DESIGN OPTIMIZATION OF TWO PASS BOILER

INTRODUCTION

Boilers of this kind, burn pulverized coal to produce thermal energy for various applications. The excess heat that fly with the flue gases are utilized to generate power with the aid of Economizers. The Economizers and its accessories like Super heaters and Reheaters absorb their heat for conversion. This could be possible only if the velocity over the economizer remains uniform and it lies as the objective of the case.

With the aid of the CFD technology, the flows of fluids in the various tubing sections are modelled with porous media and they can be interpreted and the design progress can be accelerated. Thus, CFD plays as an important tool for the Energy Recovery Engineering as it will reduce the time consuming and expensive experimental procedures.

SCOPE OF THIS RESEARCH WORK

- To predict the occurrence of flow nature, recirculation and thermal stagnation inside the boiler.
- Make the velocity profile inside the setup to be uniform and to avoid Wake and recirculation region.
- Optimize the dove section to avoid recirculation and temperature stag.

DETAILS

The Boiler setup belong to the Thermal Section of TNEB, Chennai zone. The CADD model was generated with the problem description provided and the various objectives were discussed in person

CFD ANALYSIS

With a goal of increasing the Economizer performance by making velocity uniform and avert thermal stagnation. CFD is utilized in a following systematic way to achieve the goal.

- ## VALIDATION STUDY

CFD procedure has lot of variables such as grid count, turbulence model, and discretization scheme, so it is important for a CFD engineer to play between those variables without affecting the solution accuracy. A commercial Computational Fluid Dynamics (CFD) code, ANSYS Fluent V13.0 with a k-ε Standard turbulence model with energy equation. The tubing in the Economizer are modelled using Porous media .Thus was made to study the flow pattern in the system and the distribution of heat and velocity in the economizer (Porous Media) are monitored.

The numerical results are compared with the experimental data of the base model to arrive at the best computational procedure (BCP).

PERFORMANCE ENHANCEMENT STUDY

The Performance of the Economizers depends on the thermal and velocity distribution over the inlet of the economizer which are implicitly depends on the structure of the dove neck of the boiler.

UTILIZATION OF METHODOLOGY

The simulation methodology for optimization is performed through trial and error method until the maximum heat utilization is performed by the economizer. The modifications are performed with care of no major change in structure but in the flow pattern.

INFLUENCE OF CFD TECHNIQUE IN THIS PROBLEM

The Fluid Flow inside the boiler were averted from wake and recirculation regions to avoid thermal stagnation. The geometry were modified accord to the flow and vortex techniques to avert thermal and flow separation.

******Using CFD, the results for modifications of boiler neck to form vortex to make the velocity uniform over the economizer whereas experiments is too risky and cost investment is inevitable. No experiment will provide an INSIGHT views like the temperature contour, velocity contours in different planes and positions as shown in Fig 2, Fig 3, Fig 4 and Fig 5.***

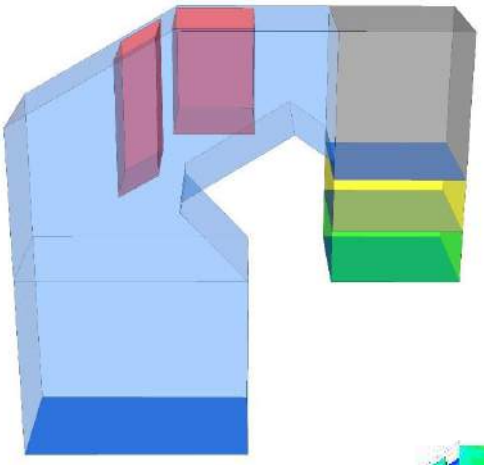

Fig 1.CAD Model

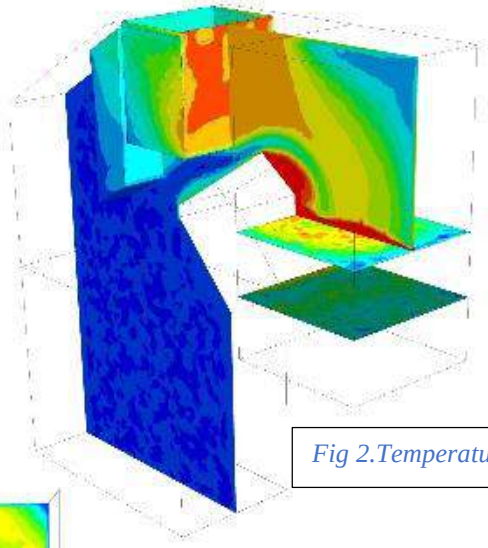

Fig 2.Temperature contour

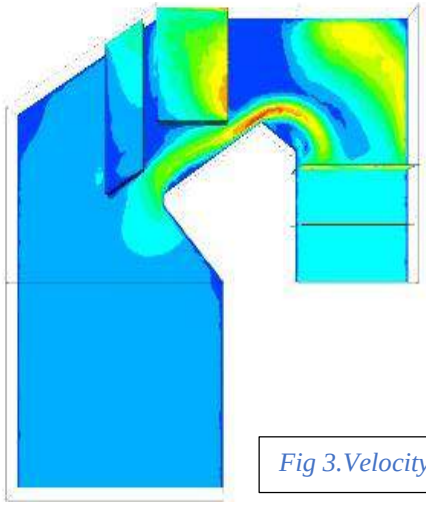

Fig 3.Velocity Contours

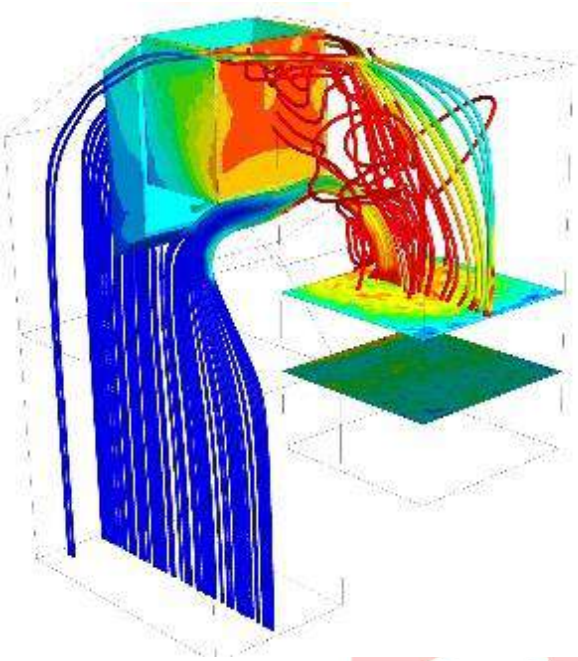

Fig 4.Path lines of Temperature

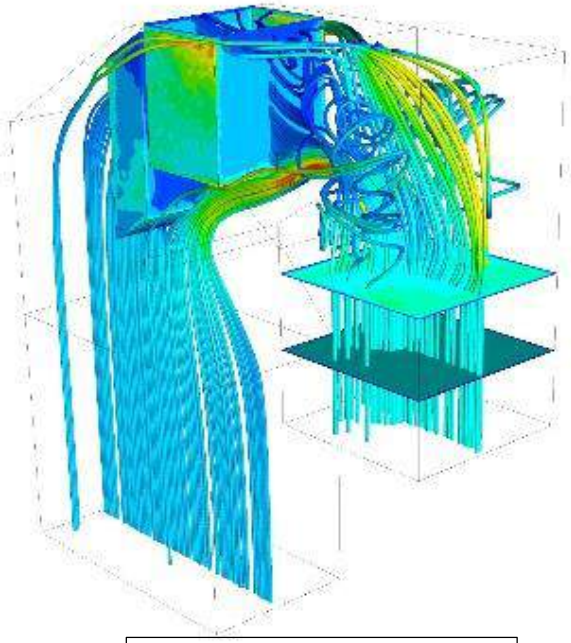

Fig 5.Path lines of Velocity

******Above Figures shows the colour path lines of vortical flow of fluid at near the economizer. And it is impossible to get this much detailed view of velocity and temperature profiles when we go for experiments so this is the place where one can see the merits of CFD techniques.***

CONCLUSION

- ✓ A validation study achieving the best practice of CFD and followed for further analysis.
- ✓ An optimization study is tried out using Taguchi method by varying six modification of design. An optimum configuration is achieved after comparing the results.
- ✓ Among 6 different variations, the optimum model is achieved by comparing the simulation results.