Closed Steam Condensate System Prevents Excess Steam from Being Wasted

Energy-saving Use of Steam in Stainless Steel Production

An international company uses an enormous amount of energy in the production of stainless steel – especially during steam generation. The use of steam is indispensable for generating the required high temperatures in the manufacturing process. As steam generation is very cost intensive, steam should be utilized economically and unused surpluses always avoided.

The previous, aged steam-water transfer stations in the plant routed the high-temperature condensate into open condensate collecting tanks. The resultant flash steam made its way via evaporation lines into the open air. Steam-water hammers, loud noises, material wear, corrosion due to atmospheric oxygen in the condensate lines and huge energy losses were the result.

Here, the steam-water heat transfer station (*figure 1*) from Baelz, a closed steam-condensate system without condensate tank, was recommended. The heat of the surplus steam is transferred to the water in two stationary heat exchangers with 6 MW (*figure 2*) each, which is then available as hot water for further use. In addition to the heat of the steam, the condensate heat in the heat exchanger is transferred, this resulting in maximum cooling of the condensate with simultaneous utilization of its heat. The enormous energy saving is evident when comparing the old system with the new one.

Energetic considerations: steam saving:

- The horizontal heat exchanger previously used without condensate cooling leads to condensate at approximately 170 °C. The amount of steam used is 10,529 kg/h.
- The newly installed stationary heat exchanger with condensate cooling leads to condensate at 90 °C. The amount of steam used is only 9,051 kg/h here, as the heat is utilized better owing to the larger heating surface, which means less steam is needed.

The difference between the former an the new solution yields a saving in steam volume of 1,488 kg/h, i.e. about 1.5 t steam per hour. At an operating time of 5,000 h, this amounts to 7,500 t of steam per year. At €30/t steam, this entails a saving of €225,000 per year.

To attain stable control with these large heat exchangers (6 MW) even in the lower load range, the control of the secondary supply temperature is realized via two condensate control valves in sequence; here the smaller control valve covers an output range of 0-20%, while the larger valve covers approximately 20-100%. In order to cushion load changes reliably on the secondary side too, it was important for the control on the primary side to be faster, with the secondary side making very slow load changes.

Figure 1. Closed steam-water heat transfer stations

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Figure 2. Two steam-water heat exchangers in sequence

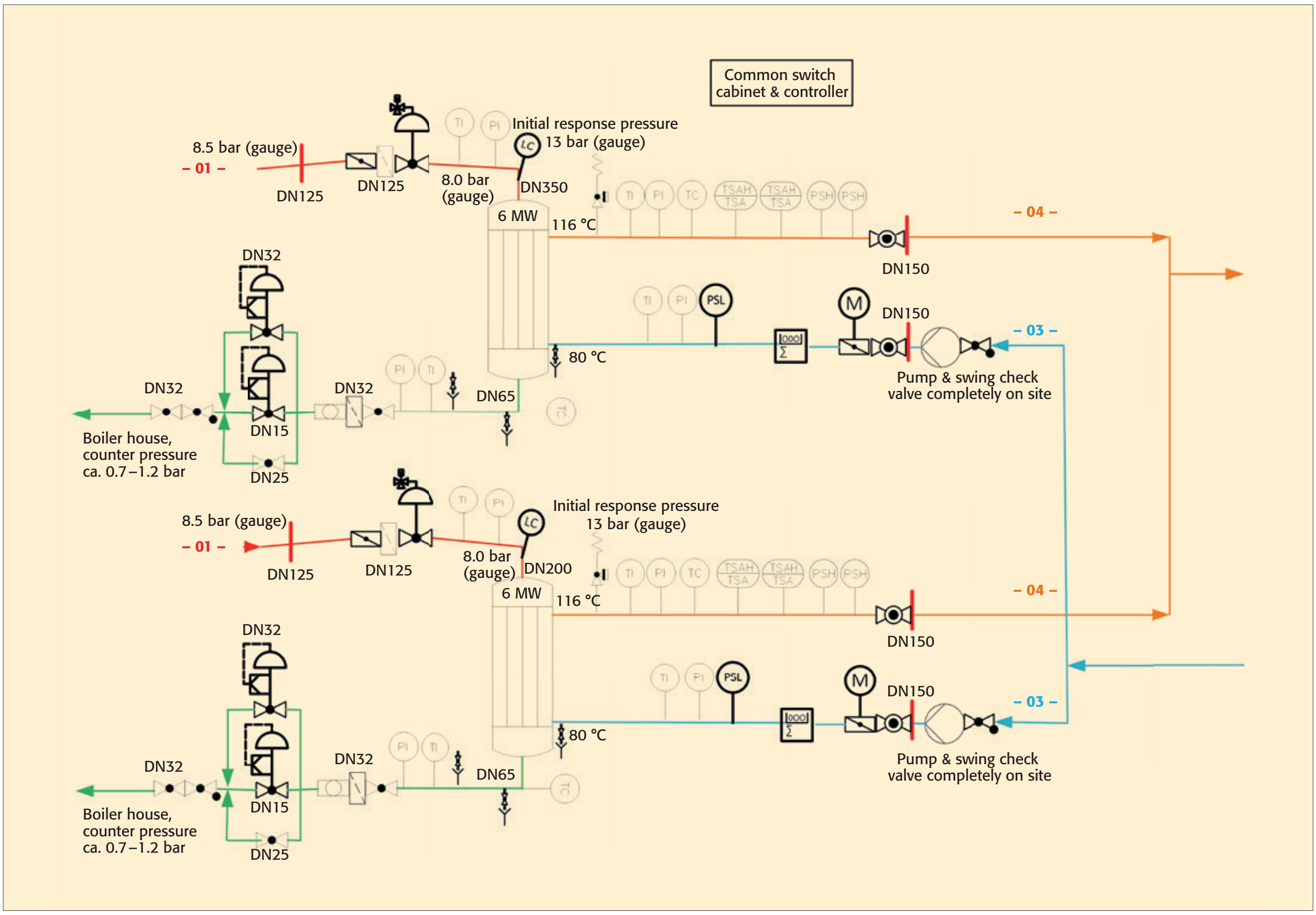

Figure 3. Hydraulic diagram of the system

Even when switching off the secondary side (0 load), the primary side must be closed first; only then can the load on the secondary side be reduced to zero. A constant, stable supply temperature of 106 °C is attained on the secondary side via the two condensate control valves. Although a short-circuit pump originally envisaged on the secondary side to reduce overtemperatures at zero load was installed at the client's wish, this pump has never actually been in operation.

Each heat exchanger has its own switch cabinet with a large display (touchscreen), on which the current values such as temperatures, flow rates and pressures can be read off.

The hydraulic diagram (*figure 3*) shows the two stations in their entirety. The level display of the respective condensate height can also be seen in the diagram.

There are no steam hammers when starting up and shutting down or during ongoing operation. If the heat generation is no longer required, it will be switched off as follows: Closing the condensate valves. However, the steam valve always remains opened and the heat exchange system is monitored via the control in the switch cabinet itself.

Special attention must be paid to the correct drainage of the steam supply line in steam-water heat transfer stations. Only in this way can the startup noises due to water hammers be prevented, which also has a negative effect on the system's service life.

The pipe is drained before the quick-action valve via a slope to the next drain in the steam supply network. After the quick-action valve, the level limiter ensures condensate outflow. If the level is exceeded, the surplus condensate flows quietly via steam pressure into the condensate network thanks to a short opening pulse directed at the condensate opening valve. This prevents condensate from entering the horizontal steam line when the system is at a standstill – zero load – which could lead to steam blows when starting up.

Conclusion

The installation of steam-water heat transfer stations made by Baelz when using steam in the production process results in tremendous energy saving. The closed steam condensate system prevents excess steam from being wasted. Its energy is conserved and is available after conversion as hot water for further use. Steam hammers along with many other of the above drawbacks are now a thing of the past. The energy and hence financial savings mean that an investment in a closed steam condensate system will pay for itself within a very short time.

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