TEFUGEN
Technologies for Future Generation

SECONDARY AIR FLOW MODELING AND BALANCING IN A WINDBOX

Objective

Benchmark case study: To assess the secondary air flow rate at burner inlets and effect of baffles in flow distribution within an **1/8th scaled model of 2.5MW** wall fired boiler windbox through CFD analysis using STAR CCM+ (commercial code) and compare the simulation results with experimental values and simulation results obtained from Ansys-Fluent (commercial code)

Challenges

- Appropriate flow model with optimized mesh settings to obtain simulation results closer to experimental values.
- Appropriate boundary conditions to achieve unifrom discharge rate of air from all burner outlets

CFD Model

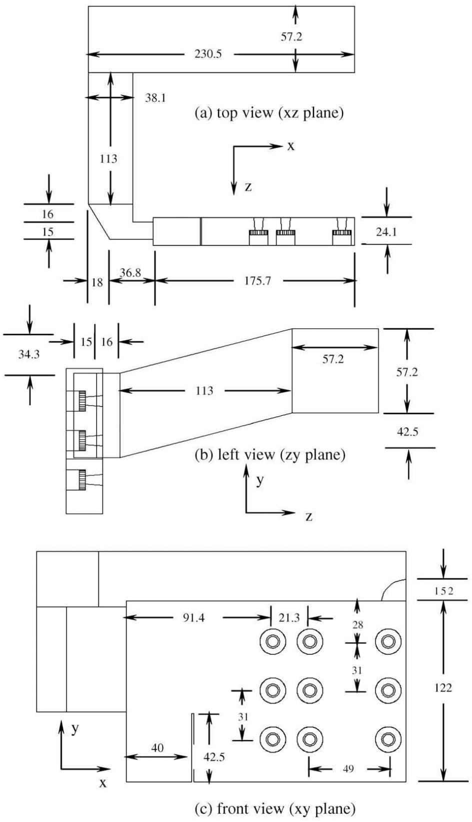


Fig-1 Geometry – Windbox

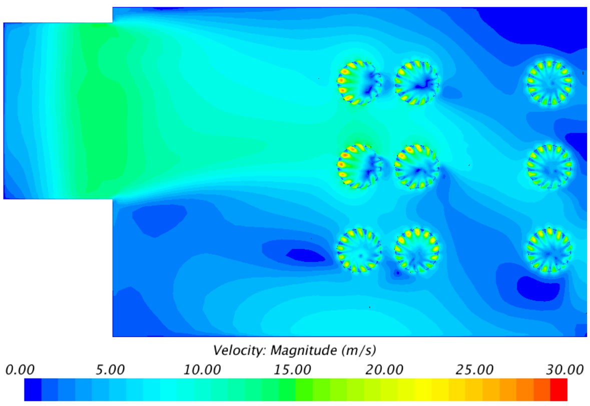
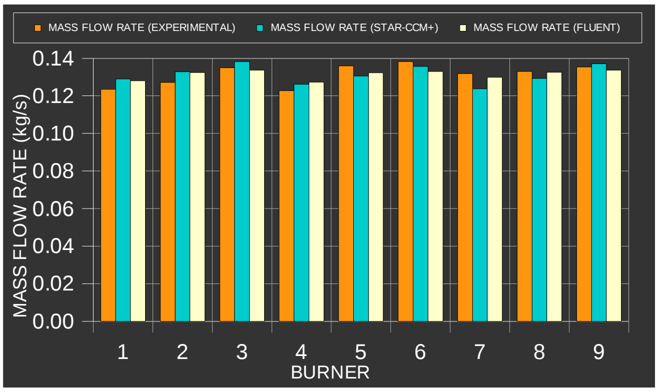


Fig-2 Velocity Contours



Graph 1 – Mass Flow Rates at Burner Inlets (half open)

Approach

An **1/8th scaled model** of 2.5MW pulverized coal wall fired boiler windbox along with burner inlet (Fig.:1) was conisdered for the CFD analysis. The secondary air flow distribution within the windbox and at burner inlets was simulated using three-dimensional Reynolds averaged Navier–Stokes equations with k–Epsilon turbulence model. Momentum driven boundary condition at inlet with refined polyhedral meshing scheme was used to predict the flow characteristics of air within the windbox and discharge rate at burner inlet. The simulated results obtained from STAR CCM+ were in close match with the results obtained through experimental and from Ansys-Fluent **(Graph 1)**

Conclusion

The results obtained demonstrates the validity of CFD codes and the reliability of simulation results with respect to such systems. These cases were compared to understand the flow behaviour, adjustment in damper opening and baffle location within windbox. It also demonstrates that CFD approach can be used as an effective tool in optimizing secondary airflow through burners to suit combustion requirements of even large scale power plants without longer boiler downtime

Benefits

- Reduce the number of attempts to adjust the damper configuration to suit optimal operation, thereby eliminating **"trial and error based approach"**
- Balanced air flow across all burners can bring significant benefits to the process of combustion, including lower **NOx** emission, **lower excess air** and reduced auxiliary power consumption
- Better combustion of fuel with reduced emission to comply with power plant emission norms

Applications

- Secondary air flow balancing at burner inlets to suit the needs of combustion
- Effective windbox and internal baffle design for better flow distribution of air within windbox

Reference: **"CFD studies on burner secondary airflow", Applied Mathematical Modelling 33 (2009) 1126–1140,** Anil Purimetla, Jie Cui

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