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COLD AIR VELOCITY TEST (CAVT) IN COMBINATION WITH CFD (COMPUTATIONAL FLUID DYNAMICS) TECHNIQUE

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The availability of the coal for most of the power stations in India is of "F" & "G" grade with ash percentage varying from 40 to 50 %. Moreover due to low calorific value, extra tonnage of coal needs to be handled by equipment. This high quantity of abrasive ash causes erosion of boiler tubes.

NEED OF C.A.V.T

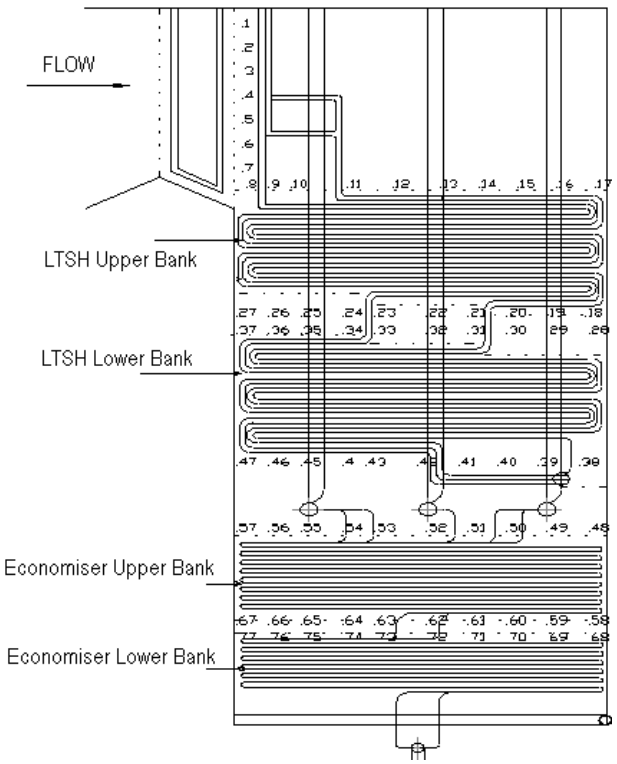
Due to use of very high ash content coal in boiler, the flue gas leaving 1st pass is heavily burdened with highly abrasive ash. This ash associated with high velocity, impinges on tubes in 2nd pass and starts tube erosion. Tube erosion leads to its thinning and ultimately results in tube failure and boiler break down. To reduce the tube erosion, the concept and procedure of (C.A.V.T) is employed, which is explained hereafter.

PROCEDURE FOR COLD AIR VELOCITY TEST (CAVT) IN 2ND PASS OF BOILER & CFD:

As high velocity of flue gas is detrimental to tube erosion, the first step is to find velocity profile in boiler. To determine the areas/ locations at which velocities are higher than respective plane average velocity, this test (CAVT) is conducted. Test is undertaken during plant shutdown when airflow of about 80% of MCR is maintained. The test is carried out at different pre-selected planes and locations where velocity measurements are taken. The instruments used for the test is hot wire anemometer. The readings are taken by a team of the service provider and witnessed by plant representatives.

The readings are then tabulated in regular formats, studied and analyzed to locate high velocity spots. The required data like specifications of coal, tube bundles' details & spacing, temperature and pressure profiles, boiler drawings etc. are to be provided by client prior to test.

CAVT Location Drawing



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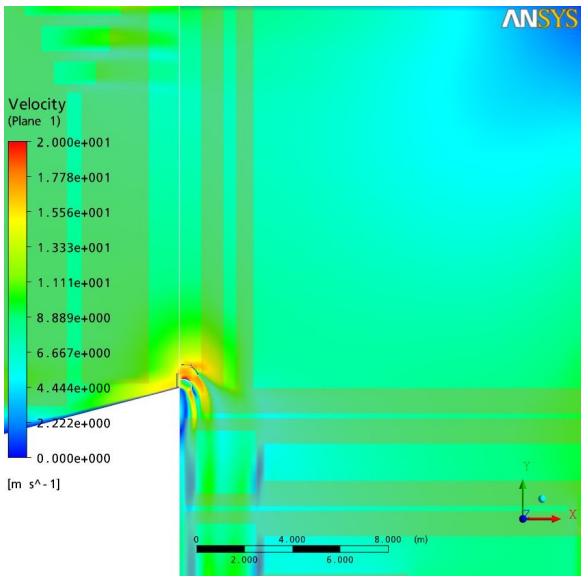
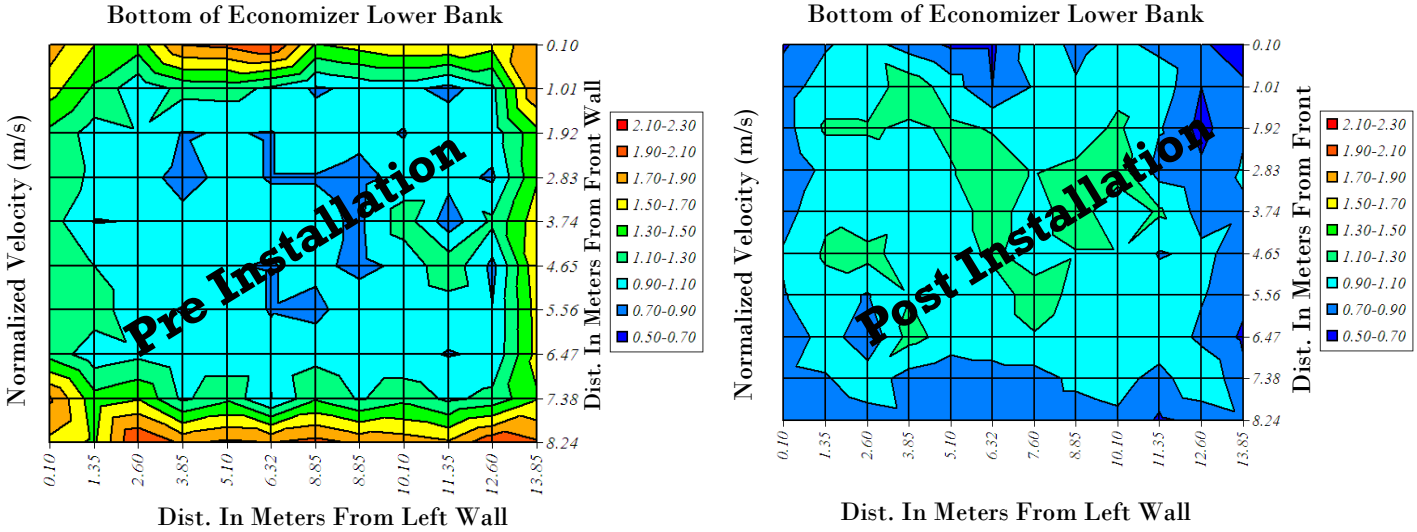


Above Fig. shows the velocity pattern obtained by carrying out CFD Analysis of Boiler

Parallely, CFD Analysis of flow in the Boiler is carried out. Based on CAVT & CFD analysis, design and locations of various types / sizes of screens along with structures at different locations to reduce / divert the flow, are evolved. The screens help in diverting flow from high to low flow regions thereby reducing velocity variations. The screens are strategically placed which, by way of new improved flow profile, reduce the erosion of tubes. This screen design is recommended in a form of well-compiled report with graphical presentation. The suggested scheme of screens and its structural supports is then discussed and finalized. Normal duration of CAVT is less than 8 Hours. The recommendations are then implemented by manufacturing, supply and installation of screens in 2nd pass of boiler.

POST-INSTALLATION CAVT:

To verify the desired effect of suggested scheme and to eliminate any doubt about adverse effect of it, if any, one more CAVT is carried out before start of the plant. Further modifications, if called for and if minor in nature, are carried out immediately (time permitting), else the same can be done in next available short duration shut down.



Above Fig. shows the Velocity pattern

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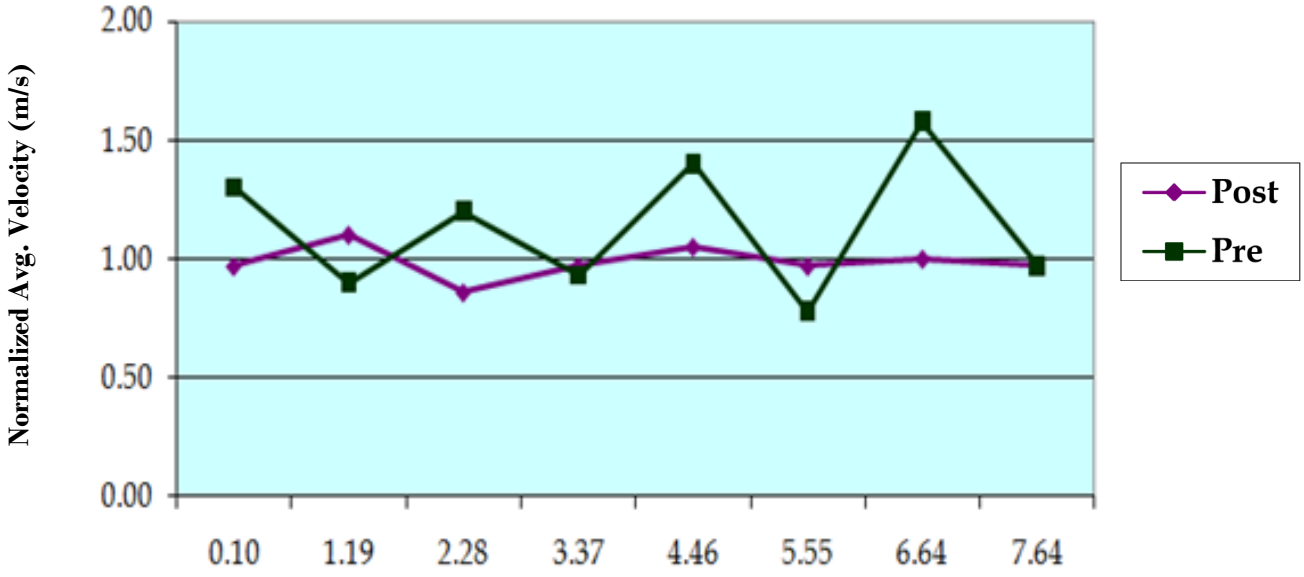
Top Of Economiser Upper Bank



Dist. In Meters From Front Wall

Above graph shows the Pre & Post Installation CAVT Comparison

BENEFITS OF IMPLEMENTATION OF EROSION CONTROL SCHEME:

1. With the implementation of erosion control scheme boiler tube leakages are expected to reduce.
2. The screens help in achieving near even flow and hence even erosion rather than a high-localized erosion.
3. The life of tubes extended and their replacements limited.
4. The requirements of tube shielding and cassette baffles reduced.
5. Number of weld joints in tubes near sidewalls and rear wall reduced.
6. Increased heat transfer.
7. If the cost saved on welding joints, DM water, fuel oil for light up and overheads are calculated even for only one shut down avoided by implementing the scheme, the pay back could be as fast as one month or even one week. The additional advantage of avoiding power purchase at peak rate by averting the shutdown can be evaluated while calculating pay back period.
8. The overall improvement in flow profile smoothens boiler operations and down stream flow profile.

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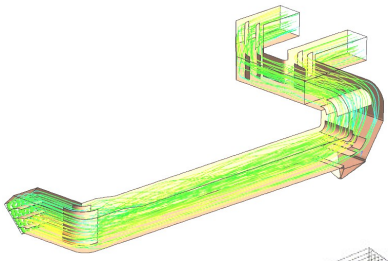
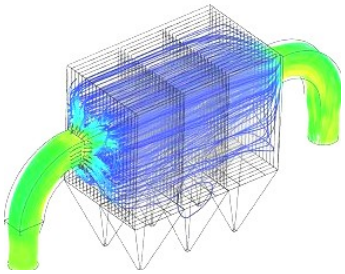
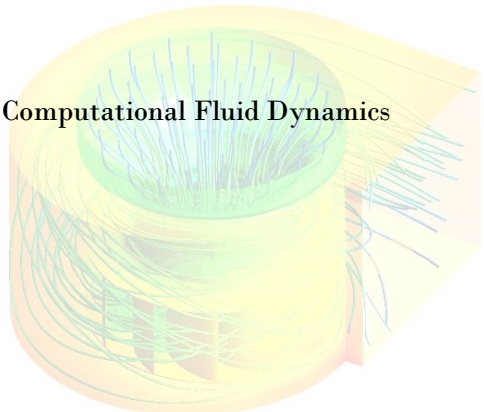




CFD ANALYSIS:-



Mechwell has the facilities for Computational Fluid Dynamics (CFD) Analysis & the same can be carried out for:-

1. Second pass of boiler.
2. Ducts.
3. Fans.

Models for Air preheater & Coal Mill are being developed. These models can help in solving all the major O&M problems. Modifications can be made in models to predict the performance to achieve the desired results, which can be listed as below:-

1. Reduced Clinker formation.
2. Avoid over heating of S/H & R/H tubes.
3. Reduction in APH outlet temperature.
4. Reduced erosion of LTSH & Economizer.
5. Reduced erosion of ducts.
6. Improved ESP performance.
7. Reduction in unburnt Carbon in ash.
8. Reduction in S/H & R/H attemperation flow.

Mechwell can undertake the comprehensive testing, analyze & suggest remedial measures & procedures to attend to the problems. It can also help in planning the activities, executing the works & supervise the activities during execution.

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.