CASE STUDY

Reference No. 010/Sin_07

Location SINGAPORE

3Ton Fire Tube boiler water treatment using BacComber ULF Descaler

History

A 3 ton/hr, 10 bar pressure steam boiler in Singapore was treated with chemicals since the day the plant was in operation. In 2002 July, the BacComber non-chemical water treatment was adopted as part of the ISO 14000 implementation programme.

Chemical Treatment

Softener and oxygen scavenger were both used for scale and corrosion control during chemical treatment. The chemical company maintained the chemical dosing system as well as the water quality. The water test records showed that the water Fe ion content levels were more than 35 ppm. It reflects that the corrosion activities were relatively high.

BacComber ULF Treatment

When BacComber ULF water treatment was installed in July 2002, the chemical treatment was stopped completely. After one month of treatment, the Fe ions level in the boiler dropped to less than 30 ppm indicating that corrosion is under control.

2002 Inspection

In Aug 2002, a month after BacComber treatment, annual boiler inspection was due. The boiler was opened for inspection. Please refer to the pictures on the next page.

It is evident from the pictures and the spalled off scale collected at the handhold, it is evident that:

- **Scale control is effective** – old scale partially spalled off with sizes up to 30cm long and 12 mm thick.
- **Corrosion control is effective** – Protective Magnetite layer formed on steel surface and showing good corrosion protection.

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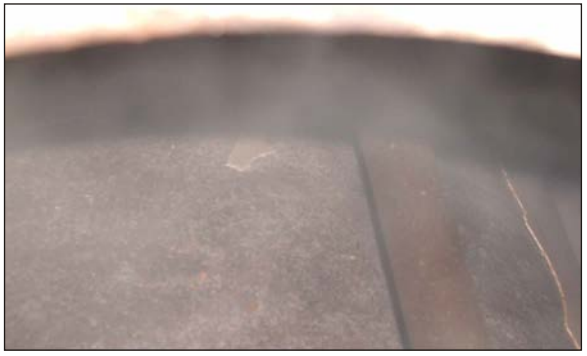
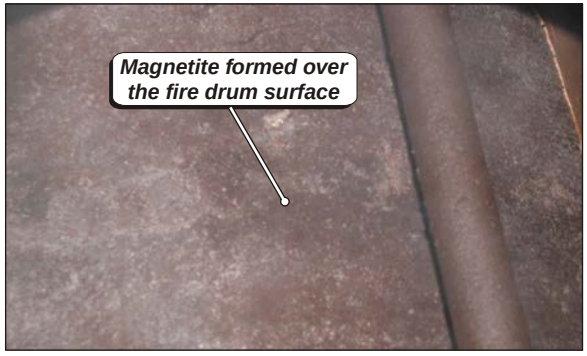
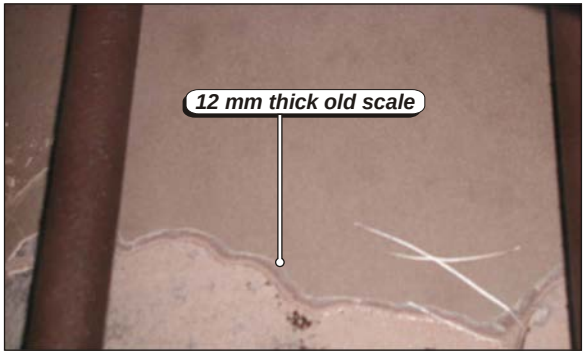
Aug 2002 inspection - one month after installation of BacComber



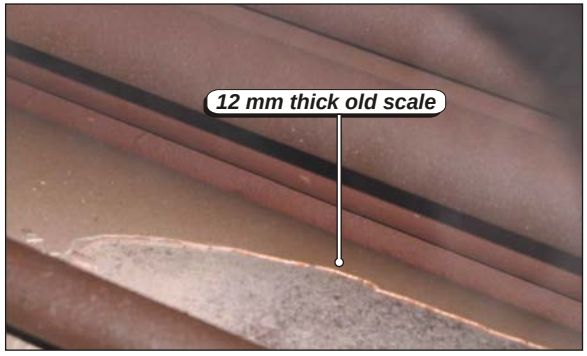
Hours after manhole opened, hot steam is still apparent.



Fire drum top, photo taken from manhole showing no scale and the magnetite layer



Fire drum top, some scales are descaled off but some stubborn old scale of 12mm approx thickness is still present.



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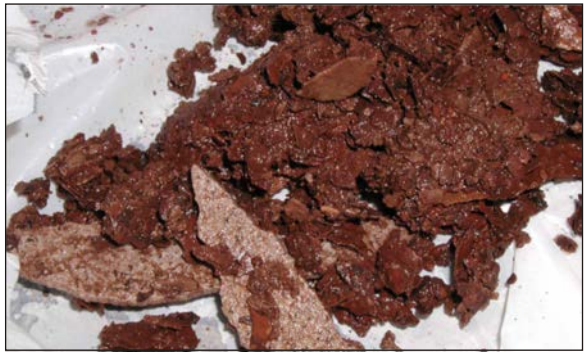
Spalled off scale colleted at the handhole



Spalled off scales up to 30cm size were colleted at the handhole

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After 2002 inspection

The boiler was hosed down. The stubborn old scales were left untouched in the boiler for future observation. BacComber treatment continued, without any chemical treatment. The softener and chemical dosing systems were also dismantled.

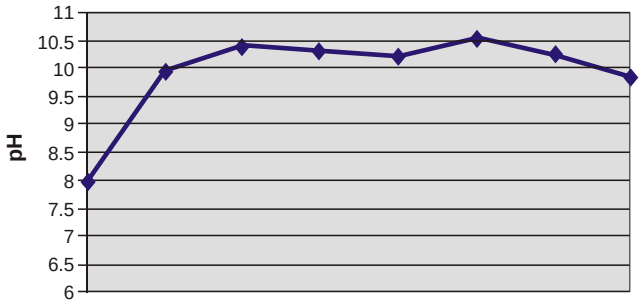
Aug 2002 to Aug 2003 BacComber treatment monitoring

During the 12 months operation, the boiler and feed tank water qualities were monitored regularly on monthly basis. The monitoring parameter including pH, TDS, Fe ions. The following graphs show the performance for 12 months.

Aug 2002 – Aug 2003 monitoring results

Corrosion control interpretation

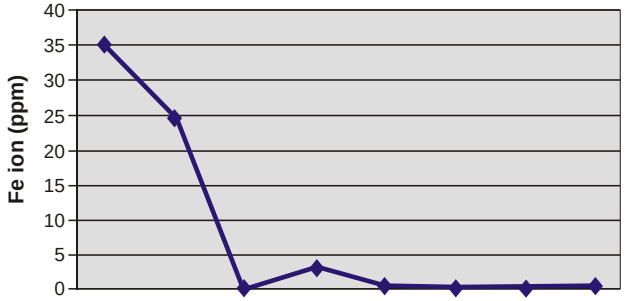
pH - BacComber treatment is able to keep the boiler water pH value consistently within the control range of 9-12 without the addition of any chemicals. It is essential that the pH be within the controlled range for effective corrosion control. This control is achieved by BacComber despite variation in feed water pH values.



pH Values
(1st Year)

Fe ions level

Fe ions level is an indicator of extent of corrosion in the boiler. When chemical treatment was carried out the Fe ion was over 30 ppm. The boiler water sample was brown in color. When BacComber treatment started, there was initial descaling effect. During this period magnetite formation took place. It therefore resulted in some fluctuation of Fe ions level during this stabilization period. However, after few months of stabilization, Fe ions level drops dramatically. ***The boiler water sample collected now is completely clear with no difference from any bottled drinking water.*** This indicates that the corrosion in the boiler is very effectively controlled.



Fe ion
(1st Year)

Scaling control interpretation

TDS level - It was recommended to keep the boiler water Total Dissolved Solid (TDS) at 2500 ppm maximum. This is as a good boiler scale control practice. It is also in line with the statutory requirement on discharge limit in Singapore. Throughout the 12 months water treatment with BacComber, the boiler water TDS was maintained within the control limit of 2500 ppm. However, no auto TDS bleeding control was installed for the boiler. There were

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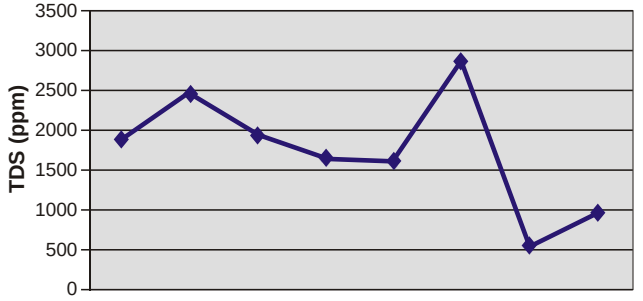
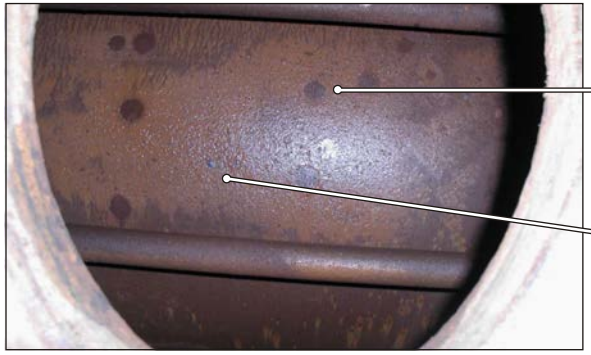
months when TDS level exceeded the control limit. It went up to as high as 5,000 ppm! Under normal circumstances with chemical treatment, high TDS level in the boiler would have resulted in scale. However, with BacComber water treatment, the scale control even under high TDS condition was still excellent. This was evident during inspection. No new scale had formed.



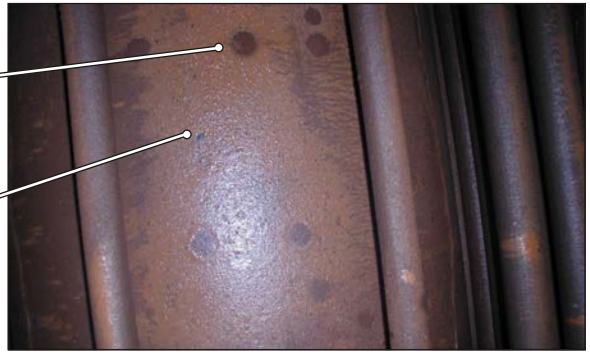
TDS
(1st Year)

Photos taken from manhole before hosing down



Water drip marks

Dirt



Magnetite layer formed well. There is no pitting corrosion after1 year BacComber treatment

Old scale thinned down. No new scale formed after 1 year BacComber treatment.

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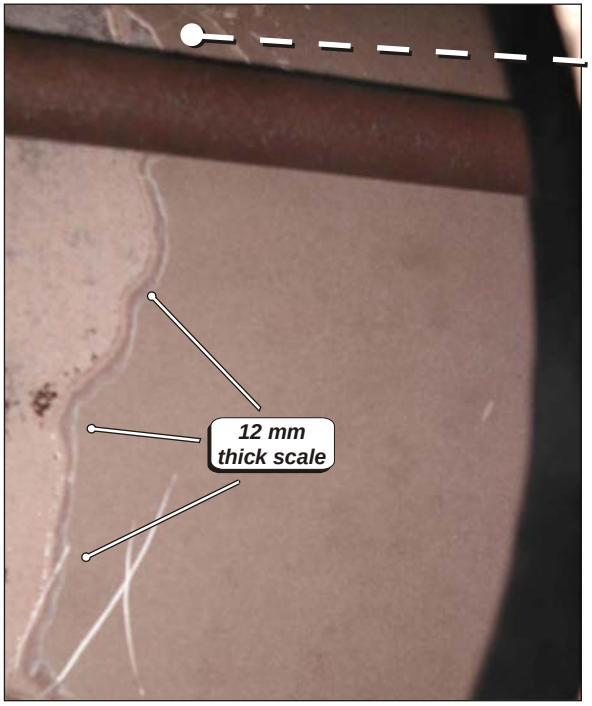
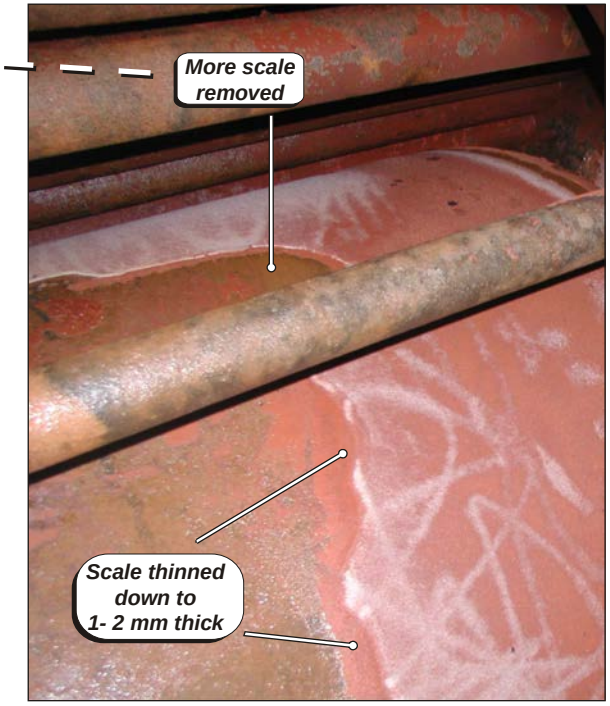
Scale control comparison after one year BacComber treatment

Photos of top of fire drum

Aug. 2002





Aug. 2003

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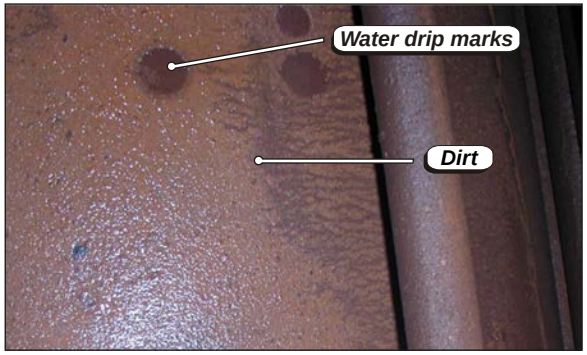
Aug. 2002



Aug. 2003

No new scale formed after one year treatment

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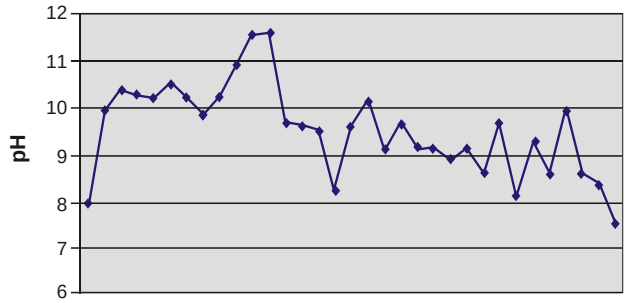
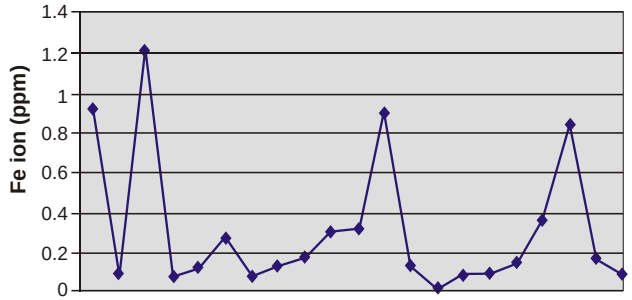
September, 2003 till December, 2005

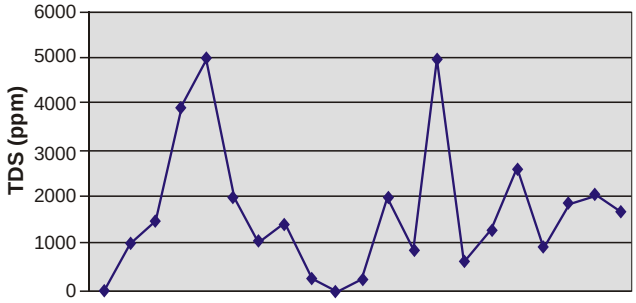
The results of August 2003 inspection confirmed that BacComber is very effective in controlling scale and corrosion. The boiler water TDS, pH and Fe ions monitoring were continued and the results were very consistent. The following graphs showed the boiler water treatment performance from **2002** till **2005**.



pH (Sept. 2003 to Dec. 2005)



Fe ion (Sept. 2003 to Dec. 2005)



TDS (Sept. 2003 to Dec. 2005)

Conclusion

The 3-year BacComber boiler water treatment in this plant has proven the following:

- Works on steam boiler - BacComber non-chemical boiler water treatment performed excellently in controlling hard scale and corrosion in fire tube steam boiler.
- Excellent corrosion control - BacComber brought down the boiler Fe ions level from more than 30 ppm during chemical treatment to less than 1 ppm. It is a dramatic improvement over the chemical treatment.
- Controls pitting corrosion - During the boiler inspection, no pitting corrosion was observed. It confirms that BacComber performed excellently in controlling both the general corrosion and pitting corrosion.
- No oxygen scavenger required - No oxygen scavenger is required if BacComber is in place.
- Effective scale control without softener – No new scale formed after the first annual inspection. No softener was used to treat the water.
- Saves fuel oil - Inspection results confirmed that no new scales formed and even the old scales were gradually removed by BacComber treatment. This improved the boiler performance and saved fuel.
- Works on high TDS water - There were certain months where TDS levels in the boiler exceeded the control limit - hitting a high of 5,000 ppm. Even at such high TDS, effective scale control could still be achieved. BacComber is effective even at very high TDS and safe guards the owner in the event boiler water TDS goes beyond control.
- Saves monitoring labor cost - Monitoring the boiler water quality once a month has shown to be sufficient with BacComber treatment. This allows the owner to cut down the manpower employed when chemicals were used.

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