

The Locomotive

Chemical Cleaning – To Clean or Not To Clean

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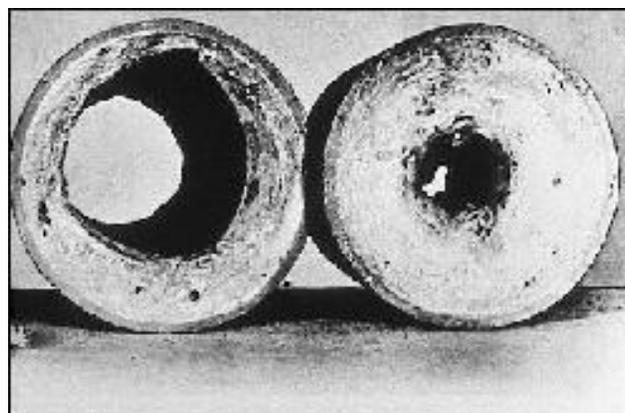
Removing Deposits

Chemical cleaning has been considered a necessary part of boiler maintenance for many years. The objective of a chemical cleaning is to safely remove all the deposits from the inside of the boiler tubes. In low-pressure boilers, chemical cleaning typically removes calcium carbonate and other hard adherent scales. In higher-pressure boilers, the major deposit removed is magnetite and some copper.

Chemical cleaning can improve the boiler heat rate and reduce the number of tube failures. It typically improves the stability of boiler chemistry. However, there also are down sides to chemical cleaning.

Warning: Chemical Cleaning May Be Hazardous To You And Your Boiler

The chemical cleaning of a boiler is a project fraught with danger and horror stories abound. For example, a few years ago a power boiler was cleaned with ammoniated EDTA (ethylenediaminetetraacetic acid). The plant operators were unaware that chemical cleaning solution had found its way into the super-heater and was not flushed out. When the unit



went back on line, the chemical cleaning solution evaporated in the superheater and caused it to fail. Complete replacement of the superheater was required.

Disposal of the chemical cleaning solution also can be a problem. Recently during evaporation of the spent chemical cleaning solution in a utility boiler, the vendor allowed the solution to impinge on a riser tube, causing it to fail catastrophically. The resulting repair cost the utility more than \$1 million.



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Another utility experienced a rash of catastrophic tube failures due to hydrogen embrittlement. The failures followed an incomplete chemical cleaning with inhibited hydrochloric acid.

Evaluating The Risks

When making the decision to clean your boiler with chemicals remember that chemical cleaning is:

- Expensive (vendor costs alone may be \$50,000 — \$150,000)
- Potentially dangerous to personnel and equipment
- An environmental and chemical spill risk
- A waste handling problem
- Time consuming, adding as much as a week to the end of an outage

Considering these risks and costs, it is important to know when a boiler needs chemical cleaning. The only thing worse than not cleaning a boiler that requires it, after all, is the chemical cleaning of boiler that does not.

When To Clean

In the past, utilities and others who operate steam generators have considered a number of factors when determining the need to use chemical cleaning. The most common criteria are:

- Deposit loading on tube samples
- Time-based cleanings (operating hours or calendar months since last chemical cleaning)
- A major contamination incident (condenser tube leak)

We will review each of these briefly.

Deposit Loading

One of the most common criteria is the deposit loading on the inside of the water wall tube. The plant will take two or three boiler tube samples from the high heat areas of the boiler and have the deposit loading analyzed on each. An average of the hot-side loading on the tubes is compared against a chart similar to the one in Figure 1. This is still the

best way to determine the need to use chemical cleaning, assuming that there have been no major contamination incidents since the last chemical cleaning.

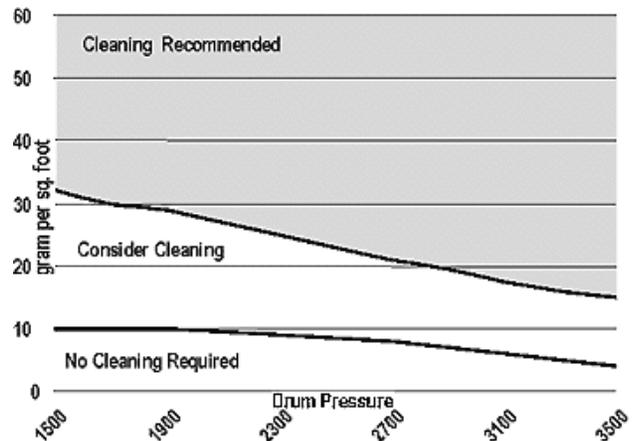


Figure 1: Deposit Loading

Time-Based Cleanings

In the past, some boiler operators cleaned based on time — either the number of operating hours or the number of years since the last chemical cleaning. This is probably the worst way to determine the need to use chemical cleaning.

Deposits do not form on boiler tube walls at a uniform rate over time. Immediately after a chemical cleaning, the boiler tubes create a protective film of magnetite that limits further corrosion of the base metal. This quickly adds 3 to 5 or so grams/ft.2 of deposits to the boiler. Over time, new deposits collect on top of this protective layer. These deposits typically come from the boiler feedwater. Boiler start-ups and shutdowns can add a tremendous amount of deposit to the boiler tube wall. The number of start-ups is a better predictor of tube deposit density than operating hours.

Time-based cleanings do not consider water chemistry (good or bad) or the amount of deposits since the last cleaning. It may be that the water chemistry control has been particularly poor and the deposit loading is high. In that case, the frequency should be increased. The opposite also might be true, and the chemical cleaning can be put off for years.

Contamination-Required Cleanings

This criterion is often overlooked, particularly by those who clean on a set time schedule. If there is a major contamination of the boiler water, a chemical cleaning must be performed at the next opportunity, preferably before the unit is restarted.

The most common contamination incidents are calcium hardness in the boiler from a condenser tube leak or demineralizer/softener malfunction. Corrosion cells are created during this contamination that lead to caustic gouging and hydrogen embrittlement. In these cases, the high risk of major water wall damage outweighs the risks associated with chemical cleaning.

Postponing Your Next Chemical Cleaning

The need to use chemical cleaning is the result of corrosion products building up on the boiler tube walls. The more corrosion products generated in the boiler and feedwater system, the more often the unit will require chemical cleaning. Reducing corrosion in these areas can improve overall boiler chemistry and extend the time between cleanings.

A large percentage of the corrosion products on boiler tube walls come in from the feedwater system during start-up. Improving lay-up and start-up practices can mean the difference between needing to clean with chemicals every three years and every 12 years. Find a knowledgeable consultant or chemical vendor that will help you develop better lay-up and start-up practices and get out of the chemical cleaning cycle.

Summary

Chemical cleaning of your boiler is one of the ways to assure safe and efficient operation. Care must be exercised, however, to clean a boiler only when needed. Techniques such as deposit loading or contamination-required cleanings can be used to determine when to clean. Improving boiler and feedwater chemistry and lay-up and start-up practices can extend the time between cleanings. Together, these techniques and practices also can save money and help reduce risk of forced shutdowns.

(In An Upcoming Issue: Choosing A Chemical Solvent)

About the Author

David Daniels, a Senior Scientist with Hartford Steam Boiler's Mechanical and Materials Engineering division, Austin, Texas, has more than 16 years experience in steam cycle chemistry and water treatment. Dave provides inspection, consulting and training services to utility, pulp and paper, and industrial steam generators. He often works with inspectors and clients of HSB to improve steam cycle chemistry at a client's facility, reducing risks and costs associated with steam and water chemistry.