

BOILER CHEMICAL CLEANING

Introduction: Oxide of Iron (FeO , Fe_2O_3 , $\text{Fe}(\text{OH})$, FeOFe_2O_3 / Fe_3O_4) are all invariably found on the walls / tubes of a boiler made generally of Carbon Steel. These deposits of oxide of iron are also in nature to protect the surface of the metal iron, in the form of iron ore. However an uneven distribution of various oxides of iron with different chemical and physical characteristics, will lead to a number of setbacks such as under deposit corrosion, transportation and precipitation of the same deposits from high heat flux area to comparatively lower heat flux area within the boiler. To avoid this a dense magnetite film is desired in every boiler. This is to protect the boiler from the transported iron oxide from porous deposits formed inside the walls. If the boiler is chemically cleaned prior to its commissioning, the layer that first forms or induced is going to be fairly uniform. In the course of running the boiler with proper EPRI phosphate continuum process, it turns into a relatively dense magnetite layer.



This layer will then prevent localised overheating resulting from porous under deposit known in industry as wick boiling. A further harm of wick boiling can be seen as localised acid and caustic attack. Acidic attack can liberate H_2 which in turn could decarbonise the base metal (of boiler) and form very voluminous methane along grain boundaries, causing cracking (intragranular) in the steel, greatly weakening its strength and resulting in ruptures. A set of chemical reaction can be given showing the above chemical phenomena in boilers.



Sampling coupons before and after chemical cleaning

Chemical cleaning or iron oxide cleaning : Water chemistry like in conventional steam generators or CCPP combined cycle is again playing an important role in HRSGs, where its importance is justly recognised by monitoring of HRSG tube conditions prior to commissioning, during the operation and also in periodic overhauling of HRSG.

A leak test of pressure part of the boiler prior to chemical cleaning is a must. A boiler cleaning should be performed just before first firing of the boiler. If there be a delay in firing the boiler should be conserved but not for several months.



Boiler

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Chinese black or Japanese black coatings cannot be removed by chemical means. These coatings are removed before construction. The detailed cleaning procedure given below is the responsibility of our company. To this day, we have performed a number of chemical cleaning operations of SG, CCPP and HRSGs. (see the attached reference list)

Following is a short description of how a chemical cleaning steps follows about all things it covers and what is its purpose. Also given here are the list of chemicals, equipments, utilities and analytical instruments.

Chemical Cleaning Description

1. SCOPE

This procedure describes the chemical activities for chemical cleaning of LP, IP and HP component of any HRSG.

2. PURPOSE

This procedure provides the requirement for chemical cleaning of newly built HRSG units prior to commissioning or the HRSG in use as well.

The aim of chemical cleaning is;

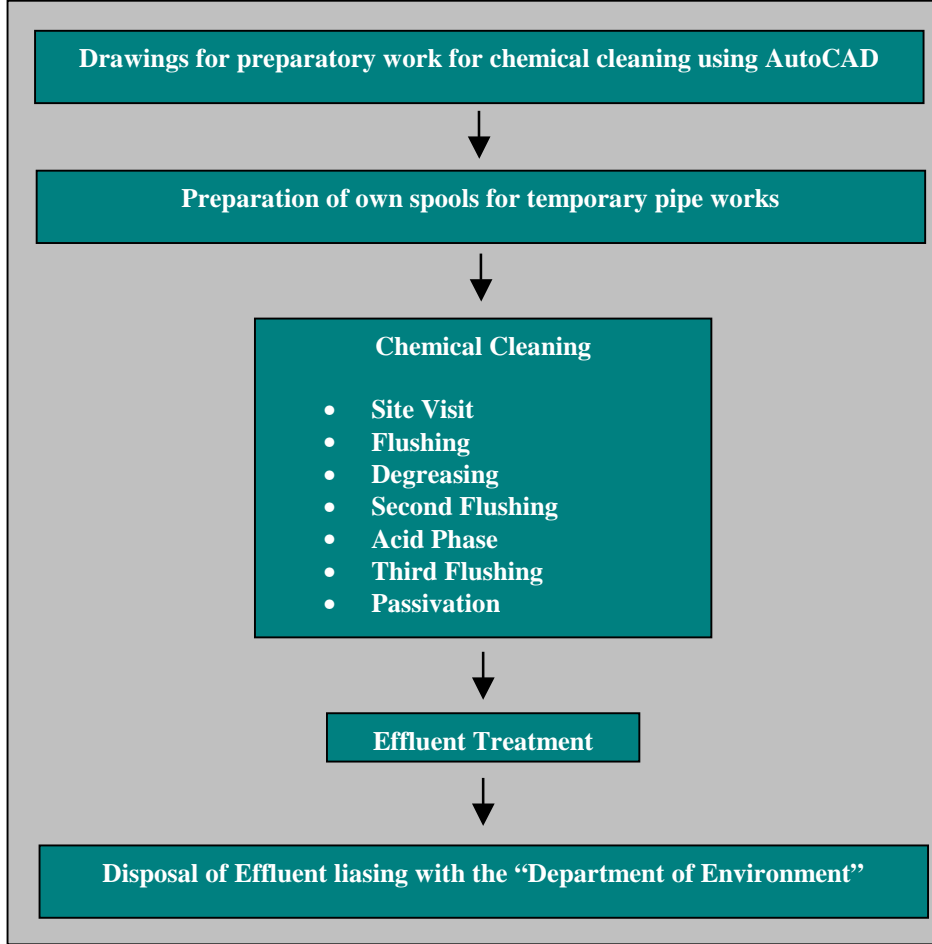
- To remove loose debris, dirt, dust, grease and oil.
- To form a clean inert metal surface with a protective layer.

3. LITERATURE CITED IN SUPPORT OF OUR METHOD ARE

- 3.1. Power / Boiler Chemical Cleaning / Mel Eschmacher P.E. and Brad Buecker.
- 3.2. Corrosion inhibitors Chemical Cleaning of thermal power equipment pp223 and also in the same reference pp 221-225 under the heading "Prestart Cleaning".
- 3.3. "Chemical Technology Review" No 132- ndc (Noye Data Corporation USA)- 1979, Corrosion Inhibitor Recent Developments pp97.

4. CHEMICAL CLEANING

It consists of several steps. Those in our method is shown below schematically.



5. CHEMICALS AND EQUIPMENTS REQUIRED

In our method of cleaning we require essentially the following chemical;

- CESA Citric Acid EDTA Sequestering Agent with inhibitors
- Nonionic Detergen Nonyl Phenol Ethyate
- Sodium Tripolyphosphate
- Citric Acid
- NH₃
- Hydrogen Peroxide

5.1. Among The Equipment Required

- Circulation pump with all necessary valves and manometers ect., as well as connections on skid.
- Circulation Tank. Skid Mounted.
- Rigs for elevated positions.
- Drain pipe to the canal / sewer.
- Human safety equipments like, gloves, goggles, boots, shovel ect.

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5.2. Utilities Required

- Raw water.
- Demineralised water.
- Electricity and steam if necessary.
- Waste Water Treatment Plant.

5.3. Analytical Instruments Required

- Online pH meter
- rH meter
- Conductivity meter
- Turbidity meter
- Photometer
- Fe HR
- Fe LR
- Test Coupons for weight check as necessary

Chemical cleaning is a very tricky process and should be carried out carefully, keeping in mind value of the plant in question. Also the cost factor and efficient cleaning is the requirement , so a very professional approach has to be made for each and every cleaning job. The close study of the system is a must and then only the viable method can be applied to achieve the desired result.

Our firm has strived to do this in the past and has to this day the experience of carrying out succesful chemical cleaning of a number of boilers.