Technical Bulletin

Steam blowing

Using the power and velocity of steam to remove impurities

Introduction

Most new power plants nowadays are producing steam to run a steam turbine. A steam turbine is a sensitive system containing turbine blades. The steam quality is very important as impurities in the steam can deposit on the turbine blades and imbalance the turbine.

To ensure good steam quality, the cleanliness of the system is of great importance, from the start of the erection of a steam generator of a new power plant.

The cleanliness of the steam and water parts of a steam generator is achieved by acid cleaning or boil-out combined with steam blow, the so called pre-commission cleaning. The reason a typical pre-commission cleaning of a steam generator consists of a chemical cleaning and steam blow, is the fact that mill scale/silicates are easier removed with chemical cleaning, which ensures less steam blow cycles are required in a later stage. This technical bulletin goes deeper into the methods of steam blow.

Steam blow operations

During the erection of new build steam generated power plants, it is impossible to prevent foreign matters remaining in the steam water cycle. And in addition, the steel of which the steam and water cycles are fabricated will be contaminated with corrosion products (iron oxides) due to heat treatments of the steel (annealing) or rust from environmental circumstances.

Although strainers (filters) are placed in the system to prevent impact of materials on the turbine blades of a steam turbine, the steam system should be free of (large) particles, as strainers can be penetrated by particles and harm the turbine.

A so called pre-commission cleaning of the steam and water cycles consist of a chemical cleaning and a steam blow. A chemical cleaning prior to a steam blow cleaning ensures the time and effort (and thus costs) of steam blow is reduced significantly, as a chemical cleaning will remove loose debris, iron oxides, mill- and annealing scales.

Steam blowing is a cleaning operation which uses the power (energy) and velocity of steam to remove impurities from boiler parts and additional pipelines, and differences in temperatures during steamblow operation will remove mill scale, due to expansion and contraction of the steam piping. Almost always a turbine manufacturer demands a steam blow cleaning to a certain cleaning criteria.

Steam blowing for a steam generating plant requires careful planning and the establishment of a steam blow program, a so called pre-engineering. One of the important parts of the engineering is the determination of the velocity of the steam inside the system. This is called K-factor. Only from a certain velocity or K-factor the steam has sufficient energy to remove the particles from the system. The K-factor is dependent on the dimensions of the boiler like production of steam, pressure, temperature, diameter of the steam lines and length of the steam lines. When the K-factor is known, the dimensions of the

temporary piping and silencers can be determined. The turbine itself will of course not be a part of the steam blow and will be bypassed with the temporary steam blow lines. Steam blow operations have to be monitored. As the size and number of particles are important, these are measured using “target plates”. These plates are mirror like steel (or other prescribed materials) plates, which are placed in the temporary steam lines. The target plates are inspected regularly during operation. The size and number of particles on the mirror plate are a part of the cleanliness criteria.

To reach the K-factor during steam blowing, there are two types of steam blow methods:

1) Shock blow
2) Continuous steam blow

Shock blow

With shock blow, the pressure inside the steam generator is raised to a certain maximum and reaching the required pressure, a temporary sacrificial valve is opened quickly. During this pressure release the K-factor or steam velocity is reached, but for a short period of time. Due to release of the pressure and temperature, the steam generator has to start again. The steam blowing operation described should last approximately four to six hours, including start-up and shutdown of the steam generating plant. Normally not more than one steam blowing operation should be effected daily in order to ensure adequate cooling of the system.

Continuous steam blow

With continuous blow there is no pressure build up, but after calculations, the K-factor is reached continuously. During the continuous steam blow the target plates are checked on impacts of particles.

Noise reduction

High pressure/temperature steam is actually water with enormous amount of energy. Releasing steam to the atmosphere with such energy gives a lot of mist formation and noise. To reduce noise levels to acceptable values, steam has to be cooled by condensation. There are two types of noise reduction methods. One is the classical silencer or knock out pot, which works like a type of cyclone; the increasing of the surface area will cool the steam. The second type of noise reduction works like spray water inlet in normal steam operations. At the end of the temporary steam blow pipe, water is introduced to cool down the steam and at the end of the line there is a condensate pot to collect the condensate steam. From this temporary condenser the water is used again for spray water inlet.

Continuous steam blowing has certain advantages in comparison with shock blowing. Specially in combination with noise reduction by means of spray water inlet (so called quenching). As the K-factor is most important for a good steam blow result, continuous steam blow has the advantage to measure this factor for a longer period, as with shock blow the K-factor is reached for a short period. Second, the amount of demin water required for continuous steam blow is much less than with shock blow. Finally, in combination with spray water inlet noise reduction, the temporary pipe work of continuous steam blow will receive a max pressure of approx. 10 bar, which enables to use less expensive temporary piping. For shock blow the temporary piping up to the silencer is PN40 at least.
In the table underneath, the differences between shock blow and continuous steam blow are given.

Vecom offers continuous steam blowing

Vecom has invested in the equipment and expertise for steam blowing. This equipment consists of:
- Quench water (spray water) silencer
- demin storage tank (30 m^3) and hot water pumps
- Condenser pot
- Temporary steam blow piping (up to DN450)
- Automatic target inserters

A reference list of previous steam blow projects can be acquired on request.

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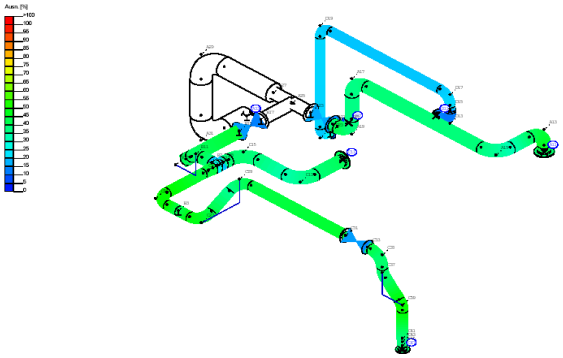
Quench water silencer

Steam separator (condenser)



Stress calculations temporary steamblow

	Continuous Blowing process to atmosphere	Shock Steam blow process
Measures for noise reduction	Quenching No pressure loss Temporary piping PN16	Silencer/Sound absorber High pressure loss Temporary piping PN63 (max 58 bar at 400 °C) or PN100
Scope/Application areas	- Removal of mill-scale as well as loose particles in steam parts of the boiler. - Design gradients of the boiler and steam lines are not exceeded. - Can still be used in case of load-restrictions of the boiler.	- Removal of mill-scale as well as loose particles in steam parts of the boiler. - Design gradients of the boiler and steam lines are exceeded. - The plant/system must be pickled.
Steam Blow-out procedure	Operation of the boiler in sliding-pressure against the atmosphere. Steam-pressure emerges from loss of pressure of the super-heater system and the temporary steam blow piping system. Operating parameters: Steam-pressure between about 15 and 35 bar. Steam blow temperature should be between 480 and 525 °C. During steam blowing, the temperature quenching should be between 250 and 480 °C. Boiler load of about 20% to 40% Boiler superheater and steam line are fully open during the entire operation. Duration of the blow-out operation is about 3 to 6 hours (demin water storage capacity). Steam blowing can be finished in a time of 4 to 5 days.	Start-up of boiler at about 50% operating-pressure (about 68 bar). Pressure-accumulation through throttling of the temporary blow-out valve (time for open/close < 10 second). 2 to 5 actions of steam blow per day are possible with the shock blow procedure. For each blowing step the combustion/heating must be put out-of-action, because the water level in the steam drum increases outside of the visible area. Adjusting the secondary-feed regulator in such a fashion that at the end of the pressure-impact/surge the water level in the drum is within visible range. The number of blow-out operation is dependent on the rate of the cleanliness during erection. Steam blowing time is incalculable.
Advantages and disadvantages	System-friendly. Gradual and uniform increase of pressure and temperature.	Not system-friendly due to rapid decrease of pressure and temperature .
	Uses less demin water in total.	Uses more demin water in total.
	Possibility to enhance the K-factor variably.	Difficult to reach/achieve the K factor 1,2
	Level of noise can be controlled by water injection.	Level of noise can be controlled by silencer.
	By means of lower blow-out pressure and substantially reduced steam temperature, temporary steam blow lines with smaller wall-thickness and low-alloyed steel is possible to use. Quick operating valves are not required.	Steam blow lines with larger wall-thickness and high-alloyed steel have to be used due to greater pressure and steam temperatures during steam blow. Quick operating valve are expensive.
	Large diameter for the steam blow lines after injections/spraying.	Consistent diameter of steam blow lines up to silencer.
	Build-up of exhaust vapour (mist) at silencer due to water quenching.	Possibility of saving process water, because no quench water is required.