PHARMA

Case Study

Injecting Flash Steam in Main Distribution Line

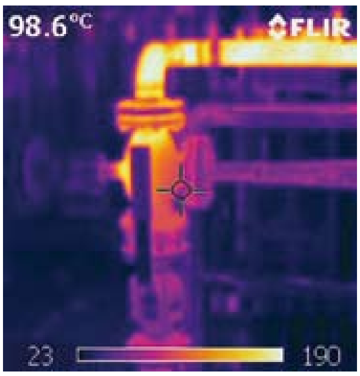
Case Summary

Energy Savings		Operational Optimizations
Steam Savings	2 000 t/year	Decreased maintenance (eliminated cavitating electrical pumps)
CO_2 Savings	320 t/year	Improved safety (no more condensate overflow)
Financial Savings	20 000 €/year	
Investment	40 000 €	
Payback	24 months	

Recovering Flash Steam

When hot pressurized condensate is discharged in a low pressure return line, part of it is re-evaporated, creating what is known as flash steam. This flash steam is important because it still contains a certain amount of heat. Recovering flash is a very effective way to improve the energy efficiency of a steam system.

However, it is sometimes difficult to find a low pressure steam application to use the flash steam. A steam ejector allows the flash steam to be injected into higher pressure live steam. This solution is often used to re-inject the flash steam into the inlet of the heat exchanger that has generated the condensate. But a more sophisticated installation allows removing this "single application" constraint. Flash steam from the general condensate return line could actually be injected into the steam main line, thus making it available for any consumer.



Thermography of a Steam Ejector

Re-injecting Flash into Steam Main Line

Armstrong had the opportunity to study and implement a flash recovery system in one particular plant. In the former situation, condensate coming from the process was collected in an atmospheric flash tank and after that, was sent to the boiler house using an electrical pump. Flash steam was lost as it escaped to the atmosphere through the tank vent line.

The system required improvement, because it was energy inefficient and was causing too many maintenance issues:

- Water was flowing through the overflow because of bad separation between condensate and flash steam
- Maintenance costs were high because of cavitation of the electric pump due to the high temperature of the condensate

Following a detailed study of the system, the design of the installation was modified. First, a new flash tank with improved sizing and design was installed. Then, a mechanical pump was used to remove the condensate from the bottom of the tank without the cavitation phenomenon. Finally a steam jet vacuum ejector was installed at the vent line of the tank to recover the flash steam.

Case Study

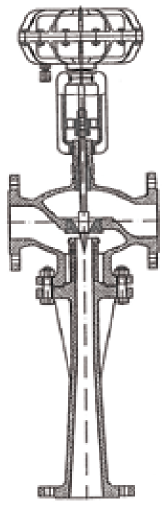
Frequently, ejectors are used to inject the flash steam recovered at the outlet of a heat exchanger, to the steam line at the inlet of that same heat exchanger. In that case, there is a correlation between the volume of flash steam generated and the demand for steam at the heat exchanger.

However, in that particular case, the flash steam was recovered from the 0,4 bar condensate return of the whole factory. Then, it had to be injected into a 3 bar steam line feeding only part of the plant. The increase of the flash steam pressure was done by using another 18 bar steam line to create motive pressure in the ejector.

In that specific application, there was no correlation anymore between the quantity of flash recovered and the demand for live steam. Thus, a modulating ejector was necessary, in order to adapt its operation to the changing conditions of the system. The measurement of the volatility of the system and the sizing of the ejector were crucial for the performance of the installation.

This solution offered several advantages compared to the previous system:

- No more flash steam losses to the atmosphere, flash steam being injected in the low pressure steam network.
- Lower back pressure in the condensate return
- Higher velocity in heat exchangers because of lower back pressure
- Flash can constantly be used because of higher pressure reached thanks to the ejector
- Lower maintenance due to elimination of cavitating electrical pumps



Steam Jet Modulating Ejector

Flash Steam – A natural phenomenon

When water is heated at atmospheric pressure, its temperature rises until it reaches 100°C, the highest temperature at which water can exist at this pressure. Additional heat does not raise the temperature, but converts the water to steam.

The heat absorbed by the water in raising its temperature to boiling point is called “sensible heat” or heat of saturated liquid. The heat required to convert water at boiling point to steam at the same temperature is called “latent heat”. The amount of heat required to raise the temperature of one kg of water by 1°C at atmospheric pressure equals 4,186 kJ. If water is heated under pressure, however, the boiling point is higher than 100°C, so the sensible heat required is greater. The higher the pressure, the higher the boiling temperature and the higher the heat content of steam.

After steam has transferred its latent heat, it is transformed back into condensate that contains only sensible heat. However, if the pressure is reduced, the maximum amount of sensible heat that the condensate could contains decreases. The difference generates an excess of energy that is transformed into latent heat, causing part of the condensate to “flash” into steam.

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