



Reduce Boiler Tube Leakages in Your Power Station

VOLUME 1, ISSUE 4

AUTHOR :- S.K. DEO, DIRECTOR

PUBLISHED DATE :- 12/01/2010

Heading of this write up may invite varied reactions from thermal power plant personnel i.e. those actually working in the plant as well as those connected with the plant directly or indirectly. Some may think that, the write up may contain the usual information i.e. reasons of tube failures viz. erosion, corrosion, overheating etc. and the steps to be taken for prevention of these reasons. Yes, there is ample or more than ample technical information now a days is available through internet, papers presented in seminars, various workshops conducted on the subject etc. Most of the concerned Operation and Maintenance engineers are also well versed with this information. Yet, the boiler tube leakage tops the list of reasons of forced outages of any unit, in most of the cases.

This write up tries to focus on basic key issues, practical constraints to which the attention is not given generally and some of the tips to overcome the constraints.

As is widely known, there are many different types of boiler tube failure mechanisms, which can be divided into six categories

1. Erosion (fly ash, soot blower etc.)
2. Water-side corrosion (caustic corrosion, hydrogen damage, pitting, stress corrosion cracking)
3. Lack of quality control (poor water chemistry control, material defects, welding defects)

4. Fire-side corrosion (low temperature, water wall, ash)
5. Stress rupture (short-term overheating, high temperature creep, dissimilar metal welds)
6. Fatigue (vibration, thermal expansion)

Of the above reasons of boiler tube leakages, the erosion related failures are focused here in details.



Above Fig. shows the Boiler Tube Leakage pattern



Reduce Boiler Tube Leakages in Your Power Station

Erosion – This may be due to fly ash in flue gases or due to air ingress in the boiler or due to steam from soot blowers.

Erosion due to fly ash.

This type of erosion is mainly observed in second pass of the boiler, normally affected zones being LTSH/ Primary SH & Economizer. The rate and extent of erosive processes are affected by particle velocity, angle of impact, particle composition and shape, and erosive resistance of the tube surface including compositional and temperature variations.

Particle velocity is the most important parameter as the rate of erosion is proportional to the velocity raised to an exponent ranging between two and four. Particle velocity is driven by the local flow velocity at any particular boiler location. The optimum long term solutions are based on identifying and reducing the highest velocity locations. It is important to be noted that local velocities, not bulk velocities across a section of the boiler are those of interest. Normally, maximum design bulk velocities are of the order of 16 m/sec or less. It has been observed that local velocities in excess of 32m/sec can cause fly ash erosion failures in 10,000 to 50,000 hours.

The fly ash erosion can be dealt with by flow modification in conjunction with a cold air velocity test before and after modification.

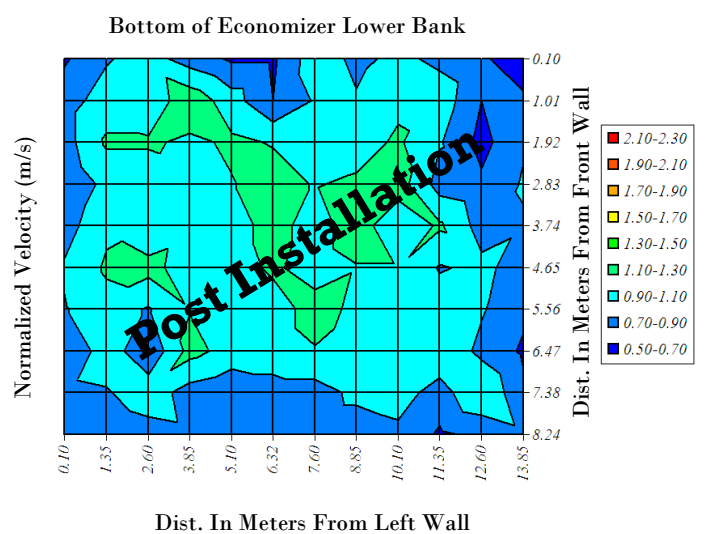
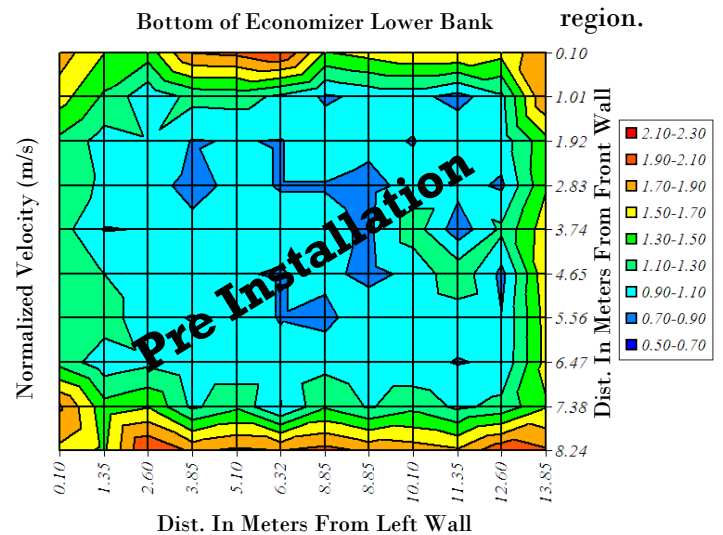
Where units have been evaluated by the cold air velocity test (CAVT) to determine local velocity profiles, maximum local velocities of two or more times the nominal velocity have typically found, and these peak velocities usually correspond to the locations of know tube erosion damage.

The use of CAVT to identify regions of excessive velocity, followed by the installation of distribution

screens, provides utilities with the most permanent solution to the problem.

However, still the technique has not been widely adopted by many power stations, which explains why fly ash erosion is still the most important failure mechanism.

Typical pre & post installation CAVT velocity graphs shown below, demonstrate the variations in the gas velocity across a particular section in Economizer



Above Fig. shows the Velocity pattern



Reduce Boiler Tube Leakages in Your Power Station

Erosion due to soot blowers

While second pass of the boiler is a major zone prone to erosion due to fly ash in flue gases, the furnace water wall tubes are mainly prone to erosion due to soot blowers steam. The causes of this type of erosion are broadly as below

Condensation in the soot blowing system

Improper setting of soot blower pressure

Poorly angled blowers

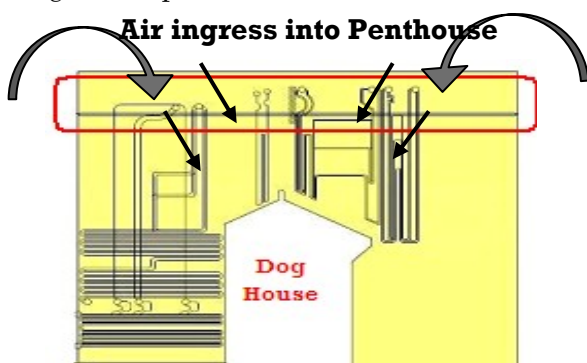
Condition of soot blower nozzle

Remaining of soot blower inside furnace accidentally with steam supply to the blower continuing

While the first four causes result in gradual reduction in tube thickness of the water tubes around the soot blower, the fifth reason can result in immediate tube failure.

Erosion due to Air Ingress

Any ingress of air in the boiler from atmosphere is highly detrimental to the boiler operation as well as availability. The air ingress affects the boiler performance as well as can result in erosion of boiler tubes resulting in boiler tube failure. The source of air is through incomplete welded fins of the boiler tubes.



Some Important aspects related to Boiler Tube Leakage

Reduction programme

Weld Quality/ Process-

This is due to careless/ negligent working of the welder and concerned staff. In many cases it is observed that the leakage is through earlier carried out welded joint. A high pressure joint needs due attention in respect of weld quality, proper alignment of the tubes, clean environment etc. Hence good effective supervision of high pressure welding activity is essential to avoid failure through weld joints

Tube thickness measurement

Erosion due to fly ash in flue gases result in reduction in tube thickness. It is therefore of vital importance that the tube thickness in erosion prone areas is to be monitored regularly to get trend of rate of erosion in particular zone. This will enable us to take anticipatory preventive action to avoid unplanned outage due to boiler tube failure

Normally extensive tube thickness survey is carried out during annual overhaul of the boiler. However the period between two overhauls range one year to two years. During this period, in some zones the erosion rate is higher causing failure between the overhauls. It is therefore advised that the tube thickness in various zones be measured during short shut downs wherever possible. All such tube thickness surveys carried out from time to time should be well documented. This will help in getting the trend of erosion so as to plan corrective actions.



Reduce Boiler Tube Leakages in Your Power Station

Analysis of each failure- It is very essential that every tube failure is properly analysed. The failed portion should be invariably sent to a laboratory to assess the exact reason of failure. The reason should not be decided **merely** by simple observation or based on the opinion of concerned staff member, as it may sometimes mislead the process of taking corrective action. It must also be ensured that the failed sample is sent to laboratory without any delay and the results are obtained immediately.

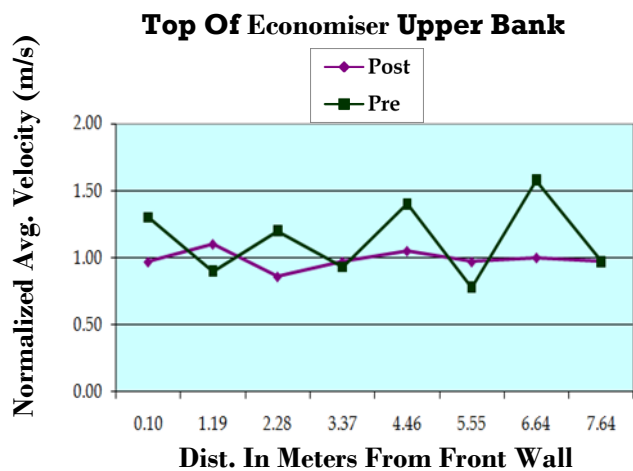
Dedicated Group—Considering the tremendous loss due to Boiler Tube Failures, it is worthwhile to have a dedicated group of one or two engineers with supporting staff to look after the tube leakage reduction programme only. Their responsibilities should mainly include,

- Tube thickness survey of various zones during every boiler outage opportunity.
- Maintain record of these surveys as well as history of all tube leakage instances.
- Supervision of H.P. welding joints.
- Sending the sample to laboratory and follow up to get analysis report without delay.

This group should be thoroughly trained and should be utilized for this particular work only.

To sum up, some simple steps as listed below can reduce the boiler tube failure instances

- To carry out CAVT & take corrective actions.
- Extensive boiler tube thickness survey during annual overhaul as well as short shut downs.
- Documentation of the tube thickness survey carried out from time to time.
- Proper operation and maintenance of water wall soot blowers.
- Identify sources of air ingress in the boiler and take corrective actions.
- Effective and continuous supervision of high pressure welding activity.
- Monitoring water chemistry.
- Small group to be created to look after various activities related to boiler tube failure.
- Quick analysis of the tube failure.



Above graph shows the Pre & Post Installation CAVT Comparison



Reduce Boiler Tube Leakages in Your Power Station

ROLE OF MECHWELL INDUSTRIES LTD. IN BOILER TUBE LEAKAGE REDUCTION PROGRAMME.

MECH-WELL India Ltd. is committed to serve power industry for all types of improvements. For boiler tube leakage reduction programme, MECH-WELL can offer every help needed to Power Utilities, including the following ones.

1. C.A.V.T. along with supply and installation of Erosion Control Devices.
2. Software for maintaining tube leakage related history and data.
3. Assistance in tube thickness survey.
4. Consultation and Advisory services on any boiler tube leakage problem.



Photograph shows our Testing Engineer carrying out CAVT



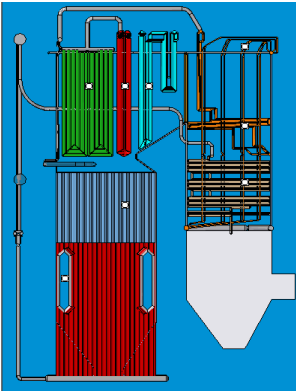
Photographs shows the Expanded Metal Screens (EMS) installed based on the C.A.V.T. measurements



Reduce Boiler Tube Leakages in Your Power Station

ROLE OF MECHWELL INDUSTRIES LTD. IN BOILER TUBE LEAKAGE REDUCTION PROGRAMME.

Boiler Expert - A Complete Solution to Record Boiler History



In our passion to serve our clients better and to enable them to develop useful database relating to boiler, we have designed a software utility, which we feel would ease the task of record keeping, retrieval of history, predict replacement/repair schedules, enhance efficiency and help faster decision making.

The Boiler Expert Report represents the summary values of boiler tube leakages and thickness parameters for :-

1. Event wise boiler history
2. Plant wise boiler history
3. Cause wise boiler history
4. Location wise boiler history

Further, it can be customized to suit the client specific requirement.

MECHWELL INDUSTRIES LTD.

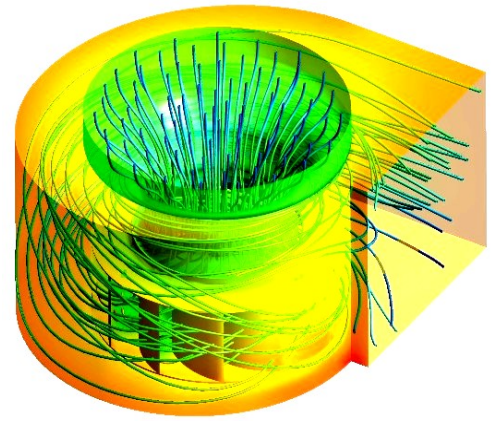
7-A, Old Anjirwadi,
Ground Floor, P.O. Box 6208,
Mazgaon,
Mumbai - 400 010.

Phone: 022-66200300
Fax: 022-66200380
E-mail: mechwell@vsnl.com

Let's Grow Green



WE ARE ON THE NET
www.mechwell.com

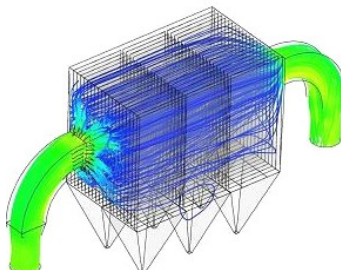
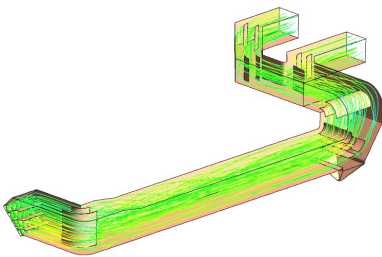


CFD CONSULTANCY

Mechwell has the facilities for Computational Fluid Dynamics (CFD) Analysis & the same

can be carried out for:-

1. Second pass of boiler.
2. Air Preheater.
3. Ducts.
4. ESP
5. Fans.
6. Silencers (Acoustics Solutions)



Our vision is to conduct an integral program of research, consulting & professional development to promote & demonstrate globally the role of design & innovation in achieving environmentally sustainable future.

