

Cleaning High Pressure Boiler Internal Surfaces

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High pressure boilers need very clean internal surfaces. The pre-commissioning cleaning involves Alkali boil out to remove any oily materials, Acid Cleaning to clean up mill scales and Steam blowing to clean superheaters, reheater, and piping. Post-commissioning cleaning is specific to each boiler.

High pressure boilers are designed to produce steam at a specified quality. Improper steam quality can lead to tube failures in the boiler, as well as turbine blade damage, resulting in large availability loss. The cleaning of internal surface of high pressure boiler can be grouped into two main methods, one pre-commissioning and the other post-commissioning cleaning.

Pre-commissioning cleaning

During manufacturing of seamless steel tubes, a quantity of mill scales are bound to be formed, and some of these can remain inside. During fabrication and erection of the pressure parts, some amount of oil and grease can also get into the tube surface apart from the weld slag and other materials. Taking all of these into consideration, the pre-commissioning cleaning has three major steps.

- Alkali boil out - which is for removing the oil and grease from the internal surface.
- Acid cleaning - for removing the mill scales in the internal surface. Both acid cleaning and alkali boil-out are done for all water-touched surfaces.
- Steam blowing - In the case of super heaters, reheaters, and steam pipes, they are cleaned by steam blowing.

Alkali boil-out

This operation in boilers is taken up after hydraulic testing of the boiler is completed and the oil burners are commissioned. Alkaline flushing is carried out before the boiler is taken for alkali boil out. It is a practice to mechanically remove the oil and grease wherever possible. The drum internals are installed before start of alkali boil out. Normally sodium carbonate and sodium phosphate in equal quantity along with a detergent to about 0.05 to 0.1% by volume are used for alkali boil out.

After the boil out solution is added, the drum level is checked through a gauge glass and confirmed before firing the boiler. The boiler is brought to 20 kg/cm square in about 8 hours time keeping in mind the rate of pressure raise and temperature raise allowed for cold startup. The drum level is maintained at normal level during this operation. After about four hours at pressure, the fire is shut down and the boiler is allowed to cool. This ensures the sludge settle down and the boiler blow down is carried out using the bottom drain. Care should be taken to maintain the drum water level within the visible range of gauge glass. This operation is done for four times to a total of about 16 hours. Solution samples are taken at regular intervals, and if the original concentration drops to half or below, chemicals are added to bring back the concentration. The boiler is then drained after the drum metal temperature is below 90 degree C. The boiler is then rinsed with clear rinse water and flushed.

Acid cleaning

Many methods are used by different boiler makers to clean the mill scale and rust inside the tube surface. It is very important that this operation is carried out by an experienced and reliable agency. The methods used are circulating acid method and soaking method.

In the case of the circulating method, external acid cleaning pumps are used to keep the acid in circulation. However in the case of soaking method the acid is kept stationary for a specified time. Many combinations of acids are used for this purpose. The most popular acid is 5% hydrochloric acid with inhibitors that are used to inhibit the action of acid on the cleaned surface of the tube. The super heater tubes should be plugged and water filled and maintained under positive pressure so that the acid vapors do not enter the tube surface. The boiler is drained under nitrogen at a positive pressure; this is needed to protect the internal virgin surface. The sludge resulting from mill scales and rust will have to be flushed from the bottom headers. The boiler then goes through a passivation operation to ensure a protective layer formation inside the tube surface.

Steam blowing

Steam blowing is used to clean the super heater coils and the steam pipes like main steam and reheater pipes. There are two methods used for steam blowing: continuous blowing and intermittent blowing. In both cases, the idea is to create a disturbance on the surface of the tube or pipe well above that is possible during the peak load operation of the boiler. It is seen that at a pressure of around 40 kg/cm squared, the internal surface of the super heater and steam pipes are subjected to such a disturbance that any loosely adhering material is dislodged when the steam is allowed to blow out to the atmosphere. The completion of steam blowing is declared if the target plate of turbine blade material kept at the predefined point is free from any indentation or is within allowed limits. To complete the steam blowing in super heater, reheater, steam pipes, etc, steam blowing is done in more than one stage.

Post-operational cleaning

During operation boilers accumulate deposits inside the tube surface depending upon the quality of water chemistry maintained. Once the boilers have operated for about five years then it is a good practice to take tube samples from the high heat flux region and evaluate them for internal deposit. The samples are taken from all the four walls of the boiler furnace walls and tested for the amount of deposit and the chemistry of deposit. If the deposit quantity is above 40 mg/cm squared, then the tube is termed dirty and acid cleaning is recommended. The type of acid to be used for cleaning will depend upon the chemistry and adherence of the deposits to the tube surface. If the deposit contains copper from the pre-boiler system, then this has to be first removed. The other ingredients of the deposit are removed subsequently. Hence the post operational cleaning can have a few stages of acid cleaning. To decide this, tube samples taken are subjected to a cleaning test in the lab using the actual acid, temperature, time and stages planned at the site. Based on the results of the cleaning in the lab and result there achieved, the final recommendation is given to the boiler owner.

Source:

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