CASE STUDY- Boiler Fins Tubes Cleaning Case Study

Customer	Confidential – Energy Production
Application	Boiler fins tubes - UHA HRSG Contaminations: Heavy, Hazardous - Sulphur built-up, rust Dec 2013 Working shift: 12 hours – 6.5 days
Cleaning System	Dry Ice Cleaning (DIC) Machines with Compressed Air. 3mm pellets medias
Benefits	Better heat transfer efficiency and lower pressure drop. Increase the productivity of the boiler 1.2 MW about 1 % Performance.

1- INTRODUCTION

The oil & gas companies as well as the power plants are under pressure of production and should be cost effective, therefore, the production and maintenance improvement are on their top priority. Looking for alterative of current cleaning practices are considered and one effective solution is Dry Ice Cleaning **(DIC).**

2- AIMS

The purpose of the study is to show the effectiveness of **DIC** method for cleaning the boiler fins tubes.

3- THE PROBLEM

The boiler at the Client‘s Power plant had experienced high back-pressure and high stack temperature due to the build up of Sulphur over 5 years of operation.

4- THE METHOD

The **DIC** system uses non-abrasive media in the form of solid CO2 3mm pellets that will not damage surfaces or equipment. The combination of **DIC**’s kinetic energy and thermal effect breaks the connection between the dirt and surface, lifting away contaminants. Unlike cleaning with other media, DIC does not leave any secondary waste, because the dry ice particles sublimate upon impact (converting from solid to gas). DIC is safe and non-toxic, does not create downstream contamination and reduces or eliminates employee exposure to dangerous chemical cleaning agents.

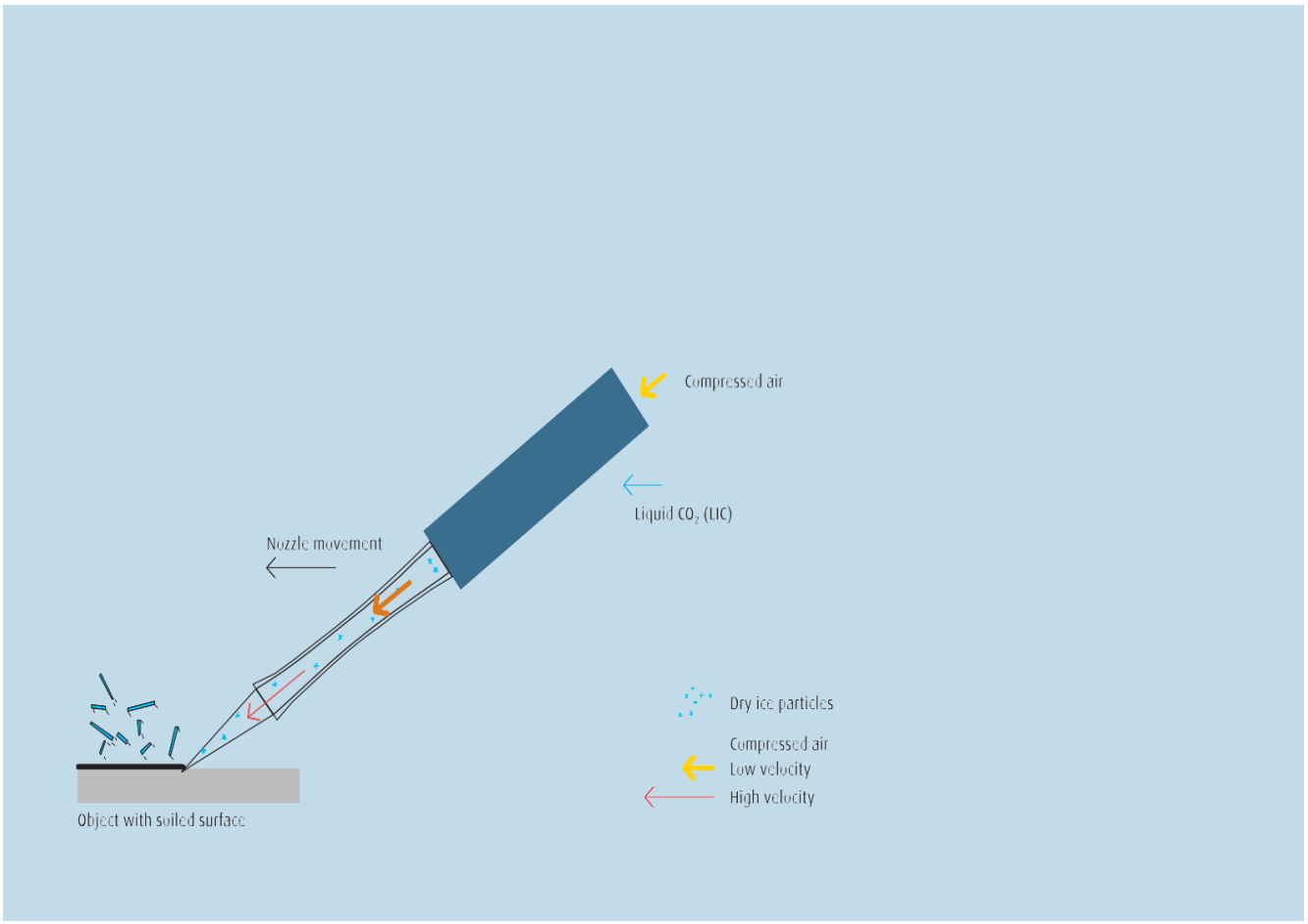
How does it work?

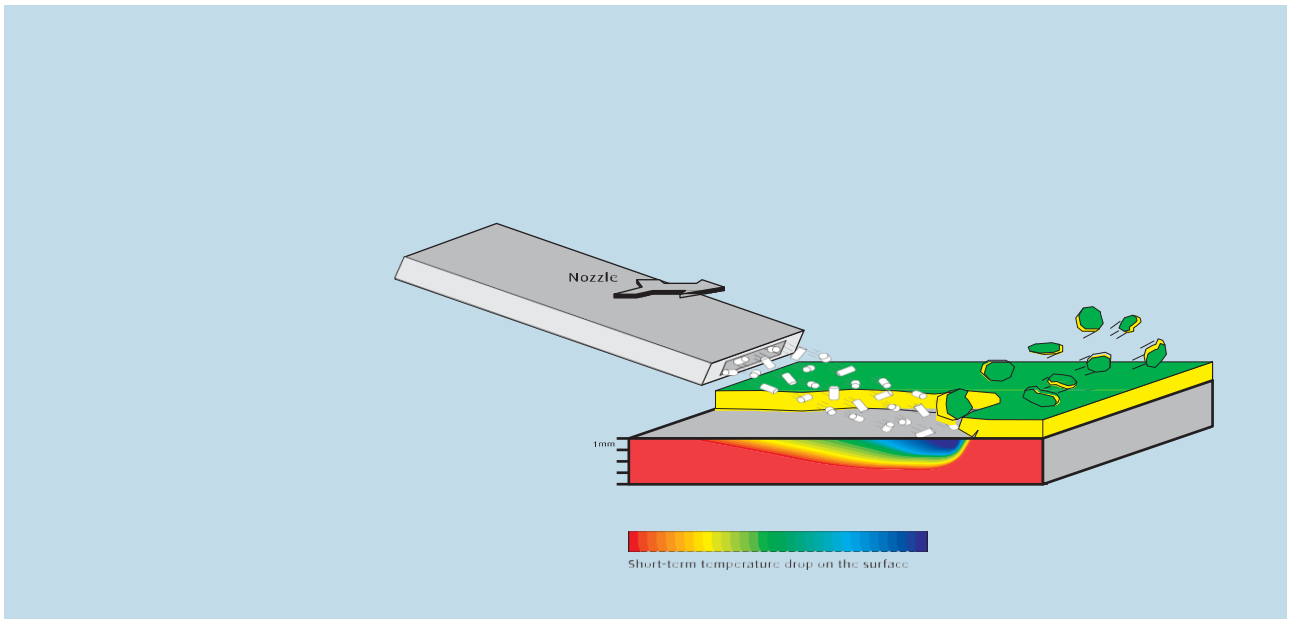
DIC features three unique actions which make the process especially effective:

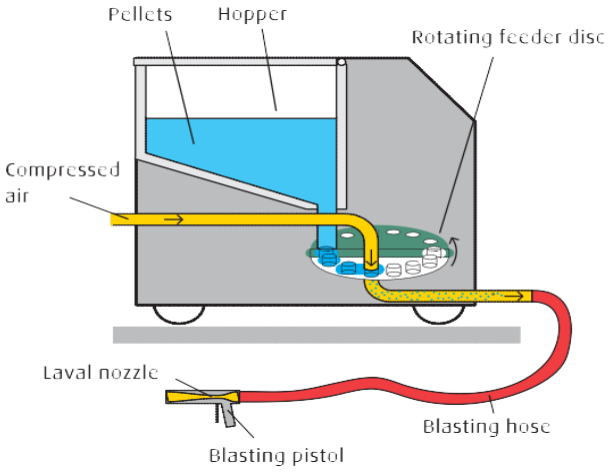
• The initial force of the dry ice pellets impacting the surface provides the primary cleaning action, removing much of the contaminant without surface damage. This is known as kinetic energy transfer.

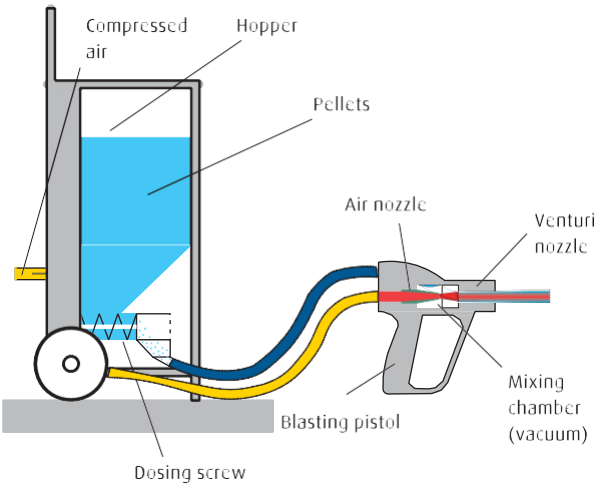
• Dry ice has a temperature of –78ºC which causes the surface and contaminant to rapidly cool down and contract at different rates, thus weakening the bond between the two materials. This is known as creating a thermal differential or microthermal shock. Dry ice contains no water.

• As the dry ice sublimes and converts to CO2 vapor it expands between the surface and contaminant forcing the two apart.
The CO2 evaporates to the atmosphere and the contaminant falls to the floor. This is known as reverse fracturing.


Compressed air
Liquid CO_2 (LIC)
Nozzle movement
Dry ice particles
Compressed air
Low velocity
High velocity
Object with soiled surface

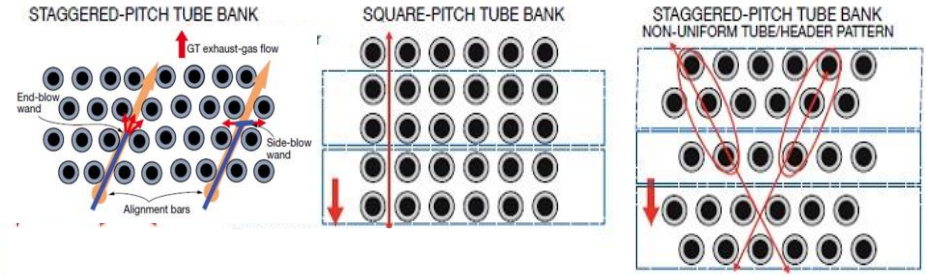

Nozzle
1mm
Short-term temperature drop on the surface


Pellets
Hopper
Rotating feeder disc
Compressed air
Laval nozzle
Blasting hose
Blasting pistol

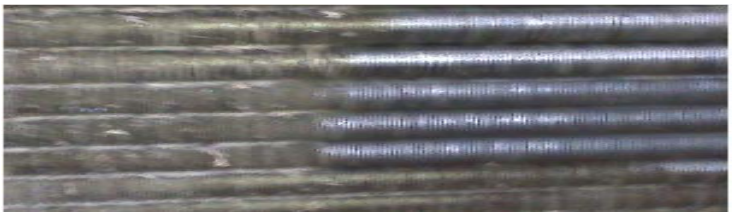

Compressed air
Hopper
Pellets
Air nozzle
Venturi nozzle
Mixing chamber (vacuum)
Blasting pistol
Dosing screw

5- THE SOLUTION

Below the flow of dry ice with compressed air beam with areas can be reached by dry ice blasting during its process, it can be shown how this beam can cover the whole tube and can reach up to 1 meter.



For this type of tubes and to avoid bending of the fins **DIC** team used special flat bent nozzle for 2 reasons, first decrease the power of the pressure second divide the flow of ice pellets to be out by the flat out put so the crushed pellets will go between every 2 fins without affect the fins itself. See nozzle photo below:

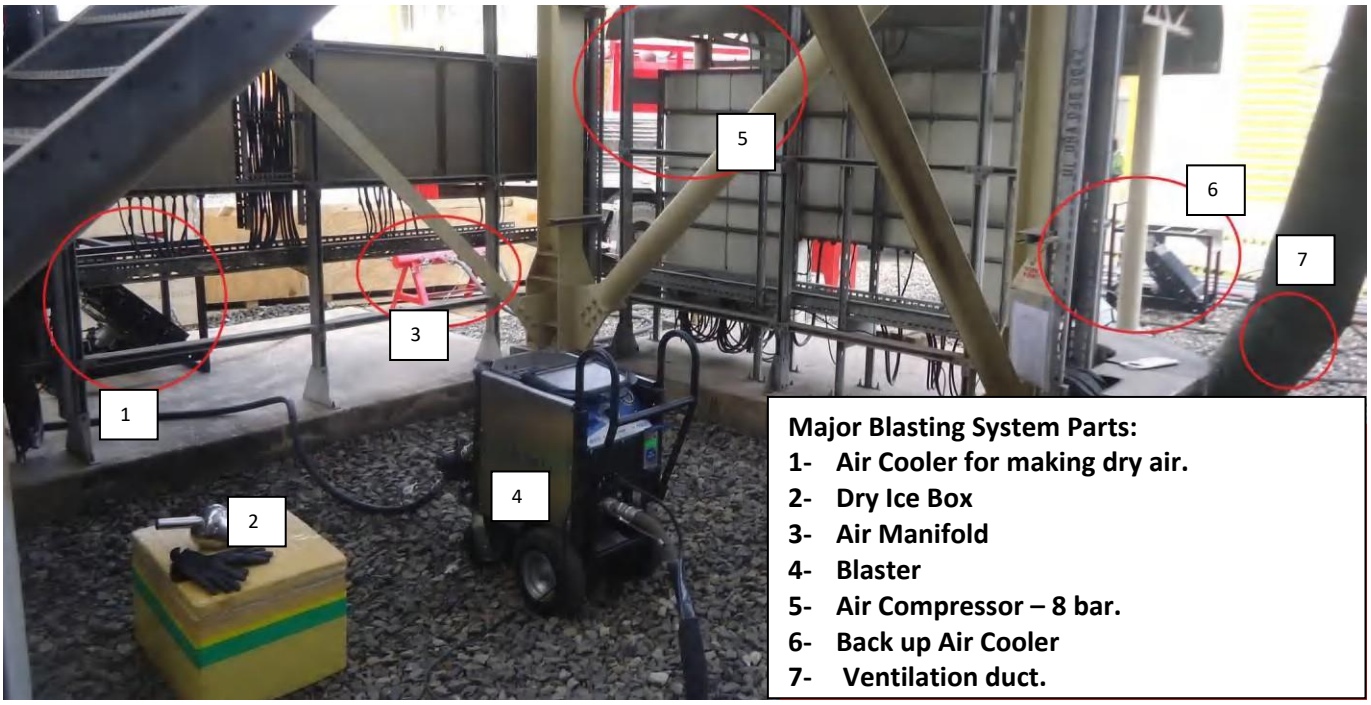


6- THE RESULTS

The **DIC** service provider completed the job in a **6.5 days** one shift coverage.
Cleaning result:
Decontamination ratio: 60% - 1st row
40% - 2nd row
10 % - 3rd row

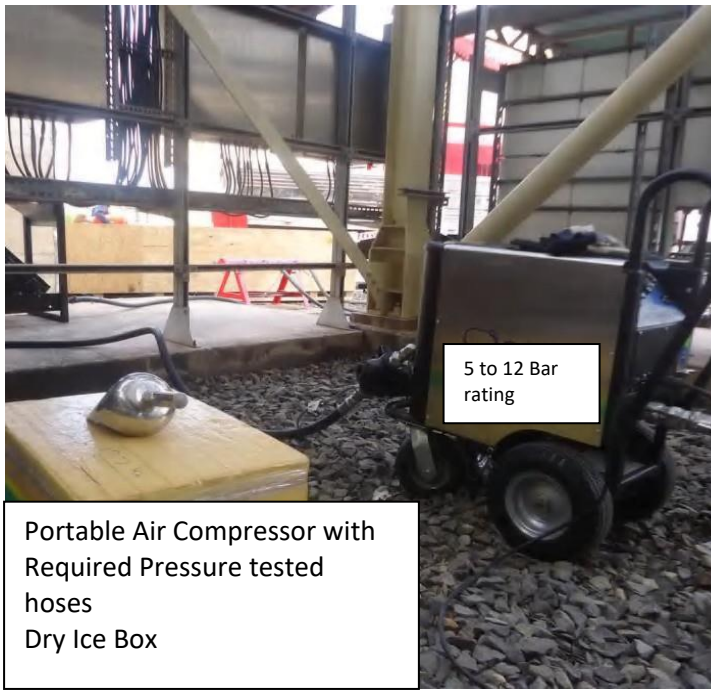
Average progress: 3-5 m2/ hour at 40 kgs of dry ice.

As result of the cleaning , the productivity of the boiler 1.2 MW increased by about 1 % Performance.

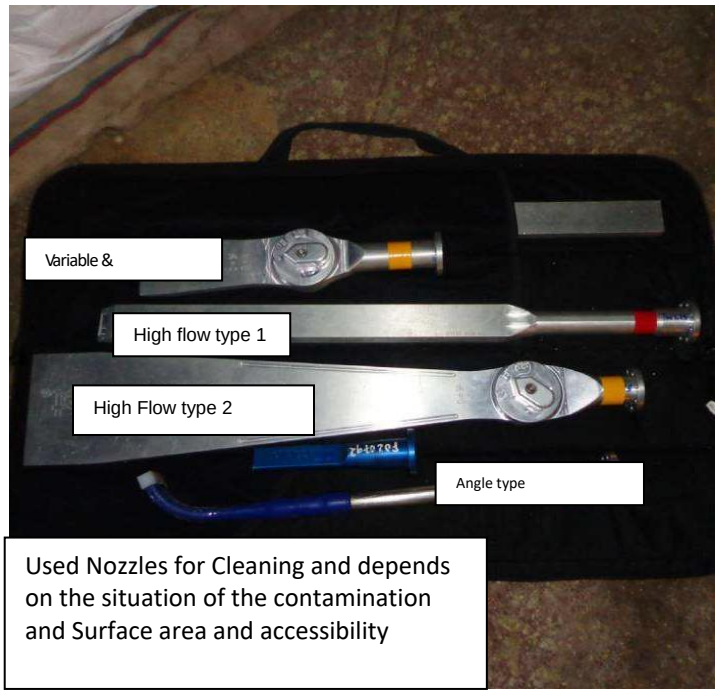


Major Blasting System Parts:

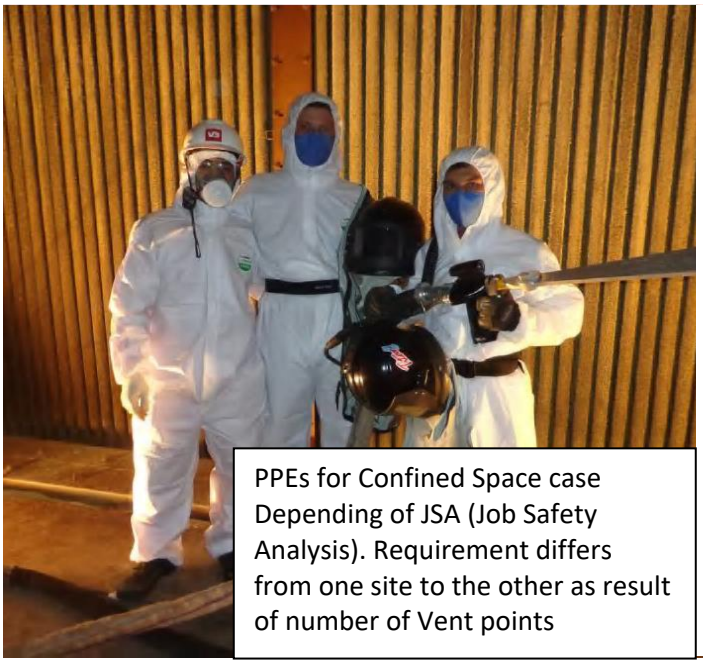
1- **Air Cooler for making dry air.**
2- **Dry Ice Box**
3- **Air Manifold**
4- **Blaster**
5- **Air Compressor – 8 bar.**
6- **Back up Air Cooler**
7- **Ventilation duct.**



Portable Air Compressor with Required Pressure tested hoses
Dry Ice Box

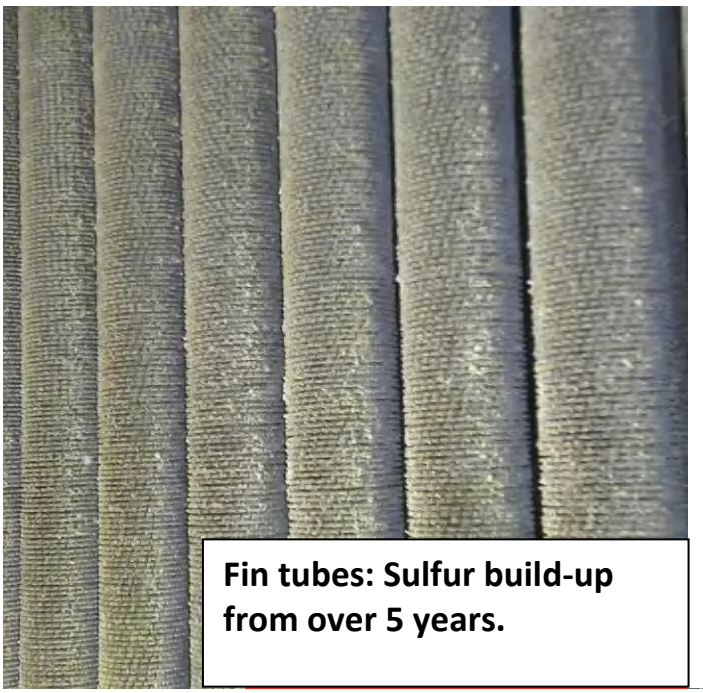


Used Nozzles for Cleaning and depends on the situation of the contamination and Surface area and accessibility

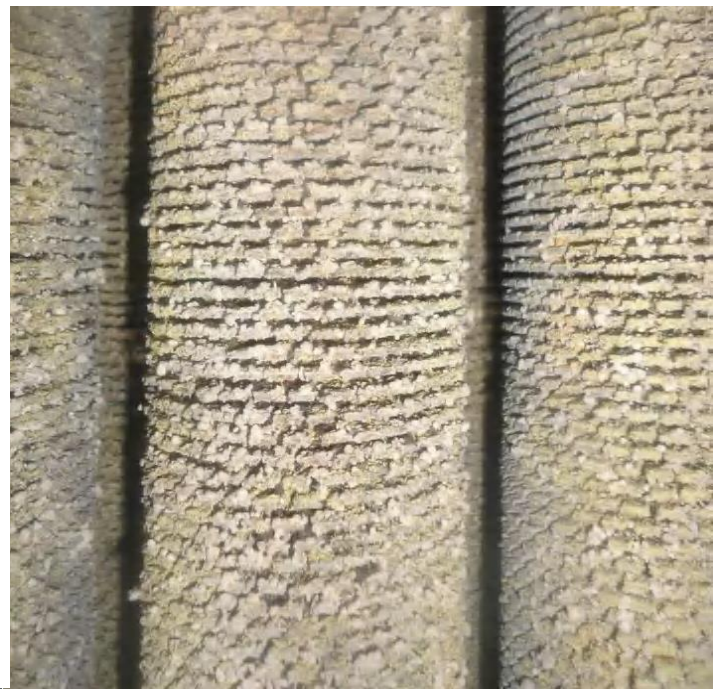


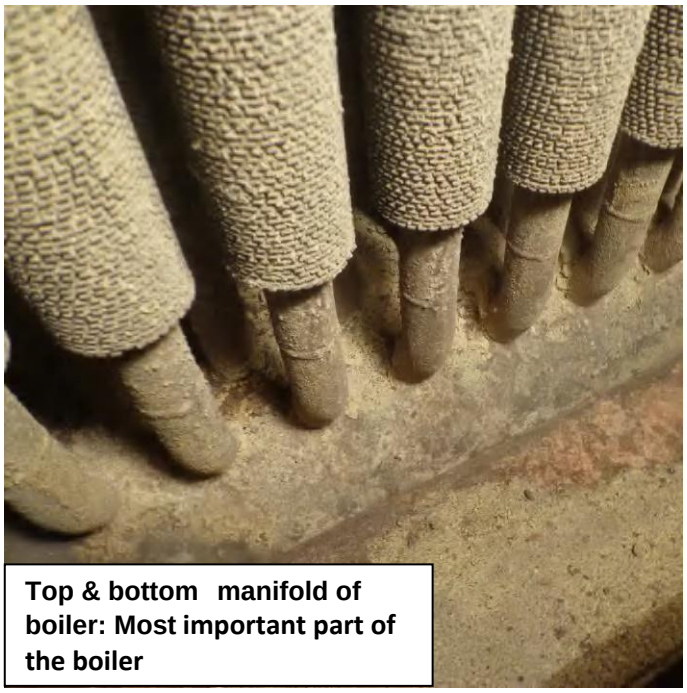
PPEs for Confined Space case Depending of JSA (Job Safety Analysis). Requirement differs from one site to the other as result of number of Vent points

BA system used during the cleaning without impacting the technician movements.



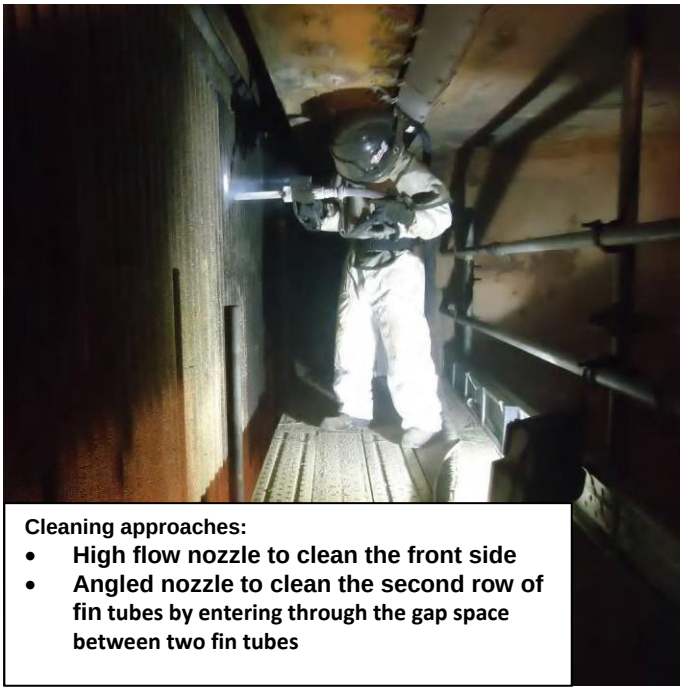
Fin tubes: Sulfur build-up from over 5 years.





Top & bottom manifold of boiler: Most important part of the boiler

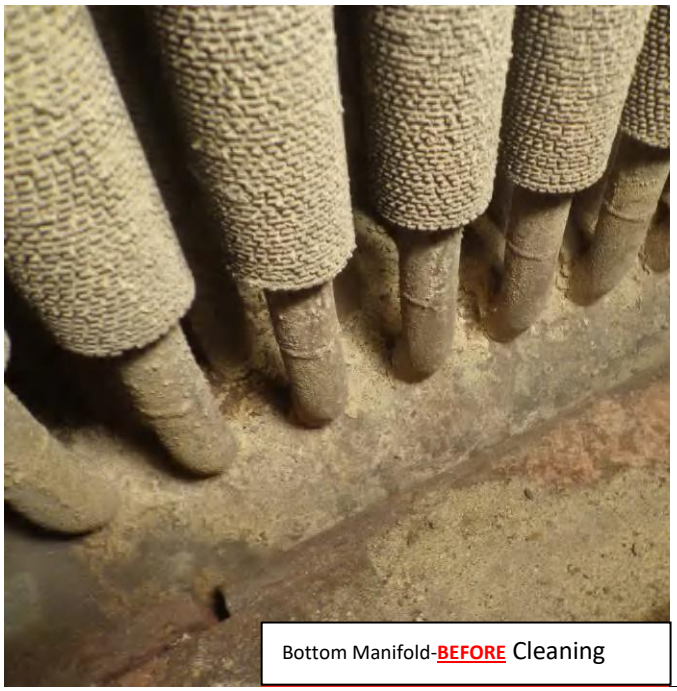
Blasting applicator with mounted light gives best visual support



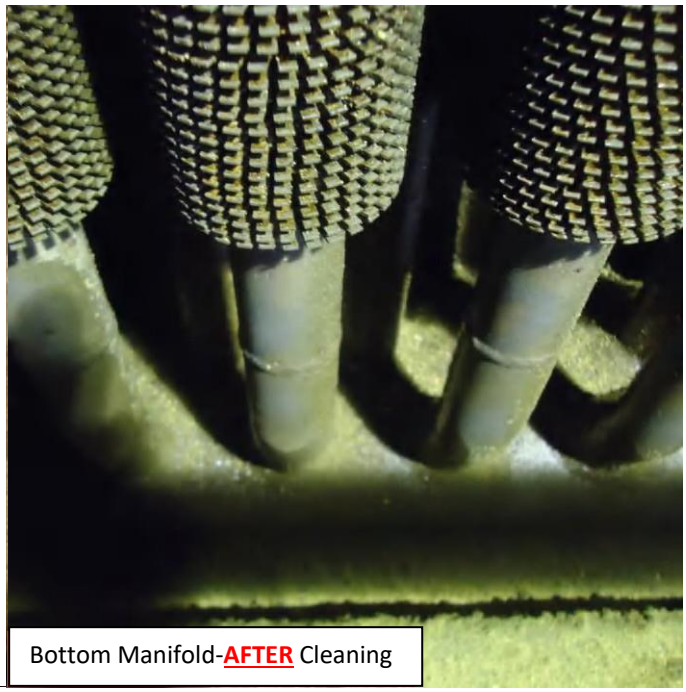
Cleaning approaches:

- High flow nozzle to clean the front side
- Angled nozzle to clean the second row of fin tubes by entering through the gap space between two fin tubes

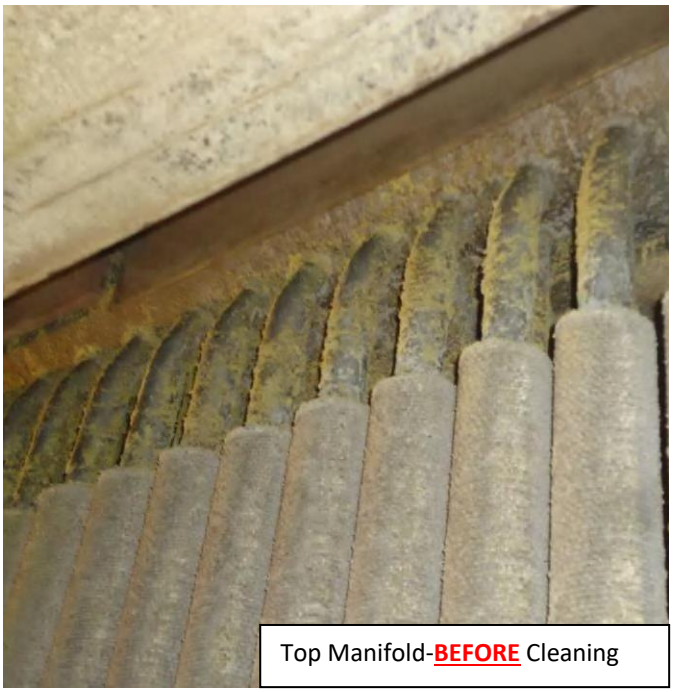
Cleaning of 10 levels of Contaminates, Scaffolding are required to reach some area.



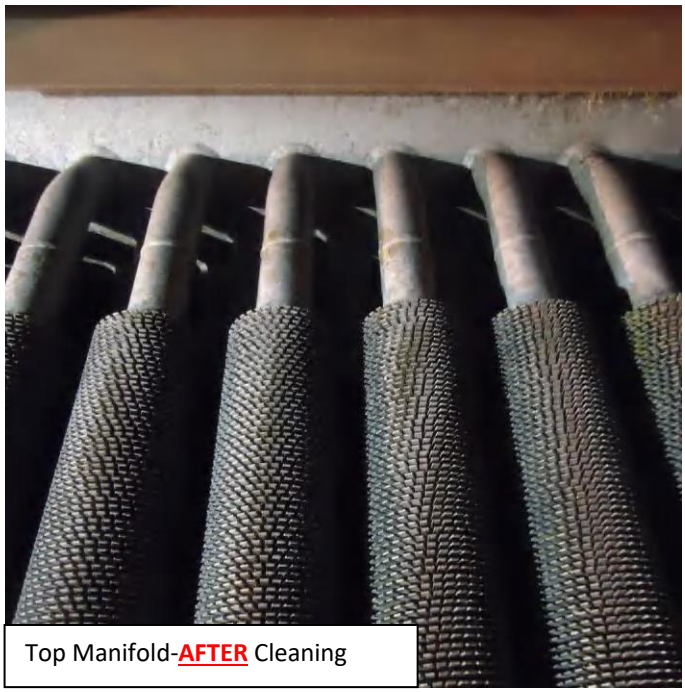
Bottom Manifold-**BEFORE** Cleaning



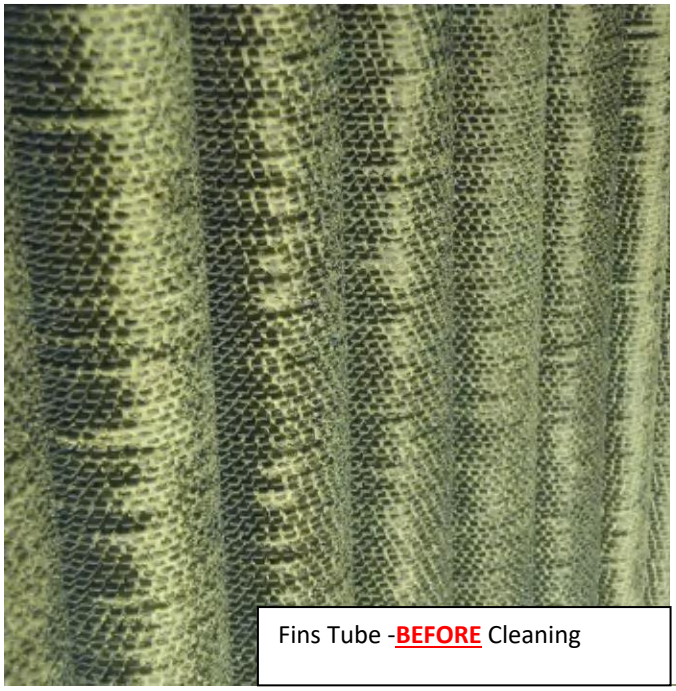
Bottom Manifold-**AFTER** Cleaning



Top Manifold-**BEFORE** Cleaning

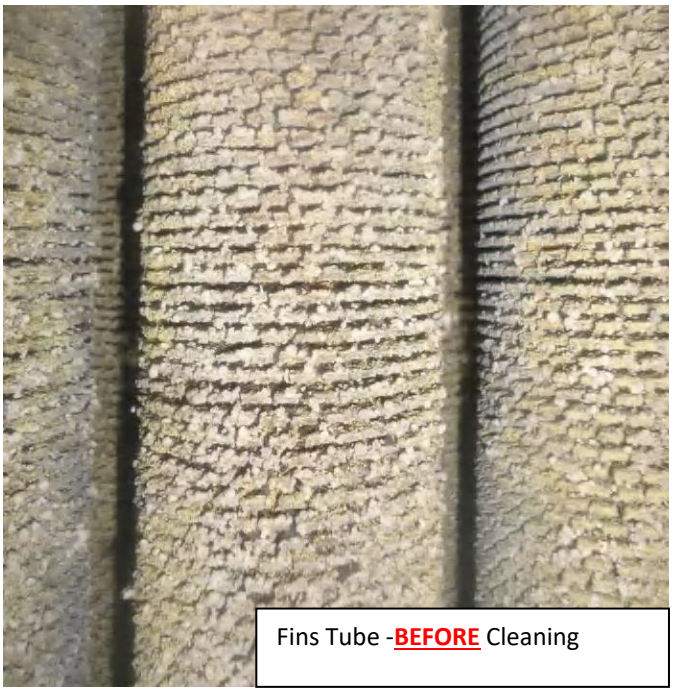


Top Manifold-**AFTER** Cleaning

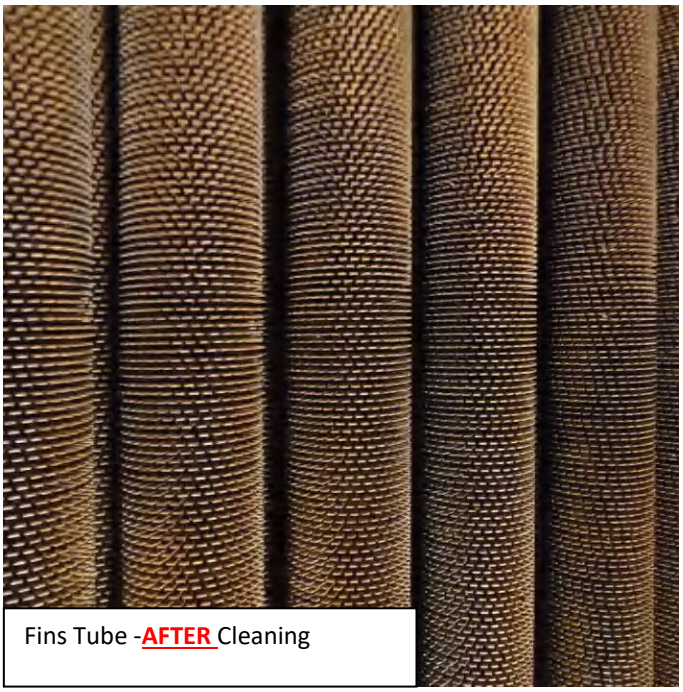


Fins Tube -**BEFORE** Cleaning

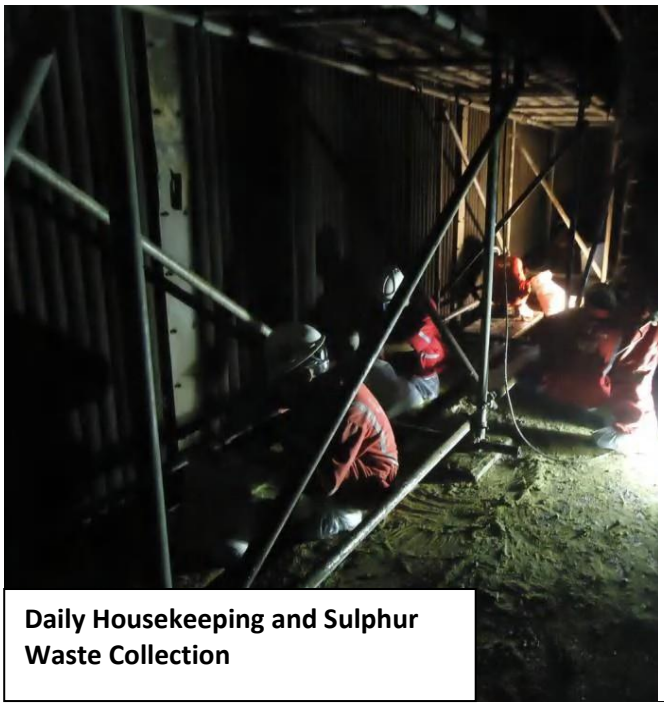
Fins Tube -**AFTER** Cleaning



Fins Tube -**BEFORE** Cleaning



Fins Tube -**AFTER** Cleaning



Daily Housekeeping and Sulphur Waste Collection

Sulphur Waste Storing in Jumbo Bags to be handled by the client