

Cleaning of Boiler smoke tubes



CASE STUDY

Cleaning of smoke tubes

Resumé

“Introduction to optimizing your boiler efficiency by having mechanical cleaning of exhaust gas tubes”

Karsten Ewald
Assistant Technical Manager
Projects@Globalboiler.com

History

Soot layer in boiler tubes causes the equipment to run harder to maintain the same output, and with efficiency loss comes additional fuel consumption which will affect the bottom line.

Effective boiler cleaning can restore boiler tubes surfaces and efficiency, which in the end saves fuel consumption. Energy efficiency in a boiler all revolves around keeping the boiler clean and free of scales and soot. The boiler is a crucial piece of equipment and is important to keep clean to ensure it stays in efficient and safe condition.

And by experience we do know that boiler cleaning often is not on the top of mind, if everything appears to be working, routine maintenance may fall to the wayside. However, out of sight should not mean out of mind. Being proactive when it comes to boiler maintenance yields benefits such as, reduced downtime, saving energy and extending the life of the boiler.

Hot gasses and unburned carbon from fuel will cause soot and scale buildup, which will cause insulating layers on the fireside of the tube. An ongoing cleaning program that consists of chemical descaling for the waterside and mechanical and industrial vacuums for the fireside will enhance energy efficiency and equipment life.

Example on the effect a layer of soot will cause

With a soot layer of 0,5mm you will experience a loss in heat transfer of approx. 16% compared to a boiler with clean tubes.

If we look at the boiler tubes as a 4mm steel layer and the flue gas boundary layer along with the boiler water boundary layer to be 1mm we will have a heat transfer set to $Q = 42000 \frac{J}{s}$ which under normal operating condition with clean tubes

Will result in a heat transfer coefficient of $k = 35,6 \frac{J}{s * m^2 * ^\circ C}$

With a layer of 0,5mm soot in the gas tubes we are looking at a reduces heat transfer due to the insulating effect the layer of soot has on the tubes, this results in a lowered heat transfer coefficient.

$$k = \frac{1}{\frac{1}{\alpha_g} + \frac{S_{soot}}{\beta_{soot}} + \frac{S}{\beta} + \frac{1}{\alpha_w}} = 29,9 \frac{J}{s * m^2 * ^\circ C}$$

As a result of the layer of soot, a reduction of the k value with $\frac{35,6-29,9}{35,6} * 100 = 16\%$ which results in the equipment must run harder to maintain the same output.

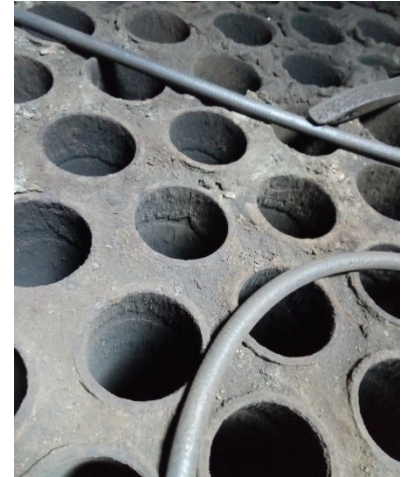


Figure 1 Layer of soot deposit on boiler tube plate and inside fire tubes

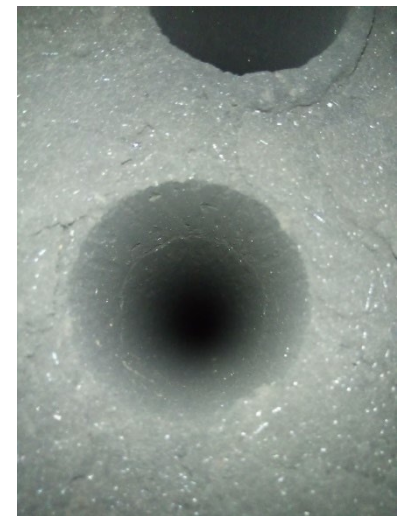


Figure 2 Heavy layer of soot covering fire tubes

Mechanical cleaning of fire tubes

The equipment for cleaning fire tubes is designed so the cleaning process can be conducted in both vertical and horizontal boilers. The Y handle for vacuum hose and brushing tools allow for easy cleaning with minimal contamination of airspace and the surrounding area along with being easy to handle, allowing one man to easily conduct the cleaning without the back breaking and highly contaminating procedure followed by a manual cleaning



Figure 3 Horizontal boiler prior to cleaning



Figure 4 Cleaning of vertical fire tubes from the bottom part of the boiler



Figure 7 Cleaning of horizontal boiler



Figure 5 Cleaning of vertical fire tubes where access only is allowed from above



Figure 6 Easy for one man to handle cleaning



Figure 8 Vacuum cleaner with cyclone separator to minimize downtime while cleaning



Figure 9 Tube condition after cleaning

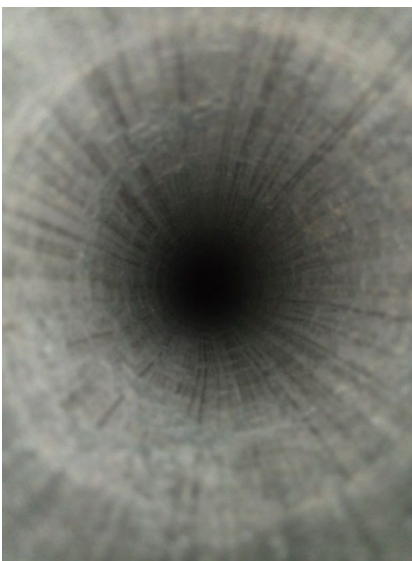


Figure 10 Tube condition after cleaning, no soot or scales left behind

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If safe and economical operation is important for you, please do not hesitate to contact us and we will find a solution that suits your needs.