BANK TUBE FAILURE IN A DISTILLERY

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INTRODUCTION

The customer had been facing frequent tube failure in boiler bank. The customer maintained that the feedwater & boiler water quality is maintained as per manufacturer recommendations. The chemical dosing is done in the feedwater tank by a regulated dosing system. Customer faced the tube failure only in one particular row of the bank tube. The failure cause was studied and measures have been brought out in this bulletin for the interest of the boiler users.

DETAILED REPORT

The Boiler Details

The boiler parameters are 7 TPH, 21 kg/cm2g & saturated steam. It is of bidrum configuration with fluidized bed combustor. The heat transfer surfaces include bed coils of hairpin type, fin-welded waterwall, bank tube assembly, and airheater. Since the boiler is not provided with economizer there was no Deaerator. However the client has provided sparger-heating system to purge the oxygen to a maximum possible extent. The feedwater temperature is maintained close to 95 deg C, whenever the boiler is in operation.

The Circulation System

The feedwater is pumped directly from the feedwater tank to the steam drum based on the signal from drum level transmitter. The water gets heated close to saturation temperature as soon as it enters the drum though the feed water distributor placed below the normal water level. The subcooled water enters though the rear set of bank tubes to the lower drum. From the lower drum the water flow gets divided into two streams. One stream flows though the front set of boiler bank. The other stream goes through the bed coil to water wall and then to steam drum.

Preboiler system

The plant is equipped with RO plant to deliver practically <50 ppm TDS level. The water is stored in Stainless steel tanks. The pH adjustment is not done at this stage. The plant uses part of the treated water. From the storage tank the make up water is transferred though MS piping to the feed water tank. The feed water tank is of MS construction. The tank is well covered from top. The suction line to boiler feed pumps is provided with suction filter.

First Call

When the failures were frequent, the client called up for immediate visit. At the time of the visit the boiler was in operation. The failed tube was inside the boiler itself. The tube was not available for inspection. The water chemistry was checked in the boiler and was found to be OK. The blow down tank appeared reddish. I could guess there is some corrosion in the boiler. Normally Iron is not analyzed in small plants. The boiler vendor does not advise the boiler user for regular analysis of boiler water for iron. However on seeing the color of the blow down water, it is necessary for the plant engineer to check the source. In this visit I recommended for the thorough analysis of Condensate water, make up water, boiler water. I requested for immediate call on the next failure.

Next Call

By the time the next call came, it appeared that many more failures had occurred. The plant had been off in between several times. The plant personnel did not follow the lay-up procedure.

I was shown the corroded iron particles collected from the mud drum and bed coil inlet headers. This time the boiler drums were opened. The drum surface was containing bubbles of iron oxide deposits. The inside of the bank tubes also contained bubbles of iron oxide deposits.

There were no pits in the surfaces. However below the loose iron oxide deposits pits were found to be forming. It was clear the large amount of corrosion products did not generate from the boiler. The feedwater tank was containing lot of iron oxides particles. The sparger heating arrangement was found to be stirring the loose iron oxides. This proved the entry of the loose iron oxide deposits into the boiler.

Now in the boiler bank the failures were found only in the first row of the bank tubes. Customer wanted to know why the failure could occur only in this location. The reason I could give was that the circulation of water should be minimum here because the refractory tiles block the heat pick up in these tubes. Hence the loose iron oxides could not have remained in motion. Nice theory! Is it not? If it were gross pitting within the boiler, not a single time the bed coil or water wall or other boiler bank tubes failed. That is how I have reasoned out.

CONCLUSION

Now coming to the source of problem. The pH is not boosted in water treatment plant. The low pH water was being pumped through the MS piping to the MS tank. The hydrogen could easily rip the iron from the metal surface. The craters in the tank & piping proved this. In the feedwater tank there was no presence of iron / iron oxides above water level or even in the roof. This proved that the pH of the water was doing the mischief.

I had recommended for SS piping from the storage tank to feed water storage tank in the boiler house. The pH boosting must be done at the outlet of water treatment plant. At least two other cases I have come across wherein the feed water tank consists of lot of iron oxide products.

WATER LEVEL DANCING IN A BIDRUM BOILER

It is a bidrum boiler wherein the drum level kept dancing. The customer had this problem since installation. The water level nearly goes out of the gauge glass at the top tapping in the steam drum. It is a plant wherein 80 % of the condensate comes back. The blow down pit looked reddish. The boiler drum showed off reddish stuff. Since it is A low-pressure boiler, there was no economizer. Otherwise the economizer could be a supply source of iron oxides. Either the oxides were forming within the boiler or it was getting transported through the condensate or make water system. First I traced down the condensate return system. There was very less chance of even oxygen getting in to the system. The plant runs practically thorough out the year and hence there was no chance of the iron oxides formation from the plant. But on inspection of the DM water storage tank, I saw junks of corrosion product. The pH from the DM plant was less than 7. The DM water storage tank was not lined with rubber or any other protection system. The pH was not being boosted up at the DM outlet.

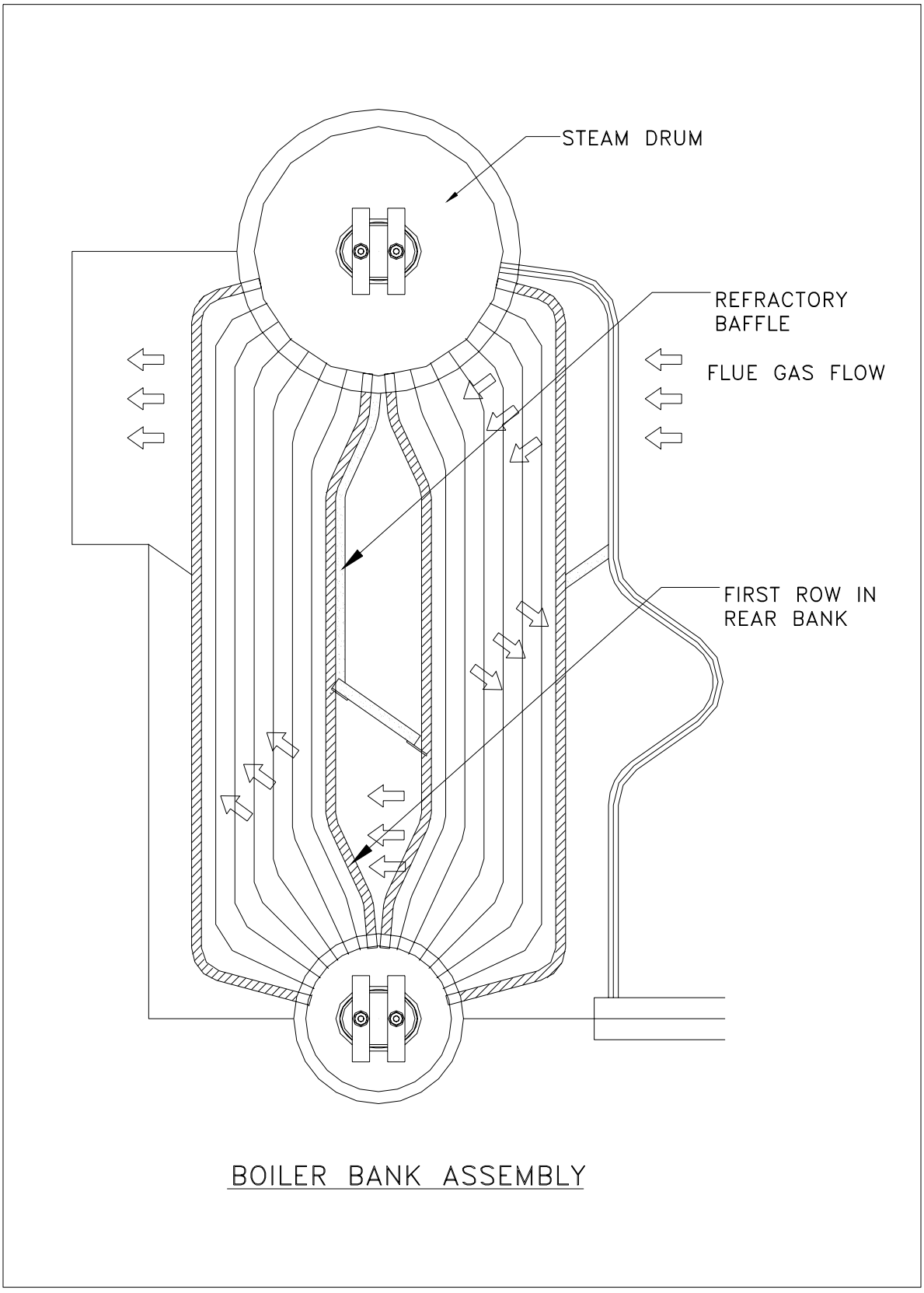
That solved the problem. Customer was advised to boost up the pH so that the corrosion would not proceed further. But the tank had to be acid cleaned to remove all the iron oxides.

FREQUENT FAILURE OF FEEDWATER PREHEATER

It is a low-pressure boiler with a boiler bank evaporator section followed by a feedwater preheater. The customer was replacing the feedwater preheater very often. The make up water pH was less than 7. The feedwater tank, DM plant outlet piping were found to be corroding inside. Customer was advised to raise the pH to 8.5 before the water leaves DM plant.

LESSONS LEARNT

The pH in feedwater and boiler water shall follow recommendations of boiler manufacturer. Ignorance of the water chemistry leads to non-availability of boiler. Low pH & high pH lead to corrosion in boiler. The pH should be in range of 8.5 to 9.5 in feedwater and 9.5 to 10.5 in boiler water. It has been very well established that the corrosion of steel in minimum in the above range.



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