CASE STUDY

Reference No. 003/Mal_01-R1

Location MALAYSIA

35 Ton water tube boiler water treatment using BacComber ULF Descaler

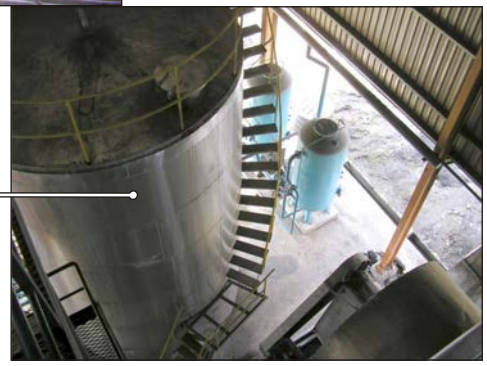
Background

A palm oil mill in Sabah, an eastern state of Malaysia produces palm oil from the oil palm plantation estates. The mill uses a 35 ton/hr water tube boiler to produce 220°C dry superheated steam at 25 bars for palm oil production as well as power generation. The mill is situated near the palm oil plantation. As it is a remote location the mill has to be self sufficient in terms of power and even water supply. No quality city water supply is available as the location is so remote. The mill therefore uses water from the nearby river. In the even of drought they use bore well ground water..

Chemical treatment

Before the BacComber installation, river water was treated with softener before feeding into the feed water tank. A good chemical treatment is expected to reduce hardness after softening to less than 0.3 ppm. However, the actual hardness was up to 3 ppm. On average, for every 1 ppm of hardness that goes into the boiler, it requires another 10 ppm of chemicals to treat the hardness. In addition to these chemicals, oxygen scavenging chemicals are required to be added forCorrosion control. The chemical treatment cost was therefore expensive. Besides the chemical cost, the boiler water requires hourly testing. These expenses add to the costs making it even more expensive.

External View of Boiler



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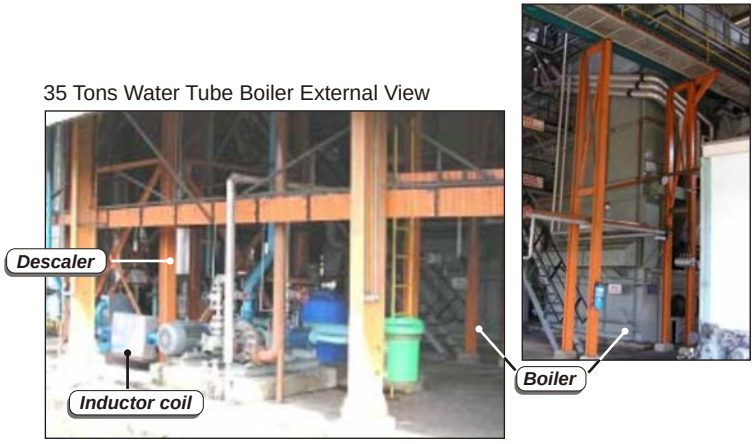
BacComber Treatment

In Nov 2004, a decision was taken to use the BacComber treatment. It was understood that BacComber does not remove the hardness from the water. It just keeps the calcium ions in the water. If these ions precipitate out they come out as soft aragonite which will be in the form of sludge in the boiler. This sludge is removed by regular or continuous blow down at a fixed rate. The blow down is required to prevent excessive build up of sludge at the mud drum.

35 Tons Water Tube Boiler External View



ULF Descaler controller

ULF Inductor Coil Unit

Post Installation Inspection

Boiler was opened every month for inspection during the first 7 months. It was to verify scale and corrosion control by BacComber.

The owner monitored TDS, pH and Fe ions by testing them regularly.

Boiler Drum Inspection

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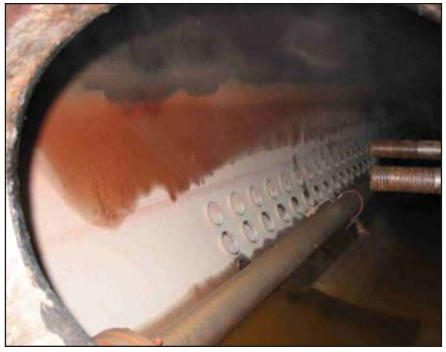
1st Inspection Dec. 04

1st Inspection Dec. 04 (Close Up)

2nd Inspection Jan. 05

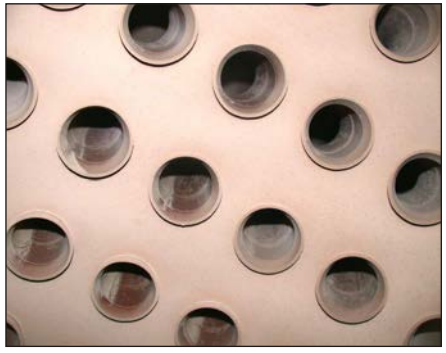


3rd Inspection Feb. 05

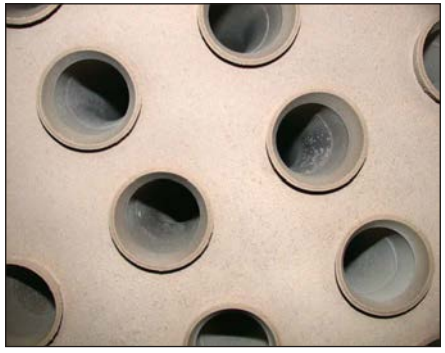
4th Inspection March 05

5th Inspection April 05

6th Inspection May 05



7th Inspection June 05



Magnetite Layer Formation

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Date monitored during first 6 months of Baccomber Treatment

Following parameters were measured during this period for the feed water and blow down water. ***They were monitored every hour during the period boiler was in operation.***

Parameter	Mean	Min.	Max.
Feed Water			
Total Hardness (TH) ppm	39	30	60
Total dissolve solid (TDS)	76	50	170
pH	7.3	7	7.9
Ratio of TH over TDS	0.54	0.3	1.23
Boiler water			
Total hardness (TH) 40	20	63	
Total dissolve solid (TDS)	998	100	1900
pH	10.8	8	11.9
P-Alkalinity	195	25	210
Cycle of Concentration (COC)	13		

In Baccomber treatment cycle, there was an increase in the Fe ion during the initial stage due to the descaling effect. This reduced within 1 month from 5.0 ppm to 2.2 ppm (mean).

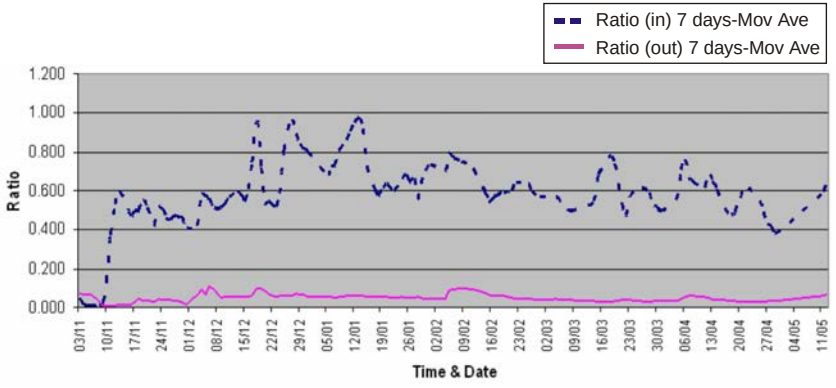
The parameters over the 8 months are shown in graphs. The trends and variations over a time can be seen.

Graph01

It shows the average value of 7 days movement over 8 months between the *Total Hardness* of the feed water and boiler blow down water. There is a big difference in the ratio of Total Hardness (TH) against Total Dissolve Solid (TDS). These values would be totally unacceptable in the normal chemical treatment . The hardness of the water is supposed to be removed by a softener before feeding to the boiler. ***Regardless of the total hardness of about 40 ppm in the feed water, which fluctuated from 30-68 ppm, there is no hard scale formation in the boiler after 8 months of operation.***

The limit set for TDS during chemical treatment was 700 ppm. Baccomber treatment was able to increase the level to 1000ppm. This reflects directly on the water and energy saving.

Graph 1 : Ratio of TH/TDS (7 days moving average) for Feed waternad Blow Down water



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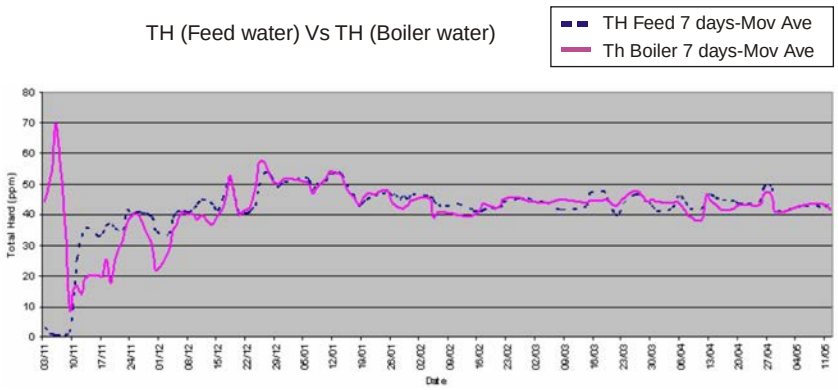
Graph02

Graph 2 : Comparison of Total Hardness in Feed water and Boiler Blow Down water



Inspection Observation and interpretations

By comparing all the internal photos of steam drum during the 7 monthly inspections, it is evident that there was no built of hard calcite scale. During these 7 months period no softener was used. Based on the following data collected, we can derive the weight of calcium carbonate formed.

Mean feed water total hardness	**= 40 ppm**
Average cycle of concentration	**= 13 cycles**
Boiler evaporation rate	**= 35 m^3 /hr**
Average working hours	**= 8 hours**
Daily weight of scale formed	**= 40 x 13 x 8 x 35 gm**
	= 145.6 kg
Scale formed In 7 mths (210 days)	**= 145.6 x 210**
	= 30.576 tonne.

It is clear from the photos that only a very thin continuous film of powdery calcium carbonate layer was present. This thin layer of powdery film also helps in controlling corrosion.

The boiler blow down water total hardness and feedwater hardness graph shows minimum difference. If all calcium ions do not precipitate, the calcium ions should rise proportionately with cycle of concentration. The fact that hardness did not increase proportionate to the cycle of concentration indicates that the calcium ions actually precipitated out. Based on the above calculation, had all precipitates formed into hard scale, the boiler would have been choked with hard scale. Hard scale on tube or drum wall would have been several inches thick. On the contrary, no hard scale was observed and only thin powdery layer was seen. This means all the scales precipitated out as powdery Aragonite and formed a sludge. This was discharged by blow down or settled at the mud drum.

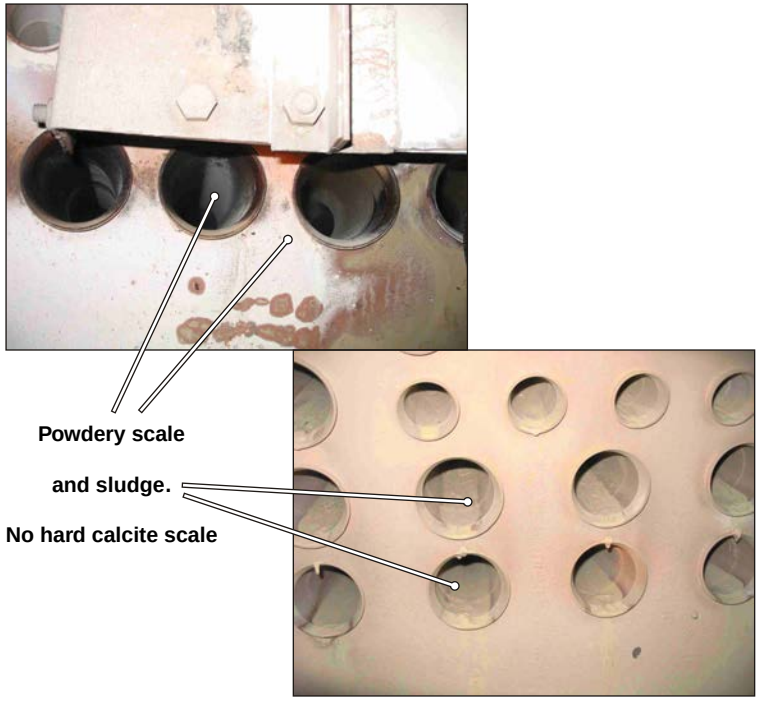
It is important to note that after 7 months without softener and chemical treatment, the boiler condition has not deteriorated. The scale on the drum which was formed during the chemical treatment period was observed to be peeling off. Magnetite was forming in those areas that peeled off. No oxygen pitting is observed on the steel surface.

Before BacComber

After BacComber

BacComber

Boiler tube is found to be clean! All the calcium carbonate was found to be in powdery form, 70% of which was mud. This shows that the calcium carbonate formed in the boiler is not calcite (hard scale) but Aragonite (soft scale). Had it been calcite, it would have stuck to the drum or walls of pipes wall and formed a very thick scale. Following figures show the condition of the boiler after 7 months of BacComber Descaler treatment. The descaling is slower than normal because the boiler is only operating about 6-8 hours per day.



Conclusion

- BacComber treatment has been successful in a high pressure superheated water tube boiler.
- BacComber controlled effectively scale and corrosion without any chemicals in the water tube boiler.
- BacComber inhibits the formation of hard calcite scale.
- BacComber forms powdery Aragonite scale which can be easily removed by blow down.
- BacComber removes gradually the old scales.
- Calcium carbonate in the boiler is formed as powdery scale and precipitates as sludge. Regular or continuous blow down is therefore required to remove the sludge.
- No pitting corrosion is observed. Magnetite layer is well formed in the boiler, providing an effective layer to corrosion control.
- BacComber water treatment for water tube boiler can tolerate higher calcium and TDS levels compared with chemical treatment.

The above has resulted in the following for the mill management

- Savings in the use of resins and other chemicals.
- Lower cost in annual boiler cleaning, labour cost, supervision cost.
- Chemical dosing system replacement cost.
- The two-hourly laboratory analysis cost.
- Easy operation and maintenance process due to less labour intensive operations.
- It is an environmental friendly system.

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