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Technologies for Future Generation

CFD OPTIMIZATION TECHNIQUES IN POWER BOILER

Objective

To assess the flow pattern of flue gas within first and second pass of a pulverized coal tangentially fired Boiler. Identify high velocity zones causing erosion of LTSH and Economiser tubes located in first & second pass, suggest suitable flow control mechanisms to reduce erosion and enhance the flow distribution.

Challenges

- Meshing of Boiler first and second pass with all tube bundles (SH, RH, LTSH &Economiser tubes).
- Comparison between porous medium and actual modelling approach.
- Optimized flow control mechanism to reduce high flow velocity without affecting the process of heat transfer.

CFD Model

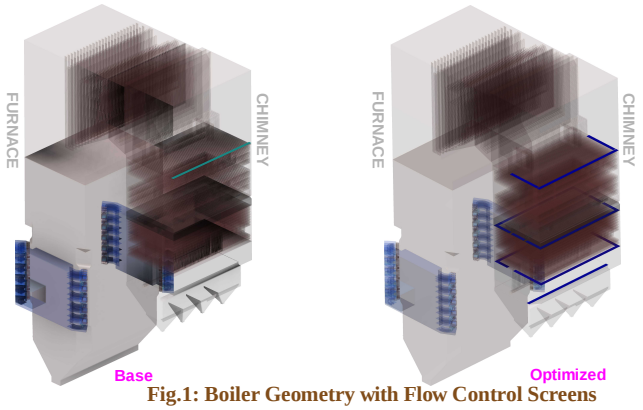

Fig.1: Boiler Geometry with Flow Control Screens

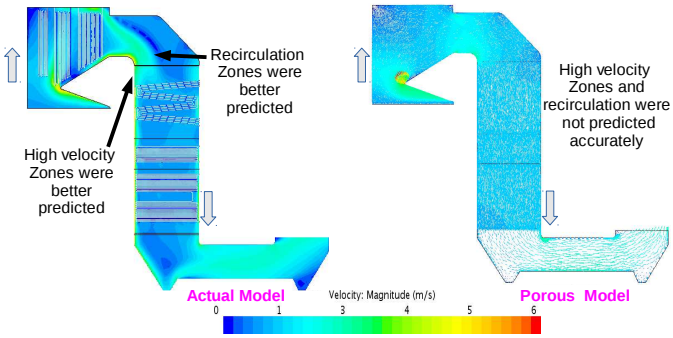

Fig.2 : Comparison- Actual Vs Porous Model Approach

- **Detailed prediction of gas flow pattern within the tube sections is possible via actual model approach.**

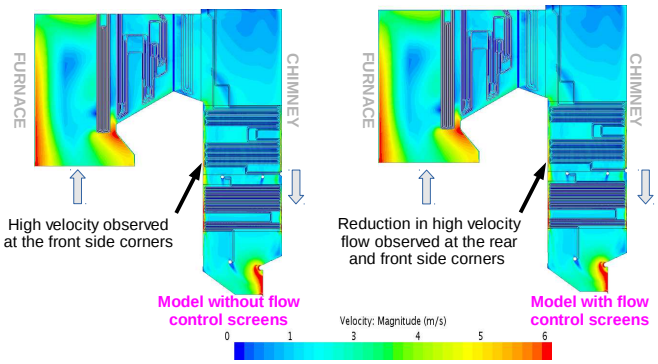

Fig. 3 : Velocity Contour- Boiler First And Second pass

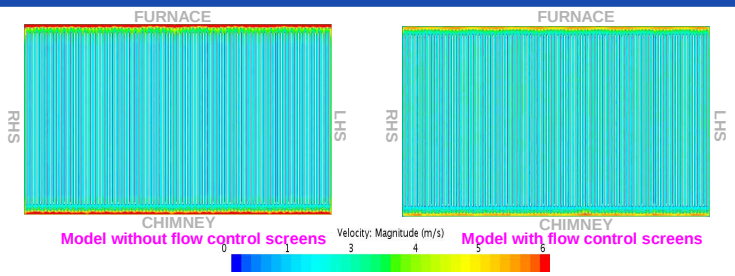

Fig. 4 : Velocity Contour- LTSH Lower Bank

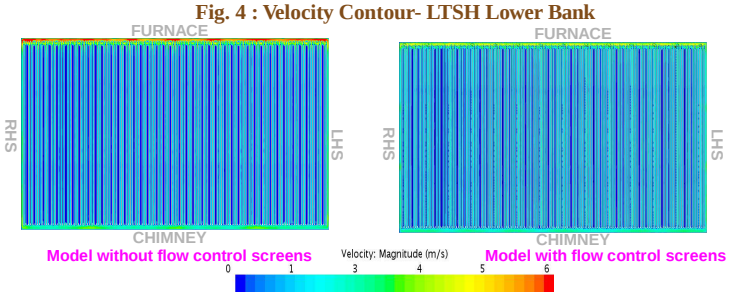

Fig. 5 : Velocity Contour- Economiser Upper Bank

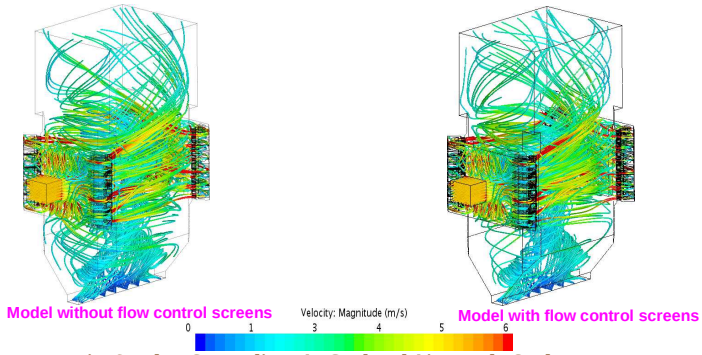

Fig. 6 : Flow Streamlines At Coal and Air Nozzle Outlet

Approach

Pulverized Coal tangentially fired boiler of 110 MW capacity was considered for the study. The flow pattern of gas from Windbox and within Boiler's first and second pass was assessed in detail through cold flow simulation using RANS based Standard K-ε turbulence model. CFD model was assessed using both porous media approach and with actual tube sections. Further optimization of flow distribution to reduce high velocity zones causing erosion of LTSH & Economiser tubes was simulated through implementing optimal shaped flow control screens at appropriate locations within the Boiler Second Pass.

Conclusion

- Optimal shaped flow control screens can significantly enhance flow distribution, reduce high flow velocity and resulting erosion in Boiler tube parts.

Benefits

- Detailed understanding of flue gas flow pattern along with visualization of flow and pressure distribution within various sections of Boiler.
- Reduced Boiler downtime for the implementation of modifications.

Applications

- Suitable flow control mechanism within sections of Boiler to reduce or control tube erosion and resulting failures.

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