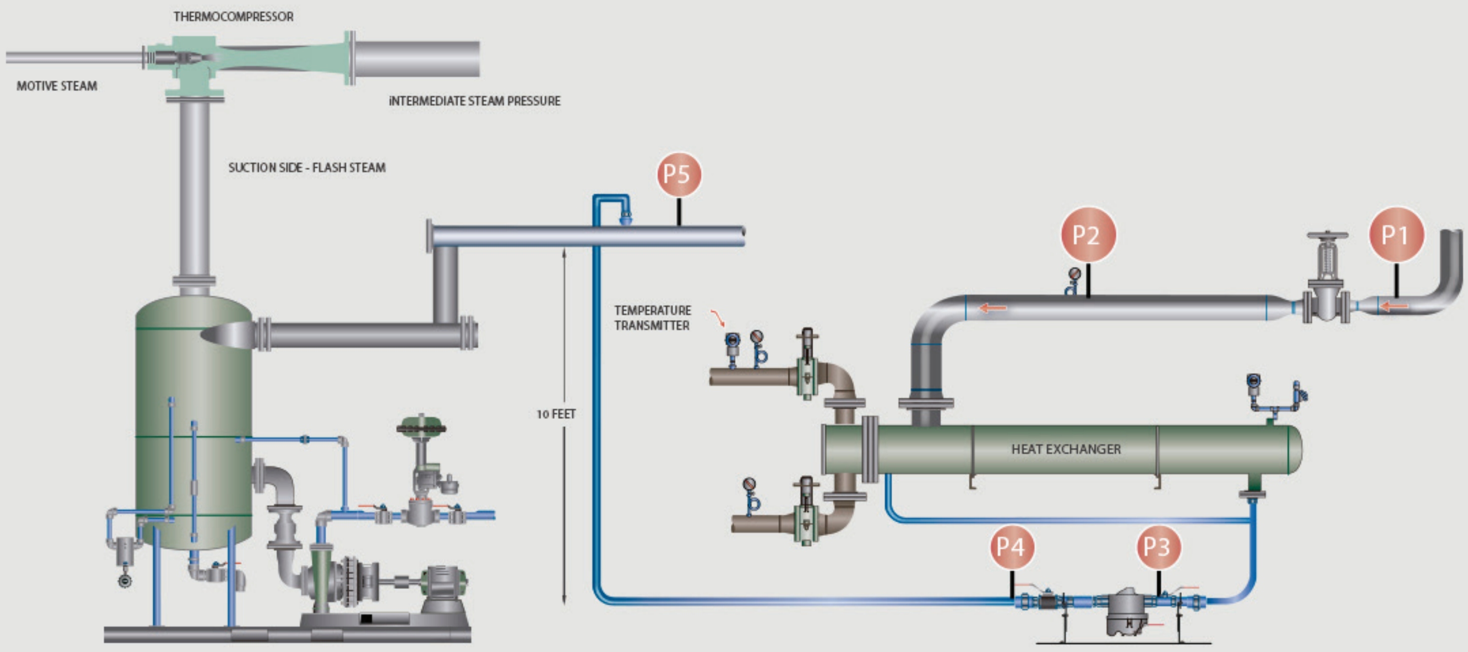

Figure 6: Thermocompressing System

Thermocompressing takes the low-pressure steam (that is normally unable to be reused) and transforms it into a higher, usable steam pressure.

The thermocompressor is a simple device that has existed for many years. It has a nozzle where high-pressure steam from a plant source is accelerated into a high-velocity fluid. The high steam velocity entrains the low-pressure steam from the flash tank by momentum transfer and then recompresses it in a divergent venturi. The result is an intermediate usable steam pressure that is useful to the plant operation.